

BORLAUG 2.0

Panel Moderator: *Louise O. Fresco*

October 16, 2015 - 11:00 a.m.

Introduction:

Ambassador Kenneth M. Quinn

President - World Food Prize Foundation

When I had finished up everything for my PhD, I had to have one of the most terrorizing or terror-filled moments in the academic world when you walk into the world and there's three or four distinguished professors who are going to ask you questions about everything you've been working on. So I wanted everyone here to feel the same terror that I felt, and so I've got four incredibly distinguished individuals here for our final session of Borlaug 101. Of course, we have the celebratory Laureate Luncheon afterwards; I hope everyone will be coming to that.

So again let me ask you to please, please, please take your conversations outside; or if you're going to stay in here, please be quiet. I'm losing my authority with each session, you can see – I'm less able to do this. So here on the stage to administer the final exam and look at this and building Borlaug 2.0 out of Borlaug 101, Louise Fresco, President of Wageningen University and whose book has now sold out at the World Food Prize for the second day. We shipped more than what's... All of them went the first day and they got more somehow – they were flown in from England overnight; they've all been sold out. So, Louise, it's clear it's going to be a best seller, but as I said the other day, Wageningen is considered the number one agricultural research university.

Ronnie Coffman is here, from Cornell, as everyone knows is the number one agricultural research university. And we had Cal Davis the other day. And Monty Jones, the 2004 World Food Prize laureate. And Dr. M.S. Swaminathan, the first World Food Prize laureate, chairman of our Selection Committee.

So I have to tell you one story. The Green Revolution – was it born in India or Pakistan or Mexico – and the Green Revolution started in Rennebohm's drug store in Madison, Wisconsin, in 1953 when a young post-doc researcher named M.S. Swaminathan was there, and he sat at the counter next to an interesting guy he had just met at one of his symposium sessions, named Norman Borlaug. That's where their relationship began and led to all of the collaboration and partnerships. And they've torn Rennebohm's down, but there's a new building, and I'm eventually going to put a plaque over there to commemorate when M.S. and Norm first met.

So, Louise, over to you.

Panel Moderator:

Louise O. Fresco

President & Chairman Executive Board, Wageningen UR

Panel Members:

Monty Jones 2004 World Food Prize Foundation

M.S. Swaminathan 1987 World Food Prize Laureate

W. Ronnie Coffman International Professor of Plant Breeding, College of Agriculture & Life Science, Cornell

Louise O. Fresco

Thank you, Ken. Thank you all for being here. This is, of course, as you can imagine, the most exciting part of the Borlaug 101, because this Borlaug 2.0. And what do we mean by Borlaug 2.0? We mean the future. We ask ourselves in this session – What would Norm Borlaug have said today when he was a young researcher and he met a young Swaminathan and a young Ronnie Coffman and even younger Monty Jones, and even a young me? What would he have said to us? What would he have wanted us to do?

So this session is going to be a little bit different, because I'm going to invite all of you also to participate in two ways. First of all, I have my Twitter tablet here, so send in your questions to #FoodPrize15 handle. And the second thing is, you all found on your seats, in principle, two sheets, a green one and a red one. Do you all have them? Yeah, okay. So because we're going to vote also, at least we're going to give the green light or the red light to things that we feel are really the priority. And mind you, we're talking about priorities for the future.

So I especially want the back, I want the young people most of all to come in and help us vote. Vote about the future. What will be the Green Revolution if we had to start it today? Or put differently – How are we going to tackle the problems that face us today, which are indeed also the problems still that Norm faced about disease pressure, about water, about this getting up to productivity of the cereal crops? As we just heard in the last session with Pamela and others and others, it's also about food quality. We also know it's about food safety. It's about the food chain. It's about avoiding waste, avoiding up to 30 or 40% of the food that is being produced, because it does not land on the plate of the consumer. So our questions are both wider but they're also very narrow, very specific because we know more, for example, about the genetics than we did before.

So what we're going to do – we have exactly one hour. Each of them, and you will see they sit here in order of their acquaintance and the length of time they have been working with Norm. I thought it was an appropriate way of doing it – don't count me. I will tell you about my relationship with Norm in a minute. So here we have M.S., with whom it all started with Norm. And then we have Ronnie, who was his PhD student, and then we have Monty who was in many ways involved. And Monty and Ronnie and I, I should say, were also involved in getting the rice productivity up, which led in part also to Monty's World Food Prize here. So this is an intimate collection of generations here, all in the spirit of Norm.

So M.S. is going to start, because he has a message he wants to tell us, and what a message it is, after 90 years – and let's assume you started early, so at least 75 years of thinking about agriculture and food productivity. M.S., the floor is yours.

M.S. Swaminathan

Thank you, Louise. I thought this is the last of the sessions of this year's Borlaug Dialogue, and now Borlaug 101 is coming. Therefore, what is the Borlaug legacy, and how do we not only continue but expand it in the overall umbrella of the zero hunger challenge?

I want to first, for the first slides I have, I want to..., not too many, but the first thing is a very important one. When Borlaug started his work in the late '50s, '60s, there was an atmosphere of doom all over the forefront. In fact, books like Paul and William Paddock, *Famine 1975*, Paul and Ann Ehrlick. They all predicted that countries like mine have no option except to starve. But then this great transition which has taken place, particularly the younger generation will want to know, we had before independence in India the very large famine in Bengal, undivided Bengal, Bangladesh and India. About 3 million women and children and men died of the hunger. From the Bengal famine, now two years ago the government of India and parliament enacted an act which gives right to food for 75% of the population have it. It is not a law to the patronage, nor the charity but is a human right to food. And there are several features of this particular legislation. One is the woman in the household; the senior-most woman is made the head of the household from the point of the food entitlements, thereby recognizing the critical role of women in household food security, particularly.

Secondly, the food basket has been enlarged. Not only wheat and rice, as before, or corn and so on, but the whole series of millets, what we call "orphan" crops, which were not considered important. But today in the context of climate change and also in the context of nutrition security, many of these crops are coming into promise, many of the millets and so on.

And thirdly, the whole lifecycle approach was adopted with particular attention to the first thousand days of a child's life.

These are some of the features of the... So the [inaudible] of the Borlaug legacy, I said, in the context of the zero hunger challenge, what kind of paradigm shifts will require? One is, obviously, in those days, we were concerned more with food production, food availability whether wheat or rice or corn in the market. But now we're talking about nutrition security, the paradigm shift from food to nutrition security – which means attention to protein, micronutrients, what's called hidden hunger, protein hunger, and also drinking water and nutrition literacy and primary healthcare. So nutrition security is a much wider concept.

The second paradigm shift we acquired from the 60, is purely what is called the Green Revolution approach, to what I have called an "Evergreen Revolution" approach, in other words, increase in productivity in perpetuity without ecological harm, the mainstream ecology in technology development and dissemination.

And thirdly, last one on point I want to make, which is Norman Borlaug's very favorite sentence, "No time to relax." In fact, I think that was the title of his Nobel Prize. When he accepted the Nobel Peace Prize, he gave a talk on "No time to relax."

The food and nutrition security today is possible. I have designed a farming system. This particular slide relates to my own recent work – “Farming Systems for Nutrition, providing agricultural remedies for nutritional maladies.” In other words, the farming system is designed with nutritional considerations. It depends upon what the nutritional considerations will require. Some cases, it may be purely micronutrient deficiencies. Sometimes it may be protein hunger. Sometimes that means calorie inadequacy, undernutrition arising from inadequate purchasing power. Farming Systems for Nutrition – agriculture provides agricultural remedies for nutritional maladies. For an educational tool for the farmers, how to design the farming system. We put in genetic gardens of biofortified plants. For example, many naturally occurring plants, something like the moringa drumstick. It’s so rich in the micronutrients. We just heard a report on the sweet potato and other yellow flesh, orange flesh.

Finally, you have trained local communities and whole community ends up like this. Their women and men are well versed with the nutritional problems of the area.

So my last point – No time to relax. Major challenges ahead. These are all well known to you, have been also made in the last few days here by different speakers – avoiding food losses and food waste, damages were shown yesterday how much food is wasted. Climate change – we do not know the full consequences, but they are slowly emerging, more frequent droughts, more floods, unpredictable weather conditions and so on. And also sinking per capita land and water resources, expanding biotic and abiotic stresses, adverse cost risk and return sector farming. In other words, the economics of farming, the price volatility, market volatility, and above all, reluctance of youth to take to farming. In addition to that, you have problems of a political nature, the Middle East, for example, today is undergoing political instability already. Price volatility is a very important point. In my country, we say the farmers’ fate is determined by the monsoon and the market. Monsoon determines whether there is water or not; the market determines whether it will be economical or not. Therefore, one of my papers for the future belongs to nations with grains and not guns. It is my conviction. Still, there may be people who believe that guns are more important than the grain. But I think in the coming years...

The last slide is the one, you see has been, I suppose, mentioned by Ambassador Quinn and Dr. Borlaug for a long time when I was in Wisconsin in 1953 onwards. One great quality of him, anybody that recognized great agricultural scientist, technologist, but his human compassion. And there I compare him with Mother Theresa, her qualities of compassion, so that correlation of the compassionate – Mother Theresa was once asked. “What you are doing, Mother, is a wonderful work, but what you are doing is just a drop in the ocean.” A young boy asked her, and she said, “What we are doing is just a drop in the ocean, but the ocean will be less because of the missing drop.” In other words, if they really want to make a contribution, that missing drop doesn’t matter whether it’s a large one or a small one, the contribution. But the correlation of the compassionate, I hope the World Food Prize Foundation and leadership of Ambassador Quinn, will become the hub of the correlation of compassion. Because again yesterday someone mentioned there’s enough food in the market. There’s food in the world but people don’t have the purchasing power, whatever may be the reason. The number of hunger is very alarming. The data were all given the hunger index by International Food Policy Research Institute.

So I will say at the moment, my concluding remarks are – No time to relax. These are the messages of Dr. Borlaug we should take forward in the coming year and then one, there’s no

time to relax, but there's also no time to relax on the scientific front. What worries me is decreasing support to organization like universities, CGIAR centers and all public research institutions. There is no time to relax in supporting them. If we think that we'll solve our problem, we will be living in an illusion. Thank you.

Louise Fresco

That's, I think, we all agree, a wonderful summing up of the new messages that Norm would have put to us. We are not yet there. Ronnie, looking back at what you learned from Norm and where you're going and where your work is going to, what are your messages? Where do we go from here?

Ronnie Coffman

Well, I think a big one – we've heard from a lot of CEOs and deputy CEOs this week, and I think one of the big messages, which Borlaug would agree with, is academia needs to work more closely with industry. And Louise and I are here – we're from two of what we'd agree are the great agriculture universities. By the way, I should set the record straight – Wageningen is number one this year, just so...

Anyway, we have absolutely no resistance to working with industry. In fact, our founder, Ezra Cornell, was an industry person. He was the IT person of his day. He made a fortune. He invented something to string telegraph wire. He made a fortune. Then he saw people were building telegraphs between two cities – bilateral. So he said, "Oh, you know, you need a network." So he spent his fortune trying to buy up a network, and he went broke and still didn't have a critical mass. But then he found out some guy down in New Jersey was doing the same thing, so he merged, made a partnership. And they called that partnership The Western Union. Just so you know where Cornell's origin came from. It's really deeply steeped in industry.

But partnering with industry these days, now that it's consolidated, can be a problem for our institutions, and I think this is one of our big challenges for the future, is how to do that. Industry is so consolidated that, if the university starts working closely with one of these giant companies, it can be stigmatizing. So this is something that I think we see as a big challenge but I know one that Dr. Borlaug would want us to address. He first worked, you know, for DuPont, and he was very proud of it, proud of what he did there. So there's no resistance to that but how to do it in this new era is a challenge.

Louise Fresco

Monty, you are truly the African Norm Borlaug in some ways because of the work you did with NERICA. Everybody knows NERICA. Is anybody of the students, doesn't know NERICA? Does it mean, that I see no hands that everybody knows NERICA, African rice? Okay, but I think Monty, give us one sentence on that one and then, please, your message from Borlaug for the future.

Monty Jones

Actually, I'm highly honored that you've named me the Norman Borlaug of Africa, grateful.

Actually, NERICA is a rice type that we developed. I say "we" because I led the process of developing an interspecific hybridization between the African indigenous species and Asian indigenous rice species. These are the two cultivated species of rice. And for 50 years people have been trying to combine the genes of these two types of rice into a single rice variety that would give the high-yield potential of the Asian rice and the adaptation of the African rice, which means resistance, tolerance, the key stresses that we encounter in agricultural systems in Africa. So we came up with the methodology that would enable us to come up with two true type progenies of these two types. And today we have the NERICA's (New Rice for Africa) with higher yield potential, higher level of resistance and tolerance to some of these key stresses, higher protein content, etc., etc. So that's the NERICA rice.

I however, believe in the concept of, "From Green to Evergreen," and we knew that the Green Revolution did not come to Africa. It went to Latin America, to Asia, but not to Africa, and we are still struggling to get the Green Revolution. And I'm sure that if Borlaug were around today, he would have liked to see the Green Revolution get to Africa. And I'm sure wherever he is, he's hoping that this will happen and happen as soon as possible.

So I will concentrate on some of the key things that I believe Borlaug would want us in Africa to address to be able to attain the Green Revolution.

I will look back to 2009, and recall the World Bank report, the Development Report. And that report actually brought a turnaround in the world's thinking of agriculture, agricultural development, and how agricultural development would result eventually to rural development. That same year we had the G-8 L'Aquila meeting, and that meeting endorsed food security, supports to food security, and even said that they would go down to the farm level. That same year, 2009, the African leaders met, and they had a summit on agriculture for the first time. And that summit decided that they should give support to agriculture, agricultural research; and they called on all African nations to increase production to the level of 6%. And that 6% translated to something like 4.4% total factor productivity.

So I think that Africa has been lagging behind in terms of agricultural productivity, lagging behind the rest of the world. So I would think that one of the things that we need to do is to focus on how to increase productivity in the continent, so that we cover the gap and catch up with the other regions of the world. And it should be total factor productivity, because when I looked at the presentations that were made since we got here, people have been talking of land productivity, water productivity, labor productivity.

Land productivity – I think we need to look at replenishing our soil; we need to look at using external inputs. But at the same time, I think we need to look at the intensification of our systems. I think this came up in a discussion yesterday. Intensification of our systems, because what we are practicing now is mostly extensive production practices i.e. shifting cultivation, which is resulting to the depletion of our soil and at the same time destruction of the environment.

And in terms of irrigation, Africa has plentiful water. Rainfall in some of the countries, like in my country, Sierra Leone, goes beyond 3,000 ml per annum to up to 4,000 ml and it rains for about six to eight months in the year. So I don't see why we should not go into aquaculture. I do not see why we should not increase the area under irrigation for the continent. We are lagging behind the rest of the World in terms of area under irrigation. When it comes to the last one, which is labor productivity, we lack the machinery. And here I am not just talking of combine harvesters or tractors, which I believe most governments would like to get for their countries, but even the small machineries for land reparation, for weeding, or threshing – those are the kind of things that we believe will increase the labor productivity.

So this is one aspect that I see that we need to address. The other aspect that I believe is very important is competitiveness of our agricultural system. Borlaug would have liked to see that happen in Africa, and I believe that the value of exports to some extent measures your competitiveness. And if we look, African competitiveness has been going down, dropping from about 8% in 1970 to something like 2% or just above 2% today. And we're losing quite a lot, because if we translate that loss into monetary terms, it spells out to something like 70 to 100 billion US dollars annually. So we need to increase our competitiveness. It means we have to produce quality products, and we have to do everything to produce excess quality products for export; and to some extent we need to add value to our products so that we can sell our products in the international world.

Now, these two issues – increasing productivity, increasing competitiveness of our system – could translate to enhancing agribusiness for the continent. How do we handle the products that we get? And if we look again at the food sector totally, and look at production I believe it was mentioned in the session before this one that Africa is emphasizing mainly food production, farming – which has been the emphasis in Africa all these years – such as production of cash crop, staple food crop, tree crops; and now we are saying that we should lay emphasis on livestock and fish production as well. These are very important, but we've neglected the other aspect of the value chain, and that is the agribusiness, so much so that today the agribusiness value-added to the value chain is only about 38%, compared to 78% for the rest of the world. This is serious. Ours is skewed towards farming, the rest of the world is skewed towards agroindustry and agribusiness. And I think that is an area that we need to develop. We need to create a balance and close that gap between these two sectors, and I think that Africa needs to stop and think and try to make sure that they concentrate not only on farming but try to bridge, what I would say the focus, more on farming, and add to the experience of agribusiness.

I will just take one more minute to say that I think that the issue of farmers; transform them to business people, the issue of promoting, even at the subsistence level, promoting smallholder commercialization and the issue of what we all know, relating to, building, the... I believe, building, mechanization for use by the people. And also, building the infrastructure, whether it is physical infrastructure i.e. roads, transport, and ICT that will enable farmers to get the necessary information.

So these are some of the things that I would like to put on the ground. All of these coupled to what the African Union achieving the aspiration of ending hunger in Africa and promoting food security and eventually sustainable development, through long-term vision, strategy

documents, true political will and capacity building. So many things on the list, but this is because we are lagging behind.

Louise Fresco

Thank you, Monty. You heard very different but also very complementary ways of getting us into Borlaug 2.0. Green, Evergreen Revolution, a focus not just on productivity but also on nutrition. And if I may add, from my perspective not just nutrition security but also food safety, increasing safety in the food chain, I think, would also be something that Norm would be thinking about. We heard about the importance of the private sector, the fact that indeed it's not just a matter of producing research results but it is a very close connection, which Norm already knew about, linking it in to agribusiness, also the entrepreneurship at the farm level.

And maybe there's one thing I may add from my perspective and also from my own interactions with Norm, particularly the last years when he was still quite active and I was at the FAO, and that is to restore the trust in science, the public trust that's evidence-based, decision-making means that science has a role to play wherever governments make up their minds about agriculture and food. Norm felt very strongly that we should openly debate complicated issues, such as genetic modification, such as the use of pesticides or chemicals in general and that we shouldn't shy away from the difficulties of moving towards a more modernized agriculture, even in countries that were lagging so much behind. And it's this balance, this idea that it is the role of us all to engage in a debate, a dialogue, a conversation with government about the trust in science. I feel that it's also very much part of Borlaug 2.0.

And let's not forget that it was Norman's success not just to work on the technicalities of breeding but also to convince government. If he hadn't gone out to India and Pakistan and discussed with those governments that they should take the risk and really work on those new varieties and get them flown in, get the seeds flown in, take the risk, dare to do something new, things would have looked very different in your part of the world. So Norm was also someone that believed that negotiation and governments were part of the Green Revolution.

Now, we have a very long list, and again I'm asking you all to come up with more Twitter questions and comments on this conversation as we go on. Can we set some priorities, or are we just adding to the problem by making it bigger. Let's assume all of you are sitting on a mountain of money. Say, you have a million, a million at your disposal. Where are we going to put that one million U.S. dollars, or if you want, even euros makes it even better for the time being. I know the exchange rate is not as good as it used to be. Anyway, let's assume you had a million every year for five years. Where would you put it first? I think we agree all these items are important. Now, question number one: Would you put it on the Evergreen Revolution, so, say, the environmental side, including, for example, adaptation to climate change, making sure we work on fewer pesticides, less impacts on the environment? Or would you put it on the nutritional side. I know this is an impossible question, but this whole revolution, Green Revolution or whatever you want to call it, is about impossible things.

So I want to have a first vote. Who says the top priority is the Evergreen Revolution? Put up your green cards. Now, I can't see you guys very much, because I have the lights in my eyes. Do I see a majority of green cards. Okay. Let me then get the second part of the question. Get the green ones down. Who feels that, no, it's not the Evergreen Revolution, but it's nutrition

security that is the top priority? The red ones, the red for nutrition security, and green for the Evergreen. So we see more red than green. My panels agrees? Okay, so nutrition security including the items that we've mentioned. I have two colors here. Nope, we're not doing two colors. Right now we're going to force you a choice, because that's exactly what governments have to do. They only have their millions, and they can spend the money once. And maybe one of the problems today is that we want to spend in little bits on all kinds of subjects. So for the time, we say food and nutrition security, including safety, is a priority.

Fresco M.S., what would Norm have said? Do you feel food and nutrition security overrides the Green, or Evergreen, Green Revolution? Should we first put our money into nutrition? Yes?

Swaminathan

That is a very important question. I mentioned earlier that one of the requirements today is for sustainable food security because the U.N. SDG Goals mention sustainable agriculture – the word “sustainable” has been added before agriculture. This will require a wide range of crops if we're going to not going back to the Incas time. Some of the books like the *Last Crops of Incas*, the *Lost Crops of Africa* by Vietmeyer published by the National Academy of Sciences, shows how rich originally the diet was. Gradually it was shrunk. I think it requires both education as well as probably climatic compulsion. If climate change necessitates some changes in the cropping sequences, I believe two years ago the United Nations had International Year of Quinoa, and I find my own country as a result of the publicity given to quinoa a lot of the world now started taking the crop. So it requires education. It requires public policy support. And also it requires much more research in the so-called orphan crops.

Fresco Monty, do you agree? Let's assume you're heading all of the endowments of Cornell for a moment, are you going to put all your money into food and nutrition security? And if so, would you go for the orphan crops, or would you go for our well-known three, corn, maize, rice and wheat?

Coffman Well, that's a hard question for an old wheat breeder, rice breeder.

Fresco I know.

Coffman But I have to say that I really admire what Jan Low, a Cornell graduate, by the way, and others are doing with these crops. I think this is a way to really deliver to the people who need it in Africa. The big grain crops are not necessarily the right medium for addressing the nutritional needs. I think that's a wonderful thing.

And I just want to mention one other thing that you alluded to. I don't know if you all... did you all see your pen? And did you pull out the banner? Oh, yeah, you've got to discover that. So a transcending issue is restoring the faith in science; I mean, science is really challenged these days. And we have something called the Alliance for Science. That's what this banner says. You can go to our website, you can join it, you can be active in it.

So I think a big issue that Norm would agree with is the need to communicate more effectively, all of us as scientists; we have to get better at it, and we have to restore faith in science. Because if we lose that, that transcends all these issues.

Fresco I couldn't agree more – faith in science. But if you have an interesting issue here that I want you to sort of carry forward in your mind. The Green Revolution in its classical form was focused mainly on the major cereals. We always had a problem, for example, expanding these to the root and tuber crops, which only came later. And today, of course, our debate is also about diversity. We heard that very, very eloquently this morning from Mehmood Khan. It's about diversity of ideas, but it's also diversity of crops. And I think when we say food and nutrition security, we acknowledge implicitly that this is about the diversity of diets. You do not get healthy by eating one thing. You get healthy because of a whole pattern. And that pattern should include more than just the classical carbohydrates crops that we know and have been working on.

I think Norm would have approved also very much in a Borlaug 2.0 of extending our work not only to orphan crops but also very much to horticultural crops. The future in terms of vitamins and minerals is very much also into horticulture and beyond that.

And here comes your second vote. We haven't talked very much about other things but crops. Don't you think Norm Borlaug would have approved of putting a major effort, for example, into fish production or other sources of protein as part of the diet diversification? Or do you feel we should continue first of all with carbohydrates as the mainstay of diets?

So I want a vote. Who thinks a Green, Green, Evergreen, food and nutrition kind of resolution should also include fish? A red one for fish. Are you in favor of spending some of your billions or millions of dollars on fish? Is anybody not in favor of fish? Okay. Now, there are a couple of fish centers that have their work spent out. But the question here, of course, the interesting questions as we move to aquaculture is the combination, of course, of vegetables and fish ponds together and making it into an integrated ecosystem. And I think that is going to be another message that the whole back row – when you start your research, those are the kinds of subjects.

Now, let's move on a little bit. We've had the Evergreen, but we haven't really talked enough about that. What do we do with climate change? Monty, I'm looking at you in Africa where possibly some of the greatest effects of climate change will happen. Now, from a Borlaug 2.0 perspective, where would you put your money in terms of mitigating, adapting to climate change?

Jones Well, looking at the projection that is made that climate change is going to have severe effects in Africa compared to other regions of the world, I would think that we should adapt the two strategy for Africa, which means try to strike a balance. Because adaptation will call for us to get the necessary varieties that will be able to get to maturity before we are hard hit with problems like drought, etc. It calls for us to make sure that we look at that duration of such materials and we look at the yield

potential of such materials. And mitigation is also a very important aspect that I think we should look at as well. So the two should go together. I know that in most cases the developed world is talking more of mitigation but Africa is talking more of adaptation, so I would throw my lot to adaptation.

Fresco Okay, here is a question for the... Sorry, Ronnie, you want to add something?

Coffman I just want to say that we should recognize that the big crops are imperiled by climate change. Wheat—yield goes down a ton for every degree the average temperature goes up. So we're looking at big problems in wheat unless we have strong, ongoing breeding programs to adapt the crop to what's going to happen. Rice—sea level is coming up two centimeters a year. Brackish water is coming up the big river deltas where most of the world's rice is grown. Unless we increase the salinity tolerance and mitigate that somehow, there's huge challenges, so that's something I think is really important to recognize.

Fresco Absolutely, yeah.

Swaminathan

A really important point which has been made. I think that so many changes have taken place today. For example, in India, BT cotton was very successful, but today a white flag has come which is devastating the crop, because that was for the bollworms. So when the temperature changes, main temperature changes, the whole spectrum of diseases also change. I've seen in the past when wheat rust, wheat rusts and loose smut became very important. So the alternating which is taking place is also, that's where eternal vigilance is the price of good agriculture. I think it's very important to strengthen one or two systems. What happens when a new technology comes, even during the Green Revolution days there had been little more attention to what is going to happen to the groundwater or to the excessive use of fertilizers. Until Rachel Carson pointed out in her *Silent Spring*, people then take note of the problems arising from wrong use of pesticide. So I believe that the whole, all kinds of research, both applied as well as anticipated research and participative research, local families have become very important.

Fresco Thank you. So we agree that probably the problem that Norm couldn't see in a way, we can see it today. The most important problem is the problem of climate change. And climate change of course means in the reality of a farmer, changes in weather patterns but also changes in pest and disease pressure and changes in the soil, changes in salinity and so on. So I want to know if you're still sitting on your million dollars a year—I hope you haven't spent them all. Actually, I should have given you sort of little bits and pieces and you could have spent all your money on one subject and you wouldn't be allowed to vote on other subjects. So this whole audience participation is not totally objective. But let me know— who feels that the issues relating to adapting crops to climate change are really foremost or should be foremost on the agenda? Salinity, drought, high night temperatures, new pest and disease pressures. Who feels that's a big issue? Green for climate change. Anybody who feels that we shouldn't do something about this? Can I have a red one up?

Okay, you're rapidly spending your money here, huh? We won't have a lot of money left. Clearly, we have to ask our governments for more money.

Coffman I like this funding that just keeps coming.

Fresco This is the sort of ultimate funding idea, the more the better. You only have two bits of paper. You don't have them even, Ronnie.

But climate change is not just about adaptation to stress. It's also about mitigation, or to put it differently, climate change is also saying – and it's important that we say it today, one and a half months from the great climate meeting we will have in Paris, the COP 21 – climate change also means, and we say that agriculture is part of the solution and not just part of the problem. Why is agriculture part of the solution? Because there are many ways in which agriculture can help to mitigate climate problems: by storing carbon in the soil, for example, or even taking out, perhaps more actively, carbon from the air than it did before; by replacing fossil fuels with bio-based materials; by decreasing, for example, methane emissions from rice fields; by decreasing emissions from animals, animals' guts and so on and so forth.

So what should we do in that area, and I'd like to ask my panel, although you are primarily crops people. What, Ronnie, should be the real challenges for mitigation?

Coffman For mitigation.

Fresco So agriculture contributing to solving the climate problem, not the adaptation side of it.

Coffman Well, you know, as a plant breeder, it doesn't take me long to get to the solution. I mean, I think more investment in plant breeding is a real key. But of course you can't look to the past, necessarily, for the solutions to the future. At the same time, as Howard Buffett said this morning, the present situation is just not acceptable. So I think a realization that we have to sustain the public investments in such an important part of science as plant breeding. I mean, this is a real crisis that we're facing. We've got climate change coming at us in a big way, and the funding for these major plant breeding programs in both the major and minor crops is not there in a sustainable way.

Fresco Monty, we know about the Maputo agreements, the commitment a long time ago that the African government made to spend money on agriculture. How do you feel today about the African government's commitment to keeping up the investments in agriculture and agricultural science in particular? Are they enough? Can we do anything there?

Jones Well, actually, I believe all countries in Africa increased their investment in agriculture and agricultural research in the last decades or so. And I think that it's because of that declaration. Some countries have done better than others, and I think that those countries that have done well in terms of getting to the 10% commitment of their national budget to agriculture and agricultural research are reaping the

benefits today. So I think that was a good thing that our leaders had to take that decision. And I believe that all countries, including my own country, we're looking at getting to that level of 10%. We're not there yet, and I believe this is the trend in all African countries. So, yes, it's beginning to pay, but the international community can do well to meet with our leaders or at least bring up this subject whenever they meet with them. That was what Norman Borlaug did when he went to India. He went direct to the president and to the prime minister of India, Bangladesh, and told them that rice seed must go with other inputs.

So whenever you the big people, from outside, meet with our presidents or our leaders, you should hammer this point to them: you should get to the 10% level or even beyond that 10% level of investment in agriculture. And that way we would see more work being done in the agricultural sector and agricultural research sector.

Fresco M.S., is the Indian government doing enough to invest in agricultural development and nutrition?

Swaminathan

The present government of India is now going to be nearly 2 years old. They have announced that they will have a pro forma policy, because India, unfortunately... I mentioned about a particular act, how we came out from Bengal famine to right to food with homegrown food. On the other hand, there are a large number of farmers who decide there are problems which are... related to the economics of farming, many of them, that have become a very disincentive for the younger generation when they see older people are not... So the government is taking some action, but in my own personal view, much more seriousness, that is little bit of complacency, because there's a big stock of 50 million tons. Usually, grain mountains and hungry billions coexist, but to help us look at that hungry millions rather the grain mountains. Well, the government, the prime minister has announced that high priority this year is the International Year of the Soil. So really high priority will be given to producers to providing to every farmer a soil health card and understanding of soil health in its totality, the physics, chemistry and microbiology of the soil.

The government has also announced a major investment in irrigation, but there are problems in irrigation in India because many of them are inter - we are a federal country, interprovincial rivers, so sharing of those waters becomes a problem.

So I think the government is pro farmer, I happen to chair the National Commission on Farmers. For the first time either in either colonial India or in independent India, there was a commission on farmers. We had a commission on agriculture but not on farmers. And we recommended a policy for pricing, insuring markets and pricing and so on. Some of them, no, action has not been taken, but I hope they will be taken. But pronouncements, the pronouncements were encouraging, I would call it. But pronouncements are to become action plans.

Fresco Exactly. Between words and deeds, there are many, many gaps and problems. I now want to hear from some of the people in the room, and especially all those under 30. The over-30s get their chance later and have already had a chance in life. If you were to advise... (It takes a while to sink in, these kinds of things.) Okay, the over 30s, you may laugh, but you're not allowed to speak right now. The under 30s in this group, you're still sitting on your one million – let's assume that. What are you going to do? What would you do tomorrow? Or perhaps putting it less in a provocative way – What is going to be your priority project to work in the spirit of Borlaug 2.0? Evergreen Revolution, nutrition security, more trust, more private sector, governance involved, all that together – what is going to be your priority? Who can I get to the floor in the back of the room. Are you under 30?

Q Am I under 30?

Fresco Yes.

Q No.

Fresco No, okay. I'm going to ask the under 30s first. I can't see a thing because of the lights, so you have to stand up and wave at me. Any under 30s with bright ideas of what they want to do? Yes, go ahead. Speak up. Give us your name and where you're from.

Q My name is Emma Flemmig. I'm from Iowa but I'm at Virginia Tech now. I think we need to focus on storage, storage and processing, that part of conservation is saving what we already produce instead of simply trying to produce more. So low-cost storage solutions is one thing I would focus on.

Fresco So you are going to work on storage tomorrow. Yes? Okay, very good, very good point. Anybody else under 30? Let me just sort of make up a little bit..., under 35 perhaps? Okay, good, go walk up to the mic. Tell us who you are.

Q Hi, I'm Ashley Sakira with the CNFA in Washington, DC. I would say we should work on improving the profitability of farming so that you stay engaged in agriculture.

Fresco Say that again.

Q Improve the profitability of farming so that you'd stay engaged in agriculture.

Fresco Okay, what are you going to do tomorrow? Yes, you.

Q Sorry, what did you say?

Fresco Are you going to do something specific tomorrow to take this forward?

Q I would say engaging the private sector and encouraging youth to stay in agriculture.

- Fresco Okay, good. Under 30 or under 35.
- Q I'm definitely under 30. I just got my ID, just got my license. So my name is Matt. I'm from Penn State. And if I still had a million dollars, I'd probably want to improve access from farms to market, through roads; so I'd probably have government investment, if that's a possibility, or private investment, especially from Coca-Cola or Pepsi.
- Fresco Okay, good. Thank you. Yes.
- Q Okay. Thank you, I'm Francis from Cameroon. I think if I have to invest my money in agriculture, I should invest in post-harvest management. It is one of the big problems we are facing in Cameroon, for example.
- Fresco Okay, thank you. Well, let me give one quick chance for the over 35s, anybody who has a bright idea. Don't get up all at once. What are we going to do, tomorrow Borlaug 2.0?
- Q Hi. I'm not 35 at all, sorry. If I had a million dollars to invest into something, I would want to do something to do a lot more development and research to help agriculture in a way that helps the environment and climate change and make sure that we just keep it sustainable.
- Fresco Okay, thank you. Yes.
- Q At some point we'll have to minimize soil loss, and I was wondering what the thoughts are on alternative land management, such as switching to more human food production instead of commodities, and then resting, since it doesn't require that much land, resting some of the land so that the soil degradation doesn't continue?
- Fresco Thank you, yes.
- Q I'm near over 35, 44. I'm Eric Engstrom. I'm a professor at Monmouth College. And if I had that million dollars, I would take it and try and encourage more of those under 30s who are interested in agriculture to think not just about going into agricultural economics, the students I teach, for instance, or agricultural research but to become farmers, to get their hands in the dirt, to realize that this is something that you can do with all your education and all your smarts – and because that's really where the rubber meets the road is with those farmers.
- Fresco Great, thank you. Yes, you're the last one, I'm afraid.
- Q Thank you. I'm over 35. My name is Jodi Reisner. And what I would do is I would try to gather people across disciplines, because I don't think we do that as well in agriculture. So getting people across disciplines and across sciences. And my specific thing would be, gather those people together and work on looking at the soil resource and protecting it, because the soil resource will also help many other

ecosystems services connected to agriculture, whether it be water quality or climate mitigation, so all of those factors.

Fresco Okay, thank you. I have room for one last question of an over 55.

Q I am way not over 55. Can I make my comment, or do you want an over 55? I'm Abby [inaudible] from Lafayette, Indiana, and I teach nothing related to agriculture. I teach biomedical sciences. So if I had a million dollars, I would probably invest that in teaching the students who know nothing about agriculture, who have zero agricultural background. I would teach them about the importance of where their food comes from and why it's important that we have things like the World Food Prize, because the majority of us are in agreement with what's being talked about here; but there's a very large majority of people who don't know and who don't understand, and they need to know.

Fresco Super. Thank you very much. Back to my panel. One last sentence, and no more than one sentence. What is the advice you would give to all those here to start tomorrow in the light of a new Green Revolution, a new Borlaug 2.0? What is your most important recommendation? M.S.

Swaminathan

I couldn't grasp what it is?

Fresco Your most important recommendation for the new generation.

Swaminathan

The most important question for the new generation is to retain an interest in agriculture and not desert this profession. And that is what I would say. And also look at the problems and the total system problem. Yesterday Dr. Per Pinstrup-Andersen mentioned, his team mentioned about aquaculture, fish culture; 97% of the world is water, is sea water. What are we doing with it? There's a big opportunity here for those that like farming and so on. So for the new generation, one, please see what I said earlier – the future belongs to nations with grains and not guns. Secondly, take interest in kind of research which has been neglected but which could open up enormous opportunities for us, both not only livelihood but also for sustainable for security.

Fresco Ronnie.

Coffman I think if Dr. Borlaug were here, he would say to you – You're all important. Work together. The great admonishment he had for me and others was, he used to say, "Keep the herd together." It's really important to be complementary in your work and work with each other, industry and academia, one discipline versus another. That's a big message I think he would send us.

Fresco Thank you, Ronnie. That's a beautiful message. Monty.

Jones I would say increase the investment in agriculture and agricultural research and to promote innovative value chain approach to technological generation, dissemination and adoption, because for Africa we have this range of crops, livestock, fish; and all these entities need to come together to address the issues to increase food security for the countries and the continent.

Fresco Thank you, panel. Well, if I may add a last few sentences based on what I think Norm would have felt, I think he would have been incredibly proud, proud that so many people still think in terms of his legacy and not only look towards the past but take his legacy as an inspiration for the future. Isn't it beautiful that we sit here and talk about Borlaug 2.0 and really seriously ask ourselves where the priorities are?

And I'd like to echo what you said – there's no time to relax. We are in a hurry. We have no time to lose. Too many words are in fact a luxury we cannot afford. We must act, and we must make sure that all those who act, act indeed together – governments, science, farmers, retail, private sector, consumers, you have it. This is a collective effort. But we can do it, and I'm very grateful that M.S. put so clearly to us, this is the zero hunger generation. The future can be without hunger. Yes, there are many, many places where this is not the case, but it's a matter of peace very often and not so much a matter of technology.

We have no time to lose. We cannot afford to relax. But what we must do is make the right choices. And I said yesterday when I spoke to the high school students – Don't fret too much about the subject matter. Don't worry too much as to whether you want to be a breeder, be a second Ronnie Coffman or a second Monty Jones or whether you want to be a soil scientist or an agronomist or a nutritionist. Don't worry too much about it. But go about it with passion and compassion and try to become a little Norm Borlaug in everything you do. Thank you very much.

Ambassador Quinn

Wait, wait, wait. One more vote. There's one more input to come. I'm 2.0 times over 35. That means I'm over 70, so I get to pose the last question. I would say what we ought to do tomorrow if we're going to do one thing is, every university, every land grant college, every agricultural research institution should have a course called Borlaug 101 or Borlaug 2.0, to make sure everybody knows about all of these issues. So now your vote by show of green or red card – was this a great panel or what? All right. Let's give them a big round of applause.