

2014 BORLAUG DIALOGUE

October 17, 2014 - 7:30 a.m.

Breakfast Address: *Dr. M.S. Swaminathan*

Introduction:

Ambassador Kenneth M. Quinn

President - World Food Prize Foundation

Hope you liked breakfast. This was especially developed for Dr. Rajaram, so that's a little Mexico, a little India – just like you, the music last night. And so let's give a round of applause for the Marriott staff and preparing the food and serving it. So we're going to turn down the lights now, and I'm going to introduce to you one of the persons in the world that I admire the most and revere. And I believe he is the most admired agricultural scientist in the world. And he worked for 60 years with Dr. Borlaug.

They first met in Madison, Wisconsin, in 1953. I was... Let's see, where was I? I was, I guess, in 6th grade but in Lacrosse, Wisconsin. And if I had known you were there, I would have had my dad drive me down just to see you. So Dr. Swaminathan is the first World Food Prize Laureate. He's the dean of the Laureate Corps. He has been a part of the World Food Prize since then. He is currently the chair of the World Food Prize Selection Committee that chooses our laureates. So some of the laureates you meet are here because of his work and the other members of our committee, who remain anonymous.

So Dr. Swaminathan continues to be one of the most insightful and inspiring individuals in the world of global food security. And he told me that his remarks are aimed a lot at all of the Global Youth Institute participants who are here. And we're going to, though, let the other adults remain here as well to hear what he has to say. But he's developed his remarks in that direction, so you all pay attention, and there may be a pop quiz afterwards. So now it is my honor and privilege to introduce Dr. M.S. Swaminathan.

BREAKFAST ADDRESS

Dr. M.S. Swaminathan

1987 World Food Prize Laureate

Thank you very much Ambassador Quinn. I hope my voice reaches over there. Any problem? All right, thank you. I want to make sure that everybody is able to hear. Chairman Ruan, Jeanie Borlaug Laube, our 2014 laureate, Dr. Sanjaya Rajaram, Ambassador Sandhu, other distinguished laureates, ladies and gentlemen and members of the Youth Institute.

I was asked by Ambassador Quinn – this is the year, centenary of Norman Borlaug, towards the end of this Borlaug Symposium, can we have a sort of looking back over the years under what conditions Norman Borlaug began his association in India, what were the conditions then, what are the conditions now? And as Ambassador Quinn said, I first met Borlaug when I was a research associate in genetics at the University of Wisconsin Madison. There was American Institute of Biological Scientists meeting that he and John Niederhauser – I had more relationship with Niederhauser, because I was working on potatoes at the time. We were partners waiting in the same session, and afterwards Borlaug said we're going to drug store. I didn't realize drug store provides everything you need – it's a multipurpose institution, the drug store. But anyway, Norman Borlaug said, "Let's go and talk in a little more detail." That is how it started. Later on from 1960 on we had a very strong relationship.

Can you put on the slides? For those who do not know history, after World War II in the 1960s, President Roosevelt had a called a meeting at Colonial Williamsburg to discuss the whole situation, finally led to the birth of FAO in Quebec – Foreign Agricultural Organization in Quebec. A lot of books came in the '60s, a very doomsday predictions. Borlaug was getting annoyed with those books. One was *Famine 1974* by Paul and William Paddock, who said that there will be very serious famines in 1974, for three reasons – growing demand, supply gap, increasing price volatility (even now price volatility is a major function in terms of hunger), and third a widespread famine because already Bengal famine in India, and so on. Paul Ehrlich, *The Population Bomb*, the very famous, Paula and Ann Ehrlich are well-known, *Population Bomb*. But they also had not much confidence that we could overcome the population food supply gap, the human capacity to produce food, and the human need for food – there would be an imbalance between the two.

That's what led to them sometime between 1970 and 1985, the world would undergo vast famines – hundreds of millions of people are going to starve to death, that is, they would starve to death until pre-thermonuclear war or some other agent kills them first. India was always the whipping boy because the population was growing and food supply, the demand, but the food need and food supply was growing. And Paul and Ann Ehrlich said, the United States would announce that they'll no longer ship food to countries such as India where dispassionate analysis indicates that the imbalance between food and population is hopeless. This was the diagnosis of very respectable people.

And it was under these circumstances that bring a backdrop to Dr. Borlaug's early work and the work conditions he started his work.

There was a late Bengal famine – this was the backdrop of India's independence, and they became independent in 1947 from colonial rule. But 1942, '44, there was a very big famine. And normally, these kinds of pictures have appeared from African countries, unfortunately, Sub-Saharan Africa. But at that time the Indian newspapers also carried pictures of this kind, and three million children, women and men died of hunger. And Mahatma Gandhi said to the hungry "God is bread."

But today this situation is very different, and almost all crops and then almost all areas there has been tremendous agricultural progress. It was triggered by what is called the Green Revolution. We call it the "Wheat Revolution," because it started first in wheat and then came into rice and corn and sorghum and millet and so on. But wheat was the starting point in India

for the revolution, and today we produce over 96 million tons of wheat, over a hundred million tons of rice, and so on, and also the horticulture production – fruits, vegetables – 40 to 50 million tons. This year there are 260 million tons – over 260 million tons of food grains, in spite of the fact that in some parts of India, they experience drought, floods. It's a large country. I won't devote everything immediately to climate change, although there is a tendency to relate any extreme weather event to climate change. But the fact remains that we do witness more often either excess or deficiency of rainfall.

Now, this was the third World Food Prize laureate, Ambassador Quinn – because Norman Borlaug felt food does not mean only great wheat or rice or corn, which would include also animal products, even fisheries. And so he went to this place called Amul. I don't know how many of you in this area... it's a really well-known place – Operation Flood, it is called, Amul. And this one gentleman, Dr. Verghese Kurien, more than anybody else... all what we achieve is usually a teamwork, but nevertheless, one can say he was the leader of the movement, and he's made a contribution was cooperative, to organize small producers, what they called the other day, "production by masses," decentralized production supported by key centralized services, services in terms of processing, marketing, pricing and so on. And from 20 million tons of milk, less than 20 million tons of milk, this year is 140 million tons. The prediction is by the end of this decade it will be 200 million tons of milk will be produced, apart from other products and so on. You see, doubling wheat production is one thing, but doubling milk production is a much more difficult process. And that's why I'm glad the ambassador, he was chosen as the third laureate; after me and Chandler, he was the third laureate.

Now, Jawaharlal Nehru, our first prime minister, visited the United States and wrote a book called, *The Discovery of America*. Earlier he has written a book called, *Discovery of India*. This time it was *Discovery of America*. And he was very impressed with the land grant college institutions and also what he called – looking at the problem in a more integrated way: the water, fertilizer, the variety, postharvest management and so on. So at this instance in the work we call the four-year plan, second four-year plan and Intensive Agriculture District Program was started, called IADP. The major aim of this program was in the districts of India where there's legation, where there's water, you put the other inputs like seeds, fertilizer, and so on. In other words, build on water, water as the essential piece; because, without water, fertilizer can't be applied, and so on.

Now, it was started in water in 15 districts, but there was a lot of disappointment to the program within a few years. It was not giving the result it was supposed to do. I made an analysis at the time and published a paper in which I said the package of practices missed one important ingredient, namely, a genitive stream which can respond to the rest of the package, in other words, the fertilizer and the water, wouldn't have a genitive stream which could respond to the rest. This was what was made good with the help of Norman Borlaug. And you all know the history of the height production genes. In the case of wheat, what was originally from the northern experiment station, identified short plants with tall panicles [inaudible] that were the difference between the earlier short varieties. We had varieties like Tom Thumb, but even the Tom Thumb would have set a small panicle which would have been be very low. The advantages of these were similar. Almost at the same time there was a discovery in the case of rice, dee-geo woo-gen, the short variety, taken to Taiwan and from Taiwan to the International Rice Research Institute, and it spread from that. So the early 60s was the starting plant of what we call "the new plant architecture," the new plant architecture which was designed, it's like a

good architect who designed a plant by taking more of nutrients. That's what Rajaram also did with his varied lines, the winter wheat into the spring wheat.

Now, as a result of this chain, the atmosphere also changed, the mode of the [inaudible], because farmers, we put large number of the demonstrations in farmers. The Borlaug report was introduced two days ago with concentration on yield gap – why do we have a bigger yield gap? At that time when Borlaug came to India, the local varieties were giving, both in wheat and rice, less than one ton per hectare. One ton per hectare was the yield. But with our demonstrations, we showed four, five, six tons sometimes, different than the farmer. So the gap was very wide; it was not a small gap. It was not two persons, three persons; it was 200 persons, 300 person, 400 person gap.

Then how was the yield gap filled? How do you fill the gap which potential yield and actual yield? Four different approaches were developed. One is called “lab to land,” taking the, bridging the scientific knowhow, field level knowhow gap within the two – you bridge the gap by means by of demonstrations and so on – that's called the “lab to land.”

“Land to lab” is taking the knowledge of farmers, particularly that ecological prudence, and marrying it with the scientific work, mainstreaming local preferences. Also when we had some of the Mexican varieties like *Lerma rojo*, “rojo” as the word indicates is red. Those who know India, the chipatis, unleavened bread – they become very dark; people don't like it. So they wanted more amber-colored grains, not the red color grains. Fortunately, now, Norman Borlaug, on the basis of what they had grown in Pakistan, he went from India to Pakistan and made group selections of material from Pakistan and sent it to us. And we identified varieties like what was called *Kalyan Sona*, *Sonalika*, which had not only a very high yield but also the desired chipati-making quality. When I say “land to lab,” this is the feedback you'll get from the land that, all right, you are high yielding, all right, but it doesn't suit us from the point of your culinary characters – your tongue is equally important. And therefore you have to have it right.

Then “lab to lab” – research networks are organized and many labs are linked together. CIMMYT organized, IRRI organized a number of networks that was a very useful contribution of international centers of network, of research institutions. What they call you you can buy – purchase time. You can purchase time by taking material from one person to the other and also gain the knowledge.

Finally, “land to land” – farm schools. Yesterday when Dr. Emma was talking, I thought to myself – the farm school is one where we put the dormitory in an outstanding farmer's field, provided they agree. And the aim is to bring other farmers and farm women to their place for a week or few days, get inspired by what they have seen. So it is spread from farmer to farmer, land to land. And when she talked. I was reminded by one of our own farmers who has almost adopted not exactly but similar ones in Kaleda, very small one-acre person who earns a lot by this kind of planning and we have put a farm school. In India under the Corporate Social Responsibility Program, many of our banking institutions, financial institutions, are willing to provide money to agricultural institutions to put up such farm schools, learning from farmer to farmer.

So you see all the methods of bridging the gap in terms of knowledge, in terms of very fast.

When Norman Borlaug first visited in 1963 and we went, took him around, I myself traveled with him all over the wheat belt, identifying the conditions. Because when I first wrote to him to send some seeds, I said, "Seeds are no problem, I will send it to you, but I want to know under what conditions they are going to be grown." Because as you know, a seed alone is the starting point of the chain, but the fact remains, it requires some proper agronomic treatment.

Glen Anderson—I put on this picture because Glen Anderson was one of the finest persons. Unfortunately, we lost him rather young. He went from India to Mexico to help Norman Borlaug. But I have never seen such a hard-working and very knowledgeable person, and I want to pay a tribute to his education; because he gave his life for wheat very quickly. And there was a close, close worker with Dr. Borlaug, and then Dr. Rajaram took his place.

You can't have genetics alone. I am a genetics, but I can't have a variety without the potential. The potential, really it all depends on agronomic conditions. For example, we have to make a large number of changes in agronomy between the semi-dwarf varieties and the tall varieties. What were farmers used to? For example, they were never used to shallow soil. They were so very deep, and these did not come up; and they were blaming the Mexican wheat for germinating—they would not germinate because the coleoptile cannot come up if you put it very deeply. So we had to tell them you irrigate... I won't take your time now. There are number of steps involved.

All that I want to tell the young people is—seed is the starting point of change, but on the other hand, for the seed to express itself, on the one hand you need agronomic practices, on the other hand the public policy measures, public policy measures in terms of economics. Scientists can determine the production potential, but if the potential is real or not is only done by public policy in terms of input/output pricing and in terms of marketing. I showed marketing; without it, farmers won't grow again, because the economics should be right. The economics is conditioned by policy.

Norman Borlaug, apart from our scientific friends, he made friends at two ends of the spectrum. One is wherever he goes in outer India, Pakistan area, he liked to meet the farmers, farmers in the area. For example, these Rajasthan farmers who put traditional cap on him. He used to enjoy going around farmers. The other one is the policymaker. Yesterday also it was mentioned, the prime minister or minister, because he understood that what we see is synergy within technology and public policy. The real outcome is synergy between technology and public policy. And therefore at two ends of the spectrum, apart from the scientific stream, he had very close friends who still remember him.

We call the Green Revolution as a symphony, because all the pieces have to work together. Technology is the prime mode of change. The services which are needed to produce the technology, like seed production and so on; public policies, which determine the economics. We have the people who are producing the food, the farmers; they're only there to help them. And therefore farmers' enthusiasm, have adopt some, they are the leaders, the sick farmers are really he leaders. For example, this chap is a national demonstration farmer, near Ludhiana who used to produce five to six tons of wheat with no difficulty, when they were used to producing only one ton, and so on. So synergy among professional skill, political will and farmers' toil—that's what makes a symphony. And they have written here, the conductor of this symphony, the earliest Green Revolution symphony, was Norman Borlaug, because the conductor in the

symphony orchestra is a very key player, is the one who shapes whether there is harmony in the whole group or not, you know, his rhythm and so on make them.

Borlaug's passion from the beginning, even before the new wheats came, for genetic containment of wheat rust. He was always concerned with all the three rusts – the stem rust, the leaf rust, and the stripe rust. And the lecture that I heard in Wisconsin when I first met him, he talked about composite varieties, phenotypically similar but genotypically diverse. It was a very interesting concept at that time. I won't take your time to go into it, but you should understand those, young people, what does it mean – phenotypically similar but genotypically different.

Shuttle breeding was the first to start, he got rid of the photosensitive genes, as a result of shuttle breeding but in two completely environments Sonora and Ciudad Obregon. Then gene pyramiding and gene deployment strategy. And the last few years of his life, he was very concerned with Ug99. Ronnie Coffman will tell you about it. In fact, one of the very beautiful pictures in science, I think, after, before passing away, showed a picture of Borlaug in the wheat field with young people, telling them about the dangers of Ug99. It was a very nice and moving picture just before, just before...

Now, Borlaug always used to tell me that one of his mentors, E. C. Stakman, because he was at the University of Minnesota student the day Ron Philipps had arranged the talk. And they were saying Borlaug is a Minnesota man, and I think Ambassador Quinn also mentioned yesterday. So he changed the career of Norman Borlaug from forestry to agriculture. But forestry's interest in Norman Borlaug continued and remained until the end. In fact, he used to write to prime ministers and presidents, "Please take care of your forests. Otherwise, you'll be in danger. Hydrologic cycles will be interrupted. You'll have problems and more floods and so on." And so this is a very relentless battle against the unholy triple alliance of weeds, pests and pathogens. Stakman was fond of saying this as an "unholy triple alliance of weeds, pests and pathogens." And Borlaug's passion was also that, the unholy alliance.

Now, one thing which I remember discussing with Norman Borlaug and dated in the '60s was a book by Rachel Carson, *The Silent Spring*, because she pointed out the difficulties of DDT. DDT had won a Nobel Prize for the discovery. On the other hand, I know in my own experience, malaria was practically eradicated as a result of DDT, on the other hand, the long residual toxicity – the problems in the human stomach and so on. So Rachel Carson gave an early warning. At that time the high-yielding varieties of wheat and rice had not come, because some people contribute it all to the Green Revolution. If you want to use the word "Green Revolution" as a revolution of yield, more production to yield, then the Green Revolution first started in Iowa. It is with Pioneer and the company, hybrid corn. I would say technically it's a term that, if it had been coined earlier, Iowa would qualify to be the first home of the Green Revolution, starting with the hybrid corn, and both company. That's a real technically, because that's the definition of the Green Revolution is increasing production, the productivity advance.

Now, when Rachel Carson published the book and there were a lot of comments about it, it created a lot of adversal environment issues that you can't overlook the environment from the point of just going about, is not enough. It's important. Then I coined the term, it was the Evergreen Revolution, because it was clear to me that the only partner which is available to us to produce more from less land is through productivity improvement – vertical growth in productivity, not horizontal growth in area expansion. There's no more area. If our world

requires, for example, 50% more rice in 2030, then in 2004 with approximately 30% less arable land as of today, increasing productivity in perpetuity without associated ecological harm – that’s the definition of Evergreen Revolution, increasing productivity in perpetuity without associated ecological harm.

E. O. Wilson, after he read my article, he wrote to me a very nice letter. And in his book called *The Future of Life*, he said, “The problem before us is how to feed billions of new mouths over the next several decades and save the rest of the life at the same time, without being trapped in a Faustian bargain that threatens freedom from security. The benefits should come from an evergreen revolution. The aim of this new thrust [that is, the evergreen revolution] is to lift the production well above the levels attained by the Green Revolution of the 1960s, using technology and regulatory policy more advanced and even safer than existing.”

I was pleasantly surprised when President Obama... I was for some years a nominated member of the Indian Parliament, so I used to be... I was present at this lecture in parliament, President Obama. Together he told the parliamentarians of India, of which I was one of them at that time – “Together we can strengthen agriculture. Cooperation with Indian and American researchers and scientists sparked the Green Revolution. Today India is a leader in using technology to empower farmers, like those I met yesterday who get free updates on market and weather conditions on their cell phone.” (And he also mentioned the name of the mobile phones.) And the United States is a leader in agricultural productivity and research. Now, as farmers in rural areas face the effects of climate change and drought, we’ll work together to spark a second, more sustainable Evergreen Revolution.

The Evergreen Revolution means, as I said, improvement in productivity and perpetuity. I have brought some data in wheat in India. Gradually has been going up. It’s been going up from 7 million tons in 1947 to 97 million tons in 2014. We are hoping to achieve 150 million tons by 2030 – that is our target, to call for 2030, 150 million tons of wheat from 30 million hectares, in other words 5 tons per hectare, at the moment 3, 3.5 tons. Punjab is more; Punjab is almost 5 tons of wheat, 5 tons of rice, so 10 ten tons it comes.

The reason for optimism, again, is seen so by Borlaug. We can double up varieties which are highly resistant to all the three rusts. We can checkmate the rest by genitive means. Secondly, we can increase the photosynthesis efficiency of the plant. For example, in agricultural research institutes, Scientist Dr. Indu Shama, she is the director of a wheat program, a remarkable work, the wheat program of India, right from 1960s. This new variety, HD-2967, is a major breakthrough in wheat breeding, and it has been absorbed popular very quickly. Because farmers are the ultimate judges of the value of a variety.

Now, let me relate it to what we have done to this Zero Hunger Challenge of the United Nations Secretary General Ban Ki-moon. You all know the Zero Hunger Challenge, zero hunger by 2025. And the five components are known to you, so I am not going to take time. One of the reasons why the Zero Hunger Challenge was, apart from the fact it was stimulated by a past World Food Prize Laureate, Mr. Lula, the president of Brazil, who was one of the World Food Prize laureates.

“South Asian enigma”, we call it – South Asia and Sub-Saharan Africa are the hotspots, the two hotspots, both from the climate point of view, climate sensitivity, as well as from the point of

view of the prevalence of malnutrition and hunger – extraordinary growth, population largely dependent on agriculture, yet two of the five children stunted. For example, I was telling Ambassador Sandhu that now 80% of people in Afghanistan depend on agriculture for their livelihood. In India it used to be so. Now it's about 60%.

Now, the price volatility is one of the real problems when you have increased variability in production, demand/supply situation. But this I have written: "The future belongs to nations with grains and not guns." Guns, you can purchase, but in the future the grains will be more... This is why it is important for countries to pay attention to research.

Those who are interested in how to achieve zero hunger, there's a small editorial I wrote in *Science*, 1st August 2014. You can look at it. It is a condensed version with strategy for achieving zero hunger by 2015.

The three major dimensions of hunger – When we talk about hunger, we talk only about hunger, but there are three major dimensions. You have to disaggregate the problem in order to overcome it. One is calendar deprivation, or undernutrition; second is protein hunger, protein deficiency; and finally hidden hunger, which is micronutrient deficiency. So 2016 has been declared by the United Nations as the year of pulses; 2015 is the year of the soil, the year of the soil, and I saw some, Dr. Rattan Lal, people like him will be developing programs for the international year of the soil. Overcoming protein hunger, the pulses revolution. What we have done is, we have in India what we call Panchayati, the local self-government – they're elected; 50% are women. We are not trying to convince them where there's not much water. Pulses are the rain legumes at higher value but grow water requiring crop. We did require high value, but grow water requiring crop. And so we said we'll grow them. So they have now formed themselves into groups for the pulses Panchayati.

The CGIAR has actively promoted under the Harvest Plus Program biofortification. There are three models of biofortification. One is what nature has done already – biofortified plants. Secondly, from the last vast collection, for example, ICRISAT or IRRI it is over a hundred thousand varieties of rice, and ICRISAT has a very large collection of millets and so on, same as CIMMYT. Most of the international institutions have large collections of germplasm. From those germplasm you identified by breeding and selection, but there is no genetic modification. The third approach is genetic modification – Ingo Potrykus and the whole area of golden rice is a very good example, the golden rice, a good example.

For example, naturally biofortified crops – *Moringa*, drumstick. According to the *National Geographic*, a recent article, 25 times iron in spinach, 17 times calcium in milk, 15 times potassium in bananas, and so on, 9 times protein in yogurt. How can you? Nature has produced such a strong biofortified plant, and this can be used in agroforestry system. Agroforestry, you can mainstream nutrition. Today everybody is talking, IFPRI is talking about combining agricultural nutrition and health. Look at the problem of the three, because they are very much strongly related. And even the FAO has now said, we should not talk about food security but food security and nutrition, add the dimension of nutrition at the addition, of the high-level panel of experts, of which now Dr. Per Pinstrup-Andersen is distinguished chairman.

Enormous diversity in these millets, unfortunately classified as core cereals. They were not – they were also called orphan crops, which do not receive adequate attention from scientists. But

you find enormous millet availability. We call them in my foundation as “climate smart nutritive cereals.” – Don't call them core cereals – climate smart. In fact, there was an article... And then many of these women are great conservers, they particularly work with what we call tribal indigenous women. They have tremendous knowledge; their memory of what the plants are useful is remarkable. For example, this Kandha tribe in Odisha, 124 medicinal plants. Cultural diversity, curative diversity, culinary diversity – these are all the foundations of diversity, conservation of diversity, the culinary diversity, cultural diversity, curative diversity and ecosystem diversity. This was from a newspaper, an article on Californian drought, and somebody was saying we should roll back and bring back the old millets, which are much more tolerant to drought. In other words, traditional wisdom or dying wisdom – revive the dying wisdom in managing crops is very important too.

And here are, I think there's two laureates. I showed Dr. Kurien's picture earlier. Surinder Vasal is here, and he and Eva Villegas won the World Food Prize in the year 2000.

Quality protein maize – this is one of the favorite areas of interest of Dr. Borlaug, because he felt quality protein maize, if it is developed with high yield, can make a lot of difference. This is the one, the second step. One is the naturally occurring biofortified crops. This hybrid, this was bred by ICRISAT along with NIRMAL seeds – the company and the ICRISAT joined together and produced a variety of corn millet with a very high iron content and all at the same time higher yield also, because, since we don't pay by quality – the market doesn't usually pay by quality – unless the yield is also good, farmers will not take it up. So that is the problem with the quality protein maize; you must have a maize which is high yielding and at the same time good in quality.

This was given to me by your last year's laureate, Bob Fraley, at the very first, the beginning of the genetic modification; 1953 was the beginning of understanding of molecular genetics by Watson and Crick, whose contemporary I was in Cambridge but later on, 30 years later in 1983, the first genetically modified petunia. In fact, he gave me a plant the original, Bob Fraley, and I have kept it in our...

Now, let me say a few words, just also here was talk about the biotechnology and so on. In India we have only one strain of one crop where genetically modified crop has been allowed. This is in cotton, BT cotton. Those of you who can see this, you see how the production has gone up. Production has gone up as a result of yield revolution, not area expansion. But wherever there is now second generation – because, as you know, those who are breeders, genetic heterogeneity is very important to limit genetic vulnerability to pests and diseases. If you don't have genetic heterogeneity... this is why Borlaug's varieties are all very wide germplasm, so that they don't have.

Golden rice – I mentioned about the golden rice work earlier, a very beautiful scientific work in terms of beta-carotene enrichment of rice. On the other hand, it has got a lot of problems in the field. This are recent photographs from the Philippines where NGOs, nongovernmental organizations, enter the golden rice field, and then they cut it off, damaged the whole thing. So there is a fear that these are not good; although we say they are rich in vitamin A, they are not good. So public perception of science is different. In fact, the *Science* magazine has been emphasizing the need for more conversation between scientists and the people, the public. The Royal Society of London has a Committee on Public Understanding of Science. They also

established recently a Committee on Political Understanding of Science, because these two – both the public and the political leaders – have to be convinced before we can have... Borlaug was very concerned about this whole area. I've just taken a small quotation from one of his... A large number of articles are there. "Although we must be prudent in assessing new technologies, the assessments must not be based on overly conservative or overly inaccurate. They must be based on good science and good sense – good science and good sense. It is easy to forget that science offers more than a body of knowledge, and the process for adding new technologies. It tells us not only what we know but what we don't know."

I think it was very cautious in one sense – that we must use good science in world. Well, I have always said I had the privilege of meeting Mrs. Borlaug a few times in Mexico and other places. I call her the unsung hero in the Green Revolution, remarkable. I think but for the support she had given – the daughter is here, so she will know better. But I think we generally forget the fact that we talk about the person, but the persons who really have received this kind of support. So I want to be on this occasion, a tribute to Margaret Borlaug was a remarkable lady, and we should remember.

Now, President Roosevelt wrote an article called, "The American Dream." I have adapted it to the Zero Hunger Dream. I said – New frontiers of the mind and technology are before us, and we are pioneered with the same vision, bullness and drive with which the battle against food shortage was fought by Borlaug through the Green Revolution. We can achieve the Zero Hunger Challenge goal sooner than generally considered possible. It's adaptation of "The American Dream," but the Zero Hunger Dream will take all. Norman Borlaug's dream, this one was... American dream, zero hunger dream.

Now, in India the government of India and CIMMYT – the DG is here. A new institute, the Borlaug Institute for South Asia has been created. It's a consortium of seven nations, all the seven countries in agri-based economy and need much more strengthening of R&D and the agriculture. The government of India and the state governments have donated land worth about \$1.5 billion. This is one and a half times the budget of CGIAR. The land alone, which has been donated to the Borlaug Institute at the present cost \$1.5 billion. It will go up. Land in India, such a precious commodity, so that you had Ludhiana, Punjab, northwest 500 acres of land has been given adjoining the Punjab Agricultural University farm. Jabalpur in Madhya Pradesh where soybean work. I have met some people here; we had strong collaboration with the University of Illinois and so on; in soybean, 550 acres of land. Then Pusa, Bihar where originally the Indian Agricultural Research Institute was established – 150 acres of land have been given and Tom Lumpkin is here, and I hope this institute will fulfill its promise. It has bought the land, all the fertile land, irrigated land, very good infrastructure.

Now, as you enter the Laureates' Hall, you will find this quotation. I think, Ken, you have put my... but it thought it was an appropriate ending. "Again and again in history some special people wake up. They have no ground in the crowd. They move to broader laws. They carry strange customs with them and demand room for bold and audacious actions. The future speaks ruthlessly through them. They change the world."

I think one of those who has changed the world... Ladies and gentleman, here was an unusual man, a great man, gift of God to humankind. But I think it's important that we continue that legacy, to continue, celebrate his life and not talk only about what he did but what we are going

to do. As Kennedy has said, “Ask not what America will do for you but what you will do for America.” Similarly, Borlaug would ask the same question – Ask not what you are saying about me, but say what you are going to do to continue my legacy. Thank you very much.

Ambassador Quinn

Well, MS, sitting there listening to you and this incredible review of Norm’s life and everything, it reminded me that the Borlaug Report, which we conceived of, was to take the place of Norm. Because when Norm would come and speak, he’d give the overview of the world, and everyone would listen. And that’s all you needed was that. And I was sitting there realizing you now have taken that place, and this is the Swaminathan Report and the assessment of the world. I think everyone was so deeply impressed by your overview of this greatest period of food production in history and now the greatest challenge that we face, and it’s never been more clear for me. So thank you so very much.

I have something. This is the World Food Prize Ambassador’s Award, so this is a new award, presented to M.S. Swaminathan for your invaluable contribution to the World Food Prize Foundation and for your support of the legacy of John Ruan and Dr. Norman E. Borlaug. And it’s signed by me and John Ruan, our chairman.

M.S. Swaminathan

Thank you very much. It’s a pleasure.