October 15, 2004 – 2:00 p.m.

ROUNDTABLE DISCUSSION
RICE RESEARCH AROUND THE WORLD

Dr. Robert Havener
Council of Advisors
The World Food Prize Foundation

We now have for you a roundtable discussion. I promised you earlier this morning and perhaps yesterday as well that there would be more opportunity for questions later in the day. We have before you experts from various parts of the world who are working on rice, and they are an each expert in their own area and their own discipline. They're going to make brief opening comments and then open the floor for you to raise questions with them and, give comments that you would like to give on the subjects on which they made statements.

The first presenter will be Dr. Ren Wang. His CV is also among those listed. He was a senior scientist in China. He worked with the Chinese Academy of Agricultural Sciences. He earns a Ph.D. in Entomology and studied at Blacksburg, Virginia, at the BPI and U in Entomology. He has joined IRRI about four years ago as the Deputy Director General for Research. I'd like first to turn to Ren Wang and we'll do that kind of a brief introduction in each case.

Dr. Ren Wang
Deputy Director General
International Rice Research Institute (IRRI)

Thank you, Dr. Havener. It is my great privilege to speak in front of this distinguished audience, and I have thought a lot about the issue that I could raise with this audience. And I'd like to follow up on what our Director General, Dr. Cantrell, has been presenting, to show that in IRRI, in addition to very intensive research and activities in developing improved germ plasm for rice, we also have been doing some intensive analysis and study pondering on the question – can Asian rice production sustain? So in other words, to think on a higher level, at a macro level, longer term, what would be the major factors and the possible solutions that could address these major issues?

And I'd like to just raise three sort of emerging and seemingly irreversible constraints that threaten Asia's rice farming in the mid- to long-term future. I know that Dr. Khush and other

experts will address some other issues related to, say, yield, seed and other issues. But these issues that I would like to address do not have anything directly related to germ plasm improvement per se.

The first one that we feel is important is the looming water crisis, and this, we believe, probably will be the most important constraining factor in the future to Asians' rice production. At the moment, our scientists calculate that in order produce one kilo of rice grain, you need three thousand liters of water. And in many Asian countries already, there is science showing a crisis of water. Mekong River has dropped to its lowest recorded level. The Yellow River in China, which actually nourishes quite a major basin for rice production, Japonica rice production, does not reach its destination to the sea; in many years even 200 kilometers before it reaches the sea, it dries out.

Some national governments are already implementing policies for charging water for irrigation. As we all know, in China and those who are in India, farmers are increasingly using pumping water to irrigate rice. And also the quality of water has been declining by contamination, heavy use of chemical fertilizers and so on.

So the first question is – Can Asian rice production sustain with this much-reduced water at the present and even more so in the future?

The second issue I would like to quickly raise has to do with the global warming. As the Intergovernmental Panel of Climate Change indicated in 1995, here I quote, "Global mean surface air temperature has increased by about 0.5 degrees Celsius in the 20th century and is projected to further increase by 1.5 degrees Celsius to 4.5 degrees Celsius over the next hundred years.

IRRI's research has shown that the annual mean maximum and the minimum temperature increased during the past 25 years by 0.35 degrees Celsius for the maximum temperature and 1.13 degrees Celsius for the minimum temperature respectively.

Also our study has shown, with concrete data in the past 12 years, that a clear linear correlation exists between the decline of biomass and the increase in minimum temperature. Also indicated was that with every one degree of increase in minimum temperature, that is night temperature, during the growing season, will result to a 10% decrease in rice yield. That has some very significant implications for the future of rice. And that's at a macro level.

Now, the third constraint I'd like to quickly refer to has to do with the people who produce rice. In other words, we feel that we see a trend of, I would say, an endangered generation of rice farmers and rice researchers.

As we saw in the case in Korea in the 1970s, more than 50% of the Korean farmers were young and below 40 years old. Nowadays more than 50% of the Korean farmers are above 60 years old. Now, the declining of the quantity, the numbers of rice farmers, has been obvious, and that is the aging factor. But that is not what is the most worrying. The most worrying, we feel, is the quality of rice farmers these days, in other words, the farmers, whether or not they have the knowledge and the skills to manage rice production so that the rice production can be profitable.

And that is really a serious question. Nowadays when you go to Asian farmers, you ask the farmers whether or not they would like their sons and daughters or grandsons and daughters to be rice farmers, most likely the answer will be no. They probably would like to encourage their kids to go to colleges or work in cities.

And also a phenomenon is the rice researchers. In many developing countries in Asia, leading scientists who are training, say, advanced institutes in developing countries or even IRRI, are reaching retirement age. And we see many countries most dramatic example exists in countries such as Indonesia, the largest Muslim country, rice-producing country in the world. And that has the surprises. We must do something to stop such a trend.

Now, one thing I'd like to mention is to follow up on what Dr. Cantrell was saying. In examining such trends, IRRI is going to launch this year the IRRI Environmental Agenda.

Dr. Robert Havener

The next gentleman is Dr. Kanayo Nwanze. Kanayo is the Director General of the West African Rice Development Association, WARDA, the place that was the home of the NERICA varieties. He is a distinguished African scientist in every sense of the word. He received his undergraduate training in biology in Nigeria and an MSC and a Ph.D. in Entomology from Kansas State University. In addition to being the Director General of WARDA, he is also serving as chairman of the Director Generals of the various CGIAR Centers. I'll turn it over to you, Kanayo.

Dr. Kanayo Nwanze
Director General
West Africa Rice Development Association (WARDA)

Thanks, Bob. Thanks for this opportunity to share with you some thoughts on rice research in Africa. Ladies and gentlemen, Monty Jones. I'll deal with Sub-Saharan Africa and exclude Egypt in my discussions on rice research in Africa.

The region spent close to about $1 billion in rice imports, buying or receiving more than 15% of the traded rice in the world market. The question is – Does Africa have to import rice in order to feed its population?

Rice research efforts date as far back as the 60s, starting with what French Agricultural Research Center for International Development called IRAT, now known as CIRAD. And other little players included ITA, IRRI and of course WARDA. Initial efforts in the region were environmental improvements in many varieties. Mostly arising from introduced sativas from Asia and Latin America were grown.

But a study that was published in 2000 by Dalton and Gay show that out of seven, the most important rice-producing countries in West Africa, revealed that despite limited investment in rice research, about 200 improved rice varieties had been released over the past 25 years and that varietal improvement was responsible for contributing at least $360 million, maybe as high as $547 million in 1998 in West Africa.

WARDA is going to host the East African Rice Research Network starting this year, and this development I believe is the first step in creating an Africa wide rice research network that will link east, central and West Africa, and hopefully southern Africa.

But the question still remains – Why does Africa have to import rice to feed its population?

NERICA is not just a product. It is a technology. First, it shows that Africa can generation scientific excellent. Monty Jones is a good example of that. Also, that a cultural revolution in Africa does not necessarily have to follow the same pathways as the Asian

revolution. The difference between NERICAs and the others is that NERICA was developed and adapted to its African environment, not needing the environment to be adapted to fit the variety.

Although it would appear that considerable effort centers around its dissemination, Guinea and Uganda serve as flagship countries, for the NERICA technology has now produced a new generation of varieties for irrigated and lowland ecologies. This work started in the late nineties, and we now have materials in participatory variety selection, which Monty explained earlier today. So the two… varieties are in the pipeline.

Next question. What is the role of rice biotechnology in Africa? How much should we invest in it and why? I believe that Africa cannot afford to miss the revolution or allow another to bypass as happened in the Green Revolution. Agricultural biotechnology can and has, we know, boost crop productivity, can be employed to enhance the nutritional content of staple foods. This is particularly relevant in Sub-Saharan Africa.

There are already modest investments in research and human resource developments in biotech, particularly through assistance collaboration with Susan McCouch of Cornell and Texas A&M at price. So we are building a new generation of scientists that will support this kind of work in Africa.

Mr. Chairman, I cannot conclude without sharing with you some of my thoughts on a couple of issues, if you allow me to do so. Science and technology by themselves would not work magic in Africa, nor would technology provide a quick fix to increase agricultural growth. What is the use of science that is not converted into technology? What is the use of a technology that has potential and is not accessible to development?

The right solutions for Africa call for fundamental changes in the mindset of leaders and followers, good governance, accountability, wise policies, improved infrastructure, and the spirit of self-reliance. The NERICA story is a good example, the technology developed by an African for Africa in an African institution, led by Africans with strong and sustained support from R&D partners.

The paradox of our times is to live in a world of plenty with spectacular technological advances, yet witness millions trapped in tragic poverty. If African leaders continue to treat hunger, disease, and nourishment a second priority to stockpiling munitions, building sport facilities and monuments, they should be brought before the international court of justice for every child who dies out of hunger, out of malnutrition, for every child who dies out of malaria – for these are crimes against humanity, crimes committed against Africa on these peoples over the last thirty to forty years.

Thanks for the opportunity to share this with you.

Dr. Robert Havener

Thank you very much, Kanayo. You can tell he feels strongly about those words, and they were profound. He also has had the experience of the last 18 months of managing a research organization whose headquarters was in a country that was being decimated by a civil war that crossed paths with his research station and his research staff. He redeployed them successfully, he kept the research program going, kept the donors more or less happy and kept the results going out to farmers' fields. He deserves a great deal of credit for his leadership during that period.

I'd like now to turn to Dr. Luis Sanint. Luis is the Executive Director of a program in Latin America called the Latin American Funded Irrigated Rice Program. He holds a bachelor's degree from the University of Los Andes in Bogotá, Colombia, a Master's Degree from Texas A&M University and a Ph.D. also from Texas A&M University in Agricultural Economics. Tell us a bit about the FLAR program and about Latin America, Luis.

Dr. Luis Sanint
Executive Director
Latin American Fund for Irrigated Rice (FLAR)

Thank you, Bob. I want to salute the laureates, Monty Jones, Yuan Longping. And also I must express my gratitude to the World Food Prize for this wonderful and inspiring opportunity to be here.

Latin America produces about 4% of the rice of the world. It holds about 9% of the population of the world. There are about 12.5% of the cultivated arable lands and 25% of the renewable water research. So this clearly indicates that there's plenty of land and plenty of water.

Rice 30 years ago, there was a production of 8 million tons in 6 million hectares. Today there are 6 million hectares but 25 million tons, so three times as much rice of the same area, of course, three times as much yield, and yields are a little over 4 tons, which is very close to the world average.

We know that behind these, we must be very grateful to people that have this vision in the vision, people like Herar, Frosty Hill, who envisioned the need to create international centers, like IRRI, like CIMIT, like CIAT. They have been instrumental to capture and capitalize the avalanche of new knowledge that we have received over the past few years.

But if you ask from the perspective of a Latin American farmer or someone in the rice sector that was here listening to the ten lessons that McPherson gave us, we would see lesson number 11. And lesson number 11 would be the internationality, the international dimension of it has been absolutely critical for the success that we have seen. And like Dr. Brady said, we're not talking about just CIAT or IRRI – we're talking about everyone, everyone in the international effort.

And we see another lesson – that when they said that they were going to set these centers up and they would work themselves out of a job, they were meaning it. And I think it also was healthy that they were meaning it. It came to a point when in Latin America, CIAT had to tell the rice sector, I am not going to be able to finance this rice program that you have had for many years, so we will have to look somewhere else for funds. And where do we look? We look at the farmers. We look at the rice sector, because they were the beneficiaries. We estimated that the annual flow of benefits of these technologies from this international research was about $900 million per year on an investment of probably $30 million; $500 million went to consumers, and $400 million went to producers.

So tell us about FLAR. Of course. CIAT went out and told the farmers, we need to keep this business going. It has been good for you. Can you pay for it? And fortunately, very fortunately, farmers said, "Sure. We'll pay for it." And that's how FLAR was created ten years ago. Thirteen countries in Latin America have participated. We have mobilized more or less $6 million – not much, but it helped. We are also working on crop management, thanks to a donation from FAO and CFC of $1 million for three years, and we are already at the end of the first year.

I must recognize the tremendous support that we got from CIAT, the director general of CIAT at the time, Robert Havener. And we still need to maintain the support of CIAT. The support of CIAT for this is absolutely critical.

If you'll allow me, I will just explore on two challenges, the immediate challenges that I see for the future in Latin America. One of them, trade – the opening up of economies. Some people probably think that Latin America is an isolated corner of the world, and I think some people in Latin America think that Latin America is an isolated corner of the world. But the world does not have any more regions that are isolated. We are in the global village. And we are entering trade agreements that are general, are global. Rice is going to be one of the crops for sure. We must maintain the viability of the rice sector, because the rice sector generates many dignified employments. I'm not talking about employment; I'm talking about dignified employments.

I want to caution the notion that market forces will define what we should do in the world. Market forces coming down, yes. Market forces would probably dictate that in a country like Colombia. People will end up producing certain kinds of plants that are not really dignified jobs. And these people that are not dignified, they are resentful, and they, like the governor said, they are not really allies.

The second challenge is nutrition, and a lot was said here about nutrition, but I have something simple. Why do we polish our rice? And I think this is a necessity that came out of three, four, five hundred years ago, because rice if you didn't polish it, was going to be very perishable. But this doesn't need to be like that anymore. I think we have to teach people to eat rice that has all the riches of rice into it, parboiled rice. Use the school feeding programs. Brazil, for example – 15% of rice consumption in Brazil is already parboiled. Brazil has this Zero Hunger program that is very successful. We're advising the government of Brazil, we, I mean IRGA, which is my partner in Brazil, to do this.

And I think the final challenge for Latin America is – we must maintain this impressive flow of innovation and technology by keeping this international effort that was so useful and so productive.

Thank you.

Dr. Robert Havener

Thank you very much, Luis. Not just because I did have something to do with its creation – I think FLAR is among the most innovative things that has come out of the CGIAR system in which producers were asked to fund a major share of its expenses. It wasn't a new idea. Dr. Borlaug started it 50 years ago in Mexico with the farmers in Northwest Mexico, but it was successfully transferred to the rice producers of Central and South America.

Next on our list is Dr. Mark Walton. Mark is going to bring to us a different perspective. He's with a private sector seed firm here in the United States, more precisely in Texas. It has some international linkages around the world, and it has long and interesting connections to the CGIAR and to the World Food Prize. But I think he will bring those to our attention as he gives us the benefit of his thoughts. He has a degree in Agronomy, BSE in Agronomy from New Mexico State University, and Master's and Ph.D. in Plant Breeding from University of Nebraska. He is the Executive Vice President for Research and Technology for RiceTec. Mark, your thoughts, please.

Dr. Mark Walton
Vice President
RiceTec

Thank you, Bob. And I would like to take a moment to thank the organizers for the opportunity to be here and to address you. It is both a real pleasure to participate on a panel as distinguished as this, and it's also a bit humbling for someone who works in a very small part of the rice world and thinks about rice probably much differently than my colleagues here at the table have had to across the course of their career – which also led me to think about what it was that I would discuss, the thoughts that I might share with you.

Without wanting to trivialize or meaning to trivialize the issues that are faced by rice farmers throughout the world, and particularly in the developing world as we've heard over the last two days and as that we're all aware of, what I've also been struck by is really the needs and the issues that a U.S. rice farmer faces are very much like those that are faced by the rice growers in China or the rice growers in Africa as well. And by that, I mean what they really are interested in doing is maximizing the income per acre from the rice that they produce and having opportunities with their rice crop to look at better cropping options that provide for those higher incomes. So, for example, in the United States, a rice grown in Arkansas that could have an early season rice variety that high yields and allowed them to grow longer-season soybeans would end up with a higher revenue per acre.

So, again, I don't want to trivialize the issues that are facing the rest of the world, most of the world, but I am struck by the similarities.

Bob also suggested that I give you a little bit of interest about RiceTec because I am a private sector person and we are a private sector company. It's a relatively unique organization in

that we are a vertically integrated rice organization. We are rice breeders in hybrid rice, and I'll talk about that in just a minute. We are also developers of specialty rice varieties. We are millers, packagers and processors of those varieties. So I forgot to ask before I came, but I suspect that if we went to the grocery stores here in Des Moines, you would find RiceTec products on the shelves. We're the ones in the clear plastic jars, so we're fairly unique and obviously to see.

RiceTec has been working and is focused exclusively on the development of hybrid rice, and that is for the seed industry, and that is the technology that we are focused on. Our hybrid rice program started in the late eighties, and it started through a collaboration with Professor Yuan and the Hunan Hybrid Rice Research Center, and that collaboration continues today. RiceTec has also been blessed by having contact, as Bob said, with a number of the major rice programs in the world, not just Professor Yuan's, but we also have had the real privilege for about 20 years of having Hank Beachell of part of RiceTec. Hank asked me, in fact, to bring his greetings to this group, expressed his wishes that he could have been here with you, but his best wishes for the organization. And Hank is very much an inspiration to all of us at RiceTec in the same mode that Dr. Borlaug is for all of us, somebody who just keeps going and keeps going.

As I was thinking about the issues that a U.S. rice grower might face or that the rice industry in the United States is facing, I thought I would bring up a couple of things. And, again, these will be different, very different, obviously from what you've heard from the other panel members and what you will continue to hear, I'm sure, from the others, but they are of importance to U.S. rice growers. As I said, the U.S. rice grower wants to optimize revenue per planted acre, and that obviously makes sense.

In the U.S. we have a lot of ways of doing that, and one of the things we're facing right now or would like to have in the industry is more herbicide tolerance options. We have one. It's a herbicide tolerance to a particular class, and then it's through a mutation. There are other herbicide tolerances that are in the wings; they are all transgenic, and so that is an issue in the United States, because half of the U.S. rice production is exported. And our export markets discourage the use of transgenic products or discourage the use of transgenic rice at this time. And so that prevents our growers, at least today, from accessing technologies that are approved, known to be effective and safe and are available if the markets would permit them.

I also would add that use of transgenic technology in general will in fact become important in the U.S., just as we've heard from Dr. Nwanze his thoughts. In the United States we are facing water issues, both in terms of availability of water, in terms of quality of water. The global warming trend affects growers in the United States. So thinking about or looking down the road at things like the photosynthetic genes cloned from maize and that would be interesting to look at in rice and potentially more than interesting but incredibly valuable. Drought tolerance or some version of drought tolerance to be able to reduce the amount of water use so that we can continue to grow rice sustainably in the United States.

The governor at lunch today talked about in Iowa the use of corn for the production of nutriceuticals and eventually pharmaceuticals. Rice is actually an excellent crop for many of those sorts of applications. And in fact there are organizations or companies in the United States today that are working towards developing and utilizing rice as a source for pharmaceuticals and

nutriceuticals. Again, industry, not industry acceptance but consumer acceptance is something that we have to deal with, that the farmer will have to be able to deal with in order to apply those.

And then I have one point that I wanted to mention specifically that relates to those of us who work in research in rice. Dr. Borlaug in his address yesterday talked about the importance of shuttle breeding, what he called shuttle breeding. Rice is the only major agronomic crop in the United States today where a complete quarantine is imposed on the importation of rice seed from anywhere else in the world. So we cannot bring rice seed into the U.S. without going through a quarantine facility. So what that means is it slows the process down, and it makes genes that could be available or valuable to the rice industry in the United States less available to them.

I would like to just finish with – I'm the only private sector scientist sitting at the table today, and in fact in the United States the majority of rice research is done in the public sector. It has been it continues to be. Private sector research is a relatively small proportion, and it is the cooperation and the collaboration that exists between the public and a growing private sector in the rice industry that I think will make it possible for us to move forward quickly with rice technology in the U.S.

Thank you.

Dr. Robert Havener

Thank you very much. We do have a cooperative research arrangement on rice research between the USDA, the federal government responsible for that portion of rice research, and the individual states in which rice is an important commodity. The USDA Task Force group on rice is headquartered at Stuttgart, Arkansas, where, along beside the University of Arkansas's rice research unit in Stuttgart as well, they work throughout the United States in a cooperative arrange with the state agricultural research service. And I think it is a fairly effective organization these days, as a matter of fact.

Let's turn then to one of our own, Dr. Gurdev Khush. Khush is well known to most of you. He's been referred to at least a dozen times or more during the process of this symposium. Dr. Khush is one of the world's authorities on crop breeding and a major force behind the development of productive rice varieties and the Green Revolution in plant breeding.

He began his work internationally at the International Rice Research Institute in 1967, and in 1996 was, in association with Hank Beachell, chosen a the laureates for the World Food Prize. He has also received the Japan Prize in 1987 and the Wolfe Prize in the year 2000. Those are probably three of the most prestigious prizes in the world.

With that, we will turn to Dr. Khush to give us his wisdom. Please, Gurdev.

Dr. Gurdev Khush
Professor of Plant Breeding
University of California-Davis
1966 World Food Prize Laureate

Thank you very much, Bob. In the initial talk of Dr. Cantrell, he kindly referred to some of the work I did on the rice improvement. That was done in partnership and collaboration with the numerous scientists, including the two laureates of World Food Prize this year. I met Professor Yuan Longping for the first time in 1976 when Dr. Brady led a team of IRRI scientists to visit China, and since then I have worked very closely with him.

Also, I had association with Dr. Monty Jones from the beginning of his career, and I always admired his determination and his foresight in picking up the best winners.

Several years ago we had a vacancy of a plant breeder, and in consultation with our Director General, I offered him a position to join our staff. Dr. Nwanze was able to persuade him to stay at WARDA. It was probably good as well, because his services are needed there, probably greater than at IRRI. And the result is obvious to every one of you.

I also had the fortune of working with the all eight direction generals of IRRI during my 35-year stay, and they all inspired me and guided me in my work. Four of them are here – Dr.

Brady, Dr. Swaminathan, Dr. Havener, and Dr. Cantrell. Thank you very much to all of you for putting up with me all those years.

We have heard many speakers talk about the need to increase the rice production. Estimates vary from 30% to 60%, but we all agree that we have to produce more rice from the existing land with less water, less labor and less chemicals. So how are we going to do that? That's the immediate challenge.

One actually is to develop the rice varieties with higher-yield potential so that we can produce more rice from the existing land. Second is to close the yield gap. We know the maximum yield potential of rice is about 10 tons per hectare, but the farmers still get about five tons on the average under irrigated conditions. Can we close that huge gap so that the farmers can produce seven to eight tons rather than five tons? That will also increase the productivity. That can only be done by developing rice varieties which have more resistance, so that we can cut down the losses caused by diseases and insects – also by developing varieties a bit more tolerant to stresses like drought and salinity and excessive water.

The third strategy is to manage the intensely cultivated system like rice and wheat or rice after rice after rice. There is some every of productivity decline because of the excessive mining of the nutrients.

So those are the three ways to meet that challenge of producing more rice. Now we have strategies for developing the varieties with higher-yield potential, the hybrid rice from Dr. Yuan Longping and Mark. We have also the conventional hybridization and selection procedures where, if there is enough input in proper improvement, there is a possibility to increase the yield potential.

You have heard how the yield potential of rice and wheats were improved by introducing the dwarfing genes. We can look to the improvements in the harvest index and biomass production.

Several years ago at IRRI we conceptualized a new plant type to modify the plant architecture so that we could increase the biomass production and improve the harvest index. Several lines have been developed with about 15-20% higher yields.

Also there are possibilities to use the genetic engineering for improving the yield potential. Dr. Swaminathan mentioned the work being done to modify the photosynthesis of rice from C3 to C4. The differences between C3 and C4 are governed by about four genes, and they have isolated these four genes, and they are introducing these one by one into rice. And all four genes have been expressed. Once these are combined together, it might be possible to convert the rice from C3 to C4. If that happens, it will lead to increase in the yield potential by about 30-35%.

Then there are molecular approaches for increasing the yield potential. With the availability of the rice genome sequence, it's possible to identify the better alleles from these large germ plasm collections, like we have at IRRI. By mining or screening those germ plasms, it's possible to identify better alleles, which can be introduced into the improved, genotized

through DNA fingerprinting at a very rapid rate. And of course you have heard about the wild hybridization from Susan McCouch and Dr. Monty Jones, which is a good strategy, to bring in some of the useful genes from the wild germ plasm.

So those are some of the strategies for increasing the yield potential.

Now for closing that yield gap, the possibility of developing varieties with disease and insect resistance are numerous. There is the possibility to use the molecular marker selection to combine more than one gene because, when you have just one gene for resistance, the longevity is not that good; and by pairing two or three genes, it should be possible to increase the durability. Thirty genes were combined in less than two years and without the availability of molecular markers, it would have taken more than ten years.

We are working on some of the technologies on rice weed system, and IRRI has a very good collaborate with India, with Pakistan, with Bangladesh to see how that productivity decline can be arrested.

Thank you very much.

Dr. Robert Havener

Thank you very much. And our final presenter is Dr. Prakash from India. He is the Executive Director of the Central Food Technological Research Institute in Mysor. He was born in Mysor District in India and was educated at the University of Mysor through his Ph.D. degree. Following his graduation with his Ph.D. degree, he did a post-doctoral fellowship at the Texas Medical Center in Houston, Texas, and at Brandeis University in Boston. And he has successively worked through the general area of food technology, nutritional concerns until he became indeed the director of the Central Food Technology Research Institute. Dr. Prakash.

Dr. V. Prakash
Director
Central Food Technological Research Institute

Thank you. Ambassador Kenneth Quinn, Dr. Norman Borlaug, and Dr. Havener, Dr. Swaminathan, all the Laureates of the World Food Prize, and organizers of the World Food Prize International Symposium, respective delegates. I think first of all I should thank the organizers for the invitation for me to be here at this roundtable. And also the kind words from Dr. Havener as chair.

My warm congratulations to the Laureates of the 2004 World Food Prize. Taking the clue from what Professor Swaminathan said in the morning about value addition in the chain to biomass, I think when we look at agriculture, higher production, higher productivity, value addition, nutrition security, and also employment empowerment, I shall spend the next six to seven minutes or so on the subject of value addition in the rice chain and the introduction of the concept of browned rice through a technology innovation from CFTRI. CFTRI is Center for Technological Research Institute at Mysor.

When we look at patty, consisting of husk, the rice bran and the polished rise, what really attracts our attention is the rice bran as the nutritionist. It is very important when we look at rice bran, we need to remove it, as all of us know; otherwise you can't keep the rice more than a couple of weeks because of the lipase action. Therefore, the challenge is to polish it, at the same time retain nutrition.

I think in this concept, the parboiling of rice or the parboiling of patty, a 1960 concept, nearly 50 millions tons of patty in the certain back home in India to an induced system of higher productivity and nutrition retention. In the 1980s when revolution took place in this technology of hot-water soaking, which really saved the energy more than 70%. Therefore, when we look at such a benchmark, nearly additional one million jobs were created as a result of this innovative technology from the Center for Technological Research Institute.

This pushed us to look at rice milling as a very important technique in the 1990s and the 2000s, where bran, the most nutritious part of the rice, the good balance of protein, fat,

carbohydrate, dietary fiber, vitamins, minerals and so on, it's amazing. The question is – why should we lose it?

If you look at the innovative technology that happened, nearly 67% of the yield of the white rice. When we look at browned rice, which this innovative technology, we're looking at 110% more yield. I guess in this we also get additional 90 million tons of nutria rice, which is of course natural, nothing to compare with GM rice.

This small addition of the existing innovation with the current 30,000 mills, can revolutionize the outburst of nutrition to the outreach of the society. I guess it is here, the stabilization and the thermal process and the color and quality of the rice bran oil, which of course is a gold oil in Japan, as a Japanese would walk any number of miles to take rice bran oil, as it has a wonderful high nutriceutical value.

When you look at brown rice, ultimately what you're looking at is a nutritious rice, not a competitive to golden rice but CNNR. The hybrid varieties, when we double the protein, perhaps we should ensure that it reaches the food cycle more than the feed cycle, because when you take the rice bran out, it gets into the feed cycle. Perhaps browned rice is a partial solution.

Lastly, when we look at the area of value addition with nearly 3,200 traditional foods in India which are rice based, I'm sure the numbers could be another zero added to that in the rest of the world where a large amount of traditional foods can be value added through brown rice. Protein malnutrition, iron deficiency anemia, loss of labor, and vitamin A, biofortification, nutrigenomics, all become part of the system.

Science to society has to reach out. What Dr. Swaminathan always says – Production by masses to cascade with mass production for livelihood and food and nutrition security is absolutely a must. Sustainability of rural entrepreneurship with adaptable technologies must be the target that we must reach by 2015.

Thank you very much.

Dr. Robert Havener

Thank you very much, Dr. Prakash for that very, very interesting and important message. Clearly you and Dr. Sanint agree on the value of brown rice in the diet. It's rather interesting – so do I, fairly recently. One of the most popular diets in the United States is called the "South Shore," "South Beach" diet? They allow you to eat brown rice. They don't allow you to eat polished rice, so you're right in step with where we are in the United States at this particular point in time.

We have 15 minutes for questions and comments from the floor and to and from the panel. Who would like to begin? Come to the mics if you can. Question right here. Again, name, rank and serial number, and your question or comment.

QUESTION AND ANSWER SESSION

QUESTION

Thank you, Mr. Chairman. I would like to ask the members – One of the things that Dr. Borlaug said, one of his dreams was the possibility of transferring the poxenia or rust resistance from rice to the other cereals. What is the possibility there, or how near or how far are we from doing that, if one of them can answer that.

DR. REN WANG

My answer – actually I'm not a geneticist – but I can see the scientists are now undertaking intensive international collaborate in defining the biological functions of all those more than 50,000 genes. And I believe that once we define the functions of those genes, one of them probably that we will pinpoint has to do with this rust resistance.

DR. ROBERT HAVENER

Do you think we'll have to wait for all 50,000?

DR. REN WANG

Well, we'll have to wait, I suppose. Probably talk to Ron Phillips sitting there, maybe can give us a better answer than I can do.

DR. ROBERT HAVENER

Gurdev, you have been fairly forthcoming in some of the advanced genetics.

DR. GURDEV KHUSH

The gene for resistance to blast, for example, or any resistance gene from rice, can be cloned, like the X21 has been cloned, but if introduced in wheat, whether it would express there or not, that's the question we have to example.

DR. ROBERT HAVENER

Are Steven and Susan still here? They've both left, okay. Anybody else care to speculate on that subject? Clearly, it's something that's theoretically possible. Scientifically, I think, it still presents some challenges, for some of the reasons Gurdev mentioned, or both of them mentioned. Other questions? Questions, comments? Have we worn you out? Back in the old days of the extension service, we used to say that the brain can only absorb as much as the seat can endure, and maybe we've about reached your end. I'm not sure. Al Clausi, please

Al Clausi

Al Clausi – I'm on the Council of Advisors to the Prize. I'm left with a question. While we recognize that in many parts of the world, there's a severe shortage of food, there's a choleric need, if you will, that we must deal with in the case of rice, in other parts of the world where you already have a net export capacity, are there other research challenges that we face in rice that perhaps we haven't spent a lot of time on? Although, I think Dr. Prakash was suggesting that, with his comments on the value of brown rice.

DR. ROBERT HAVENER

Who would like to answer that question? If we were not rice deficit in feeding the world's population, or in a particular country where that is not the case, are there other research challenges we ought to be addressing? Okay, go ahead Dr. Prakash.

DR. V. PRAKASH

I guess when we look at production versus productivity, balancing with nutrition, today we may look at the real challenge of nutrition in the rice, not just calories but also the powerful nutrients that it has. Rice is just not a ball of calories. And therefore I think as we look at biofortified rice that is in the picture, it shall emerge as a very, very staple food not only in the countries where it is growing but also in countries where it is not consumed today. Therefore, rice, when we look at the content of rice, for example, the rice bran, which was going to the feed industry way back, today is going to the farmer industry. And I think this is something, a very, very different perspective. So on the one hand we look at the prospectives, the perspectives of rice, in terms of yield and productivity versus production, but there's another big word there in terms of nutrition. This nutrition is not just protein. And we have many other goodies in rice bran, which perhaps we need to explore the genes in that to fix it. And I'm sure that tomorrow nutriceuticals. As the Iowa governor said at the luncheon time, and I think there's a big opening in that in terms of even countries which don't eat rice which still can produce it and use the bran for the farmer industry and still partially retain the bran to really look for the developing countries. There is a big potential.

DR. ROBERT HAVENER

Other questions, other comments, not just for these speakers, but others you may have heard presentations from over the last… You know, Dr. Cantrell is still here. And I think that's Ron Phillips, is that right? Ron, identify yourself, please.

RON PHILLIPS

Ron Phillips, University of Minnesota. Ren said maybe I could make some comments on the question of the immunity gene transfer that Dr. Borlaug was talking about. I think it's wonderful that Dr. Borlaug is stimulating this kind of research. We've talked about the aspects of one species not being susceptible to diseases of others, but we've never really gotten into it. So I think that's a major contribution just in stimulating it. It may be very complicated, like nitrogen fixation where it requires physiological and morphological factors to create that immunity. But on the other hand, it may not be that complicated. We have a lot of what we call disease lesion mimics in plants where it appears that when an organism attacks a plant, why the plant responds and gives a lot of the symptomology due to the plant change.

In our case, we've been crossing oats by corn, and through the embryo culture you can regenerate plants from that cross, and two-thirds of the time the chromosomes of corn and oats come together and the corn chromosomes are lost, and you end up with a half… of oats. But a third of the time the oat plant that you get out retains one corn chromosome, so you can bring one chromosome at a time over from corn into oat. And so you can start to ask that kind of question with that sort of technology as to what happens to various disease resistances in those kinds of progeny.

So I'm hopeful that we're starting to get tools like that with the genoming sequencing information and so on, that will allow us to start to address this important question.

DR. ROBERT HAVENER

Other comments, other questions? I'm surprised a colleague of mine hasn't held up his hand. Maybe I should call on him. We have with us today Dr. Thomas Mumkin, who happens to be the Director General of the Asian Vegetable Crops Research Center. And I suspect he has a slightly different take on how you deal with nutritional problems. Do you want to make a quick comment, Thomas?

DR. THOMAS MUMKIN

Thank you, Bob, RA18993875, spec 4, still have that memorized. Well, I'm Director General of the AVRDC. We've renamed ourselves the World Vegetable Center, and we're going to be making a much bigger presence in the world in the coming years. And at the AGM down in Mexico there's initiative that's going to be coming forward.

I don't think this is a good opportunity or the right venue for me to go off an make an advertisement for myself, but I am affected by what Ren Wang said. And I think this room is full of leaders, and it's important for leaders, and especially since you're not elected in most cases, to look way down the road, and take some of your time and look way down the road. And I think looking down the road at water, looking down the road at global warming. I'm personally

concerned about phosphorous and potassium, nonrenewable resources. With the growing affluence in China and India, that isn't going to go back very much, and the trend is only going to be up there. There's a whole change, I think, and agriculture is going to be changing.

The world is going to be changing very much as these resources get scarce. And we've got to envision a new kind of agriculture that uses new sources of inputs to be productive. And I think this room full of leaders needs to put some time to thinking about that.

DR. ROBERT HAVENER

Thank you very much, Tom. Kanayo, was it you who mentioned water problems? Or was it Ren Wang. It was Ren, okay. Ren, would you like to respond?

DR. REN WANG

Well, actually I don't think because of the time probably I should not elaborate about that. I was actually going to make another point if I may.

DR. ROBERT HAVENER

You may.

DR. REN WANG

Seeing Tom reminded me of a very important issue, that we all know that now probably more than 90% of the rice of the world is produced in Asia. And one of the distinguishing characteristics of Asian rice production has been the small scale, the fact that farmers produce rice on very small holding. For instance, in China the average farm hold is about 0.1 hectare.

DR. ROBERT HAVENER

0.1.

DR. REN WANG

0.1 hectare per person, I think. Now, with that kind of resources, farmers have to find ways to earn profit. And a big trend nowadays is diversification, because as I think Dr. Cantrell mentioned, growing rice alone cannot make farmers rich. So more and more you see farmers giving up rice production to grow vegetables. And in upland situations now because of the purpose of protecting environment and also we are promoting again diversification, growing other crops other than rice, so what would be the role of rice production? And we believe that the solution really is again looking at increasing the productivity and to increase the yield so that farmers can produce more rice on a small piece of land so that they can release their resources to produce something else. So there's a great potential for increased crop diversification and also crop systems involving rice and vegetables and other types of crops.

DR. ROBERT HAVENER

Thank you very much. Got a hand up or person up? Okay, last one, or maybe last one but one.

LES EVERETT

Les Everett, University of Minnesota and formerly a maize scientists at ITA. A question for Dr. Nwanze. I'm wondering if when you talk about the need for African scientists and African solutions if the educational institutions in Africa at this point are sufficient to provide those African scientists. Or do we need to start thinking about an international solution such as an African graduate school of agriculture?

DR. ROBERT HAVENER

Good question. Kanayo.

DR. KANAYO NWANZE

Thank you very much. When I refer to African solutions for African problems, I wasn't saying that those solutions necessarily have or can or should be found only in Africa itself. I do believe that, given the trends today in globalization, that there are strong opportunities for partnerships between African institutions and other institutions. Let me just quickly add that, with respect to educational institutions, if you're familiar with the history of educational institutions in Africa in the last 25 years, they have deteriorated tremendously. Universities have become eroded in many countries.

So I think again it's a question of investment in education by governments and putting their power to use in the right places. The CGIAR is almost a global agricultural university that's coordinated by IFPRI. And this is an initiative that aims at enhancing agricultural education the approach, and my understanding it's I think about close to about thirty-some or more African institutions are involved in this initiative.

So I do believe that, yes, the African graduate programs and partnerships with institutions in Europe and North America and an open universities approach is necessary. We do have to invest, and reinvest in education across Africa.

DR. ROBERT HAVENER

Thank you all very much. Let's all thank the panel for an outstanding job. Thank you, gentlemen. We're going to wind up in just a few minutes. Dr. Jones' paper and Secretary Lorenzo's paper are available outside. Dr. Prakash's book is available outside, for those of you who are interested in it. The World Food day posters, a reproduction of Nadine Hawbaker painting commemorating Dr. Borlaug's 90th birthday, that poster is available outside for those that want it, except high school teachers who are here for the Youth Institute will get theirs tomorrow at the Youth Institute meetings.

This brings us to the close of this Symposium and the Award Ceremony recognizing the contribution of two great scientists working on rice for the betterment of human welfare. It has

been my distinct pleasure to chair this Symposium for you. Are there other announcements we need to make?

JUDITH PIM

I have one more announcement, but I wanted to say – On behalf of the World Food Prize and President of the World Food Prize, Ambassador Quinn, we want to thank you, Bob, for the wonderful job you have done in leading us these two days in our Symposium.

DR. ROBERT HAVENER

Thank you, dear.

JUDITH PIN

Thank you so much. The announcement that I did want to make is that all of the presentations will be transcribed, and they'll all be available on our website, I'm not quite sure how soon. We'll get them on as soon as we can. But there have been some wonderful, wonderful presentations, all of them. And we will make those available on our website. The website is www.worldfoodprize.org. Thank you for coming, and mark your calendars for a year from now. We'll be meeting here for our World Food Prize Symposium and Laureate Award Ceremony October 13th and 14th, 2005.

DR. ROBERT HAVENER

Judith, thanks to you for all of your arrangements. Thanks once again to you and convey them to all of our staff. Ladies and gentlemen, consider our Symposium closed. Thank you very much for our participation.