

Food and Our Future

A Conversation with Dr. Norman E. Borlaug

Thomas R. Felt

Dr. Norman E. Borlaug



The principal operations of Inter-Regional Financial Group are in the agricultural regions of the Midwest and Rocky Mountain states. In serving the financial needs of corporations and individuals, the Company's future is closely tied to farming, food processing and agribusiness. Thus the world food crisis has special significance for IFG's future plans and operations.

For a current insight on food and the world's future, Thomas R. Felt, a director of IFG, visited with Dr. Norman E. Borlaug at CIMMYT, the International Center for the Improvement of Corn and Wheat, located in Mexico. Dr. Borlaug, an agronomist, humanitarian and leader in the Green Revolution, was awarded the Nobel Prize for Peace in 1970 for his work in plant genetics which dramatically increased world grain production.

His views on what may be the world's greatest challenge--feeding its people--are expressed in the following interview.

FELT: I would like to ask you your views on the current status of the Green Revolution and its relationship to the World Food Crisis. For instance, do you think the impact of the Green Revolution has been lost through higher oil and fertilizer prices? In other words, have higher prices cost the world the margin of time to control population growth?

DR. BORLAUG: Certainly, the changes in both fertilizer prices and petroleum prices have complicated the situation. However, I would like to clarify one other point which has a bearing on why we find ourselves in the situation as far as fertilizer prices are concerned. We have to go back to about 1947 and the policies used by the food exporting nations of the world and also the policies used at that time and for the next 25 years by food-importing nations. You see, agricultural production was expanded to feed the peoples of Europe, North Africa and Asia amid disruptions of World War II. Most of that expansion took place in the United States, Canada, Australia and Argentina. By applying new technology, especially the use of higher yielding varieties in Europe and more fertilizer, production soared and the exporting countries were caught with surpluses. With these abundant stocks of food (and some of them were exported under soft currency arrangements), we found the countries who were grain importers ignoring their agriculture and trying to industrialize, as they were advised to oftentimes by sound economists. I would illustrate this by the case of India. They spent the first 15 years trying to industrialize, only to find later that the mass of their people, 70% rural, had no income to buy most of the industrial goods. So this was a wrong decision in the first place. Then they went back to begin improving their agriculture. Time was running out and we saw big changes. Back home in the USA where we have only about 3½ percent of the people engaged in agriculture, when the shortages started appearing just three years ago, people had no way of understanding what had happened; what had gone wrong with agriculture; why food prices soared when the elevators really went empty. So we had confusion at home and, in the same way, we had confusion in the countries because they hadn't expanded their agriculture as they should have. A sad situation.

Fertilizer consumption started going up very rapidly in the last ten years when the benefits became manifest in the developing nations. Part of the work on wheat opened the door to this. Suddenly a piece of land that under irrigated conditions would produce something on the order of 10 bushels of wheat, when you used the right seed and the right cultural practice with the fertilizer, was capable of producing 75 or 80 bushels. So the demand for fertilizer grew at the rate of about 9 percent per year over the decade until 1972. Whereas investment in plant capacity was going up at only 6 percent. So we ran into the shortage of fertilizer even before the petroleum crisis. About ten months before, I could see it unfolding in Pakistan and India. Lack of investments at the right time in the right places made us vulnerable even before the petroleum crisis. Now, of course, it's a disaster.

Countries such as India expanded fertilizer production capacity greatly in the period from 1965 to 1972. All of that, with few exceptions came from imported crude oil. So immediately, when the prices went up, you can imagine what happened. Their imports of crude oil had been cut back. That cut back the fertilizer production and, in turn, wheat production last year went down by about 5 to 6 million tons. That's something on the order of 200 million bushels.

FELT: I'd like to ask you whether you think the world has reached a condition called "lifeboat ethics"-- that is to say, the decision as to who will be given food to survive and who'll be allowed to die?

DR. BORLAUG: Well, Tom, the way the situation stands at the present time, in the next couple of years, a large number of people are going to die from starvation or the indirect effects of malnutrition. Millions are in a serious situation. The

curious thing is if we had carried adequate stocks of grain we still would have, excluding the vagaries of a bad year of harvest, the possibilities of producing the food we need for the peoples of the world for the next 10 or 12 years. I mentioned that we had a surplus so the U.S., Canada and Australia were cutting back on acreages. They had these huge surpluses they were trying to divest themselves of, but somebody miscalculated. What was an adequate reserve? When '72 came, there was bad weather in Russia and in China and Australia. And the same summer in the case of rice and sorghum and corn, south Asia emptied all the warehouses. Here we were without reserves and prices exploded. I'm firmly convinced that in the early stages the greatest inflationary pressures came from the jump in food prices. Had we carried the stocks to get us through the bad crop of '72, we could still have produced the food we need for the next 10 or 12 years.

FELT: One of the questions that comes up frequently in the minds of Americans is the conflict between the strict environmentalists and those people who feel that the use of herbicides and pesticides is allowable in the world food production problem. Could you comment on this controversy?

DR. BORLAUG: Well, I think that it's most unfortunate that this has gotten all out of balance. The truth of the matter is that we have to have fertilizers; we have to have herbicides and pesticides and we have to learn to use these all in the proper way. It's no different really than the use of medicine. For example, you're ill. You go to a good doctor. He'll diagnose your ailment, he'll prescribe a certain drug and if you take it properly, you'll probably be cured. And if you take it improperly, it may kill you. With these sorts of things, there has to be reasonable control. But to deny their use where we have need for them is to deny us the possibilities of producing food and fiber and paper and lumber that's needed to maintain our economy, not only in the U.S. but around the world. Some of the extremists in this movement say that, if we just leave things alone, the balance of nature will work things out. I would like to say that if you go down that road, then you have to go the whole way. Starting with...when your children are young, don't vaccinate them. When they're sick, don't take them to a doctor. When you've got an intestinal parasite, don't take a drug to kill it because that parasite has got the right to live also. And if we do that, we all know what kind of balance of nature it will be. I don't think even some of those who play around with these nice cliches would like to live in such a world. I think one thing that brings out the issue pretty clearly is what happened in our Douglas and white fir forests of the Pacific Northwest in the last few years. You see, here's a good case in point. There were widespread outbreaks of a moth in '72, with the defoliation of 400,000 acres in Oregon, primarily. There were those who were sure that this was going to be headed off by bacteria and virus which sometimes prey on this insect. The second year came and the infestation spread. It defoliated again the 400,000 acres that were defoliated the first year and it extended to another 300,000 acres, a total of 700,000. Much of that timber that was defoliated the second year was killed outright. This defoliation, then, cost us a great deal of timber but, even more, the many years that it will take to regrow these forests. And when forests are killed off like this, it affects, indirectly, many other species, wild life of different kinds. In this case, this past spring, one application of an insecticide, which was known to be highly effective against this insect, stopped the infestation. I say to those who become over-concerned about the impact on the environment that we need not be concerned if we use these chemicals in a reasonable way. It's no different than a medicine.

FELT: Another area of confusion for Americans surrounds our Food for Peace program, P.L. 480 as it's known. Many people don't know whether we're engaged in philanthropy, surplus crop disposal, or frankly, whether the whole program isn't dictated by foreign policy considerations, since 80 percent of our food shipments

abroad go to South Vietnam and South Korea. Would you comment on that?

DR. BORLAUG: Well, Tom, I think that all three of these have been involved, say from 1947 to 1972 when we ran out of food, as far as reserves are concerned. Certainly in the early years, say from the late '40s into the middle '60s, there was surplus disposal, sales and long-term credits. There was also a lot of philanthropic giving of food. There's no question about that. I'm sure that in emergencies, this was necessary. I think we, as citizens of the world, have certain obligations to help our fellow human beings in whatever country of the world, whatever political philosophy they follow. But to do this to an extent where it has an adverse effect or destimulation, if you'll permit me to use the word, of their own agriculture--I'm opposed to this. It's a two-edged sword. You start out to help and that removes the pressure from the political leaders of their own government. Then they fail to make the investments in agriculture that are absolutely necessary to improve the standard of living of their own people and to cope with their own population growth. Now, undoubtedly, there have been ties between foreign policy and food. But to stoop to deciding who is to be given food in times of emergencies on the basis of their political systems would be a disastrous decision, as far as I'm personally concerned. It could only lead to more misunderstanding in the world and greater distrust.

FELT: Thank you, Dr. Borlaug. Producing sufficient food for the world's population is an enormous problem as everybody can see, but the transportation and distribution aspects of the problem are often not fully understood. It seems as though this problem will require a breakthrough in productivity equivalent to the Green Revolution. Can you foresee any real improvement in these aspects of the problem?

DR. BORLAUG: First I would like to point out the magnitude of the food production problem. Our world population by the end of this year will reach approximately 4 billion. First, we must recognize that the amount of good arable land is limited. It's estimated that only 11 percent of the total land area of the world is of this kind. That means we have to make it produce near to maximum if we're going to avoid disaster. There are a few countries of the world that still can bring new land under cultivation, but it's costly and it's a slow process. They include the tropical areas south of the Sahara in Africa and also vast areas in Brazil. But we can't open these up fast enough to meet the growing demand. Therefore, we must rely in large part on increasing yields from land already under cultivation for the next 10 to 20 years so we can buy time to adjust population growth. Now what is the magnitude of the food production problem? Cereal grains are perhaps the best yardstick because they occupy more than 72 percent of the cultivated area of the world, they provide 56 percent of the calories of the world and slightly more than 50 percent of the protein. And when I talk about cereals, I mean all the major ones--wheat, corn, barley, oats, rye, rice, sorghum and millet. Now 1971 was a world record harvest of cereal grains. The production was approximately 1.2 billion metric tons--a figure which means nothing at all to me and I doubt if it means anything to people who are not directly involved in the moving of grain. But perhaps if we visualize it this way, it will be more meaningful. It's equivalent in volume to a highway, built of grain, that goes around the earth at the equator. This highway will be about 55 feet wide and the road bed will be 6 feet deep. Now that is what it took in 1971 to feed about 3.7 billion people. But if it were as simple as building a highway of cement or macadam that will last for 25 or 30 years we'd be in pretty good shape. But this cereal highway we consume entirely every year. Then we have to make provisions for the growth in population so we have to rebuild this highway around the world every year and then beside it, we have to begin to construct a second highway, the same width and depth of roadbed, at the rate of 650 miles. In 1971 the exporting nations of the world felt very confident that they had achieved the right balance between production and stored grain to meet any

emergency and that it was not burdensome to their own economies. Came the one bad harvest, overnight the reserve disappeared. We hadn't calculated correctly what was an adequate reserve. There's another aspect of this that never comes into focus adequately. And that is that we have to carry a bigger reserve, but that it should not be the sole responsibility of the food-exporting nations to finance all of this stored capacity to meet the vagaries of bad weather that happened in 1972 and then again in 1974. That is why we've gotten into these tremendous difficulties now. We didn't carry adequate reserves to protect and keep food prices at reasonable levels during the bad harvest. We're worse now because we have shortage of fertilizer from the petroleum crisis. This petroleum crisis has had tremendous effects on transport of food and fertilizer. In July of '72, it cost about \$7 a metric ton to ship solid fertilizer from Gulf ports in the southern U.S. to Buenos Aires, Argentina. Today it will cost you on the order of \$45. Now this is true for grain; it's true for food all around the world. In the long run we know that the fossil fuels are limited. We've got to find alternative sources; we've got to be less wasteful. I still believe the average American doesn't realize how vulnerable we all are. That any day, it can be turned off. This hasn't come home yet--clearly and loudly.

FELT: Would you say that the Achilles heel of American agriculture is its heavy dependence on fertilizers derived from fossil fuels?

DR. BORLAUG: Well, nitrogenous fertilizers come from fossil fuels. You can take the nitrogen out of the air, although it's very energy intensive, but for the moment, most of it comes from petroleum. I'm not in full agreement with some who say we can no longer justify using nitrogenous fertilizers because of the shortage of fossil fuels. When I fly over the Persian Gulf and the Arabian peninsula at midnight, it looks like midday because of the flaring off of gas at well heads and at refineries. This is simply waste, waste that can be converted into fertilizer that can be converted to food. It's not restricted to the Persian Gulf and the Arabian peninsula; we see it in Latin America. It wasn't too many years back before we saw it all across south Texas and Louisiana. So we've got to try to be more efficient, not wasteful.

There's one other point about energy in food production that I think should come into the picture. A large amount of the energy that goes into food production before it reaches the home is not on-farm use energy. Processing plants, refrigeration and transport consume a large amount of the energy that's sometimes classified as food in the broad sense. But the total that goes into agriculture--most for nitrogenous fertilizer and second would be power for tractors--would still be something like no more than 25% of the total energy going into the food system. Now there are some who would like to go back to the good old days of horses and mules. Well, I went through those and they weren't so good. We have to look at what it would take in good land to feed the 35 to 40 million head of mules and horses that would be needed. And I think if we were going to handle all of those horses, we wouldn't have just 3½ percent of the population on the farm. We would have to recruit a few million out of the urban areas. This, of course, is done in the People's Republic of China. Each year they just go around and round up about a million youth and it isn't voluntary. I don't think that would be the solution that the American people would like.

FELT: The financial support for the Green Revolution in most of the last 30 years has come from foundations like Ford and Rockefeller. Today it's probably a little more broadly based than that with other governmental support. I'm wondering if you could point to some role that the U.S. private business sector might be able to play to support the Green Revolution.

DR. BORLAUG: It's true that the original work in the research or experimental stages

was largely financed by the Rockefeller and Ford foundations. At the present time there are ten institutes in operation or in the process of being built that are working on different aspects of food production problems. This center, the International Maize and Wheat Improvement Center, commonly known by the acronym, CIMMYT from the Spanish title, is one of the ten. The financial support is broad at the present time. It includes the two foundations, the Mexican government, Canadian foreign assistance program, U.S. aid, World Bank, International Development Bank, the government of West Germany and some special funds from the government of Britain and the government of Denmark. The other institutes have some of the same donors but others are from different agencies. The production of fertilizer, it seems to me, is where the private sector can help, assuming that reasonable arrangements can be worked out with the governments of the countries. I've seen, in more than one country, modern fertilizer plants that are producing at only 50 to 60 percent of rated capacity, mainly because of lack of technical know-how in managing and maintenance of those plants. I'm sure it's true in many other industries that produce inputs for agriculture. I think there has to be a lot of imagination used by private business, and there have to be good concrete understandings worked up with the host governments so these investments not only improve agriculture but are sound investments from the standpoint of the capital that's put into the country.

FELT: I've read where the development of cereal grains remains approximately at the level achieved by neolithic woman until the advent of the Green Revolution. Is that a fair statement?

DR. BORLAUG: Well, I think it's a bit exaggerated. Up until the end of WWII, most of the increase in food production in the world came from increases in area under cultivation rather than increases in yields per acre. So, in one sense, what you have just said, Tom, is true. There was improvement all along the line but it was gradual. There was still plenty of food and new lands were opening up in our own United States, Canada, Australia, Argentina, other parts of South America and in parts of Asia and Africa. So the pressure wasn't on for the use of new techniques. For example, take the case of hybrid corn and the fertilizer that went with it. I was born on a little farm in northeast Iowa, a very small farm. Even in a good year, when I was in high school the average yield of corn on the best farms was on the order of 30 bushels an acre. A year ago, in '73, I was back on the same little farm and the average yield on that same farm was 125 bushels an acre. Now that was due to a series of inputs. First of all, part of the land was poorly drained so it had been tilled. Secondly, it was hybrid corn. And thirdly, fertilizer was applied. And when you put these three together with good management, why, you'll see these jumps from 30 to 125 bushels on that same little farm. This is change that has come, as you've pointed out, much of it since the end of World War II. The curious thing, though, is that we haven't changed the basic crops or the animals we depend on from the day that the neolithic woman domesticated both of them. Stop to think about it. There must have been many days when neolithic man didn't bring home the meat but always neolithic woman, during those many, many thousands of years was collecting wild grain, fruits, nuts, roots to supplement the family larder. She apparently used to notice that certain grains grew up in the same place each year. And so agriculture was born. We scientific men haven't added a new species that compete with any of these. What we have been able to do up to a modest point, is to increase its efficiency by genetic manipulation, finding out how to cultivate it better, how to fertilize it and how to control the diseases and insects. That's our contribution. The last 8 or 9 years we've been trying here in CIMMYT to work with what's called triticale. This is a cross between wheat and rye, which in the last two or three years shows promise. Maybe we can develop a plant that will approach something neolithic woman did 10,000 years ago. It looks promising. As the world gets more crowded, we have to improve the nutritive value

of the cereal grains I've mentioned. We have to remember that we are privileged people in the Americas. The average consumption per person of grain in the third world nations, let's say the case of India, would be on the order of about 375 pounds of grain per capita. But in the United States, it would be on the order of nearly 2000 pounds. In other words, we consume 5 times more, not as grain per se, but most of it converted to steak, eggs, milk, animal products and so we need to improve the nutritive value of the grains to provide a decent diet based on vegetable products and on the plant products alone. This can be done by mixing grains and beans and vegetables and fruits. We want to improve the grains from a nutritive standpoint and it looks like we're on the verge of achieving this in corn, barley and perhaps in sorghum. Wheat and rice are still weak. All of the grains are deficient in one or more of the essential amino acids that make up the protein. That is, the balance is incorrect for a satisfactory human diet. Ordinarily, of course, you can balance a diet simply by using grain, and then beans or lentils or some of the legumes, plus vegetables and fruits. This is the way it's done in many of the Asiatic countries. The trouble is that the protein part of that diet, in other words, the beans or the soybean or lentils, chickpeas, peas, is the expensive part. In the developing nations, 70 to 80 percent of the total population is rural. They're the poorest people of all. Now you can correct for the defects in corn, wheat, oats, barley, etcetera by producing synthetic lysine for example, but the problem is to get it in the stomachs of these poor people with no purchasing power. The stage is set now. The basic discovery goes back to Purdue University where Doctors Mertz and Bates found that one type of corn which was just a curiosity, of no commercial value, had double the amount of lysine in its protein. When this corn was fed to white rats, and subsequently, to newly-weaned suckling pigs and compared to normal corn with only the vitamins and minerals added, those that received the so-called opaque-2 corn grew at twice the rate of those receiving ordinary corn. When this was repeated a year or so later with children that were in the advanced stage of protein deficiency in Colombia, South America, a little girl who received the opaque-2 recovered spectacularly in 7 to 8 weeks time and the others would have died had they not been put onto milk. But the problem was that this original corn was low-yielding and therefore had no farmer acceptance. It was soft in texture, which meant that it was more vulnerable to the fungi that rot the ear and the insects that attack the grain. So it was a long struggle and it's only now getting to a point where this will become available in certain areas of the world for commercial use. This has great significance, especially to the subsistence farmer. Once he has this, he automatically, without additional cost, increases the nutrition of his family who largely depend on corn. It has lots of implications also for livestock men. When we ran short of soybeans in 1972 and the prices skyrocketed and this, in turn, shot the price of meat skyhigh, had we had such corn hybrid, the amount of soybeans needed to balance the ration for swine or beef or for poultry would have been much less. We probably wouldn't have had that horrible spiral in prices.

FELT: Comparisons are frequently drawn between the United States' agricultural system of production and that of China or Russia. We know, for example, that it takes 8 Chinese employed in their agricultural system to feed 10 of their people whereas we employ approximately 5 to feed 100 of our citizens. It would seem, therefore, that food production gains are going to have to come from the socialist or third world countries. Could you amplify that supposition?

DR. BORLAUG: Certainly this is true, up to a point. There are many third world countries where the yield per acre of the basic food crop is extremely low and where the possibility of increasing these yields is very great. For example, I have seen wheat crops in India on a farm where the yield prior to 1967 or 1968 was on the order of 10 bushels an acre, jump to 75 bushels and I've even seen it go to 100 bushels per acre with the manipulation of these factors that together made

possible the Green Revolution. Now in that one crop, I saw the production of wheat go from 11 million metric tons to 26½ million metric tons, in other words, more than double, from 1967 to 1972. This is the most rapid change that the world has ever seen. Unfortunately, now it's fallen because of the fertilizer petroleum crisis. Now, in some of the new nations there remains a lot of chance for increasing productivity. But it is a very difficult thing to achieve because you are dealing with millions and millions of people, the large majority of whom are illiterate; and to get the new technology demonstrated for each of the crops; to get through the bureaucracy; to make sure that the fertilizer is there at the right time and that there is some credit for that small farmer too so that he can get it when he needs it. I have a horrible fear of bureaucracy in any kind of government. The thing they produce most of is paper and reports. I have seen some of the best reports in the world written in third world nations about how to improve agriculture, but the report has had no impact whatsoever. Because they don't have the technology and no one knows how to apply it. Any report that I have ever written in the early stages of production could have been written on three sheets of paper. But then there is the going out and fighting it through, showing what can be done. Theoretically you can bring many small farmers into an experiment station and say "This is the way the soil is when it is not fertilized and this is the way the crop is when it's done as we recommend." But you aren't going to convince many of those small farmers that way because he's got built-in fear. He's got fear of bureaucracy just like I have. But if you'll take these same simple demonstrations out onto hundreds or thousands of small farms, and there you have to have trained people who know what they are doing, you will see that he is very receptive.

I was in China this past summer for a month. And there, of course, 8 Chinese are employed to feed 10 people. There is little doubt of this because 80% of the total population are on communes in the rural areas. But they do a surprisingly good job of cultivating rice, especially. I think it might be interesting to know what China has done in the last year when the world started running short of nitrogenous fertilizer. And I should point out that for three or four years previous they were the largest importer of nitrogenous fertilizer in the world. India was second. As soon as the prices skyrocketed, they made a decision that probably represents something on the order of \$8 billion worth of capital investment. They are building currently eight 1,000-ton-a-day anhydrous ammonia plants. Then they have to have the acid plants to go with it and the converters to convert it to solid fertilizer urea. Each of those installations in itself will cost somewhere between \$100 and \$150 million and that doesn't include the development of raw material sources, the transport and the warehousing. But here you see a country that said "we can't survive without fertilizer with our density of population." This past year and the year before, they imported something on the order of 15,000 tons of high-yielding Mexican wheat seed and this current winter they will be growing a lot of this also. I presume there will be an increase in wheat production of considerable magnitude.

Just to add a bit to what I have already said about triticale. It looks promising now that this new cereal might find a place where it can outperform the conventional cereals. We don't expect it to displace wheat or corn or rice, but it will find perhaps some soil niches where it fits and does better than others. It's also higher in protein and it seems to have better amino acid balance than wheat. This means that for subsistence people it has great potential. It might be used for livestock. Now what is triticale? It was known a long time back as a natural cross between rye and wheat. Of course, these plants were almost entirely sterile. You have a similar situation when you cross a donkey and a horse. You get a mule. It's a fine animal but a mule won't reproduce itself; it's sterile. And so it was with the original triticale. We've worked now for nearly 10 years and it looks like now we may have a commercial crop. Some of them fit well into very acid soils, soils where wheat doesn't do well, such as in parts of Brazil and Ethiopia, in the outer ranges of the Himalayas, India, Pakistan and Kenya. We think that

they may find a place in other parts of the world. Now we are trying to intercross a lot of other grasses, such as barley and wheat, and others here are trying to cross sorghum and corn. This is not at all easy and we haven't got very far. We've got the will to do it but Mother Nature seems to be fighting us every step of the way.

FELT: One of the recent events in the world that seemed to capture everyone's interest and hopes was the Council of Rome meeting in April of 1974. Could you comment on whether you feel there's any constructive assistance for the world famine situation as a result of that meeting?

DR. BORLAUG: Well, I was very disappointed in it. I personally served on a committee of 20 that was assigned to make some concrete recommendations to the Secretary General. Even in this small group that was supposed to be scientists representing different parts of the world and different disciplines, we couldn't come to agreement on what needed to be done. In part, I think that our lack of agreement was the fact that very few people had been directly involved in agricultural production. Only two out of the twenty. So I think those who were familiar with the obstacles to increasing production, both from a technical and a socio-economic point of view, didn't have a very loud voice. If this was true with a committee of 20 that was supposed to be representative of scientists from various parts of the spectrum, then I think it's not surprising that the total conference didn't come to much general agreement except to disagree on all of the basic issues. It seems most unfortunate that in a conference of this kind, when we have a crisis before us, that representatives of government don't come to grips with the basic issues. The conference was used more as a forum for expressing political philosophies than for coming to grips with both the immediate and long-term problems of what to do about food production. In addition, the problem of population growth was played down to a point where it was ridiculous. So, I came away with great frustrations. I said that it's too bad you can't round up all of us. Round us all up, lock us all up, for the fourteen days that we were to have been at the World Food Conference and give us no food and for the last three days, no water. Then maybe we'd come to grips with some of the basic issues. That sounds a bit ridiculous, but I don't believe that many of these people have any comprehension of the misery and poverty and the hunger of millions upon millions of people in the world.

FELT: Last year you said that perhaps the most productive single hour of your scientific life was persuading the right person in India to spend money for fertilizer. Is that a sample of what you mean about how difficult it is?

DR. BORLAUG: Yes. You see you can develop the basic new technology which has the potential to increase food production very greatly--three or four-fold or ten-fold. By that I mean producing varieties with the right adaptation and disease resistance; acceptability from the farmer; finding out what needs to be done to the soil to restore it to its productive capacity. You can do all of this and still not increase food production by one ton, simply because you have got to get this change brought about on farms and you have to demonstrate it so that the farmer will be willing to take it up. But then you have to make sure that the government is going to have the fertilizer available, the seed available, and that the farmer is going to have some credit and that he is assured of a decent price for his grain when he harvests. Too often the prices are skyhigh for grain during most of the year. When the harvest begins, they will go down by 50 percent in a period of 10 or 12 days. And two months later, after the grain has been bought up, it goes back to original price. Somebody else profits and the farmer gets very little for it. So if he is going to invest in fertilizer, he has to be protected against these sorts of abuses. And so there comes a time when you talk to the political leaders and the economic planners. They have to be brought into focus if you're going to

provoke a change and an increase in production. I was just speaking to the Minister of Agriculture of Iraq a few minutes ago and we were discussing changes they have made a lot of progress on in just the last two or three years. And as a result, they have increased their production of wheat very greatly. So technology alone isn't the answer. It's got to be hooked to economic and to political decisions. If a scientist is going to be involved in trying to produce revolution in production in food, he also has to have a feel for human considerations, political realities and basic economic principles. Then always one has to try to get across the point that we are only buying time. That unless population growth slows in many of the already densely populated nations of the world, there will be greater trouble ahead. I think I can put it this way--there are many countries of the world, a considerable number in Latin America, where population growth is going on at the rate of $3\frac{1}{2}$ percent per year. That means that population doubles every 20 years. If this growth continues, by the time a child born today is 20 years old, we must have twice as much agricultural production. By the time he is 40 years of age we will have to have 4 times as much. By the time he is 60 years of age we will have to have 8 times as much. This kind of population growth can't go on without having serious repercussions from political, social and economic points of view. If population density is already fairly high it's a deceiving sort of growth that most people fail to understand. For example, even if population growth slows to a point where there is only replacement, that is to say a 2.1% increase, population would still grow for at least 40 or 45 years because more than 50 percent of the total population is below the age of 16 or 17. Even though there were just reproduction at the rate of replacement, new fathers and mothers being a large part of the population, total population would grow for another 45 years. So our job is to try to expand food production as best we know how, to try to bring a better standard of living to people, to try to buy time, to permit education, to bring about adjustments in population growth--and time is short.

FELT: I have one other question I'd like to ask you, Dr. Borlaug. Because you are the recipient of the Nobel Peace Prize, perhaps the most prestigious award that any person can receive, how do you feel about the expenditure of our resources on armaments in relation to the resources we apply to other problems?

DR. BORLAUG: Well, of course, this is one of the disasters of recent generations. I haven't seen the most recent figures, but a year or so ago the world was spending something on the order of \$200 billion for armament. And the United States is one of the largest spenders. We spend about $4\frac{1}{2}$ percent of our total budget on agriculture. On armament, certainly, it would be something on the order of more than 50 percent. So you see a tremendous disproportion there. It's even worse in many other countries, including the third world nations that are on the verge of starvation. They seem to have funds for armament but very small amounts going to food production and into improving the standard of living of their people. I would like to make one comment which I think has some significance. I was named recipient of the Nobel Peace Prize in 1970, two years before the current world food crisis. I was found by the press out in a wheat field harvesting in Toluca Valley about 40 miles from here. It had rained the night before and I was covered with mud. I had with me several of my professional staff here at CIMMYT and several young scientists from other countries--two from Rumania, two or three from Brazil, one from India and one from Pakistan--when we were confronted and I was told that I had been awarded the Nobel Peace Prize. And I was asked in the same breath, what does this mean? I said, so far as I can understand, it must simply mean that the Nobel Committee is concerned about attitudes in the world. They are saying that people think that food comes from the supermarkets. They forget who put it there--and the costs and investment and work and sweat that goes into producing our food. They seem to be saying, I said, that the privileged nations of the world have

forgotten that more than a third of the world is hungry most of the time. This was just a guess but the day of the ceremony, I found out that this essentially was what the committee had made the decision on. They selected me as someone who had spent a lifetime, at that time 27 years, in foreign food-deficit countries, struggling with this food production problem. Trying to do something about it. Generally, not very effectively, but trying to build teams of scientists that could cope with this problem. And I accepted this honor at the ceremony in the name of all who were involved in food production--the farmers and ranchers throughout the world, the professors and the educators, the agricultural scientists, and the government officials who were involved in food production. It is curious that two years before the food crisis appeared, this committee was thinking of this problem.

INTER-REGIONAL FINANCIAL GROUP INC.

100 Dain Tower
Minneapolis,
Minnesota 55402

