IFIC INTERNATIONAL SEMINAR REPORT 1989-03

TRANSFORMING AFRICAN AGRICULTURE

—The Role of IITA—

27 JUNE 1989, Tokyo

INSTITUTE FOR INTERNATIONAL COOPERATION (IFIC)
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

TRANSFORMING AFRICAN AGRICULTURE

—The Role of IITA—

JICA

TRANSFORMING AFRICAN AGRICULTURE

—The Role of IITA—

Dr. Stifel

Dr. Barker

Institute for International Cooperation
International Cooperation Centre Bldg.
10－5, Ichigaya, Honmura-cho,
Shinjuku－ku, Tokyo 162 Japan
TEL. 03 (269) 3201
FAX. 03 (269) 2054

Printed in Japan by
Daito Printing Co., Ltd. Tokyo

CONTENTS

Lecture

by Dr. Stifel

&

Dr. Barker

●講演者略歴

Dr. Laurence D. Stifel

(IITA所長)

1954年　ハーバード・ビジネス・スクール卒(M.A.)

ウエスト・リザーブ大学（比国）よりph. D.取得

1959—1960年　フルブライト研究員

1960—1964年　USAID プログラムエコノミスト（ミャンマー）

1965—1973年　ロックフェラー財団プロジェクトリーダー（タイ）

1969年　イエール大学客員研究員

1974—1985年　ロックフェラー財団副理事

Dr. Randolph Barker

(IITA理事)

1953年　コーネル大学卒

アイオア大学よりph. D.取得

1957—1964年　米国農務省

1965—1967年　フィリピン大学大学院教授

1967—1968年　国際稲作研究所

1978年～　コーネル大学教授

KATO (Director, Institute for International Cooperation, JICA) Thank you for coming to the lecture by Dr. Stifel and Dr. Barker of the International Institute of Tropical Agriculture (IITA). At the Institute for International Cooperation, we invite experts from the academic world and sometimes the world of business to take up issues concerning development. We have, recently, directed your attention to the development of Africa, and as one of our efforts in this area, we have asked Dr. Stifel, Director General of IITA, and Professor Barker of Cornell University and a Trustee of IITA, to talk to us about the role of IITA. We are very grateful to both Dr. Stifel and Dr. Barker for making themselves available to come here to deliver lectures for our sake.

Dr. Toriyama is going to give a short biography of the lecturers, and therefore, I will leave the introduction of these two distinguished people we have as lecturers up to him.

As you know, IITA is an institution which is part of the consultative group on international agricultural research (CGIAR). We are told that we rank third in terms of the amount of assistance that we give or the amount we contribute, to CGIAR behind the U.S. and the World Bank. In order to dispatch experts and to conduct surveys, JICA has also dispatched experts to IITA to learn the expertise that is required in this field. The staff from JICA has also participated in training courses that have been offered by IITA. Needless to say, there are various issues in African development related to the economy, society, culture, and development issues ; and the Japanese government has, as you know, been trying to expand cooperative efforts to Africa.

Although there are a considerable number of experts on Asian affairs here in Japan, we do not have many people that can be called experts in the area of African development ; and, therefore, in that respect, we consider the lecture that will be provided today, to be very useful to try and expand our development effort activities towards Africa.

As you know, the government of Japan is trying to expand official development assistance. In this development or circumstance, we consider that

not only our Institute for International Cooperation (IFIC), but also JICA and other institutions that are in the area of development must coordinate and create lectures with institutions in international institutes and agencies in the industrialized countries and international organizations. In this respect, we have, in this institute, already invited Dr. Graham Allison of the Harvard University, who is the Director of the John F. Kennedy School at Harvard University, and we have also had Dr. Dwight Perkins of the HIID of the Harvard University participate in our program. Before that, we have had an expert from CIDA, the Canadian International Development Agency, give us a lecture, too. In the lecture, there was a presentation concerning the strategies in African development. Today, we have the participation of Mr. Cisse of the Embassy of Senegal, and also, we have had the participation of Director Foster of the Office of Arid Lands Studies of the University of Arizona.

We hope that we will be able to take opportunities of this sort, including the lecture today, to try to build our interest in African development, and also to build a network of people who will be able to engage in African development and we would like to do our very best in order to be able to fulfill this purpose that we feel ourselves bound to.

Now I'd like to call upon Mr. Toriyama to give us the introduction of our two distinguished lecturers that we have today.

TORIYAMA Thank you for your introduction, I am one of the directors of IITA. My name is Toriyama. I would like to briefly introduce you to Dr. Stifel and Dr. Barker. Dr. Stifel graduated from the Harvard University in 1952, and graduated in 1954 from the Harvard Business School. He was a Fulbright Fellow from 1959 to 1960, and under the fellowship, he visited the Philippines. From 1960－64, he served as the program economist of USAID in Burma, where he was stationed. Following that, for eight years, he was in Thailand, as a project leader of social science projects. Therefore, in that respect, he is a person with deep insights into Asian affairs.

After that, he went back to New York and for ten years, till 1985,

he served as the Deputy Director of the Social Science Department of the Rockefeller Foundation. Before he became Director General of IITA, he was the Vice-President of Program Directorship, and therefore, he was a person in a very important office. In 1985, he assumed the position of Director General of IITA. Because of the capabilities of our erudite scholar and Director of this organization, we see an expanding development of our organization.

Now, I would like to introduce you to Dr. Barker. Dr. Barker graduated from Cornell University in 1953, and received his M.S. at Oregon State University and received his doctorate at Iowa State University. Dr. Barker is also a person well versed in Asian Affairs. From 1957 to 1964, he was with the U.S.D.A. and from 1965 – 67, at the University of the Philippines, he was a professor in the post-graduate school. From 1967 – 78, he was in the International Rice Research Institute (IRRI), where he was in charge of agricultural economics. In 1978, he went back to Cornell University to teach agricultural economics. At the present, he is the Director of the South-East Asia program at the university and at the same time, he is a Director of IITA supporting our activities. I would like to invite these two people to lecture to us. Dr. Stifel.

STIFEL Thank you very much Mr. Kato and Mr. Toriyama. It is a great pleasure for Dr. Barker and me to have the opportunity to address this distinguished group at the JICA training center.

IITA was established twenty-one years ago as the first international agricultural research institute in what was to become, the Consultative Group on International Agricultural Research, what we call the CGIAR. This organization of donors organized by the World Bank, FAO, and UNDP, supports the international research institutes of which we are the initial African component. The Japanese have provided generous funding and leadership to the CGIAR over the years and for that reason, it is particularly appropriate and pleasant for us to have this opportunity to report to you.

IITA was set up to do research on the key food crops in the humid

and subhumid tropics of the world, and even more importantly, to develop new improved farming systems, that would replace the shifting cultivation, or bush-fallow farming practices which have been predominant in tropical Africa in the past. You heard from our introductions, that Dr. Barker and I have both had long experience working in southeast Asia. The differences between Africa and Asia are so significant, that we thought that it would be desirable to start this session with a discussion by Prof. Barker on the differences between the situations which exist in Asia and the situation which exists in Africa.

Now, on your agenda of this meeting, there is only one line for that topic. That is not because it is only worth one line, but it's because when I completed the agenda, I did not yet have the details from Prof. Barker about what he was going to say. But I think that a starting point for work in Africa is to understand its distinctiveness and it is a great pleasure to introduce Dr. Barker, who is certainly the leading authority in the United States on the rice economy of Asia, to be able to address that topic. Dr. Barker.

BARKER Mr. Kato, Dr. Toriyama, ladies and gentlemen, it is a pleasure to be here and to have the opportunity to speak to you. As Dr. Stifel has said, like many of you, we too, feel most comfortable in Asia and as in my case, of course, particularly with Asian rice. I want to start, though, and, therefore as a matter of introduction to Dr. Stifel's talk about IITA, show you, a little bit of contrast between what is happening in Asia and what is happening in Africa. In order to do that, I am first going to show you some figures on different growth rates, and then I am going to show you a series of slides about how people grow rice in Asia, which you probably all well know ; and then show you another set of quick slides on how people grow rice in Africa, and talk briefly about the implications of that for thinking about development in Africa. So if I could have the first slide.

I'm going to start here. I don't want to throw too many numbers at you. In this particular slide, you see two columns, one is for south Asia

which includes India, Bangladesh, Pakistan, Sri Lanka, Nepal, and the other is for sub-Saharan Africa. The first line shows you the annual growth rate in the production of major food crops, and the thing to notice here is that compared to south Asia the growth in sub-Saharan Africa is considerably lower, 2.7 versus 1.7. The total consumption of food is not too different, because as you will see later, Africa imports a good deal of its food. The population growth rate is more rapid in sub-Saharan Africa than in S. Asia. And the consequence of the slow growth in production of major food crops is that food production per capita is declining in sub-Saharan Africa : + 0.3 for S. Asia, − 1.1 for sub-Saharan Africa. Food exports have been rising in S. Asia, partly as a result of the "green revolution", food imports have been declining. Food exports have risen 5.4% and food imports declined 5.5%.

But just the opposite is happening in sub-Saharan Africa. Food exports have been declining, at an annual rate of 7.1%, and food imports have been increasing at an annual rate of 9.2%. Now, if we were to be talking about sustainable agriculture, which is a familiar topic these days, we would have to say that the situation in sub-Saharan Africa is not sustainable. What I want to do now, is to show you briefly, something about the difference in production of rice, because for you, and for me, the starting point for what we understand about agriculture, is rice, and so, let's look at the way that we grow rice in these two different parts of the world, and then I'll come back and say a little bit about the implications of this.

Next slide. This is the way that for the most of Asia, we prepare land in growing rice. Next slide. Transplanting. A common practice. Next slide. And the neat kind of pattern we see in the irrigated rice paddies of much of Asia. This is a picture I took in the Yangtze Delta, up near Wu Han. Next slide. Weeding. Common practice, weeding rice. Next slide. Harvesting rice with a sickle. This is the common practice in South Asia, not in Japan, but in South Asia.

Next Slide. We'll go through the same sequence. This is how we prepare land in Africa. First, we burn to get rid of the trees and the brush. Next slide. And after that, the rice is sown in this kind of field. As you

see, it's not exactly a well prepared paddy field. Next slide. And later on people weed this rice. Next slide. Harvesting. Harvesting is done, as you can see, sort of sometimes one stalk at a time. Sometime with a sickle, sometimes without a sickle, but even the sickle is not serrated in such a way that cuts the rice very easily. Next slide. And finally, there is an example of the final product of the rice cut, in this case as stalk paddy, some of you may be familiar to the way they used to do it in Indonesia. Next slide.

Now let's compare the results. One of the things that is important to understand is that about forty percent of S. Asia is irrigated, or cultivated here in S. Asia. About five percent of Africa is irrigated. Rice yield per hectare is low in S. Asia still, because as you know, places like E. India still have very low yields. But its even lower in largely upland rice production in Africa. Rice labor per hectare is much higher in Africa than it is in S. Asia. Why is the labor so high? Because, for example, everything is done, of course, by hand, but the clearing of the land takes more labor, and there is no animal to prepare the land, as there is in the case of S. Asia ; then you have serious problems with the weeds, and with birds and other pest control that is much more serious in upland fields in upland Africa than in Asia. The consequence is that for a days work, a farmer in S. Asia, who by Japanese standards is very inefficient, is much more efficient than an African farmer who receives only six kilograms per day, whereas, the S. Asia farmer gets sixteen kilograms per day.

Now, you might jump to the conclusion as you look at these figures, that the answer is that we should all go and irrigate Africa, but the problem is that the physical conditions of Africa are such that you can't, there is not the potential for irrigating Africa, in growing crops in the way that we grow them in Asia. Even if we wanted to, even if we had the money, and its extremely expensive for irrigation equipment, but for what little irrigation investment we do put into Africa, the cost is extremely high. For most irrigation projects, the cost per hectare in Africa to develop the project, is maybe ten-thousand dollars ; whereas it would be around three-thousand dollars to do the same thing in Asia. The costs are almost prohibitive. But

even if we had the money to do it, the physical environment is such that we could not easily irrigate as much land in Asia – the soils are poor, there is less water potential for developing the area.

So, we have a problem, in terms of trying to decide, not just how to produce rice, but how to produce other crops as well, because some other crops other than rice, might be the answer to some of what we wish to do. And Dr. Stifel, of course, will be talking about this. The other thing that is of course important to understand is that knowledge of how to do things in Asia is probably not going to help you too much in Africa, because the environment is so different, because technology tends to be location specific. The ability to transfer knowledge, to transfer anything but the pure genetics from the experience of Asia to Africa is extremely limited. That means that we must have research on location in Africa, we must train people on location to understand African physical environment, African problems and the African situation. We can not rely on what we know from our Asian experience. We can not assume that we can have a "green revolution" in Africa that follows the pattern of the "green revolution" in Asia.

And finally, I want to leave you with the last slide. After a third of a century of independence, many African states are several generations behind Asia and Latin America in terms of the scientific, political and institutional material. This is from Karl Jaeger who is a very well known economist that has spent most of his life working in Africa. And we are going to have to start at the foundation, at the floor, and build over a period of half a century, perhaps, a solid base for African agriculture. And now Dr. Stifel is going to tell you, at least from the IITA perspective, how we are beginning to do some of that. Thank you.

STIFEL I think we will keep the lights dimmed and have slides during my presentation, please.

Thank you very much Dr. Barker. I would like to emphasize, what is perhaps, self evident, that the statistical trends, which Dr. Barker showed, decreasing food production per person, and increasing agricultural imports

per person, is more than an economic problem. It is translated in human dimension, in terms of hunger and malnutrition, and the spreading degradation of agricultural lands in Africa, and of course that is what IITA is all about. This picture shows our campus in Nigeria ; we have a thousand hectares donated by the Nigerian government. We have scientists from over forty-five different countries, and a staff of some twelve hundred or so working here at our headquarters. But I would like to emphasize that the work we do is academic, if it is not utilized by national system, and ultimately transmitted to farmers.

Although I am going to be talking to you about research, I do want you to keep in mind the fact that we are working as an applied institute. We are too small to be able to transfer our technology to farmers. We depend heavily upon national agricultural research systems. And as you can see, we look upon ourselves as a chain, which extends from the basic research institutes on the left to the work of IITA and the other international centers. We work with national systems of research, which turn their findings over to the extension workers who ultimately reach the farmers, who are the ultimate researchers, because they are the ones who decide whether to adopt or not to adopt a particular technology. Therefore, a great deal of our time is spent with national scientists.

We look upon IITA as an institution with two major functions. One is the research and one is the transfer of that research, the sharing of that research with national systems that test and adapt the results of technology to their own particular environments. This means that in addition, it shows that we have approximately about fifty scientists, working outside of our headquarters in Ibadan, in countries across Africa, where they are working in close collaboration with the scientists of the national systems, so that the technology which is created by our research is made available through the national systems to the extension workers and the farmers.

If you have the agenda for the meeting, there is a reference to the four strategies we use in order to get the maximum impact from the resources we have for research. The four strategies are on the next slide,

focus upon the small farmer, particular concentration on west and central Africa, focus on the major ecological zones of the region, and finally, focus on the most significant commodities for which we have a comparative advantage.

The first focus is upon the small farmer. Eighty-five to ninety-five percent of the farmers of west and central Africa are small family farmers which are growing commodities with their family labor. We believe that these farmers are smart, hard working, experimental and that they make the best use of the resources and the knowledge they have. What they need is new and improved technology that can permit them to increase their production to reverse the downward cycle of per capita production, and feed the rapidly growing urban populations. These farmers are, for the most part, resource poor, they do not have funds to purchase optimal amounts of fertilizer and insecticides, but they require new varieties which are resistant to diseases, resistant to pest, which are resistant to adverse environments, and better cropping systems or better management systems of the resources they have.

The second dimension of our research is a focus on central and western Africa. This area is responsible for most of the lowland, humid and subhumid tropics of Africa. Although we are an international institution and we produce technology which is relevant throughout the global tropics, we focus our major attention upon this region because it is an area where the need is so acute, and where we have a comparative advantage, due to our long period of work.

In this region, we have several ecologies, which have quite distinctive agricultural systems and agricultural requirements. We have the northern arid zone in the brown and the tan, the light green is the more moist savannah, and the area along the coast and central Zaire is the tropical and heavy rainfall forest area. We are concentrating upon those ecologies which are listed here, the humid forest, the transition zone, and the moist savannah, and the most important commodities which are grown in those systems – cassava, maize, rice, cowpeas, plantains, and yams. There are two exceptions to that, this is just a photograph of our commodities, two exceptions to that.

One is that we have a small but important program on soy beans, because it is a crop of such potential for the tropics and secondly, we have transferred responsibility for rice breeding programs to one of our sister organizations which permits us to use our researches to focus on the other commodities.

Now, I would like to turn to IITA's research program, and single out four examples of research, to illustrate what IITA is doing, some of its accomplishments, and at least one of the major challenges which is in front of us. I was going to emphasize at this point, something that Dr. Barker has already stated, and that is the importance of understanding the limitations of the "green revolution" of Asia. It is not possible to transfer the results of research in Asia to Africa, and IITA's responsibility is to do research in Africa on African problems to develop improved technology which is appropriate for African farmers and which is tested under African conditions.

Now, to start, I would like to say a few words about these farming systems. Firstly, the African farmer is poor because his productivity is low and because his technology is primitive. The two tools he has are a cutlass, as shown in this photograph, and a hoe. And it is hand agriculture with practically no addition of mechanization. The second characteristic is that African farming systems are complex. Again, as Dr. Barker has said, when you take an American out to see an African farmer, and stand in the middle of the farm, the American will say, "where is the farm?" The farm consists of many things growing in a disorderly fashion, as shown here, and there is a system. A system developed over hundreds of years, sometimes thousands of years which makes the optimal use of the limited resources. But, nevertheless, it is extremely complicated, and understanding it is the first step to improve it.

The African agricultural population, African population generally, is growing at the most rapid rate in the world. As opposed to elsewhere in the world, the population is continuing to grow faster, as health measures improve conditions and extend longevity.

The systems of agriculture are systems called bush-fallow, or shifting cultivation. When the farmer plants on land that has been cleared by fire,

he has a good crop the first year. The second year, the fertility is lower and there are sharply declining yields from the land, because he does not have fertilizer to apply, and by the third year, its not economical to farm it anymore. He shifts, he clears additional land, and he will leave that other land fallow from anywhere from eight to fifteen or twenty years. That system was sustainable and it was viable, although at a low level of productivity, as long as there was sufficient land in relation to the population. But the problem in Africa is that those systems in Africa are starting to break down. Population growth is increasing rapidly, and this projection by the World Bank creates an impression of the enormous pressure that will be on African farmers in the twenty-first century. At IITA we say that we are working on some of the problems of the twenty-first century, the problems of developing sustainable, productive agricultural systems which will replace the old traditional shifting cultivation.

The work at IITA after fifteen years or so on this topic, has produced many new approaches, but one of those which appears to be most promising, is an approach called alley farming. Alley farming is a type of agro-forestry, which permits the trees and the crops to be grown together at the same time, rather than be separated in two distinct phases. They permit the agricultural system to be sustainable, if properly managed. You can see here that trees are planted and they form alleys, in which food crops are grown. The trees are leguminous, which means that they can fix nitrogen in the soil and add a substitute for fertilizer. The alley farming produces other products besides food. The leaves are valuable for mulch, or animal fodder, the trees are usable for stakes, for growing yams, and if the trees are grown on a contour, they can help prevent soil erosion. Compared to traditional farming practices, alley farming is capable of producing higher yields of maize, without fertilizer, on a sustainable basis, in certain parts of Africa. So far, it is used only in fairly limited parts, but we think it has great promise, and we have established a network of scientists, from all over Africa, who are working together in a network to test and adapt the concept of alley farming to their own national environments. This is a picture of alley

farming at the IITA campus, cowpeas grown in the alleys, and scientists from our collaborating countries, working together with our scientists, studying research and planning research for the future in an effort to develop systems that are sustainable, economically viable and environmentally sound.

Now, the second type of research I wanted to mention, refers to maize, or what the Americans call corn. Maize is an important and growing crop in the middle portions of Nigeria, and the savannah across western Africa. It actually was the result of research in the fifties, that provided resistance to certain diseases that permitted maize to grow into the moist savannah regions. But as the maize spread into these regions, it encountered a very serious virus disease called maize streak virus. You can see the reason for the name is the streaks in the leaves. This disease had the capacity to wipe out a maize crop, and it discouraged farmers from practicing better management. It discouraged them from buying fertilizer to improve productivity, because they realized that there was a possibility for loosing everything. And maize yields in West Africa are notoriously low.

This was a challenge to IITA scientists. In 1975, we launched a major, ten year research program to identify sources of resistance to this disease and to breed that resistance into African maize varieties. It was a major achievement that IITA succeeded in developing maize streak resistance in maize, shown here in the contrast between the healthy maize on the right and the infected maize on the left. At the present time, IITA scientists are sharing this genetic resource with scientists from other countries. We are working very closely with the national seed service of Nigeria, for instance, which multiplies improved seed. And it is estimated that two-million hectares will be seeded with streak-virus resistant strains by the end of 1990.

This is another picture to show some of our maize scientists with the former Head of State, General Olusegun Obasanjo, who is retired from government, and engaged in farming, and works very closely with us. He visits our campus often, and he is growing a great deal of maize, with our streak-virus resistant strains. Every two years, the CGIAR issues an award for excellence in international agricultural research. In 1986, the IITA received

this award in a ceremony at the World Bank in Washington for the outstanding success in developing the resistance to maize streak virus.

I would like to emphasize that the improved technology is built into the seed ; thus, it is readily acceptable to the small resource-poor farmer. It reduces his risks, increases its yields, and encourages him to practice better management in order to increase productivity. And the result of our work in maize in Nigeria, for instance, has lead to the formation of a number of private seed companies that provides these essential seed to farmers across the country.

Now the third item of research that I would like to call your attention to, relates to cassava. A field of cassava is shown here. Cassava is a food crop, in some areas the leaves are eaten, but more importantly, the roots are the major source of calorie. This is the largest source of food energy, in the humid and subhumid tropics of agriculture, and they say that it is the poor man's crop – the poor man's crop, because it grows in very unfavorable soil conditions, and because it can be stored underground until it is necessary to eat. It's a misnomer, it's an error to call it a poor man's crop, because it really is the women who grow cassava. They are engaged particularly in the difficult, time-consuming labor which is necessary to produce it. This shows a healthy cassava plant, being harvested with the edible roots being full and in contrast to this, a cassava plant which has been attacked by the cassava mealybug. The cassava mealybug is a destructive pest which was introduced accidentally from Latin America. Under normal circumstances, the checks and balances that evolve in natural systems keep species in equilibrium. Cassava was brought into Africa some three hundred years ago, without the mealybug. When the mealybug, about ten or fifteen years ago, was introduced, it caused enormous damage to cassava, and tremendous losses to the poorest segments of the population which depended on cassava.

The approach IITA made, was to start a program of biological control to find insect pests that would destroy the dangerous pest, the mealybug. The white mealybug is shown on fresh leaves of cassava here, with a type of lady bug. It turned out that the lady bug was not very effective in

controlling the cassava mealybug. Consequently, we launched a major program in Latin America, which is the source of origin of cassava mealybugs, and we sought its natural enemies there. We covered thousands of square kilometers to identify the natural enemies of the mealybug and we finally identified a parasitic wasp that is effective as a control agency. In this map, you see the areas which were explored and the flow of insects to the United Kingdom, CIBC, which is the Common-wealth Institute of Biological Control, and then through a quarantine process to assure that they were safe, and would not be dangerous otherwise, they were brought to IITA, and then at IITA we have developed a program for the distribution of the natural enemies. Because the cassava plants are scattered in out of the way areas without roads, where the poor population lives, much of the area had to be reached by the aerial distribution of the cassava mealybug wasp, and this shows the IITA plane releasing the natural enemies, over farmers fields. The wasps multiply rapidly and destroy the mealybug in very large numbers. The villagers do not even understand what happened, because, suddenly, their cassava is healthy again. This is called biological control. The cassava belt of Africa is an enormous area, much larger than the United States. As a consequence if we can save cassava for these millions of small farmers, we will save substantial amounts of money.

Now the mealybug wasp does not permit more cassava plants to be grown, it does not increase the yield, but it prevents the loss. It prevents the yields from falling. And economists who have studied this project, estimate that the savings, in terms of cassava which would otherwise have been destroyed, is approximately three-billion U.S. dollars. An amount which would cover our core research budget for over one-hundred years. It shows that research can pay off. It pays off in increased welfare of small farmers, even if it is not as spectacular and as conspicuous as the "green revolution".

Now, it would, perhaps have been possible to control the mealybug with frequent applications of pesticides. But that would have been ecologically unsound, and completely out of the question for the small farmers of Africa. And it shows an African problem, dealt with in Africa in a way that was

appropriate to African conditions.

The last research example is a present challenge we have at IITA. It concerns plantains. Plantains are a food similar to bananas, but rather than being eaten for dessert, as a nice part of a meal, for millions of people in the humid tropics. They are the staple. They're particularly valuable during the hungry season before the new harvest when other sources of food are less available. They're ideal for the small farmer because they fit into his farming systems. They prevent degradation of the land, and they produce high yields. As economic conditions in Africa worsens, the demand for plantains increases.

Recently, a foreign disease called black Sigatoka entered Africa accidentally. Like the cassava mealybug, this is a disease coming from another part of the world, in this case, from Fiji Island; a disease for which there is no natural defense in the environment of Africa. A disease which is a fungus whose spores move by wind, very rapidly, from country to country. We saw it in Gabon a number of years ago, and already it is with us in Ibadan. You can see the disease causes the leaves to wither, which causes sharply declining yields and losses which can be so great that it is no longer economical to grow the plantains. The disease again can be controlled by chemicals, but at a high cost of environmental quality and at a cost, completely out of the question to the small farmers.

A number of national governments have come to IITA and urged us to give urgent attention to the problems of black Sigatoka in Africa, and we are working on bananas and plantains in our substation in eastern Nigeria. Here we are screening cooking bananas from east Africa, which are partially resistant to the disease, because of the possibility that the plantains, which are so popular in west Africa, may be completely destroyed. At the same time, we are launching a breeding program at this station to develop varieties. The pressure upon our scientific staff to develop resistance to this disease is tremendous, because people are seeing it move across country after country with devastating results. It took us a period of ten years to develop resistance to maize streak virus, which I had referred to earlier. Plantains are a much

more difficult commodity to breed, and time is running out on those people who are planting and depending upon plantains. This shows a IITA scientist in the field in our eastern Nigerian station who is a breeder agronomist, working on black Sigatoka disease for plantains.

Now, these are the four examples that I wanted to call to your attention. They represent a range of different types of activities which IITA is engaged in with funding from Japan and other countries to deal with the African food crisis. We believe firmly that Africa can feed itself again – it was an agricultural surplus country at one time. It is encouraging to us that many of the countries of Africa are improving their agricultural policies, and they are trying to strengthen their agricultural infrastructure, although they have a long way to go. But as those other conditions are improved, increasingly, it is the lack of technology which is the limiting factor in terms of agricultural development. So, research is not the only answer but research is part of the answer to the most pressing problem in Africa, and we, at IITA, feel very privileged to have the opportunity and the generous support to work with this problem which is a problem both of today, and a problem of the twenty-first century. Thank you very much.

Questions and Answers

KUROKAWA We would like to have about half an hour for a question and answer session. Those of you who would like to ask a question, please raise your hand first and I would like to ask that you use the microphone in raising your question, for the sake of the interpreters. So please state your name and affiliation before stating your question. So I would like to invite questions from the floor.

1st Question There seems to be many Japanese participants, so I would like to raise my question in Japanese. When I used to be a board member of IITA, there was a Dr. Pendel, and he was interested in knowing when it would be that the African agriculture would take off. I think he made some projections, and I remember that there was this projection that the African agriculture would take off in the 1990's. With regard to this time frame of the 1990's as the take-off point that was registered by Dr. Pendel, what is your view, Dr. Stifel? Do you think that the African agriculture will take off in the 1990s?

STIFEL Thank you very much, ... we are searching for a "green revolution" because we all want to make progress as fast as we can. I feel, however, that the prediction of the "green revolution" in Africa is made by people who have not been in Africa long enough to understand the differences between Africa and different parts of the world. It is tempting to look at the beautiful fields of Nebraska or the beautiful rice paddies of Japan, and say Africa can be like that. But I think that that is not realistic, for reasons which are many.

I think that we have to look at these very complex mixed systems and improve parts of that one by one over time, and that continuing process of testing and adapting and improving will lead to, what I call, a quiet revolution but not a spectacular "green revolution". The closest thing to a "green revolution" we see in Africa is the spread of maize in the moist savannah, and that is taking off in a sense, which is important. But I think that we are in this business for the long term, and that the problems are

not going to be solved in this century, and the pressure of population, which I showed in the chart, shows how difficult it is to avoid a declining production per person. I said at the end of my talk that I was optimistic. I'm optimistic because I believe in the small farmer's ingenuity, hard work and dedication. I'm encouraged by government policies which are better. And I think that Africa will be able to feed itself, but I don't think it's going to be an easy or a short term phenomenon. Thank you very much for the question.

KUROKAWA Thank you very much. Now I would like to invite a second questioner, if there are any questions, please. Yes, please.

2nd Question My name is Aggrey Orlans from Ghana, and I work in Yokohama at the International Timber Organization. I would like to just make a little observation on some of the statements made by Dr. Barker, and I suppose corroborated later by Dr. Stifel about the limitations of the "green revolution", and the fact that there has to be less and less comparisons between the development efforts of various continents or places. That is true, but why is it that a human being continues to persist in comparison, because it is a fact that development has to be seen in comparative terms? If, for nothing else, than to encourage aspirations.

In having said so, one then, has to get to certain basic facts. The fact is, if you have somebody who comes from Asia who lives in the tropics, who has learned to produce the "green revolution" in rice, come to Africa, our belief in Africa is that this person with the same competence and knowledge, would be able to pass on whatever knowledge and technical know-how to the African, is able to adopt better to the African, and is able to, therefore, encourage Africa to aspire to some form of green revolution, than the person who comes, say, from Nebraska. I am sure that, if, for nothing else, this person who comes from Asia, would have lived through a similar cultural, traditional, rural and generally a certain standard of life, which approximate to what we have in Africa, and, therefore, will be able to pass

on, as I said, this technical know-how and experience. And I think, that it is from this angle that one often makes these comparisons, and I want, therefore, to know form both the speakers whether it is belaboring the point to keep making all these comparisons, and whether there is not some basic truth in the fact that if Asia and Africa were to collaborate more effectively, Africans can benefit better, than say, Africa and Europe, in terms of personal exchanges, experience exchanges and so on.

BARKER Well, I don't think that given the nature of your questions, that we should worry about whether it should be Asia collaborating with Africa or the U.S. or Europe, or whatever; the fact of the matter is we are moving towards a world agricultural system, a world economy, a world agricultural system. And collaboration is needed at all levels, and let me give you an example of what I mean. As we move on in science and technology these days, and as the land resources of the world become scarce, even in Africa, we are going to have to rely on higher yields everywhere. Higher yields means that we are going to have to develop the science and technical capacity to raise those yields.

Formally we did this with chemicals, with fertilizer, with what produced the "green revolution", but we are all aware that that is not a long term solution either. We can not rely on the fossil fuels, number one because, of course, they are limited in supply, but number two, because environmentally, they are damaging. And therefore, we have to search for new solutions for Nebraska, for Asia, for Africa, and many of those new solutions are going to come from strange places, where people did not do agricultural research before, laboratories in biotechnology, molecular biology, genetics, and so forth, to produce solutions that are economically and environmentally sound. For example, to produce substitutes for fossil fuels, to produce substitutes for reliance on chemical fertilizers.

And to a large degree, we are going to have to think in terms of not just comparisons in Asia, Africa and so forth, but as I said, in terms of the world system. I am particularly knowledgeable, for example, about the

work on biotechnology in rice. The funny thing is there are fifty laboratories around the world that are supported by the Rockefeller Foundation, and about fifty percent of the people working on the rice on areas that are going to be instrumental to future rice yields, have never seen a rice plant. They work on the DNA and they grind up the seedlings and so forth to get a look at the chromosomes, to do work at this level in terms of gene transfer.

So, we are looking at a revolution in the way we think about agricultural and scientific research. And I don't think I agree with you. We should not limit ourselves to necessarily comparisons of Africa and Asia, but I feel that the solutions for Africa are not going to come out of, necessarily, what we did in Asia, but it may require our best science in areas that were, maybe, never possible in Asia at earlier times. We are going to apply our best science to Africa, not necessarily things that we learned in Nebraska earlier, or things that we learned in Asia earlier. So, the future, to me, is going to be very different than the past for Nebraska, for Asia, and for Africa, so we need to keep that in mind.

STIFEL I might comment just for a moment on how IITA relates to this process that Dr. Barker has described, because I think that it's important for you to understand. The slide I showed of a chain stretching from the advanced laboratories of the first world, to IITA, which is concerned with applying research to African problems, and then to the national systems. The first world science is accelerating at a tremendous pace in institutions in the private sector, primarily, which are concerned about profit making opportunities which necessarily exist in the first world. We are very concerned that Africa shares in those scientific advances, and we look upon it as one of our responsibilities, to understand what is happening in biotechnology and its relevance to tropical food crops.

And in a sense we are an intermediary, or a middle man, to be sure that the interests, or to strive to do our best to assure that the interests of African countries are taken into account. We are working with scientists in the African countries, but for the most part they don't have the resources,

the laboratories, and the contacts to effectively monitor these developments. They are developments that may change agriculture in a very fundamental way in the future. And it is our responsibility, as the custodian of this task in Africa, to be sure that the Africans share in these exciting development. Thank you.

KUROKAWA I think that we can solicit one other person for a question, please.

3rd Question I am Shirasu of the International Development Center. You mentioned agricultural technologies and their advances. The transfer of agricultural technology that was developed in various laboratories, but when agricultural production technology makes advances, and you want to incorporate it into the African agricultural system, there seems to be some kind of gap created in between the understanding that you will be able to solicit from African farmers, and the kind of technology that they are willing to accept. So, I would like to ask you to comment on that.

And the second point is, that when a new technology is developed and is made to be a sure technology, what kind of specific difficulties do you encounter in the process of trying to have African farmers implement the new remedies to the problems they have in their farms? Have you had any experience which illustrate the difficulties that you had to overcome? And can you sight some of the difficulties and some successes which you have obtained in the process of introducing new technology to farmers in Africa? So these were the two points I wanted to ask you.

BARKER The first question had to do with the gap that is created in the process of developing new technologies to cope with farm problems in Africa, and the willingness of the farmers to adopt that technology. As technology advances, I have a feeling that maybe the farmers feel that they don't want to take in those technologies, because they are too foreign.

The point, if I understand it correctly, raised here, is number one,

the difficulty in the gap between the advanced technologies created and the willingness of farmers to accept the technologies, and secondly, the degree to which the technologies are suitable for African farmers and whether they were.

Technology transfer is a major problem for agriculture. We have had difficulties, not only in Africa, but in Asia and elsewhere in technology transfer. Part of the reason for that is that typically, if we are not careful, we have what we might call, a top-down system – we develop the technology, we hand it to you as a farmer, and we say, "you must use this technology, you must adopt our variety, you must accept out fertilizer, you must do these things." You can not expect success if that is the approach, and there's a good deal of frustration in Africa today among scientists who say, "I can produce high yields in the experiment station, but somehow, my farmers don't seem to be willing to accept this technological change." The only way that I know that you can solve this problem is you have to have feedback. If I think of the flow chart that Dr. Stifel pointed, when I looked at that flow chart, the one thing that I thought of, I hadn't seen that flow chart before, is that the arrows should go two ways. The arrows should go down to the farmer from the scientist, but there should be another arrow coming back up. That's the way you achieve success in Japan. It is the way that we achieved success with our so-called research extension farmer system in the United States, and it is ultimately the problem that we face in Africa of achieving that success.

Now, the problem, of course, is that we don't have the quality research extension system in place in Africa. That creates an issue for us, because obviously, IITA does not necessarily have that. Now, one example of a solution that worked well in recognizing the limitations, was the biological control of the mealybug. The advantage of biocontrol is that if it is successful, and it is very seldom successful, but in this case of the mealybug it was successful, is that by using that solution rather than the chemical fertilizers or something else, which you have to extend to farmers and convince them to use it, or can they afford it, is that the biocontrol on the

mealybug is, what we say in economics, it has sort of, externalities while everyone benefits from the technology. But the farmers don't have to understand it in detail for that success.

Now these are rare opportunities that we can find the technology that is so successful as that, and that we can avoid the technology transfer problem, though that is extremely rare. Typically what we have to do is interact with farmers, and those of you who are familiar with work in agriculture know that in the last decade or so, we have developed an area of research called farming systems. The purpose of the farming systems research is to create a feedback from the farmer to the researcher, and the only way that you can do that, is that the research person himself has to understand the farming system.

It is not just that he has to do research in the farmer's field, but he has to communicate with the farmer in such a way that ultimately, you can begin to feed back information to the researcher so that ultimately whether it comes from advanced laboratories or anywhere else, you begin to design the technology that is going to be relevant for his situation. If he cannot afford a certain level, you don't design technology that is expensive in that way. But obviously for Africa, this is an enormous task. And it is an enormous task because, not only you do not have the research extension system in place, but very often, you won't have the transportation system, the agricultural infrastructure that we come to assume in Asia, is not available to us easily in Africa. So the problem of transferring that technology to farmers is going to take much longer time.

As Dr. Stifel said, research is only one part of the answer. There is going to be,at least, half a century in which we will have to invest in infrastructure in Africa in roads, and markets, in credit institutions, in all those things that we take for granted in many parts of the world that are going to have to be developed in Africa, and the rates of return on those initial investments are going to be extremely low, much lower than the World Bank would find acceptable. The World Bank insists that you must get an internal rate of return of twelve percent, but you can't get that in Africa,

until another thirty, forty, or fifty years, until we've laid the foundation to make it possible for those things to happen.

Now, think back in Asia, how long have we invested in irrigation, for example, in Asia? How long in Japan, how long have you built the infrastructure for Asia which laid the foundation of the "green revolution", which took off? That Asian irrigation infrastructure was developed, in some cases, over centuries. And yes, then all of a sudden, we had a "green revolution". So, don't be impatient with Africa. Give us time. Think not in terms of 1990 take off, think hopefully, in terms of 2090, yes, now we are moving ahead. But it is going to take time, and we must be patient. But we, including JICA and USAID and so forth, must not be discouraged not to make the effort. After we have done something for five or ten years, and we don't see this high rate of pay off, the government says we better try something different, because this is not working. But I think we should sit down together and think fifty years ahead, and think what it takes for that investment to work fifty years ahead, and be patient, and do that.

STIFEL Be patient, but not complacent. Be patient, but work hard. At IITA, we say that we are in a race against time to increase food production in pace and faster than the growth of population. We have a specialist who visited IITA a few months ago, and he sat down and said, "Well, the problem with African agriculture is the farmer. The farmer is ignorant. The farmer is stubborn. The farmer is resistant to change." I told him that our experience in W. Africa is completely opposed to that assumption. If the farmer is resistant to change, he knows that the proposed change is not in his interest or he has good reason to think that it is not in his interest. And so, as Dr. Barker said, we learn from the farmer, and technology is flowing one way, but if it is going to work, information has to be flowing in the other direction as well.

So we firmly believe that the farmer is not the problem. The farmer is our ally, he is seeking ways to improve his livelihood. The farmers work very hard. They make extraordinary use of the limited resources they have,

and they want to improve their livelihood just as much as we want to help them do it. So, we look upon the starting point as the farmer and his conditions and his aspirations. Thank you.

KUROKAWA If there are not any urgent issues or observations, we would like to close the lecture. We would like to thank the lecturers by a round of applause. Thank you very much.

JICA