Session 2

Naoya Fujimoto: Good morning ladies and gentlemen. Maybe you spent a very good nightlife in Tsukuba City yesterday. Today, I would like to start Session 2. The title of the session is, "Research Issues for African Rice Promotion." Myself, Naoya Fujimoto, I am a project leader to Japan International Research Center for Agricultural Sciences, JIRCAS; and my colleague, Mrs. Oka, please introduce yourself a little bit.

Naoko Oka: Good morning, my name is Oka Naoko, a staff of JIRCAS. I hope we can have a good discussion through this session.

Naoya Fujimoto: Thank you very much. We have 2 hours and 10 minutes and we have four executive speakers such as Mr. Kubota, Dr. Kumashiro, Mr. Yamada, and Dr. Sakagami.
Before we start the presentation, I would like to inform the schedule of this session. We have 130 minutes, so each presenter has 25 minutes in each slot. But I would like to suggest the four presenters to finish in about 20 minutes because we would like to receive clarifications or questions for each presenter. The floor staff will show you the warning that 20 minutes have passed from the start of your presentation. Please summarize in 3 minutes after you see the flag.
After the four presentations, we would like to move to the general discussion. According to the suggestion of the secretariat of this symposium, we are expected to talk about the future prospects of research. In each presentation, maybe, each presenter would like to explain the current status of study, research, or field activity; but we would like to focus on future prospects of research activities in general discussion. I hope I would like to ask you, audience, to see what the problem is or what is the next step to each research activity when you hear each presentation.
Now, we would like to start the first presentation by Mr. Kubota Hiroyuki. He is the Executive Advisor to Director General of Rural Development in JICA. Mr. Kubota, please.

Hiroyuki Kubota: Good morning. Thank you, chairpersons. Distinguished keynote speakers, distinguished participants of the symposium, on behalf of Japan International Cooperation Agency, I would like to express my appreciation to the organizer who kindly extended the invitation to us to this important symposium.
Why is it important for us? This is a great opportunity for JICA to share the update of this initiative but also, beyond each of our activities in each of countries and regions to be reviewed, to expose to the professionals such as agricultural researchers and practitioners. That is the great opportunity again, to have a base of good communication having critical comments and good suggestions for further improvement of operations.

Today, I would like to share some of our experiences as a part of the founding member of this initiative. Of course, JIRCAS is another founding members. Usually, I spend a few minutes with a few slides why we picked up rice as a focused commodity for this initiative. But since yesterday in this specific occasion, I don't think it's really necessary.

Some explanation is shown in the poster in front of the auditorium about some unique nature of rice as a commodity in Africa. We compare it with other important crops such as maize, cassava, millet. Only wheat and rice have the widening gap between consumption and local production. That gap has been filled with import, that was described by some of the keynote speakers yesterday.

This is a summarized structure and the purpose of CARD initiative, currently being participated by 11 organizations. This is a good mixture of research institutions, financial institutions, technical or some political bodies. We collectively picked up around 23 African rice-producing countries in two groups. In the first group the rice development is economically or socially, sometimes politically, very important. Second group as well; however, the magnitude of the impact is quite different.

What is the structure and the forecast of the CARD? I don't want to spend much time today for that explanation. Some description is in the leaflets, and the documents and some other information is available in public at the homepage of the CARD Secretariat, www.riceforafrica.org. Then I may, a little bit, touch on some background to underline the purpose of this initiative in the view of development agencies such as JICA.

In the World Bank Development Report 2008, there was one very specific chart which shows the financial flow to agricultural sector of Africa. Once upon a time, around 10% or more of the ODA, the Official Development Aid, to that sector in that region nosedived in the late 1980s or 1990s to the level of around 4% share. This is simply because people were fed up to spend money for agriculture in Africa. The taxpayers or financers found the investment to the agricultural sector in Africa was not effective. The JICA should take some responsibility for that result.

However, around 3 years ago when the global food price went up, people suddenly found something wrong. Some of them have left the ground. Some of them shifted their focus from the ground to the upper stream, like a policy. Then, many development partners came back. However, the one common understanding among the institutions, like here around 11 organizations, was nobody can cope with even one segment of the full range of

agricultural sector. Everybody has some relative advantages but nobody can cope with the challenges even on one single commodity.

We decided to team up, to work together, and explore any possibility of synergy effect. This is not a funding initiative. We do not secure so-called CARD funding or something, however, we try to expose ourselves, be efficient enough, and explain our taxpayers and the subscribers or sponsors that investments to agriculture in Africa is good enough and it is possible to make situation different. We picked up rice as an entry point to revitalize African agricultural development.

This is a step-by-step chart, what kind of exercise we have been doing. The first stage is drafting so-called National Rice Development Strategy. Is it really a strategy document? I don't think so. This is a kind of parallel exercise of the Poverty Reduction Strategy paper, but this is a very important exercise.
In various countries, in Africa, each of the segments is under the different ministries. In some countries, they have a very good irrigation scheme which produced maybe more than half of national rice production. But irrigation scheme is under the Ministry of Water Management or Natural Resources, agronomy is under the Ministry of Agriculture, research is under the Ministry of Science and Technology. They never sit together at one table.
We start supporting them to organize by themselves, sharing the same information, and discuss on it and analyze it, then set the direction to be shared among the national system, wide stakeholders. So, NRDS is a kind of set of documents which consists of the commonly accepted statistics and some policy backgrounds, and some directions technically feasible.

Then, maybe when you go back to your office and click the homepage of the CARD Secretariat and if you read NRDS document, it is still something floating between the dream and daydream. Some figures are very, very rosy. We accept it. Some cases after the exposure of the African rice market to the globe, the head of states started some campaigns – this is good – political campaign to increase the production. But often they use the figure picked up from somewhere in the air and unrealistic target they set. Researchers, administrators, anybody else cannot supersede that political statement. We, the developing partners, start from that reality.

However, once the document is set as a first draft this is a base for the argument and discussion among the stakeholders nationally and also we, the developing partners one by one have some stakes for the investment. Our message to the national counterpart is, once we sit on the table for the investment, our discussion will be serious and based on the reality check. However, the National Development Strategy with some rosy figure, we accept it, is still good enough as a base of the discussion among the national stakeholders.

Based on this National Development Strategy, the wider range of stakeholders, often we support and facilitate the discussion with the latest information of something happened in other places or the flow of the new good practice cases by each of core members. Then, the national stakeholders analyze the current situation of rice development; geographical distribution of the production and consumption patterns, and what type of intervention, either government or development partners, what type of interventions in what magnitude. They found some gaps. Then, at next stage they try to identify the prioritized intervention to be. the last of the strata is alignment to sector strategy and solicitation. We ask them not to sell that idea to us. They sell those prioritized concepts to their own national government, first in the ministry and then to the national budget procedures.

We have this initiative, so-called the CARD, but at the same time, the so-called CAADP, Comprehensive Africa Agriculture Development Programme, which was initiated in 2003 by the so-called Maputo Declaration by heads of states of the African countries.
CAADP is now the one single initiative in pan-Africa to promote agricultural development. If the rice sub-sector is important in the agricultural development in that country, it must be well aligned to the whole sectoral framework. All of the 11 core members of the CARD initiative, the supporters are all supporters of CAADP. We would like to see well-aligned rice development strategy in the whole agricultural sector strategy. That is what this initiative was designed for.

At the very beginning the guidelines and the format of NRDS were drafted by the Africa Rice Center, and IRRI, and JIRCAS. Particularly those three research institutions work together to help us formulate the vast set of frameworks. The other development partners work on that, facilitate the national discussions, and encourage them to align rice segments into the agricultural sector strategy. This is actually capacity-building process, capacity building for those national systems and at the same time the capacity building for us, supporting institutions, because we could have more comprehensive picture of rice development as an entry point for revitalizing the agricultural sector.

First group is around somewhere there, and second group is somewhere here. This shows the milestone of this initiative to date. We officially started the initiative at the first CARD meeting around 3 years ago, then just last week, as Marco kindly introduced to you yesterday, last week we had the fourth meeting. The major points are: The first two updates are where we are – the previous slide showed – then how it is aligned to the National Development Strategy or National Development Policy. This is now reviewed by the NEPAD, the sub-organization under the African Union.

One more thing, we discussed about how we are going to do in the coming years. That includes some elements of the public-private partnership in rice segments or mechanization of the sub-sectors. They are all very difficult stuff. Each of the countries is now going back to their own audiences and they are discussing what direction each country will take. Up to now they had almost the same exercise, but maybe from now on, particularly for the first group, the pace and their choice is quite different. Then, our supporting partners should be ready to support their choice.

This is not exhaustive map. This is based on some of the questionnaires where we are doing. Most of the countries, the plural partners are doing something about rice development. This is in terms of collaboration.
This is just for JICA. JICA has collaboration with various partners. This is something that happened in the last 3 years. This is the production – because we set very simple, some people say that it's too simple - but doubling the production in 10 years, then how it is? Actually, we had the update figure from each national counterpart last week based on the 2010 production. If we sum up those figures, around 30% to 40% increase more, then it is good. Of course, the quality of statistics is another issue. Then that issue will be dealt with us and you, particularly you, but the trend is positive.

This is showing aggregated. The first two is a benchmark, 14 million, so far so good. But, of course, this is not because of CARD. This is a result of the previous investment by many others. I should not claim and we should not claim that this is because of CARD. At the end of the day, also this is not because of just CARD, corrective action, but we would like to facilitate each of the national systems can cope with the challenge by themselves. They dictate the direction, we support. That is our purpose of the initiative.
The small box, right hand side, this is something we should do. All of them are not new at all but how to approach it, then different from maybe 5 years ago. At the end of the list, capacity building at any level, at any place, that is really a key. In the past the investment to agricultural development was not too small, as I mentioned at the very beginning, sometimes over 10% share the agricultural sector had.

Why people were fed up? Because no impact. One of the reasons is that investment did not go along with capacity building, so we, as JICA, at least, focused on capacity building in many places and we work together with other development partners and the national system too to make the national system capable to digest once our sponsors, taxpayers, subscribers are comfortable to invest their funds, both private and public, to this sector.
Thank you very much.

Naoya Fujimoto: Thank you very much, Mr. Kubota. He explained the detail of the platform of CARD. I would like to accept a couple of questions from the floor. If somebody would like to ask clarification or question please show your hand, please.

Marco Wopereis: Good morning, everyone. Thank you very much, Dr. Kubota-san for a very clear presentation. I think, first of all, I am very happy to see that figure of 12% annually because doubling means 7% increment per year, so we are going to do better than doubling. That is a very good trend.
For me the big advantage of CARD is really that there is a lot more interaction between the different institutions in the Steering Committee and I think that is a very good thing, a lot of learning among each other, but I have also seen it among the countries when we were developing these strategies and when they are developing the concepts now there is also a lot learning and actually because of that, becoming more realistic in terms of what can be done in each country. I think that is a very positive element of CARD. Now, we are in a phase where we sort of are in a capacity to streamline the different interventions of the different development partners.

There I have actually two questions. When we do that, is there a way to stimulate more of a regional approach within CARD, because we are now very much on national rice development strategies but if you think, for example, the Mano River Union, there is a lot of scope there even if Liberia is in the second group and Sierra Leone is in the first group to do things in a regional level? That is the first question.
The next one is: Do you think there should be feedback loops when we start to revise these strategies over time?

Hiroyuki Kubota: Thank you very much. Those two questions are very important. First, the regional approach. We, JICA, ourselves once tried to make some concrete steps to support Guinea, Ivory Coast, Sierra Leone, Liberia as the Mano River Union, but now a little bit setback, to be honest. There are some difficulties. Each of the national interest is slightly different. It is a very common issue since we observed very early stage of ASEAN. ASEAN bureaucrats and national bureaucrats had some fundamental source of conflicts of their interest. Then the regional approach based on the same agro-ecological zone share and the same regional market share, that is the justification of the regional approach I think.
Those two elements are getting more important now. Once that balance changed clearly, I think their response was quite different. We should not stop our knocking their door for the regional approach because rice as a commodity is freely moving around across the border. Then for the production site maybe national basis is fine, but once we try to tackle on rice as a commercial commodity, as much talked yesterday, the regional approach is inevitable.

Then, the second question about the feedback system. Yes, last week at the Steering Committee, among the 11 members that was one of the main issues, how to monitor and feedback to the system. Then strategy itself is, as I

said, something little lousy. It is everybody, ourselves and African producing countries. Everybody understands this is a living document and it must be revised from time to time. We may introduce some kind of monitoring or an evaluation mechanism and the feedback to the national system to help them to revise. That is what we discussed last week.
Thank you very much.

Naoya Fujimoto: Thank you very much. Because of the time constraint, I stop this question and clarification now. Please give a big applause to Mr. Kubota. Thank you very much.
Okay. Next presenter is Dr. Kumashiro. He is a staff of Africa Rice Center, but formerly our colleague. His presentation is, "Advances in Rice Breeding for Africa."
Dr. Kumashiro, please.

Takashi Kumashiro: Thank you very much, chairman, for the nice introduction, and good morning, ladies and gentlemen. First of all I would like to express my many thanks to the organizers of this international symposium, JIRCAS, for providing me a good opportunity to talk in this international symposium and also to be in Tsukuba. This morning I would like talk about advances in rice breeding for Africa, mainly emphasizing on our ongoing activities in Africa Rice Center.

I took this figure from the GRiSP document and this is indicating the needs of technology by farmers in Africa. Farmers in Africa want the technologies to control weeds, then birds, and droughts and diseases, the flooding and nutrition problems, including problem soil and insects. These are needs or demands by farmers and that should be reflected in the breeding targets.

In Africa Rice Center we are conducting rice breeding, targeting four major environments. They are rainfed lowland, upland, irrigated, and high elevation. In trait-wise what we are doing is mainly gap filling improvement because there are so many constraints in rice production in Africa. In the area of abiotic stress, we are targeting drought, submergence, cold, heat, and problem soil such as iron toxicity, P-deficiency, and salinity. In the area of biotic stress, we are dealing with three major diseases: blast, RYMV (Rice Yellow Mottle Virus), BLB (bacterial leaf blight), and one insect, African rice gall midge. Also, we are evaluating important trait such as grain quality mainly focusing on the appearance or physical trait.

This indicates the flow of development of new varieties. Actually, it consists of several phases. First one is evaluation of germplasm, and then pre-breeding to identify genes or even to acquire molecular markers. In breeding, we just incorporate traits of interest by marker selection or conventional selection. The last phase is evaluation of developed breeding line under a multi-site and multi-year to select the best line. Each phase corresponds pretty well with our GRiSP Theme 1 and Theme 2, which I will talk in detail later.

First topic is germplasm. At Africa Rice Center we are storing about 20,000 accessions that include the very African domestic germplasm such as Oryza glaberrima, and O. barthii, and landraces in Africa. For those accessions, we are evaluating agro-morphological traits. Very recently, we have initiated a systemic evaluation of O. glaberrima and O. barthii for major disease resistances.
This is one example of evaluation of germplasm. In this case, I am showing the germplasm tolerant to salt. First, we screened landraces; about 180 landraces collected from salt-affected area in Africa and we found 8 salt-tolerant landraces. You can see the detail in this table. We extended our screening to Lowland NERICA, about 60 different varieties, and among 60 we found 4 Lowland NERICA showing tolerance to salt. Also, we evaluated O. glaberrima, about 100, and identified 4 accessions carrying the tolerance to salt. Interestingly, majority of these tolerant lines seems to carry a different gene from the reported gene “saltol”. This tolerant germplasm will be incorporated in our breeding program.

Next topic is breeding for cold tolerance and I think many people wonder whether the cold tolerance is needed in Africa, but the answer is yes, in two areas. The first one is in Sahal zone in West Africa where temperature goes below 12 degree during winter season, and the second area is high altitude areas in East Africa. For example, Madagascar alone has more than 120,000 hectares potentially affected by cold.
In our breeding program for cold tolerance we are using two different screening methods. One is the controlled condition using low air temperature as well as cold water. The second one is to screen in a hot spot for cold. We identified the hot spots in Tanzania, Senegal and Mali. Current breeding status is in BC2 using a tolerant donor such as Kunming and recipients such as these popular varieties listed in this slide.

Next topic is breeding for disease resistance. First case is RYMV. This is a very devastating viral disease in Africa and prior studies with IRD in France identified several resistant genes. In the case of RYMV, actually four resistant genes have been identified. One is from O. sativa and the other three are from all different O. glaberrima, and these reside in the same locus. Recently we found a new gene called RYMV 2 again in O. glaberrima, and we are conducting breeding for this resistance using molecular-assisted selection.

This shows us a scheme of marker-assisted selection for RYMV resistance. As a donor of a resistance we are using Gigante and we are using marker for RYMV 1-2, and we try to incorporate resistance to these major varieties.

Now, they are in BC3F4 generation and we selected tolerant lines among them and evaluated them for the resistance.

This is just an example of field evaluation in Cotonou this year. This is a resistant donor Gigante, and this is a recipient variety, IR64. This is our introgressed line. You can see some symptoms here in IR64 but no symptom in this introgressed line. Also, RYMV resistance is confirmed by evaluation in a hotspot in Nigeria last year and also by artificial inoculation with the virus.
Very recently this year, IRD just identified a marker for new gene RYMV 2, so we initiated to combine both resistances, RYMV 1-2 and RYMV 2, to develop a more durable resistance to RYMV. We have started this MAS-mediated breeding work.

Next topic is again disease. In this case, I'll talk about blast. Blast is also a serious fungal disease in Africa. This is showing just a diversity of isolates. In blast we have so many isolates, so we are collecting isolates from West Africa and this work was done under collaboration with JIRCAS. So far, we have just evaluated about 100 isolates from West Africa and using differential varieties carrying each specific resistant gene we just checked frequency of virulent races for each differential variety. Overall pattern, this is West Africa and this is Asia, is s similar between these regions but number of isolates from Africa is not large enough so we are still collecting isolates from Africa and by doing so we can identify prevalent isolates in Africa

Regarding the resistance to blast, our strategy is just to use so-called field resistance. Efficacy of these two genes, Pb1 and pi21, have been confirmed in breeding in Japan and also gene identified in NIAS, Japan. We obtained marker information from NIAS and we also obtained resistant donor carrying these resistant genes from Genebank NIAS. We selected a recipient variety in irrigated and upland conditions and we now started incorporating these field resistant genes.

In the previous two topics, I have talked about the marker selection for RYMV and blast. Other than those, as this slide shows, we are employing MAS to develop salt tolerant variety using saltol, and submergence tolerance using sub1, both of which are identified at IRRI and being utilized in IRRI. We would like to expand application of MAS into other important traits.

Now, I would like to talk about hybrid rice for Africa. In 2009, we initiated a hybrid rice program. There are two activities. The first one is evaluation of Chinese hybrid under African environment. We obtained about 270 lines from China and we evaluated in 8 countries in Africa for 2 years and identified about 29 promising hybrid lines. These lines are now in PVS trials, in this season.

We also initiated to develop our own hybrid variety. To develop a hybrid variety, we need to have restore lines and we identified these varieties carrying a restore factor. In the area of development of male sterile line, we are introducing the WA cytoplasm by backcross to these varieties. Other than that, we are checking combining ability using these lines and also we have conducted trials for seed production which is very important for hybrid rice.
I would like to talk about multi-environmental testing network that is under Africa Rice Breeding Task Force. We launched this task force last year. This is aiming at the evaluation of breeding lines under multi-site and multi-year. To this, we put all promising line developed in-house and ones developed by NARS, IRRI, and CIAT. All of these lines are to be evaluated under this scheme. This evaluation consists of three phases. First one is regional trials, then the selected lines proceed to national trials, then rice garden multi-location trial and baby trial which is a kind of PVS. The selected lines through these three phases will become recommended variety to the target countries and the target regions.

There are several features in this Breeding Task Force. First one is multi-location, multi-year evaluation. Second one, we are applying the same experimental design and measuring the same trait in all sites. The data will be analyzed in a central manner. This provides breeders with strong supports in identifying of promising breeding lines The fourth feature is the involvement of NARS breeders in all evaluation phases. That facilitates exposure of promising lines to NARS at very early stage of evaluation, and we hope this results in a shorten time for variety release in each country.

This is now a real status of regional trial and national trial in this year. For the regional trial we are using 13 sites, and for the national trial 16 sites, and the number of lines is like this. Among the lines under evaluation, we have breeding lines carrying the salt tolerance, iron toxicity tolerance, and resistance to African gall midge, and blast, and some with improved grain quality.

This map indicates the site for Breeding Task Force. You can see many sites in West Africa and East and Southern Africa. In terms of ecology, it covers high elevation, irrigated, lowland, and upland. By evaluating through this Breeding Task Force, we hope we can speed up evaluation of promising breeding lines and increase the number of varieties to be recommended to each country.

I think I have to talk about the status of dissemination of different varieties. First one is NERICA. We have 18 NERICA varieties for upland and that is being disseminated in 22 countries. Among 18, most popular varieties

areNERICA 1 and NERICA 4. Also, lowland NERICA is being disseminated in 9 countries. Among 60 lowland NERICA, popular varieties are NERICA L19 and NERICA L20.

There is estimated acreage of NERICA. It's approximately 700,000 hectares that's based on statistics and estimation using a model, and these are figures taken from our Rice Statistics Project. This is an example of estimated acreage in four countries. If you make a total of these four countries, it becomes more than 500,000 hectares, so the figure of 700,000 hectars in Africa could be underestimation.

I have to say we are developing a disseminating rice variety other than NERICA. This table shows varieties released since 2007. As you see, many new varieties have been released in upland, lowland and irrigated condition. If you see the case of Senegal, 16 varieties are being released and all these are Sahel series, and occupation of these series in Senegal irrigated area is nearly 90%.

Again, I am showing the flow of development of new varieties. This is to show how each product line of GRiSP Theme 1 and 2 is related. Product line of Theme 1 is shown in green, and that of Theme 2 is shown in yellow box. You can see the ultimate goal of this Theme 1 and Theme 2 together is to develop varieties released to the countries or to farmers. To achieve this goal, we have to implement all of these activities in a very efficient manner. Also, an important thing is to deliver the output of each phase to the next phase in a seamless way and without delay. By doing so, we can develop many new varieties. But, I have to say these activities cannot be done by a single institute, therefore, we need collaboration.

Last slide is showing a collaboration status under GRiSP Theme 1 and 2. During my talk, I already mentioned collaboration with IRD in France, in the area of RYMV, and I mentioned our collaboration with NIAS and JIRCAS in the area of blast. Also, as Dr. Wissuwa mentioned yesterday, we are collaborating with JIRCAS in the area of P-deficiency. In Breeding Task Force we are collaborating with many institutes, including NARS in Africa, and, of course, IRRI and CIAT. I think the important thing is to further strengthen the existing collaboration and also we have to expand collaboration with new partners. By doing so I believe we can generate and deliver new varieties with clear added value to farmers.
Having said that, I would like to conclude my talk. Thank you very much.

Naoya Fujimoto: Thank you very much, Dr. Kumashiro. He explained his current study not only on breeding but also dissemination and collaboration. I would like to accept only one clarification because of the time constraint. If there is a question, please raise hand from the floor. Okay, please.

Osamu Koyama: Thank you very much. I was so interested in the second or third slide on the technology demand of African farmers. It says that weeding problem is dominant in the future. My first question is how that evaluation was made. Do you know what kind of survey, well how did you make that kind of survey?
The second question is: Are you going to tackle with that problem from breeding side or not?

Takashi Kumashiro: The annual budget benefit in the 2nd slide is just based on interviews to many farmers in Africa. The questions were addressed on what kind of problems farmars are facing and what kind of technology farmers want to have to solve the problems.
Regarding the second question on breeding for weed tolerance. yes, we are doing a little bit, and we have developed a screening method to select weed competitiveness and actually that is not to evaluate tolerance to weed but that is to evaluate mainly early vigour. We'll incorporate weed tolerance or weed competitiveness to our breeding targets in the near future.

Naoya Fujimoto: Okay. Thank you very much. Please give a big hand to Dr. Kumashiro. Thank you very much.
The next presenter is Mr. Yamada. He is my colleague. He is a Sub-Project Leader to JIRCAS. The name of his presentation is, "Low-Cost Technologies for Paddy Field Infrastructure Development in Africa."

Junichiro Yamada: Thank you, Chairpersons. Good morning. I am Yamada from JIRCAS. First of all I would like to say thank you very much for all the guests, all the participants and the organizers of this symposium. Today, I will speak about research regarding the low-cost technologies for paddy field infrastructure development in Africa. Our research is mainly focused on the paddy field infrastructure, hardware, so I will talk about that.
This is a content which I am going to speak. At first, I will tell you the structure of all JIRCAS research programs and the position of the research for low-cost technologies for paddy infrastructure development. I think most of you know about this very well, so I will go through this part very quickly.

Second, I will speak about the aim of the research, the current progress of the research and, finally, how the research achieves its aim. These are the contents of what I am going to tell you.
I will go through this very quickly. These are the JIRCAS's four research programs. We have four research programs, namely, Environment and Natural Resource Management; Stable Food Production; Rural Livelihood Improvement; and Information Analysis. This research of low-cost paddy field infrastructure development is in the second program, Stable Food Production.

This is the content of the Stable Food Production Program. This program is for the technology development for increased productivity and stable food production of agricultural products in the tropics and other unstable environments like in Africa.
This program consists of the following six projects. The research of paddy field infrastructure is in the first one, Development of Rice Production Technology is in Africa Project. This is a flagship project of this program and we have other five projects also in this program.

Now, I will explain to you about the project, Development of Rice Production Technologies in Africa. This project consists of following three sub-projects.
First one, sub-project number one is, "Development of Technology Adaptable to Africa for Evaluation of Upland and Lowland Germplasm and Improving Stability in Rice Production". This sub-project is mainly focused on the rice variety itself.

Second one, sub-project number 2 is, "Formulating a low-cost Asian-type reclamation model in the rain-fed lowland in Africa", Low-cost Paddy field Model in Africa. The research of low-cost paddy field infrastructure development is done in this sub-project number 2.
The last one, sub-project number 3 is, "Development of low-input rice cultivation system in flood-plains in Africa." This sub-project mainly focused on the rice production in flood plains in Africa.
These are three subprojects in the project. The research regarding the paddy field hardware or infrastructure is done in the sub-project number 2.

Okay. I will talk about the aims of the sub-project number 2, "Formulating a low-cost Asian-type reclamation model in rain-fed lowland in Africa."
We have a big general target. Rice production in Africa is to be increased, so to contribute to the CARD and also many other purposes. To contribute to this target, in this sub-project 2 we mainly focused on the hardware of the rice cultivation. The sub-project number 2 focuses on hardware of rice cultivation to develop a low life-cycle cost of paddy infrastructure technologies and Asian-type rice cultivation system in Africa and a paddy field model sustainable to African conditions.

I want to explain some terminology. I think all of you already know, but just for your information. Low life-cycle cost means the cost including the construction and operation and maintenance for in-service period of the hardware like irrigation facilities and so on. Asian-type rice cultivation means such as irrigated paddy fields which are bunded, leveled, and puddled; we call it Asian-type rice cultivation with those hardware. Last one, African conditions means such as heavy rainfall and the availability of local materials and tools. We will consider those aspects and we mainly focus on the hardware or infrastructure of the rice cultivation in Africa to contribute to get the target of rice production in Africa to be increased.
This sub-project number 2, formulating a low-cost Asian-type reclamation model in rain-fed lowland in Africa, has 10 sub-components. First group of the sub-components is mainly for the low-cost irrigation infrastructure. We have three sub-components here.

One is, evaluation of existing irrigation technologies. Second one is development and selection of low-cost irrigation facilities. We develop and select low-cost irrigation facilities which the African farmers can afford and which can be made using local materials and tools.
Third one is evaluation of farming improvement and selection of optimum structures. We will evaluate the African farming and also we will study how to select the optimum irrigation structures. Farmers will know how to improve their irrigation facilities; also how to select the best one for them.

This is the second group of research in this subproject. In the second group we mainly focus on the first group of CARD such as Ghana. First one is the development of improved infrastructure and technology for rice production in Africa. Also, we have a research sub-component, improvement of soil fertility with the use of indigenous resources in rice systems of Sub-Saharan Africa. Those two are working in Ghana now. In the first one we want to introduce Asian-type rice farming system in Ghana.

In the second one, we are doing the study mainly focused on the soil fertility. Soil is also a very important factor of rice cultivation, as you know. Third one is the formulation of guideline for Paddy Infrastructure Design Criteria. Fourth one is research for promotion of farm mechanization. We build improved hardware. Also, they need mechanization or they need some tools to make the best use of the improved hardware.

The third group, this one is mainly working in the second group of CARD like Ethiopia. First one is the same as 2-a, development of improved infrastructure and technology for rice production in Africa. Because in Ghana and in Ethiopia there are differences in the natural conditions and the local conditions and farmers' intention also. So, We have this project in Ghana and also in Ethiopia. Also, we have research for the water resource management. Of course, water resource management is also very important for irrigation.

Last one is the research of condition for formation of south-south cooperation. We have a lot of activities regarding the hardware improvement and regarding research for the infrastructure improvement and farming improvement, but we also have to think about how to disseminate our knowledge or technologies to other areas or

to other countries. We have a research on how to disseminate the knowledge. One example, I thought, is south-south cooperation.

The next slide, as I told you there are 10 sub-components in this sub-project. Most of them started this year, but among the 10 we have 3 sub-component researches which had started before last year. I will show you some results and the current progress of the three researches.
First one is, "Development of Improved Infrastructure and Technology for Rice Production in Africa." We call it DIITRPA. This one is funded by Ministry of Agriculture, Forestry and Fisheries of Japan. We have a counterpart in Ghana and also in Ethiopia.

We are working with the Ministry of Food and Agriculture, Ghana; Soil Research Institute, and also the Crops Research Institute in Ghana. Mainly, we are working in Kumasi City about 5-hour's car drive from Accra.
Also, we have a counterpart in Bahir Dar, in Ethiopia, Ministry of Agriculture. Other research and development organizations are also involved.

This project, now we are in the fourth year of the 4-year plan, I mean, we are in the last year. We have lots of activities and outputs so far. One output is a technical manual for DIITRPA that has been twice drafted after various confirmed research activities concerning paddy land, farming and rice variety, including on-the-job training for extension officers and farmers, and finally the manual will be finalized within this Japanese fiscal year. By March next year, we will have a technical manual from this research.

This is also important, I think, after the on-the-job training for the extension officers or farmers, the extension officers by themselves can instruct farmers without researchers, and the farmers (farmers nearby the research field) by themselves can reclaim land and can do this type of paddy cultivation. I think this is a very good example of the knowledge dissemination from the research.

I will show you some photos from the activity of DIITRPA. This is in Ghana. Left photo is before the development. Actually, it is a rainfed area. You can see some paddy on the ground. To introduce Asian-type rice cultivation, at first we show them how to construct the bunds. Of course, as you know, we need the bunds to do the irrigated Asian-type rice cultivation. At first, we guide them how to construct the bunds. Also, left photo shows they are constructing a drainage canal. In some areas without drainage, the paddy field is always inundated, so we show them that drainage is important and how to build the drainage and so on. After that, we put the irrigation water and they are doing leveling.

As you know, the most popular way of planting in this area is broadcasting. Now, they are doing the transplanting. Right photo shows the paddy planted. After this, we got better yield with these technologies.
Also, the second research, this is the current progress of the second research. Title is, "Improvement of soil fertility with use of indigenous resources in rice systems of Sub-Sahara Africa." We have a counterpart for this research also, Soil Research Institute in Ghana; and University for Development Studies in Tamale, Ghana.

This is in the middle of the 5-year plan. We have activities in this research.
Effective application of various local organic matters and rock phosphate has been investigated with different scales of experiments, in laboratory, greenhouse, on-station and on-farm. Also, farmers affordability to those low-cost technologies has been socioeconomically surveyed and analyzed.

These are some photos of this research. Left one is at the farmers' workshop. They are choosing the local resources which are available. The center photo shows the carbonization of rice straw with a simple local apparatus. The right photo shows on-farm trial around the Tamale City in Ghana.
This is one of the outputs so far from this research. We put rock phosphate; low level, medium level, high level – I mean, the amount of rock phosphate. Also, we put the TSP as a normal fertilizer. How much of those materials we put is shown in the table on the right top side. This one shows the effect of direct application of Burkina Faso phosphate rock, as rice grain yield at farmer fields in villages of northern and Ashanti Regions. This one shows the direct application of rock phosphate. When we put more, rice grain yield almost the same as the popular fertilizer like the TSP, so it seems application of phosphate rock can work almost the same as TSP.

Last one, how does the sub-project achieve its aim? The 10 sub-components of the sub-project cover most of the major hardware elements of rice cultivation. For example, irrigation, farmland, soil, water resources and also we need improvement of farming related to the improvement of the hardware. So I put farming also here. These are some images. Major hardware means soil, irrigation, water resource, and farmland itself; and also we need the improvement of farming related to the hardware improvement.
This one shows which sub-component of the research mainly targets on which hardware.
This is the last slide.

These are the fruits of the sub-project number 2, formulating a low-cost Asian-type reclamation model in rain-fed lowland in Africa. As I told you we mainly focus on the hardware elements of rice cultivation in the subproject, LPM, like irrigation, soil, farm land, water resources, also some farming activities related to the hardware improvement. Also, we will produce some manual, guidelines. Of course, together with other JIRCAS

researches and also working with some other research organizations, development organizations, we get the output. The output will be utilized by the JICA and/or other development projects. Now we are working with JICA in Ghana.

Finally, we will contribute to increase the rice production in Africa from the hardware side and contribute to the CARD. That's our purpose. Thank you very much for your attention.

Naoya Fujimoto: Thank you very much, Mr. Yamada. He introduced 5-year's research programs of JIRCAS and projects he is now involved. Thank you very much, Mr. Yamada.
Next presenter is Dr. Sakagami. He is also a Sub-Project Leader to JIRCAS, and his presentation is "Lowland Rice Environment and Potential in West Africa."

Jun-Ichi Sakagami: Thank you, Mr. Chairman. The title of my presentation today is, "Lowland Rice Environment and its Potential in West Africa." The lowland rice that I want to say that rice is planted under the wetland or wet situations. I would like to describe the latest finding of our research related to lowland rice and discuss more about potential of lowland and deep water as well.

This is the topic of my presentation. Rice ecosystems in the West Africa as first topic and second is limiting factors of lowland rice, and then the water stresses including submergence and drought tolerance in rainfed lowland, and genetic by environment interaction, G by E, in the rainfed lowland. The last is development of rice cultivation technologies in the flood plains which is an ongoing project in Ghana by our team.

Based on water regime, rice lands are classified as three major ecological groups. First is upland with no standing water; and second is lowland including irrigated and rainfed with less than 50 centimeters depth of standing water; and deepwater including floating, with more than 51 centimeter to 5 to 6 meters depth of standing water. However, the last these two fields, lowland and deepwater overlap each other in some cases of rice prodution.
Buddenhargen classified rice culture in West Africa into four main types and eight subtypes based on the soil conditions, water and agricultural or technological level, and climate. First is upland; dryland and hydromorphic. Second, irrigated rice. Third is inland swamp with nontoxic soil or toxic soil; and flooded, river basin shallow or deep and boliland and mangrove.

When we estimate the percentage of rice crop area in West Africa with the four ecologies, the largest is rainfed upland. It's about 38%, and then the rainfed lowland, irrigated lowland, and the last place is deepwater. Based on these figures rice crop areas in West Africa, more than 60% of the rice crop areas are based on the wetland.
Definition of the lowland: Land is either prepared wet or dry but water is always held on the field by bunds. Irrigated rice can manage flood water. Of course in rainfed lowland, the rice is not irrigated, the soil surface is flooded for, at least, part of rice cycle. About 35% of the West Africa is grown as rainfed lowland and about 15% as irrigated lowland on rice cultivated areas.

I believe that rainfed lowland including deep waters, these ecologies are very important economically and bio-agronomically. We have to concentrate some additional technology to these ecologies to develop rice cultivation and also improve the rice production in West Africa. However, rice plants often confront shortages and excesses of water in rainfed lowland. That is the main problems. Water stresses' main cause is low yield of the rice growing in the rainfed lowland and the deepwater as well. In this case, rice fields are subject to alternating drought and flooding. Rice plant must tolerate submergence and drought, to anaerobic and aerobic.
Since yesterday, we have been discussing about drought and submergence in some parts of the presentations from the keynote speakers on the aspect of the genetic and breeding matter. I would like to discuss on these issues on the physiological aspects in my presentation.

If the rice plant has functions or adaptation abilities reducing the effects of soil and air dryness, plant water deficits are alleviated, so it can be called drought avoidance. The ability of the physiological functions to withstand internal water deficit of plants is called the drought tolerance. Prior to those two abilities, the ability of plants avoiding or encounter drought itself, is called drought escape. From our investigations the rice cultivars better able to develop roots, have axcess to more water, and should be more able to avoid drought in the rainfed lowlands.
I picked up some results concerning the droughts. We have some points in Guinea to categorize the soil environment. This figure is a typical rainfed lowland, and this figure is a typical upland. We recognized hardpan layers underground 50 centimeters to 20 centimeters in the rainfed lowlands. It is possible that hardpan layers affect the development of the roots under the drought conditions in the rainfed lowlands.

We have some experiments in the pots. This treatment is soil density at 1.5 gram, we call the compact soil, and this is 1.2 gram, call loose soil. We tested 102 genotypes, including interspecific progenies of the glaberrima and sativa. We look at the dry matter weight of the roots in the compact soil to loose soil in lower layers. Glaberrima is the largest compared to sativa and the interspecific progenies on the ratio.
Now, I'll talk about flooding. This picture is the inundation of the rice seedling in Guinea, and this one is just heading of deep water rice in Niger River basin. In general the rice has two different ways of strategies to survive under flooding. One is submergence tolerance and the other is submergence escape. Submergence tolerance is

characterized by the slowing of ethylen-promoted leaf elongation to conserve energy under the flash flood less than 2 weeks.

On the other hand, the escape is characterized by rapid leaf elongation by low oxygen escape syndrome to restore contact between the leaves and air. The other escape strategy is characterized by the rapid internodal and stem elongation to resume anaerobic metabolism and photosynthesis under the long-term floods with deepwater.
When we proceed direct sowing in the lowland fields, of course we need good germinations and seeding establishment is required. In the case of Japan, farmers have some technologies. We have some practice, seed coating with oxygen-generating products, we call the Calper. This product gives the oxygen under the water to the seeds to promote and develop the bud and germination, also seeding establishment. However, it's not so easy to transfer this technology to African farmer according to the costs. We need some improvement of the genotype in these conditions, in particular for farmers in Africa.

First is the germination issue. Anaerobic germination is an ability of the germination under low oxygen condition. We have 60 cultivars and tested. I've picked up some pictures. LAC23, you look at this one. Anaerobic is submergence treatment. Germination is not so good in anaerobic condition for LAC23. FR13A is typical submergence tolerance genotype, also low germination rate in anaerobic. However, IR06F561 is good germination in this experiment. In the same experiment, we classify 60 genotypes as 6 cluster groups. As I mentioned at the last slide, IR06 lines are categorized in the first cluster group.

The other IR genotypes are also categorized in the first cluster group, so this group showed high and rapid water absorption and in particular in phase A. Also, we compared these same genotypes about seedling establishments. This is the kind of mechanism of these lines to anaerobic germinations in our results. During submergence, root elongation rate does not correlate to the days to reach surface water. However, shoot dry matter weight after the submergence correlates closely to days to reach surface water.

Also, we focus on chlorophyll. Chlorophyll is the pigment of the green color, so it is good indicator to understand the injury of submergence to rice plants. We look at AG+Sub1. AG+Sub1 lines are categorized under the first cluster group as IR06 lines. AG+Sub1 lines are low in chlorophyll content, sub to control, at 1 day after submergence. However, 5 days after submergence the chlorophyll content for these genotypes increased mostly.
Also, there is relationship between the plant height and the chlorophyll content in this experiment.
Also, visually we understand a higher concentration of starch grain as third leaf submergence plants at 6 days submergence for AG+Sub1 lines. These starch grains contributes to the increase of the photosynthetic rates and also maintains the rice body during submergence. That is one of the characteristics to germination and seedling during submergence for AG+Sub1 lines.

I'll move to the other topic, submergence escape. This is the change of the leaf areas for 40 days submergence with 60 centimeters depth of water, and 40 centimeters depth, and the control. We tested submergence tolerance type Sub1 and elongation type, and Oryza glaberrima. You look at 60 centimeters depth of the water, so sub1 cannot survive. Plants are dead 25 days after submergence. On the other hand, elongation type increased. However, leaf area is always small in the 60 centimeter water depth than in 40 centimeter. However, glaberrima CG14, leaf areas in the 60 centimeters increased as same as 40 centimeters of water depth.

The other experiment, this is a relationship between net assimilation rate and photosynthetic rate at 37 days after submergence, completely and partially. We have five different genotypes. Now, you look at this one and the other one. Yele1A is glaberrima, and this is the Nylon of sativa, both of the cultivars are deepwater rice. These deepwater rice increased net assimilation and the complete submergence at 37 days after submergence. However, Yele1A of the glaberrima is the highest among the genotypes in photosynthetic rate.

Now, we move to the fields experiments. To understand the evaluation of the submergence escape, you look at the average. The shoot elongation during the submergence and the shoot biomass after the submergence is higher in the Oryza glaberrima than in Oryza sativa significantly. When we evaluate the score of submergence escape in the fields, most glaberrimas are higher than the other genotype in sativa.

Next topic is G by E interactions in rainfed lowlands. This experiment also is conducted in Guinea, since 2007 and this year is the last. To understand the limiting factors of rainfed lowland and yields, and also we want to select a good performance, rice cultivar in the rainfed lowland environment. We are testing 25 genotypes including sativa, glaberrima, and Lowland NERICA. This is just one of the results and the conclusion.
We classify 25 genotypes into the four cluster groups; 1, 2, 3, and 4. So, number 1 is panicle weight type the same as spikelet number type. Number 3 is a panicle number type. In the case of this experiment in this ecosystem, panicle weight type is the highest on the yield compared to panicle number type.

Last of my topic which is an ongoing project in Ghana, "Sustainable rice system in the flood plains for development". The research goal is development of rice cultivation system under the flood plains to extend cultivation area which is not used for rice cultivation at present in Africa. In the background, rice is a cash crop and high-price at the markets. However, there are some problems, constraints and limiting factors for rice production.

High-cost fertilizers and the chemical and also rental fee of the tractors in some cases. Also, labor competition exists. We need to develop the low input and sustainable rice cropping system in these regions. To achieve these objectives we input some research; natural, social, and economical research. I picked up some slides as results. Quickly I will show you that.

We have the two different sites in the Tamale region in northern part of Ghana. Mainly, we are focused on the Zaw Village along the White Volta River. This is a land use map of Zaw Village. This white color is cultivated areas. This land is occupied by the upland crop like the maize, the yam, and the cassava and so on. This is the river. You look at between the river and the upland, no crops, no plants. This is lowland which we focus on. We want to introduce our technologies and our rice based cultivation system in this band.

We interviewed households to understand the idea of the farmers. In conclusion, 67% of the non-rice farmers want to cultivate rice in that region. Why? Initial capital and tractor restrict initiation of rice cultivation in Zaw Village. Also, we tried to analyze the soil from these areas and characterize, and we found that the higher soil fertility is in the lower lands than in the uplands.

Also, we found some natural resources. Rock phosphate, which has a higher concentration of major or minor elements and high qualities to apply rice cultivation. Also, we have identified more than 120 species of weeds in these regions. Dr. Kumashiro said that the weed is a very, very big problem even in these savanna regions. We made the database. The name is, "Plants in lowland savanna in West Africa." If you have the chance and the time, please visit our homepage and look at the information.

We evaluated some genome to adapt in this flood-plain environment, the flooding escape and tolerance, and also part of the drought in the field through the laboratory experiments.
Thus, conclusions: there are large lowland areas, including rainfed lowland which can adapt to rice, in particular river basins where it is not used for rice cultivation at present in West Africa. The environment of rainfed lowland and deep waters has stable productivity for reason of soil fertility, water availability and sustainability in some cases. However, introducing rice cultivation requires that several adequate cultivars developed for floodplain environment.
Last is acknowledgment. Thank you, our colleagues and collaborators in African countries. Thank you very much for your attention.

Naoya Fujimoto: Thank you very much Dr. Sakagami. Because of the time constraint, it is a responsibility for me. I'll skip the question time, particularly for Dr. Sakagami. Thank you very much, Dr. Sakagami.
Now, we would like to enter into the general discussion time. Hearing four presenters' presentations, I think we must focus on three points. One is natural conditions. Four researchers are now tackling with natural conditions such as temperature. Dr. Kumashiro talked about how to tackle with cold conditions. The second natural condition is water. Dr. Sakagami mentioned how to tackle with drought condition or flooding condition, and he also mentioned about weed, how to control weed. The second issue is how to tackle or how to collaborate with social conditions.

In fact, Mr. Kubota talked about the collaboration using CARD and maybe his recommendation is included in his presentation, how to make some NRDS, National Rice Development Strategy. Dr. Kumashiro also mentioned about the dissemination. Dissemination in itself is a kind of a social condition. Mr. Yamada mentioned about the south-south collaboration. These three speakers mentioned about the social conditions.
Finally, Dr. Sakagami has kindly suggested us to think about the rice system. It is not only considering national condition but also a social condition. Now, maybe we'll have the 20-minute discussion. If you have any question and clarification to all four presenters, please indicate to whom you would like to ask questions.
I welcome suggestions on the framework of national conditions, tackling of national conditions or tackling of social conditions, or considering system for rice cultivation. If you have any clarification and questions and suggestions, I would like to open to the floor. Please raise your hand and say your name. Thank you.
Okay, Dr. Sakagami, don't ask to yourself.

Jun-ichi Sakagami: I have one question to Dr. Kumashiro. Doctor, you mentioned the problem of weeds. In our case also the big issue is to control the weeds, I want to know detail of your program of the weeds, how to protect rice from the weed and how to control the weed.

Takeshi Kumashiro: Thank you very much. I think weed control is dependent on the agriculture practice. What we can do from the breeding point, maybe there are some varieties which carry the early covering capacity, so rapid growing in the seedling stage is one solution. Our research direction is aiming at that –not to control completely the weed, only early stage.

Naoya Fujimoto: Dr. Sakagami, are you satisfied? Okay, so any other question, clarification, please?

Yamauchi: My question is, several speakers were emphasizing the importance of rainfed lowland field and I would like to know which ecosystem of rice production is promising in the context of Africa as Dr. Sakagami clearly identified from upland to the deepwater rice field. But am I correct to understand that rainfed lowland is

one of the most promising areas for increasing rice production in the context of African situation? This is my question. It is for Dr. Sakagami.
My next question is to Dr. Yamada who was suggesting to import or apply Asian-type paddy development. He was talking also about the rainfed lowland project by producing rainfed condition by making the land bund, leveling, and those Asian types of technologies. Is it for the currently upland rice field to be converted to the rainfed Asian-type lowland field? If so then, I would like to know how that would be feasible and realistic if those Asian technologies would be accepted by the rice farmers in Africa. Thank you very much.

Naoya Fujimoto: Thank you very much. He has two questions. First one is to Dr. Sakagami. I think you can answer. Rainfed lowland is suitable for rice production concerning that issue?

Jun-ichi Sakagami: Thank you Professor Yamauchi. In my understanding, the priorities of the ecosystem, ecology in the CARD strategy should be rainfed lowlands. The global economic situation at the present, it's impossible to promote the big irrigation scheme in Africa. I think this is one point, economically. The rainfed lowlands have the potential as well as the irrigation because lowlands have the higher potential on soil fertility, of course, compared to uplands, and also easy to introduce the rice cultivation in the rainfed lowlands. That's the reason why I say that lowland rice is high in potentials in several types of ecologies in West Africa. Thank you.

Naoya Fujimoto: Thank you very much. The second question is to Mr. Yamada. You mentioned about the introduction of Asian-type paddy development. You mentioned about the change of upland to paddy field? Please answer the question.

Jun'ichiro Yamada: Thank you. I think to introduce Asian-type rice cultivation, we need water. We need water to irrigate to make best use of Asian-type rice cultivation. But if the upland is without enough water, I think it's difficult to introduce Asian-type rice because if we need a lot of money to get water and to build expensive irrigation infrastructure I think it's not feasible to the African farmers. Thank you.

Naoya Fujimoto: Okay. Next question.

Marco Wopereis: Thank you, Mr. Chairman. This may not be a question, just a few comments if that's possible. First of all on the importance of rainfed lowland, upland, and irrigated systems in Africa. For our strategic plan, we did an analysis on that based on surveys in 18 countries and technologies that we can expect to be developed for these systems. In the rainfed lowland, if you look at the sub-Saharan African context, it comes first in terms of expected impact that we can achieve through research, followed by upland irrigated mangrove. But you have to keep in mind that it is very country specific.

Many countries in the National Rice Development Strategies have already indicated whether they want to actually stabilize the rice production on uplands, or they want to perhaps expand irrigated areas or rainfed lowland areas.
For example, if you go to Sierra Leone they clearly want to put emphasis on development of rice in the rainfed lowland systems. If you go to Nigeria, it's the same. In the north, they want to expand irrigation and also do more with the further master of rainfed lowland systems. However, if you go to Uganda, Uganda wants to promote upland rice because they believe that the wetlands should be preserved and they don't want any rice there. They want to preserve the wetlands, so it's very much country specific. But if you look at the African continent as a whole, or sub-Saharan African context, then our work shows that the rainfed lowland systems have scope for the highest impact.

If I still have the floor, Mr. Chairman, I would like to say a few words on the last two presentations. Because here we see there is tremendous scope for links with GRiSP and the topic of this forum, this seminar, is how Japanese research can link with GRiSP and CARD. The speakers clearly showed tremendous good work is being done there. Of course, I knew about it but in terms of linkages much can still be done. GRiSP is still very young. GRiSP started last year, but if you look at the third presentation, for example, there are clear links with Theme 3 of GRiSP.

The work on Sahara type systems is ongoing as well as AfricaRice. We tackle that from two few points based on hardware, if you like, what this presentation also stressed, but also based on software really working with farmers and communities to see what type of approaches are best suited to work with farmers and to see which steps should be taken first in terms of Sahara development, in terms of inland valley development, and also to decide with communities where to start really in that respect.

If you like that soft part of inland valley development is funded by European Union, but the hardware type of work is funded actually also by the Government of Japan, another reason to really work together. But that work is done in different countries, in Togo, Mali, and Benin, whereas this work presented here was done in Ghana.
I think there is a tremendous scope for links with GRiSP. The last presentation as well, all the topics mentioned there, I think maybe all, not all. Perhaps almost all fit under Theme 2 or Theme 3 of GRiSP. The work on flooding is extremely interesting. Work there also is being done at IRRI, of course, and at AfricaRice as well. The work on development of low-input systems fits on the Theme 3 and the work on satellite imagery as well. In a nutshell, I think, it will be highly beneficial if JIRCAS could indicate some focal points in looking at the GRiSP work plan for different products there so that we really know whom we can link up with. That's one element.

The second one is very strong JIRCAS participation next year in the GRiSP Meeting, the global annual forum. I am sure Dr. Dobermann will talk about it as well. But the next global forum is going to be in Africa, so that's a doubly good occasion to showcase JIRCAS' work there because there will be an Africa GRiSP Forum plus the global forum.
The last thing I want to say is that we are developing communities of practice now under GRiSP on different topics. The first one for Africa, we would like to propose a community of practice on inland valley development.

In fact, AfricaRice has been convening a consortium on inland valleys called the Inland Valley Consortium since '91 and we are now moving that consortium into a community of practice, very much opening the door for new partners and we will have a website for that under the GRiSP umbrella by January. That way hopefully the JIRCAS work in Ghana can feature on that website and we can open discussions within that community of practice which would be a first under GRiSP, at least in Africa. Sorry to be long.

Naoya Fujimoto: Okay. You said comment, but maybe it included several questions you would like to answer. First of all, somebody must answer what is the position of JIRCAS to collaborate with GRiSP. It should be answered by Dr. Koyama.

Osamu Koyama: It's already mentioned in the keynote speeches that JIRCAS is a strategic partner of GRiSP, but our involvement in the real activities are not so very active at this moment but we have started to participate in various forums, including global forums and regional forums, particularly in Africa. Dr. Fujimoto, yourself attended the Africa Regional Meeting. We gradually know what the issues are in GRiSP and what the connections are between our activities and GRiSP's activities. I am quite optimistic about the future collaboration. As far as this lowland rice project is concerned, this was mainly funded by external source. That's why we hesitated to collaborate with other partners, but from now on in the third medium-term plan of JIRCAS we regard all the JIRCAS activities in one single research strategy, so maybe we can deepen the collaboration with other partners. That's the basic thing.

Naoya Fujimoto: Okay. Thank you very much. Marco also mentioned the third presentation and the fourth presentation but I would like to answer the last question you raised. In fact, I have a project in Ghana and beginning of November 23rd until December 1st I will accept delegates from AfricaRice representing Dr. Shin Abe. We would have on-the-job training in Kumasi. The collaboration between AfricaRice and JIRCAS is continuously growing. Do you have any comment? Okay. Yes, please answer that, Dr. Wakatsuki.

Toshiyuki Wakatsuki: Thank you, Chairman. My name is Wakatsuki from Kinki University. I'll just make a comment or my impression on yesterday and today especially for the rice development in Africa. I feel we need good variety and good ecology, and I also understand we have very good scientific background for varietal improvement, so good breeder and now genetic engineering is also available. But agriculture needs two. One, biology, rice; and another is ecology. But actually we have no good concept on how to improve the ecology to encourage rice.
We can say sometimes for Asian type of the paddy field, but you have to understand such Asian type of environment actually is the result of thousand years of farmers' efforts in the Asian farmer. But Africa, we have no time. We can't wait 1000 years. Maybe we have to solve, improve the ecology, maybe within half a century. We have to focus more to improve the ecology, rice environment. For rice variety improvement the breeder and the geneticist are available. But for rice ecology, we have no such breeder and also no such for academic background.
My impression on rice ecology, maybe the focal point is water control, how to control the water for drought and also flooding. Mainly discussion was made on submergence or drought tolerance but we need a kind of infrastructure. We need something for a very clear concept to research on improving the ecology. Thank you.

Naoya Fujimoto: Thank you very much. I must conclude this discussion. Lastly, Dr. Wakatsuki raised the issue of some kind of an ecosystem. Okay, currently, Dr. Sakagami, you raised the importance of rice system, so we must consider not only tackling of natural conditions but also social conditions including some kind of ecosystem. It is not the conclusion but the discussion should be continued. Maybe today is a starting point of the discussion. If you have any question to the particular presenter, please use the lunchtime to ask individually. Thank you very much.