

**Chair Kano:** We'd like to start last part of this symposium, General Discussion. My name is Takeshi Kano, Chair of this symposium program committee. So, I'd like to chair this general discussion with four chairs of each session.

In this symposium, first we had valuable keynote speeches concerning the theme of the symposium. Then in the following two sessions, situation in the fields of developing regions, research results from the viewpoint of soil, fertilizer or microorganisms, and research results from crop improvement or breeding. Those were introduced by the speakers.

Since time for discussion is now limited, we would like to have comments from participants mainly about the cooperation between soil science and crop breeding. Now, we would like to start general discussion. To have lively discussion, I would like to name a few participants.

First, I would like to have a comment from Dr. Wani. He is Director of ICRISAT Development Center. Dr. Wani, please. Microphone, please.

**Dr. Suhas Wani:** Thank you very much, Chairman. As we have heard from the morning, the various sessions dealing with soil environment, crop production towards stable crop production, the issues or the take-home message which has clearly emerged that the scientists working in different areas, whether they are in the areas of physiology, soil science, agronomy, crop breeding for overcoming the various stress factors what we are trying to achieve the sustainable food production, need to work together in the multidisciplinary team to address the issues holistically. And what we continue to work traditionally as a compartmental approach does not really take us much towards reaching the final solution.

And a step forward to take it if we are going to the farmers field, as was evident in the keynote speaker's presentations, that we really need to not only bring in the convergence amongst the scientists but also we'll have to bring the convergence amongst the different actors who are involved in the impact chain. They may be the policy makers. They may be the extension workers. They may be the bankers or the farmers and scientists play a critical role to ensure that we play the role of bridge broker and catalyst to achieve the food security.

So the important thing is we need to really work together and understand the various aspects of the particular phenomena or the trait what we are working, otherwise the molecular biologist working in isolation may not also be able to solve the problem. Although they may know the solution, but they don't know then how to grow the crop and for that definitely the agronomy, physiology, soil scientists are needed to ensure that the results are translated into the impacts. Thank you very much.

**Chair Kano:** Thank you very much, Dr. Wani. Next I would like to have a comment from Dr. Kawashima, JIRCAS. At JIRCAS, research activities concerning the theme of this symposium have been implemented under two research programs. One of the programs is Environment and Natural Resource Management Program. He is Program Director. Dr. Kawashima, please.

**Dr. Tomoyuki Kawashima:** Okay. Thank you, Chairman. As the Chairman mentioned, the cooperation between soil science or plant nutrition and plant breeding is very important. On this occasion, I'd like to address two issues. First one is relating to BNI. This morning Dr. Subbarao presented his paper on biological nitrification inhibition.

The BNI research is a very good model of the cooperation between plant nutrition and plant breeding. He is doing very well. And so far, we have built up very good collaborations with CGIAR research institute, such as ICRISAT, CIAT and CIMMYT, and we are planning to expand more activities through this collaboration.

But looking at national, domestic research networks, we have only limited collaborations with universities. So, I think this is a very good opportunity to promote the importance of BNI research and its impact on the nitrogen use efficiency to Japanese researchers. So if you are interested in BNI research, just talk with Dr. Subbarao would like to promote more and more.

Second issue is the climate change. The technology development to meet climate change is one of the major research subjects in my program. The tight linkage between plant nutrition and plant breeding, I believe the linkage can generate the big synergies and give us a good solution or a breakthrough to meet climate change, not only in the adaptation area but also mitigation measures as well.

In this context, the relatively younger researchers in JIRCAS, in the area of plant nutrition and plant breeding, they start communications and then starting sort of the collaborations. I expect this kind of collaboration will contribute to find out a good solution to meet climate change. I hope they are going to present some papers outcomes in this JIRCAS International Symposium in near future. Thank you.

**Chair Kano:** Thank you very much, Dr. Kawashima. In this symposium, we had presentation about genetic approach to fertilizer use efficiency and salt tolerance. I hear that in International Rice Congress held in Thailand this October, genetic approach to nitrogen use efficiency in rice has received much attention. So, I'd like to have a comment from the participant of floor about this issue. Can anyone comment about this? Please.

**Dr. Obara:** Thank you, Chair. I am Obara, a JIRCAS staff. Regarding with the impact of the nitrogen use efficiency, I have a lot of questions from the participants to the IRC 2014. Today, my comment to the general discussion is nearly close to Dr. Wani's.

So, I'll briefly introduce my recent topics about nitrogen use efficiency or why the genetic improvement in rice successfully it is difficult to evaluate the nitrogen uptake in rice for the genetic gene isolation. So for QTL mapping, I established a precise growth condition for the evaluation of the nitrogen uptake. Upon successful growth condition, fortunately I isolated the effective gene for the nitrogen uptake.

Now our JIRCAS project is in accordance with Africa Rice have introduced the gene into the mega variety in Asia and Africa for the stable production of rice production. Regarding the future research, I need one additional subject in genetic approach. It will be needed, the gene pyramiding between the nitrogen usage and P or another blast resistance gene should be better for rice production. Thank you.

**Chair Kano:** Thank you very much. Very new information from Dr. Obara, JIRCAS. Thank you very much. Today, first, we heard very valuable keynote speeches. So, I'd like to ask to keynote speakers to comment about this issue, this cooperation between soil science and crop breeding. Dr. Dar, can you?

**Dr. William Dar:** Yeah. It is necessary to really describe the whole objectives of any research activity. At the initial or at the beginning, it could be a discipline-oriented activity. But as Suhas Wani said when we are almost ready and of course even at the beginning there should be some synergy to be made in terms of looking at the whole ecosystem, it's not just say soil science at one end and crop improvement at the other end. But looking at what is that ecosystem as a whole so that at the end the synergy of all of this can lead to greater impacts. So again, high-end science can have disciplined approach, but looking forward for a holistic view in terms of creating impacts.

**Chair Kano:** Thank you very much. Next Dr. Kosaki, may I have a comment from you?

**Dr. Takashi Kosaki:** First of all, this is a very good opportunity to call not only soil scientists, I'm myself soil scientist, but other scientists from different field to discuss about the current problems. As many of them have already mentioned, the collaboration or cooperation of the scientists in different field should be of course very, very important to solve the problems. But I suppose I should say one or two things.

If you allow me to talk about my personal career, I have been working as a soil scientist. I should say I have been the soil surveyor that means digging up pits all around the world, maybe I dug pits around one-third or maybe two-third pits everywhere. The one thing I found was or the most serious thing that I found was the variability or variation in terms of the characteristics of the soils and the environment. So, the natural resources have such a wide variations, but as a scientist we always look for some universal rule of something.

In my case, distribution of soils or the characteristics of the clay mineralogy or such and such topics, but it's not easy because we are working for natural resources and nature.

To find the current solutions everywhere in the world, we should not avoid such a variability in terms of different aspects, soils and the plant characteristics or climate etcetera. So, I am quite sure that there is no rule of thumb or the magic method, or variety, or the ace of spades that means the card of almighty, the methodology. So, I suppose the collaboration is very much necessary among the scientists, but we should always think that technology should depend on the area site or maybe a given ecosystem. And maybe a kind of package made of soils and varieties or farming systems can be very much useful in the given conditions, but may not be such a strong tool to solve the problem in another site.

So we should have of course such accumulations or database for different types of sites and/or the ecosystems. That is of course very necessary and it takes time, it takes money, and it takes energy. Of course, I know the environment or the social, economic condition, may not allow us to do freely, but we always should try to do that and don't rush to find the best solution or best technology only. Maybe just second choice, third choice can be the first choice in another places. So such variation is really very necessary I suppose.

Another thing is what is the goal to build up such combination of technology? That's very important. So if we look at only the goal which is beneficial to human beings that may be difficult for some other members of the ecosystem, the water and the fauna, or flora or whatever. Those are old members of society or the community that is land. So, it's of course very difficult, but we always pay some attention not only to the human beings but some other elements and find out not best but better solutions or the better technique to improve a little bit. Not to maybe double or three times or four times. Well, that seems to be a dream to me. So maybe 10% increase, 20% increase, is the first step to do. So, it may be a slow step but we should be very much – we have to tolerate for such a slow step, but nature cannot allow our so quick advancement. That's my impression, but we have to try to continue to find the relatively better solution for the individual problems. That's my impression.

**Chair Kano:** Thank you very much, Dr. Kosaki. So, I am sorry discussion time is almost up. Lastly, I'd like to ask one more comment from Dr. Bationo. Can you have a comment for us? Microphone, yes, please.

**Dr. Andre Bationo:** I think the collaboration between two scientists, we all agree, is very important. But, we have to recognize it's easy to tell but how to do it is much more complicated. How is really the question? You can agree on the principle, but how to do it is not always easy. You have some scientists who never want to collaborate. It is really part of their nature. So nothing we can do about it almost. It means that selection of scientist is very important if we have to really make sure that people will collaborate across team.

I think also that the way an institution is established, the time you always you have a department for breeders, a department for soil scientists. Everybody seems tends to stay indeed, we finish department and so what that means the way you structure, the institution is structured, can make a big difference to have collaboration between the scientists to have more collaboration. So, I think we all agree that it's a very important issue, but how to make it happen is much more complicated and not always simple and need to be a little bit – I may think it has to be institutionalized which will be a way at institute level to ensure that people are collaborating to what I can add. Thank you.

**Chair Kano:** Okay. Thank you very much, Dr. Bationo. Dr. Koyama, do you want to make a comment? So, last speaker.

**Dr. Osamu Koyama:** I thought that we still have plenty of time. My name is Koyama. Listening to the comments from Dr. Bationo and others, we all agree the importance of collaboration or integration between discipline-based researches. Saying is easy but doing in practice is not so easy. We need the kind of system or mechanism, or structure to enhance this kind of collaboration among the disciplines, such as breeding and soil science and so on.

I have a good example that I cannot explain very well. One of the CG Centers, AfricaRice, is now implementing rice hub system. In that they selected many sites with various ecosystem and they check the soil conditions, climate conditions, and they are doing evaluation of breeding materials using those sites, so working together in a site-specific manner. Maybe we take advantage of Dr. Saito from AfricaRice here. He can explain more. I think that is one of the best examples of collaboration among soil scientists, agronomists and breeders.

**Chair Kano:** Thank you very much, Mr. Koyama. We would like to continue this discussion, but I think the time is almost up. So, we'd like to – sorry. Dr. Saito, can you have one comment about this?

**Dr. Saito:** Thank you very much, Koyama-san. So, I just quickly talk about what we are doing in the rice sector development hubs. We just established with national partners. AfricaRice just does not work alone. We work together with national partners because AfricaRice just take the developed technology; but if national partner does not adapt such a technology, we cannot disseminate technologies. Then AfricaRice also work together with multi-interdisciplinary team so we have the agronomy and breeding. So once breeder develops the varieties, immediately agronomist evaluates performance of such varieties and phenotyping and characterization. Then we will provide the variety-specific recommendation. So, we have a kind of linkage using specific environment because technology always need to adapt local condition. Fine tuning is always needed. We have a kind of technology testing field. We call it rice sector development hub. So, we really want to have more technology from Japan because Japanese science develops more advanced technology. I think Africa also want to have such a technology to test in Africa. So, we welcome all the Japanese scientist come to Africa to test your technology. We are open for such technologies. Thank you very much.

**Chair Kano:** Okay, thank you. Thank you, Dr. Saito. Thank you very much everybody. Anyway, this symposium theme is very important so you have a lot of comments maybe, but we can have next chance to discuss about issues. Lastly, I'd like to thank you very much all the participants. Thank you very much. I'd like to close.