Panel Discussion

Panel Chair: **Yasunari Fujita**

Program Director/Food, JIRCAS

Speakers:

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JIRCAS International Symposium 2024
Resilient Genetic Resources for Food Security in the Era of Global Boiling
Panel Discussion
Panel Chair: Yasunari Fujita


Sarada Krishnan


HASEGAWA Toshihiro


NAGATOSHI Yukari


EHARA Hirosh


Prakit


Venuprasad Ramaiah

Panel Discussion (35 min- 16:50-17:25)
Panel Session Theme: Resilient Genetic Resources for Food Security in the Era of Global Boiling – Opportunities and Challenges for Conservation and Utilization

FUJITA Yasunari: I am Yasunari Fujita, Program Director of JIRCAS' Food Program.
We are currently facing intertwined crises of biodiversity loss, environmental degradation, and malnutrition. Our food systems depend on genetic resources, and their conservation and use require urgent action.

There is a boost to the scientific debate to promote resilient crops, and the technology for their use is rapidly evolving, and the momentum needed to accelerate that opportunity.

First, we will discuss how to unlock the potential of resilient non-major crops.

Dr. Krishnan, in your keynote speech, you shared a historical perspective and future prospects for the conservation and use of genetic resources. Can you tell us more specifically global discourses on the opportunities to unlock non-major crop genetic resources in the age of global boiling?

Sarada Krishnan: Thank you for the question. You know, in my talk I did talk about an initiative, a global initiative called the VACS initiative, which stands for Vision for Adapted Crops and Soils. And this initiative is through the US Department of State and headed by Dr. Cary Fowler, who was the 2024 World Food Prize Laureate. So, for the VACS initiative, the objective is to improve nutrition, food security, and resilience to climate change through the development and cultivation of climate-resilient and demand-driven crops, while also prioritizing soil conservation as the foundation of soil health. So, the VACS through the US government, they have an implementer's group, the Crop Trust along with the CGIAR led by CIMYTT. The IFAD and FAO are the main implementing partners. So last year we got funding through the VACS initiative from the Norwegian government to develop programs for opportunity crops in Africa. So, we're calling that program a BOLDER, which is under a BOLD project, which BOLDER stands for "Building Opportunities for Lesser known Diversity and Edible Resources. So, we are currently working in four African countries which are Benin, Ghana, Uganda and Tanzania. And the way we do I showed the four pillars. So, we look at conserving and utilizing crop diversity research, evaluation, breeding, seed systems development as well as policy-enabling environment. So, we have all these four countries. We have selected 2 crops each based on stakeholder consultation. So, we work with farmers of seed suppliers and all of the different stakeholders, bringing them together to identify these crops because we need buying from everyone to improve the crop. And so that is one of the projects. And recently we got funding from the German government as well as Irish government, and we have developed a funding facility called the Power of Diversity funding facility. So next year we'll initiate the Power of Diversity pilot project and the five additional countries and three in Africa which are Rwanda, Nigeria and Zambia and then one in Asia which it will be India and then in Latin America and Colombia. So, we will use almost the same process, and we will start working on all of these five-year projects because to see impact you need a little bit of time to make sure that seed systems are developed. All of these things are in place. So that is our project that we are currently working on. Thank you.

FUJITA Yasunari: Thank you, Dr. Krishnan. Dr. Nagatoshi, from a resilience and nutrition point of view, quinoa is a very interesting crop. How do you think the lessons from quinoa will contribute to advancing research of resilient crops?

NAGATOSHI Yukari: Thank you for asking the important point. As already mentioned by Dr. Sarada, using unutilized crops, I say orphan crops, are very important for future food and nutritious security. In this

point, I think the progress of our quinoa research including establishment of the breeding platform and also finding the involved in useful agronomical trait will provide a road map for utilization for the other orphan crops, I hope so. In addition, for major crop, I think new findings from quinoa or the other orphan crops are useful for their improvement as presented in this symposium, maize and rice, major crop research is at the forefront of the plant science. But I strongly believe that we will find new mechanism or new genes involved in high nutritious content or stress tolerance from quinoa. So, I expect these findings to give a new hint for major crop improvement. Thank you.

FUJITA Yasunari: Thank you, Dr. Nagatoshi. Prof. Ehara, sago can be grown in poor environments, but can you talk about the innovation and policy challenges and opportunities needed to unlock its potential?

EHARA Hiroshi: Thank you, Dr. Fujita. About the very important questions, first, I'd like to talk about the innovation. Recently the NGO and supporting/partner organization in Indonesia, they would like to expand the opportunity to utilize the sago palm. One of the new challenges is to plant the sago palm at the post mining site. So, for the deep devegetation, because of the post mining of the area, we'd have a serious problem in the soil. Such kind of opportunities expanded to say utilization will be expanding. However, when we increase the opportunity to utilize sago palm, of course, sago starch production will be increased, but at the same time, the amount of the residue also will be increased. Actually, at this moment, almost half of the stored carbohydrate starch in the trunk will remain after such extraction in the residue. So, how we can utilize such remaining resource will be one of the very important agenda. For finding the better solution, we are working with our former international students. For example, to produce the biodegradable material, the seeds, like the styrofoam-like material. However, to expand the opportunity to utilize the residue, probably much easier access devices should be prepared. So, another example is for producing the organic fertilizer utilizing the sago, the residue. So our partner in the Sulawesi island, they're trying to utilize such organic fertilizer for the post mining of the area. So, this will be one of the recent challenges. So, then it's about the policy. So, we expected the new challenge from the producing country. We introduced the one example from Indonesia, so the government of Indonesia started to support the development of the infrastructure for the sago starch, sago-producing area. Because the center of the sago production area will be very far from the large city, it will be difficult to provide the material for the consumers. That's why they started to select several provinces to support, to develop their infrastructure. Yesterday I heard a news from the Philippines, our partner organization in the Philippines, they got the new budget to utilize sago resource, to be one of the components for their ecology services just like the Satoyama activities. Such kind of new trial from the support, the local and central government, will be already launched so we'd like to support their activity together with our partner organizations.

FUJITA Yasunari: Prof. Ehara, thank you for your good news. Next, Dr. Somta, despite its socioeconomic importance, mungbean has a low yield and is susceptible to biotic and abiotic stresses. You talked about technological advances in overcoming stress tolerance. What conditions can accelerate and enable the development of more resilient varieties?

Prakit Somta: OK, thank you for the question. I think the availability and the easy accessibility to the diverse genetic resource will be the key to rapid development of the climate resilience cultivars. And also, for example, in my case that I showed in my presentation, we screened a lot of the germplasm for the salt tolerance, thousands of germplasms. But finally, we got one from one mungbean, only one accession that shows the resistance and now we are using it for the development of the new cultivar with salt tolerance. And also, for the minor crops such as the mungbean. The wide availability of the reference genome and the genomic tools are really important to push forward the new cultivar development.

FUJITA Yasunari: OK. Thank you, Dr. Somta. So, in conclusion, thank you for such interesting topics. As

policies such as the Vision for Adapted Crops and Soils or VACS initiative attempt to unlock the secrets of quinoa's high nutritional value and stress tolerance and use them to create a resilient crop, along with the innovation of policies related to the sago palm. Also, the issue of the gap between traditional breeders and plant biotechnologists.

And we move to the next, on harnessing resilience in major crops. To ensure food security, it is essential to ensure the resilience of staple crops, the opportunities and trade-offs for the use of genetic resource diversity, the development of the latest technologies, and the need for international initiatives.

So next, I would like to ask the panelists about the opportunities and challenges of harnessing resilience in major crops.

Dr. Hasegawa, you talked about the IPCC's viewpoint on the significance of genetic resources in adapting to climate change. Can you tell us about the urgency of adapting research for major crops like wheat and rice to ensure food security under the scenarios of climate change and global population growth?

HASEGAWA Toshihiro: Thank you, Fujita-san for the question. The urgency of adaptation, adapting to climate change is actually immense as its impacts from floods, heat, the outbreaks of the pest and diseases are already threatening global food security. So, mitigating these negative impacts from biotic and abiotic stresses is a primary adaptation measure with these genetic improvements serving as a critical component, but enhancing this stress tolerance is a key, but it's increasingly difficult. The hurdle is going up and up as the intensity and frequency of these extreme events are rising with every degree of warming. We must acknowledge that we are approaching, unfortunately, the adaptation limits for the maintaining yields and the rising environment pressures, so this is alarming. So, we need to make really strong efforts to mitigate the climate change at the same time.
For staple crops like wheat and rice, there's another really serious concern, that is, the yield potentials. The yield potentials are unfortunately showing some signs of plateauing, particularly rice and wheat. It is a contrast to some other major crops like maize and soybean that show us almost consistent growth. And that's also alarming, so we need to highlight urgent efforts to boost the yield potentials at the same time. And to do that, we also do the ordinary research breeding program, but at the source, at the same time, we need some program that even leverages some of the positive side of climate change. For instance, rising temperature, also rising CO2, so those are the issues that can be leveraged in some way to enhance yield potential. But at the same time, I also would like to mention something about the minor crops or underresearched crops, they are as important as major crops as they provide important source of nutrients. And they are really underresearched, diversifying cropping system not just for major crops, another key issues to be resilient against climate change. So, I think I'll just reiterate what the speakers said, the importance of these minor crops. But finally, that said, the genetic improvements alone are not sufficient to address all the full spectrum of challenges posed by climate change. And we need a comprehensive approach, one that integrates advanced breeding with better resource management and sustainable farming practices in resilient infrastructure. By taking these coordinated and urgent action, we can build a more resilient agricultural system capable of securing the food supply for a growing population in an increase in volatile climate. Thank you.

FUJITA Yasunari: Thank you, Dr. Hasegawa. You mentioned the importance of a comprehensive approach and to building a more resilient agriculture system, that is a very important thing, thank you. Prof. Matsuoka, wheat has been domesticated for a long time. Modern species have lost the potential for resilience that wild species possess. What do you think about that possibility, or how would you balance the loss of desirable traits of modern species?

MATSUOKA Yoshihiro: OK. Thank you for the question. And then my simple answer is that the possibility of wheat germplasm is priceless, basically limitless because in the genus Triticum and Aegilops, there are about 30 species and each species is a reservoir of alleles that may not exist in bread wheat. And then if we can transfer these alleles to bread wheat, they should provide some new novel phenotypes in bread wheat. Each of these species has the potential. We have at least 30 species. So, this is the reason why I think the wheat germplasm is priceless and countless, are limitless. And then I would like to add that we need to do more pre-breeding in order to achieve our goals to save our next generation from hunger. Thank you.

FUJITA Yasunari: Thank you, Prof. Matsuoka, and thank you for telling me the importance of the wild wheat in wheat improvement. So, Dr. Ramaiah, rice is cultivated in a wide range of growing areas, thus the development of new varieties needs to meet the challenges of each local environment. Your presentation highlighted the potential of using technologies such as AI to optimize GxE. In turn, what strategies do you think are necessary to make more use of Genebank?

Venuprasad Ramaiah: Thank you for the question. There are two among the several strategies I presented, which are AI application in the gene bank era and how we can better exploit GxE to utilize gene and genetic resource tools. These are two separate topics. Going forward, maybe AI can come in to even help us with optimizing those GxE, but right now we are not there yet. Among other strategies that are relevant for us as an international center is you have to remember we are not the only institute doing this type of work, so there are plenty of other researchers who are actually doing similar work in the national program, so we can enhance their program by enhancing the access of the genetic resources to these. So, at IRRI, every year we send out 25 to 30,000 samples globally, and there are lot of other users that we have to also tackle to understand their needs to come up with strategy how to better serve them, that is one of our strategies. To attend this, what we do is every few years, mostly five years, we conduct a user survey and try to understand -- What is the trend? What are the users looking for? So, our recent survey was just around the pandemic time and then one interesting thing which came out was going forward, the users want wild species in more, they are more interested in that before to address climate change. This is the message that we got. And one of the other recommendations was that from a gene bank perspective, wild species are difficult to manage and there is very less amount of seed production, so we give very less in our center. We give only 50 seeds, many times the partners want more. So, since the wild species is going to become much more important going forward, we said, okay, let us tackle this strategy. So, we now have a revamped regeneration system for the wild species at IRRI so that now we can produce more seeds. And then we are able to attend to their needs. So, this is one of the strategies that we are following. Also, to make the genetic resources much more amenable, we have to make sure that the system in which we provide this material is smooth. Currently there are some bottlenecks. We are much better, but still there is lot of bottlenecks to solve. It is not as easy, sometimes their request takes months before the seed is provided and available to the researcher. So, there are few steps we can address that.

Then also, I think this was pointed out by others, the current information system, database systems that genebanks handle somehow are not so user friendly unfortunately and I myself, I'm a user, and I have this complaint myself. So, what are the ways in which we can make the information easily accessible? So here again AI can come in and then there are now we are developing what is called as chat bots where the users can just communicate with the system and they get the required information and so that it becomes faster, easily available. Right now, we have to run pillar to post to access certain information and then see what I want. So, these are some of the additional strategies in addition to what I mentioned in my talk, which could further help to make the genetic resources more useful and available to the users.

FUJITA Yasunari: Dr. Ramaiah, thank you for the important comment and about promoting the gene bank

by improving the user demand and user friendliness. And thank you for providing us with very interesting topics on the importance of a comprehensive approach to building a more resilient agricultural system, the importance of wild wheat in wheat improvement, and on promoting the use of gene banks by improving the end user demand and user friendliness.

Dr. Yamanaka, in your presentation, taking advantage of its subtropical environment, JIRCAS has been conducting research on the conservation and utilization of tropical genetic resources through international joint research over the past 50 years. What are some of the best lessons for the future of international collaboration of genetic resources?

YAMANAKA Shinsuke: Thank you very much for your comment and question, Dr. Fujita. So, during these fifty years, of course, I don't know about 50 years ago, but we have many experiences and learned so much from our research activities. The first point to be mentioned regarding the handling of genetic resources in international collaborative research is that international attitudes toward genetic resources have changed drastically in the last 20-30 years. As you know, the CBD, The Convention on Biological Diversity, adopted at the Rio Summit in 1992, reconfirmed the sovereign rights of the country of origin and regulated compliance with national laws and regulations. In addition, in 2010, the Nagoya Protocol was established under the CBD which establishes laws and regulations concerning opportunities for the access to genetic resources and the fair and equal benefit-sharing, ABS arising from their utilization. Besides the CBD and the ABS, the ITPGR-FA, International Treaty on Plant Genetic Resources for Food and Agriculture was also adapted at FAO. And these three treaties have been signed and are in effect even in Japan. As long as JIRCAS is conducting research activities on genetic resources with international collaboration, it is a law that must be complied with, and those who handle genetic resources are required to take the utmost care in their handling of genetic resources. We also take sufficient preparation and prior coordination into account when introducing and providing genetic resources. At the moment, some developing countries have not yet developed domestic laws that correspond to these international treaties, but we think that more careful procedures will be required in the future, as they will no doubt be strictly applied in all countries. Considering the current situation, it is not easy to introduce genetic resources from overseas to Japan in the future, and the genetic resources that have been already introduced in the past and are currently in our possession will become extremely valuable.

FUJITA Yasunari: Dr. Yamanaka, thank you for the important comment increasing the usefulness of currently held genetic resources and through the entry into force of the Nagoya Protocol. We don't have enough time. Is there anyone who has any questions about the presentations or panel discussion at this symposium? Only one question. So, is there any?

Questioner:
To all the speakers, thank you very much for wonderful talks. I'm very inspired to all the sessions you gave. My question is really to everyone, now this is about research as usual, but when do we shift this to crisis management? I'm from the Norin Chukin Research Institute, which is agricultural and forestry central bank’s research institution, which means I am in the position to advise the Japanese farmers what we should be doing and from the talk today, I think the climate change is really serious and it’s going to be even more serious because the fossil subsidies is over $1 trillion and it's not going to decrease and all majors are not going to give up their rights and also the oil-producing countries are not going to give up their lives too. And the United States has elected Donald Trump to be the next president and that he's going to protect the fossil industry. And US-UN climate change or SDGS are going to fail, meaning that we are going to face the big, big climate change very soon. And I think we need to be prepared. I mean, the farmers need to be prepared to change their seeds, their farming styles, the insect management and so, when and how are we going to advise is my question. Thank you.

FUJITA Yasunari: Thank you for your question. We don't have enough time but please answer Dr. Hasegawa.

HASEGAWA Toshihiro: I think the first thing is that we shouldn't give up. Curbing the climate change, well, that's one thing. The other thing is that the involvement of farmers' participation from the early step of this development of innovative technology is another issue. So, I think sharing information about how and what the impacts are that we are currently seeing? What is the technology that we can develop? And should be shared from the beginning with the farmers and in that way, the adoption of the technology can be much quicker. So hopefully we can provide more, better platforms to do to enhance this activity. Thank you. Very short answer.

FUJITA Yasunari: Do you have any comments from the panelists please?

Sarada Krishnan: Maybe I think we need to go into emergency situation now. I think we shouldn't be waiting because breeding takes such a long time, especially in, I mean, I work on coffee genetic resources. A coffee breeding program can take 25 to 30 years. So, we need to think about 2050 and beyond now. And we have all those predictions that we are doing. And looking at those predictions, if that is what is predicted, we need to start breeding now for 2050.

Venuprasad Ramaiah: Just to supplement to what Sarada mentioned, if you remember my slide about my last work in Vietnam. This is one strategy where best adapted material is provided to the hands of the user today. It's not about a promise of breeding a better line tomorrow, so that is one way in which genebanks can contribute to some of the crisis management scenario wherever possible.

FUJITA Yasunari: Thank you. So, anyone has any question and comment? OK, thank you. Dr. Krishnan and Dr. Hasegawa, can you give us your final message on how the international community can promote genetic resource research to ensure food security in the era of global boiling? Dr. Krishnan, please?

Sarada Krishnan: Sure. So, genebanks around the world are the guardians of crop diversity and many genebanks are underfunded, which impacts the operations of the genebanks. So, if you go nationally, a lot of national genebanks are very under resourced and underfunded. And so that impacts the quality of the material that they're conserving in the genebanks. So, we need to ensure that genebanks are very well funded as well as well managed to make sure that they are meeting international standards. And that will ensure the diversity, the crop diversity is protected not just for our current generation, but for future generations.

HASEGAWA Toshihiro: Thank you. I will just reiterate what Yamanaka-san said. This international community is really important and respecting the safeguarding rights of local communities is really immensely important. Also, ensuring equitable access to those materials that are really important and in breeding really has to be accelerated, At the same time also it is critically important that effectiveness of these innovation must be evaluated across multiple dimensions. And so, economic, environmental, institutional and physical dimensions will be also important. So, I think the breeders and also the other scientists must collaborate very closely internationally to make this evaluation very effective. And also, we first bear in mind that these target environments are unfortunately changing, so the breeding targets will be changing all the time. So, I think we have to look ahead like Dr. Krishnan said, 30-40 years from now. So those are the target environments, so at the same time, we have to make 10 years efforts to curb the climate change. OK, I really conclude the sentence again. Don't give up trying to fight this climate change. Thank you

FUJITA Yasunari: Thank you, Dr. Krishnan and Dr. Hasegawa. And it's time. Thank you, all panelists, for this interactive and insightful discussion on today's topic and the straightforward answers. We will retain the international research collaboration, and multidisciplinary approaches are important to build resilient food systems in the era of global boiling. Especially, we need to conserve and restore the diversity of nutritiously rich genetic resources and harness their inherent resilience to biotic and abiotic stresses. There are still a lot of challenges, but we will continue working hard to address them. Thank you to all of you who attended on-site and online, and we hope to see you again on future occasions. Finally, please give a round of applause to all the panelists.