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# ROLE OF TECHNOLOGICAL DEVELOPMENT AND JAPAN'S CONTRIBUTION

Panelists:

**Shigeru Araki**, Kyoto University

**Yuki Morinaga**, Meiji University

**Takeshi Sakurai**, Hitotsubashi University

**Masa Iwanaga**, JIRCAS

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*Shigeru Araki*, Kyoto University received a Ph.D. in agriculture from Kyoto University for his geochemical study of red soils. A professor at the Graduate School of Asian and African Studies at Kyoto University, he has been studying indigenous agricultural systems in various parts of Africa (Zambia, Tanzania, Zimbabwe, Namibia, and Cameroon) from an agro-environmental perspective. He is currently involved in the Forest-Savanna Sustainability Project (in Cameroon), which is part of the JST/JICA SATREPS program.

*Yuki Morinaga*, Meiji University holds a Ph.D. in science from Tsukuba University (in Japan). An expert in climatology, she is a professor at Meiji University. She worked at the Institute of Meteorology and Hydrology for two years, beginning in April 2003.

*Takeshi Sakurai*, Hitotsubashi University received a Ph.D. in agricultural economics from Michigan State University and is a professor at the Institute of Economic Research at Hitotsubashi University (in Tokyo). His expertise is in the area of economic development of Sub-Saharan Africa, with a particular focus on risk management and technology adoption in agriculture. He worked for Japan's Ministry of Agriculture, Forestry and Fisheries and at Wako University (in Tokyo) before assuming his current position.

*Masa Iwanaga*, JIRCAS received his Ph.D. in plant breeding and plant genetics from the University of Wisconsin (in the United States) in 1979. He was named the president of JIRCAS in April 2011, after serving as director general of the National Institute of Crop Science (NICS) at the National Agriculture and Food Research Organization (NARO). He has a long career working with CGIAR centers, including the post of director general at the International Maize and Wheat Improvement Center (CIMMYT) (in Mexico).

**Master of Ceremonies:** Ladies and gentlemen, we would now like to start the panel discussion. I would like to now introduce the chairs as well as the panelists. First of all the panelists, from your right, are Prof. Shigeru Araki from Kyoto University, Prof. Yuki Morinaga of Meiji University, Prof. Takeshi Sakurai of Hitotsubashi University and Dr. Masa Iwanaga of JIRCAS.

The co-chairs will be Dr. Masuo Ando of JIRCAS and Dr. Kazumi Yamaoka of JIRCAS.

I would now like to give the microphone to the chairs for the proceeding of this panel discussion.

**Chairman Dr. Kazumi Yamaoka:** Thank you very much for the introduction. My name is Yamaoka, of JIRCAS. Together with the floor we hope to engage in a lively discussion. I would like to ask for your cooperation.

Now, first of all I would like to briefly explain the CVs of the panelists. They are all Japanese panelists, therefore in order to have a deep discussion we would like to have the panel discussion in the Japanese language. You can refer to the simultaneous interpretation on channel 2. Let me first of all introduce the panelists.

First of all, Prof. Araki. He received his doctorate in agriculture from Kyoto University with his geochemical study of red soils. He is a well-known researcher in red soils. He has been working on indigenous agricultural systems in various parts of Africa

Next I would like to introduce Prof. Yuki Morinaga. She is a professor at Meiji University. She is an expert in climatology. In Mongolia, she has studied the climate as well as agriculture and traditional methods.

Prof. Takeshi Sakurai is from Hitotsubashi University. His expertise is in the area of economic development of Sub-Saharan Africa, particularly focusing on risk management of agricultural farms as well as technology adoption in agriculture.

Last but not least, we have Dr. Masa Iwanaga, who has a Ph.D. in plant breeding and plant genetics.

Now, let me first talk about how we would like to proceed in this panel discussion. We have one hour in total. We would like to divide this into two parts. The first 30 minutes will be free comments from each of the panelists for five minutes each. For the remaining 30 minutes we would like to engage in general discussion. I would like to invite active participation by the floor as well.

Yesterday we heard from Dr. Fan and Prof. Umetsu. We have conducted four sessions over two days, talking about resilience in terms of building resilient food systems, strengthening against risks. The current status as well as the challenges and future initiatives have been discussed. So I would like to invite the panelists to talk about their impressions as well as their views regarding resilience. What are the preconditions of a food system that has resilience? Also, talk about how the Japanese research community has been making contributions. We would like to have the panelists share your views.

I would first like to call upon Prof. Araki, please.

**Prof. Araki:** Thank you for your kind introduction. I am Araki from Kyoto University. In my research institute, this is a graduate school without an undergraduate school, so we mainly engage in fieldwork with students from different backgrounds, not some specific area of expertise, but many people go to fieldwork for a long term to make master or doctorate course studies. We would also go together to visit the field. Based on that experience I would like to make some comments.

Our area of expertise is original study not limited to agriculture but anthropology and economics, so different

sectors, and we move forward through discussion. The agricultural sector is not necessarily a major sector. Sometimes we may feel alienated or some people may say even in Africa that agriculture is not an area of such great importance. We have felt such difficulties in the past. But recently agriculture is becoming one area of attention, so that is the subject I would like to cover.

First, why is it that we are discussing agricultural development? That is the business of this symposium. Let me talk about it. The second point is resilience, as mentioned by Dr. Fan. When we say agricultural development, so far we are thinking of a concept of sustainability. How is that different or similar to resilience? How is that related? Third, food security, food self-sufficiency is another keyword. So these are the subjects that I would like to cover in my comments. I have only five minutes, so I will be brief.

So why is it agricultural development now? After the year 2000, international grain prices went up all of a sudden and the price is not going down, so there is not sufficient food to provide for food assistance. That is because until then, with respect to ODA in the last 20 or 30 years in the agricultural sector not much money was provided to the area of agricultural studies. According to World Bank material, in the 1980s 16% of ODA was for the agricultural sector, but in 2005 it was only 4%. There is that situation. Agriculture was an area that was overlooked. After the 1980s, through structural adjustment and eradication of poverty, investment in the social sector, insurance, education areas of investment started to be the focus. There is not much role to be played by the agricultural sector. After the year 2000, with high crop prices, globally the stockpile of food has been declining. With this background, agriculture crisis management for example, how to treat the local agriculture became an urgent issue. Including food self-sufficiency, food security and economy, and liberalization of food, we must think of agriculture from a more basic point of view.

Now, finally people involved in agricultural studies are facing a situation in which it is possible to have real benefits. In the last decade, we are now at a major milestone in the agricultural sector to provide our contributions. How is the agricultural sector linked to social, technology area? I think this is now a very good opportunity to think about their interrelationship.

About resilience, as mentioned by Dr. Fan, unexpected disasters such as typhoons and floods happen, so how that is different from the concept of sustainability is the question I had in mind. In particular, in the case of drought every 10 years there are droughts. With an unstable climate that is always happening, for example in Africa, and a sustainable response was not taken so far. So far we are not discussing so much from the point of view of resilience. As Prof. Umetsu also mentioned, if it is impossible to secure food then people go to the urban areas to work, and people working in urban areas send their money back to their home town. There are a lot of networks established within society for people to survive. Including that, I think we must consider not only investment in the agricultural sector to the farmers. From that point of view, it is not possible to have a clear view of the situation in Africa. From that point of view, I think we must think from a social network perspective in order to be able to enjoy the benefits of real developments. Arid areas or semi-arid area capacity should be raised, and in that sense that is a very difficult area in terms of risk management, crisis management it is necessary, but with the increase of the global population the rural areas' population will almost be absorbed into the urban areas by around 2025. So an increase in population and increase in carrying capacity in the rural areas is not a sector that we can expect that much in the future.

That is all. Thank you.

**Chairman:** You can continue later on. Then, Prof. Morinaga, please.

**Prof. Yuki Morinaga, Professor, Meiji University:** Thank you very much. I am with the School of Commerce at Meiji University. There, I belong to the groups which was used to be called the Humanitarian Course, and I teach environmental science. Mongolia is my expert fields but I seldom have the opportunity to mention my

expertise in the classes that I have, so I have greatly enjoyed this symposium since yesterday and I was very much motivated. Climatology is my expert fields, so first of all I would like to talk about resilience and climate change or global warming, then meteorological conditions and traditional knowledge in the pastoral systems in early warning systems. That will be my second point. Temperature rise is expected but it goes down but then floods increase but also droughts increase. Qualitatively much is said, but quantitatively what would happen to what degree when? That is very necessary for rural policy-making, but that is not seeing much progress, although at the continental level much progress has been said, prediction at the country level is not well done. So what we use as a model has seen improvement in precision for temperature but not for precipitation and drought. It is much related to the soil moisture, which is mainly affected by a combination of temperature and precipitation. So the level of precision is low. Is drought going to increase or decrease? Rather than trying to predict at the country level, I think we need a perspective of being prepared rather than having to rely on precision and prediction. That is my impression.

For a quarter of a century, global warming has been much studied. What are the lessons learnt? In the mists of uncertainty we need to be prepared for several types of surprises and I think that ultimately is the greatest lesson learnt. In that sense, Prof. Umetsu has shown one of the most important themes of the resilient agricultural production systems. In the developing world, with much arid area, as a system nor measure to tackle global warming I think that is the most healthy, constructive and productive way. In the future, we might discover that the hypothesis of global warming was incorrect, but even then we will have some assets that we can hand on to the future generation of humanity.

In what way can Japan contribute? Collection of metrological data and analysis of such information is of great importance. This time, we saw much analysis being conducted based upon those weather-related data. Sometimes, rather than looking at IPCC's future forecast, just one year's worth of data that is locally collected may be more worthwhile than looking at the IPCC forecast. And especially very remote areas where it is mostly the young researchers who are sent, at those remote localities if metrological data is collected then that has much application. Of course, one year's data may not be sufficient, you may say, but early warning systems, especially for locusts, that could be used for measures against such pests. So as a souvenir we such data truly hope that you can take that back from this symposium. There are many analysts who can analyze such data and further it can contribute to the improvement of metrological models.

Finally, I would like to make a comment on Mongolia. Our counterpart is the metrological agency and if you identify them as a counterpart you receive many benefits. If you suffer from health conditions in remote areas, in Mongolia there are several metrological agency outposts and you can rely on those agency outposts as you travel. Also, because of the high literacy of Mongolians, when you want to conduct a poll-based interview surveys, if you use the network of those outposts your work can be very efficient. Metrological data is extremely useful in diverse ways. That was one point I wished to make.

Along with the metrological agency of that locality we came up with weather forecasts for the local nomads. During the summer drought and *dzud* to follow the summer drought we provide such weather forecasts. An early warning system is being created based on such data. Let me explain about the system by giving you an analogy. In 2003, after the 1999 *dzud* the early warning system development began. But the project received a deadline and it was terminated without completion, and then a huge *dzud* occurred in 2010. Unfortunately the early warning system did not function. I was regretting that situation, but I was beginning to forget it and then I suddenly received an email one day: Prof. Morinaga in Mongolia, I thought you were involved in the early warning system for drought and *dzud*. After we experience that *dzud*, your system did not work. But that's not continuing? That email was from a JIRCAS colleague. So I responded to that JIRCAS fellow saying that you probably do not have many friends because you send those mean emails to people you could have called friends. But anyway we ended that early warning system projects in failure, so I came up with a document for a project proposal once again in order to resume that challenge and we were given the grant.

So I want to use this opportunity to make a declaration to motivate myself as well. Yesterday, in the pastoral session that Dr. Kawashima chaired he said that he wants to maybe have another session with the same participants in a few years to have them report back. That is very important. We have to get together a few years later and review our progress; else future projects will not be effective.

I am running out of time but early warning systems may also be improved by factoring in the traditional knowledge of the local pastoralists. In the case of nomads, they experience very cold winters. How can they locate their tents and how do they prevent overgrazing? That kind of traditional knowledge is what they own. And whatever traditional knowledge can be factored into the early warning system, I think we should.

We have started work on fermented horse milk. During the summer season some people only drink fermented horse milk. It is a traditional beverage that they use even to feed the babies. At the threshold marginal area where the weather conditions are above the cropping threshold, it is very difficult to create stably that kind of beverage. So we should verify the knowledge that they have in coming up with such a traditional beverage, and come up with some efforts to support the stable production of those traditional foods and beverages. I think that Mongolians would love to hear of this kind of research; it would be welcome. I am often flooded with emails from my Mongolian friends when I propose that we should do research on this fermented horse milk. I have never experienced such a popular proposal before, I think partly because they love to drink alcoholic beverages. But this I think is a very good idea.

**Chairman:** Prof. Sakurai, please.

**Prof. Takeshi Sakurai, Hitotsubashi University:** My name is Sakurai. Yesterday, in Prof. Umetsu's presentation my name was mentioned. The resilience project is something we pursue together, in the field in Zambia. In our project we have continued to discuss what the meaning of resilience is. Taking that into consideration, I would like to offer some thoughts for the general discussion. I would also like to talk about technology development.

For the word "resilience" in the past one or two years it has become more prevalent around us. In international development as well as agricultural development globally, poverty and poverty reduction were important. Is resilience going to replace the poverty and poverty reduction? That is the question I would like to pose. In poverty, in economic terms the measurement has been standardized to a certain extent. Poverty per se is a static definition. It is a certain situation in which we judge whether one is in poverty or not.

There is also a related expression of "vulnerability," whether people are exposed to poverty. Looking at one point, judging whether there is vulnerability or not is very difficult. What is similar is resilience. If you look at one focal point you cannot tell whether it is resilience or not. Compared to poverty there is no standardized measurement for resilience. How can this be put into use in terms of empirical studies is very important. As mentioned yesterday, I would like to emphasize once again that it is a concept very difficult for empirical studies.

Now, what I would like to emphasize is the point made by Mr. Hanai. Vulnerability and resilience are two sides of the same coin. Yes, I would agree with that. But when we talk about poverty and vulnerability, there is a negative connotation, and I think we have to overcome this negative connotation. But resilience is somewhat more neutral; we do not know whether it is good or bad. I believe that resilience per se is neutral. I am not sure whether resilience is something that should be enhanced. There is an expression called the "poverty trap" in economic theory, and in this area there is a stable equilibrium. To come out of this trap is very difficult. In this case a positive external shock will mean that income will increase but then it will revert back to the trap. So that is the resilience situation. The poverty trap is resilience, so does that mean it is good? No, that is not the case. We have to be careful when we use these words. As already expressed, not be able to move from one equilibrium to another equilibrium could itself be considered an equilibrium. When there are two equilibriums you cannot always judge which is the better equilibrium.

What I am trying to study Burkina Faso of western Africa. In 2002, before the internal conflict in the semi-arid area there was a certain political structure of stability, going to Cote d'Ivoire and working at the cacao plantations, using the remittance livelihood was maintained. But with the 2002 internal conflict there was a shock and this system was not sustainable. So whether they should go back to Code d'Ivoire or find a livelihood in their own land should be considered. There are some people who engaged in cotton production as well as engaged in vegetable cultivation. To look for a different type of livelihood, whether it is equilibrium or not. When there is a different equilibrium, with the absence of the shock they would still be dependent on Code d'Ivoire, but once they had gone into poverty, judging which equilibrium to go to will depend on the judgment made. This is very much related to resilience. Therefore, you cannot just simplistically say that resilience should be enhanced. That is the point I wanted to make in terms of using words.

Before technology development I have a related topic. Another characteristic of resilience is that for a certain shock, when one wants to judge whether it is resilient or not can be made, but if you look at income as well as consumption, the reason for the shock does not have to be identified. Regardless of the shock from the positive aspect, if there is consumption then one would say that it is resilient. For example, when we talk about drought, drought per se is something unpredictable. But it does occur at a certain frequency. For this type of event you can make preparations. In terms of technology development, drought resistant crops can be cultivated so that even with drought, cultivation can be maintained. However, on the back of climate change are droughts going to increase or are we going to have torrential rain? Future predictions are going to be difficult; we cannot say for sure what is going to happen in the future. So that means that we have to be able to maintain a stable livelihood regardless of what happens. That is resilience. And technology development to have cold weather resistance or drought resistance, if we only focus on those areas it will be unilaterally geared to that direction. But we have to enhance the resilience of the household, and the alignment with that will have to be considered.

Technology development to enhance resilience: what does this mean? It is very difficult to define. For the household there are various choices to be made available. I believe that is first and foremost. At any rate nobody knows what is going to happen in the future. That is the difficulty of technology development. The same can be said for insurance as well. There was a question posed after the presentation: insurance is only defined for events that have probabilities. When there is complete uncertainty it is very difficult to offer insurance. But even in Sub-Saharan Africa, insurance is lacking, it hardly exists. This is going to be very important to stabilize the livelihood, I would not deny that. But that will not suffice because resilient communities will not be established just by providing insurance. That is also the point that I would like to assert.

So I have talked about the technology development already and I did not say that it is not important. In terms of enhancing agricultural productivity, technology development will have an important role to play in increasing the income of households. For droughts, which are highly probable, to have shock-resistant crop development and shock-resistant agricultural systems are called for; there is no doubt about the importance thereof. However, when we look at Africa, have we realized this? I do not think it has become prevalent yet. We need to think about incentives to make this more prevalent. This is constantly being discussed. I think we have to cover these points as well. In introducing new technologies, there is a high risk. If insurance can be provided for risk and for introduction of new technologies, there would be more comfort. There is no lack of credit as well, because credit is not provided because of the risk of default. So insurance and credit must be combined together, and by so doing, farmers can utilize this and access new technologies.

Another point that I want to make is an important function of insurance. Agricultural farmers in Africa, in order to accumulate their assets for livestock in a proactive manner, they are trying to accumulate their assets, but they are compelled to sell when there is a shock. By selling their productive assets, long term poverty will become a problem. So instead of purchasing this productive asset by acquiring insurance, we can ensure that farmers do not use the productive assets. That is important for enhancing the resilience of the household.

The discussion will become even more complex by going into the details. That is all.

**Chairman:** Now Dr. Iwanaga, please.

**Dr. Masa Iwanaga, President, JIRCAS:** Thank you. I will try to be brief because of the lack of time. First, within this panel discussion, regarding my role, when I was first asked to participate in this panel discussion, rather than from the president of JIRCAS, able to have a broad view of the global situation, I thought about considering biodiversity. From that assumption I decided to participate in the panel discussion. If there is time to prepare more sessions, maybe I would have made another session on biodiversity and resilience.

I think biodiversity's importance is already recognized, generally speaking. Having biodiversity means that it is possible to minimize shocks by external events and if something happens then the ability to recuperate is assumed from the common-sense point of view, if there is biodiversity.

There are many ways of defining biodiversity, among them in a situation with large biodiversity the opposite direction of that is the so-called monoculture of agriculture, to concentrate on only type of crop or even only one variety of crop being widely used. If pests or disease happen, the total crop is destroyed. The opposite of monoculture is a situation with a large variety in the production system with biodiversity.

So what are we doing in terms of research? I actually have the impression that we are doing a lot of things. First, for example, in the case of drought when there are difficulties, before an event happens measures are taken and after the event happens there must be an ability to recover. Before an event occurs, to enhance diversity crops used globally you should not only focus on the crops that can be harvested, but important crops for specific regions should be fully studied: types of beans, types of legumes, agro beans, agro forest, yams. Also in one method, by manufacturing different varieties it is possible to diversify and risk and also in the case of disease, by making multiple lines we have been trying to cope with the difficulties.

What I felt through the meeting was that we researchers working in the field have to consider the broad scope of resilience. What is the significance of the work we are doing? We should be aware of that, though we are already involved in some specific area of study. It is important for us to have the awareness of the importance of the work we are conducting. Through this symposium I think we could to some extent enhance that awareness amongst ourselves.

In addition to that, after an event happens, for example earthquake, tsunami, drought happens, how can we have the ability to recuperate, to return to the previous situation as soon as possible, or how can we become even better than we used to be? I do not think there are many examples of such cases. I think cost accompanies the preparations to be able to do that. That is the issue that we face.

But in the case of biodiversity, make a seed bank as genetic sources to keep seeds in your bank. And if one type is eradicated we can have other measures applied from the seed bank. I think there are many success cases of this nature. Or in the case of salinization for example, after the tsunami in Tohoku, people tried to look for varieties of soybean and rice that are strong against salt damage. Of course, this process is costly but as researchers instead of saying that this was something unexpected we should always be expecting. Though it may not happen, we must be prepared, bearing in mind the possibility of some event happening and keeping that in mind and trying to be prepared without spending so much cost on that. For example, in the case of Japan instead of developing new varieties against things that may never happen in Japan, we can be prepared by introducing varieties that can be used in situations overseas. To be able to recover, the whole society should respond. From a technical point of view, when an event occurs, information or knowledge may be lost, or to recover a certain information or knowledge may be necessary. Therefore to be prepared, conserving knowledge or information in advance may be necessary.

Thank you very much.

**Chairman:** Thank you very much. We heard views from various different perspectives. We would like to now call upon Dr. Ando to moderate the panel discussion.

**Chairman Dr. Masuo Ando:** Thank you very much to the four panelists. We have half an hour remaining for free discussion. Time is very limited so I would like to give you some of the focal points.

The title is “Role of Technological Development and Japan’s Contribution.” This is a grand subject given to this panel discussion. In order to promote the deliberations I would like to present a few points or issues that need to be kept in mind if Japan is to make contributions. I think that those are some points worthy of deliberation.

That was what I had thought prior to the beginning of the panel discussion. But after having heard the four panelists my impression was that you all represent different fields but there is one thread that is common. Whether it be crops, economics or developmental science or agriculture—I am in the area of management—I found one common thread between all these different disciplines. I look at this from a farm management perspective. Diversification is constantly appearing in this theory. Resilience and diversity are closely related. In other words, we heard about agriculture management and profitability or economy of scale must be taken into consideration. As Dr. Iwanaga said, mono-cropping would be the ultimate way in pursuit of profitability, but that would lead to resilience being undermined. So by having more variety rather than single variety or having multiple crops rather than single cropping or different species of livestock. Also beyond agriculture, if you engage in different sectors, not only in agriculture, diversification will be promoted and that may lead to resilience. So that is my theory from the agro-economic perspective. Prof. Araki mentioned that resilience in relation to sustainability, the strategy for survival is factored in, and there is much wisdom to survive also in agriculture. I think that is what I am referring to as diversification. Furthermore, Prof. Sakurai mentioned that whatever happens, for the household economy there are several alternatives that will lead to resilience. I think he said something to that effect. Dr. Iwanaga used the word “monoculture.” The diversity of variety of vegetation was mentioned that may lead to resilience. So when we think about resilience those points need to be kept in mind.

So far we have only focused on the technological perspective, but against the backdrop from the four panelists and furthermore from Prof. Morinaga’s viewpoint the traditional knowledge, the hose milk wine, and diversity as such may lead to resilience and the reproducibility or recovery. From such a perspective I would like to ask the panelists to speak on the point that I have just raised. Are there any other points that need to be kept in mind to upgrade resilience? Are there any volunteers from the floor? Prof. Araki, you mentioned embedded survival strategy. Am I correct in interpreting your words as such?

**Prof. Araki:** Yes, you are. A combination of traditional crops, not single cropping, usually multiple crops are being grown in the farmland in small lot farmers. That is the reality. When there is heavy rain you get rice harvests, but then millet will be relied upon when there is drought. So that kind of resilience can be upgraded, but it is very difficult to strike a balance. For example, if such foreign species as cassava are introduced then of a course technological approach can enable such a variety but will that variety become deeply rooted? It is difficult to come up with a standardized model in order to find out whether that kind of methodology would apply or not. Maybe we should start from there. In one form or another, disease-resistant varieties can be introduced and there are certain models as such. But would that be acceptable at farm level? And if not, how do we think about village-level diversification? Traditional and our scientific approach may need to be blended, but where should the balance be struck? Maybe that is the source of wisdom to enhance resilience, and we may be able to create new wisdom. Just because there is traditional knowledge, or just because there is diversity, that in itself will not be effective alone. So, how can we improve the traditional wisdom by applying science?

**Chairman:** Thank you. Prof. Morinaga, to this point you seem to be somewhat reserved. From what I have just



expressed do you have anything to add, regarding the horse milk wine or even beyond that?

**Prof. Morinaga:** I do not think I have a good understanding about resilience so it is difficult to respond. What does “nomadic resilience” mean? In Inner Mongolia, there is guidance given to fix the residence location, because there is more stability for the household and this result has been verified. But on the other hand there are people who say that being nomadic will diversify risk. It is a very difficult call to make and in fact I do not have an answer to this. For Inner Mongolia they do not create a significant amount of fermented horse milk, but it is very difficult to have a significant number of horses and that is why the fermented horse milk can no longer be created in large quantities. But on the other hand there is household stability. I am sorry that I am answering in a haphazard way. But for the nomadic livelihood I think further consideration will be required. I am sorry but I will leave it there. Thank you.

**Chairman:** Prof. Sakurai, the discussions we are having so far are in a sense about risk management or risk finance. But actually it is not only production risk but marketing risk, price fluctuation risk or in case of contract cropping there is a pricing risk. Also institutional risk—the state may collapse. So I did not think our discussions sufficiently covered on these subjects related to resilience. Do you have any comments on that?

**Prof. Sakurai:** Yes. I wanted to talk about diversity but in any event I may sound repetitive but there are specific measures against risk of a certain event. For market price risk there must be some measure against that. But it is necessary to study resilience from a more comprehensive point of view, including measures not being affected by such risks. It is not only a matter of production risk. If we focus too much on production risk we may be misled. But for technological development, if you are involved with that you may be familiar with that concept.

About diversity, it is true that in many rural areas in Africa there is highly diverse agriculture taking place. Generally speaking, to reduce risk, yes this is reducing risk but in some other cases this may be raising the risk, as I have mentioned. There is equilibrium at the lower level within the poverty cycle. So including non-farming income and gifts and money sent from urban areas, it is true that they are making a living through that method. If we say whether it is better to go back to that situation or not, that includes judgment in terms of a sense of value, so I do not know. In the case of agriculture, with high diversity it may look stable, but it should be considered whether continuing with that kind of agriculture is right or not, including technological development. On the other hand, not being as dependent on agriculture as was mentioned by Dr. Ando, there are many farmers not totally dependent on agricultural income. Agriculture is used only to produce what they eat. So depending on that, the direction of technological development may change.

Is having diversity good or not? I have a question mark on that.

**Chairman:** Dr. Iwanaga, coincidentally the words used were different but essentially your comments were something which I sympathize with. Could you elaborate on that? Or any other subject that you wish to talk about would be fine.

**Dr. Iwanaga:** Diversification was the word used by Dr. Ando. How biodiversity can be developed on the farmland is what diversification on agricultural land is all about. The word resilience has been chosen as the keyword for this symposium. In the process of thinking about what we should be choosing as the keyword, one trigger was what happened right after March 11. I received many emails from my overseas friends who sympathized with the situation that Japan has experienced. After that major disaster, as Japan strived to recover—recover may not be the right word but many people used the word “resilience” rather than “recovery.” I was wondering what the Japanese word would be and I could not find the perfect Japanese word. Maybe a close expression would be “to reduce back to the original level.” Resilience also has that connotation but I could not find an exact match in the Japanese vocabulary. So the fundamental nature of resilience is comprehensive strength. That is how I interpret the word resilience.

This time I have tried to control myself to talk about biodiversity, which is my expert field, but if I did not impose that constraint on myself I would probably have looked at a bigger picture. In the midst of globalization, one disadvantage of globalization may be resilience. But we may see resilience as one positive aspect of globalization. So it depends on how that word is interpreted and at what stage resilience is looked at. “Production systems” was included in the title of this symposium. We tried to limit the concept of resilience because if we do not impose any framework on the concept of resilience, we thought that the debate may become overly diluted to cover too many points. Also, although I think diversification is one key word, another concept in building resilience, which is technically necessary, is intensification. For example, say there is one piece of limited land plot and in that limited land plot you have double or triple cropping or two species of crops, diversification and intensification are both necessary in agricultural production as we try to promote technological development. Thank you very much.

**Chairman:** We should open the floor. Maybe there are those who wish to make additional comments to those comments already made, or new perspectives. Please raise your hand and first of all identify yourself and your affiliation, and deliver your comment or question.

Yes, please go ahead Mr. Koyama.

**Mr. Koyama:** My name is Koyama, of JIRCAS. I would like to talk about diversification. Dr. Ando has posed this issue and I think there is a common understanding surrounding this word.

Inherently when we talk about diversification in Asia, for the traditional rice-based society that is where we are now embarking on a new diet and new production systems. I think that is how diversification is used in this context. By the same token, diversification can also mean—you talked about low-level equilibrium or static equilibrium—what has been in that situation could now be subject to globalization. Being privy to new options in terms of income generation as well as new information. I think that will have to be encompassed in terms of diversification. Of course, traditional knowledge is important and that should be at the base. However, I believe that’s diversification has to be more dynamic and it has to be more positive. That is the point I wanted to make.

**Chairman:** Thank you very much for that supplementary information. Yes, indeed you are correct. We are not reverting back to the past. Based on the current technology we are trying to seek diversity. In that sense, yesterday and today we have talk about monitoring as well as insurance and other new technologies that are made available to us. But it is not instead of traditional technology but rather it is complementing the technologies that are available today. So you are right in that regard.

Anything else? We have about 10 minutes. Any comments or points of view?

Mr. Hanai, yes.

**Mr. Hanai:** I am Hanai from JICA. We have been discussing resilience since yesterday in terms of agricultural production or the community or household resilience. There is one thing that I would like to ask for your comments on. Resilience of agriculture as an industry is also related to diversification. In rural areas of Kenya in Africa, there are households with more non-agricultural income. Urbanization is progressing. So there is a shortage of manpower in these regions. If we concentrate our discussions only on agricultural productivity or income resilience as a farmer, agriculture as an industry may not be viable any more at some point in the future.

The work of JICA is to provide technical cooperation and improve productivity, but it is not only limited to that. We are focusing in our project on how to make them profitable, how to make agriculture an attractive industry. How can agriculture be profitable for the household? We must keep the point of view of resilience of agriculture as an industry. I would like to ask for your comments on that. Thank you.

**Chairman:** It is a very difficult question. Prof. Sakurai, profitability and resilience.

**Prof. Sakurai:** Thank you. Yes, that is related to what I am working on. Of course, I am always saying that profitability is important. Without profitability, it is not possible to adopt new technology, and in agriculture itself there may be small farmers, but as an industry agriculture will not expand. And with that it is impossible to increase food production. If there is no food production increase at the national level, food security cannot be established. Wage will be maintained at the high level and at the industrial sectors. The issues are not only in rural areas but also in urban areas. In Africa, light industry like Asia is not established. That is a major problem in Africa and that is also related to the low agricultural productivity. So agriculture as an industry to have higher productivity is an important issue remaining for Africa. In that sense, I absolutely agree with you.

With respect to diversity, as Mr. Koyama said, low risk, low income may be one type of diversity but a more profitable area to invest in areas that can expand and be more profitable, and by doing so this is a way of diversifying. Comparing agriculture and non-agriculture, currently agriculture has higher risk so many people have more income from the non-agricultural sector. I think this will continue. Agriculture is affected by the weather, has higher fluctuations, and having stable income through non-agricultural income and to be self employed they may enjoy higher income. Agriculture fluctuates then there may be a way to have an industry of risky agriculture and have a higher return which could be considered. If you stabilize agriculture you have impressions that agriculture will be shrinking. So both points of view are necessary.

**Chairman:** Are there any other panelists? Dr. Araki?

**Dr. Araki:** Kenyan highland agriculture is very much commercialized, and it is an agriculture that is quite healthy and viable with good weather and water conditions. But we also see slash and burn agriculture, so there is a wide variety of agriculture. So self-sufficient, sustainable agriculture versus commercial agriculture, and I think there are many more people who are only involved in small-scale farming, so when technological innovation is trying to be forced into such agriculture it increases risk. They may be enjoying low-level equilibrium at the moment, but they would be more exposed to various vulnerabilities. So is there a role to be played by social scientists? By taking into consideration diversification, what kind of model will be effective in such areas? Agriculture experts should try to come up with those models for diversity. There could be risks that are beyond any imagination, but how should we prepare for various conditions? Do you not think that kind of technological model could be empirically developed? I think that is the direction we should be trying to pursue. Thank you very much.

**Unidentified Speaker:** I have this impression that resilience and profitability are in conflict, because if we are to pursue resilient agriculture then in principle that could mean family-based agriculture. So production and consumption being matched or self sufficiency being high, and the village is based upon the spirit of mutual aid. That kind of notion of resilience has been strong. However, from the profitability perspective, non-family based, corporate agriculture would lead to higher profitability. However in that case the advantages of the family-run agriculture would be lost. So resilience and profit seeking may be in conflict. This is only my impression but I think it would be very difficult to try to pursue both.

**Unidentified Speaker:** President Iwanaga, if I agree with Dr. Ando that would be against my true will. I use the word globalization, but what was exposed is the supply chain in agriculture and it has become very similar to the industrial world. Agricultural produce has a lesser likelihood of reaching the international market, in comparison to the automotive industry. If we look at the ratio of produce that reaches the international market, although wheat is an international commodity, a lower percentage reaches the international market than automobiles.

But to a certain extent we have seen some progress in commercialization. I think it was this year that we were requested by the national broadcaster NHK to do a survey on the volatility of food prices in Africa. Koyama-san

and Sano-san did some analysis and they went to remote areas in Africa to do a survey on food prices in villages. Chicago mercantile market price is very much linked, they found, although with a time lag. But that is where we are in terms of globalization and that in itself offers advantages as well as disadvantages. But this is a fact that they found out, and we should keep in mind that that is the fact, as we try to think about the desirable society.

**Unidentified Speaker:** Now, regarding resilience, the word per se is not being used but in the civil engineering world, some time ago when there was the Great Hanshin earthquake, the earthquake in Kobe, I am sure that you saw the length of the expressway that was broken. Also the bullet train rails were damaged. The civil engineering people were very much placed in shock. What they focused on is that foundation is very important. The foundation was done well. And on top of that the rail was established. But with the earthquake, the foundation was not damaged, but all the energy went to the bridge beams and the girders collapsed. Therefore, the foundation and the upper structures must be designed together. If that was the case, such detrimental damage could have been avoided. After that, new construction methodologies have been introduced in civil engineering.

Now we are discussing whether agriculture should be for the industry or for the household. But I think there are similarities to what I have discussed in terms of civil engineering. It has to be considered in the overall context. You cannot strengthen one or the other. You have to have a holistic attitude, taking into consideration both sides, not one or the other.

**Chairman:** Thank you very much. We have gone beyond the allocated time by 10 minutes. I am sorry that we have exceeded the time limit. With that, I would like to bring this to a close. The discussions that we had yesterday and today, as well as the panel discussion, were very important in enhancing resilience. I hope that you can take away important observations from this symposium. Please have at least one important take away from this symposium. Thank you very much for your kind attention.

Also, let us give a big round of applause to the four panelists.