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Annual Report 2014 (Apr. 2014– Mar. 2015)

JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

JIRCAS
JAPAN

Japan International Research Center for Agricultural Sciences

Annual Report 2014

(April 2014-March 2015)

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Annual Report JIRCAS 2014

Message from the President 2014

President
Dr. Masa Iwanaga
(FY2011-)

Food and nutrition security is an essential fabric of any sustainable human society. Unfortunately, 795 million people worldwide are still classified as undernourished, i.e., their daily food intake is inadequate in terms of quantity (calories), according to the recent Global Food Insecurity Report (FAO, 2015). If we add other essential aspects of food security and nutrition, namely, quality (micronutrients) and safety, the number of people suffering from undernourishment increases drastically. This human tragedy takes a high toll, mostly on women and young girls in developing countries.

The year 2015 marks the end of the monitoring period for the Millennium Development Goal targets. For the developing regions as a whole, the share of undernourished people in the total population has decreased from 23.3 percent in 1990–92 to 12.9 percent. This is really a welcome progress, but at too slow a pace to reach the MDG 1c target of halving the proportion of the chronically undernourished, the report notes. Moreover, its progress varies greatly among regions. A total of 57 developing countries out of 129, or close to half of the countries monitored, have not yet reached the MDG 1c hunger target.

Also highlighted in the FAO report was the fact that "in some regions, including western Africa, south-eastern Asia and South America, undernourishment declined faster than the rate for child underweight, suggesting room for improving the quality of diets, hygiene conditions and access to clean water, particularly for poorer population groups." Thus, dealing with global hunger issues raises the obvious question: Can we produce enough food sustainably and at a price affordable to all?

Recent events around the world – droughts, land rush (investing in foreign farmlands), and shocks in energy supplies and prices – underline the scarcity of resources we depend on to produce the world's food supply. According to a recent FAO estimate, we will have 9.6 billion people by 2050 – an increase of 2.6 billion people from 2013. It is increasingly clear that sustainably feeding an ever-increasing number of people requires a much more careful and integrated approach to the use of land, water, and energy than we currently apply. It is an absolute must that we start now to produce more food using fewer resources and to use the harvest more efficiently. Demographic changes, rising incomes (and associated consumption patterns), and unstable climatic conditions, alongside persistent poverty and inadequate policies and institutions, are all placing serious pressure on the natural resource base that supports current and future societies. This presents a 'perfect storm' scenario, especially in light of the recent trends in and increased likelihood of extreme weather events.

The year 2014 was highly significant for JIRCAS because it was one year before the end of the 5-Year Business Plan for 2011-2016. We have started seeing verifiable evidence of successful implementation of the Projects and delivery of expected outputs under our four newly formed Programs (Fig. 1). This annual report describes how JIRCAS has carried out the major activities that have produced proud moments and highlights.

Let me recap the main points of our Program-based management and strategy:

Introducing the four Programs

The four Programs developed using the mission-based principles are as follows:

1) Development of agricultural technologies based on sustainable management of the environment and natural resources in developing regions (Environment and natural resources management)
2) Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments (Stable food production)
3) Technology development for income and livelihood improvement of the rural population in developing regions (Rural livelihood)
4) Information gathering, analysis, and dissemination of domestic and overseas data of the agricultural, forestry and fishery industries in developing regions (Information analysis)

Program-based management

We now have 17 "Projects" that are placed under "Programs" (see Fig. 1). The programs will enable us to clarify our overall goals that need to be achieved and the manner by which we attempt to accomplish our research. Especially assigned

Program Directors are in charge of budget, personnel, goal achievement management, and evaluation. Programs A to C have their own so-called flagship projects, representing the most important activity in each program. Projects under each program collectively and coherently contribute to the major goal of their respective programs.

Partnership is the center of our activities

Most of our activities are carried out together with our partner institutions around the world. Effective partnership makes it possible for us to conduct joint research activities that would be of value for social impact for our target beneficiaries in developing regions. The map (Fig. 2) shows locations of our current activities based on formal institutional Memorandums of Understanding. We value such partnerships and place it as our organization's core value. In 2013, we consulted our partners for their feedback on our research activities, and we made the necessary adjustments in our planned research, accommodating our partners' suggestions and our own reflections: this was needed as a mid-course adjustment for better impact delivery. JIRCAS's operational cycle (Fig. 3) illustrates our focus towards impact-oriented research for development. Consequently, we were able to develop a clear impact pathway for the delivery of our research outputs to the respective target beneficiaries of each project.

Strive for impacts

By introducing the program-based system for output development and delivery, JIRCAS shall be able to depict more succinctly, not only to taxpayers and Japanese citizens but also to people in developing countries, what it essentially does and for whom. Promotion of more efficient and accountable research will further be feasible. Accordingly, it is important for every researcher, manager, and support staff to work together to produce well-considered outputs that will be deemed suitable, acceptable, and adaptable for users. We will keep striving to take advantage of this new structure with the undying passion of our 44-year-old "research for development" tradition, hoping to produce deliverables that will be used by our target beneficiaries.

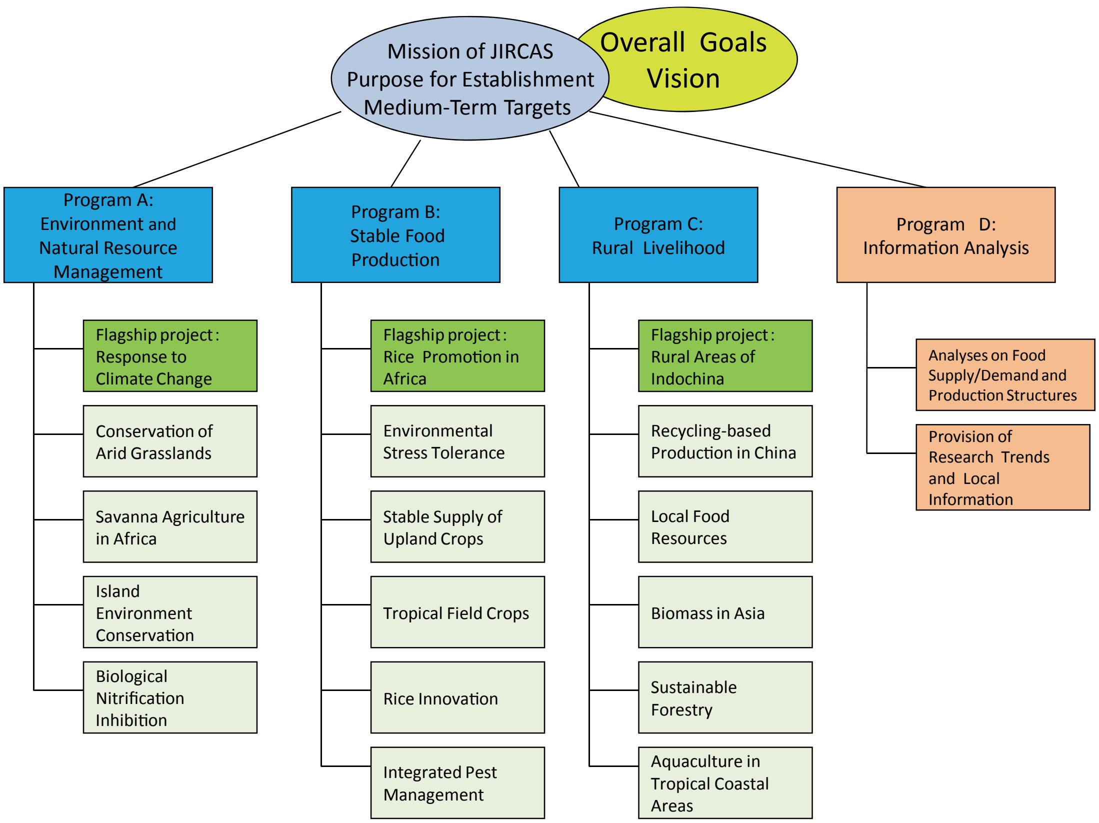


Fig. 1. Program-Project Research Framework

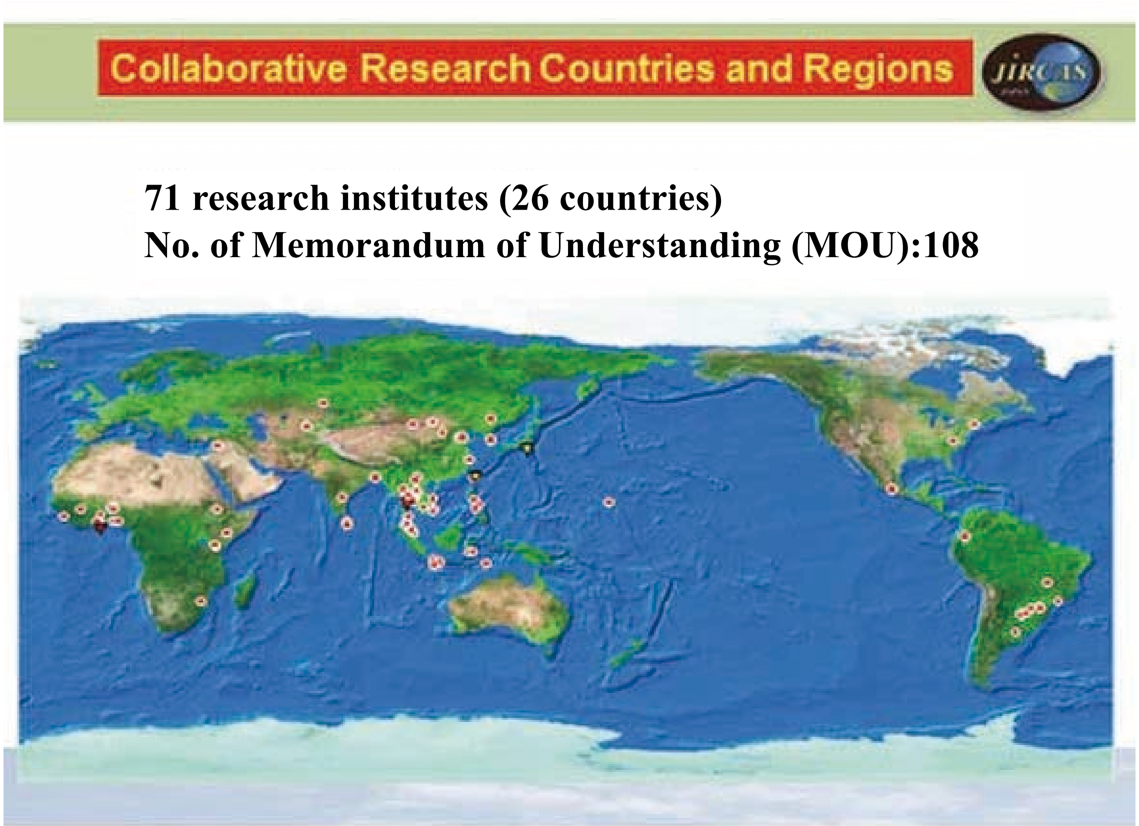


Fig. 2. Locations of our current activities based on 108 MOUs with partner institutions

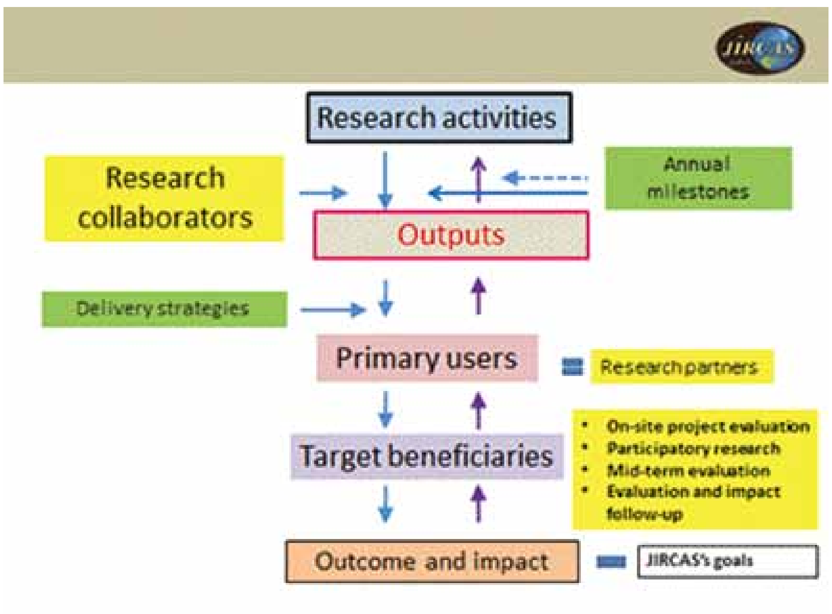


Fig. 3. Impact-oriented research for development (Operational Cycle)

HIGHLIGHTS FROM 2014

JIRCAS International Symposium 2014

JIRCAS International Symposium 2014, entitled *Soil Environment and Crop Production: Toward Stable Crop Production in Developing Regions*, was held in Tokyo on November 28, 2014. The symposium was organized by Japan International Research Center for Agriculture Sciences (JIRCAS) and co-organized by the Japanese Society of Soil Science and Plant Nutrition, with the kind support of the Research Council Secretariat of the Ministry of Agriculture, Forestry and Fisheries and the National Institute for Agro-Environmental Sciences as well as Japan Forum on International Agricultural Research for Sustainable Development.

Climate change and rising food prices are still serious problems in many parts of the world. For this reason, recognizing the increasing importance of technology development is a key to increased productivity and stable production of agricultural products in the tropics and other unstable environments. This approach would help reduce malnutrition in developing regions and improve global food security.

Solutions to problems related to soil environment, soil health, and fertilizer, which are indispensable for crop production, are urgently needed, particularly in areas like Africa where unstable environments that limit productivity are widely distributed. We recognize that tackling these problems is an urgent matter, following the Tokyo International Conference on African Development (TICAD V) of 2013 and ahead of the United Nation's declaration of 2015 as the International Year of Soils.

In this symposium, topics focusing on the improvement of nitrogen and phosphorous use efficiency as well as countermeasures against salinity were discussed by researchers and specialists in a comprehensive manner, not only from the aspect of soil science or plant nutrition but also from that of crop breeding or crop improvement.

There were two keynote speeches. Dr. Dar explained important issues related to soil in developing regions and showed examples of programs for addressing them in his speech entitled *Sustainable intensification through improved soil health in smallholder agriculture*. Dr. Kosaki, on the other hand, presented a theoretical clarification of issues on soil from the viewpoint of soil science and their application to agriculture in developing regions in his speech entitled *Soil degradation: Challenge to achieving human security*.

Session 1 (Improvement of crop productivity in infertile soils) was divided into two parts: The first half focused on nitrogen issues while the second half highlighted phosphorus issues.

The first half of Session 1 began with the speech *Overview on soil fertility and crop production in SSA* (Dr. Bationo), followed by *Nitrogen use*

JIRCAS International Symposium 2014
Akihabara Convention Hall, Tokyo, Japan
November 28, 2014

and efficiency in East Asian agriculture - A step towards application in Africa (Dr. Mishima), *N2Africa: Delivering biological nitrogen fixation (BNF) technologies to African small-scale farmers for enhancing soil fertility and legume production* (Dr. Karanja), and *Biological Nitrification Inhibition (BNI) -Potential for reducing nitrification and N_2O emissions from agricultural systems* (Dr. Subbarao).

The second half of Session 1 commenced with the topic *Soybean yield is affected by previous crops and mycorrhizal fungal colonization under no P fertilizer condition -A Japanese study with applicability to developing regions-* (Dr. Isobe), followed by *Agricultural use of indigenous phosphate rocks in Sub-Saharan Africa* (Dr. Tobita), and *Pup1 and beyond: New ideas, traits and genes for higher phosphorus efficiency* (Dr. Wissuwa).

Session 2 (Mitigation of soil salinity problems) opened with a speech titled *Sustainable technologies for crop production under salt-affected soil in India* (Dr. Sharma), followed by two speeches: *Soil salinization and its mechanism in checkdam farmlands in the Loess Plateau, China* (Dr. Shimizu) and *Genetic improvement of salt tolerance in soybean* (Dr. Xu).

The last part of the symposium was allotted for the General Discussion, whose main focus was the collaboration between soil science and crop breeding. There were several comments, for example, on the importance of recognizing soil diversity in different regions or on the selection of suitable technologies by comparing them under different environments in different specialized areas.

The proceedings of this symposium including the transcribed speeches and discussions are available at JIRCAS's website (http://jircas-d.job.affrc.go.jp/Ver-1/english/research-trend/symposium-proceedings/). A special edition of JIRCAS Newsletter (Issue No.74) was also published, focusing not only on the outline of the symposium but also on JIRCAS's research outputs as presented at the symposium. Furthermore, symposium-related research activities such as the genetic approach of nitrogen use efficiency in rice, cultivation improvement for increasing rice yield in Africa, and countermeasures against salinization in Uzbekistan were described by JIRCAS researchers.

APAARI-JIRCAS Expert Consultation on Assuring Food Safety in Asia-Pacific

JIRCAS, together with the Asia-Pacific Association of Agricultural Research Institutions (APAARI), co-organized the "Expert Consultation on Assuring Food Safety in Asia-Pacific" in Tsukuba on August 4-5, 2014. The objectives were to deliberate on recent developments on the science and regulation of food safety, identify country level gaps in the effective implementation of food safety measures, and set priorities for regional and sub-regional cooperation. The expert consultation was attended by 23 policy makers and scientific experts from national agricultural research systems and universities in Chinese Taipei, India, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, and Japan as well as from international organizations such as the Food and Agricultural Organization of the United Nations (FAO) and the Consultative Group on International Agricultural Research (CGIAR).

Group photo of the participants at the expert consultation

Dr. M. Iwanaga, president of JIRCAS, and Dr. J. K. Karihaloo, APAARI coordinator, welcomed the participants, followed by an opening remarks by Mr. A. Endo, director of International Research Division, MAFF. Regional food safety issues and the actions required to solve them were presented and discussed over the ensuing sessions, namely, I: Keynote Presentations: Overall Scenario of Food Security and Food Safety; II: Country Status Reports; III: Issues and Scientific Advances in Specific Commodities; IV: International Initiatives; and V: Discussion of Key Issues. Although the consultation was specifically related to food safety, it was emphasized that food safety has a very close relationship with food security, nutrition security, and sustainability, and thus this relationship should be well understood to maximize the impact of this important subject on the food scenario.

Recommendations were made under the following items: (i) Policy and standards, (ii) Traditional foods, (iii) Stakeholders involvement, (iv) Food control systems – risk management aspects, (v) Laboratories, (vi) R&D, (vii) Farm level good agricultural practices (GAP), (viii) GM foods, and (ix) Others. In addition, areas of collaboration at the national/regional levels were identified, which included suggestions to increase coordination between competent authorities within countries and to create an information network for knowledge and resource sharing. Programs to strengthen food safety for non-packaged foods were also identified as an important area for regional collaboration.

Workshop to deepen research collaboration with Burkina Faso, West Africa

Burkina Faso is located south of the Sahara desert. It has a population of 17.5 million, of which 80% is engaged in agriculture. However, farmers struggle with very low crop yields due to erratic climate and widely-distributed infertile soils. In order to discuss sustainable agricultural development in Burkina Faso focusing on research and technology development, a JIRCAS workshop entitled "International Collaborative Research of Japan for Sustainable Agricultural Development in Burkina Faso" was held on Sept. 16, 2014 at Splendid Hotel, Ouagadougou, with strong support from the Japanese Embassy in Burkina Faso and Japan International Cooperation Agency (JICA). The Japanese side was led by Dr. Masa Iwanaga (JIRCAS President), Mr. Masato Futaishi (Japanese Ambassador), and Mr. Takumichi Morishita (JICA Representative). The Burkina Faso side, on the other hand, was led by Mr. Salif Ouédrago (Minister of Environment and Sustainable Development), Dr. Compaore R. A. Maxim (Secretary General, Ministry of Scientific Research and Innovation), and Dr. Hamidou Traoré (Acting Director of the Institute of Environment and Agricultural Research, INERA).

In Session 1, Mr. Morishita (JICA) presented a summary of all Japanese collaborative activities in Burkina Faso and the roles of each institution including JICA and JIRCAS. Dr. Takeshi Kano (JIRCAS Program Director) outlined JIRCAS's international research activities especially in African countries.

In Session 2, on-going research projects for agricultural development were presented by both Burkina Faso and Japanese researchers. The following research topics were presented: 1) conservation agriculture extension, 2) cowpea variety dissemination and grain quality research, 3) efficient utilization of local resources, and 4) effective management and utilization of water resources for rice production.

In Session 3, several topics for possible collaboration in agricultural research were discussed, such as the integration of livestock raising and agriculture, shea butter cultivation technology, Burkina rock phosphate research, and so on.

Prior to the workshop, JIRCAS signed a Memorandum of Understanding with INERA and a Joint Research Agreement with the Ministry of Environment and Sustainable Development for further research collaboration to achieve sustainable agricultural development in Burkina Faso.

Photo 1. Group photo of the workshop participants

Photo 2. Signing of MOU between INERA (represented by Dr. François Lompo) and JIRCAS (represented by Dr. Masa Iwanaga)

International Seminar and Workshop on "Rice Research Collaboration: Past and Future"

The International Seminar and Workshop on "Rice Research Collaboration: Past and Future" were held in Tsukuba on March 4 and 5, 2015 to look back and evaluate the achievements during the past three decades of Japanese collaboration and reflect on the current situation, identify new research areas for future collaboration, and strengthen the partnership between Japanese and Consultative Group for International Agricultural Research (CGIAR) scientists. A total of 169 participants attended these international events.

During the International Seminar held on March 4, Dr. Masa Iwanaga, president of the Japan International Research Center for Agricultural Sciences (JIRCAS), delivered the opening remarks. He noted that JIRCAS now plays an important role in international rice research as a strategic partner of the Global Rice Science Partnership (GRiSP). Dr. Iwanaga's opening remarks was followed by welcome remarks given by Mr. Akira Endo, director of International Research Division, Ministry of Agriculture, Forestry and Fisheries (MAFF), Professor Takuji Sasaki, a member of CGIAR's Independent Science & Partnership Council (ISPC), and Professor Akinori Noguchi, board member of the International Rice Research Institute (IRRI).

Invited guests for the international seminar on March 4, 2015

The opening remarks during the international workshop on March 5, 2015

There were two keynote speeches. The first speech was done by Professor Keijiro Otsuka, Oversight Committee member of GRiSP and professor at the National Graduate Institute for Policy Studies (GRIPS). He talked about the role of Japanese research institutions and collaborations for future rice researches. In the second keynote speech, Dr. Gurdev Khush, IRRI's former breeding director and now adjunct professor at the University of California, Davis, discussed how to feed 5 billion rice consumers by 2050.

There were three presentations on international rice research. Dr. Matthew Morell, IRRI's deputy director general for research, discussed the research collaboration of IRRI-Japan and its future. Dr. Marco Wopereis, deputy director general of Africa Rice Center, and Dr. David Johnson, head of IRRI's Crop and Environmental Sciences Division, discussed the Japan-GRiSP collaboration in Africa and Asia, respectively. Prof. Kensuke Okada, professor/director at the University of Tokyo, discussed the Japanese collaboration with CIAT. At the end of the international seminar, Dr. Tokio Imbe, president of the National Agriculture and Food Research Organization (NARO), delivered the closing remarks.

Dr. Masa Iwanaga also delivered the opening remarks during the international workshop on March 5. This was followed by the welcome speech of Mr. Masato Iso, vice president of the International Research Corporation of NARO. As part of the opening session, Dr. Morell and Dr. Wopereis also presented how to enhance international rice research through collaboration of their respective institutions with Japanese organizations.

After the opening session, three parallel sessions were held. Twenty-four international and Japanese speakers participated in these sessions. Session 1 was on genomics, genetic resources, and breeding wherein yield potential, diversification of breeding program, phosphorous absorption, development of tolerant varieties for South Asia, breeding program in Africa Rice, and resistance to planthoppers and leafhoppers were presented. Session 2 was on physiology and production environment which covered presentations on rice grain quality under heat stress, heat tolerance and escape at flowering, root development for drought tolerance and nitrogen uptake, food safety and phyto-remediation, physical and tasting quality in rice, high quality rice using post-genomic tools, and paddy weed management. Session 3 was on climate change and impact assessment which covered presentations on stress-tolerant rice and its impact, determinants of rice productivity in Tanzania, global supply-demand of cereal crop, rice response to elevated carbon dioxide crop management for unfavorable rice environments in Asia, rice production system in West Africa, past and future impact of climate change on the major crops, and review on climate change research between IRRI and Japan.

The events were organized by JIRCAS and GRiSP with support from the Research Council Secretariat of MAFF, NARO, National Institute of Agrobiological Sciences (NIAS), National Institute for Agro-Environmental Sciences (NIAES), as well as the CGIAR research centers (IRRI and AfricaRice).

2014 Japan International Award for Young Agricultural Researchers

JIRCAS, in cooperation with the Agriculture, Forestry and Fisheries Research Council (AFFRC) Secretariat, presented the Japan International Award for Young Agricultural Researchers for the eighth consecutive year. The award recognizes and honors young foreign researchers (under 40 years of age) who are highly recommended by their institutes, and whose outstanding achievements promote research and development of agricultural, forestry, fishery and other related industries in developing regions. The 2014 commendation ceremony was held last November 27 at the Akihabara Convention Hall in Tokyo.

AFFRC Chairman Eitaro Miwa welcomed the awardees and guests, and congratulatory remarks were delivered by Council for Science and Technology Policy (Cabinet Office) Executive Member Yuko Harayama and Japan International Cooperation Agency (JICA) Senior Special Adviser Masahito Enomoto. Selection Committee Chair Keiji Kainuma explained the selection process.

The seven-member selection committee conducted a document review, with the chairman of the AFFRC determining three winners from among 34 candidates. Each awardee received a testimonial and a USD 5,000 cash prize.

The 2014 awardees and their research achievements are as follows:

Dr. Giriraj AMARNATH
Nationality: Indian
Institute: International Water Management Institute (IWMI)
Research achievement: Enhancing Resilience to Agricultural Flood-Risks and Adaptation for Smallholder Farmers in Asia and Africa

Dr. HO Le Thi
Nationality: Vietnamese
Institute: Cuu Long Delta Rice Research Institute (CLRRI)
Research achievement: Allelopathy and Allelochemicals in Vietnam Local Cucumber Variety and Vietnamese Rice Cultivars

Dr. Asad JAN
Nationality: Pakistani
Institute: Institute of Biotechnology and Genetic Engineering, The University of Agriculture Peshawar, Pakistan
Research achievement: Analysis of Plant Growth Regulation under Abiotic Stress Conditions

The 2014 awardees, members of the selection committee, and other officials

NEW RESEARCH COLLABORATION

New relationships with the Agricultural Research Institute of Mexico and FAO

JIRCAS signed a Memorandum of Cooperation (MOC) with the National Forestry, Crops and Livestock Research Institute of the United Mexican States (INIFAP) to conduct research on soybean rust pathogen and development of resistant varieties. The signing, witnessed by President Enrique Peña Nieto of Mexico and Prime Minister Shinzo Abe of Japan, took place at the National Palace in Mexico City, Mexico, on July 25, 2014.

JIRCAS also signed a Memorandum of Understanding (MOU) with the Food and Agriculture Organization of the United Nations (FAO) on October 31, 2014 at the FAO Regional Office for Asia and the Pacific (FAO RAP) in Bangkok, Thailand. JIRCAS is currently a participant to a Technical Cooperation Program (TCP) of FAO RAP to develop a standard econometric model framework for assessing food supply-demand situation at country level through the ASEAN Food Security Information System (AFSIS) Project.

JIRCAS also sent representatives to FAO-organized meetings such as the "High-Level Multi-Stakeholder Consultation on Sustainable Agricultural Mechanization in Asia and the Pacific" held on June 26-27, 2014 in Bangkok, Thailand.


Photo 1. Signing ceremony in Mexico

Photo 2. Signing ceremony in Bangkok

OPEN RESEARCH FACILITIES (Lysimeters)

Open research facilities (lysimeters) were constructed at the Tropical Agricultural Research Front in 2003 to accelerate research activities on reducing soil erosion and water deterioration, and to increase water use efficiency in island environments. The facilities consist of lysimeters (indoor and outdoor), artificially prepared sloping fields, and artificially constructed waterways. Weighing lysimeters are also located outside. These are used for analyzing evapotranspiration, fertilizer and water release, water use by plants, soil erosion extent, and water quality, among others.

Drained water and nutrients from the lysimeters can be collected and measured, and irrigation pipes are installed to supply water from the bottom. Rooting behavior can be observed with rhizotrons. Latest sensors and instruments are installed to measure soil environmental conditions. The equipment for water status observation, soil physics analysis, water quality and root development measurement, transpiration and soil erosion estimation as well as plant water measuring operation are also linked to the lysimeter system.

The facilities are open to researchers interested in the environmental conservation of agricultural ecosystems. Collaborative researches with JIRCAS have been carried out with research organizations. In 2014, two universities and one private enterprise utilized the facilities for collaborative research. In addition, three external organizations including one private enterprise used the facilities for their own research purposes. We have also been using the facilities for JIRCAS research projects implemented under the "Environment and Natural Resource Management Program" in order to elucidate the dynamics and leaching of soil nitrogen in island conditions and to analyze the effects of cover crops on soil erosion. JIRCAS Newsletter No.64 (September 2012 issue) highlighted the results of our research results using the facilities.

We hold operating committee meetings on both regular and extraordinary basis to discuss effective utilization and extensive publicity campaigns for the facilities. We collect fees for using the facilities/equipment for external uses in accordance with operating regulations.

ACADEMIC PRIZES AND AWARDS

Certificate of appreciation from the National Agriculture and Forestry Research Institute, Lao PDR

The National Agriculture and Forestry Research Institute (NAFRI) celebrated its 15th anniversary on April 9 and 10, 2014 at the NAFRI campus in Vientiane, Lao PDR, with a series of activities including the presentation of a certificate of appreciation to JIRCAS. The anniversary ceremony consisted of three parts: a specimen and poster exhibit showing the activities of each organization, a workshop on the research activities of Laos researchers and foreign researchers, and an awarding ceremony in recognition of NAFRI staffs for their long-service and of overseas organizations for their cooperation.

Twelve posters showing the outcomes of collaborative research were displayed at JIRCAS's exhibit booth. The posters were used to explain the activities of the project to the guests, which included the Minister of Agriculture and Forestry and the Minister of Science and Technology. At the awarding ceremony, Project Leader Masuo Ando of JIRCAS, on behalf of the project members, received a certificate of appreciation from NAFRI Director General Bounthong Bouahom for the tight cooperation between JIRCAS and NAFRI.

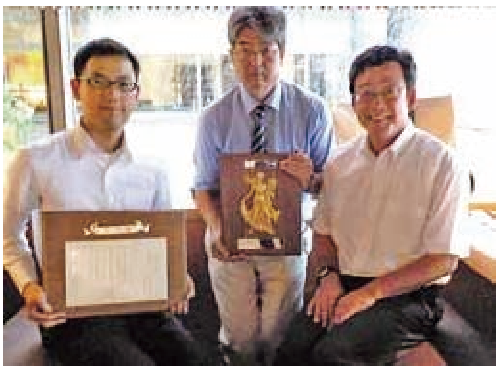
Minister Sitaheng Rasphone (right) of the Lao Ministry of Agriculture and Forestry visits JIRCAS's booth at NAFRI's 15th anniversary ceremony.

JIRCAS Project Leader Masuo Ando (right) receives the certificate of appreciation from NAFRI Director General Bounthong Bouahom.

Multiple awards for the "Fallow Band System" in the Sahel

For their outstanding achievements in the development of a new countermeasure against desertification (called the "Fallow Band System") in the Sahel, West Africa, Dr. Kenta Ikazaki, a researcher of Crop, Livestock and Environment Division, and Dr. Satoshi Tobita, director of the division, together with colleagues, received the "Environment Minister's Prize" at the 2014 Environmental Awards ceremony hosted by the Hitachi Environment Foundation and Nikkan Kogyo Shinbun (The Business and Technology Daily News). Dr. Ikazaki also received the "Achievement Award for Young Scientists" at the 13th Japan Prize in Agricultural Sciences ceremony hosted by the Foundation of Agricultural Sciences of Japan.

The "Fallow Band System" was developed under the JIRCAS collaborative project with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Kyoto University from 2005 to 2012. It can control desertification caused by wind erosion by 70% and increase crop yield from 36 to 81%. Thanks to superior and obvious results as well as its almost-nothing-to-do feature, the system is now being adopted by 500 farmers (from 89 villages in 23 districts of 5 states) in Niger.



Mongolian University of Life Sciences awards honorary professor title on JIRCAS researcher

Dr. Seishi Yamasaki, project leader of the Crop, Livestock and Environmental Division, was conferred the title of "Honorary Professor" by the Mongolian University of Life Sciences (MULS), Mongolia, in a decision reached by the Scientific Council on November 04, 2014. His diploma was awarded in recognition of his "contributions for the development of agricultural higher education, research and development in Mongolia."

JIRCAS has been promoting collaborative research projects with MULS from the start of the JIRCAS 2nd mid-term phase (from 2006). Dr. Yamasaki, who specializes in animal production and grassland sciences, has been an active participant in the development of a sustainable agro-pastoral system in the region, among others. During the course of the projects, he worked not only with JIRCAS colleagues but also with MULS co-researchers and students. The title given this time was an expression of appreciation and an expectation for further cooperation from the university.

The diploma was presented by Dr. Tomorbaatar Kheruuga, president of MULS, on November 28, 2014, in a ceremony commemorating "Researchers' Day," in the presence of MULS researchers in Ulaanbaatar City, Mongolia.

Diploma of Honorary Professor awarded by the Mongolian University of Life Sciences (MULS), Mongolia, to Dr. Seishi Yamasaki

Certificate of appreciation from the National University of Laos

On December 9, 2014, the National University of Laos (NUOL) awarded a certificate of appreciation to JIRCAS for "the technical assistance provided to research and human resources development at the Faculty of Agriculture." JIRCAS and NUOL started collaborative research on animal feeding and silage production in Laos in 2007. The partnership has been strengthened through projects, including an ongoing research (since 2012) on fermented fish foods. Currently, the research group is playing a major role in the research field of applied microbiology in Laos. JIRCAS and NUOL have reaffirmed its commitment to the partnership and will develop a higher level of cooperation in the future.

LAO PEOPLE'S DEMOCRATIC REPUBLIC
PEACE INDEPENDENCE DEMOCRACY UNITY PROSPERITY

No: ____/NUOL

THE NATIONAL UNIVERSITY OF LAOS
AWARDS THIS CERTIFICATE OF APPRECIATION TO:

JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCE

FOR THE FINANCIAL AND TECHNICAL ASSISTANCE PROVIDED TO RESEARCH AND HUMAN RESOURCES DEVELOPMENT AT FACULTY OF AGRICULTURE, NATIONAL UNIVERSITY OF LAOS, LAO P.D.R.
2007 – 2014

ISSUED BY THE NATIONAL UNIVERSITY OF LAOS
PRESIDENT

PROF. DR. SOUKKONGSENG SAIGNALEUTH

Certificate of Appreciation from the National University of Laos

Dr. Oudom Phonekhampheng, dean of the Faculty of Agriculture (left), presents the certificate to Dr. Masayoshi Saito, program director of JIRCAS.

Certificate of appreciation from the Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Thailand

On February 11, 2015, the Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL) in Thailand commended JIRCAS Researcher Isao Tsutsui with a certificate of appreciation and a plaque for his 'devoted contribution to support education and research activities' through a project named "Development of aquaculture technologies for suitable and equitable production of aquatic products in tropical coastal areas."

JIRCAS has been implementing a joint research activity with KMITL since 2011 on the development of a co-culture system for giant tiger prawn and unexploited benthos. This research activity has generated scientific knowledge and achievements, inspiring both organizations (KMITL and JIRCAS) to look forward to a more fruitful relationship in the future.

Dr. Isao Tsutsui (left), researcher at JIRCAS, accepts the plaque from Dr. Surayud Chulanont, chancellor of the council of King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand.

RESEARCH OVERVIEW

OVERVIEW OF JIRCAS' RESEARCH STRUCTURE

1. History

The Japan International Research Center for Agricultural Sciences (JIRCAS) was first established in 1970 as the Tropical Agriculture Research Center (TARC), one of the research institutes of the Ministry of Agriculture and Forestry of Japan. TARC was reorganized into JIRCAS in 1993.

On April 1, 2001, JIRCAS became an Incorporated Administrative Agency (IAA) under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries (MAFF), in accordance with the administrative reforms of the Government of Japan to facilitate the reorganization of national government-affiliated research organizations.

2. Mission

Through research and development (R&D) and dissemination of information related to agriculture, forestry and fisheries in developing regions, JIRCAS contributes to the improvement of the international presence of Japan and towards a secure and stable supply of food worldwide including Japan.

3. The IAA System

An IAA is an organization responsible for key public services that the government is not required to provide, but which the private sector is likely to neglect for various reasons. The IAA system was introduced in 2001, as part of central government reforms based on the scheme that the planning sectors and the implementing sectors should be separated. Under the IAA system, MAFF defined JIRCAS' Third Medium-Term Goals in FY 2011, including the enhancement of research efficiency and the improvement of the quality of research programs and financial performance. Based on the Third Medium-Term Goals, JIRCAS drafted and began to implement a detailed five-year plan, the Third Medium-Term Plan (FY 2011- FY 2015).

4. Evaluation

The performance and budgeting management of research activities conducted by JIRCAS undergo regular evaluation by the IAA Evaluation Committee established within MAFF. As for the activities of each fiscal year, the Committee investigates and analyzes the progress towards achieving the Medium-Term Plan, and the results of this evaluation shall be applied as deemed necessary to the modifications of the operational and financing systems for subsequent fiscal years. To meet the requirements of the general guideline concerning evaluation of the national research and development (a decision of the Prime Minister in 2008) which require efficient evaluation, JIRCAS has modified the in-house evaluation system in the initial year of the Third Medium-Term Plan. The in-house evaluation in FY 2014 was carried out as follows:

1) Research activities were evaluated, and summary reports were prepared in each Research Program.
2) These reports were then collectively evaluated at the meeting for the evaluation of research programs of the Medium-Term Plan by external reviewers (government officials from the Ministry of Agriculture, Forestry and Fisheries and specialists from other research institutes) and internal reviewers (the President, the Vice-President, an Executive Advisor and Auditor, the Program Directors and the Directors of each research division) in February 2015.
3) Comprehensive evaluation of all JIRCAS activities, which also include administrative operations, was performed by external reviewers of the JIRCAS External Evaluation Committee in March 2015.

The external reviewers are listed in the Appendix. The results of the in-house evaluation and a summary of all activities were submitted to MAFF in June 2015.

5. Medium-Term Plan

JIRCAS implements four programs for research activities under the Medium-Term Plan. Each program consists of several projects. Major accomplishments and research highlights of the programs in FY 2014 are described in the following sections. The contents of the Medium-Term Plan are also described in the Appendix.

Table 1. Number of Programs in the Third Medium-Term Plan (FY 2011 - FY 2015)

Program	Projects
A (Environment and Natural Resource Management)	5
B (Stable Food Production)	6
C (Rural Livelihood)	6
D (Information Analysis)	2

Third Medium-Term Plan (FY 2011 - FY 2015)

[Research Approach 1]
Research and development on agricultural, forestry and fishery technologies geared towards providing solutions to international food and environmental problems

Program A
Development of agricultural technologies based on sustainable management of environment and natural resources in developing regions

Projects:
1. Development of agricultural technologies in developing countries to respond to climate change
2. Development of resilient agro-pastoral systems against the risks of extreme weather events in arid grasslands in Northeast Asia
3. Development of technologies for sustainable agricultural production in the African savanna
4. Development of environment-friendly agricultural production technology in islands
5. Utilization of Biological Nitrification Inhibition (BNI) function for the development of breeding materials and application to cropping systems

Program B
Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments

Projects:
1. Development of rice production technologies in Africa
2. Development of genetic engineering technologies of crops with environmental stress tolerance
3. Development of breeding technologies toward improved production and stable supply of upland crops
4. Evaluation and utilization of diverse genetic materials in tropical field crops
5. Rice innovation for environmentally sustainable production systems
6. vDevelopment of integrated pest management (IPM) techniques for stabilization of agricultural and livestock production in developing areas

Program C
Technology development for income and livelihood improvement of the rural population in developing regions

Projects:
1. Establishment of sustainable and independent farm household economy in the rural areas of Indochina
2. Design and evaluation of a recycling-based agricultural production system in upland farming areas of Northern China
3. Advanced application of local food resources in Asia
4. Development of biofuel and biomaterial production technologies using biomass resources in Southeast Asia
5. Development of forest management and conservation techniques through sustainable use in Southeast Asia
6. Development of aquaculture technologies for sustainable and equitable production of aquatic products in tropical coastal areas

[Research Approach 2]
Program D
Collection, analyses and dissemination of information for grasping trends of international agriculture, forestry and fisheries

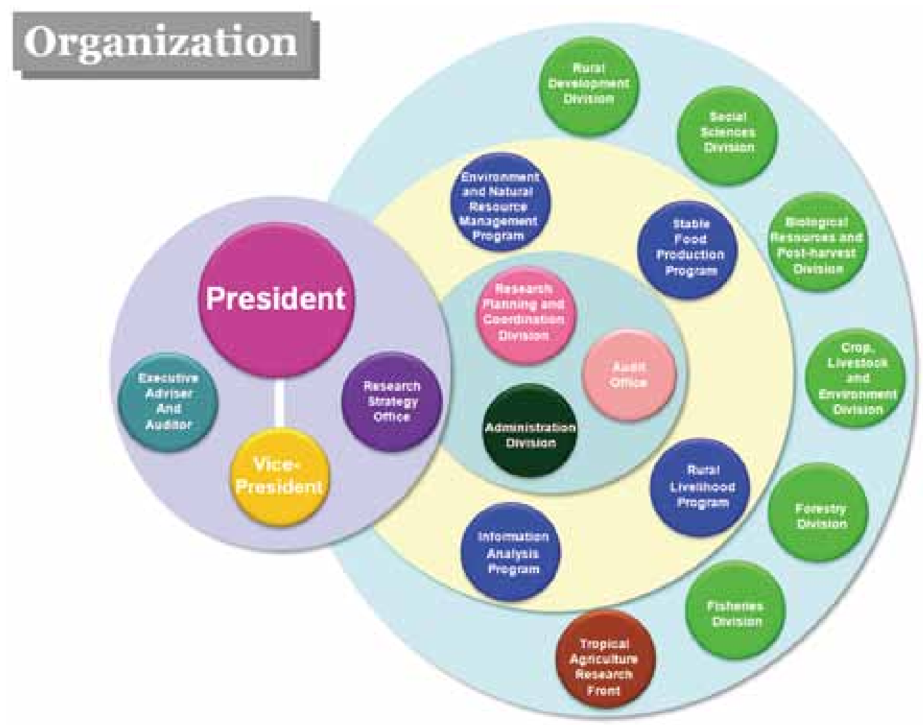
Projects:
1. Collection and analysis of international food supply and demand as well as production systems
2. Dissemination of research trends and local information

6. Collaborative Research

JIRCAS is required to cover a wide range of research fields. Human resources at JIRCAS, however, are limited. This makes collaborative research with other institutes or universities necessary towards achieving JIRCAS' project objectives. Whenever JIRCAS and its collaborators reach an agreement on the commencement of collaborative research after exchanging ideas and opinions, a Memorandum of Understanding (MOU) or a Joint Research Agreement (JRAs) is usually concluded. JIRCAS developed the concept of JRAs in 2006. A JRA is a contract for collaborative research with a particular research subject and with a fixed term. A total of 108 MOUs or JRAs remained in force at the end of FY 2014.

In 2004, JIRCAS was given a Certificate of Recognition by CGIAR as a key partner and as the CGIAR focal point institution in Japan. JIRCAS has been playing an important role in promoting mutual understanding and collaboration between CGIAR and the Japanese government. It has also been intensively implementing collaborative research with several CGIAR research centers.

JIRCAS has been regularly dispatching researchers and research managers to promote research in the developing regions. In FY 2014, 134 JIRCAS researchers or administrators were dispatched abroad for a total of 530 duties. Likewise, we have been dispatching researchers from other institutes and universities to promote the effective implementation of JIRCAS' projects with the cooperation of such organizations. JIRCAS has likewise implemented several invitation programs for overseas researchers and administrators at counterpart organizations. These programs facilitate not only the promotion of international collaborative research but also related exchanges of information and opinions.



7. Organization of JIRCAS

The organizational structure of JIRCAS for the Third Medium-Term Plan period is summarized in the figure above.

Four Program Directors, whose positions were newly-established, are responsible for the implementation of individual programs during the Third Medium-Term Plan period.

The directors of divisions, offices, and the Tropical Agriculture Research Front (TARF) are responsible for managing staff and enhancing the capabilities of researchers.

TARF (formerly the Okinawa Subtropical Station), located in Ishigaki Island in the southernmost part of Japan, is JIRCAS's sole substation. It focuses on agricultural, forestry, and fisheries research being carried out in overseas regions with highly similar climatic and geographic conditions as Okinawa, taking full advantage of its subtropical weather and geographic location.

MAIN RESEARCH PROGRAMS

PROGRAM A
Environment and Natural Resource Management

"Development of agricultural technologies based on sustainable management of the environment and natural resources in developing regions"

The Environment and Natural Resource Management Program focuses on impact analyses and the development of adaptation and mitigation technologies to cope with climate change. The program also deals with sustainable resource management and environmental conservation technologies in regions vulnerable to climate change.

[Response to climate change]

The impacts of climate change on agriculture were analyzed using econometric models including climate variables. The effects of meteorological disasters on rice production in Bangladesh were analyzed based on each event, such as cyclones or periodic floods, using a stochastic supply and demand simulation model for rice. During development of a world food model, a long–term outlook of rice, wheat, maize, and soybean yields for 126 countries or regions until 2050 was conducted by estimating yield functions incorporating a crop model under various IPCC emissions scenarios. The results indicated that crop yields in low–latitude regions will decrease due to climate change.

Regarding adaptation measures for climate change, near-isogenic lines (NILs) containing early morning flowering traits were developed with the genetic background of IR64. The aim was to reduce yield reduction caused by spikelet sterility under heat stress at flowering. The field and pot experiments indicated that the time of day of flowering was advanced by two hours in NILs compared with those with tropical Indica-type genetic backgrounds.With regard to technologies for adaptation to climate change under rainfed rice production systems, a yield improvement technique was confirmed by an on-farm field experiment in which supporting information on the timings of sowing and fertilizer application provided by a prototype decision support system was utilized.

Regarding mitigation measures, continued monitoring has demonstrated that methane emission from ruminants can be mitigated by feeding various total mixed rations (TMRs) compared with feeding a forage-only diet. Methane emission from grazing beef cattle continues to be monitored, indicating higher methane emission intensity during dry season (when body weight gain is generally lower) than during rainy season. Regarding greenhouse gas (GHG) emission from paddy fields under water-saving irrigation treatment (alternate wetting and drying: AWD), a yearly increase in rice yield and a decrease in GHG emission apparently resulted from continuing the triple rice cropping experiment in a farmer's paddy field in Mekong Delta, Viet Nam. Regarding Clean Development Mechanism (CDM), an international effort that helps disseminate mitigation measures, a monitoring activity of the biogas digester (BD) program in Mekong Delta, Viet Nam, was carried out for a year, and the amount of reduced GHG emission had been submitted to a designated operational entity (DOE) for verification. It was also indicated in the monitoring report that the amount of gas produced by each small-scale farmer's BD was dependent on the source amount of domestic animal wastes, and that stable BD use was realized by utilizing unused biomass resources like water-hyacinth as supplementary source materials.

[Utilization of Biological Nitrification Inhibition (BNI) function]

On BNI function's contribution as a mitigation strategy against global warming, it was shown that the nitrification inhibitory activity in the rhizoplane of sorghum was stronger in acidic soil than in neutral soil. Additionally, the nitrification inhibitory activity of various phenolic compounds, which are valuable for elucidating BNI mechanism, was clarified.

[Resilient agro-pastoral systems in Northeast Asia]

The goal of this research is to develop technologies that will help conserve the environment and promote the implementation of sustainable natural resource management methods particularly in areas vulnerable to climate change. In semi-arid Mongolian grasslands, the procedures for mapping pasture biomass were revised, based on spectral data that is applicable to areas with different vegetation types. Rapidly-updated carrying capacity prototype maps at a regional scale were then created and presented.

[Sustainable agricultural production in the African Savanna]

With regard to the development of a conservation agriculture (CA)-based cropping system in African Savanna regions, we are developing an evaluation system to detect CA extension priority areas based on both natural and socio-economic factors, enabling mapping on a GIS software under different conditions. In the Nacala Corridor, Mozambique, we revealed that the intercropping system (i.e., alternating soybean with corn using popular varieties in the region) achieved higher crop productivity than the monocropping system. Moreover, its effects were much pronounced under conditions of drought stress as well as lower doses of nitrogen fertilizer.

[Island environment conservation]

For the effective use of island water resources, we proposed a calculation method for creating a water management standard. The method is based on a numerical simulation of sustainable water withdrawal (without causing saltwater upconing) from freshwater lenses in the Republic of the Marshall Islands. In Negros Island, Philippines, it was highly probable that part of the base fertilizer used in sugarcane production was leaching into the groundwater because of insufficient nitrogen absorption. The problems associated with the practical application of a desalination device being developed were also confirmed.

TOPIC 1

Sustainable use of biogas digester by applying unused biomass

A biogas digester (BD) is a simple and manageable farm equipment that collects biomass and produces gas through anaerobic respiration (Fig. 1). It was introduced as a Clean Development Mechanism (CDM) project in farming households in Vietnam's Mekong Delta. Pig manure is the main feedstock for BD; however, biogas production will diminish if the number of pigs decreases due to sale of mature pigs, disease outbreaks, or lowered profitability. When biogas shortage is prolonged, households become more inclined to stop using BDs. On the other hand, there is plenty of unused biomass like the fast-growing water hyacinth in canal networks and ponds. With the appropriate technology, applying unused biomass as feedstock will make BD use sustainable.

Annual monitoring was conducted on 435 households from 1 June 2013 to 31 May 2014, and results showed that 44 households did not use biogas for more than one day during this period. Cited as the main reason (55%) for the non-use of BD was the absence of pigs due to stoppage of pig raising activities, pig disease, and sale of mature pigs to market (Fig. 2). Can Tho City, where the CDM project is being implemented, is located at the center of the Mekong Delta and surrounded

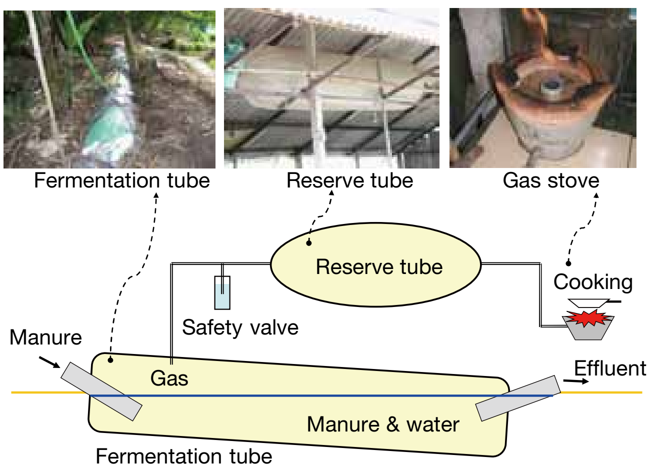


Fig. 1. Plastic-type biogas digester system

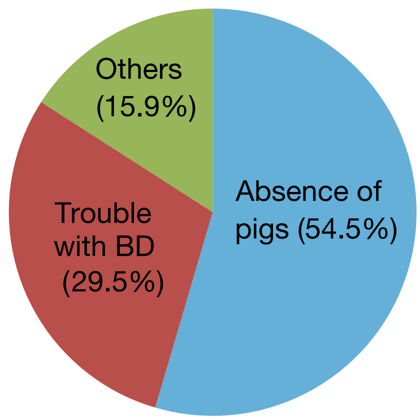


Fig. 2. Reasons for non-use of biogas

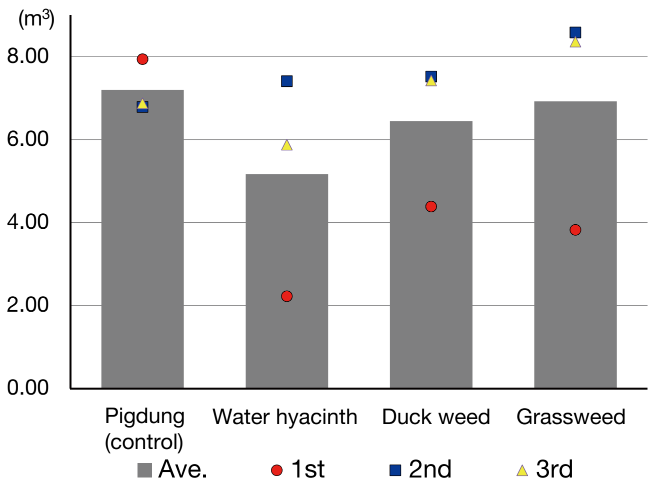


Fig. 3. Biogas production by applying unused biomass

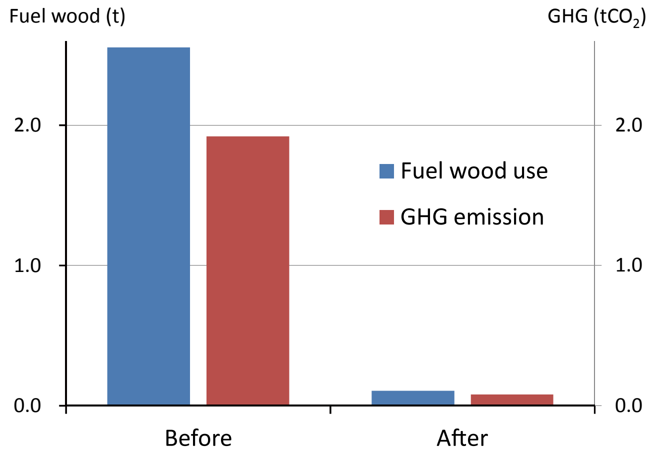


Fig. 4. Results of a verification study on a BD household applying only *Pistia stratiotes*. Graph shows significant drop in fuel wood use and GHG emissions over a one-year period.

by tributary streams and canal networks. Plenty of productive and unused biomass like water hyacinth grow in these waterways and ponds. If the unused biomass is applied as feedstock for BD in case of pig shortages, BD use will be stabilized. Experiments applying unused biomass to BD were conducted to examine biogas production from selected materials. The experiments consisted of 4 materials: (1) pig manure (control), (2) duckweed (*Pistia stratiotes*), (3) water hyacinth (*Eichhornia crassipers*), and (4) grass weed, including *Oryza rufipogon* Griff. The size of BD was the same as the one used by households. After cutting these materials to 20-30cm, 2.7kg (dry matter weight) of each material was filled to each experimental BD every day continuously for 30 days and the biogas produced from BDs was measured for 60 days from the start of the experiment. The experiments were replicated 3 times. Results of the experiments showed that biogas production from water hyacinth and from both duckweed and grass weed was 70% and 90%, respectively, compared to the control (Fig. 3). As a verification study, one household that installed a BD was asked to apply only duckweed to the BD as feedstock for a year from the beginning. Results of this study showed that biogas from duckweed could be used as cooking fuel continuously, that it substituted with 2.4t of fuel wood, and that it contributed to 1.8tCO_2/year of GHG emission reductions (Fig. 4).

In summary, this technology contributes to sustainable BD use by bridging the gap in BD feedstock when livestock manure is in short supply. One important thing to consider, however, is that farm households that apply unused biomass as feedstock for BDs must have easy and continuous access to the resource. Although the collection time for unused biomass is shorter compared with fuel wood, it is longer compared with livestock manure. Unused biomass, therefore, should be applied as supplemental feedstock only when livestock manure is insufficient.

(T. Izumi, E. Matsubara)

TOPIC 2

Development of a near-isogenic line with early-morning flowering trait in the genetic background of Indica-type variety in the tropics

Rice spikelets are most susceptible to heat stress at flowering. Air temperature at 35°C is the general threshold for heat-induced spikelet sterility (HISS) at flowering. Even a one-hour heat exposure to flowering spikelets can cause sterility. It is predicted that global warming will increase the risk of spikelet sterility in rice. Early-morning flowering (EMF) trait is considered effective in alleviating heat stress by shifting flower opening time (FOT) to earlier in the morning when it is cooler. In this study, we attempted to develop a near-isogenic line (NIL) with EMF trait in the genetic background of Indica-type variety, IR64.

Marker-assisted selection was employed to

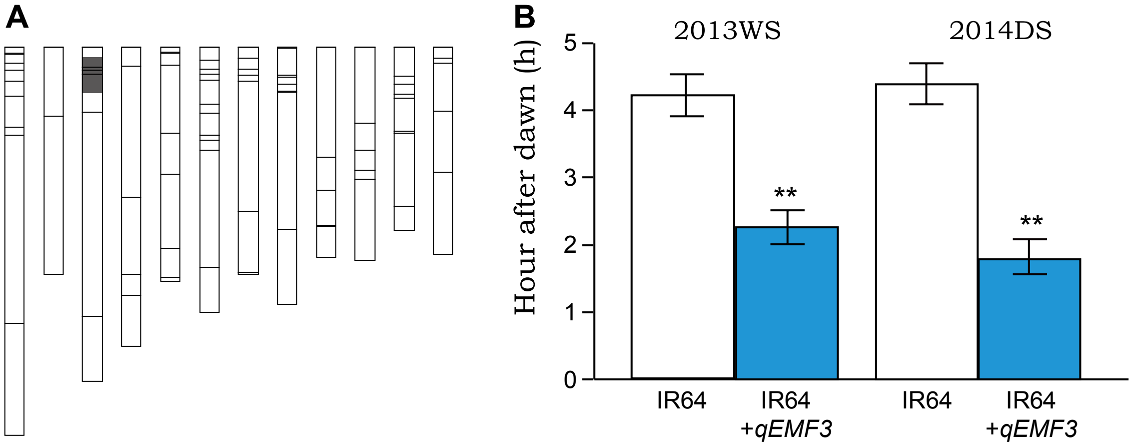


Fig. 1. Graphical genotype of IR64+*qEMF3* (A) and 50% of flower opening time in IR64 and IR64+*qEMF3* (B).
Gray bar on rice chromosome 3 is a locus of *qEMF3*. Other regions on chromosomes 1-12, indicated in white, refer to the IR64 genetic background. The horizontal lines on each chromosome refer to the positions of available SSR markers. Dawn was set as 0. Values indicate mean±SE of three or four replications. **Significant at 1% level by *t*-test. WS: wet season. DS: dry season.

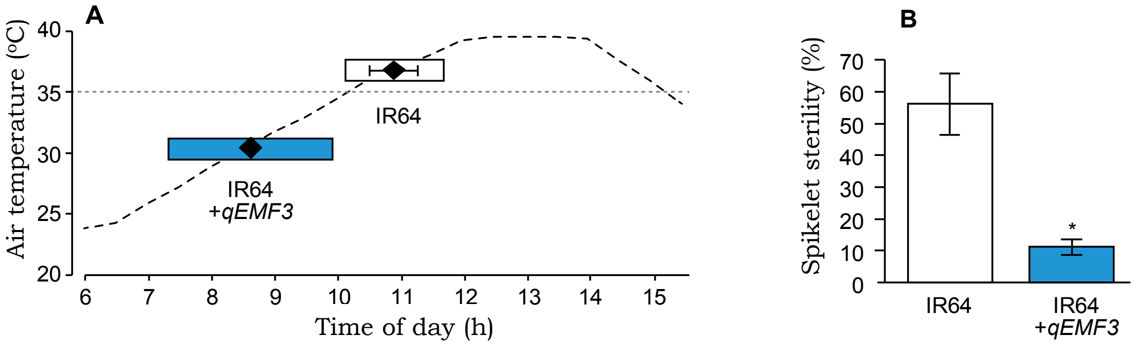


Fig. 2. The changes in time of day of flowering under elevated temperature conditions (A) and percentage of spikelet sterility at maturity (B).
(A) ◆ indicates 50% FOT±SE of three replications. The left and right sides of the horizontal bars indicate 10% FOT and 90% FOT, respectively. Horizontal broken line indicates the general threshold temperature (35ºC) for HISS at flowering.
(B) *Significant at 5% level by *t*-test.

transfer the QTL for EMF (*qEMF3*) using the backcrossing approach. Eventually, the NIL with clear genetic background other than the QTL region was obtained (Fig. 1A). Under field condition, the developed NIL advanced peak (50%) FOT by 1.5-2.0h compared with the recurrent parent, IR64, both in the wet season and dry season (Fig. 1B). The NIL for EMF was further tested under elevated temperature regimes in environmentally controlled chambers. The times from dawn (zero hour) to 10% (T10), 50% (T50) and 90% (T90) FOT were calculated based on the R program. (T10, T50, and T90 means the starting, peak, and finishing FOT, respectively.) Under the given temperature regimes, T90 of NIL for EMF finished before the temperature reached 35ºC, while T10 of IR64 started after the temperature exceeded 35ºC (Fig. 2A). This result indicated that almost all flowered spikelets of NIL for EMF could escape from heat stress at flowering, but most of flowered spikelets of IR64 were exposed to heat stress. Spikelet sterility in IR64 and NIL for EMF was manually counted at maturity. The percentage of spikelet sterility was 55% in IR64 and 10% in NIL for EMF (Fig. 2B), indicating that NIL for EMF could significantly reduce heat-induced spikelet sterility at flowering. The NIL for EMF, therefore, is a novel breeding material that can be used for the development of heat-resilient rice to cope with future hotter climates.

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Heat tolerance and flower opening time of popular rice varieties in the tropics

Rice spikelets are most susceptible to heat stress at flowering, inducing spikelet sterility. Moreover, rice varieties face a higher risk of exposure to heat stress because of progressive global warming. Hence, improving heat tolerance and shifting flower opening time (FOT) to the cooler early morning period are among the recommended strategies to mitigate damage by heat stress at flowering. In this study, the heat tolerance and FOT of 23 popular varieties in the tropics were investigated.

The spikelets of 23 popular varieties were exposed to heat stress at 38°C for 6 hours (0900h-1500h) at flowering. It was found that there is a wide genetic variation in heat tolerance (Table 1). Ciherang, a popular Indonesian variety, and Samba Mahsuri, a popular Indian variety, showed high heat tolerance comparable to that of N22, the heat tolerance check variety (Table 1). This result indicated that Ciherang and Samba Mahsuri are useful new genetic resources for heat tolerance at flowering. On the other hand, Fedearoz50, a popular variety in Latin America, showed moderate heat tolerance, whereas Sahel329 and Nerica L-19, popular varieties in West Africa, and KDML105, famous aromatic rice in Thailand, showed high heat susceptibility (low heat tolerance) similar to that of Morobrekan, the heat susceptibility check variety (Table 1). These results suggested that the heat resilience of Sahel329, Nerica L-19, and KDML105 must be improved. With regard to the FOT of the 23 popular varieties, no variety had early-morning flowering (EMF) trait when compared with near-isogenic line (NIL) for EMF trait (Fig. 1), clearly indicating transferring quantitative trait locus (QTL) for EMF to these popular varieties would be effective at increasing heat escape capability at flowering. Because NIL for EMF showed significant earlier FOT than *glaberrima* (which is known as an EMF variety to this day), NIL for EMF is considered a novel breeding material for improving heat resilience to cope with future hotter climates.

(T. Ishimaru, K. Sasaki[Univ. of Tokyo], H. Hirabayashi[NARO], R.B. Gannaban[IRRI], W. Oane[IRRI], W. Shi[IRRI], S.V.K. Jagadish[IRRI])

Table 1. Heat tolerance of popular varieties

Variety	Countries grown	Fertility (%)		Tukey's test in heat stress
		Control (30°C)	Heat stress (38°C)	
Ciherang	Indonesia	93.6 ± 1.7	92.1 ± 1.5	a
Sambha Mahsuri	India	96.1 ± 2.6	88.1 ± 2.5	a
N22[1]	India	94.9 ± 1.8	88.4 ± 5.6	abc
Fedearoz50	Columbia, Costa Rica, Venezuela, Panama	92.9 ± 1.8	56.3 ± 6.3	d
Sahel329	Senegal, Mauritania	85.2 ± 1.2	22.7 ± 3.5	ef
Nerica L-19	Nigeria, Mali, Burkina Faso, Liberia, Sierra Leone, Cameroon, Togo	78.4 ± 5.8	25.7 ± 4.7	f
KDML105	Thailand	92.0 ± 2.3	13.8 ± 3.0	f
Moroberekan[2]	Côte d'Ivoire	92.7 ± 1.2	9.8 ± 4.8	f

Humidity was maintained at 60-70%. Different alphabet in Tukey's test indicates significant difference at 5% level.
[1]Check variety for heat tolerance, [2]Check variety for heat susceptibility. Data not shown for the rest of 16 varieties.

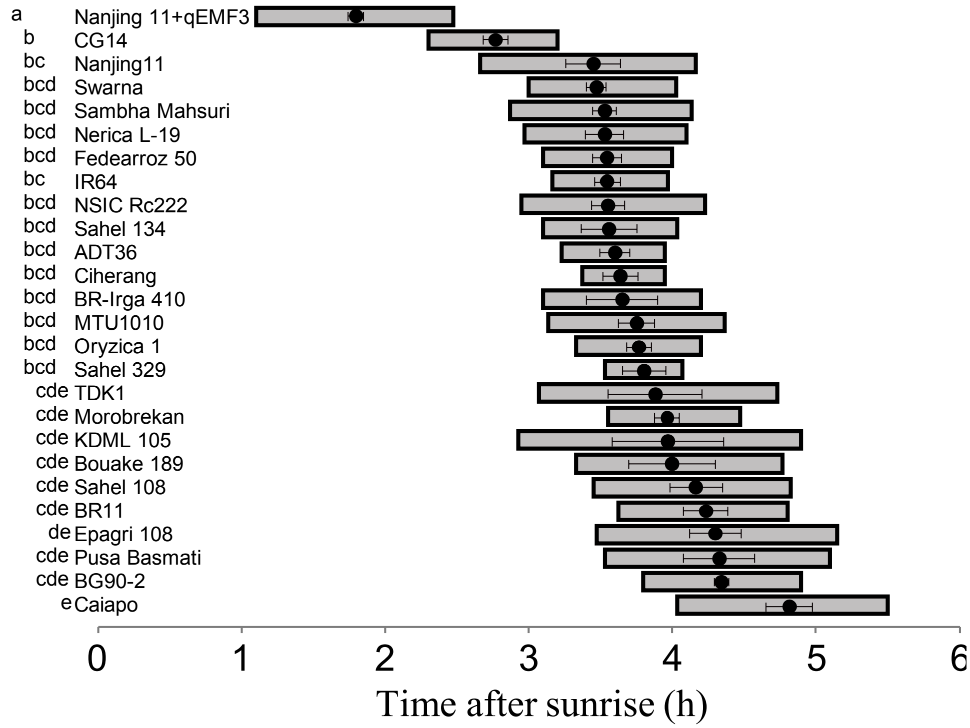


Fig. 1. Flower opening time of popular varieties, NIL for EMF (Nanjin11+*qEMF3*), and *glaberrima* (CG14). ◆ in each genotype indicates 50% FOT±SE of at least three replications. The left and right sides of the horizontal bars in each genotype indicate 10% FOT and 90% FOT, respectively. Different alphabets in left side of each genotype indicate the significance at 5% level by Tukey's test.

TOPIC 4

Long–term global outlook of crop yields under climate change

A long–term outlook of crop yield is necessary for an economic evaluation of climate change on food supply and demand. If the temperature is lower than the optimum level, the crop yield will increase with rising temperature. Conversely, if the temperature exceeds the optimum level, the crop yield will decrease with rising temperature. The yield function, which considers the inverse U–shaped relationship between temperature and yield, is required for long–term outlook under climate change.

The purpose of this research is to analyze the effects of climate change on major crop yields using yield trend functions, incorporating parameters of yield for climate variables obtained from a crop model. The scenarios used in this research are those of the Representative Concentration Pathway (RCP) in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). There are four scenarios, i.e., RCP8.5, RCP6.0, RCP4.5, and RCP2.6, in descending order according to CO_2 concentration.

The parameters and functions for 46 crops of the crop model used for analyzing the Global Agro Ecological Zone of the FAO are presented in the report of the International Institute for Applied Systems Analysis (IIASA). The relationship between temperature and yield as indicated in Figure 1 is obtained from the parameters and the functions of the biomass production and photosynthetic rate of the model. These functions are smoothed using cubic spline interpolation.

The target crops are rice, wheat, maize, and soybeans, covering 126 countries or regions, the same number as when the world food model was developed. Data on crop yields were obtained from the FAO (data from 1961 to 2007).

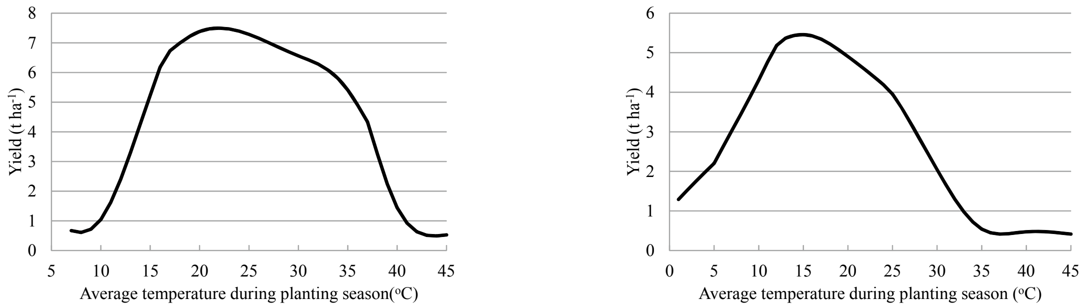
Logistic functions or linear functions with logarithmic time trends are estimated for each crop yield for each country as yield trend functions. Climate parameters of the crop model are incorporated into the trend function.

Climate data in this research are those of the Model of Interdisciplinary Research on Climate (MIROC5), which is a Global Circulation Model (GCM), and these are aggregated for large countries such as China based on the crop cultivation map of the United States Department of Agriculture (USDA).

Figure 2 depicts wheat yields in India and China. The baseline scenario assumes unchanged temperature, solar radiation, and rainfall values during simulation (period 2008-2050). Wheat yield in India is decreased by climate change under the RCP8.5 scenario. Climate change simulation results in China, on the other hand, show substantial fluctuation because the slope of the yield to temperature as indicated in Figure 1 (ii) is steeper than those of other crops.

Figure 3 presents differences in wheat yields between baseline and RCP6.0 scenario during the periods 2021–2030 and 2041–2050. These figures suggest that wheat yields in southern Asian and sub–Saharan African countries will decrease under the RCP6.0 scenario.

(J. Furuya, S. Kobayashi, Y. Yamamoto, M. Nishimori[NIAES])



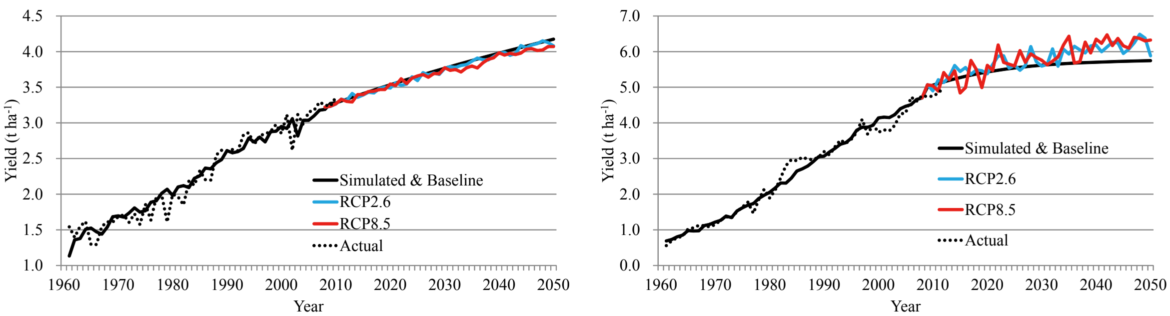
(i) Indica rainfed rice

Planting days (N)=195(day), Harvest Index (HI)=0.38,
Leaf Area Index (LAI)=4.8,
Dry matter production rate on an overcast day (bo)=195(kg ha^{-1} day^{-1}),
Dry matter production rate on a clear day (bc)=375(kg ha^{-1} day^{-1}),
Solar radiation (Rg)=16 (MJ m^{-2} day^{-1})[Average in India]

(ii) Winter wheat

N=270(day),
HI=0.2,
LAI=5.5,
bo=190(kg ha^{-1} day^{-1}),
bc=369(kg ha^{-1} day^{-1}),
Rg=14 (MJ m^{-2} day^{-1})[Average in China]

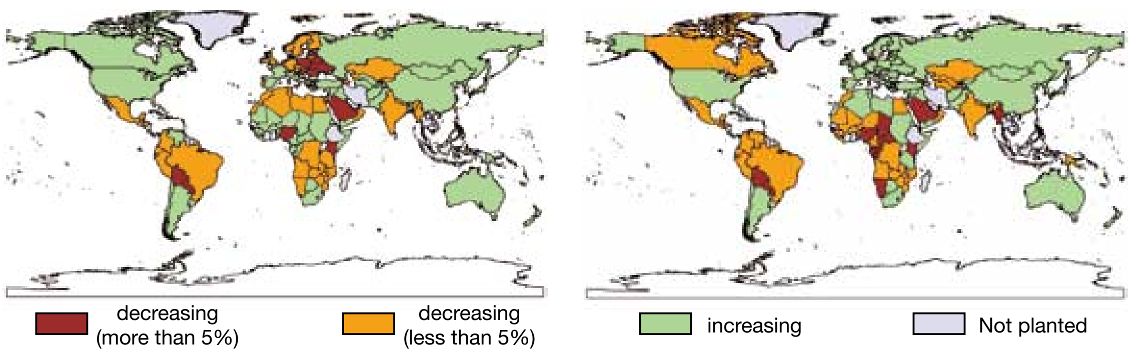
Fig. 1. Relationship between potential yield and temperature



(i) Rice in India

(ii) Wheat in China

Fig. 2. Trends in crop yield



(i) 2020s

(ii) 2040s

Fig. 3. Effects of climate change on wheat yield: differences between baseline and RCP6.0

Improvement of land use efficiency and drought resistance with a maize-soybean intercropping system in Northern Mozambique

Subsistence maize production is the first priority for smallholder farmers in Northern Mozambique; however, soybean has been attracting increased attention as a new cash crop in recent years. Our study, therefore, examined the simultaneous growth of maize and soybean in an intercropping system. Intercropping systems are considered particularly suitable in areas with unreliable rainfall and little external inputs as it diversify environmental risks and increase resource-use efficiency among the component crops. However, there is little empirical data available in the region on maize-soybean intercropping.

The performance of the intercropping system was assessed with respect to the land equivalent ratio (LER) using different fertilizer management practices in three agricultural environments, from a hot and semi-arid climate to a cool and humid climate, in Northern Mozambique. LER is calculated as the sum of the relative yields of maize and soybean in the intercropping plots with respect to the monocropping plots. It is generally accepted that LER values above 1 indicate that an intercropping system offers superior land-use efficiency over a monocropping system.

Locally recommended cultivars of maize (cv. Matuba; early maturity) and soybean (TGX-1937-1F; intermediate maturity) were grown at planting densities of 6.25 hills m^{-2} (80 × 20 cm) and 12.5 hills m^{-2} (40 × 20 cm), respectively, in the monocropping system. In the intercropping system, a maize row was replaced by three soybean rows every other two rows, which correspond to the planting densities of maize and soybean at two thirds (=0.67) and a half (=0.50) of those in the monocropping system, respectively (2Maize:3Soybean strip allocation). Three weeks after sowing, urea was side-dressed along the maize rows for both monocropping and intercropping systems at three different rates (0, 30, and 60 kg N ha^{-1}). No additional fertilizer was applied to any soybean rows.

The experimental results are summarized as follows:

- Maize-soybean intercropping demonstrated consistent advantage in productivity over monocropping, with LER values above 1 irrespective of N application rates to maize or experimental sites. LER values were particularly high in Nampula where a long dry spell occurred during the seed-filling stage of soybean (Table 1).
- The high LER values were partly attributed to more vigorous maize growth in intercropping than in monocropping, providing relative yields of 75-86% with two thirds of planting densities across fertilizer treatment and experimental sites (Table 1).
- When exposed to a dry spell, intercropped soybean (shaded by maize canopy) showed an apparent benefit in drought avoidance, as reflected by the slow depletion of soil water potential and the retention of the aboveground biomass relative to the monocropped soybean (Fig. 1).
- Under moist field conditions in Gurue and Lichinga, the LER values tended be smaller with increasing N application rates to maize because maize plants became more competitive and depressed the intercropped soybean yields to greater degrees.

Based on these results, it is concluded that maize-soybean intercropping can be recommended, allowing the introduction of soybean while ensuring subsistence maize production particularly in the low-N-input and drought-prone environment that prevails in the rainfed-upland areas of Northern Mozambique.

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Table 1. Maize and soybean yields in the monocropping system, relative grain yields of maize and soybean in the intercropping system, and LER values at different N application rates in three sites

Location (Alt.)	Maximum consecutive no-rain days	Fert.[a]	Monocrop Yield (t/ha)		Relative yield of intercropping		LER
			Maize	Soybean	Maize	Soybean	
Nampula (372m)	15	0N	1.61	0.57	75%	62%	1.37
		30N	1.78	-	82%	60%	1.41
		80N	2.13	-	86%	63%	1.49
Gurue (691m)	9	0N	1.75	1.87	81%	48%	1.29[ns.]
		30N	2.81	-	76%	39%	1.16
		80N	3.93	-	82%	33%	1.15
Lichinga (1397m)	6	0N	2.81	2.01	81%	46%	1.27
		30N	3.57	-	82%	45%	1.27
		80N	4.46	-	82%	33%	1.15[†]
ANOVA		Location (L)	***	***	ns.	***	**
**P<1%, ***P<0.1%		Fert. (F)	***	-	ns.	P=0.07	ns.
ns. not significant		L x F	**	-	ns.	ns.	ns.

LER values with underbars are significantly different from 1 at P<5% with one-sample t-test (n=4). †P=0.061, ns.P=0.11.

a: 0N, 30N, and 80N indicate the plots applied with 0, 30 kg and 80 kg ha^{-1} of N as urea to the monocropped and intercropped maize rows at three weeks after sowing.

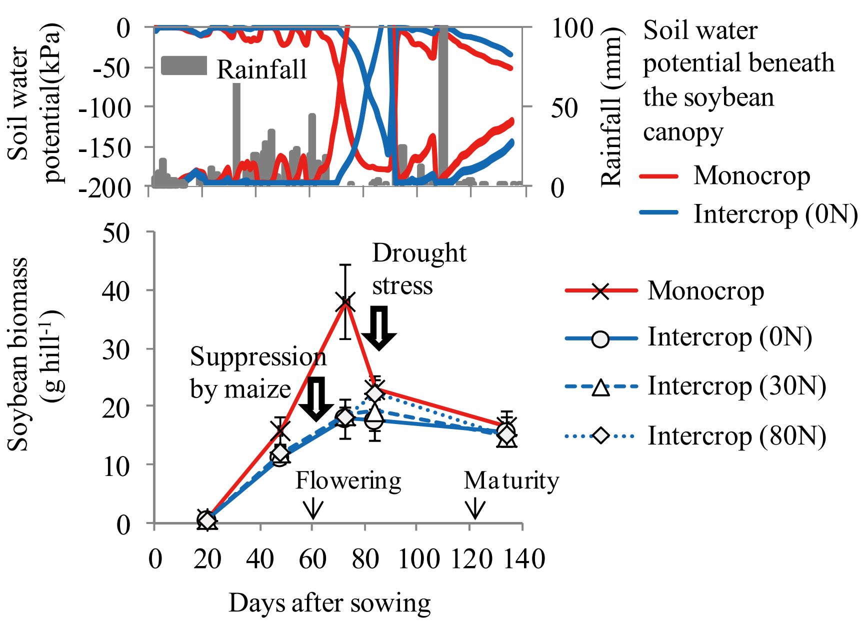

Fig.1. Changes in soil water potential beneath the soybean canopy at 20 cm deep (above figure) and in aboveground soybean biomass (below figure) in Nampula.

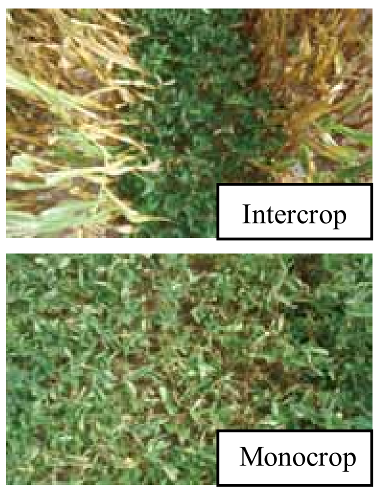

Fig. 2. Comparison of soybean growth after a long dry spell in Nampula. Monocropped soybean was more severely affected by drought stress with substantial leaf abscission.

Extraction of gully erosion-affected areas by image analysis of high spatial resolution satellite data

Gully erosion is a natural phenomenon that occurs during and after severe rainfall leading to the loss of topsoil, the formation of ditch-like features on sloping areas, and the deterioration of productive agricultural lands. Over the past decade, gully erosion has developed significantly on hilly areas along Cagayan River in the northern part of Luzon Island in the Philippines. Photo 1 shows the natural landscape at the site on November 23, 2010. In order to grasp the actual condition and spatial distribution of gullies in this area, the author attempted to develop a method to extract gully information using high spatial resolution satellite data.

Gully-eroded areas are presented as dark linear features on satellite images on the condition that the spatial resolution of satellite data is small enough. According to the survey report by the Philippine Bureau of Soil and Water Management (BSWM), the average gully top width was about 2 meters, which was considerably larger compared with the 0.5 meter spatial resolution of the WorldView panchromatic data adopted in this study. After performing median filtering to reduce local noise, the Sobel filter was applied to enhance the edge features of the images. Enhanced linear parts were contaminated with gully and non-gully objects, and the following processes were undertaken to extract only the gully-affected areas: First, the topographic factors were considered by enhancing the image contrast of the pixels oriented orthogonally to the slope orientation. Second, texture parameters (window size: 21 by 21 pixels) were calculated and non-gully objects were discriminated after setting an appropriate threshold. This method was effective in masking out non-gully parts such as roads, houses, piles of crop residue, irregular ground conditions on arable land, and so on. Third, forest areas (another mask data) were estimated from multi-temporal ALOS/AVNIR2 data, which has a 10-m spatial resolution. Figure 1 shows extracted gully-affected areas overlaid on WorldView imagery for a part of the study site. To verify the results, the author compared it with the gullies surveyed by the BSWM. Figure 2 shows the heads and ends of the surveyed gullies. Because the survey data indicated only the location of gullies including branches and did not indicate continuous features, the agreement between extracted and surveyed gullies was ranked into 4 levels by manual interpretation and then assigned quantitative values. Table 1 shows the average ratio of properly extracted gullies weighted by length and it concludes that 63.4 percent of gullies were properly extracted.

Photo 1. Gully erosion appears at the study site near Ilagan City, Isabela Province, Philippines (taken on November 23, 2010)

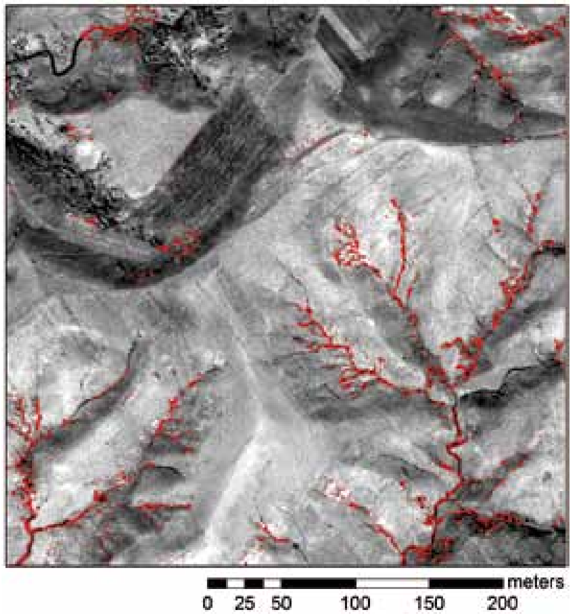

Fig. 1. Image overlay showing the gully erosion-affected areas (in red) extracted from satellite imagery

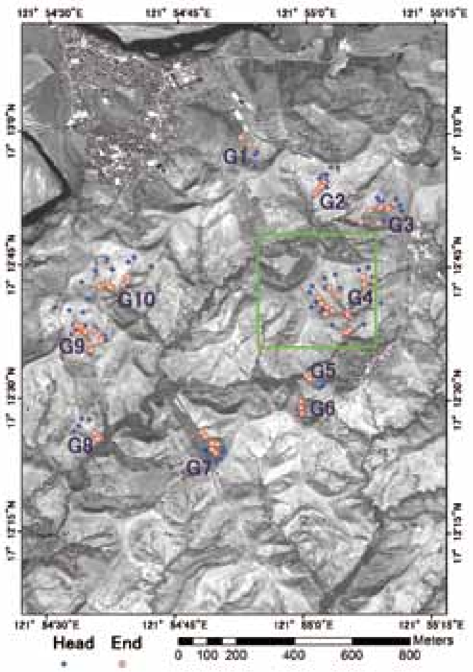

Fig. 2. Location map of gullies surveyed by BSWM (Green rectangle indicates spatial range shown in Fig. 1)

Table 1. Agreement (Ratio of extraction) between the extracted gully erosion features and the surveyed gullies (data by BSWM)

ID	Ratio of Extraction (%)	Number of Branches
G1	53.7	3
G2	78.0	6
G3	61.8	8
G4	76.1	19
G5	65.0	2
G6	35.0	6
G7	21.1	8
G8	30.8	4
G9	82.1	14
G10	72.0	9
Weighted average by length	63.4	Total 79

The method mentioned above can be applied to any region in the world if high spatial resolution satellite data (taken in the period when ground is barely covered) can be obtained. This can realize rapid mapping of gully erosion-affected areas seamlessly over wide areas and without conducting field surveys. It is also advantageous that the output data are readily available in georeferenced digital format and are of homogeneous quality, thus facilitating spatial analysis operations for the characterization of existing gullies. Adjustment of parameters, however, may be necessary to discriminate gully and non-gully features in accordance with image conditions.

(S. Uchida)

TOPIC 7

Sorgoleone release determines the hydrophobic-BNI capacity in sorghum root systems

Nitrification and denitrification are the two most important processes that contribute to greenhouse gas emissions and the inefficient use of nitrogen. Suppressing soil nitrification through the release of nitrification inhibitors from roots is a plant function, termed 'Biological Nitrification Inhibition (BNI)'. Sorghum releases two categories of nitrification inhibitors from roots: hydrophilic BNIs and hydrophobic BNIs. Our earlier published work on sorghum mostly focused on characterizing hydrophilic BNI release. Here we report the characterization of hydrophobic-BNI release in sorghum. The functional role and contribution of sorgoleone release to hydrophobic-BNI function and the existence of genotypic variability for sorgoleone release is the focus of this investigation. Three sorghum genotypes (Hybridsorgo, IS 41245 and GDLP 34-5-5-3) were evaluated for their capacity to release sorgoleone in hydroponic, in soil culture, and under field environments. Sorgoleone released from roots is measured using a high performance liquid chromatograph (HPLC) and BNI activity is determined using a luminescent recombinant *Nitrosomonas europaea* assay.

Sorgoleone was found to be the dominant and major component of hydrophobic-BNI activity released from sorghum roots, and

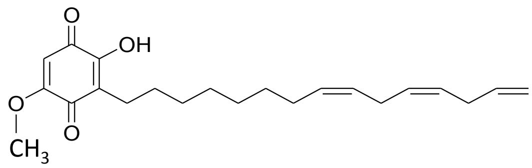

Fig. 1. Chemical structural formula of sorgoleone

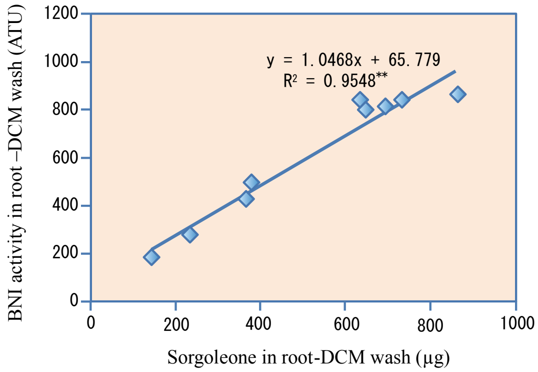

Fig. 2. The relationship between total sorgoleone concentration (μg) and BNI activity (ATU) in root–DCM wash of three sorghum genotypes

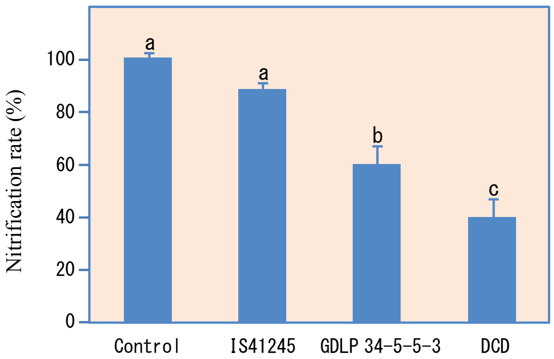

Fig. 3. Nitrification rate at 30-day incubation period along with NH_4^+ inoculation of rhizosphere soil collected from two sorghum genotypes (IS1245 and GDLP 34-5-5-3) grown up to heading stage in potted soil. Control pots were included with bare soil without plants but handled the same way like pots with plants. As positive control, soils taken from control treatments were also incubated with DCD addition at 25 ppm (a known synthetic inhibitor) as a reference.

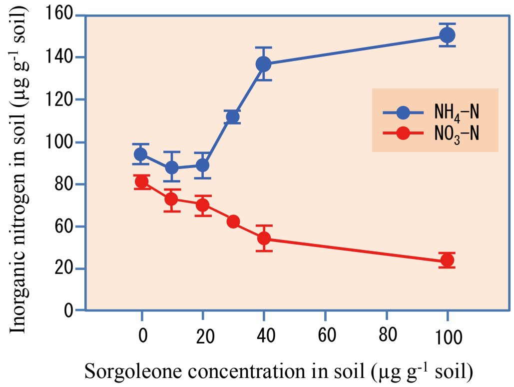

Fig. 4. Concentration of inorganic N (NO_3^- and NH_4^+) in soil samples incubated after adding different concentrations of sorgoleone (0, 10, 20, 30, 40, and 100 μg g^{-1} soil) for 60 days

there were significant genotypic differences for sorgoleone release (Fig. 1). Sorgoleone release and BNI-activity release in sorghum roots are closely associated, i.e., 1 μg of sorgoleone released is equivalent to 1 ATU activity in the bioassay (Fig. 2). Sorgoleone genotypes release varying quantities of sorgoleone. GDLP 34-5-5-3 and Hybridsorgo have higher capacity for both sorgoleone release and BNI activity than IS41245. In soil culture, GDLP 34-5-5-3 released significantly higher quantities of sorgoleone into the rhizosphere, had higher BNI activity, and suppressed soil nitrification better than IS41245 (Fig. 3). Purified sorgoleone inhibited *Nitrosomonas* activity in the bioassay; when amended to soil, sorgoleone suppressed nitrification, improved NH_4^+ availability, and reduced NO_3^- formation in soils during a 60-day incubation study (Fig. 4). These results demonstrate genetic differences for sorgoleone release and its functional link to hydrophobic-BNI release and BNI capacity in sorghum.

Sorgoleone release contributes significantly to BNI capacity in sorghum. The significant genetic differences for sorgoleone release from sorghum roots suggest that there is potential for genetic improvement to improve sorgoleone release and BNI capacity in sorghum. Higher BNI capacity is critical to the development of low-nitrifying sorghum production systems and the results presented here suggest the feasibility of this approach.

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PROGRAM B
Stable Food Production

"Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments"

The Stable Food Production Program is aimed at developing technologies that will improve and sustain productivity through collaborative research with local institutions and international research centers, especially for areas under adverse environments such as those found in tropical regions. Research outcomes are expected to contribute to global food security and help reduce starvation and malnutrition, which remain serious problems in developing regions. 'Research Highlights 2014' of Program B are introduced as 'Topics' at the latter half of this article.

[Development of rice production technologies in Africa]

The program's flagship project, "Development of rice production technologies in Africa," tries to fulfill the main target of the Coalition for African Rice Development (CARD) to double rice production in Sub-Saharan Africa within ten years (by 2018). Four lines (YTH150, YTH183, YTH191, YTH199) out of several high-yielding lines bred for Asian conditions were selected for further trials based on the field evaluation at AfricaRice Sahel Station in Senegal. The selected lines were subjected to multi-environmental tests by the Breeding Task Force, a testing network coordinated by AfricaRice. In sub-Saharan Africa, the rainfall patterns are sometimes not suitable for rice cropping; therefore, it is necessary to construct small-scale irrigation facilities, such as reservoirs, that can be built quickly, maintained easily, and adjusted flexibly to changes in the environment. A research was started in Ghana with the aim of developing low-cost construction techniques or methods for farmers to maintain the facilities and manage water. Also, a technology for effective rice production in flood plains is being developed to expand rice cultivation. Field experiments with local farmers to prove the effectiveness of several techniques like fertilizing and sowing have been started.

[Topic 1]: Manual of soil fertility improvement technologies in lowland rice ecologies of Ghana
[Topic 2]: A flexible high-throughput marker system to distinguish African rice (*Oryza glaberrima*) from Asian rice (*Oryza sativa*)

[Rice innovation for environmentally sustainable production systems]

A low-input and environment-friendly variety of rice and a new cultivation technology in Asia that ensures stable productivity in poor environmental conditions will be advanced. On a related note, the JIRCAS project, "Blast Research Network for Stable Rice Production," has progressed. This research focuses on the development of a differential system for blast pathogen and resistance genes in rice varieties in Asia and Africa. In several Asian countries, isogenic lines of local important varieties have been continuously developed to improve their resistance against blast disease using the differential system. A total of 32 blast isolates were selected as a candidate set of international standard in correspondence with the monogenic lines as differential varieties' set.
[Topic 3]: Variation at the *Pup1* locus within the genus *Oryza* predates domestication
[Topic 4]: Identification of QTL for efficient root elongation under a wide range of nitrogen concentrations in a rice variety with an Indica-type genetic background

[Development of genetic engineering technologies of crops with environmental stress tolerance]

The development of genetic engineering technologies as tools to improve crop cultivation in developing countries is important, especially in areas under unstable environments where drought or poor natural conditions affect stable crop production.

Several drought-tolerant soybean lines were selected in the confined screenhouse at Embrapa, Brazil. Among them, four lines were tested in the confined field, and one line was found to be drought-tolerant.
[Topic 5]: Integrated analysis of the effects of dehydration and cold on rice metabolites, phytohormones, and gene transcripts
[Topic 6]: Four AREB/ABF transcription factors function downstream of three SnRK2 protein kinases to regulate drought stress tolerance

[Development of breeding technologies toward improved production and stable supply of upland crops]

In South America, soybean production has been threatened since the early 2000s by Asian soybean rust (ASR) caused by *Phakopsora pachyrhizi*. ASR, along with drought, is currently the most serious threat to stable soybean production. To cope with ASR, we evaluated its pathogenicity and are developing resistant soybeans using backcrossing and marker-assisted selection. Marker-assisted selection of soybean lines having three resistant genes (*Rpp2*, *Rpp4*, *Rpp5*) has continued in Paraguay, and several lines were produced by backcrossing with recurrent parents. Tentative variety registration will be done after selection of the best line. Soybean lines with both NaCl and alkaline tolerance were developed and shown to be tolerant to NaCl and alkali.

[Evaluation and utilization of diverse genetic materials in tropical field crops]

This project aims to develop effective evaluation and breeding techniques for better utilization of a wider range of germplasm for genetic improvement in tropical field crops.

Yam (*Dioscorea* spp.) is a traditional staple crop of economic and socio-cultural importance in West Africa. Genome analysis and improved molecular techniques, if incorporated into the breeding program, would tremendously facilitate germplasm characterization as well as genetic mapping and tagging, thus effectively establishing its scientific bases. We generated the first reference genome of *D. rotundata,* the most popular species in West Africa. Ongoing activities include the genotyping of 125 Guinea yam germplasm, including breeding lines and local varieties, and the phenotyping of basic agronomic traits and starch properties. The results are expected to provide improved tools for biodiversity analysis and for identifying useful germplasm.

Cowpea (*Vigna unguiculata*) is traditionally important as a good source of protein and minerals and of cash income for small scale farmers in sub-Saharan Africa. Therefore, the development and deployment of cowpea varieties with adequate nutritional value and quality that meet the needs of consumers should enhance cowpea consumption and production in the region. Based on the data of 240 cowpea germplasm, including breeding lines, we could identify wide genetic diversity in various grain quality-related traits (seed size, appearance, crude protein, minerals, etc) and relationships among the traits. Several germplasm with the favorable traits were also identified from germplasm evaluation. Through market surveys in Nigeria, 26 major cowpea varieties being frequently distributed were identified. Grain samples of those major varieties collected from the various markets were cultivated, evaluated and multiplied for further specific analysis to understand the preferred grain quality-related traits of the markets.

Characterization and preliminary evaluation of tropical fruits germplasm are steadily ongoing to better utilize JIRCAS's collections, and remarkable germplasm accessions that have been identified are progressively being used in breeding activities. A promising passion fruit breeding line, with large fruit size, high soluble solid-acid ratio, and good skin color even under high temperature condition, has been selected and is currently under multi-location performance trials in Japan.
[Topic 7]: Low night temperature inhibits fertilization and consequently reduces fruit set in 'Monthong' durian

Sugarcane is widely cultivated as a food and energy source in the tropics. However, inferior environmental conditions such as poor soil and rainfall deficiency hinder stable production. We are attempting to utilize a wild relative, *Erianthus*, to improve biomass productivity of sugarcane even under unfavorable environments. Characterization and evaluation of major agronomic traits of 150 Thai *Erianthus* accessions were completed, and genetic diversity analysis of this collection using SSR markers is ongoing. A series of intergeneric hybrids between sugarcane and *Erianthus* were generated and are currently under evaluation for major traits under different environments.

[Development of integrated pest management techniques for stabilization of agricultural and livestock production in developing areas]

Multi-purpose sugarcane (MPS), which was developed during JIRCAS' Second Medium-Term Plan period, is expected to help address global food and energy issues because it can be used for both food (sugar) and energy (ethanol) production purposes. However, a phytoplasma disease, sugarcane white leaf (SCWL), is an obstacle to field production in developing areas. A quantitative detection method for pathogenic phytoplasma was developed from extracted DNA samples of viruliferous vector insects using real-time PCR technique. We surveyed sugarcane farmers in northeast Thailand about their farm management method to know the possibility of growing MPS. The cost structure of sugarcane production was clarified, focusing on the combination of new planting and ratooning. Three varieties of MPS were registered as new varieties at the Department of Agriculture, Thailand, in February 2015.

TOPIC 1

Manual of soil fertility improvement technologies in lowland rice ecologies of Ghana

The impact of fertilizer application on crop production in Sub-Saharan Africa (SSA) is considered enormous as the region is very low in soil fertility. However, access to chemical fertilizers is difficult especially for small-scale SSA farmers who do not have sufficient financial resources in a market-oriented economy. This crucial issue underscores the urgent need for the farmers to increase agricultural productivity, which can be achieved through inexpensive and cost-effective techniques of improving soil fertility in rural areas.

With financial support from the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, JIRCAS carried out a study on technology development for improved soil fertility using indigenous resources that are accessible and acceptable to local farmers. The study, with rice being the target crop, was aimed at contributing to the goal of the Coalition for African Rice Development (CARD) to double rice production in SSA by 2018. Ghana was selected as the country of implementation because it has two major rice ecologies (rainfed lowland and irrigated lowland) and has good research counterpart institutions.

As one of the products of the study, a technical handbook, titled "Manual of soil fertility improvement technologies in lowland rice ecologies of Ghana," was published. Written in English, this manual would greatly benefit extension workers and assist them in disseminating the technologies to rice farmers. A summary of the manual's features is listed below.

1. The manual describes the application of indigenous organic matter as well as their composting and charring technologies, the application of phosphate rocks from neighboring Burkina Faso and its solubilizing technologies, and the enhancement of early rice growth using a minimum quantity of chemical fertilizer (Table 1).
2. The technologies mentioned in the manual were developed in consideration of available materials in each rice ecology and corresponding region. The technologies were evaluated for effectiveness and affordability to the rural communities in on-farm participatory studies.
3. Government officers as well as counterpart researchers in Ghana were actively involved in the editorial process, enhancing their sense of ownership of the manual and technologies. The foreword was written by the deputy minister of the Food and Agriculture (MoFA), Ghana.
4. This manual is compact enough to be carried around. It is printed on A5 size paper and contains only 44 pages, with visually descriptive text and plenty of visuals (photographs and illustrations).
5. The technologies adopted in the manual may be extended to other SSA countries having the same rice ecologies.

(Satoshi Tobita, Satoshi Nakamura, Monrawee Fukuda, Fujio Nagumo)

Table 1. Technology options adopted in the soil fertility manual

Options	Rice ecology (Agro-ecological zone)	
	Rainfed lowland (Guinea Savannah zone)	Irrigated lowland (Equatorial Forest zone)
Organic matter application	Rice straw base ❖ Direct application or composting ❖ If applicable, small quantity of chemical fertilizer shall be recommended.	Poultry manure base ❖ Prompt effect by direct application ❖ Direct application of rice straw and sawdust causes N starvation in this ecology.
Composting	Cow dung + rice straw ❖ Not acceptable to some farmers	Poultry manure + sawdust/rice straw ❖ Utilization of waste resources
Charring (Kuntan)	Soil physical/biological improvement, no direct effect on soil fertility improvement	
	Rice husks as material	Sawdust as material
Phosphate rock application	Phosphate rocks may appear in the Ghana market in the near future, depending on decision by stakeholders and policy-makers in Ghana. This option is applicable in neighboring PR-producing countries.	
	Direct application ❖ Very effective in all areas in the first year of application. Residual effects differed among fields.	Direct application ❖ Very effective in all areas in the first year of application, as well as having residual effects for at least 3 years.
	Burkina Faso PR is fine powder in texture, thus the spreading method, like mixing with mud, shall be considered.	
Dual application of organic matter and phosphate rock	Optimization of quantity and timing of application ❖ Rice straw shall be incorporated into soil just after harvesting to have better C/N ratio for the next season and to avoid unnecessary burning. ❖ Phosphate rock shall be applied at sowing or transplanting.	
Pretreatment	Early growth of rice is enhanced by pretreatment with a small quantity of water-soluble P fertilizer	
	❖ Coating of fertilizer with rice seeds ❖ Compatible with direct sowing	❖ Soaking of rice seedlings in fertilizer solution ❖ Compatible with transplanting
Technologies for the enhancement of phosphate rock solubility	Useful in upland environments where the solubility of PR is lower (for growing upland rice or upland crops).	
	(1) Incorporate PR in the composting process to make P-enriched compost	
	(2) Incorporate PR in the charring process, expecting calcination in relatively low temperature, to make P-enriched char	

Photo 1. Charring of saw dust (Kumasi City)

Photo 2. Demonstration in an on-farm field (at Ziong Village, a suburb of Tamale City)

TOPIC 2

A flexible high-throughput marker system to distinguish African rice (*Oryza glaberrima*) from Asian rice (*Oryza sativa*)

The African rice *Oryza glaberrima* is an important reservoir of genes for abiotic stress tolerance. To discover such tolerance genes and to exploit them in rice improvement, a flexible, high-throughput marker system is needed. Single nucleotide polymorphism (SNP) sites, where the genome sequence of two or more individuals differs by a single base, are increasingly becoming the marker of choice. Although the number of discovered SNPs has increased significantly over the past few years, most of these efforts have focused on variations within the Asian rice *Oryza sativa*. The aim of the present study was to detect a set of SNPs that differentiate between *O. sativa* and *O. glaberrima*, and to use a representative subset to develop a high-throughput PCR-based genotyping panel.

A genome-wide 44,000 SNP genotyping array identified a set of 9523 SNPs polymorphic between *O. glaberrima* and *O. sativa* subspecies *indica,* and 7444 SNPs between *O. glaberrima* and *O. sativa* subspecies *japonica* (Figure 1A). From the above set, a subset of 1540 SNPs was selected in collaboration with partners within the Generation Challenge Program (GCP) for conversion into PCR-based markers, using the KASP (competitive-allele PCR) technology. A final set of 2015 SNPs were successfully converted to KASP markers, which are evenly distributed in the genome, with the exception of small gaps in chromosomes 4 and 10 (Figure 1B). The panel was validated in the 'New Rice for Africa' (NERICA) parents. Of the 2015 markers tested, 745 markers were polymorphs between CG14 and WAB56-104 (upland NERICA parents) and 752 between TOG5681 and IR64 (lowland NERICA parents) (Figure 2). Several subsets of these markers have been used successfully to map *O. glaberrima* introgressions in NERICA rice varieties and interspecific breeding lines.

This new genotyping panel is a cost-effective, gel-free genotyping platform that allows maximum flexibility for 'pick-and-choose' markers according to individual breeder's needs. Presently, it is fully outsourced to service companies that can perform all steps, from DNA extraction to genotyping, which would extend the capacity of low-resource laboratories to perform molecular breeding using local rice varieties.

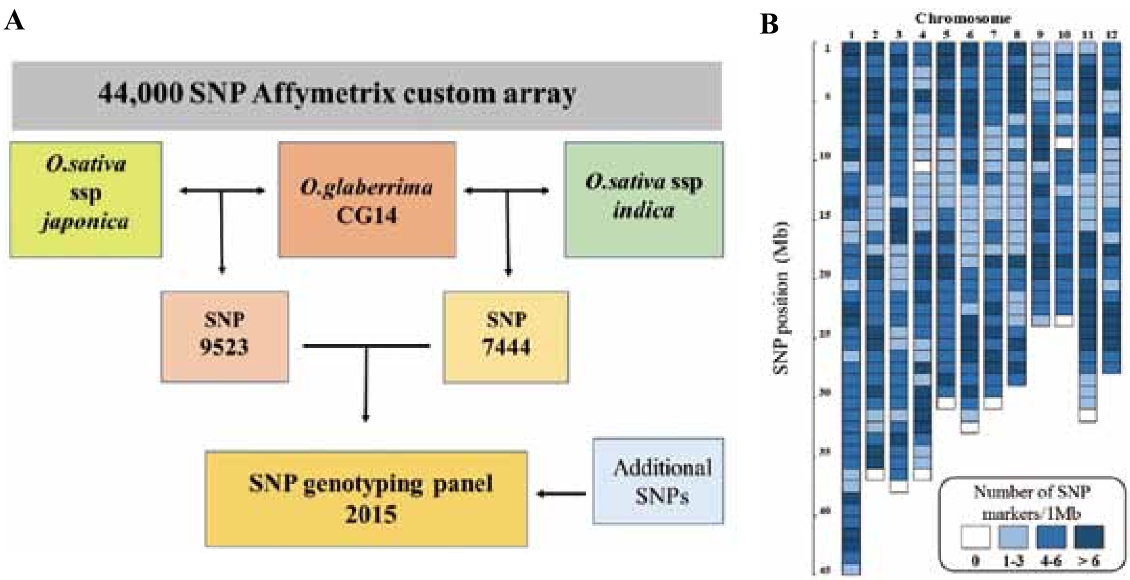

Fig. 1. Flow chart indicating the selection of polymorphic SNPs between *O. glaberrima* vs *O. sativa* ssp *japonica* and *indica* for conversion into PCR-based markers (A). Distribution of SNP markers along the rice genome. Color represents the number of markers per 1 Mb (B).

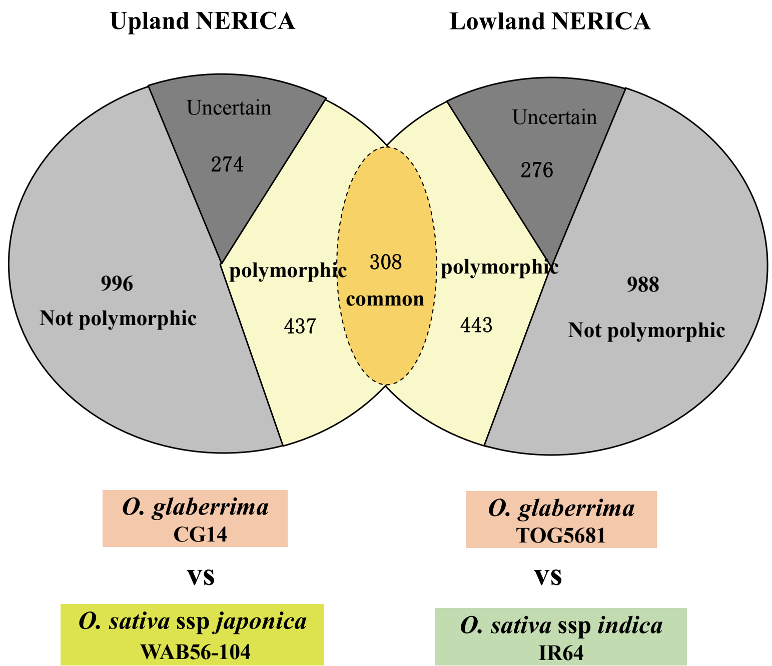

Fig. 2. Distribution of polymorphic SNP markers for crosses of *O. glaberrima* vs *O. sativa*. There are 745 and 751 polymorphic markers for upland and lowland NERICA varieties, respectively.

In addition, the information for each SNP is publicly available allowing the rice breeding community to complement the set with their own subset of markers. JIRCAS is expanding its collaborative rice breeding network with applications ranging from parental surveys, development of QTL mapping populations, and marker-assisted introgressions of major stress tolerance genes like *OsPSTOL1*.

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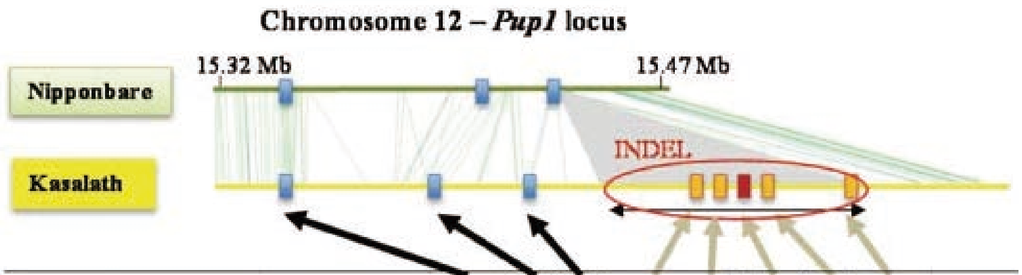
TOPIC 3

Variation at the *Pup1* locus within the genus *Oryza* predates domestication

The deficiency of phosphorus (P) in soil is a worldwide problem, and though there are many approaches to tackle this problem, the development of rice cultivars with enhanced P efficiency would represent a sustainable strategy to improve the livelihood of resource-poor farmers. Recently, the *Pup1* locus (Fig. 1), a major QTL for tolerance to P deficiency, was successfully narrowed down to a single-candidate gene, the protein kinase: P starvation tolerance (*OsPSTOL1*). The aim of this study was to search for novel *OsPSTOL1* alleles and to survey *Pup1* locus variation in Asian (*O. sativa*)- and African (*O. glaberrima*)-cultivated rice and their wild progenitors. This information would help in designing a suitable strategy for marker-assisted introgression of *Pup1/PSTOL1* into rice megavarieties.

A novel *OsPSTOL1* allele was detected in *O. glaberrima.* This allele has 35 base-pair changes (when aligned to Kasalath allele), but none of the functional domains were affected and it is expressed. Allele-specific markers were then developed for single PCR and/or duplex PCR system, which produce a band pattern clearly distinguishable on agarose gels (Fig. 2), and are therefore suitable for most marker laboratories throughout the world. Using these markers to survey allelic distribution of *PSTOL1* across the genus *Oryza* showed that the novel allele is common in accessions belonging to *O. glaberrima* and its ancestor *O. bartii*, but is not restricted to African rice as *O. sativa*, *O.*



Oryza species		Pattern (type)	K05	K20-2	K29-3	K41	K42	K46-K/G (*PSTOL1*)	K48	K59	Number of accessions
			co-dominant			dominant marker					
African rice	cultivated *O. glaberrima*	CG14(G)	-	-	-	-	-	G	K	K	6
		CG14+(G+)	K/-	any	any	-	-	G	K	K	7
		Kasalath'(K)	-	K	K	K	K	K	K	K	1
	wild relative *O. barthii*	CG14(G)	-	-	-	-	-	G	K	K	4
		CG14+(G+)	K/-	any	any	-	-	G	K	K	5
		Kasalath''(K)	K	U	K	K	K	K	-	K	1
Asian rice	cultivated *O. sativa*	Nipponbare(N)	N	N	N	-	-	-	-	-	6
		CG14 and Mix(M)	U	K	U	K	-	G	U	-	7
		Kasalath(K)	K	K	K	K	K	K	K	K	5
	wild relative *O. rufipogon*	Nipponbare(N)	N	N	N	-	-	-	-	-	3
		CG14 and Mix(M)	N	N	N	K	-	G	K	-	1
		Kasalath'''(K)	N	K	K/N	K	K	K	K	K	5
	wild relative *O. nivara*	Nipponbare(N)	H	N	N	-	-	-	-	-	1
		Mix(M)	K	K	N	K	-	G/K	K	-	5
		Kasalath(K)	K	K	K	K	K	K	K	K	2
		Total									59

K: Kasalath; N: Nipponbare; G: *O. glaberrima*; U: novel allele; H: Heterozygous; -: no amplification; any: non-specific

Fig. 1. Characterization of the *Pup1* locus in Nipponbare and Kasalath, and cultivated and wild rice genotypes. A main difference is the absence of a 90 kb INDEL region in Nipponbare containing *OsPSTOL1* and 20 other Kasalath-specific genes.

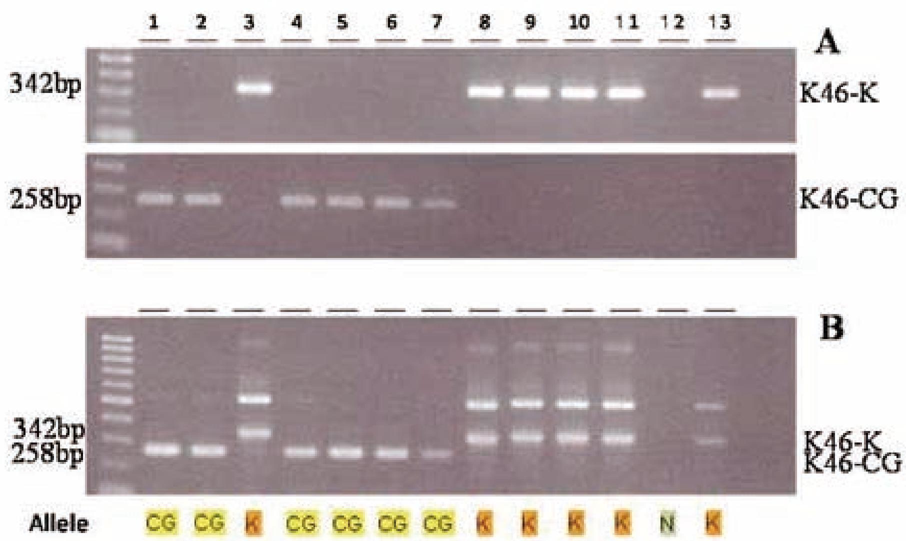


Fig. 2. Amplification of *OsPSTOL1* alleles using allele-specific markers for Kasalath and CG14 in single PCR (A), and duplex PCR system to detect both alleles in one reaction (B).
(1: CG14, 2: IRAT, 3: NERICA16, 4: WAB56-50, 5: NERICA1, 6: NERICA10, 7: WAB181-18, 8: IDSA, 9: IR12979, 10: WAB56-104, 11: IAC165, 12: Nipponbare, 13: Kasalath)

rufipogon, and *O. nivara* accessions do carry the *glaberrima* allele at low frequency (Fig. 1).

Using additional allele-specific markers across the entire *Pup1* locus revealed two main patterns in the Africa rice (*O. glaberrima* and *O. barthii*): the more typical 'Africa pattern' characterized by the novel *PSTOL1* allele and partial presence of the *Pup1*-specific INDEL region, but general absence of 90 kb of a region upstream of *PSTOL1* (pattern G, Fig. 1); and the less common pattern (K) with Kasalath alleles across most of *Pup1*. Within *O. sativa,* the Kasalath (K) and Nipponbare (N) patterns could be distinguished as described earlier, but in addition a mixed pattern (m) with partial presence of Kasalath, *O. glaberrima*, and novel alleles was detected. These three patterns were already present in *O. rufipogon* and *O. nivara*, the wild ancestors of *O. sativa*. Results suggested that *Pup1* locus variation was already a common feature within wild ancestors of cultivated Asian and African rice. Thus, divergence at *Pup1* appears to predate domestication of rice.

Since the function of other genes within the *Pup1* locus remains unclear, it would be desirable to transfer the entire *Pup1* region from Kasalath into recipient varieties during marker-assisted selection. Thus, we propose using two foreground markers (K46-K and K20-K) in breeding programs aimed at introgressing *Pup1*.

(M. Wissuwa, J. Pariasca-Tanaka, JH. Chin[IRRI], NK. Drame[Africa Rice])

TOPIC 4

Identification of QTL for efficient root elongation under a wide range of nitrogen concentrations in a rice variety with an Indica-type genetic background

Because root is the sole organ for uptaking water and nutrients such as nitrogen from surrounding soils, improving root architecture and physiological functions are required for enhancing stability and production in rice. IR64, an elite Indica-type variety with high adaptability and high yield, has been widely accepted as a mega variety in rice production and breeding programs in many tropical regions. The International Rice Research Institute-Japan Collaborative Research Project has developed a total of 334 introgression lines (ILs) derived from ten high yielding donor varieties with the genetic background of IR64. Among them, a line designated as YTH183 showed stable and higher yield in tropical regions as well as in temperate regions compared with IR64. However, quantitative trait locus/loci (QTL) for the stable and higher yielding line have not been identified. Furthermore, QTL for root elongation efficiently under a wide range of nitrogen concentrations have not been identified in varieties with the genetic background of IR64. The aims of this study, therefore, were to map and characterize the QTL derived from YTH183 to understand the architecture and functions of roots in YTH183.

The longest root of YTH183 was significantly higher than that of IR64 seedlings hydroponically grown for 8 days in 5 µM NH_4Cl (Fig. 1). As a result, YTH183 had a QTL for root elongation, designated as *qRL6.4-YP5*. The longest root of near-isogenic line (NIL) for *qRL6.4-YP5* with the genetic background of IR64 was significantly higher than that of IR64 (Fig. 1). The QTL *qRL6.4-YP5* (R^2=0.37) was identified in the flanked region between RM6395 and RM8242 on the long-arm region of chromosome 6 (Fig. 2). Further characterization of *qRL6.4-YP5* was done using the NIL. Compared with IR64, total root length was always higher in the NIL and was enhanced in response to the increase in exogenous concentrations of nitrogen (Table 1). The length of the longest root was always higher in the NIL. It was enhanced under nitrogen concentrations of up to 50 µM NH_4Cl, but not in 500 µM NH_4Cl (Table 1). The effect of *qRL6.4-YP5* on root number was not proven in these conditions (Table 1).

To our knowledge, *qRL6.4-YP5* is the first promising QTL for efficient root elongation under a wide range of nitrogen concentrations in rice varieties with the genetic background of IR64. These achievements should help improve root architecture of rice for a stable and high yielding production system in tropical developing countries.

(M. Obara, T. Ishimaru, T. Abiko[Kyushu University], D. Fujita[Kyushu University], N. Kobayashi[NARO-NICS], S. Yanagihara, Y. Fukuta)

Fig. 1. Typical phenotypes of seedlings grown for 8 days in 5 μM NH_4Cl.
YTH183 and NIL have positive allele of *qRL6.4-YP5*. Scale bar in individual pictures indicates 50 mm.

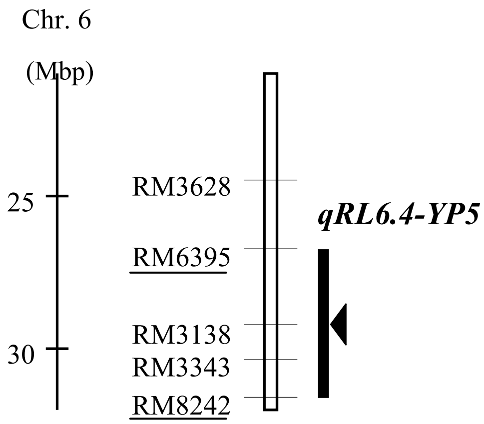


Fig. 2. Physical position of *qRL6.4-YP5* on the long-arm region of chromosome 6.
Closed vertical column indicates candidate region for *qRL6.4-YP5*. Closed triangle indicates the position of the peak *F* score.

Table 1. Elongation and development of roots in NIL for *qRL6.4-YP5* under a wide range of nitrogen concentrations

Traits	Variety・line	Nitrogen concentration							
		0 μM		5 μM		50 μM		500 μM	
Total root length (mm)	IR64	643		742		907		1108	
	NIL	801	**	864	**	1080	**	1276	**
Length of longest root (mm)	IR64	121		128		137		114	
	NIL	145	**	158	**	161	**	140	**
Root number (plant-1)	IR64	7.6		8.0		11.0		16.6	
	NIL	8.0		7.8		10.6		15.6	

Plants were grown for 8 days.
NH_4Cl was the sole nitrogen source.
Asterisks (**) represent a significant difference between IR64 and NIL at P-value of 1% level (one-way ANOVA).

Integrated analysis of the effects of dehydration and cold on rice metabolites, phytohormones, and gene transcripts

Land plants must mount suitable responses to overcome the adverse effects of water stress caused by either drought or low-temperature conditions. Among external stresses, water stress is one of the most important limitations to crop productivity. Discoveries of useful genes for molecular breeding using metabolomics and transcriptomics promise to facilitate the improvement of crop yields under water stress conditions. It is important to identify plant metabolites and transcripts that respond to water stress to determine the essential steps in molecular processes related to the effective adaptation of plants to stress conditions. Metabolomic and transcriptomic data have provided much information on the metabolite, phytohormone, and transcript networks that control plant growth and development. Rice is important not only as a major crop but also as a model monocot.

In this study, we performed an integrated analysis of the metabolites, phytohormones, and gene transcripts in rice plants subjected to dehydration or cold treatments. Our aim was to comprehensively survey the molecular responses of rice to dehydration or cold stimuli. We used three types of MS systems: gas chromatography coupled with time-of-flight MS (GC-TOF-MS), capillary electrophoresis coupled with MS (CE-MS), and liquid chromatography coupled with MS (LC-MS). We identified and characterized representative dehydration-responsive and cold-responsive metabolites and phytohormones. We also performed a transcriptome analysis using a rice oligonucleotide microarray. We analyzed metabolite–gene and phytohormone–gene correlations and identified several genes encoding metabolic enzymes that might play key roles in the responses of rice plants to dehydration or cold. We compared the roles of the identified rice genes with those of their counterparts in Arabidopsis under dehydration or cold conditions.

An integrated analysis of metabolites and gene expression indicated that several genes encoding enzymes involved in starch degradation, sucrose metabolism, and the glyoxylate cycle are upregulated in rice plants exposed to dehydration or cold, and that these changes are correlated with the accumulation of glucose, fructose, and sucrose (Fig. 1). In particular, high expression levels of genes encoding isocitrate lyase and malate synthase in the glyoxylate cycle correlate with increased glucose levels in rice, but not in Arabidopsis, under dehydration conditions, indicating that the regulation of the glyoxylate cycle may be involved in glucose accumulation under dehydration conditions in rice, but not in Arabidopsis. An integrated analysis of phytohormones and gene transcripts revealed an inverse relationship between abscisic acid (ABA)-signaling and cytokinin-signaling under cold and dehydration stresses; these stresses increase ABA signaling and decrease cytokinin signaling (Fig. 2). High levels of *OsNCED* transcripts correlate with ABA accumulation,

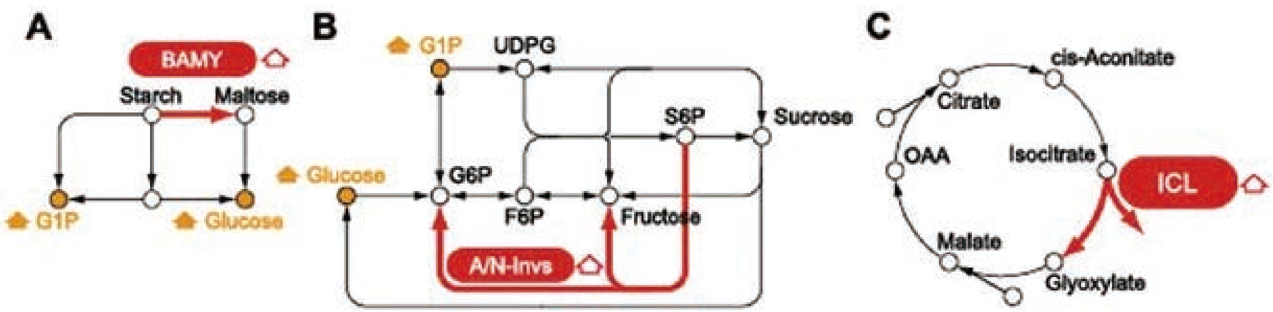


Fig. 1. Carbohydrate and amino acid metabolic pathways. (A) Starch degradation; (B) Sucrose metabolism; (C) Glyoxylate cycle: BAMY, b-amylase; A/N-invs, alkaline/neutral invertase; ICL, isocitrate lyase.

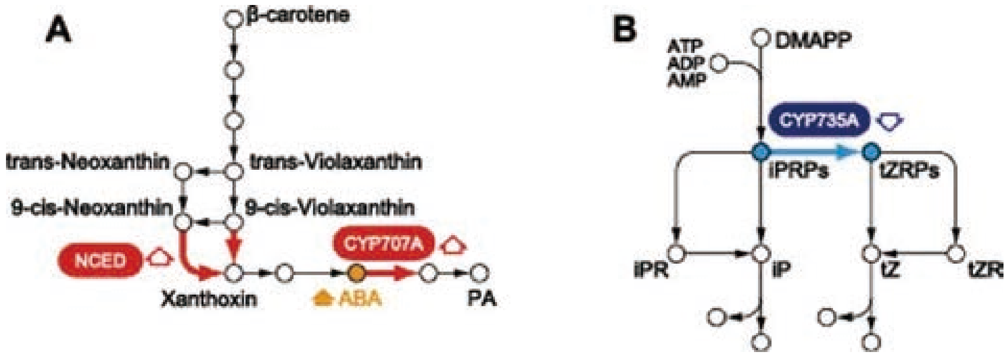


Fig. 2. Pathways for ABA and CK biosyntheses. (A) ABA biosynthesis; (B) CK biosynthesis. NCED, 9-cis-epoxycarotenoid dioxygenase.

and low levels of *CYP735A* transcripts correlate with decreased levels of a cytokinin precursor in rice. This reduced expression of *CYP735As* occurs in rice, but not in Arabidopsis. Therefore, transcriptional regulation of *CYP735As* might be involved in regulating cytokinin levels under dehydration and cold conditions in rice, but not in Arabidopsis.

(K. Maruyama and K. Yamaguchi-Shinozaki[The University of Tokyo])

TOPIC 6

Four AREB/ABF transcription factors function downstream of three SnRK2 protein kinases to regulate drought stress tolerance

Global climate change has increased the frequency and severity of drought, resulting in significant yield losses in staple crops worldwide. Drought is one of the major abiotic stresses that adversely affect plant growth, survival, distribution, and productivity. Under drought conditions, many genes involved in drought stress response are induced in a wide range of plant species. The plant hormone abscisic acid (ABA) plays a crucial role in coordinating the responses to reduced water availability as well as in multiple developmental processes. Endogenous ABA levels in plant cells are increased in response to drought stress, leading to expression of stress-responsive genes. In a model plant Arabidopsis, under drought stress conditions, ABA controls stress-responsive gene expression mainly through three bZIP transcription factors (TFs) -- AREB1/ABF2, AREB2/ABF4 and ABF3 -- which are activated by SNF1-related kinase 2s (SnRK2s) such as SRK2D/SnRK2.2, SRK2E/SnRK2.6/OST1, and SRK2I/SnRK2.3 (SRK2D/E/I). However, as the three AREB/ABFs are required, but not exclusive, for the SnRK2-mediated gene expression, transcriptional pathways regulated by SRK2D/E/I remain unknown.

In this report, we show that a Clade A bZIP transcription factor, ABF1, function as a homolog of AREB1/ABF2, AREB2/ABF4, and ABF3 in ABA-dependent gene expression in Arabidopsis. In spite of lower expression levels of ABF1 than those of the three AREB/ABFs, the *areb1 areb2 abf3 abf1* quadruple knockout mutant plants exhibited enhanced sensitivity to drought and reduced sensitivity to ABA in primary root growth compared with the *areb1 areb2 abf3* triple knockout mutant. Large-scale transcriptome analyses uncovered that expression of downstream genes of SRK2D/E/I, which include many functional genes in drought stress responses and tolerance such as TFs and LEA proteins, was mostly impaired in the quadruple mutant. These results indicate that the four AREB/ABFs are the predominant TFs downstream of SRK2D/E/I in ABA signaling in response to drought stress during vegetative growth.

Considering that many findings strengthen the view that ABA signaling has contributed to land colonization and adaptation to various environmental changes, the manipulation of genes involved in ABA signaling has the potential

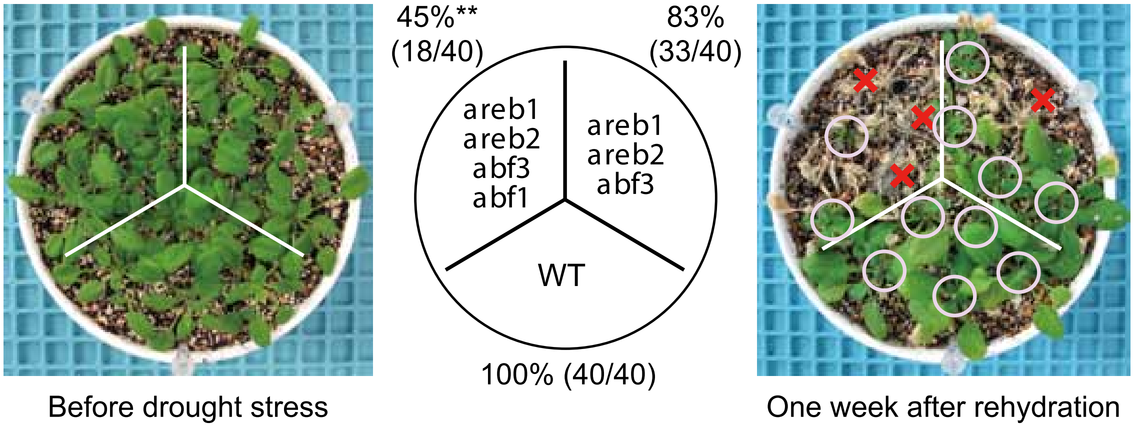


Fig. 1. The *areb1 areb2 abf3 abf1* quadruple knockout mutant displays enhanced sensitivity to drought compared with the *areb1 areb2 abf3* triple knockout mutant. Watering was withheld from 4-week-old plants for 11–12 d, and then the plants were re-watered for 1 week before the photograph was taken. Circles and crosses indicate survival and dead plants, respectively. Wild-type (WT) and two kinds of mutant plants (n = 5 each) were grown in soil in a 9 cm pot. Survival rates were shown in the central column and calculated from the results from eight independent experiments (n=40). Representative result is shown. $^{**}P < 0.01$ (Student's *t*-test, based on comparison with WT)

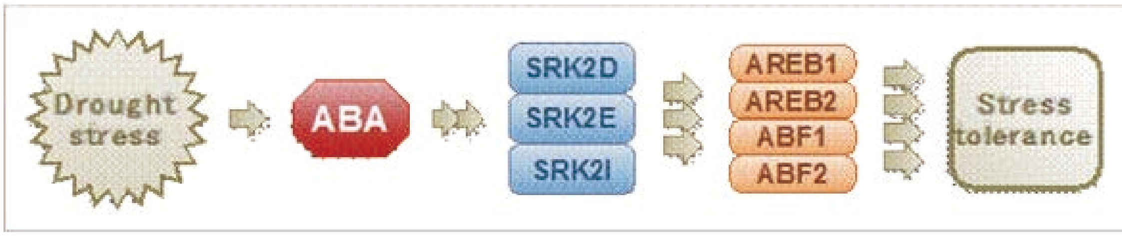


Fig. 2. Model showing the AREB/ABF-SnRK2 pathway that controls ABA-mediated transcriptional regulation in responses to drought stress in plants

to improve crop productivity and quality under drought stress conditions. AREB/ABFs, which are key players in drought stress response, are well conserved in land plants, so that the four AREB/ABFs can be good candidates to engineer enhanced drought tolerance. Thus, engineering ABA signaling through manipulation of SnRK2-AREB/ABF-mediated transcriptional regulation would create a new path to face climate change through improvement of crop production.

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TOPIC 7

Low night temperature inhibits fertilization and consequently reduces fruit set in 'Monthong' durian

Durian flowers mainly in January in Chanthaburi, the main production area in Thailand. Chanthaburi's average minimum temperature for January is 20.7°C (10-year average); however, in 2014, the daily minimum temperature dropped to lower than 15°C for the first time in five years, with record-low temperatures (below 17°C) lasting about a week. Usually, durian trees set fruits at 15-30%; however, the fruit set was quite poor that year especially for 'Monthong', the leading cultivar in Thailand. Empirical observations have shown that 'low temperature' during anthesis reduces fruit set, but the effect of low temperatures on the development of fruit set in durian is not fully understood because the trees grow very high in the fields where environmental factors, such as temperature, are difficult to control.

In this study, we developed a temperature controller that can be used in the orchard, and we examined the effect of night temperature on fruit set. Morphological development of ovules was also observed and its influence on fruit set was evaluated.

A polystyrene foam box equipped with Peltier devices was attached to a bearing branch to enclose one cluster (Fig. 1). The temperature inside the box was fixed at 15°C or 25°C during nighttime (2000 to 0800h) for 7 days after pollination (DAP). The box was detached after the 7th day. At 25°C, about 30% of the flowers set fruits at 28 DAP, whereas all flowers abscised by 21 DAP at 15°C (Fig. 2). Pollen tubes elongated within the styles in both 15°C and 25°C. However, at 15°C, 14.7% of ovules remained at the mature stage (Fig. 3A, Table1), which is the normal stage before accepting pollen-tube nucleus. No mature ovules were found at 25°C. On the other hand, 22.7% of ovules proceeded to the endosperm nuclei division stage at 25°C (Fig. 3B, Table 1). No endosperm-nuclei-division ovules were found at 15°C. Endosperm nuclei are the result of fertilization; therefore, it was considered that fertilization occurred at 25°C but did not occur at 15°C. The average length of the ovule at 15°C was considerably shorter than the one at 25°C (Table 1).

These findings suggest that night temperature of 15°C inhibits fertilization and consequently causes poor fruit set in 'Monthong' durian. 'Monthong' is the most important cultivar in Thailand; however, the fruit set is easily affected by night temperatures. To avoid risk caused by low temperature, planting other cultivars besides 'Monthong' or applying plant growth regulators to extend the flowering period is recommended. Adaptation of other cultivars that set fruits at low temperature conditions is also an effectual way for the stable production of durian. In this regard, the temperature controller we have developed can be a useful tool for examining cultivars that set fruit even at low-temperature conditions.

(N. Kozai, T. Ogata, O. Chusri [Chanthaburi Horticultural Research Center] S. Tongtao [Chanthaburi Horticultural Research Center])

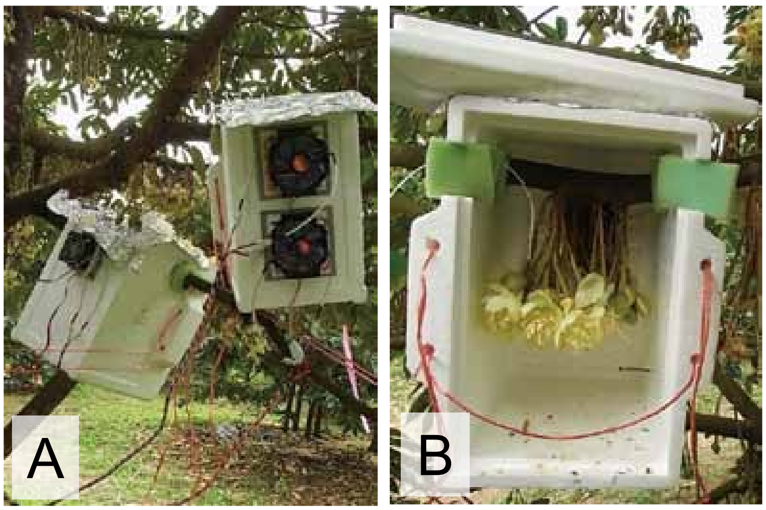


Fig. 1. Temperature controller set on a flower cluster.
A: A polystyrene foam box equipped with Peltier devices was used as controller.
B: Inside the controller (The lid was left open during daytime).

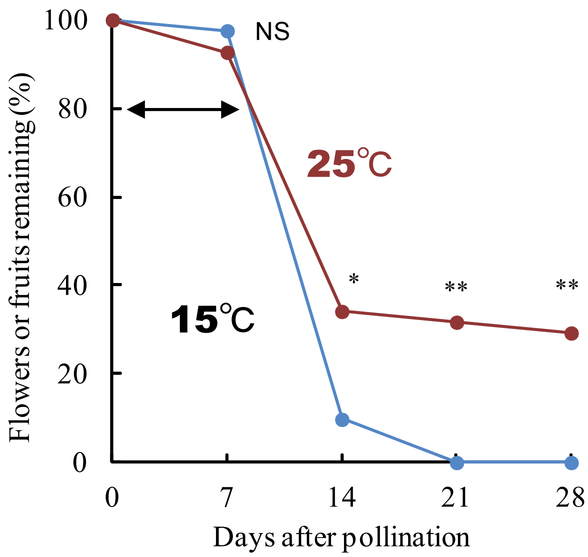


Fig. 2. Percentages of flowers or fruits remaining after pollination. Asterisks (* and **) indicate significant differences between the treatments based on Fisher's exact test at P<0.05 and P<0.01, respectively. NS indicates a non-significant difference. Arrow shows the duration of temperature treatment.

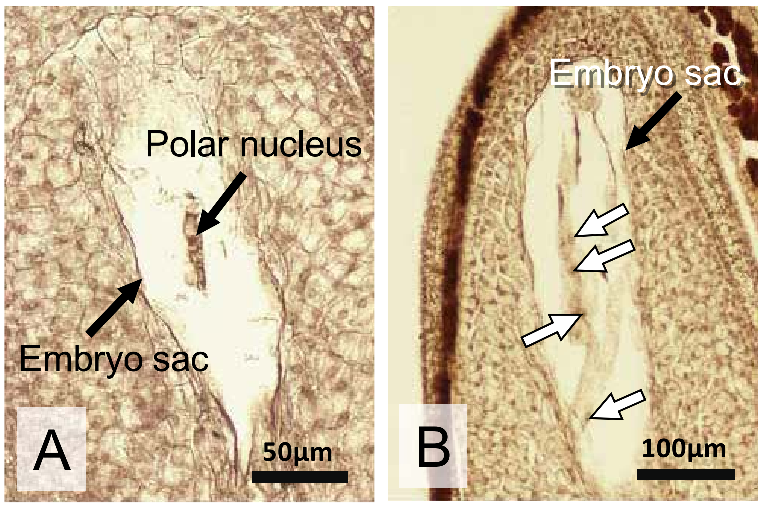


Fig. 3. Micrographs showing the morphological development of ovules at 7 days after pollination (DAP). A: Ovule at the mature stage containing an embryo sac with a fused polar nucleus (15°C). B: Ovule at the endosperm nuclei division stage (25°C). White arrows indicate endosperm nuclei.

Table 1. Average length of the ovules and the developmental stages at 7 DAP

Treatment	Number of ovules observed	Length of ovules (mm)	Stages of ovule development (%)			
			Mature	Endosperm nuclei division	Deformed	Degenerated
15 °C	21	1.19	14.3	0	66.7	19.0
25 °C	22	1.48	0	22.7	45.5	31.8

PROGRAM C
Rural Livelihood

"Technology development for income and livelihood improvement of the rural population in developing regions"

The Rural Livelihood Program supports the sustainable development of agriculture, forestry and fisheries, and the development of technologies that generate income and improve living conditions in developing regions. Research activities have been carried out mainly in Lao PDR, Thailand, Malaysia, Philippines, and China. The technologies that have been developed are being transferred to the farmers, industry workers, and local government officers.

[Sustainable and Independent Farm Household Economy in IndoChina Project]

In this project, the development of technologies and its assembly for establishing an intensive and multiple agricultural management strategy was conducted on the basis of information from terrain and land use maps of Nameuang Village, a community situated in a mountainous area in Lao PDR. Regarding upland agricultural systems, the technologies for improving the yield of upland rice and other non-rice crops, and those for integrating upland cropping with livestock or fruit production, were studied. As for lowland agricultural systems, desirable management practices in rice culture to improve yield, e.g., by efficient utilization of water resources and adequate soil amendment, were offered. In addition, the actual situation as regards the collection and utilization of non-timber forest products (NTFPs) as well as animal feed were surveyed. This study has contributed towards understanding the role of NTFPs in the diet and income of villagers, and it has emphasized the importance of local resource management to the villagers.

The results of the studies were explained and demonstrated to the Lao side at the anniversary ceremony of the National Agriculture and Forestry Research Institute (NAFRI) and at the steering committee meeting. Moreover, a village meeting was held and a demonstration farm was established at the target village so that the villagers and regional government officers will have a better understanding of the ongoing research activities (Photo 1). Furthermore, a room for exhibiting JIRCAS's activities was opened at the district agriculture and forestry office (Photo 2).

[Recycling-based Agricultural Production in China Project]

As an output of this project, we published a book, titled "China Agricultural Outlook 2030," which summarizes the results of research on food supply and demand and the medium and long-term prospect of grains, especially maize. In order to promote a recycling-based agricultural production system, a maize-wheat cropping system in Hebei Province and a high value-added vegetable cultivation method that uses less fertilizer in Inner Mongolia are being developed. The economic effect of organic matter input was studied, and an impact factor analysis on maize yield (based on fertilizer cost, seeds price, seeding density, etc.) was carried out. Finally, we have also conducted farmer surveys and compared the support systems in China, EU, Japan, and America in order to proceed with the analysis of institutional support policies for the establishment of a recycling-based agricultural system.

Photo 1. Village meeting at the study area

Photo 2. Poster discussion at the exhibition room of the district agriculture and forestry office in Lao PDR

[Food Resource Utilization Project]

To advance the agenda of utilizing local food resources, the Asian Food Resource Network (AFRN) published a database of traditional fermented foods in Thailand on the web (http://www.jircas.affrc.go.jp/DB/DB11/). In Thailand and Lao PDR, the project team studied the effects of salinity and fermentation period on the quality of fermented freshwater fish seasoning. Knowledge that contributes toward product management and improvement was obtained.

In August 2014, JIRCAS held an expert consultation on assuring food safety in cooperation with several international organizations, such as the FAO and CGIAR, in order to contribute toward establishing international standards for local products through the AFRN. The project activities and results were highly esteemed; for example, there was an official invitation to the celebration of the National Day of the People's Republic of China, and a certificate of appreciation was awarded by the National University of Laos.

[Asia Biomass Project]

In order to encourage biofuel- and biomaterial-producing technologies from agricultural residues, we successfully developed a new saccharification technology, a non-cooling ethanol fermentation technology, and a detection method for sugar accumulation in felled palm trunks. To demonstrate this energy production technology using agricultural residues (old palm trunks and waste water) from oil palm mills, we started a feasibility study with a Japanese company in Malaysia. These achievements are good examples of developed technologies that have practical applications.

[Sustainable Forestry Production Project]

Technology development on sustainable management and conservation of forest resources has been implemented. In Thailand, an estimation of carbon storage amount was studied. In Malaysia, the effects of selective cutting rules to recover timber resources was examined, and methods to establish transfer zones of forest reproductive materials in the peninsular area were presented. We also carried out outreach activities, such as technology transfer to the locals on the production of compressed lumber using oil palm trunk waste, in cooperation with a Malaysian timber industry organization.

[Tropical Coastal Aquaculture Project]

The improvement of aquaculture technologies and stock management programs in tropical waters was the aim of this project. In Thailand, a black tiger shrimp co-culture system involving seaweed and snail was developed. In Malaysia, the population dynamics of blood cockle were investigated. Improved breeding strategies and seed production technologies were also developed for a sustainable shrimp culture.

TOPIC 1

Economic benefits of various non-timber forestry products to Lao PDR's farm economy

Agriculture in Laos is primarily rain-dependent due to its tropical monsoon climate. Farmlands are often subjected to droughts and floods, rendering crop production unstable. Therefore, in addition to rice cultivation, Laotian farmers collect non-timber forestry products (NTFPs) in mountainous areas, thus providing a safety net to local residents in terms of livelihood support. To understand the actual utilization of NTFPs and its contribution to rural household economies, a study was conducted on all 140 households (104 valid responses) in a farming village in the northwestern part of Vientiane Province from July 2012 through June 2013, recording each day the types and quantities of NTFPs collected as well as their intended uses. To determine the economic values, a price table was created, with each NTFP's trade price multiplied by its trade value and then converted to a monetary amount.

Over 400 diverse types of NTFPs, including 289 plant-type products (such as mushrooms) in addition to 124 animal-type products, were utilized. Excluding the types of NTFPs categorized as textiles, resins, and medicines, over 90 percent of NTFPs were used by the collecting households and mostly consumed as food. Out of 24 mushroom-type NTFPs, which are easily influenced by the forest environment, nine types accounted for 90% of collected amounts. Of these, five types are collected

Table 1. Number of NTFPs, amount, economic value, purpose of collection, and main products based on the attributes of NTFPs collected

Category	Number of NTFPs	%1)	Amount collected: Weight (Kg)2)	Amount collected: Number of pieces	Economic value KIP	%3)	Intended use(%4)): Self-consumption	Intended use(%4)): Sale	Main products
NTFPs of plant origin	289	100	44,587	39,874	397,131,470	100			
Food	262	91	33,515	18,614	202,303,120	51	99	1	
Edible wild plant	133		11,481	105	62,205,920				*Azadirachta indica, Centella asiatica*
Flower	10		347	5	854,700				*Musa* spp.
Fruit	19		2,384	1,872	6,674,750				*Livistona saribus, Dialium indum*
Bud	68		14,719	16,632	76,082,950				*Schizostachyum blumei, Calamus tenus*
Root & Tuber	2		17		154,500				*Curcuma longa*
Spice	6		82		491,700				*Alpinia* spp.
Mushroo	24		4,485		55,838,600				*Lentinus polychrous, L. Squarrosulus, Schizophyllum comune*
Craft	13	4	228	21,143	68,722,200	17	93	7	*Calamus gracilis*
Fiber	4	1	7,891	114	119,961,650	30	9	91	*Thysanolaena maxima, Broussonetia papyrifera*
Resin	2	1	1,240		2,598,400	1	9	91	*Shorea obtusa*
Medicine	8	3	1,713	3	3,546,100	1	41	59	*Smilax glabra, Coscinium fenestratum*
Per household			429	383	3,818,572				
NTFPs of animal origin	124	100	5,331	5,543	172,372,200	100			
Mammals	21	17	133		49,816,400	29	97	3	*Callosciurus erythraeusm, Rattus norvegicus*
Birds	19	15		2,244	10,150,000	6	98	2	*Spilopelia chinensis, Ixobrychus cinnamomeus*
Fish & shelfish	33	27	4,155	2,544	80,807,200	47	99	1	*Cyprinidae* spp., *Clariidae* spp., *Synbranchidae* spp., *Viviparidae* spp.
Reptiles	5	4		97	2,210,000	1	97	3	*Colubridae* spp., *Varanidae* spp.
Amphibian	4	3	446	92	9,919,500	6	98	2	*Rana temporaria, Pelophylax esculentus*
Insects	42	34	597	566	19,469,100	11	94	6	*Gryllidae* spp., *Rhynchophoridae* spp.
Per household			51	53	1,657,425				

1) Percentage of each attribute in all NTFPs of plant and animal origins

2) Air-dry weight for craft, fiber resin, and medicen. Wet weight for others.

3) Percentage of each attribute of NTFPs of plant and animal origins in the economic value

4) Percentage of each intended use. self-consumption and sale, in total number of times of collection

during rainy season, whereas one type, *Lentinus polychrous* (Lao name: Hed bot), is collected during dry season (Fig. 1). Mushrooms are, therefore, valuable sources of food that are collected throughout the year.

NTFPs categorized as textiles, resins, and medicines were collected for sale, and of these, approximately eight tons (dry weight) of textiles were collected (Fig. 1). The majority of these NTFPs were summer cypress, from which flower clusters are collected to make products such as brooms. Summer cypress appears in fallow land after slashing and burning and can be collected in great quantity for the first three years. It is also a valuable source of income between periods of farming.

The economic value was estimated at 5,480,000 kip (broken down into 3,820,000 kip from plant types and 1,660,000 kip from animal types) (Fig. 1). This equates to approximately 2.4 tons of glutinous rice, enough to feed 9.6 people (at 250 kg/person/year) and contributing greatly to the rural economy.

This study is important towards understanding

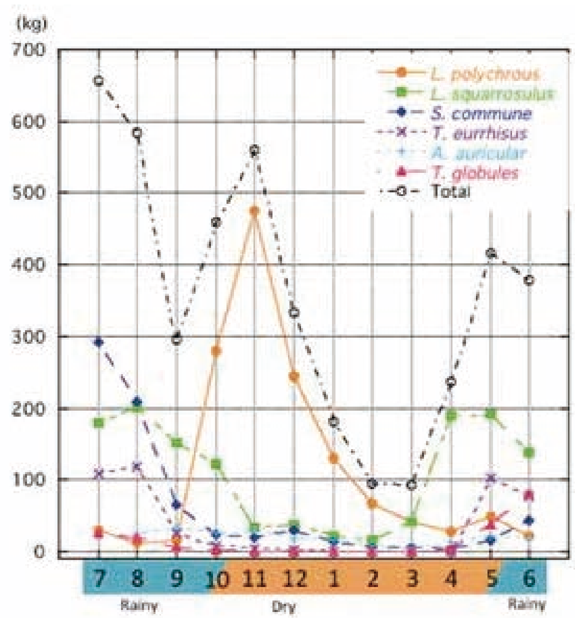


Fig. 1. Monthly collection for each type of mushroom

the subsistence strategies of area residents in Laos over a full year. It can also be used as a basis for implementing safeguards, including the protection of indigenous peoples/ area residents and the maintenance of species diversity, by institutions that implement rural development programs and forest preservation programs such as participatory forest management. Lastly, it provides concrete data on NTFPs, as identified in forestry strategies by Laotian government organizations such as the Agriculture and Forestry Office and the Ministry of Natural Resources and Environment.

(K. Kimura, S. Kobayashi, R. Yoneda, S. Xayalath[Forest Sciences Research Center], B. Khampumi[FSRC])

TOPIC 2

Resource management of a small-sized cyprinid population in an isolated small stream based on its ecological characteristics

The indigenous cyprinid *Rasbora rubrodorsalis* is widely distributed in agricultural water masses (e.g., irrigation canals) of various Indochinese countries including Laos. This species is small-sized (max. ca. 30 mm), occurs abundantly in remote rural areas of hilly/ mountainous regions, and is an important food resource in the area. In recent years, however, settlements and habitat expansion of invasive alien fishes as well as agricultural exploitation / urbanization in such areas are becoming a concern, possibly causing the decline in species diversity/stock level of indigenous fishes. This situation necessitates the acquisition of ecological information conducive to the species' resource management.

The following ecological features and relevant findings were obtained in the present study.

1) The sex ratio of *Rasbora rubrodorsalis* is remarkably biased towards females (male : female = 0.43 : 1), and the females grow larger than males in size (figure omitted).
2) Mature female occurrence ratio increases with seasonal day-length extension (figure omitted), and breeding is more active during high-temperature period (March to October). However, mature females also occur even during low-temperature period (November to February), indicating that the species breed

Fig. 1. Laotian indigenous cyprinid *Rasbora rubrodorsalis* (adult, 24.3 mm SL)

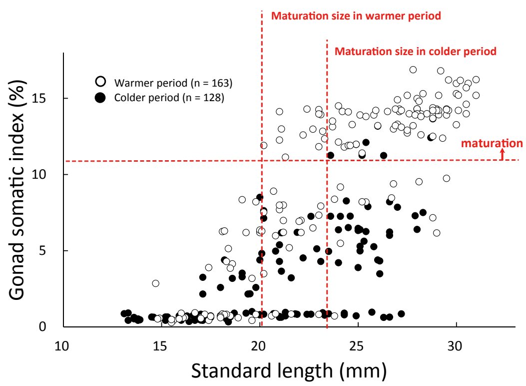


Fig. 2. Relationship between standard length and gonad somatic index in female *Rasbora rubrodorsalis* both in warmer and colder periods

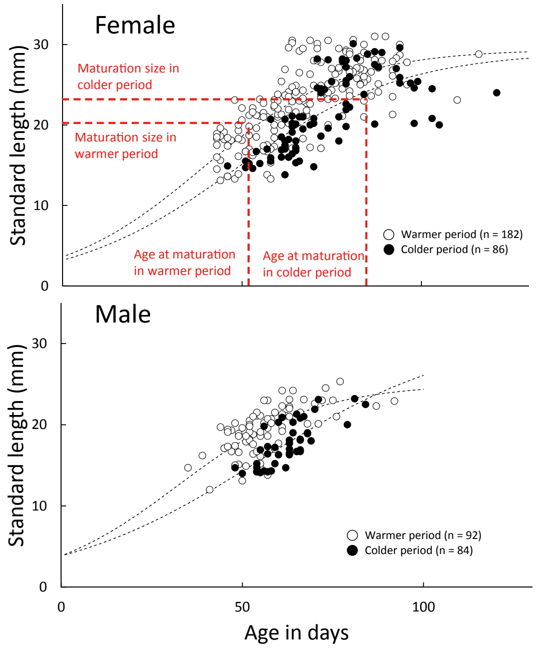


Fig. 3. Growth models of female and male *Rasbora rubrodorsalis* (fitted by Gompertz growth curves)

throughout the year (Fig. 2). Maturation sizes of females are > 20 mm SL and > 23 mm SL during high- and low-temperature periods, respectively (Fig. 2), and the maturation ages (in days) were estimated to be 50 and 80 days during high- and low-temperature periods, respectively (Fig. 3).

3) Longevities were estimated to be 150 days in females and 100 days in males (Fig. 3); therefore, plural generation alternations are considered to occur within a year.

4) Seasonal fishing control is considered not efficient for stock management of the species due to its short longevity. Although the upward migration of the species over the small waterfall located at the mid-stream is considered impossible because of limited swimming ability, stock provision from upstream to downstream areas is highly possible insofar as upstream breeding population is well conserved. Hence, continuous fishing in the downstream area concurrent with fishing prohibition in the upstream area is strongly recommended for the conservation of the breeding population and is contributory to both sustainable fisheries and species conservation (Fig. 4).

In addition to the above, environmental conservation is also indispensable for realizing the above-mentioned method for species conservation. Furthermore, considering the deterioration of genetic diversity as observed in the sympatric cyprinid *Esomus metallicus* and the ambassid *Parambassis siamensis* probably due to the geographical isolation, such deterioration may also be occurring in the *Rasbora rubrodorsalis* population. Genetic soundness, therefore, needs to be examined by microsatellite DNA marker analysis.

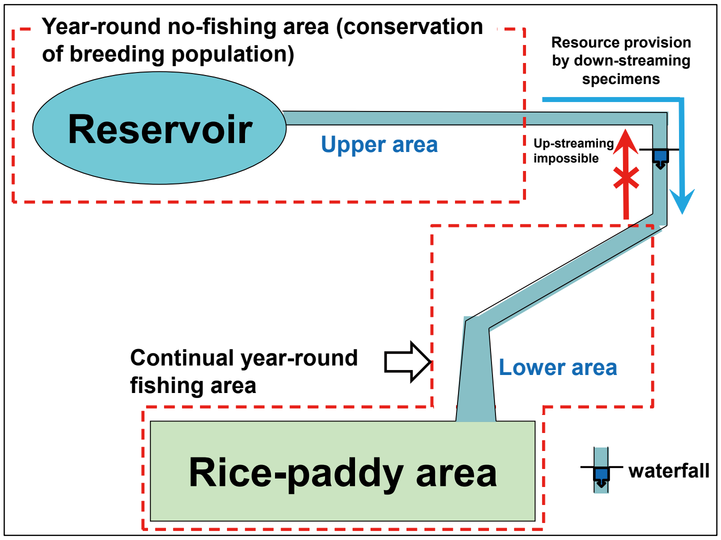


Fig. 4. Schematic drawing of the stream investigated in this study and the suggested year-round no-fishing area and continual fishing area for *Rasbora rubrodorsalis*

(S. Morioka, N. Koizumi [National Institute of Rural Engineering], B. Vongvichith[Living Aquatic Resources Research Center])

TOPIC 3

Decomposition analysis of maize yield change in China

China, the world's second largest producer and consumer of maize, has been a net importer since 2010. On the other hand, maize production nearly doubled during the period 2000–2012, with a 28% increase in yield per harvested area. Accordingly, this study examined the effects of prices and quantities of agricultural inputs as well as climatic factors on maize yield in China.

Maize yield was decomposed using results from factor demand functions and from a crop response model. The results show that the annual yield rate change (1.8%) is decomposed to the decrease in seed density (–3.4%) and the increase in seed productivity (5.2%) (Fig. 1). Values of the direct effect (–3.4%) and indirect effect through seed productivity (4.1%) of the seed density imply negative correlation between seed density and yield. Seed density decreases with the rise in seed price (–3.8%), and this effect seems larger than those of other prices. When comparing the contribution of fertilizer content to seed productivity, the value of potassium (0.8%) is higher than the others. The rapid increase in fertilizer input (6.8%) is parallel with the higher cost of capital (2.8%). The result of regional analysis revealed that the yield decreases with lower seed density in several regions where seed density is lower than the average (Fig. 2). The contribution of land rent to feed density and fertilizer per area is higher in the Northeast and North China Plains, which are major maize producing areas. On the other hand, the contribution of capital, agricultural machines, and draught animals

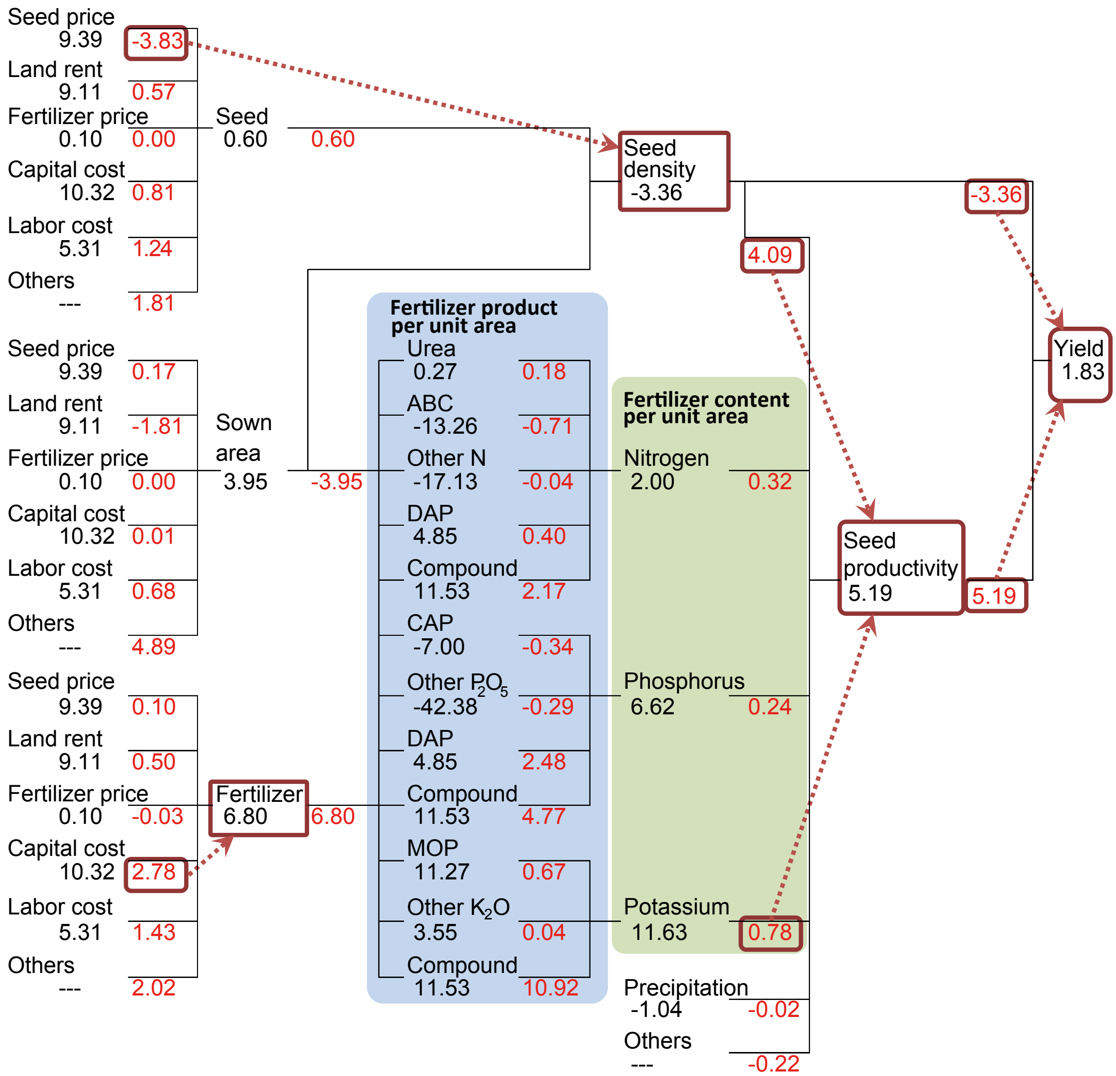


Fig. 1. Effects of factors influencing change in maize yield, China (2004–2012)
The number below each item is the annual average rate of change (%). The numbers below the lines are the contributions of the left-hand items to the right-hand items, in percentage points. Values are calculated from data of 18 provincial-level divisions.

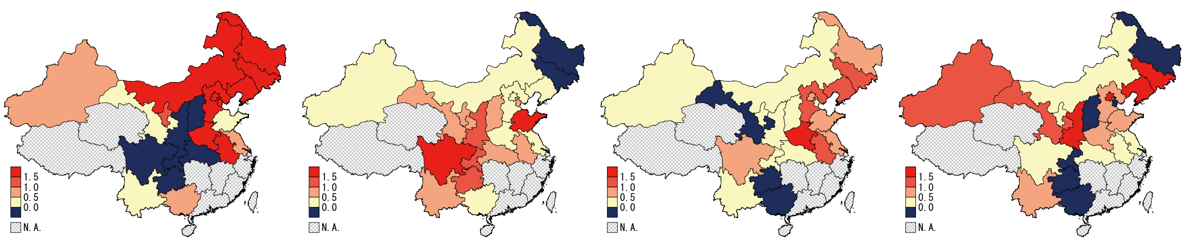


Fig. 2. Annual average rate of change of factors composing each item (in percentage points, 2004–2012 data)

seems higher in the southern regions.

This study clarified the effects of each price and quantity of input goods on the maize yield. The result can help promote discussion on the effects of policies to increase maize yield in China. Furthermore, the results can bind macro-level individual studies on yield, economic factors, and agricultural input goods. However, there are several limitations. This study did not analyze the effects of disseminating higher yielding seeds and of improving production circumstances on the decreasing seed density. The effects of nutrient balance should also be analyzed in more detail.

(E. Kusano, H. Chien, Y. Chen [China Agricultural University], O. Koyama)

TOPIC 4

Importance of salt concentration and long-term fermentation in the quality of salty-fermented freshwater fish paste in Thailand and Laos

The salty-fermented freshwater fish paste known as *pla-ra* and *pa-daek* in Thailand and Laos is universally used in daily meals as a storage-stable almighty seasoning or protein-rich cooking ingredient. It is traditionally made at home and also sold on the market nowadays. For the preparation, raw fish is mixed with salt and rice bran or roasted rice powder, and then fermented at tropical temperatures for at least 6 months. It is generally believed that longer fermentation makes the products taste better. Moreover, consumers often think the taste of the products varies from place to place. Scientific evidences regarding such characteristic features and microbes involved in the fermentation are expected to be useful in promoting quality improvement and consumption of *pla-ra / pa-daek* products, which are traditional high-value-added products that highly utilize indigenous fishery resources particularly in the inland region of Southeast Asia.

Regional characteristics of the pH and salt concentration are observed in the samples examined (Fig. 2A). The product pH is positively correlated with the salt concentration (Fig. 2A). Multiple species (2-8 species) of lactic acid bacteria are detected by the culture-independent method (summarized in Fig. 1) in 10 *pla-ra / pa-daek* products collected from central, northern, and northeastern Thailand, and Vientiane in Laos (Fig. 2B). The products can be classified into two groups by the representative genus of lactic acid bacteria, such as *Tetragenococcus* or *Lactobacillus*. Salt concentration of approximately 10% is the dividing point between these two groups (Fig. 2A). Products in the latter group contain relatively higher amount of lactic acid. The amount of glutamic acid, which is the source of delicious taste, increases in a fermentation-time dependent manner by 4 to 6 months in products prepared by following a common recipe (Fig. 3). Glutamic acid is one of the amino acids generated by the digestion of fish protein during fermentation.

Taken together, salt concentration is a key factor in determining the activity of lactic acid bacteria and the resulting lactic acid amount that relates to the regionality in taste preference. The producers can utilize a simple tool, such as a test

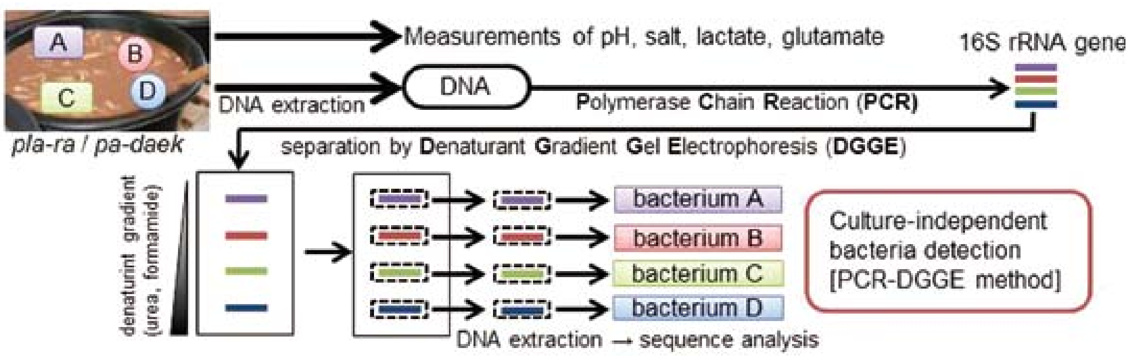


Fig. 1. Scheme of the taste component measurement and genetic identification of bacteria by culture independent method (PCR-DGGE)

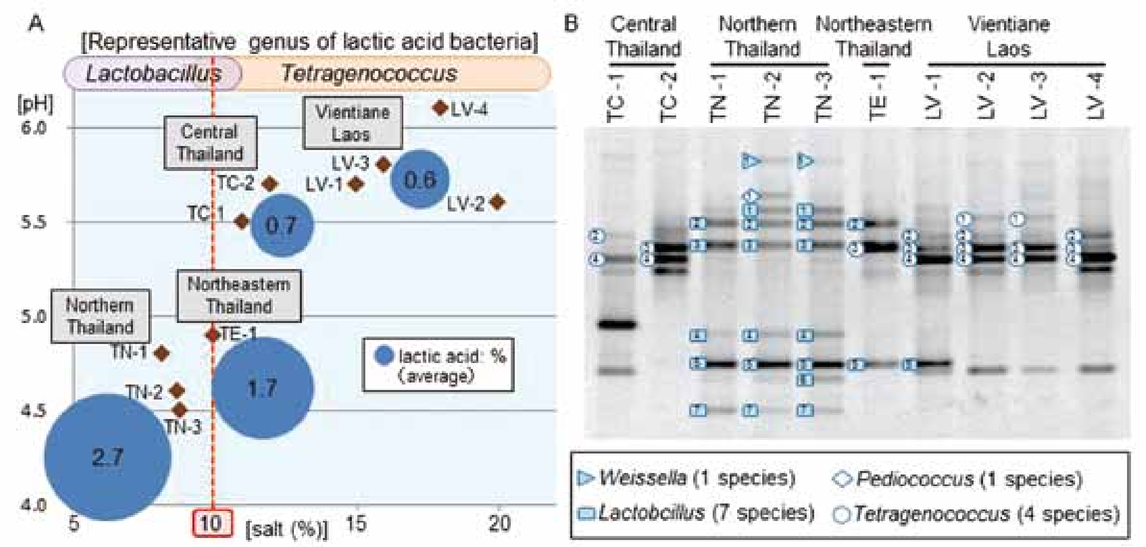


Fig. 2. A: Correlation and regionality of the taste components; B: Characteristics of lactic acid bacteria species detected by the PCR-DGGE method

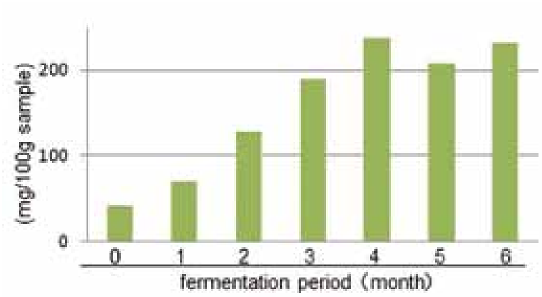


Fig. 3. Time-dependent change of the glutamic acid (source of delicious taste) during fermentation of *pla-ra* prepared by following a common recipe

paper, to monitor the salt concentration and pH for improving product quality and productivity. The overgrowth of *Lactobacillus* species that possibly results in acidification of the product by excess acid production can be prevented by controlling the salt concentration accordingly. It is recommended that the fermentation be continued long enough to generate a sufficient amount of glutamic acid.

(J. Marui, S. Boulom[National University of Laos], W. Panthavee[Kasetsart University], G. Trakoontivakorn[Kasetsart University], P. Tangkanakul[Kasetsart University], K. Kusumoto[National Agriculture and Food Research Organization, National Food Research Institute])

TOPIC 5

Direct saccharification technology from lignocellulosic biomass

Technology is important because of the high cost of obtaining fermentable sugars efficiently from cellulosic biomass. Many microorganisms capable of producing cellulose and hemicellulose-degrading enzymes have been reported and characterized. Currently, fungal cellulases are prepared and utilized to saccharify cellulosic biomass. It is known that the fungus *Trichoderma reesei* is able to produce high levels of secreted cellulases and several functionally distinct cellulase components. However, utilization of cellulases is an impediment to industrial application due to the high cost of enzymes.

On the other hand, *Clostridium thermocellum*, an anaerobic, thermophilic, spore-forming bacterium, is the most potent cellulose-degrading bacterium known to produce cellulosomes. The cellulosomes of *C. thermocellum* contain a surprisingly large variety of enzymes and show attractive enzymatic properties for the degradation of complex plant biomass. In a previous study, we demonstrated remarkable improvements in cellulolytic activity of cellulosomes from

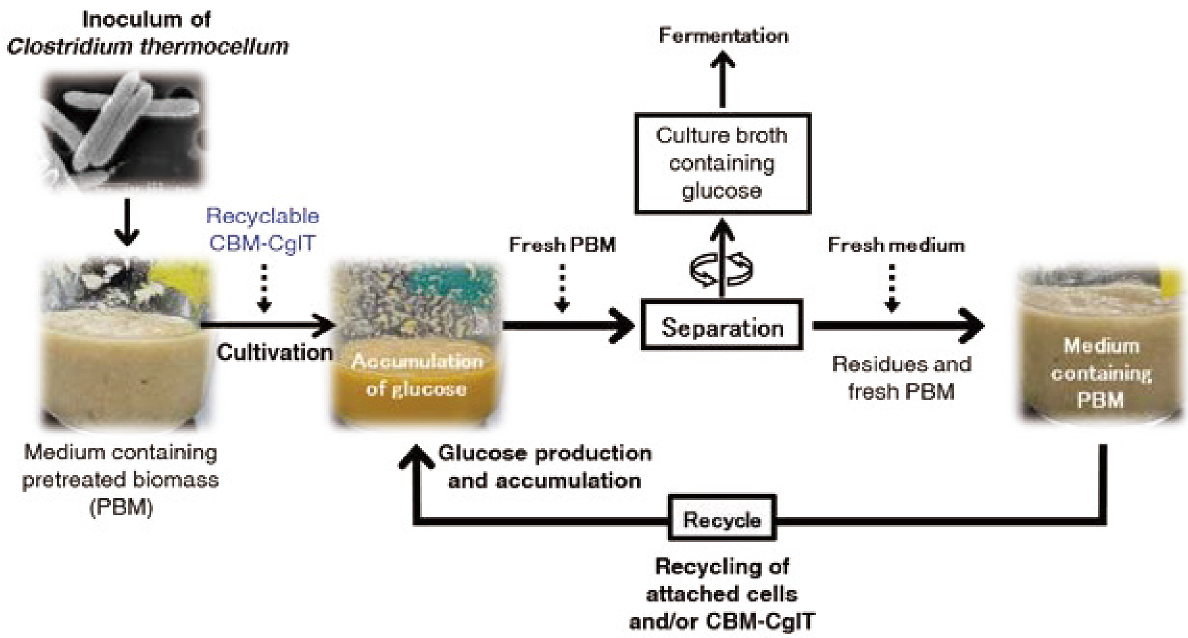


Fig. 1. Schematic of consecutive biological saccharification method by recycling of the hydrolyzed residue. Culture of *C. thermocellum* and supplementation of CBM3-CglT were only carried out the first biological saccharification round without further culture and addition of any enzymes[2]. To recover free cellulosomes and CBM-CglT, fresh pretreated cellulose substrates were added to the hydrolysis slurry, and then reabsorbed from the supernatant. A second round of biological saccharification was subsequently performed using the recovered enzymes by binding to fresh substrate and the hydrolysis residues containing *C. thermocellum* cells. Consecutive biological saccharification using these recycling procedures may be repeated several times.

the hypercellulolytic *C. thermocellum*[1] in combination with a thermostable β-glucosidase from *Thermoanaerobacter brockii* (CglT)[2, 3].

In this research, we report on saccharification by *C. thermocellum* cultures supplemented with thermostable β-glucosidases, which we named biological simultaneous enzyme production and saccharification (BSES)[4]. BSES required no addition of cellulolytic enzymes. It can directly produce glucose from cellulosic materials due to supplementation of cellulose degrading cultures with CglT. Exclusive glucose accumulation of glucose occurred when *C. thermocellum* was cultured with a thermostable β-glucosidase under a high cellulose load. This approach may resolve a significant barrier to economical production of bio-based chemicals and fuels from lignocellulosic biomass.

[1] Tachaapaikoon C, et al: Biodegradation. 2012, 23:57-68.
[2] Waeonukul R, et al: Bioresour Technol. 2012, 107:352-357.
[3] Waeonukul R, et al: Bioresour Technol. 2013, 130:424-430.
[4] Prawitwong P, et al: Biotechnol Biofuels. 2013, 6:184.

(A.Kosugi)

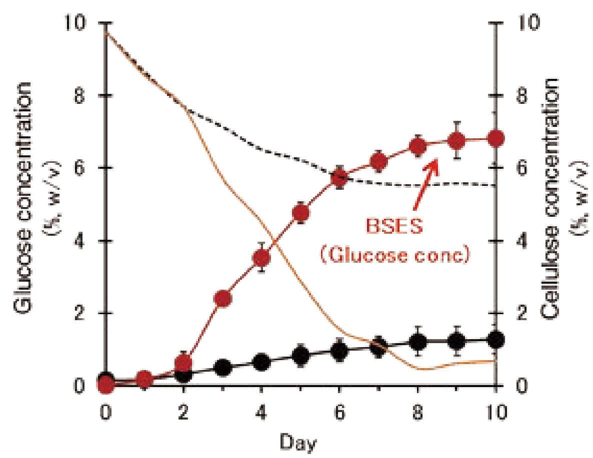


Fig. 2. Biological saccharification using *C. thermocellum* culture supplemented CglT. Cellulose hydrolysis ability and free sugars (glucose) accumulation was monitored under cultivation of *C. thermocellum* with or without CglT (+CglT/−CglT), respectively. Solid and dotted lines indicated residual cellulose contents (w/v) in culture broth. Error bars represent ± SD (n=3).

Impacts of the oil palm development program in Indonesia on small scale farmers

Since 1977, the Indonesian government has been implementing an oil palm development scheme called the Nuclear Estate Smallholders (NES) program. The program aims to share the benefit of plantation development between palm oil companies and rural communities by allocating a part of the plantation to small scale farmers (hereinafter referred to as 'plasma farmers'). Under the NES program, the company is also responsible for supporting the plasma farmers through various activities, such as providing soft loans and technical support as well as purchasing fresh fruit bunch (FFB) from farmers at a guaranteed price. Although there are significant differences in the level of performance from one NES case to another, it is difficult to evaluate because of a lack of indicators. Recently, the number of small scale farmers called 'independent farmers,' referring to those who don't join any collaboration programs with companies, is increasing in Indonesia, especially in Sumatera Island. This study aimed to identify the effects of the NES program by comparing the FFB production of plasma farmers and independent farmers based on the survey results about farm household economies.

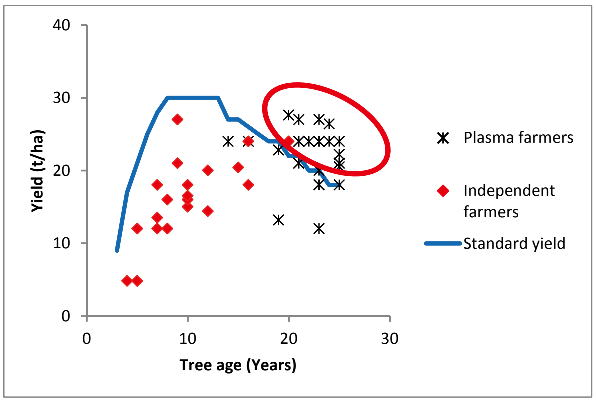
Tree age of oil palm strongly affects FFB yield. In general, the yield gradually decreases after achieving highest yield between the tree ages of 8 and 13 years. In the NES case of Company A in Riau Province, some plasma farmers were able to maintain or improve FFB yield even with trees aged 20 years or more (Fig. 1A). Such high yields in older trees were not observed in the NES case of Company B (Fig. 1B). From the graph, it can be seen that the net profit of plasma farmers in Company A was significantly higher than those of independent farmers (Fig. 2).

It must also be noted that the amount of fertilizer application by plasma farmers was higher than the amount applied by independent farmers. The amount of potassium fertilizer applied by independent farmers was particularly lower than the standard fertilizer application rate (Fig. 3). Applying the appropriate amount of fertilizer has contributed to better yield for plasma farmers.

While all plasma farmers planted high quality seedlings with certification provided by Company A, most independent farmers purchased seedlings without any quality assurance from local shops or nearby farmers (Fig. 4). Clearly, the quality of seedlings was another factor affecting FFB yield. Other factors that have contributed to higher yield by plasma farmers include continuous technical assistance, Company A's attitude towards the plasma farmers (e.g., fulfillment of contracts), and Company A's higher dependency on plasma farmers as a source of FFB for their palm oil mill.

The above findings can be used by local administrative agencies to formulate yield improvement policies that would benefit small scale oil palm farmers.

(T. Sugino)



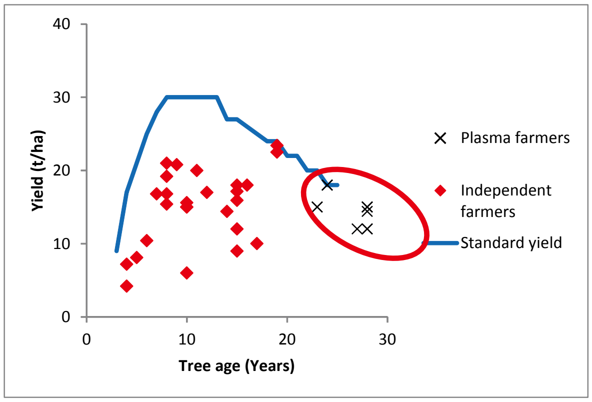


Fig. 1. Relationship between tree age and fresh fruit bunch (FFB) yield (left: Company A case study, right: Company B case study).

The standard yield shows the general relationship between tree age and FFB yield as reported by Adlin (1990). In the Company A case study, some of the plasma farmers maintained or improved FFB yield in spite of the higher tree age of 20 years or more (circled in red).

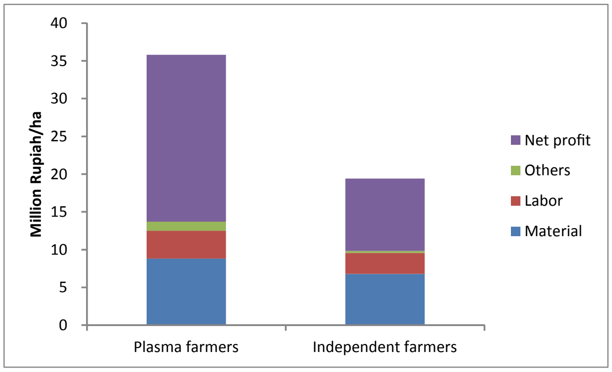


Fig. 2. FFB production cost and profit (Company A case study)

Cost and profit numbers were averaged for 26 plasma farmers and 22 independent farmers. Significant differences were observed in net profit (significant level: 1%), other cost (1%), labor cost (5%) and material cost (5%).

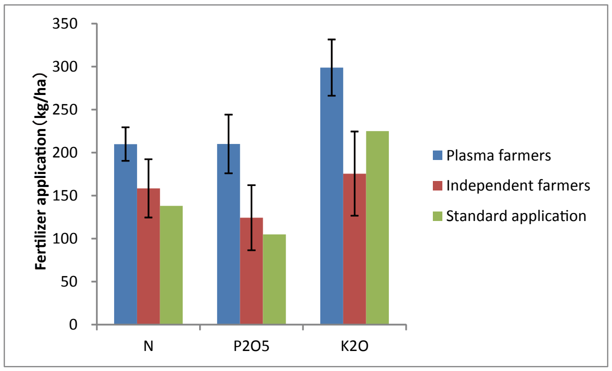


Fig. 3. Fertilizer application by farmers (Company A case study)

Percentages were averaged for 12 plasma farmers and 8 independent farmers. The error bars show the standard errors.

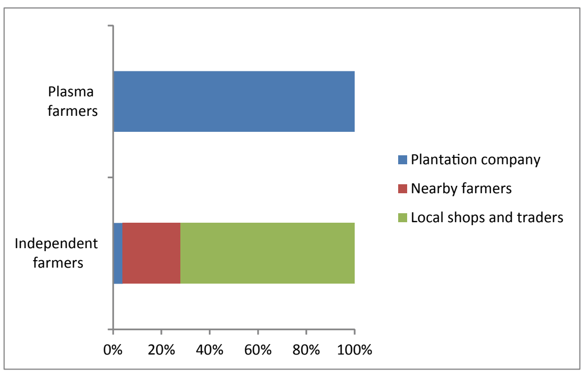


Fig. 4. Source of oil palm seedlings (Company A case study)

Number of respondents: 27 plasma farmers and 25 independent farmers

TOPIC 7

Methods to establish transfer zones of forest reproductive materials in Peninsular Malaysia

Uncontrolled transfer of forest reproductive materials (FRMs) has resulted to failures, sometimes taking many years to develop even after seemingly successful establishment. Failures, which should have been caused by less adaptation of transferred FRM to new environments, were often due to climatic, insect, or disease events that had much less impact on the native source. In uniform plantations, failures reduce the productivity of the new plantation, where better productivity is expected than in the previous plantation. Another problem arises in enrichment planting, which is commonly conducted in tropical rain forests in Southeast Asia. If transferred FRMs reach reproductive stage, they genetically contaminate the next generation through mating with native trees because enrichment planting is conducted in primary or secondary forests. Genetic contamination should not be ignored as the fitness of native forests in this region is affected when large volumes of transferred FRMs are introduced.

To avoid these problems, some methods have been proposed to establish FRM transfer zones. Provenance trials should provide the most reliable information for determining the limits of FRM movement and discerning which seed sources are best for planting locations. However, these trials have disadvantages and they are costly in terms of resources and time. If progeny test materials involve a few seed sources, then they can be used for assessing FRM transfer zones. Short-term common-garden studies, compared with field provenance trials, have the disadvantage of not evaluating seed sources during extreme climatic events and naturally occurring pest problems over time. However, they provide information about adaptation to environment expressed at the early stage of their growth. Although molecular markers are considered as neutral or nearly neutral against adaptation (selection), processes such as migration (movement of alleles among locations), population size, and genetic drift (random loss or fixation of alleles) affect the distribution of variation in molecular markers. There have been continuing discussions on how molecular markers are used for determining FRM transfer zones. Because the advantage of molecular markers are less time and labor, FRM transfer zones established by molecular markers should be considered tentative until confirmed by adaptive traits in a common environment (Fig. 1). Therefore, adaptive management should be introduced for FRM transfer zones based on molecular markers, which are going to be revised by the latest information on adaptive traits.

Because of the urgent necessity and the less time and labor it entails, we adopted the method of using molecular markers to establish FRM transfer zones. We analyzed the genetic structure of two important timber species in Peninsular Malaysia as examples. Genetic marker analysis has detected that the genetic diversity of *Neobalanocarpus heimii* (local name: chengal) was well explained when genetic diversity was separated as four different clusters. These four different clusters were localized at different regions in Peninsular Malaysia. When the localization of clusters was applied in determining the FRM transfer zone, four regions were recognized as FRM transfer zones. On the other hand, genetic marker analysis detected that the genetic diversity of *Shorea curtisii* (local name: seraya) was explained when genetic diversity was separated as three different clusters. These three different clusters, however, showed lower probability as regards cluster separation and showed ambiguous correspondence to localization in Peninsular Malaysia. This result supports the idea that strict regulation is not required for the species (Fig. 2). We must remember that the result was obtained using neutral genetic markers. If adaptive genetic variation is detected by long-term field provenance trial, medium-term progeny test, short-term common garden nursery and/or non-neutral genetic marker analysis in the future, then further revision of the regulation is required. Thus, FRM transfer zones should be determined for each important timber species in Peninsular Malaysia.

(N. Tani, N. Muhammad [Forest Research Institute Malaysia], S. L. Lee[FRIM], C. H. Ng[FRIM], L. H. Tnah[FRIM], K. K. S. Ng[FRIM], C. T. Lee[FRIM], N. F. Zakaria[FRIM], Y. Tsumura[University of Tsukuba])

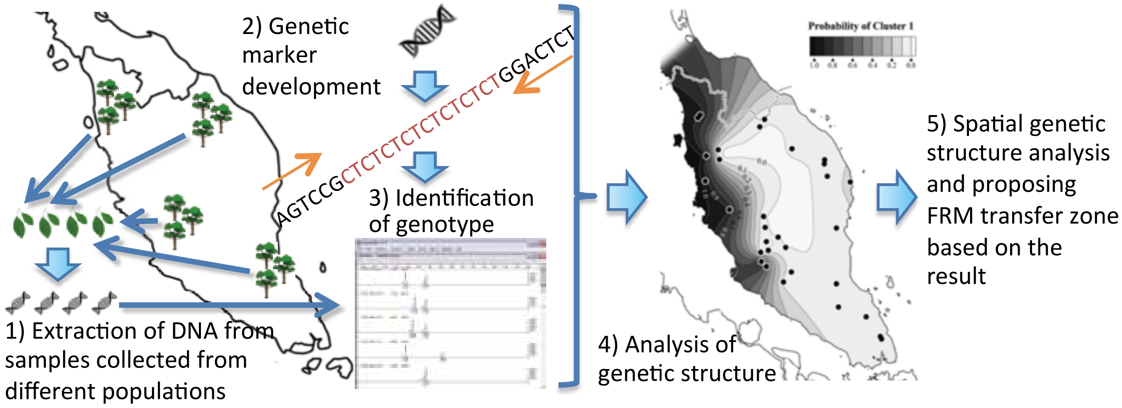


Fig. 1. Research flow showing the proposed forest reproductive material (FRM) transfer zones based on molecular markers

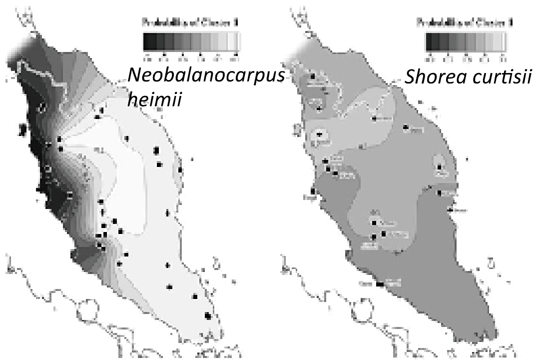


Fig. 2. Examples of two timber species, which showed distinct patterns of genetic structure, in Peninsular Malaysia

TOPIC 8

Extraction of *p*-hydroxybenzoic acid, a promising raw material for plastics, from oil palm biomass

Malaysia is one of the world's leading producers of palm oil. Huge amounts of residues like empty fruit bunches (EFBs), kernel shells (accumulated in mills), fronds and trunks (left at plantation fields) are generated from oil palm (*Elaeis guineensis* Jacq., Arecaceae). Low-molecular-weight phenolic compounds (LMPCs) extracted from subcritical water treatment of oil palm biomass has shown promise as a raw material for producing plastics, thereby promoting the efficient use of waste resources. In this study, the LMPC yield for each part of the oil palm was clarified.

An oil palm plant sample was divided into 11 parts for use as residue materials for extracting LMPC [e.g., *p*-hydroxybenzoic acid (PHBA)] (Fig. 1). We carried out subcritical water extraction of the oil palm trunk and the condition of transformation/extraction was optimized for a given combination of temperature and time. In contrast to supercritical water extraction, which causes pyrolysis, subcritical water extraction possesses a high hydrolytic ability. PHBA is a native constituent in oil palm, and its yield markedly increases with the degradation of ester linkages in high-molecular-weight secondary metabolites (Fig. 2A). Evaluations showed that the kernel shell had the highest PHBA yield. In comparison, the frond (including leaves, petiole, and rachis) was evaluated as superior, in consideration of the resource amount being up to six times that of EFB or trunk, although the PHBA yield from this part is not very high (Fig. 3).

Subcritical water treatment is an environmentally friendly method of extracting phenolic constituents because it does not require organic solvents, acids, alkalis, and so on. It can be performed if there is a pressure-tight container, which can withstand high temperatures of about 200–250˚C, and a temperature controller.

Subcritical water extraction, therefore, has an advantage in terms of equipment cost and energy consumption. There is a huge amount of residue resources, particularly fronds; however, there are few utilization methods available at present. In this study, the potential of fronds was appreciated from LMPC yield data and resource amount for each part of the oil palm. The kernel shell, on the other hand, exhibited the highest PHBA and LMPC yields. Although the resource amount is less than that of fronds, it was classified accordingly as available raw material because palm kernel shells are regularly accumulated in palm oil mills as wastes.

(F. Kawamura, R. Hashim [Universiti Sains Malaysia], O. Sulaiman[Universiti Sains Malaysia], N.S. Saary[Universiti Sains Malaysia])

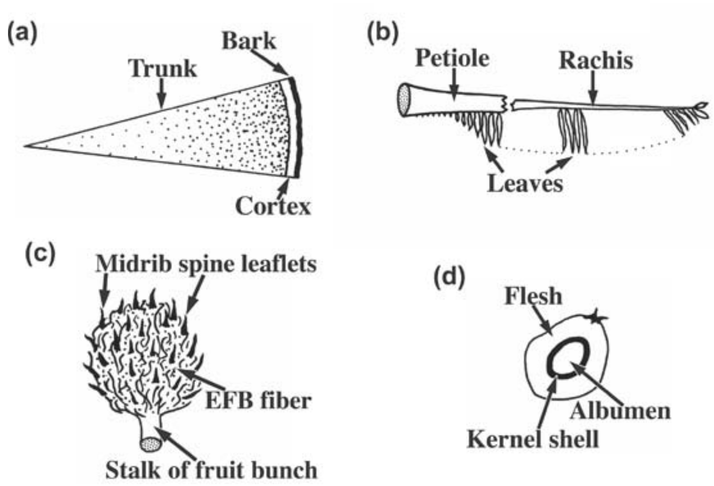


Fig. 1. Parts of the oil palm (a: cross-section of trunk, b: frond, c: empty fruit bunch, d: cross-section of fruit)

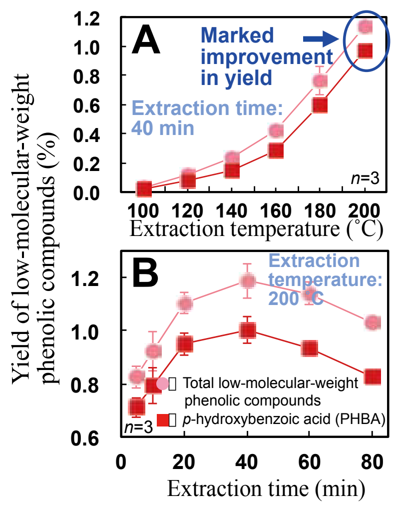


Fig. 2. Effect of temperature (A) and time (B) on the yields of low-molecular-weight phenolic compounds from oil palm trunk during subcritical water extraction

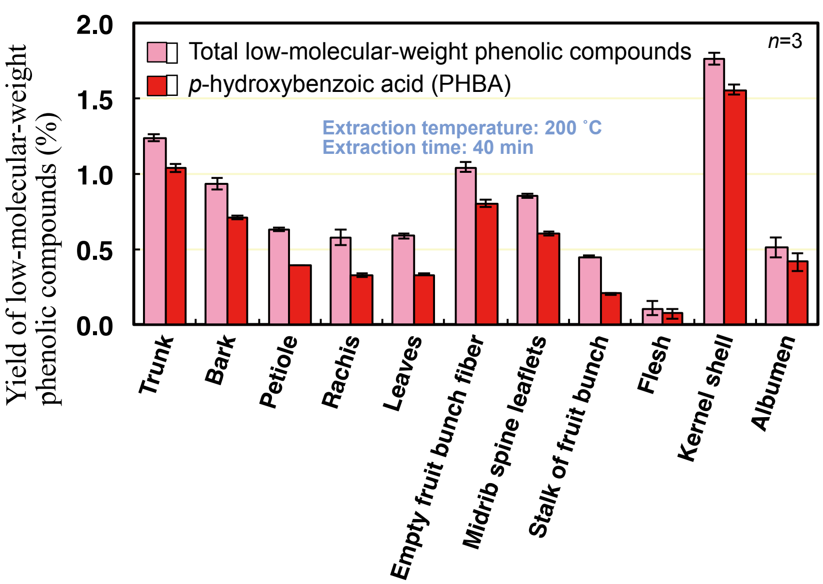


Fig. 3. Yields of low-molecular-weight phenolic compounds from each part of oil palm

Disincentive factors affecting stable aquaculture production of the blood cockle, *Anadara granosa*, in Malaysia

The blood cockle, *Anadara granosa*, is an important bivalve aquaculture species in Southeast Asian countries. They thrive where there is a widespread presence of mud flats, as in the west coast of Peninsular Malaysia, which provide suitable habitat and is a center for sowing aquaculture. Blood cockle spats are naturally abundant along the coasts and are exported to neighboring countries as aquaculture seeds. Recently, however, a huge reduction in the number of spats in aquaculture grounds in the west coast has been noted. Likewise, the farming process has been seriously affected by mass mortality. Therefore, some of the possible causes were investigated and countermeasures were formulated. In this study, we revealed the disincentive factors affecting blood cockle aquaculture and considered future measures for achieving stable production.

Regular monitoring was carried out in three sampling stations in blood cockle aquaculture grounds. Results showed failure of sexual maturation in Station 1 during the monitoring period (Fig. 1). In addition, surface sediments in Station 1 had been significantly reduced, according to an environmental survey carried out in November 2010 (Fig. 2). High organic loading in the aquaculture grounds was suggested as one failure factor for the phenomena. On the other hand, a case study of the mass mortality event in mid-February 2012 (more than 30% mortality in Selangor coast) revealed that the blood cockle was in its spawning season and that it was in failure condition due to reduced food availability, based on histological observations of the gonad and digestive ducts, respectively (Fig. 3). Moreover, these results suggested that the cockles failed to absorb nutrients as evidenced by the flattening of epithelial cells in their digestive glands (Fig. 4). Incidentally, mass mortality occurred during a week-long rainy period (over 30 mm/day for four days). Environmental changes associated with freshwater inflow, carrying with it high-suspended matter from rivers, may have weakened the blood cockle's environmental resistance especially because they were spawning. Thus, it was inferred that reduced feeding opportunities and nutrient absorption disorders may have led to the blood cockle's debilitated condition.

For a sustainable blood cockle aquaculture, it is important to lower the mortality rate in the aquaculture process and produce a stable supply of blood cockle spats. In the future, we need to establish water and sediment quality standards in aquaculture grounds as a fisheries management strategy and connect sound management approaches to stable production, with the Malaysian local government and fishermen

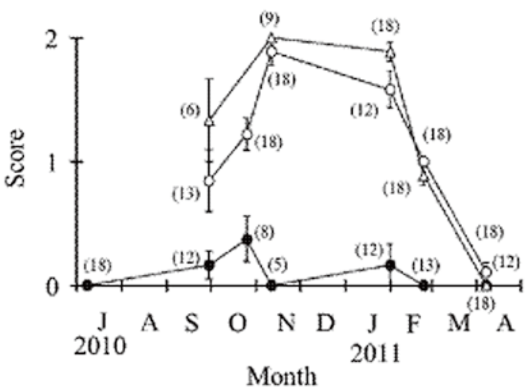


Fig. 1. Naked-eye observations of the visceral area covering the gonad of the blood cockle.

Score 0: immature, score 1: developing, and score 2: mature. Number in parentheses refers to the number of individuals used for observation. The graph shows that there was no gonad development at Station 1 (●), whereas significant development was observed at Stations 2 and 3 (○ and △). Error bar indicates standard error.

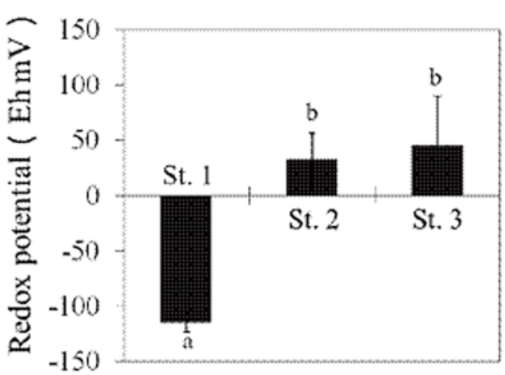


Fig. 2. Redox potentials in surface sediments around the blood cockle aquaculture grounds.

Significant reduction was detected at Station 1 where sexual maturation of the blood cockle was not observed. Significant difference ($P < 0.01$) was observed between a and b. This survey was conducted in November 2010 when gonad development was observed in Stations 2 and 3. Error bar indicates standard error.

playing leading roles in managing water and sediment quality. We intend to recommend this system to the Department of Fisheries in Malaysia for implementation and realization in the near future.

(T. Yurimoto, Faizul Mohd Kassim [FRI Malaysia], R. Fuseya[FRA Japan], Alias Bin Man[FRI Malaysia])

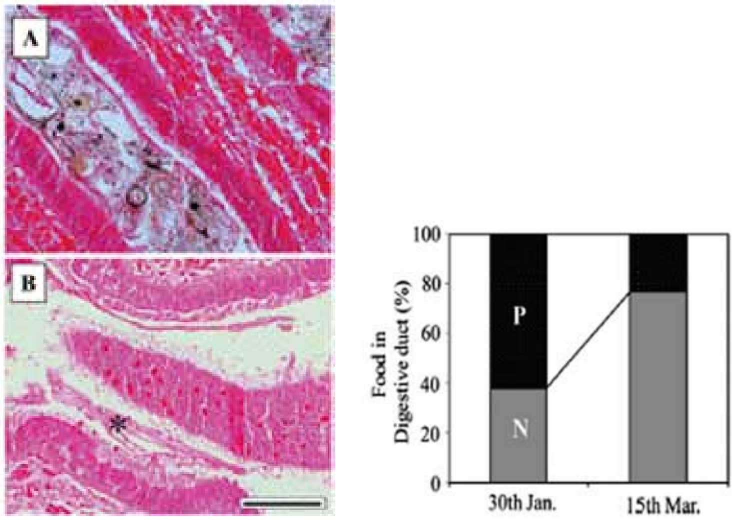


Fig. 3. Presence and nonpresence of food in the digestive duct of the blood cockle before and after the mass mortality event.

Photo A: digestive duct filled with food, Photo B: no food in the duct (asterisk shows the empty digestive duct.) Scale bar in photo: 100 μm. Graph data shows an increase in the number of individuals with empty digestive ducts after the mass mortality event.

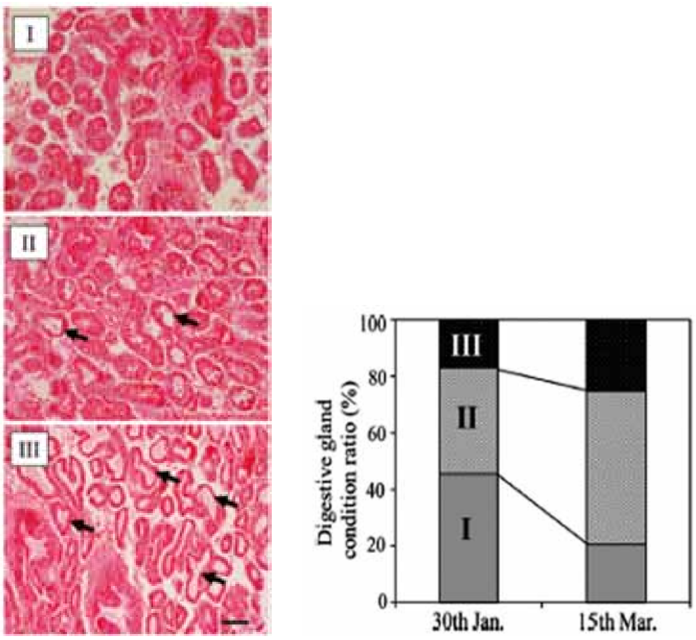


Fig. 4. Condition of epithelial cells in the digestive gland of the blood cockle before and after the mass mortality event

Photo I: good condition of epithelial cells, photo II: partial flattening of epithelial cells (arrows), photo III: substantial flattening of epithelial cells (arrows). Scale bar in photo: 100 μm. Graph data shows an increase in the number of individuals with flattened epithelial cells after the mass mortality event.

PROGRAM D
Information Analysis

"Collection, analysis and dissemination of information for grasping trends of international agriculture, forestry and fisheries"

Under the Third Medium-Term Plan of JIRCAS, activities for the collection, analysis, and dissemination of information for identifying trends related to international agriculture, forestry, and fisheries were separately specified from their research and investigation activities. These activities were divided into two main subjects: A) the analyses of the current situation and forecasts concerning food supply and demand and the production structure of agriculture, forestry, and fisheries in foreign countries, and B) the collection, analysis, and dissemination of information and materials related to the international food situation, to the agricultural, forestry, and fishery industries as well as to rural areas.

Subject A was made in order to contribute to the solution of global food and environmental problems. Subject B was made in order to formulate and conduct research and other projects related to agriculture, forestry, and fisheries in developing regions.

Information was collected in a regular, institutional, and systematic manner through collaboration with related organizations in Japan and overseas, and through long-term dispatch of staff to priority areas of activities. The respective information and materials were provided to a broad range of researchers, government agencies, and private companies.

Evaluation of fiscal year 2014 accomplishments showed that Program D performed well in comparison with the original annual implementation plan. Below is a summary of Program D's outputs, among others.

Under Subject A, JIRCAS continued developing a standard econometric model framework for assessing food supply-demand situation at country level through the ASEAN Food Security Information System (AFSIS) Project, which is being implemented by the ASEAN Secretariat, the Statistics Department of the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, and the UN FAO's Regional Office for Asia and the Pacific through its Technical Cooperation Program (TCP). A prototype model was developed and training workshops were held in Bangkok in May and December 2014 to disseminate the model. For Myanmar, where not enough study on the subject has been made so far, a database of detailed information on demand and supply of major agricultural commodities was developed. The statistical information for the trend analysis of the rice market in Africa was also analyzed and partly publicized. The environmental impacts of livestock product consumption in China were assessed by the renewed econometric models. Continuous efforts were also made to collect information on agricultural market projections through participation in meetings such as the World Outlook Conference, where subject-matter experts congregate. Information on agriculture and water was also collected and cooperation with water-issue organizations, such as the World Water Council and the International Commission on Irrigation and Drainage, was enhanced. In addition, a staff member of JIRCAS has been sent on a long-term assignment to the International Renewable Energy Agency (IRENA) to conduct bio-energy resources and supply cost assessments. The results were publicized in the report titled "Global Bioenergy Supply and Demand Projections: A working paper for REmap 2030."

Under Subject B, JIRCAS actively participated in the Global Rice Science Partnership (GRiSP), a Consultative Group on International Agricultural Research (CGIAR) research program, and the Coalition for African Rice Development (CARD), playing an important role in contributing to technology development and in connecting related national and international stakeholders. JIRCAS also participated in G20-related networks for agricultural research, such as the Meeting of Agricultural Chief Scientists (MACS), the Wheat Initiative (WI), and the Tropical Agricultural Platform (TAP), and contributed to international consensus building on agricultural development. Using an internal competitive fund known as the "President's Incentive Budget," various innovative activities including incubation researches, need-finding surveys, and networking events were carried out. Among others, a seminar co-organized with the Ministry of Agriculture and Irrigation of Myanmar was held in Naypyidaw, Myanmar to identify potential areas for research collaborations.

In November 2014, JIRCAS organized an international symposium titled "Soil Environment and Crop Production: Toward Stable Crop Production in Developing Regions" to identify solutions to problems related to soil environment and fertilizer, which are indispensable for crop production, particularly in areas like Africa where unstable environments that limit crop productivity are widely distributed. At the symposium, topics focusing on the improvement of nitrogen and phosphorus efficiency as well as countermeasures against salinity and other stresses were discussed in a comprehensive manner, not only from the aspect of soil science or plant nutrition but also from that of crop breeding.

Furthermore, JIRCAS continuously gathered local information on agricultural research priorities in Southeast Asia and Africa by maintaining liaison offices. Regional representatives also attended various meetings and events to exchange ideas on current and future collaborations.

TOPIC 1

Production and trade of major crops in Myanmar

Myanmar has drawn attention as "the last frontier" after shifting to civilian rule and being relieved of economic sanctions in 2011. The agricultural sector is expected to grow rapidly as a result of an increase in investments, which had been very limited. Using official data published by the government of Myanmar, this study generated maps covering 14 administrative regions to grasp the spatial characters of agricultural production.

Maps showing paddy, oil crops (e.g., sesamum, sunflower, ground nut), pulses for food (e.g., green gram, black gram, pigeon pea), and several other crops were created (Table 1). Sown area, yield, and production quantity were displayed in maps subdivided into administrative regions (Fig. 1). In addition to these basic data, also generated were the estimated annual average rate of change of those items, the proportion of sown area in arable land, the contribution of yield change to production change, and the per capita supply of those items. Figure 2 shows a visualized time series data of sown area, yield, production quantity, domestic supply, and trade. Prices (e.g., market price, producer price, and export or import price) deflated by the consumer price index, or the GDP deflator, were juxtaposed in each graph. Graphs depicting domestic supply and trade included self-sufficiency rates, export rates, trade quantities, values, and prices. Trade values and prices in local currency, which were originally associated with "official exchange rate," were revised with "parallel market exchange rate." Furthermore, domestic market prices were added to the graphs of export or import price to show the gap between prices within and outside Myanmar.

The results of this study have been published by the Research Strategy Office and uploaded to JIRCAS's Program D webpage. Although the report is written in English, some contents and descriptions are also written in Japanese. The spatial and temporal characteristics of agriculture in Myanmar can be grasped easily; for example, production quantities and deflated prices, such as market price, producer price, and export or import price, will help estimate the relationship between prices and supply responses. There are issues of reliability in the raw data; nevertheless, this report would be useful for gaining a rough perspective on the agricultural situation and could provide materials for further discussion. An update will be considered in 2016.

(E. Kusano, O. Koyama)

Table 1. Target crops

Commodity group	Commodity		
1 Paddy	1.1 Monsoon		
	1.2 Summer		
2 Oil crops	2.1 Groundnut	(1) Rain	
		(2) Winter	
	2.2 Sesamum	(1) Rain (Early)	
		(2) Winter (Late)	
		(3) Summer	
	2.3 Sunflower		
	2.4 Oil palm		
3 Pulses	3.1 Black gram		
	3.2 Green gram		
	3.3 Pigeon pea		
	3.4 Chick pea		
	3.5 Other pulses	(1) Cow pea	
		(2) Bocate bean	
		(3) Krishna mung	
		(4) Rice bean	
		(5) Butter bean	
		(6) Duffin bean	
		(7) Lima bean	
		(8) Sultani bean	
		(9) Sultapya bean	
		(10) Soy bean	
		(11) Lablab bean	
		(12) Garden pea	
		(13) Lentil bean	
4 Other crops	4.1 Wheat		
	4.2 Maize	(1) Seed	
		(2) Cob	
	4.3 Sugarcane		
	4.4 Tea		
	4.5 Coffee		

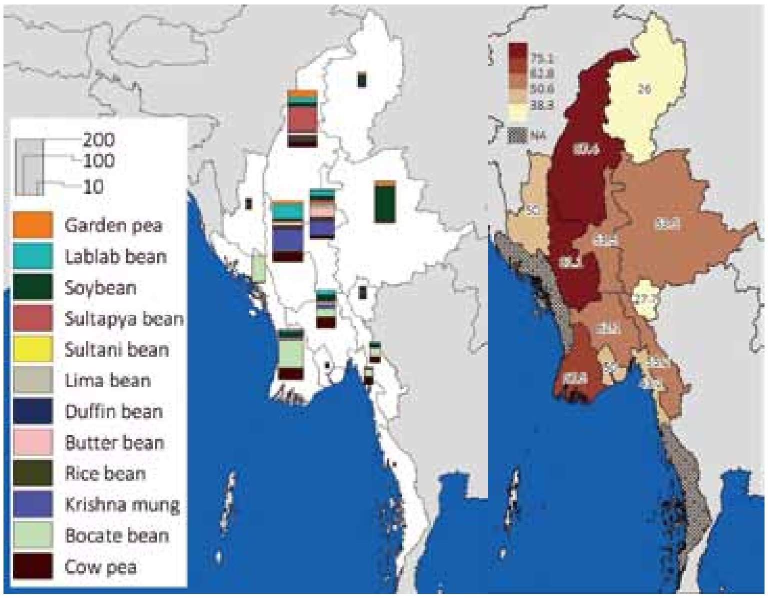


Fig. 1. Thematic maps
Left: Sown area of beans for food in 2010 (1,000ha).
Right: Contribution of the yield change in sesamum production during 2000–2009 (%)

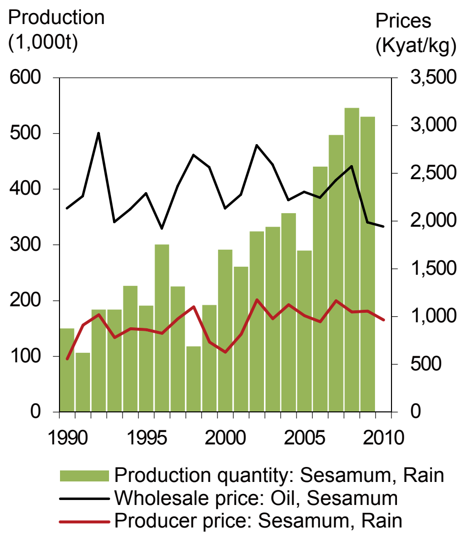


Fig. 2. Production quantity and prices (deflated to 2010 level). 1 kyat ≈ 0.001USD in 2010

TRAINING AND INVITATION PROGRAMS

INFORMATION EVENTS

INVITATION PROGRAMS AT JIRCAS

In keeping with its role as an international research center, JIRCAS has implemented several invitation programs for foreign researchers and administrators at counterpart organizations. These programs facilitate the exchange of information and opinions on agriculture, forestry, and fisheries research. At the same time, their implementation and administration serve as an opportunity to strengthen research ties among scientists and administrators in participating countries, mostly in the developing regions. Current programs are described in detail below.

Administrative Invitation Program

Under the Administrative Invitation Program, JIRCAS invites administrators from counterpart organizations to its Tsukuba premises to engage in discussions and reviews of ongoing researches to ensure that collaborative projects run smoothly. In addition, the program exposes administrators to the current activities at JIRCAS and other MAFF-affiliated Incorporated Administrative Agencies (IAAs). Furthermore, the program provides opportunities for the exchange of information and opinions concerning policy-making and project design at the administrative level, thereby contributing to deeper mutual understanding and international collaboration. Forty nine individual visits to JIRCAS were made during FY 2014 under the Administrative Invitation Program. Invited administrators and their home institutions are listed below.

Administrative Invitations, FY 2014

Suhas P. Wani	International Crops Research Institute for Semi-Arid Tropics (ICRISAT), India	Apr. 28-May 7, 2014
Taksina Sansayawichai	Khon Kaen Field Crops Research Center, Department of Agriculture (DOA), Thailand	Jul. 6-15, 2014
Jawahir Lal Karihaloo	Asia Pacific Consortium on Agricultural Biotechnology (APCoAB), Asia-Pacific Association of Agricultural Research Institutions, India	Jul. 31-Aug. 6, 2014
Iftikhar Ahmad	Pakistan Agricultural Research Council (PARC), Pakistan	Aug. 2-6, 2014
Antonio Labastida Acedo Jr.	Resilient Dryland Systems, AVRDC South Asia, ICRISAT Campus, India	Aug. 3-7, 2014
Kohei Makita (蒔田浩平)	Rakuno Gakuen University, International Livestock Research Institute (ILRI), Japan	Aug. 5, 2014
Mohamed Shafit Bin Hussain	Malaysian Agricultural Research and Development Institute (MARDI), Malaysia	Aug. 2-6, 2014
Preeyanooch Tippayawat	Department of Agriculture (DOA), Thailand	Aug. 3-6, 2014
Urairat Ferebee	Asia-Pacific Association of Agricultural Research Institutions (APAARI), Thailand	Aug. 2-6, 2014
Cheng Chun-Lung	Council of Agriculture Executive Yuan, Taiwan	Aug. 3-6, 2014
Wedagedara Induka Prabath Wimal Kumara	Sri Lanka Council for Agricultural Research Policy (SLCARP), Sri Lanka	Aug. 2-7, 2014
Meenakshi Singh	Food Safety and Standards Authority of India, India	Aug. 2-6, 2014
Pawan K. Singh	Global Wheat Program, International Maize and Wheat Improvement Centre (CIMMYT), Mexico	Aug. 2-6, 2014

Vishweshwaraiah Prakash	Council of Scientific and Industrial Research (CSIR), India	Aug. 3-6, 2014
Kiran Kumar Sharma	Translational Platform for Transgenic Crops (PTTC), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India	Aug. 2-6, 2014
Shashi Sareen	Food and Agriculture Organization of the United Nations (FAO), FAO Regional Office for Asia and the Pacific, Thailand	Aug. 3-6, 2014
Digna L. Sandoval	Department of Agriculture, Bureau of Agricultural Research (DA-BAR), Philippines	Aug. 3-8, 2014
Edralina Paningbatan Serrano	College of Agriculture, University of the Philippines at Los Banos (UPLB), Philippines	Aug. 3-8, 2014
Inácio Calvino Maposse	Agricultural Research Institute of Mozambique (IIAM), Mozambique	Sep. 15-26, 2014
Luisa Celma Caetano Meque	Directorate of Animal Sciences (DCA), Agricultural Research Institute of Mozambique (IIAM), Mozambique	Sep. 15-26, 2014
Carolino António Martinho	Northwest Zonal Centre, Agricultural Research Institute of Mozambique (IIAM), Mozambique	Sep. 15-26, 2014
Constantino Estevão Cuambe	Northeast Zonal Centre, Agricultural Research Institute of Mozambique (IIAM), Mozambique	Sep. 15-26, 2014
Dumrong Jirasutas	Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand	Sep. 25-28, 2014
Suwit Chaikiattiyos	Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand	Sep. 25-28, 2014
Chamrong Daoruang	Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand	Sep. 25-28, 2014
Dheera Ratthanaphan	Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand	Sep. 25-28, 2014
Peyanoot Naka	Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand	Sep. 25-28, 2014
Ajcharee Taecholarn	Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives (MOAC), Thailand	Sep. 25-28, 2014
Idupulapati Madhusudana Rao	International Center for Tropical Agriculture (CIAT), Colombia	Oct. 5-10, 2014
Abu Talib Bin Ahmad	Fisheries Research Institute, Department of Fisheries, Malaysia	Nov. 15-23, 2014
Andre Bationo	Action for Integrated Rural Development (AIRD), Republic of Ghana	Nov. 24-30, 2014
Nancy K.N. Karanja	University of Nairobi, Kenya	Nov. 25-30, 2014
Dinesh Kumar Sharma	Central Soil Salinity Research Institute, India	Nov. 25-29, 2014

William Dollente Dar	International Crops Research Institute for the Semi-Arid-Tropics (ICRISAT), India	Nov. 25-29, 2014
Suhas P. Wani	ICRISAT Development Center, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India	Nov. 26-30, 2014
Manabu Ishitani (石谷学)	Biotechnology Unit, International Center for Tropical Agriculture (CIAT), Colombia	Dec. 10-13, 2014
Carolina Saint Pierre	Global Wheat Program, Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), México	Dec. 10-13, 2014
Amelia Henry	Crop and Environmental Sciences Division (CESD), International Rice Research Institute (IRRI), Philippines	Dec. 11-13, 2014
Gantulga Gombo	Mongolian University of Life Sciences, Mongolia	Feb. 2-6, 2015
Togtokhbayar Norovsambuu	Mongolian University of Life Sciences, Mongolia	Feb. 2-6, 2015
Manabu Ishitani (石谷学)	International Center for Tropical Agriculture (CIAT), Colombia	Feb. 27-Mar. 12, 2015
Idupulapati Madhusudana Rao	International Center for Tropical Agriculture (CIAT), Colombia	Feb. 27-Mar. 7, 2015
Masahiro Kishii (岸井 正浩)	International Maize and Wheat Improvement Center (CIMMYT), Mexico	Feb. 28-Mar. 6, 2015
Jose Ivan Ortis Monsterio Rosas	International Maize and Wheat Improvement Center (CIMMYT), Mexico	Feb. 27-Mar. 4, 2015
Kanwar Lal Sahrawat	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India	Feb. 28-Mar. 4, 2015
Victor Maurice Kommerell	International Maize and Wheat Improvement Center (CIMMYT), Mexico	Feb. 28-Mar. 4, 2015
Sobhana Sivasankar	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India	Feb. 28-Mar. 4, 2015
Gurdev Khush	Department of Plant Sciences, University of California, Davis, United States of America	Mar. 2-7, 2015
Marco Wopereis	Africa Rice Center, Benin	Mar. 3-11, 2015

Counterpart Researcher Invitation Program

The Counterpart Researcher Invitation Program provides invitations for periods of up to six months to researchers engaged in collaborative work with JIRCAS research staff. Counterparts conduct in-depth research at JIRCAS, at other MAFF-affiliated IAAs, at prefectural research institutes, or at national universities. This invitation program aims to enhance the quality of research conducted overseas and to facilitate exchanges of individual research staff between JIRCAS and the counterpart institutions. Thirty seven researchers were invited under this program during FY 2014. Invited researchers, their affiliated research organizations, and their research activities are summarized below.

Counterpart Researcher Invitations, FY 2014

Cecile Celine Julia	Southern Cross Plant Science, Southern Cross University, Australia	Relative contribution of seed P reserves and exogenous P uptake during early growth in rice: the role of the P transporters	May 1-Jul. 28, 2014
Michael Frei	Institute of Crop Science and Resource Conservation, University of Bonn, Germany	Fine mapping for ozone tolerance	May 26-31, 2014
Stephanie Jane Watts-Williams	School of Biological Sciences, Monash University Clayton Campus, Australia	Interaction analysis for enhanced P uptake between P efficient genotypes and soil microbes	Jun. 10-Jul. 27, 2014
Thiago Jonas Nakayama	Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil	Development of Genetic Engineering Technology of Crops with Stress Tolerance against Degradation of Global Environment	Jun. 29-Sep. 28, 2014
Olajumoke Olaleye	Bioscience Center, International Institute of Tropical Agriculture (IITA), Nigeria	Phenotyping quality traits of cowpea and yam germplasms	Jul. 1-25, 2014
Asad Jan	Institute of Biotechnology and Genetics Engineering (IBGE), KPK Agricultural University, Pakistan	Search for novel genes conferring abiotic stress tolerance in plants	Jul. 2-Aug. 9, 2014
Phornphimon Janchai	Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI), Kasetsart University, Thailand	Development of a thermotolerant yeast suitable for ethanol fermentation using cassava pulp	Jul. 7-Nov. 28, 2014
Alexandre Lima Nepomuceno	Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil	Development of Genetic Engineering Technology of Crops with Stress Tolerance against Degradation of Global Environment	Jul. 20-Aug. 2, 2014
Lucimara Chiari	Research and Development, Embrapa Beef Cattle, Brazil	Development of stress-tolerant monocot crops using environmental stress tolerance genes	Jul. 20-Aug. 2, 2014
Hugo Bruno Correa Molinari	Embrapa Agroenergy, Parque Estação Biológica, Brazil	Development of stress-tolerant monocot crops using environmental stress tolerance genes	Jul. 20-Aug. 2, 2014
Adilson Kenji Kobayashi	Embrapa Agroenergy, Parque Estação Biológica, Brazil	Development of stress-tolerant monocot crops using environmental stress tolerance genes	Jul. 20-Aug. 2, 2014

Ifeanyi Amara Ndubuisi	Faculty of Biological Sciences, University of Nigeria, Nigeria	Development of thermotolerant yeast suitable for bioethanol production from agricultural crop residues	Aug. 2-Nov. 30, 2014
Yupa Hanboonsong	Faculty of Agriculture, Khon Kaen University, Thailand	Elucidation of risk factors for vector transmission of sugarcane white leaf disease	Aug. 16-22, 2014
Rafaela Ribeiro Reis	Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil	Development of genetic engineering technology of crops with stress tolerance against degradation of global environment	Sep. 4-21, 2014
Juliane Prela Marinho	Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil	Development of genetic engineering technology of crops with stress tolerance against degradation of global environment	Sep. 4-21, 2014
Oscar Oamil Carpio	Bureau of Soils and Water Management, Department of Agriculture, Philippines	Development of evaluation method for nitrogen pollution in groundwater	Oct. 5-Nov. 1, 2014
Singkone Xayalath	Forest Science Research Center, National Agriculture and Forestry Research Institute, Lao PDR	Clarification of forest products use in livelihood and development of the measures to manage forest through sustainable use.	Oct. 21-31, 2014
Ke Fuyan (柯福艷)	Institute of Rural Development, Zhejiang Academy of Agricultural Sciences, P.R. China	Comparative study on rural and agricultural development of mountainous areas between Japan and Zhejiang province of China	Nov. 10-17, 2014
Prajongwate Satmalee	Institute of Food Research and Product Development, Kasetsart University, Thailand	Food histochemical studies on Thai fermented rice noodle, Kanomjeen	Oct. 5-25, 2014
Suchart Nimpila	Royal Forest Department, Ministry of Natural Resources and Environment, Thailand	Exchange of views on improvements of tree growth and soil properties, wood utilization and low cost planting trial	Nov. 2-15. 2014
Hirendra Nath Barman	Plant Physiology Division, Bangladesh Rice Research Institute, Bangladesh	Statistical analysis of relationship between rice cultivar characteristics and climate change adaptability	Nov. 19, 2014-Jan. 31, 2015
Harby Mohamed Sorour Mostafa	Faculty of Agriculture, Benha University, Egypt	Study on management-fee collection system for the participatory irrigation management in Africa	Jan. 12-Mar. 12, 2015
Oyunbileg Tsend	School of Agroecology, Mongolian University of Life Sciences, Mongolia	Participation, presentation and discussion at the Workshop on GrassRISK Project 2015 and courtesy visit to the Ministry of Agriculture, Forestry and Fisheries of Japan	Feb. 2-6, 2015
Tuvshinbayar Danzan	School of Agroecology, Mongolian University of Life Sciences, Mongolia	Participation, presentation and discussion at the Workshop on GrassRISK Project 2015 and courtesy visit to the Ministry of Agriculture, Forestry and Fisheries of Japan	Feb. 2-6, 2015
Myeruyert Yetyekbai	School of Economics and Business, Mongolian University of Life Sciences, Mongolia	Participation, presentation and discussion at the Workshop on GrassRISK Project 2015 and courtesy visit to the Ministry of Agriculture, Forestry and Fisheries of Japan	Feb. 2-6, 2015

Erdenetsetseg Baasandai	Institute of Meteorology, Hydrology and Environment (IMHE), Ministry of Environment and Green Development of Mongolia, Mongolia	Participation, presentation and discussion at the Workshop on GrassRISK Project 2015 and courtesy visit to the Ministry of Agriculture, Forestry and Fisheries of Japan	Feb. 2-6, 2015
Erdenejargal Tumurbaatar	Department of State Administration and Management, Ministry of Food and Agriculture, Mongolia	Participation, presentation and discussion at the Workshop on GrassRISK Project 2015 and courtesy visit to the Ministry of Agriculture, Forestry and Fisheries of Japan	Feb. 2-6, 2015
Byambadorj Naidan	Livestock Policy Implementation and Coordination Department, Ministry of Food and Agriculture, Mongolia	Participation, presentation and discussion at the Workshop on GrassRISK Project 2015 and courtesy visit to the Ministry of Agriculture, Forestry and Fisheries of Japan	Feb. 2-6, 2015
Ms. Yang Xiaomei (楊 暁梅)	Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Science (CAAS), P. R. China	Development of a recycling technology for organic material inputs in corn-wheat cropping system	Feb. 9-Mar. 8, 2015
Tana (塔 娜)	Institute of Grassland Research, Chinese Academy of Agricultural Sciences(CAAS), P. R. China	Development of cultural practices with environmentally-sound material cycle in locations with unfavorable conditions	Mar. 15-22, 2015
Emmanuel Dugan	Council for Scientific and Industrial Research (CSIR), Soil Research Institute, Ghana	Development of conservation agriculture based cropping system and evaluation of its effects on soil conservation and on productivity increase	Feb. 16-Mar. 29, 2015
Saïdou Simporé	Institute of Environment and Agricultural Research, Natural Resources Management and Production System Department, Burkina Faso	Development of conservation agriculture based cropping system and evaluation of its effects on soil conservation and on productivity increase	Feb. 16-Mar. 30, 2015
Jacobo Arango Mejia	International Center for Tropical Agriculture (CIAT), Colombia	Attendance to International Biological Nitrification Inhibition (BNI) Workshop 2015	Feb. 27-Mar. 7, 2015
Margaret Leigh Worthington	International Center for Tropical Agriculture (CIAT), Colombia	Attendance to International Biological Nitrification Inhibition (BNI) Workshop 2015	Feb. 27-Mar. 7, 2015
Iris Dimaano Bugayong	Crop Environmental Science Division, International Rice Research Institute, Philippines	Presentation of research outputs of CCARA project at the internal workshop and carrying out the role as executive committee member for the organization of international seminar/workshop	Mar. 1-7, 2015
Nur Hajar Binti Zamah Shari	Forestry and Environment Division, Forest Research Institute Malaysia (FRIM), Malaysia	Development of sustainable usage of forest resources in hill dipterocarp forests of the Peninsular Malaysia	Mar. 17-30, 2015
Samuel M. Contreras	Bureau of Soil and Water Management, Department of Agriculture, Philippines	Relationship between frequent gully formation and herbicide-resistant corn variety extension in Luzon Island, Philippines	Mar. 23-31, 2015

Project Site Invitation Program

In FY 2007, JIRCAS launched this invitation program to invite researchers from developing countries to the project sites in developing countries where JIRCAS researchers are engaged in JIRCAS-funded collaborative research activities on various research themes relevant to the projects on site, and other countries where workshops or planning meetings are held. Thirty five invited researchers implemented their programs during FY2014 as listed below.

Project Site Invitations, FY 2014			
Bayarmaa Sugirjargal	School of Biological Resources and Management, Mongolian State University of Agriculture, Mongolia	Presentation and discussion at the 5th China-Japan-Korea Grassland Conference, P.R. China	Aug. 20-24, 2014
James Ogbonna	Biotechnology Development Center, University of Nigeria, Nigeria	Evaluation and selection of conversion technology for utilization of crop residues in Africa, Ghana	Sep. 25-27, 2014
Li Chengyun	Yunnan Agricultural University, P.R. China	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014
Thelma F. Padolina	Plant Breeding and Biotechnology Division, Philippine Rice Research Institute, Philippines	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014
Poonsak Mekwatanakarn	Ubon Ratchathani Rice Research Center, Thailand	Participation in the workshop for “Blast Research Network for Stable Rice Production” and “Annual meeting for Blast Research Network for Stable Rice Production Research from 2014 to 2015”, Thailand	Oct. 25-28, 2014
Lei Cailin	Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, P. R. China	Participation in the workshop for “Blast Research Network for Stable Rice Production” and “Annual meeting for Blast Research Network for Stable Rice Production Research from 2014 to 2015”, Thailand	Oct. 25-28, 2014
Nguyen Thi Minh Nguyet	Molecular Biology Department, Agricultural Genetics Institute, Vietnam	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014

Hoang Hoa Long	Department of Molecular Plant Pathology,Agricultural Genetics Institute (AGI), Vietnam	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014
Vo Thi Minh Tuyen	Agricultural Genetics Institute (AGI), Vietnam	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014
Nguyen Thi Lang	Cuu Long Delta Rice Research Institute, Vietnam	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014
Chanthakhone Boualaphanh	Rice and Cash Research Center, National Agriculture and Forestry Research Institute (NAFRI), Lao PDR	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-30, 2014
Sathya Khay	Plant Protection Office, Cambodian Agricultural Research and Development Institute (CARDI), Cambodia	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014
Loida M. Perez	Genetics Resources Division, Philippines Rice Research Institute, Philippines	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014
Dwinita Wikan Utami	Indonesian Center for Agricultural Biotechnology and Germplasm Resources Research and Development, Indonesia	Participation in the workshop for “Blast Research Network for Stable Rice Production”, Annual meeting for “Blast Research Network for Stable Rice Production Research from 2014 to 2015” and “International Rice Conference”, Thailand	Oct. 25-Nov. 1, 2014

Thanapa Somjai	Ubon Ratchathani Rice Research Center, Thailand	Participation in the workshop for "Blast Research Network for Stable Rice Production" and "Annual meeting for Blast Research Network for Stable Rice Production Research from 2014 to 2015", Thailand	Oct. 25-28, 2014
Acharaporn Na Lampang Noenplab	Phitsanulok Rice Research Center, Thailand	Participation in the workshop for "Blast Research Network for Stable Rice Production" and "Annual meeting for Blast Research Network for Stable Rice Production Research from 2014 to 2015", Thailand	Oct. 25-28, 2014
Ansar Ali	Plant Pathology Division,Bangladesh Rice Research Institute, Bangladesh	Participation in the workshop for "Blast Research Network for Stable Rice Production", Annual meeting for "Blast Research Network for Stable Rice Production Research from 2014 to 2015" and "International Rice Conference", Thailand	Oct. 25-Nov. 1, 2014
Sengthong Phongchanmixay	National Agriculture and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry, Lao PDR	Participation and presentation in the "International Conference of International Society of Paddy and Water Environment Engineering 2014", Taiwan	Oct. 29-Nov. 1, 2014
Antonio Juan Gerardo Ivancovich	Estación Experimental Agropecuaria Pergamino, Instituto Nacional de Tecnología Agropecuaria (INTA-EEA), Argentina	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 11-16, 2014
Adrian Dario De Lucia	Estación Experimental Agropecuaria Cerro Azul, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA), Argentina	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-14, 2014
Monica Isabel Heck	Estación Experimental Agropecuaria-Cerro Azul, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA), Argentina	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-14, 2014
Ruti Scholz	Instituto Paraguayo de Tecnología Agraria (IPTA), Ministrio de Agricultura y Ganadería (MAG), Paraguay	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-14, 2014
Anìbal Morel Yurenka	Instituto Paraguayo de Tecnología Agraria (IPTA), Ministrio de Agricultura y Ganadería (MAG), Paraguay	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-15, 2014

Gabriela Morel	Instituto Paraguayo de Tecnología Agraria (IPTA), Ministrio de Agricultura y Ganadería (MAG), Paraguay	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-14, 2014
Miori Uno Shimakawa	Fundacion Nikkei-Cetapar, Paraguay	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-15, 2014
Rafael Moreira Soares	Embrapa-Soja, Brazil	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-14, 2014
Silvina Stewart	Instituto Nacional de Investigacion Agropecaria (INIA), Uruguay	Annual project meeting on "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 12-15, 2014
Anan Chaokaur	Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Thailand	Participation in the workshop on "Progress and goals for the collaborative project on Establishment of monitoring technology and development of mitigation technologies of methane emission from enteric fermentation", Thailand	Feb. 24-26, 2015
Peerapot Nitipot	Faculty of Agro-Industrial Technology, Rajamangala University of Technology Isan,Thailand	Participation in the workshop on "Progress and goals for the collaborative project on Establishment of monitoring technology and development of mitigation technologies of methane emission from enteric fermentation", Thailand	Feb. 25-26, 2015
Nguyen Van Thu	Faculty of Agriculture & Applied Biology, Can Tho University, Vietnam	Participation in the workshop on "Progress and goals for the collaborative project on Establishment of monitoring technology and development of mitigation technologies of methane emission from enteric fermentation", Thailand	Feb. 24-27, 2015
Agung Purnomoadi	Faculty of Animal and Agriculture Sciences, Diponegoro University, Indonesia	Participation in the workshop on "Progress and goals for the collaborative project on Establishment of monitoring technology and development of mitigation technologies of methane emission from enteric fermentation", Thailand	Feb. 23-27, 2015

Jutamas Sitthiwong	Faculty of Agriculture, Ubon Ratchathani Rajabhat University, Thailand	Participation in the workshop on "Progress and goals for the collaborative project on Establishment of monitoring technology and development of mitigation technologies of methane emission from enteric fermentation", Thailand	Feb. 24-26, 2015
Gabriela Morel Gadea	Instituto Paraguayo de Tecnología Agraria - Centro de Investigación Capitán Miranda (IPTA - CICM), Paraguay	Training course of pathogenicity evaluation of soybean rust under JIRCAS project "Monitoring *Phakopsora pachyrhizi* populations in South America and Development of resistant cultivars by marker-assisted selection", Brazil	Feb. 23-26, 2015
Miguel Lavilla	University of Northern Buenos Aires Province (UNNOBA), Argentina	Training course of pathogenicity evaluation of soybean rust under JIRCAS project "Monitoring *Phakopsora pachyrhizi* populations in South America and Development of resistant cultivars by marker-assisted selection", Brazil	Feb. 22-26, 2015
Marcelo Julian Rodriguez Alonzo	Instituto Nacional de Investigacion Agropecuaria (INIA), Uruguay	Training course of pathogenicity evaluation of soybean rust under JIRCAS project "Monitoring *Phakopsora pachyrhizi* populations in South America and Development of resistant cultivars by marker-assisted selection", Brazil	Feb. 23-26, 2015

FELLOWSHIP PROGRAMS AT JIRCAS

JIRCAS Visiting Research Fellowship Program at Tsukuba and Okinawa

The current JIRCAS Visiting Research Fellowship Program has its beginnings in FY 1992 with the launching of the JIRCAS Visiting Research Fellowship Program at Okinawa under which researchers are invited to conduct research on topics relating to tropical agriculture for a period of one year at the Tropical Agriculture Research Front (formerly Okinawa Subtropical Station). Since October 1995, a similar program (JIRCAS Visiting Research Fellowship Program at Tsukuba) has been implemented at JIRCAS's Tsukuba premises, which aims to promote collaborative research that address various problems confronting countries in the developing regions. In FY 2006, these fellowship programs were modified and merged into one. In FY 2014, a total of five researchers were invited to conduct research at JIRCAS HQ.

JIRCAS Visiting Research Fellowships at Tsukuba (October 2014-September 2015)

Di Tingjun	Bureau of Agriculture of Shuifu County, P. R. China	Analyzing the role of plasma membrane anion channels in the release of biological nitrification inhibitors	Oct. 15, 2014-Sep. 30, 2015
Cao Dong	Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, P.R. China	Identification of environmental stress tolerance genes in soybean and their application to soybean improvement	Oct. 3, 2014-Sep. 30, 2015
Mekonnen Bekele Wakeyo	Agriculture, Environment & Rural Development Directorate, Ethiopian Development Research Institute, Ethiopia	Study on appropriate management approach for irrigation facilities in Africa	Oct. 3, 2014-Sep. 29, 2015
Junjarus Sermsathanaswadi	Chemical Technology, Suan Dusit Rajabhat University, Thailand	The study of cellulosomes from thermophilic, alkaliphilic and anaerobic bacteria	Oct. 20, 2014-Sep. 30, 2015
Wichittra Bomrungnok	Department of Food Science and Technology, School of Science and Technology, University of the Thai Chamber of Commerce, Thailand	Development of a highly efficient bioplastic production technology using felled oil palm trunk	Oct. 19, 2014-Sep. 30, 2015

JIRCAS Visiting Research Fellowship Program at Project Sites

This fellowship program has been implemented since May 2006 at collaborating research institutions located in developing countries where collaborative researches are being carried out by JIRCAS researchers. It aims to promote the effective implementation of ongoing collaborative researches at the project sites through the participation of local research staff. Furthermore, through this fellowship program, JIRCAS intends to contribute to capacity-building of the collaborating research institutions. In FY2014, one researcher was invited to Mongolia. The fellow and his research subject are listed below.

For inquiries on the JIRCAS Visiting Research Fellowship Program, please contact the Research Coordination Section (Tel. +81-29-838-6335; Fax +81-29-838-6337; e-mail: irs-jircas@ml.affrc.go.jp)

JIRCAS Visiting Research Fellowships at Tsukuba (October 2014-September 2015)

Chuluunbat Gantumur	School of Biological Resources and Management, Mongolian State University of Agriculture (MSUA), Mongolia	Development of a technique for processing and conservation of underutilized feed resources and its effects on the meat quality in Mongolia	Oct. 1, 2014-Sep. 30, 2015

Other Fellowships for Visiting Scientists

The Government of Japan sponsors a postdoctoral fellowship program and a researcher exchange program for foreign scientists through the Japan Society for the Promotion of Science (JSPS). The program places post-doctoral and sabbatical fellows in national research institutes throughout Japan according to research theme and prior arrangement with host scientists, for terms of generally one month to three years. Fellowships can be undertaken in any of the ministries, and many fellows are currently working at various IAAs affiliated with MAFF. The visiting scientists that resided at JIRCAS in FY 2014 are listed below.

JSPS Postdoctoral Fellowship for Overseas Researchers (April 2014 to March 2015)			
Salirian Rachael Claff	Southern Cross University, Australia	Zinc uptake of rice as affected by interactions of soil zinc pools and iron oxide root plaques	Oct. 9, 2012 - Oct. 8, 2014
Amrit Kaur Nanda	Australian National University, Australia	Characterizing candidate genes to improve rice performance on zinc-deficient soils	Sep. 8, 2014 - Sep. 7, 2016
Josefine Nestler	University of Bonn, Germany	Investigation of root traits and candidate genes associated with P uptake efficiency	Apr. 1, 2014 - Mar. 31, 2016
Mohammad Ashik Iqbal Khan	Bangladesh Rice Research Institute, Bangladesh	Study for co-differentiation of blast races and resistance genes in rice	Nov. 1, 2014 - Oct. 31, 2016
Vincent Pujol	Australian National University, Australia	Influence of the rhizosphere and root microbiome on phosphorus uptake in rice	Sep. 8, 2014 - Sep. 7, 2016

JSPS Invitation Fellowship for Research in Japan (April 2014 to March 2015)			
Short-Term			
Eric Wajnberg	French National Institute for Agronomic Research, France	Comparative studies on hymenopterous and dipterous parasitoids for efficient biological control	Mar. 20, 2015 - Apr. 10, 2015

JSPS BRIDGE Fellowship Program (April 2014 to March 2015)			
Adel Elsayed Elbeltagy	El-menoufia University, Egypt	Towards reduction of nitrogen fertilization use and greenhouse gases emissions for sustainable agriculture through biological nitrification inhibition	Aug. 25, 2014 - Oct. 8, 2014

Research seminar on "Advanced application of major food resources in China 2014"

JIRCAS, together with China Agricultural University and Henan University of Technology of China, co-organized a research seminar entitled "Advanced application of major food resources in China 2014" on May 31, 2014 in Beijing, China. The seminar had a special meaning as it commemorated the first death anniversary of Prof. Li Lite, who had made great efforts to develop joint research projects between China Agricultural University and JIRCAS since 1997. A total of 160 participants associated with Prof. Li, from both Japan and China, attended the seminar.

Participants to the research seminar, "Advanced application of major food resources in China 2014"

The objectives of the research seminar were to exchange information on the latest research achievements on advanced application of major food resources and to develop the Food Resources Research Network. Twelve speakers presented their research, covering various topics including: industrialization of traditional local major food processing, development of preservation and distribution technology, theory and applications of advanced food processing technologies, value-addition to traditional agricultural products and conventional processed foods, and utilization of local minor crops as staple food.

Japan's 'Global Food Value Chain Strategy,' which aims to effectively utilize agricultural resources and increase income in rural areas by promoting high-value-added agriculture, was introduced during General Discussion. Dr. Masayoshi Saito, program director at JIRCAS, summarized the importance of the research network for promoting research cooperation, sharing information, and implementing technology transfer for mutual benefit.

Joint seminar on "Identifying Collaborative Research Subjects in Myanmar"

JIRCAS, together with the Ministry of Agriculture and Irrigation (MOAI) of Myanmar, organized a seminar titled "Identifying Subjects for Collaborative Research between Myanmar and JIRCAS: Achievements and Challenges of Agricultural Research" on 5 November 2014 at the Department of Agricultural Research (DAR), MOAI, in Nay Pyi Taw, Myanmar. The seminar provided an occasion for researchers and experts to exchange opinions directly and to explore and identify concrete subjects for future collaboration between JIRCAS and

Group photo of seminar participants

research institutions in Myanmar. About 60 researchers and experts, mainly from JIRCAS, JICA, and MOAI (including Yezin Agricultural University), participated in the seminar.

The seminar was opened by Dr. Tin Htut, director general of the Department of Agricultural Planning, MOAI, and Dr. Masa Iwanaga, president of JIRCAS. Research collaboration projects conducted by JIRCAS were introduced, followed by a presentation on the current situation of agricultural research in Myanmar. Three specific themes, namely, 'rice cultivation and irrigation,' 'response to climate changes,' and 'field crops' were selected for more detailed presentations on research activities and outputs. In total, 16 research topics (8 from JIRCAS and 8 from Myanmar institutions) were introduced. Researchers and experts of both sides deepened their understanding of the research needs and priorities in Myanmar through active discussion. Local TV stations and newspapers covered the seminar.

In advance of the seminar, Dr. Iwanaga met with MOAI Minister Myint Hlaing at the MOAI headquarters. They exchanged opinions on the potentials and challenges as well as future agricultural development strategies in Myanmar.

Workshop on "JIRCAS Research on Measures against Salinization" in Uzbekistan

Salinization causes farmland damage including reduced agricultural productivity as can be observed in the irrigated lands of arid or semi-arid zones. Uzbekistan, where large scale irrigation and drainage systems have been developed, has the largest salinized area in Central Asia. Due to inappropriate water management and insufficient drainage condition, the groundwater level has increased, thus worsening the salinity problem.

In view of the situation, JIRCAS started a research project in 2013 to seek measures to mitigate salinization under current drainage conditions in Uzbekistan. A workshop, titled "JIRCAS Research on Measures against Salinization," was held in Tashkent, Uzbekistan on February 20, 2015 to build a consensus among concerned scientists/specialists in Uzbekistan and Japan on the research direction.

Fifteen (15) participants attended the workshop. In the first half, JIRCAS members and an Uzbek researcher presented the research concept and schedule, and the results of research activities on groundwater, soil, irrigation, and drainage technologies. In the second half, the participants exchanged opinions. They pointed out the importance of studying prior research results and sharing new results in soil analysis. They also emphasized that soil conditions must be appropriate in order to introduce the new Japanese mole-drain machine called "Cut-drain." The participants were highly interested in the research and achieved mutual understanding as regards the future of research activities. Finally, the steering committee members from Japan summarized the workshop.

JIRCAS scientists/specialists share the contents of the research with their Uzbek counterparts.

Participants in the workshop

International Symposiums and Workshops, FY 2014			
1	6th Steering Committee Meeting, JIRCAS Islands Environment Conservation Project	April 21, 2014	Majuro Atoll, Republic of the Marshall Islands
2	1st Residents' Briefing, JIRCAS Islands Environment Conservation Project	April 22, 2014	Majuro Atoll, Republic of the Marshall Islands
3	Impacts of cultivating unsuitable new corn varieties on Philippine slopes	May 13, 2014	Ilagan, Philippines
4	Research seminar on advanced application of major food resources in China 2014	May 30, 2014	Beijing, China
5	Expert Consultation on Assuring Food Safety in Asia-Pacific	August 4-5, 2014	Tsukuba, Japan
6	Workshop on Technology Transfer: Binderless particleboard and compressed panels	August 12, 2014	Penang, Malaysia
7	Collaborative Research with Japan for Sustainable Agricultural Development in Burkina Faso	September 16, 2014	Ouagadougou, Burkina Faso
8	JIRCAS-CTU Climate Change Project Workshop 2014	September 27, 2014	Can Tho, Vietnam
9	Project completion workshop on "Development of sustainable soil fertility management for sorghum and sweet sorghum through effective use of biological nitrification inhibition (BNI)" funded by the Government of Japan	September 30, 2014	Patancheru, India
10	6th Seminar on Conservation and Management of Freshwater Lens, JIRCAS Islands Environment Conservation Project	October 24, 2014	Majuro Atoll, Republic of the Marshall Islands
11	(1) Workshop: "Blast Research Network for Stable Rice Production" under the JIRCAS research project "Rice innovation for environmentally sustainable production systems" (2) Annual meeting: "Blast Research Network for Stable Rice Production" Research from 2014 to 2015	October 26-27, 2014	Bangkok, Thailand
12	Workshop on Development of Genetic Engineering Technology of Crops with Stress Tolerance against Degradation of Global Environment	October 30, 2014	Londrina, Brazil
13	Identifying Subjects for Collaborative Research between Myanmar and JIRCAS: Achievements and Challenges of Agricultural Research	November 5, 2014	Nay Pyi Taw, Myanmar
14	Annual Meeting of "Soybean Rust Project"	November 13-14, 2014	Foz do Iguaçu, Brazil
15	Public symposium on "Herbaceous bioenergy crops: Potential and prospects of *Erianthus*, *Miscanthus*, and *Napiergrass*"	November 14, 2014	Tokyo, Japan

16	Interactive workshop for active utilization of advanced measurement technology in agricultural research	November 14, 2014	Ishigaki, Japan
17	International Workshop on Plant Water Stress Responses and Water-Use Efficiency	November 26, 2014	Tokyo, Japan
18	JIRCAS International Symposium 2014 "Soil Environment and Crop Production : Toward Stable Crop Production in Developing Regions"	November 28, 2014	Tokyo, Japan
19	Research seminar on advanced application of local food resources in Asia 2014	December 8-9, 2014	Vientiane, Laos
20	East Asia Conference on Standardization of Rice Function	December 10-12, 2014	Kyoto, Japan
21	Annual Meeting of GM Drought Tolerance Project 2014	December 12, 2014	Tsukuba, Japan
22	10th Conference on Biomass Science (2nd Asian Conference on Biomass Science)	January 13-16, 2015	Tsukuba, Japan
23	Workshop on the GrassRISK Project 2015	February 3-4, 2015	Tsukuba, Japan
24	JIRCAS-DAD Workshop on Development of Technologies for Improved Water Management of Tank Cascade System Adaptable to Climate Change	February 12, 2015	Anuradhapura, Sri Lanka
25	Workshop on "JIRCAS Research on Measures against Salinization"	February 20, 2015	Tashkent, Uzbekistan
26	Workshop on "Progress and goals for the JIRCAS collaborative project, Establishment of monitoring technology and development of mitigation technologies of methane emission from enteric fermentation"	February 25-26, 2015	Khon Kaen, Thailand
27	International Biological Nitrification Inhibition (BNI) Workshop 2015	March 2-3, 2015	Tsukuba, Japan
28	International Seminar and Workshop on "Rice Research Collaboration: Past and Future"	March 4-5, 2015	Tsukuba, Japan
29	3rd Planning Seminar for the Reforestation Programme CDM in Five Prefectures, Eastern Paraguay	March 6, 2015	Caaguazu, Paraguay
30	Invitation to the JIRCAS SE Asia Liaison Office (Bangkok) Seminar "Technological Innovations of Agriculture in Thailand through JIRCAS Research Collaborations with DOA"	March 6, 2015	Bangkok, Thailand
31	International workshop on utilization of WeRise for intensification of rice production in rainfed areas of Southeast Asia	March 18-19, 2015	Manila, Philippines

APPENDIX

PUBLISHING AT JIRCAS

English		
1) JARQ (Japan Agricultural Research Quarterly)		
	Vol. 48	No. 3, No. 4
	Vol. 49	No. 1, No. 2
2) Annual Report 2013		
3) JIRCAS Newsletter	No.71, No.72, No.73, No.74	
4) JIRCAS Working Report Series		
	No. 82	A Reforestation Clean Development Mechanism Project in Paraguay, Implemented on the "Beneficiary Pays Principle"

Japanese	
1) JIRCAS News	No.71, No.72, No.73, No.74

REFEREED JOURNAL ARTICLES 2014-2015

Y. Aoi, K. Fukushi, T. Itono, N. Kitadai, K. Kashiwaya, H. Yamada, T. Hatta, Y. Manpuku (2014) Distribution and mineralogy of radioactive Cs in a reservoir sediment contaminated by Fukushima nuclear accident. Journal of Mineralogical and Petrological Sciences 109 : 23-27.

P. Osei Bonsu, H. Omae, F. Nagumo, R. Owusu Bio and P. Pinamang Acheampong (2015) Evaluation of two jab planters for planting maize in the forest zone of Ghana. International Journal of Innovation and Applied Studies 10(1) : 30-35.

P. Osei Bonsu, R. Owusu Bio, H. Omae, F. Nagumo (2015) Effect of planting device and seed sorting on yield of maize. International Journal of Scientific & Technology Research 4(1) : 316-318.

Anan Chaokaur, Takehiro Nishida, Ittipon Phaowphaisal, Kritapon Sommart (2014) Effects of feeding level on methane emissions and energy utilization of Brahman cattle in the tropics. Agriculture, Ecosystems and Environment DOI : 10.1016/j.agee.2014.09.014.

Cheng Leilei, Yin Changbin, Chien Hsiaoping (2014) Demand for milk quantity and safety in urban China: Evidence from Beijing and Harbin. Australian Journal of Agricultural and Resource Economics DOI : 10.1111/1467-8489.12065.

Chien H., T. Sakurai, S. Muranaka (2014) "Variety Name" in Determination of Cowpea Retail Price in Nigeria: Providing Information about Unobserved Quality Characteristics. Journal of Rural Economics, Special Issue 2014 : 238-241.

Suphavadee Chimtong, Chakrit Tachaapaikoon, Somphit Sornyotha, Patthra Pason, Rattiya Waeonukul, Akihiko Kosugi, Khanok Ratanakhanokchai (2014) Symbiotic Behavior during Co-culturing of *Clostridium thermocellum* NKP-2 and *Thermoanaerobacterium thermosaccharolyticum* NOI-1 on Corn Hull. BioResources 9(2) : 2471-2483.

Samuel M. Contreras, Gavino Isagani P. Urriza, Fujio Nagumo, Silvino Q. Tejada, Arnulfo Gesite, Rogelio P. Creencia, Ronald Allan A. Dimaano (2014) Evaluation of Pigeon Pea (*Cajanus cajan*) Cover Cropping and "No-till" as a Soil and Crop Management Practice in Corn (*Zea Mays*) Areas of Isabela, Philippines. Journal of Tropical Agriculture and Development 58(2) : 66-74.

Kunihiro Doi (2014) Analysis of the logistics of governmental emergency food supplies for the people affected by the Great East Japan Earthquake. Journal of Rural Society and Economics 32(2) : 6-11.

Yoichi Fujihara, Yukiyo Yamamoto, Yasuhiro Tsujimoto, Jun-Ichi Sakagami (2014) Discharge simulation in a data-scarce basin using reanalysis and global precipitation data: a case study of the white Volta basin. Journal of Water Resource and Protection DOI : 10.4236/jwarp.2014.614121.

Furuya J, Kobayashi S, Yamamoto Y, Nishimori M (2015) Climate change effects on long-term world crop production: Incorporating a crop model into long-term yield estimates. Japan Agricultural Research Quarterly 49(2) : 187-202.

Gao Zhongchao, Nakamoto Kazuo, Wang Qiuju, Liu Feng, Cheng Jishan, Li Mingfeng, Kuang Enjun , Wang Xueyang, Araya Ken, Liu Tingting (2014) Effects of Deep Application of Rice Husk on Physical Properties and Alfalfa Yield in Alkali Soil. Chinese Journal of Soil Science 45(271) : 228-233.

Hamano Kaoru, Miyoshi Tatsuo, Aue-Umneoy Dusit, Srisapoome Prapansak, Maeno Yukio, Tsutsui Isao (2015) Waterborne and cannibalism-mediated transmission of the Yellow head virus in *Penaeus monodon*. Aquaculture DOI : 10.1016/j.aquaculture.2014.11.038.

Hang X., Chen Y., Chien H. (2014) How much feed grain does China need now? Journal of Agrotechnical Economics 8 : 60-68.

K Hayashi, S Tatsumi, R Agbisit, S Nakamura, O Ito (2014) Application of Ultra Compact Element Analyzer for Soil Fertility Diagnosis of Agricultural Research in Southeast. International Journal of Recent Development in Engineering and Technology 3(4) : 107-112.

H. Hirabayashi, K. Sasaki, T. Kambe, R. B. Gannaban, M. A. Miras, E. V. Simon, P. D. Lumanglas, D. Fujita, Y. Takemoto-Kuno, Y. Takeuchi, R. Kaji, M. Kondo, N. Kobayashi, T. Imbe, T. Ogawa, I. Ando, K. S. V. Jagadish, T. Ishimaru (2014) *qEMF3*, a novel QTL for the early-morning flowering trait from wild rice, *Oryza officinalis*, to mitigate heat stress damage at flowering in rice, *O. sativa*. Journal of Experimental Botany DOI : 10.1093/jxb/eru474.

Tetsuro Hisayoshi, Mayu Shinomura, Kanta Yokokawa, Ikumi Kuze, Atsushi Konishi, Kumi Kawaji, Eiichi N. Kodama, Keishi Hata, Saori Takahashi, Satoru Nirasawa, Kiyoshi Yasukawa (2015) Inhibition of the DNA polymerase and RNase H activities of HIV-1 reverse transcriptase and HIV-1 replication by *Brasenia schreberi* (Junsai) and *Petasites japonicus* (Fuki) components. Journal of Natural Medicines DOI : 10.1007/s11418-015-0885-9.

Daisuke Hoshino, Tomoki Sakamoto (2014) Coastal forest damage and tide prevention function following the 2011 Tohoku Earthquake Tsunami －North Sanriku coast area －, Jpn J For Environ 56 (1) : 7-19

MM Hossain, H Akamatsu, M Morishita, T Mori, Y Yamaoka, K Suenaga, RM Soares, N Bogard, AJG Ivancovich, and N Yamanaka (2014) Molecular mapping of Asian soybean rust resistance in soybean landraces PI594767A, PI587905 and PI416764. Plant Pathology DOI : 10.1111/ppa.12226.

Roland Nuhu Issaka, Moro Mohammed Buri, Satoshi Nakamura, Satoshi Tobita (2014) Comparison of different fertilizer management practices on rice growth and yield in the Ashanti region of Ghana. Agriculture, Forestry and Fisheries DOI : 10.11648/j.aff.20140305.17.

Izumi Taro, Matsubara Eiji (2015) Trials for sustainable use of household biogas digester in Viet Nam. Water, Land and Environmental Engineering 83(2) : 27-30.

Izumi Taro, Taminato Tomohiko, Matsubara Eiji (2014) Effectiveness of Measures against Global Warming on Rural Development in Developing Countries. Water, Land and Environmental Engineering 82(8) : 15-18.

Kawamura Fumio, Saary Nur Syahirah, Hashim Rokiah, Sulaiman Othman, Hashida Koh, Otsuka Yuichiro, Nakamura Masaya, Ohara Seiji (2014) Subcritical Water Extraction of Low-molecular-weight Phenolic Compounds from Oil Palm Biomass. Japan Agricultural Research Quarterly 48(3) : 355-362.

Kayama Masazumi (2014) Effects of difference of habitats on growth and concentrations of elements of seedlings planted at a site of clearcutting. Journal of the Japanese Society of Revegetation Technology 40 : 3-7.

Mohammad Ashik Iqbal Khan, Partha Pratim Sen, Rejwan Bhuiyan, Enamul Kabir, Abul Kashem Chowdhury, Yoshimichi Fukuta, Ansar Ali, Mohammad Abdul Lati (2014) Phenotypic screening and molecular analysis of blast resistance in fragrant rice for marker assisted selection. Comptes Rendus Biologies DOI : 10.1016/j.crvi.2014.02.007.

Satoshi Kidokoro, Keitaro Watanabe, Teppei Ohori, Takashi Moriwaki, Kyonoshin Maruyama, Junya Mizoi, Nang Myint Phyu Sin Htwe, Yasunari Fujita, Sachiko Sekita, Kazuo Shinozaki, Kazuko Yamaguchi-Shinozaki (2014) Soybean DREB1/CBF-type transcription factors function in heat and drought as well as cold stress-responsive gene expression. The Plant Journal DOI : 10.1111/tpj.12746.

Hiromi Kimoto-Nira, Seishi Yamazaki, Keisuke Sasaki, Akio Takenaka, Chise Suzuki (2014) New lactic acid bacterial strains from traditional Mongolian fermented milk products have altered adhesion to porcine gastric mucin depending on the carbon source. Animal Science Journal DOI : 10.1111/asj.12270.

Kenichiro Kimura, Shintaro Kobayashi, Reiji Yoneda (2014), The Economic Evaluation on the Non-Timber Forest Products collected in the Rural Areas in Central Laos. : Case Study on N Village in Fuang District, Vientiane Prefecture. Papers on Environmental Information Science 28 : 55-58

Kobayashi, S., Furuya, J. (2015) Development of a tool for socio-economic evaluation of agricultural technologies directed toward adaptation to climate change. Japan Agricultural Research Quarterly 49(2) : 135-141.

Shintaro Kobayashi, Katsuhiro Sakurai, Ataru Nakamura, Jun Furuya (2014) A Study of the Evaluation Method for Climate Change Mitigation Technologies in Agriculture to support research and development. Papers on Environmental Information Science 28 : 65-70.

Kobayashi, S., Yokoyama, S. (2015) Comparison of Development Options in an Erosion-Prone Reservoir Area: A Case of Wonogiri, Central Java, Indonesia. The Japanese Journal of Rural Economics 17 : 76-81.

Kazuhisa Koda, Tsutomu Kobayashi, Satoshi Ishida, Shuhei Yoshimoto (2014) Situation of the Freshwater Lens in Laura, Majuro Atoll, the Republic of the Marshall Islands. The Japanese Geotechnical Society, Vol.682/683(No.11/12): 30-33.

Kodama, M., Sumbing, J.G., Lebata-Ramos, M.J.H., Watanabe, S (2015) Metabolic rate characteristics and sediment cleaning potential of the tropical sea cucumber *Holothuria scabra*. Japan Agricultural Research Quarterly 49(1) : 79-84.

Junji Koide, Naoya Fujimoto, Naoko Oka, Harby Mostafa (2015) Rice-fish Integration in Sub-Saharan Africa -The challenges for participatory water management-. Japan Agricultural Research Quarterly 49(1) : 29-36.

Yohei Koide, Akiko Kawasaki-Tanaka, Theophile Odjo, Mitsuhiro Obara, Seiji Yanagihara, Yoshimichi Fukuta (2014) Identification of QTLs and candidate genes for days to heading in an upland New Rice for Africa (NERICA) variety. Euphitica DOI : 10.1007/s10681-014-1289-8.

Naoko Kozai, Orwintinee Chusri, Theerawut Chutinanthakun, Sombat Tongtao, Hirokazu Higuchi, Tatsushi Ogata (2014) Pollination and Subsequent Ovule Development through Fruit Set in ‘Chanee’, ‘Monthong’, and ‘Kradumthong’ Durian. Tropical Agriculture and Development 58(2) : 58-65.

Kozai Naoko, Higuchi Hirokazu, Tongatao Sombat, Ogata Tatsushi (2014) Low night temperature inhibits fertilization in ‘Monthong’ durian (*Durio zibethinus* Murr.). Tropical Agriculture and Development 58(3) : 102-108.

Juliana Paula Leite, Elton Gargioni Grisoste Barbosa, Silvana Regina Rockenbach Marin, Juliane Prela Marinho, Josirley de Fátima Corrêa Carvalho, Renata Fuganti-Pagliarini, Anelise da Silva Cruz, Maria Cristina Neves de Oliveira, José Renato Bouças Farias, Norman Neumaier, Francismar Corrêa Marcelino-Guimarães, Kazuko Yamaguchi-Shinozaki, Kazuo Nakashima, Kyonoshin Maruyama, Norihito Kanamori, Yasunari Fujita, Takuya Yoshida, Janete Apparecida Desidério, Alexandre Lima Nepomuceno (2014) Overexpression of the activated form of the *AtAREB1* gene (*AtAREB1ΔQT*) improves soybean responses to water deficit. Genetics and Molecular Research DOI : 10.4238/2014. August.15.10.

K. C. Lim, V. C. Chong, P. E. Lim, Tatsuya Yurimoto (2014) Length-weight relationship of stingrays in Kuala Selangor, Malaysia. Journal of Applied Ichthyology DOI : 10.1111/jai.12455.

Liu C., Duan Y., Yang L., Wang X., Chien H., S. Mishima (2014): Present Situation of Soil Nutrient Balance in Heibei Province. Chinese Agricultural Science Bulletin 30(9) : 170-174.

Liu L., Yin C., Qian X. (2015) Calculation methods of paddy ecosystem service value and application: a case study of Suzhou City. Progress in Geography 34(1) : 92-99.

Rui Liu, Jiaqi Shi, Xiangli He, Satoru Nirasawa, Eizo Tatsumi, Haijie Liu (2014) Effect of slightly acidic electrolyzed water on germination and sprouts growth of soybean seeds. International Agriculture Engineering Journal 23(3) : 50-56.

Liu, Y., Zhou, Y., Nirasawa, S., Tatsumi, E., Cheng, Y., Li, L. (2014) In vivo anti-fatigue activity of sufu with fortification of isoflavones. Pharmacognosy Magazine DOI : 10.4103/0973-1296.137380.

Hiroki Maeda, Takumi Takata, Norihiko Fujii, Hiroaki Sakaue, Satoru Nirasawa, Saori Takahashi, Hiroshi Sasaki, Noriko Fujii (2015) Rapid Survey of Four Asp Isomers in Disease-related Proteins by LC-MS combined with Commercial Enzymes. Analytical Chemistry DOI : 10.1021/ac504413e.

Taichi Maki, Osamu Morita, Yoshinori Suzuki, Kenji Wakimizu and Koji Nishiyama (2014) Artificial rainfall experiment by seeding liquid carbon dioxide above the Izu Islands of Tokyo on March 14 in 2013. J. of Agricultural Meteorology 70(4) : 199-211.

Taichi Maki, Osamu Morita, Yoshinori Suzuki, Kenji Wakimizu, Koji Nishiyama (2014) Artificial Rainfall Experiment by Liquid Carbon Dioxide in March 2013 near Miyake and Mikura Islands in Japan (Japanese). Journal of Arid Land Studies 24(2) : 277-284.

Taichi Maki, Osamu Morita, Yoshinori Suzuki, Koji Nishiyama, Kenji Wakimizu (2014) Artificial Rainfall by the Aircraft Seeding of Liquid Carbon Dioxide near Miyake and Mikura Islands of Izu Islands in 2012 and 2013. J. of Arid Land Studies 24(1) : 65-68.

Junichiro Marui, Sayvisene Boulom, Wanchai Panthavee, Mari Momma, Ken-Ichi Kusumoto, Kazuhiko Nakahara, Masayoshi Saito (2014) Culture-independent analysis of the bacterial community during fermentation of *pa-som*, a traditional fermented fish product in Laos. Fisheries Science DOI : 10.1007/s12562-014-0780-4.

Matsubara Eiji, Izumi Taro, Nguyen Huu Chiem, Nguyen Hieu Trung (2014) Emission Reduction and Financial Feasibility Evaluation of a Household Biogas CDM Project in Viet Nam. Irrigation, Drainage and Rural Engineering Journal 82(6) : 55-64.

Matsuda Keishi, Wilder Marcy N. (2014) Eye structure and function in the giant freshwater prawn *Macrobrachium rosenbergii*. Fisheries Science DOI : 10.1007/s12562-014-0734-x.

Mogami, J., Fujita, Y., Yoshida, T., Tsukiori, Y., Nakagami, H., Nomura, Y., Fujiwara, T., Nishida, S., Yanagisawa, S., Ishida, T.,Takahashi, F., Morimoto, K., Kidokoro, S., Mizoi, J., Shinozaki, K., Yamaguchi-Shinozaki, K. (2015) Two Distinct Families of Protein Kinases Are Required for Plant Growth under High External Mg2+ Concentrations in Arabidopsis. Plant Physiology DOI : 10. 1104/ pp. 114. 249870.

Morioka S, Koizumi N, Vongvichith B (2014) Seasonal growth and reproduction of *Rasbora rubrodorsalis*, a small-sized cyprinid fish from central Laos (Teleostei: Cyprinidae). Ichthyological Exploration of Freshwaters 25(3) : 277-287.

Harby Mostafa, Naoya Fujimoto (2014) Water saving scenarios for effective irrigation management in Egyptian rice cultivation. Ecological Engineering DOI : 10.1016/j.ecoleng.2014.04.005.

Hiroki Mukai, Tamao Hatta, Hideaki Kitazawa, Hirohisa Yamada, Tsuyoshi Yaita and Toshihiro Kogure (2014) Speciation of radioactive soil particles in Fukushima contaminated area by IP autoradiography and microanalyses. Environmental Science & Technology DOI : 10.1021/es502849e.

Muranaka, S., Shono, M., Myoda, T., Takeuchi, J., Franco, J., Nakazawa, Y., Boukar, O., Takagi, H. (2015) Genetic diversity of physical, nutritional, and functional properties of cowpea grain and relationships among the traits. Plant Genetic Resources DOI : 10.1017/S147926211500009X.

Noda Iwao, Himmapan Woraphum (2014) Effects of Silvicultural Alternatives on Model-Based Financial Evaluation of Teak (*Tectona grandis* L.) Farm Forestry Management for Small-Scale Farmers in Northeast Thailand. Open Journal of Forestry DOI : 10.4236/ojf.2014.45060.

Obara, M., Ishimaru, T., Abiko, T., Fujita, D., Kobayashi, N., Yanagihara, S., Fukuta, Y. (2014) Identification and characterization of quantitative trait loci for root elongation by using introgression lines with genetic background of Indica-type rice variety IR64. Plant Biotechnology Reports DOI : 10.1007/s11816-014-0320-9.

Hide Omae, Addam Kiari Saidou, Satoshi Tobita (2014) Improving millet-cowpea productivity and soil fertility with crop rotation, row arrangements, and cowpea density in the Sahel, West Africa. World Journal of Agricultural Sciences DOI : 10.5829/idosi.aejaes.2014.14.02.12307.

Hide Omae, Addam Kiari Saidou, Satoshi Tobita (2014) On-farm evaluation of effect of organic and mineral fertilizers on biomass and yield of millet/cowpea intercrop in the Sahel, West Africa. Journal of Life Sciences 8(7) : 582-592.

Oniki Shunji, Gebremichael Negusse (2015) Communal Land Management in the Highlands of Northern Ethiopia: Evidence of Transaction Costs. Japanese Journal of Rural Economics 17 : 40-45.

Juan Pariasca-Tanaka, Joong Hyoun Chin, Khady Nani Drame, Cheryl Dalid, Sigrid Heuer, Matthias Wissuwa (2014) A novel allele of the P starvation tolerance gene *OsPSTOL1* from African rice (*Oryza glaberrima* Steud) and its distribution in the genus *Oryza*. Theoretical and Applied Genetics DOI : 10.1007/s00122-014-2306-y.

Juan Pariasca-Tanaka, Mathias Lorieux, Chunlin He, Michael J. Thomson, Matthias Wissuwa (2014) Development of a SNP genotyping panel for detecting polymorphisms in *Oryza glaberrima*/*O. sativa* interspecific crosses. Euphytica DOI : 10.1007/s10681-014-1183-4.

Prapassorn Rugthaworn, Yoshinori Murata, Masashi Machida, Waraporn Apiwatanapiwat, Akiko Hirooka, Warunee Thanapase, Hatairat Dangjarean, Satoru Ushiwaka, Kozo Morimitsu, Akihiko Kosugi, Takamitsu Arai, and Pilanee Vaithanomsat (2014) Growth Inhibition of Thermotolerant Yeast, *Kluyveromyces marxianus* in Hydrolysis from Cassava Pulp. Applied Biochemistry and Biotechnology DOI : 10.1007/s12010-014-0906-2.

Saito Kazuki, Fukuta Yoshimichi, Yanagihara Seiji, Ahouantona Kokou, Sokei Yoshimi (2014) Identifying high-yielding rice varieties adapted to rainfed upland conditions in Benin and their plant characteristics. Tropical Agriculture and Development 58(2) : 51-57.

Hikaru Sato, Junya Mizoi, Hidenori Tanaka, Kyonosin Maruyama, Feng Qin, Yuriko Osakabe, Kyoko Morimoto, Teppei Ohori, Kazuya Kusakabe, Maika Nagata, Kazuo Shinozaki, Kazuko Yamaguchi-Shinozaki (2014) *Arabidopsis* Dpb3-1, a novel DREB2A interactor, specifically enhances heat stress-induced gene expression by forming a heat stress-specific transcriptional complex with NF-Y subunits. The Plant Cell DOI : 10.1105/tpc.114.132928.

Junjarus Sermsathanaswadi, Somsak Pianwanit, Patthra Pason, Rattiya Waeonukul, Chakrit Tachaapaikoon, Khanok Ratanakhanokchai, Krisna Septiningrum, Akihiko Kosugi (2014) The C-terminal region of xylanase domain in Xyn11A from *Paenibacillus curdlanolyticus* B-6 plays an important role in structural stability. Applied Microbiology and Biotechnology DOI : 10.1007/s00253-014-5748-x.

Zhihong Shen, Eiichi Kusano, Hsiaoping Chien, and Osamu Koyama (2014) Predictive analysis of nitrogen balances resulting from the production and consumption of livestock products in the Huang-Huai-Hai Region, China. Japan Agricultural Research Quarterly 48(3) : 331-342.

W. Shi, T. Ishimaru, R. B. Gannaban, W. Oane, S.V.K. Jagadish (2014) Popular Rice (*Oryza sativa* L.) Cultivars Show Contrasting Responses to Heat Stress at Gametogenesis and Anthesis. Crop Science DOI : 10.2135/cropsci2014.01.0054.

Subbarao, G.V., Yoshihashi, T., Worthington, M., Nakahara, K., Ando, Y., Sahrawat, K.L., Rao, I.M., Lata, J.C., Kishii, M., Braun, H.-J. (2015) Suppression of soil nitrification by plants. Plant Science DOI : 10.1016/j.plantsci.2015.01.012.

Sudo, H., Kajihara, N. (2015) Mortality of juvenile Japanese flounder *Paralichthys olivaceous* caused by scavenging amphipods and ostracods in trap experiments. Fisheries Science DOI : 10.1007/s12562-014-0848-1.

Sugino Tomohide, Mayrowani Henny, Kobayashi Hiroaki (2015) Determinants for CSR in developing countries: The case of Indonesian palm oil companies. Japanese Journal of Rural Economics 17 : 18-34.

Tomohide Sugino, Henny Mayrowani, Supadi Sunarsih, Hiroaki Kobayashi (2014) The Impact of Loans for Oil Palm Smallholders as CSR Activities: A Case of the State-own Enterprise in Sumatra Island, Indonesia. Journal of Rural Economics, Special Issue 2014 : 242-247.

Kanako Suzuki, Ryoichi Matsunaga, Keiichi Hayashi, Naruo Matsumoto, Ramadjita Tabo, Satoshi Tobita, Kensuke Okada (2014) Effects of traditional soil management practices on the nutrient status in Sahelian sandy soils of Niger, West Africa. Geoderma 223-335 : 1-8.

Tamiru, M., Yamanaka, S., Mitsuoka, C., Babil, P., Takagi, H., Lopez-Montes, A., Sartie, A., Asiedu, R., Terauchi, R. (2015) Development of Genomic Simple Sequence Repeat Markers for Yam (*Dioscorea* spp.). Crop Science DOI : 10.2135/cropsci2014.10.0725.

Yoko Terazawa, Takako Koga, Masayoshi Saito (2014) Changes in the Properties and Amount of Available Lysine of Ground Beef during Grilling. Nippon Shokuhin Kagaku Kogaku Kaishi 61(12) : 599-604.

Tesfamariam,T., Yoshinaga, H., Deshpande, S.P., Srinivasa Rao, P. S., Sahrawat, K.L., Ando, Y., Nakahara, K., Hash, C.T., Subbarao, G.V. (2014) Biological nitrification inhibition in sorghum: the role of sorgoleone production. Plant and Soil DOI : 10.1007/s11104-014-2075-z.

Thaikua Sarayut, Kawamoto Yasuhiro, Ebina Masumi, Kouki Kaori, Inafuku Masahito, Akamine Hikaru, Shimoda Katsuhisa, Suenaga Kazuhiro (2014) Preliminary evaluation on digestibility and the relation to morphology and water content of *Brachiaria* spp. and their heritability. Grassland Science DOI : 10.1111/grs.12082.

Mahendar Thudi, Hari D Upadhyaya, Abhishek Rathore, Pooran Mal Gaur, Lakshman Krishnamurthy, Manish Roorkiwal, Spurthi Nagesh Nayak, Sushil Kumar Chaturvedi, NVPR Gangarao, Asnake Fikre, Paul Kimurto, Prakash C. Sharma, MS Sheshashayee, Satoshi Tobita, Junichi Kashiwagi, Osamu Ito, Andrzej Killian, Rajeev Kumar Varshney (2014) Genetic Dissection of Drought and Heat Tolerance in Chickpea through Genome-Wide and Candidate Gene-Based Association Mapping Approaches. PLoS ONE DOI : 10.1371/journal.pone.0096758.

Tsutsui Isao, Miyoshi Tatsuo, Aue-Umneoy Dusit, Songphatkaew Jaruwan, Meeanan Chonlada, Klomkling Sirimas, Sukchai Halethichanok, Pinphoo Piyarat, Yamaguchui Iori, Ganmanee Monthon, Maeno Yukio, Hamano Kaoru (2015) High tolerance of *Chaetomorpha* sp. to salinity and water temperature enables survival and growth in stagnant waters of central Thailand. International Aquatic Research DOI : 10.1007/s40071-014-0092-4.

Satoshi Uchida, Fujio Nagumo (2015) Development of a method to extract gully erosion features using high spatial resolution satellite data. Journal of the Japanese Agricultural Systems Society 31(1) : 11-20.

Takatoshi Wakabayashi, Benesh Joseph, Shuhei Yasumoto, Tomoyoshi Akashi, Toshio Aoki, Kazuo Harada, Satoru Muranaka, Takeshi Bamba, Eiichiro Fukusaki, Yasutomo Takeuchi, Koichi Yoneyama, Toshiya Muranaka, Yukihiro Sugimoto, Atsushi Okazawa (2015) Planteose as a storage carbohydrate required for early stage of germination of *Orobanche minor* and its metabolism as a possible target for selective control. Journal of Experimental Botany DOI : 10.1093/jxb/erv116.

Yunxia Wang, Lianxin Yang, Meike Höller, Shao Zaisheng, Juan Pariasca-Tanaka, Matthias Wissuwa, Michael Frei (2014) Pyramiding of ozone tolerance QTLs OzT8 and OzT9 confers improved tolerance to season-long ozone exposure in rice. Environmental and Experimental Botany 104 : 26-33.

H. Yamada, S. Yokoyama, K. Tamura, Y. Watanabe, K. Morimoto, T. Hatta, and T. Watanabe (2014) Synthesis and phase relations in montmorillonite－stevensite series under hydrothermal conditions. CLAY SCIENCE 18 : 11-18.

H. Yamada, S. Yokoyama, Y. Watanabe, M. Suzuki, S. Suzuki, T. Hatta (2015) Cesium-adsorption behavior of weathered biotite from Fukushima Prefecture depends in the degree of vermiculitization. Journal of Ion Exchange 25 : 207-211.

Ryuichi Yamada, Yasuhiro Tsujimoto, Taku Mori, Satoshi Tobita, Cassamo Sumila (2014) Rainfed Upland Farming in the North-West Mozambique: A case of villages located near Lichinga City, Niassa Province. Japanese Journal of Farm Management 52(3) : 77-82.

N Yamanaka, NG Lemos, R C Jara, MM Hossain, K Suenaga, and Y Yamaoka (2015) Prevention of leaf yellowing in Asian soybean rust infected plants is associated with green cotyledon color and the infection index. Euphytica DOI : 10.1007/s10681-015-1414-3.

Yang Xiao-mei, Li Gui-hua, Li Gui-chun, Zhou Ying, Liu Zhen-dong, Nagumo Fujio, Yin Changbin (2014) Effects of combined application of chemical fertilizer with manure on yield and nitrogen use efficiency of winter wheat in cinnamon soil on North China Plain. Soils and Fertilizers Sciences in China 2014 (4) : 48-52.

Yano Yutaka, Hamano Kaoru, Satomi Masataka, Tsutsui Isao, Ban Masatoshi, Aue-Umneoy Dusit (2014) Occurrence, molecular characterization, and antimicrobial susceptibility of *Aeromonas* spp. in marine species of shrimps cultured at inland low salinity ponds. Food Microbiology DOI : 10.1016/j.fm.2014.11.003.

Shigeki Yokoyama, Takeshi Sakurai (2014), Participation and Impacts of Rice Cultivation Training: The Case of SRI in Madagascar. Japanese Journal of Farm Management 52 (3) : 83-88.

Shigeki Yokoyama (2014) International Trends of Agricultural Extension and Rural Advisory Services. Journal of Agricultural Extension Research 19 (2) : 90-104.

Yoshida, T., Fujita, Y., Maruyama, K., Mogami, J., Todaka, D., Shinozaki, K., Yamaguchi-Shinozaki, K. (2014) Four Arabidopsis AREB/ABF transcription factors function predominantly in gene expression downstream of SnRK2 kinases in abscisic-acid signaling in response to osmotic stress. Plant Cell & Environment DOI : 10.1111/pce.12351.

Tatsuya Yurimoto (2015) Seasonal changes in glycogen contents in various tissues of the edible bivalves, pen shell *Atrina lischkeana*, ark shell *Scapharca kagoshimensis*, and Manila clam *Ruditapes philippinarum* in West Japan. Journal of Marine Biology DOI : 10.1155/2015/593032.

Tatsuya Yurimoto, Faizul Mohd Kassim, Reiko Fuseya, Alias Man (2014) Mass mortality event of the blood cockle, *Anadara granosa*, in aquaculture ground along Selangor coast, Peninsular Malaysia. International Aquatic Research DOI : 10.1007/s40071-014-0077-3.

Tatsuya Yurimoto, Faizul Mohd Kassim, Alias Man (2014) Digestive tube contents of blood cockle (*Anadara granosa*) in a tropical mangrove estuary in Malaysia. International Journal of Aquatic Biology 2(4) : 180-183.

Tatsuya Yurimoto, Faizul Mohd Kassim, Alias Man (2014) Observation of phytoplankton cells using a small hand-held microscope with an LED lamp for field surveys. Bioresearch Bulletin 4(2) : 1-5.

Tatsuya Yurimoto, Faizul Mohd Kassim, Alias Man (2014) Sexual maturation of the blood cockle, *Anadara granosa*, in Matang mangrove estuary, Peninsular Malaysia. International Journal of Aquatic Biology 2(3) : 115-123.

Tatsuya Yurimoto, Faizul Mohd Kassim, Alias Man, Reiko Fuseya (2014) Spawning season and larval occurrence of blood cockle (*Anadara granosa*) off the Selangor coast, Peninsular Malaysia. International Journal of Aquatic Biology 2(6) : 299-304.

Yun Zhou, Dan Zhao, Charles G. Winkworth-Smith, Tim J. Foster, Satoru Nirasawa, Eizo Tatsumi, Yongqiang Cheng (2015) Effect of a small amount of sodium carbonate on konjac glucomannan-induced changes in wheat starch gel. Carbohydrate Polymers 116 : 182-188.

Zhu, Q., Li, J., Saito, M., Tatsumi, E., Yin, L. (2014) Development of Stable Water-In-Oil Emulsions Using Polyglycerol Polyricinoleate and Whey Protein Isolate and the Impact on the Quality of Bittern-Tofu. Journal of Dispersion Science and Technology DOI : 10.1080/01932691.2014.964360.

THIRD MEDIUM-TERM PLAN OF THE JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

The Japan International Research Center for Agricultural Sciences (JIRCAS) has been contributing to the improvement of technologies for agriculture, forestry, and fisheries, in tropical and subtropical areas as well as other overseas developing regions (hereinafter referred to as "developing regions"), by performing technical trials and research activities.

During the First Medium-Term Goal period (FY2001 to 2005), JIRCAS worked on research and development (R&D) for the sustainable development of agriculture, forestry, and fisheries, as well as on the expansion of international research exchanges and networks, taking into account both domestic and overseas situations, such as the adoption of the U.N. Millennium Development Goals for the eradication of poverty and hunger in the world.

During the Second Medium-Term Goal period (FY2006 to 2010), JIRCAS created a multilateral collaborative research system, promoted collaborative research with world-class research organizations led by the Consultative Group on International Agricultural Research (CGIAR), established a dynamic research system, and implemented major research activities as projects at JIRCAS. In fiscal 2008, JIRCAS took over international activities from the dissolved Japan Green Resources Agency and strengthened its field activities.

Based on the outcomes of JIRCAS's research strategy and in accordance with the Basic Plan for Agriculture, Forestry and Fisheries Research (determined at the meeting of the Agriculture, Forestry and Fisheries Research Council on March 30, 2010), three research agendas have been identified over the course of this Medium-Term Goal period, namely: (1) the development of agricultural technologies in developing regions, based on sustainable management of resources, (2) the development of technology for increased productivity and stable production of agricultural products in the tropics and other unstable environments, and (3) the development of technology for income and livelihood improvement of the rural population in developing regions. Research resources will be allocated to these agendas on a priority basis, and a system that will allow the research results to be to put into practice most effectively in developing regions will be established. To best understand the highly diverse subjects and goals of technological development in developing regions, JIRCAS will also strengthen its capability related to the collection, analysis, and dissemination of information on international agriculture, forestry, and fisheries.

Through this series of activities, JIRCAS is committed to fulfill its responsibilities as Japan's only research institution mandated to carry out comprehensive international research in agriculture, forestry, and fisheries, and to contribute to the enhancement of food security in the country by solving global food problems.

I MEASURES TO BE TAKEN TO ACHIEVE THE GOAL OF EFFICIENT BUSINESS MANAGEMENT

A) Cost reduction

1. Reduction in costs such as general and administrative expenditures

a) Administrative operations implemented by operational grants will be reviewed and efficiency will be further promoted. Average annual reduction targets are at least 3% with respect to the previous year for general and administrative expenditures (excluding personnel expenditures), and at least 1% with respect to the previous year for research expenditures. The general and administrative expenditures will be thoroughly examined and reviewed to determine whether there is any further room for cost reduction.

b) With regard to pay standards, the salaries including allowances for directors and staff will be carefully scrutinized in light of the general pay standards for government employees. As JIRCAS's payment level for fiscal 2009 was 104.7 against a base figure of 100 for government employees (for administrative/technical personnel, age considered), its pay standards will be reviewed and reduced to the equivalent level for government employees by fiscal 2011; and in succeeding years the payment level will be in accordance with the pay regulations for government officials. The results of the assessment and progress of implementation will be made public. With regard to total personnel expenses, ongoing cost reduction efforts of more than 5% over a period of five years from fiscal 2006, according to the Act on Promotion of Administrative Reform for Realization of Small and Efficient Government (Act No. 47 of 2006), are to be consistently maintained through fiscal 2011. The reduction target for JIRCAS's total personnel expenses for this fiscal year (excepting retirement allowances, welfare expenditures [legal and non-legal welfare expenditures], and salaries revised in accordance with the recommendation of the National Personnel Authority) is more than 6% with respect to the fiscal 2005 level. Based on the Treatment Related to Salary Revisions for Government Officials (determined at the Cabinet meeting on November 1, 2010), and in accordance with the government's personnel cost-cutting efforts, JIRCAS will conduct a rigorous review of its personnel expenses as part of the planned fundamental review of the incorporated administrative agency (IAA) system. Personnel expenses related to staff taken on from the Japan Green Resources Agency, which had already achieved a personnel expenses reduction of more than 5%, are not subject to the current personnel expenses reform, in accordance with the Treatment of Across-the-board Personnel Cost Cuts for Organizations such as Incorporated Administrative Agencies Which Cooperate in Accepting Staff from Dissolved Agencies (notice of June 9, 2008 from the Administrative Reform Promotion Office, and other government departments, to personnel in charge at the ministries).

Personnel expenses related to the following permanent staff are not included in the reduction targets:
(i) Fixed-term staff employed by means of competitive or contracted research funds, or external funds from the private sector for collaborative work.
(ii) Fixed-term researchers (a) employed by means of government commission fees or subsidies; or (b) engaged in important research agendas (strategically important science and technologies designated in the Third Basic Program for Science and Technology [determined at the cabinet meeting on March 28, 2006], in line with national policy), who are employed by means of operational grants; or (c) 37 years of age or younger as of the end of fiscal 2005.

2. Review of Contracts

a) According to the Inspection and Review of Contracts of Incorporated Administrative Agencies (determined at the cabinet meeting on November 17, 2009) and other related policies, and based on the plan to review free contracts, a thorough review will be conducted on uncompetitive free contracts, and improvements will be made on biddings involving only one bidder/applicant in general competitive biddings.
b) Contract methods (such as the use of multi-year vs. single-year contracts) will be reviewed from a cost-saving viewpoint, with reference to other IAAs.
c) With regard to contracts with organizations deemed to be in close relation to JIRCAS, information provision will be reviewed to enhance transparency.

B) Implementation and feedback from evaluations and checks

1. To ensure work priority and transparency, JIRCAS will conduct evaluations and checks on its operations and research activities in a fair manner by utilizing external specialists prior to annual evaluation by the IAA Evaluation Committee. To allocate research resources on a priority basis, JIRCAS will clarify the basic policy and specific methods of supplying the respective results, along with the results from the IAA Evaluation Committee, to the administrative management. Research activities in particular will be reviewed on a flexible basis, with their necessity and progress taken into account. Evaluation and feedback results will be made available on JIRCAS's website.

2. For the purpose of evaluating research activities, a process sheet enumerating the annual goals will be prepared prior to the start of research. The process sheet is important for two main reasons: First, it ensures the improvement of technologies concerning agriculture, forestry, and fisheries in developing regions to address their food problems, thereby contributing to Japan's food security; Second, it becomes the basis for conducting evaluations at high international standards. Numerical goals and specific indicators will be set wherever possible. Research resource input and obtained results will be analyzed and utilized to evaluate research activities.

3. JIRCAS will endeavor to streamline and upgrade its evaluation methods by ensuring the mutual utilization of data needed for a multiple evaluation system. It will also improve this evaluation system where necessary.

4. Based on third-party evaluation, including that of administrative departments, each of the 10 or more research outcomes which are useful to developing regions will be designated as a 'Major Outcome for Dissemination' within the Third Medium-Term Goal period. The dissemination and use of such designated and other research results will be understood, analyzed, and utilized for the improvement of administrative management.

5. JIRCAS will make performance evaluations of its personnel and appropriately integrate the results into their treatment.

C) Effective use, improvement, and upgrading of research resources

1. Research funds

a) Research activity evaluation results will be appropriated into budget allocations for the effective and efficient promotion of the Medium-Term Goals research programs supported by operational grants.
b) To further promote research and development, efforts will be made to obtain external funds, such as funds for commissioned projects and competitive funds, and to utilize them more efficiently.

2. Research facilities and equipment

Research facilities and equipment are classified into three categories based on their age-related condition and JIRCAS' research prioritization, as follows: (i) facilities that will not conduce to research promotion without renovation and upgrading, (ii) facilities that will hamper the progress of research without renovation due to their severe age-related condition, and (iii) facilities required to be renovated by law or regulations. Planned renovation and upgrading of facilities essential to research promotion will be implemented while the use of such facilities will be promoted to increase the rate of utilization. With regard to the Island Environment Technology Development Laboratories, which are open facilities located at Tropical Agriculture Research Front, research proposals will be made to other research centers and publicity activities will be augmented to encourage the use of the facilities.

3. Organization

To achieve the Third Medium-Term Goals, the administrative and research organizations will be reviewed in a flexible manner, based on research evaluation results, to promote collaborative work with other IAAs in the agricultural field.

4. Improvement of staff qualifications and development of human resources

a) JIRCAS will revise its human resource development program in accordance with the Act on Enhancement of Research and Development Capacity and Efficient Promotion of Research and Development by Advancement of Research and Development System Reform (Act No. 63 of 2008), as well as changes in the surrounding environment of research and development, and other factors.
b) Efforts will be made to improve the qualifications of researchers who play key roles in international collaborative research, by dispatching them abroad and conducting collaborative studies with invited overseas researchers.
c) JIRCAS will create a competitive and cooperative environment for research personnel, provide them with effective incentives, develop their career path by utilizing a range of employment systems, conduct effective personnel exchanges with other research organizations including IAAs, and promote various forms of human resource exchange with governmental departments. JIRCAS will also cooperate with other agricultural IAAs in developing the international skills of their staff.
d) JIRCAS will make efforts to improve its personnel's qualifications by mandating that administrative and technical staff actively participate in various training sessions organized and implemented by external organizations or other IAAs. Efforts will also be made to improve the system that allows

technical staff to engage positively in research support.

e) The management ability and leadership of research project leaders will be improved through the implementation of various training systems.

D) Improvement, upgrading, and promotion of the efficiency of the research support sector

1. Research support work will be streamlined wherever possible by conducting work in conjunction with other agricultural IAAs, such as the joint implementation of training programs and joint creation of manuals.

2. The work of the General Affairs Section will be reviewed to ensure efficiency in the operational system. The efficiency of clerical management will be promoted by speeding up and simplifying clerical procedures.

3. JIRCAS will provide efficient local support to researchers dispatched abroad when they perform experimental and accounting work.

4. Efforts will be made to streamline, upgrade and enhance technical support activities by reviewing work and focusing on areas that require highly specialized technology and knowledge that meet the needs of advanced experimental and research work.

5. The Ministry of Agriculture, Forestry and Fisheries Research Network (MAFFIN) will be utilized to streamline, upgrade and enhance work on the collection and dissemination of research information; and efforts will be made, both to promote information-sharing across JIRCAS and to streamline operations, through the use of groupware.

6. Efforts will also be made to rationalize research support staffing by reviewing overall support work and continuing to promote outsourcing.

E) Promotion and enhancement of collaboration and cooperation between industry, academia, and government

1. To further promote collaborative research and researcher exchange, efforts will be made to improve information exchange and alliances with national and public research organizations, universities, and the private sector.

2. JIRCAS will actively support alliances and cooperation with other agricultural IAAs, including personnel exchanges, keeping in mind the division of roles.

3. Cooperation will be provided to the National Agriculture and Food Research Organization (NARO), as necessary, in implementing breeding research and other work.

II MEASURES TO IMPROVE THE QUALITY OF SERVICE AND EXECUTION OF OTHER DUTIES RELATING TO THE PUBLIC

A) Research and investigations

1. Priority research promotion

The research activities described in the attachment will be promoted on a priority basis.

a) To fulfill JIRCAS's responsibilities as Japan's only research institution mandated to carry out comprehensive international research in agriculture, forestry, and fisheries for developing regions, efforts will be made to improve information exchange and alliances with related organizations in Japan, through close coordination with the Japan Forum for International Agricultural Research for

Sustainable Development (J-FARD) and other organizations for sustainable development. JIRCAS will also actively strive to make international contributions, utilizing Japan's technology in these areas by collaborating with developing and developed nations, international research institutes, private organizations such as NGOs, and international research networks, to effectively promote international collaborative work. Questionnaires on joint research will be sent to related overseas research institutes to further the effective performance of such activities.

b) To ensure the prompt and practical application of research results, JIRCAS will make efforts to encourage the beneficiaries of technologies and research results to participate in research projects from the planning stages, and to conduct such research activities focusing on the utilization, diffusion, and commercialization of research results.

c) At least 525 collaborative researchers and research managers will be invited from agricultural, forestry, and fisheries research organizations in developing regions during the Third Medium-Term Goal period to conduct collaborative research or improve the capability of the researchers concerned. At least 85 effective Memoranda of Understanding (MOUs) will be maintained per year.

d) Collaborative research utilizing research resources owned by respective organizations will be promoted efficiently by further strengthening alliances with other IAAs in the field of agricultural research and development.

e) As a sub-bank in the NIAS Genebank Project implemented by the National Institute of Agrobiological Sciences (which serves as the central bank), JIRCAS will efficiently collect, store and characterize gene resources in close cooperation with the central bank.

2. Collection, analysis and dissemination of information for identifying trends related to international agriculture, forestry and fisheries

a) To help solve global food and environmental problems, JIRCAS will analyze the current situation and make forecasts concerning food supply and demand and the production structure of agriculture, forestry, and fisheries in foreign countries.

b) To contribute to research and other projects related to agricultural, forestry, and fisheries in developing regions, JIRCAS will collect, analyze, and disseminate information and materials related to the international food situation, to the agricultural, forestry, and fishery industries as well as to rural areas. It will be carried out in a regular, institutional, and systematic manner, through collaboration with related organizations in Japan and overseas, and through the long-term dispatch of staff to priority areas. The respective information and materials shall be provided to a broad range of researchers, government agencies, and private companies.

3. Flexible response to government needs

JIRCAS will flexibly respond to government needs that will arise during the Third Medium-Term Goal period, and carry out necessary research and development in a consistent manner.

B) Reinforcement of ties with government departments

1. JIRCAS will appropriately reflect the opinions of the departments of the Ministry of Agriculture, Forestry and Fisheries in its research activities and dissemination of research outcomes. At every stage during development, from research design to dissemination of outcomes and practical applications, JIRCAS will make efforts to seek a common awareness of issues with related governmental departments, through close exchange of information, and will welcome them to participate in annual meetings to examine research results and plans. Alliances with government departments will be assessed on a yearly basis with the respective departments' participation, and the results will be utilized to further strengthen ties.

2. Keeping in mind the division of roles with other IAAs, JIRCAS will provide technical information and dispatch experts to governmental departments and related committee meetings, including emergency response, and will hold symposiums and other forums.

C) Promotion of the release and dissemination of research results

1. Securing interactive communication with the public

a) To fulfill accountability to the public, JIRCAS and its researchers will make efforts to secure interactive and continuous communication with the public by effectively utilizing various forms of information media.
b) The research staff will actively pursue community outreach activities such as open lectures for citizens, and their efforts will be conscientiously evaluated.
c) JIRCAS will seek the understanding of residents in areas where research is implemented, through cooperation with research partners and local governments concerned.

2. Promotion of utilization of research results

JIRCAS regards PR and the dissemination of new knowledge and technologies, along with their integration into government policy, as important activities. Researchers and related departments will make efforts to promote such activities.

In light of these aims, JIRCAS will first combine research results obtained during the Third Medium-Term Goal period with those already obtained in the previous Medium-Term Goal period, compile them in a database, and create manuals for proper utilization. At the same time, JIRCAS will conduct PR activities in countries where research facilities are located and actively promote the dissemination and utilization of research outcomes in developing regions by conducting collaborative research with international research or cooperation institutions.

3. Public relations and the release of research results

a) Research results will be released at academic meetings in Japan and overseas. At least 560 refereed papers will be published in academic journals and bulletins during the period covered by the Medium-Term Goals. In addition, at least 35 international symposiums and workshops will be held during that period, and the respective research results will be widely released in Japan and overseas.
b) Details of research results and other activities will be released on JIRCAS's website and through exhibitions. JIRCAS will also issue more than 11 press releases of major research results during the period covered by the Medium-Term Goals.

4. Acquisition of intellectual property rights and promotion of their utilization

a) JIRCAS considers important the generation of results beneficial to the entire world, transcending national and regional borders (global public goods). When promoting practical application and utilization of research results, special attention will be paid to find balance between contributing to the progress of developing regions and promoting Japan's industries, including agriculture.
b) JIRCAS will implement intellectual property management to promote research and development, with the ultimate aim of promoting practical application and utilization. Obtaining rights to research results and handling licenses will be carried out in an integrated manner, from the design stage of research and development onwards.
c) JIRCAS will aim to win patent rights in a strategic manner, including filing and licensing overseas, for possible patent licensing in the future or for the protection of research results. JIRCAS will file at least 20 patent applications in Japan and abroad during the period covered by the Third Medium-Term Goals.
d) JIRCAS will review its own patents, as needed, in light of licensing and the development of alternative technologies. It will waive rights to less important patents.
e) Bred materials applicable to Japan will be registered in the Registry of Plant Varieties to promote their dissemination and utilization.
f) JIRCAS will grant at least three licenses for domestic or international patents each year within the Third Medium-Term Goal period.
g) JIRCAS will actively provide information related to patent rights to outside parties, and strengthen efforts necessary for technological transfer.
h) JIRCAS will review its own Basic Intellectual Property Policy as necessary, in line with the Strategy for Agricultural, Forestry and Fisheries Intellectual Property (decided by the Agriculture, Forestry and Fisheries Research Council in March 2007).

D) Other social contributions in specialized fields

1. Analyses and appraisals

On request from the government, relevant organizations, or universities, JIRCAS will perform analyses and appraisals that require its highly specialized knowledge and/or are difficult for other organizations to carry out.

2. Training sessions and seminars

a) JIRCAS will hold training sessions and seminars as often as possible, and actively cooperate in events sponsored by the government and other organizations.
b) JIRCAS will actively welcome participants and trainees from other IAAs, universities, national and public institutions, and the private sector, to develop human resources, raise technical standards, and disseminate technical information. JIRCAS will also welcome trainees from abroad.
c) JIRCAS will dispatch young researchers of universities to overseas countries, and promote the development of researchers engaged in international agriculture, forestry, and fisheries research.

3. Cooperation with international organizations and academic societies

a) As an organization that carries out comprehensive research on agriculture, forestry, and fisheries, JIRCAS will dispatch its staff to committee meetings and conferences held by related international organizations and academic associations. It will also provide domestic and overseas technical information on request.
b) JIRCAS will plan and hold international symposiums jointly with international organizations, with the aim of contributing to the development of agriculture, forestry, and fisheries in developing regions.
c) JIRCAS will implement a commendation program for young researchers at agricultural, forestry, and fisheries research organizations in developing regions.

[Attachment] Directions related to research and investigations

1. Development of agricultural technologies based on sustainable management of the environment and natural resources in developing regions

To overcome current global environmental problems, as well as maintain and expand the agricultural, forestry, and fishery industries in developing regions, JIRCAS will aim to develop sustainable resource management and environmental conservation technologies in relevant areas through collaboration with local and international research centers. More specifically, the following priority research projects will be carried out:

a) Projects addressing global warming including (1) the development of global warming mitigation technologies such as those for the reduction of greenhouse gas emissions from livestock and agricultural land and by soil carbon sequestration, (2) the development of adaptation technologies such as nutrient management technology to reduce stresses imposed by climate change, (3) the assessment and analysis of global warming impacts (and its countermeasures) on the food market by employing a global food supply and demand model, and (4) the development of a sustainable rural community model with low GHG emission by employing clean development mechanism (CDM) project activities.

b) JIRCAS will establish a sustainable farming system for dry and semi-dry areas by developing antidesertification technologies and by optimizing soil and grazing management as well as employing a cropping system that conserves soil in agriculture (conservation agriculture) through the use of non-tilling farming and cultivation of cover crops suitable to the African Savanna. JIRCAS will also develop water-saving cultivation and groundwater resource conservation technologies on islands in developing regions which are highly susceptible to abnormal climate conditions caused by global warming.

c) JIRCAS will strive to develop technologies that will enhance nitrogen use efficiency by utilizing the biological nitrification inhibition function of certain crops, thereby promoting sustainable agricultural systems and resource management.

2. Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments

This program seeks to develop technologies to improve and sustain productivity through collaborative research with local institutions and international research centers, in specific research fields wherein Japan has shown predominant comparative advantage, focusing especially on adverse environments such as those found in tropical regions. The program also aims to reduce starvation and malnutrition, which remain serious problems in developing regions, and to contribute to food security in the world and in Japan. More specifically, the following priority research will be carried out:

a) To help fulfill the goal of the Coalition for African Rice Development (CARD) to double rice production in Africa by 2018, JIRCAS, as the implementing institute for the flagship project "Development of rice production technologies in Africa", will evaluate rice genetic resources, introduce biotic/abiotic stress tolerance into rice strains suitable to African environmental conditions, develop an Asian-type low life-cycle cost paddy infrastructure technology, and establish a cultivation system for low-input rice production in flood plains which have previously been considered unsuitable for rice production.

b) Stable crop productivity shall be attained in unstable environments by overcoming adverse factors such as drought, submergence, salinity, diseases, and pests. This research will be done by (1) establishing genetic engineering technologies to develop crops suitable to developing regions, (2) developing breeding technologies and materials to secure sustainable production against factors that inhibit the production of main upland crops such as soybean, (3) developing technologies for the evaluation and utilization of diverse genetic materials and breeding lines in tropical field crops such as sugarcane, (4) improving Asian-type rice cultivation by utilizing low-input/high-yield cultivation technology and greater genetic diversity, and (5) developing integrated pest management techniques to stabilize agricultural and livestock production in developing regions.

3. Technology development for income and livelihood improvement of the rural population in developing regions

This program aims to improve income in rural areas by (i) promoting their appropriate development in line with the respective natural conditions and cultural background, and (ii) evaluating the multilateral values of various agricultural, forestry, and fishery products. To achieve this objective, JIRCAS will develop key production technologies for sustainable agriculture, forestry, fisheries, and rural development. JIRCAS will also develop modern processing, distribution, and storing technologies through collaborations with local and international research centers to effectively utilize the products. More specifically, the following priority research projects will be carried out:

a) In rural areas in Indochina, JIRCAS will establish stable production systems for rice and field crops, livestock, forest, and fish culture, which can adapt to diverse geographical environments (forests, open fields, rice fields, and rivers), to encourage self-sufficiency, eradicate poverty, and enhance the economic independence of farmers.
b) In East and Southeast Asia, where the structures of food supply/demand and rural communities are changing due to rapid economic growth, JIRCAS will examine and propose measures to support sustainable agriculture, forestry, and fisheries. The project aims to develop food processing technologies by utilizing varied traditional food resources in these areas, as well as biofuel production technologies that do not compete with food production by utilizing the unused biomass resources in Southeast Asia. To help boost the forestry and fisheries industries in Southeast Asia, JIRCAS will develop techniques for the sustainable use of forest resources by taking advantage of forest multi-functionality. JIRCAS will also develop sustainable aquaculture technologies while preserving habitats through co-culture techniques.

FINANCIAL OVERVIEW

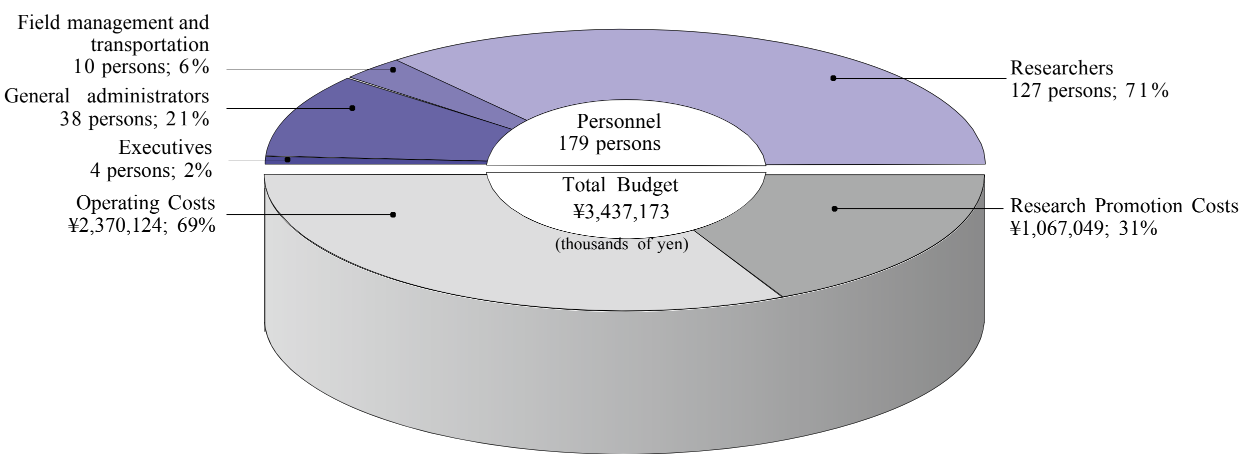
Fiscal Year 2014

thousands of yen

TOTAL BUDGET	**3,437,173**
OPERATING COSTS	**2,370,124**
Personnel (179)	2,003,796
President (1), Vice-President (1), Executive Advisor & Auditor (2)	
General administrators (38)	
Field management (10)	
Researchers (127)	
* Number of persons shown in ( )	
Administrative Costs	366,328

RESEARCH PROMOTION COSTS	**1,067,049**
Research and development	415,737
Overseas dispatches	233,516
Research exchanges/invitations	12,082
Collection of research information	70,772
International collaborative projects	321,888
Fellowship programs	13,054

Budget FY 2014 (Graph)



MEMBERS OF THE EXTERNAL EVALUATION COMMITTEE

Members of the JIRCAS External Evaluation Committee

Hiroto ARAKAWA	Former Special Advisor, JICA Research Institute
Kiyoko IKEGAMI	Professor, Graduate School of Social and Cultural Studies, Nihon University
Hiroko ISODA	Director, Alliance for Research on North Africa, University of Tsukuba
Toshihiko KOMARI	Vice President, Corporate Strategy Division, Japan Tobacco Inc.
Shin-ichi SHOGENJI	Professor, Graduate School of Bioagricultural Sciences, Nagoya University

JIRCAS STAFF in FY 2014

President

Masa Iwanaga

Vice-President

Masami Yasunaka

Executive Advisor & Auditor

Hitoshi Nakagawa
Hitoshi Yonekura

Research Strategy Office

Osamu Koyama, Director

Research Coordinator
Kazumi Yamaoka, Agricultural Water Management
Shun-ichi Nakada, Bioenergy Policy

Regional Representative for Southeast Asia or Africa
Tomohide Sugino, Representative of Southeast Asia Office (Thailand)
Haruyuki Dan, Representative of Africa Office (Ghana)

Researcher
Eiichi Kusano, Agricultural Economics

Program Director

Tomoyuki Kawashima, Program A: Environment and Natural Resource Management
Takeshi Kano, Program B: Stable Food Production
Masayoshi Saito, Program C: Rural Livelihood

Research Planning and Coordination Division

Hiroshi Komiyama, Director

Research Planning and Management Office
Yukiyo Yamamoto, Head

Research Planning Section
Mie Kasuga, Head

International Relations Section
Koshun Ishiki, Head

Senior Researcher
Kazuo Ise, Rice Breeding

Field Management Section
Takashi Komatsu, Field Operator
Hiroyuki Ishiyama, Field Operator

Research Support Office
Tokichi Kojima, Head

Research Coordination Section
Takahiro Sato, Head
Keiko Ikeda, Assistant Head
Yoshihiko Sumomozawa, Coordination Subsection Head
Katsunori Kanno, International Relations Subsection Head

Research Support Section
Akira Urushibara, Head
Toshiki Kikuchi, Budget Subsection Head
Koichi Fuse, Support Subsection 1 Head
Gen-ichiro Hanaoka, Support Subsection 2 Officer

Information and Public Relations Office
Shinsuke Morioka, Head

Senior Researcher
Masaki Morishita, Rural Development

Public Relations Section
Yumiko Arai, Head

Technology Promotion Section
Yuzou Manpuku, Head

Publications and Documentation Section
Masahiro Maeda, Head
Hiromi Miura, Network Subsection Head
Takanori Hayashi, Managing Subsection Head (Librarian)

Intellectual Property Expert
Akira Hirokawa

Safety Management Office
Yasuyuki Nakanishi, Head

Senior Researcher
Kunimasa Kawabe, Plant Pathology

Administration Division

Toshiyuki Kawaura, Director

General Affairs Section
Takayuki Kitamura, Head
Masao Yoshimura, General Affairs Assistant Head
Takashi Oosato, Personnel Management Assistant Head

Yoshihiko Takahashi, General Affairs Subsection Head
Kazuyo Kadowaki, Welfare Subsection Head
Midori Yamamura, Welfare Subsection Officer
Gaku Takeda, Personnel Subsection 1 Head
Kumi Ehara, Personnel Subsection 2 Head

Accounting Section
Toshinori Baba, Head
Kazuo Miyajima, Accounting and Examination Assistant Head
Toru Shimura, Procurement and Asset Managing Assistant Head
Takeshi Usuku, Financial Subsection Head
Jun-ichi Irino, Accounting Subsection Head
Ryoichi Mise, Overseas Expenditures Subsection 1 Head
Yuka Takatsuto, Overseas Expenditures Subsection 2 Officer
Hifumi Takahashi, Audit Subsection Head
Takayuki Yamamoto, Procurement Subsection 1 Head
Masayoshi Takanashi, Procurement Subsection 2 Head
Tsuneyoshi Sasaki, Supplies/Equipment Subsection Head
Kazuya Fujikawa, Facilities Subsection Head

Administration Section (Tropical Agriculture Research Front)
Takao Oga, Head
Hiroe Nagatomo, Accounting Subsection Head

Audit Office

Norio Tadokoro, Head

Rural Development Division

Kunihiro Doi, Director

Project Leaders
Naoya Fujimoto, Agricultural Water Management
Eiji Matsubara, Rural Development
Kazuhisa Kouda, Agricultural Engineering

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Hideki Furihata, Agricultural Engineering

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Yukio Okuda, Rural Engineering
Takeru Higashimaki, Rural Development
Ryo Miyazaki, Rural Development
Naoki Horikawa, Hydrology
Takeshi Matsumoto, Grassland Management
Shinji Hirouchi, Agricultural Engineering
Tomohiko Taminato, Civil Engineering
Koichi Takenaka, Rural Development Forestry
Masakazu Yamada, Rural Development
Taro Izumi, Rural Development
Mamoru Watanabe, Rural Development
Keisuke Omori, Soil Salinization in Dryland
Naoko Oka, Agriculture Water Management
Hiroshi Ikeura, Irrigation
Shutaro Shiraki, Rural Development
Ken-ichiro Kimura, Forest Chemistry
Katsumi Hasada, Rural Development

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Chikako Hirose, Agricultural Engineering
Aritsune Uehara, Grassland Science
Toshihiko Anzai, Irrigation and Drainage

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Subproject Leader
Jun Furuya, Agricultural Economics

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Satoshi Uchida, Geographic Information Systems
Shigeki Yokoyama, Agricultural Economics
Kazuo Nakamoto, Agricultural Economics
Shunji Oniki, Agricultural Economics
Akira Hirano, Geographic Information Systems
Shintaro Kobayashi, Agricultural Economics

Biological Resources and Post-harvest Division

Kazuhiro Suenaga, Director

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Kazuo Nakashima, Plant Molecular Biology
Masayasu Kato, Plant Pathology
Kazuhiko Nakahara, Food Chemistry
Akihiko Kosugi, Molecular Microbiology

Subproject Leader
Seiji Yanagihara, Rice Breeding

Senior Researchers
Tamao Hatta, Mineralogy and Geology
Xu Donghe, Plant Molecular Genetics
Eizo Tatsumi, Food Chemistry
Satoru Nirasawa, Food Functionality

Yasunari Fujita, Plant Molecular Biology
Tadashi Yoshihashi, Food Science
Yoshinori Murata, Applied Microbiology
Naoki Yamanaka, Plant Molecular Genetics
Kyonoshin Maruyama, Plant Molecular Biology
Takamitsu Arai, Molecular Microbiology
Norihito Kanamori, Plant Molecular Biology
Tsutomu Ishimaru, Plant Breeder

Researchers
Mitsuhiro Obara, Plant Physiology and Genetics
Jun-ichiro Marui, Molecular Microbiology
Yukari Nagatoshi, Plant Molecular Biology

Crop, Livestock and Environment Division

Satoshi Tobita, Director

Project Leaders
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Fujio Nagumo, Soil Science
Seishi Yamasaki, Animal Nutrition

Subproject Leaders
Kazuyuki Matsuo, Cropping Systems
Naruo Matsumoto, Soil Fertility and Nutrient Cycling
Masato Oda, Crop Management
Tomoyuki Suzuki, Animal Nutrition
Keiichi Hayashi, Soil Management

Senior Researchers
Satoshi Nakamura, Insect Ecology
Guntur V. Subbarao, Crop Physiology and Nutrition
Matthias Wissuwa, Physiology and Genetics
Sada Ando, Animal Nutrition
Takeshi Watanabe, Soil Chemistry
Tetsuji Oya, Crop Science
Takayuki Ishikawa, Plant Physiology
Yoshiko Iizumi, Hydrological Science

Researchers
Yasuhiro Tsujimoto, Crop Science
Hidetoshi Asai, Crop Science
Kenta Ikazaki, Soil Science

Forestry Division

Iwao Noda, Director

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Daisuke Hoshino, Silviculture
Reiji Yoneda, Silviculture
Masazumi Kayama, Tree Physiology

Fisheries Division

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Toru Shimoda, Marine Chemistry
Marcy N. Wilder, Crustacean Biochemistry
Tatsuya Yurimoto, Aquatic Biology
Tsuyoshi Sugita, Fish Nutrition and Fish Physiology
Masashi Kodama, Marine Chemistry
Tomoyuki Okutsu, Aquatic Animal Physiology

Researcher
Isao Tsutsui, Aquaculture

Tropical Agriculture Research Front

Yoshinobu Egawa, Director
Tsutomu Fushimi, Public Relations Officer

Project Leaders
Hiroko Takagi, Plant Breeding
Yoshimichi Fukuta, Rice Breeding
Shotaro Ando, Soil Science

Senior Researchers
Mariko Shono, Plant Physiology
Hide Omae, Crop Science
Shinkichi Gotoh, Soil Science
Shinsuke Yamanaka, Molecular Biology
Takuma Ishizaki, Plant Molecular Biology
Yoshifumi Terajima, Sugarcane Breeding
Youichi Kobori, Entomology

Researchers
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Satoru Muranaka, Plant Physiology
Shin-ichi Tsuruta, Molecular Genetics

Technical Support Section
Tatsushi Ogata, Head
Koji Yamato, Machine Operator
Hirokazu Ikema, Machine Operator
Masato Shimajiri, Machine Operator
Masakazu Hirata, Machine Operator
Yasuteru Shikina, Machine Operator
Masashi Takahashi, Machine Operator
Masahide Maetsu, Machine Operator
Yuto Hateruma, Machine Operator

THE JAPANESE FISCAL YEAR AND MISCELLANEOUS DATA

The Japanese Fiscal Year and the Annual Report 2014

The Japanese fiscal year is defined as the period of fiscal activity occurring from April 1 through March 31 of the following year. Thus, Fiscal Year (FY) 2014 covers the period from April 1, 2014 through March 31, 2015. The Annual Report 2014 summarizes the full extent of JIRCAS activities that occurred during this period. The subsequent Annual Report will detail events and programs from April 1, 2015 through March 31, 2016 (FY 2015).

Buildings and campus data

Land	(units: m^2)
Tsukuba premises	109,538
Okinawa Tropical Agriculture Research Front	294,912
Total	404,450

Buildings	(units: m^2)
Tsukuba premises	10,766
Okinawa Tropical Agriculture Research Front	9,485
Total	20,251

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About JIRCAS' symbol mark (shown on front/back cover): The mark was conceived by Takayuki Ishikawa of the Crop Production and Environment Division, and Toshifumi Murakami, former Senior Researcher in the Research Planning and Coordination Division. The Earth enveloped in a revolving swirl of clouds represents the dynamics of international research and JIRCAS' aim to target all world areas. The star was added to serve as a polestar for international agricultural research and to represent the importance of cooperation.

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