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Farmers taking a short break during millet sowing after the rains in early July, near Niamey, Niger (Photo by H. Takagi)

IN THIS ISSUE

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

New Wave of Crop Production and Environment Research

Recent trends in crop production and environment research

For the past few decades, research on crop production had been focused on increasing productivity from a unit farmland. A major effort was put into development of technologies that could realize the potential of high-yielding varieties developed by breeders. Eventually these new varieties shared common characteristics for most of the major cereal crops, such as the dwarf trait, high responsiveness to fertilizer application, improved harvest index, and high tolerance to abiotic and biotic stresses. Accordingly, a similar approach was applied to other varieties and crops in order to develop production technologies requiring higher input of resources such as fertilizer, water and energy. Although productivity was dramatically increased, for example being doubled within 30 years in the case of rice, those farmers who had little access to the necessary resources did not benefit from this illustrious revolution that mostly took place in environments favorable for agricultural production.

In recent years, more attention has been focused on the resource-poor farmers, most of whom have their lands in environmentally unfavorable areas. In order to improve agricultural production in such areas, a holistic approach of research is indispensable. Every technology being developed should be thoroughly investigated not only from the technical, but also from the socio-economic aspect and should be formulated in such a way as to fit into the farming system already operating in farmers' fields. No technology should be directly applied to other situations without modification. Site-specificity is being increasingly emphasized nowadays in the international arena for agricultural research. A technology adopted in one location is not always successful in other locations because of differences in natural and social environments.

Regarding adoption of the technology, the stage at which technology transfer is to be started should be given serious consideration. Three different approaches can be considered. The first is to deliver the technology to the farmers through extension process after its development, which is the so called classical top-down approach. The second is to demonstrate the new technology on a trial farm and help the interested farmers incorporate it. The third is to involve the farmers from the early stage of technology development, which is called the " farmer participatory approach. " Participatory breeding, participatory natural resource management and other similar approaches have been widely practiced in many international projects. Since the decision made by the farmers is very site-specific, the results obtained by this approach may not be applicable to many other cases. The major issue concerning this approach is how the outcome obtained could be extrapolated for wider coverage and generalized for upstream science.

One last aspect that requires no further mention is the sustainability issue that has been extensively discussed for the past one or two decades from various aspects of agricultural research at different scales of time and area. The point to be remembered however, is that there still remains a fundamental need to increase food production in order to feed the ever-growing world population, and that we should achieve this in an environmental-friendly manner, an aspect that was not seriously taken into account during the first phase of the green revolution. This places a heavy burden on scientists working on development of crop production technologies.

Thrust of Crop Production & Environment Division

The Division evolved from the former Environmental Resources Division at the time of its reorganization in April 2001. The research focus of the new Division is to study the relationship between abiotic and biotic environments and crop production, rather than the global impact of agricultural activities as was done previously. The Division carries out research to develop sustainable agricultural technologies in harmony with the natural ecosystems, and environmental conservation through effective utilization of diversified functions of crops and microbes, and appropriate utilization of natural resources. The Division consists of five research groups: material cycling, crop management, plant physiology and nutrition, water resources management and plant protection. More than one third of the scientists in the Division are dispatched overseas on long-term assignments to conduct work on various comprehensive projects organized by JIRCAS.

The Division is responsible for three sub-themes in the mid-term plan of JIRCAS: 1) evaluation of material cycling especially for nitrogen and improvement of technology for soil amelioration in diversified agro-ecosystems, 2) development of labor- and resource- saving crop production technologies for rice and upland crops in Thailand, Vietnam and other regions, and 3) elucidation of current status of occurrence of major pests and diseases of rice, soybean and other crops, especially in Southeast Asia and South America. Under these three sub-themes, there are eight specific sub-themes which are the joint responsibility of all the research groups in the division. In the fiscal year 2002, the Division had forty-two research activities officially registered to the institute that were conducted by twenty scientists in the Division.

In order to develop a production technology with higher adoption potential, we introduce the farmer participatory approach at an early stage of our research and take into consideration the indigenous knowledge that has been accumulated in the farmer ŝ communities. We have frequent interactions with farmers by working in close cooperation with socio-economists, not only to gather information on farmers 'livelihoods but also to jointly conduct experiments with them. In relation to the sustainability issue, we quantify the material flow within the administrative boundary of the target region based on available statistical information and develop a flow chart where amount of the material flowing between any two compartments is estimated. From the chart, it is possible to suggest appropriate measures for sustainable development of agricultural activities in the community.

Our research target can be achieved only through close linkage with many partners from various disciplines and institutions. Through such multi-disciplinary integration considering every option available, we should be able to develop a crop production technology that can be successfully integrated into the current farming system.

Osamu Ito
Director, Crop Production & Environment Division, JIRCAS

New Project: Improvement of Fertility of Sandy Soils in the Semi-Arid Zone of West Africa through Organic Matter Management

The semi-arid zone of West Africa is a region where food security is most severely threatened. Under the harsh climatic conditions, a close cooperation between millet/sorghum-based farmers and cattle herders has developed. This agro-pastoral system is the basic agricultural system in the region. However, recent population increase and inadequate management of soils associated with climate change have affected the agro-environmental resources of the region, and are now endangering the sustainability of agriculture and the livelihood of the people.

The soils in semi-arid tropical Africa are mostly sandy, having a minimal content of clay, a nutrient-retaining medium. Low nutrient retention capacity is thus an intrinsic limiting factor for agricultural production in the region. In such soils, organic matter (OM) is important for soil fertility, as a source and retention medium of nutrients. Even under conditions when a sufficient amount of chemical fertilizers is applied, the maintenance of soil organic matter is important for the preservation of soil fertility. However, efficacy and the role of OM in sandy soils in the semi-arid zone have not been sufficiently elucidated. Also, the sources of OM such as crop residues and manure are very limited, which is an actual constraint on the improvement of soil fertility through organic matter management. To cope with this soil problem in the region, JIRCAS has initiated a five-year project at Niamey, Niger from April 2003 in collaboration with International Crops Research Institute for Semi Arid Tropics (ICRISAT) and Kyoto University.

Participants of the Planning Meeting of the project held at JIRCAS, Tsukuba on May 28, 2003.

Farmers sowing cowpea in between pearl millet plants after the rains in Fakara region, near Niamey, Niger (Early July, 2003).

The main activity of the project is to study the effects of OM on soil fertility by elucidation of the structure and function of organic-inorganic complexes in sandy soils under semi-arid conditions. Since pressing problems in Africa, especially agriculture-related ones, have been forcing scientists to solve them on a short-term basis, fundamental research issues such as the dynamics and the retention of organic nitrogen in soils, and the interaction between organic and inorganic fertilizers have not been thoroughly addressed. Recently, it has been demonstrated that there is a large difference among crop species in their ability to utilize different fractions of organic nitrogen in soils. Accumulating such fundamental information and knowledge could be useful to develop rational fertility management systems for the region.

The project also implements systematic evaluation of plant genetic resources (PGR), with emphasis placed on efficient utilization of legume crops in agricultural systems. Indigenous and exotic PGR will be evaluated from the standpoint of soil fertility preservation such as biomass production as a source of OM, solubilization of immobile nutrients, prevention of soil erosion and nitrogen-fixing ability.

Based on the outputs of these research activities, improved systems/techniques for sustainable management of natural resources to preserve soil fertility in the region will be proposed and tested, eventually, in on-farm trials in close collaboration with ICRISAT, Kyoto University and other research institutes in the region.

Hiroko Takagi
Research Planning and Coordination Division, JIRCAS

The Distribution of Vector Insects of Citrus Greening Disease Coincides with that of Orange Jasmine in the Southwest Islands of Japan

Citrus greening disease (Huang Long Bing), caused by phloem-limited bacteria-like organisms is one of the most serious obstacles hindering citrus production in the tropical and subtropical regions of Asia and Africa. Growth of infected trees is severely retarded leading to death. The disease was first detected in Japan in 1988 on Iriomote-jima Island, and had spread all over Okinawa prefecture, excluding Daito Islands by the end of 2001. It was subsequently also detected on Yoron-jima, Okinoerabu-jima, and Tokuno-shima Islands (Fig. 1).

The disease is mainly transmitted by an insect vector, Asian citrus psylla (*Diaphorina citri*; Homoptera, Psyllidae) (Fig. 2), in addition to grafting, making vector control indispensable for the control of the disease. Citrus psylla requires newly sprouted shoots of the host plant, to be able to reproduce abundantly. Although the climate in the Southwest Islands of Japan is not very cold even during winter, newly sprouted shoots of citrus trees are not always present during winter, and this prevents citrus psylla from reproducing continuously on citrus trees. However, they also use orange jasmine (*Murraya paniculata*) (Fig. 3) as a host plant. Orange jasmine grows naturally on calcareous coral soil, and is cultivated as ornamental and hedge plants in Amami and Okinawa areas. Since the orange jasmine sprouts new shoots much more frequently when compared with citrus trees, citrus psylla can reproduce all year round on this plant.

We therefore investigated the distribution of citrus trees, orange jasmine trees, citrus psylla, and two parasitic wasps of citrus psylla all over the Southwest Islands of Japan. Citrus trees were observed on all the islands investigated, orange jasmine and citrus psylla on all the islands south of Amami-oshima Island, and at least one of two parasitic wasps of citrus psylla on all the islands where citrus psylla was detected. These results indicate the continuous presence of citrus psylla in the area.

Citrus greening disease has not yet been detected on Amami-oshima and neighboring islands; however, the disease will soon spread if infected seedlings are brought into these islands, since the insect vector of the disease already exists. Citrus psylla infection was detected in cultivated orange jasmine on Yaku-shima Island after our survey had been completed. The vector will not be able to reproduce continuously on the Southwest Islands of Japan in the absence of the orange jasmine. Therefore, the most practical method of controlling this disease would be to remove orange jasmine cultivation from areas neighboring citrus orchards.

An international collaborative research project for the control of citrus greening disease in Southeast Asia is now being planned for the next fiscal year, for which a different strategy for citrus psylla control should be considered, since newly sprouted shoots of citrus trees favorable for the reproduction of citrus psylla are present all year round in this region.

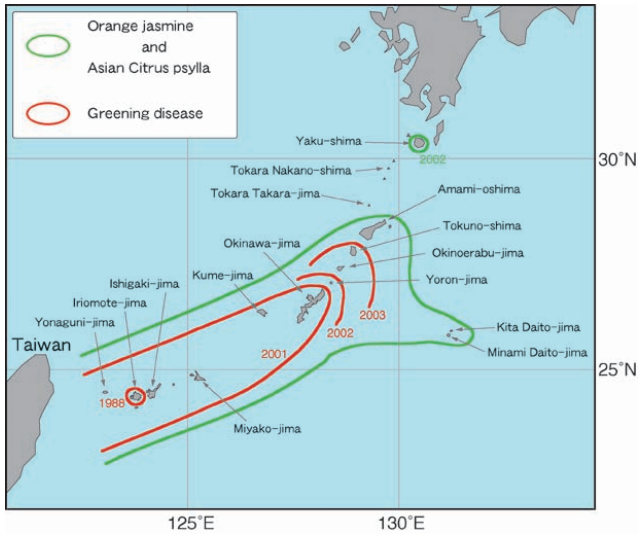


Fig. 1. Distribution map of greening disease, Asian citrus psylla and orange jasmine on Southwest Islands of Japan.

Katsuyuki Kohno
Okinawa Subtropical Station, JIRCAS

Fig. 2. Asian citrus psylla (*Diaphorina citri*) adult on orange jasmine.

Fig. 3. Orange jasmine (*Murraya paniculata*).

Diversity of Drought Tolerance at Seedling Stage of Rice in Africa

The demand for rice in sub-Saharan Africa is growing at a fast rate. Rapid population increase and urbanization in the region have changed food preferences from traditional foodstuffs to more easily prepared and highly nutritious rice and bread. Rice in Africa is largely produced under upland condition and is hampered by a number of constraints including drought. It is therefore necessary to develop rice varieties adaptable to drought conditions. The West Africa Rice Development Association (WARDA) has developed New Rice for Africa (NERICA), inter-specific hybrids between Asian (*Oryza sativa*) and African (*O. glaberrima*) rice, in order to combine favorable characteristics of both species. NERICA has shown high ability to adapt to the upland ecosystem in general; however, its genetic traits have not been analyzed sufficiently. Such studies are needed to provide a sound scientific basis for breeding of drought-tolerant rice varieties.

It is necessary to first understand the diversity of this complicated trait for genetic studies and breeding of such varieties. We evaluated a total of 455 accessions/lines, including 260 Asian accessions provided by International Rice Research Institute (IRRI) and Ibaraki Agricultural Center, 86 African accessions stocked at WARDA, and 109 NERICA lines. A rainout shelter was used at WARDA to evaluate drought tolerance of the accessions in the rainy season under upland condition (Fig. 1). Each accession was sown in 40 cm-long and 12 cm-wide rows. Drought and control plots were established and both plots were irrigated for 14 days after seeding. In the drought plot, irrigation was interrupted after 14 days, while irrigation was continued in the control plot. At 45 days after interruption (60 days after seeding), response of each accession was evaluated according to the Standard Evaluation System developed by IRRI.

Varied responses were observed in the drought plot (Fig. 2). Shoots of susceptible accessions had completely wilted and were seriously damaged (A). Some of the accessions showed dark green and needle-like rolled leaves (B). Tolerant accessions maintained fresh shoot tips and had no rolled leaves (C), although their growth was retarded compared with the plants in the control plot. Based on the evaluation, seven varieties were selected as candidate donors for drought tolerance, most of which were of Asian origin (Table). The drought-tolerance characteristic of Azucena, one of the selected varieties, was confirmed in this study. Contrary to the previous observations at WARDA, no African rice and NERICA lines were evaluated as being drought-tolerant in this trial.

Fig. 2. Responses observed in drought plot.

Further studies are necessary to confirm these results. Genetic and physiological studies are also required for a better understanding of this tolerance. Crossing experiments between tolerant and susceptible varieties are underway to elucidate the mode of inheritance of this trait. Genetic analysis using molecular markers will be initiated to map the genes related to drought tolerance. Once the genes are mapped, a marker-assisted selection will be established and serve as a powerful tool in the breeding programs. Physiological characteristics of the selected varieties are also being evaluated. These studies will provide us important information for the development of drought tolerant rice varieties.

Hiroshi Tsunematsu
Biological Resources Division, JIRCAS

Fig. 1. Rainout shelter used in this study.

Table. Varieties selected for drought tolerance

IRGC[a)] Acc. No.	Variety name	Source country
328	Azucena	Philippines
5075	Short Grain	Thailand
14957	LAC23	Liberia
23364	Kinandang Patong	Philippines
23754	Ma Hae	Thailand
40275	Black Gora	India
43675	Trembese	Indonesia

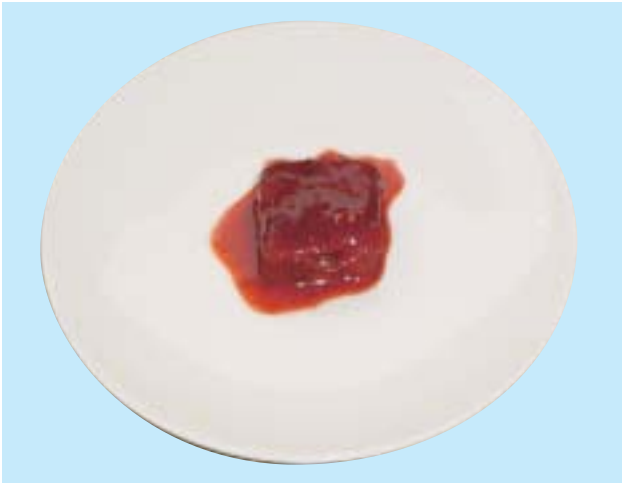
a) International Rice Genebank Collection at IRRI

Physiological Functions of Peptides from Sufu, a Traditional Fermented Food from China

Microorganisms have long been used to preserve food and to improve its taste, and a wide variety of traditional fermented foods have been produced by this method. A type of fermented tofu, called sufu (see photo) produced in China, is very popular all over the country. A similar fermented tofu product called tofuyo is produced in Okinawa and is also considered to have originated in China. Although processing and physiological functions of tofuyo have been studied extensively, those of sufu have not been systematically studied yet.

People are now becoming increasingly interested in the physiological functions of foods, especially in terms of their antioxidative activities and anti-hypertensive effects. Many types of fermented soybean foods have been reported to exhibit a much stronger antioxidative activity compared to unfermented ones, and peptides derived from proteins during the fermentation process contribute to this activity. We investigated the antioxidative and angiotensin I-converting enzyme (ACE) inhibitory activities of sufu from China and tofuyo from Okinawa. ACE which is known to increase the blood pressure, plays a key role in the renin-angiotensin system that regulates the blood pressure and the blood circulatory system. Therefore, ACE inhibitory peptides are considered to be useful for preventing hypertension.

Although the antioxidative activity varied depending on the conditions of production, all sufu samples except one showed higher antioxidative activity compared to tofuyo samples (Fig. 1). All samples exhibited ACE inhibitory activity, with the inhibition being greater in sufu samples (Fig. 2). Samples with high antioxidative and ACE inhibitory activities contained a large amount of small peptides.



Sufu (fermented tofu) produced in Beijing, China.

It is clear from these results that sufu contains highly functional peptides. Studies on the identification of the physiological activity of various sufu products, and the relationship between their physiological functions and the processing conditions are now in progress, and these results will enable the development of an improved processing method for the production of highly active functional sufu.

Masayoshi Saito[1], Eizo Tatsumi1 & Li Li-te[2]
[1]Food Science and Technology Division, JIRCAS
[2]China Agricultural University, China

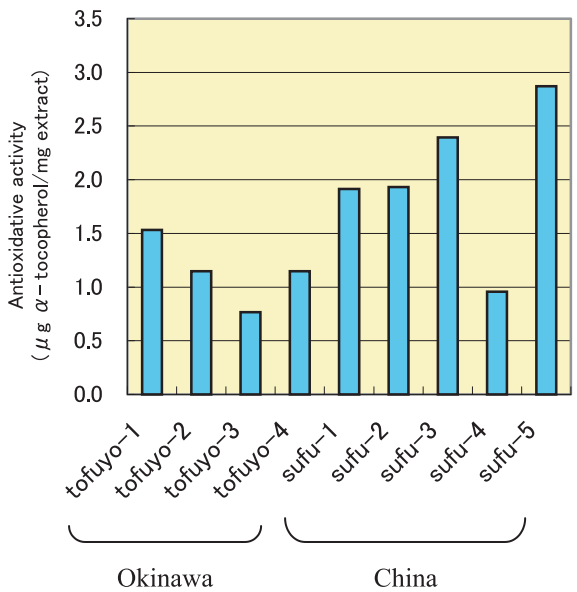


Fig. 1. Antioxidative activities of tofuyo and sufu extracts. Antioxidative activities were expressed as the equivalent concentrations of α-tocopherol.

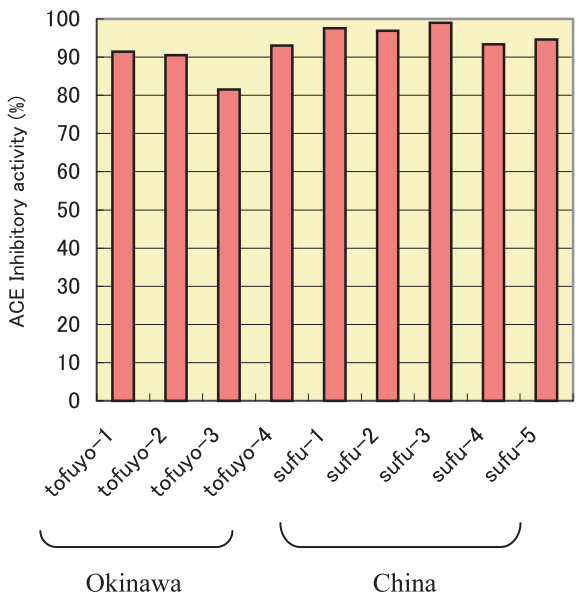


Fig. 2. Angiotensin I-converting enzyme (ACE) inhibitory activities of tofuyo and sufu extracts. 1.25% (w/v) extract was used for ACE inhibitory activity measurement.

International Symposium by UNU, CSAS Kyoto U., JIRCAS, " Alternative Approaches to Enhancing Small-Scale Livelihoods and Natural Resource Management in Marginal Areas — Experience in Monsoon Asia "

United Nations University, Center for Southeast Asian Studies of Kyoto University, and JIRCAS jointly hold this symposium in order to exchange experiences and views on development and the environmental issues emerging from various activities in different regions, and strengthen partnerships between scientists involved in these activities.

Background

Monsoon Asia has benefited from so-called modern technologies, such as high-yielding crops, chemicals and irrigation, which have brought about many miracles in agriculture and rural development. Despite this, more than two-thirds of the world's poor live in the region, and a significant portion of them still relies on small-scale livelihoods and fragile natural resources, especially in marginal areas. Marginal areas are characterized by geographical diversity such as mountainous, semi-arid and rainfed areas, forest margins, and wetland areas, which extend from the Himalayas and Southeast Asian inland areas to coastal areas and the Korean and Japanese mountain ranges.

Marginal areas share the common characteristics of inadequate soil fertility and water, low agricultural potential, and difficult access to commercial inputs, yet have very complex and diverse natural and socio-economic conditions. And, these areas have scarcely benefited from modern technologies and most people are still suffering from poverty and environmental degradation.

Recognizing the limitations of the modern technologies for marginal areas, various alternative approaches have been proposed to overcome these limitations and to explore wider options for agricultural development. These include farming systems research and extension and participatory research and development, in which, in most cases, farmers' site-specific knowledge and site-appropriate technologies play a significant role. Some of these approaches have placed emphasis on institutional reforms and better governance for enhancing the social capital of the poor and their roles in policy making, such as community organization and development. Still others focus on policy options, including access to markets and public services.

In this region, various efforts for the sustainable development of marginal areas are expanding to meet the increasing pressure for poverty reduction, food security, and environment protection. These include projects, programs and policies, and abundant field experiences on alternative approaches have been accumulated, and there is an urgent need to bring together these various experiences to offer better approaches.

Objective

The objective of this Symposium is to review and exchange lessons from field experiences using alternative approaches for enhancing small-scale livelihoods and natural resource management in marginal areas in monsoon Asia.

Symposium Themes

The Symposium will focus on the following themes and issues for marginal areas of monsoon Asia

■ Theme 1: Contributions of ' modern technologies '

How have ' modern technologies ' including technological innovation and dissemination affected the agricultural development process and natural resources?
How have ' modern technologies ' been influenced by alternative approaches?

■ Theme 2: Contributions of alternative approaches

How have alternative approaches such as farming systems research and extension, participatory research and development, and community-based approaches contributed to the enhancement of small scale-livelihoods and natural resource management?
How have ' alternative approaches interacted with ' modern technologies ?

■ Theme 3: Institutional reforms and empowerment

How have both modern technologies and alternative approaches been connected to and influenced local and national policies focused on institutional reforms, better governance, and empowerment?

Target Audiences and Participation

The target audiences for the Symposium will be development practitioners, extensionists, scientists, and policy makers. In particular, scientists from Japanese institutions collaborating on East, Southeast, or South Asian development, as well as those from countries in these regions are welcome. The Symposium will be open to all other interested individuals and institutions willing to share their knowledge and experiences relating to the above mentioned themes.

Admission to the symposium is free. Due to space limitation, only one hundred participants will be accepted in the order of receipt of the registration form (download from http://www.unu.edu/env/plec/news-events.html) by fax or email. The registration form is attached separately.

Date and Location of the Symposium

29-30 October 2003.

Elizabeth Rose Conference Hall, UN House, 53-70, Jingumae 5-chome, Shibuya-ku, Tokyo 150-8925, Japan (directions to the UN House: please see http://www.unu.edu/hq/ginfo/unu-location.html).

Language: English

Symposium Planning and Operation

The symposium will be co-organised by:

- United Nations University
- Center for Southeast Asian Studies, Kyoto University
- Japan International Research Center for Agricultural Sciences

Symposium Web Page

Further details and latest information of the Symposium will be provided at http://www.unu.edu/env/plec/news-events.html

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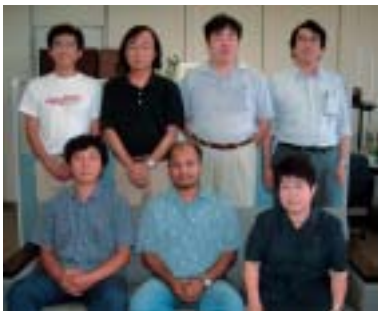
Looking Back ..... Looking Forward

Time flies faster than one expects, and the first thing that comes to mind while writing this report is that my time here in Tsukuba has passed quite quickly. I clearly remember the day of my arrival in this city from Matsuyama, a southern city of Japan, where I had spent over five years to study and conduct research as a foreign student from Bangladesh. At JIRCAS, it has been over one and half years since I started working for the Food Science and Technology Division, conducting collaborative research concerning anti-proliferative activity of some food components and drugs on mammalian cancer cell lines.

During my stay in Tsukuba, particularly by working here, I have gathered diverse impressions about how the Japanese scientists conduct their research everyday in high spirits, with high creativity, and how they strive to face challenges emerging from rapid increase in world population, deterioration of environment, destruction of cultivated lands, urbanization, industrialization and harmful use of chemicals to intensify agricultural production. Improved diets with smooth supply is the urgent need in many countries, and using bioresources to address the energy scarcity is essential; protecting the environment from deterioration is necessary to keep the world safe for us and for future generations. At JIRCAS, researchers are doing their best to resolve global problems related to agriculture, food, fisheries, forestry, and environment, with a focus on developing regions. I am proud to say that I have been a part of this effort, by carrying out collaborative research for about two years. I am grateful to Dr. Kazuhiko Nakahara and other researchers for their excellent suggestions for my research. I am also thankful to Dr. Toru Hayashi, Director of Food Science and Technology Division for his support and encouragement during my work in this division. My sincere gratitude is particularly due to JIRCAS for its financial support through the Visiting Research Fellowship program.



Dr. Roy (center) with his colleagues

Thus, I have to say that working at JIRCAS is simply great, not only because of the research facilities and support, but also because of the wonderful opportunity to expand one's views and understanding, in an international atmosphere. I look forward with the same enthusiasm, to expanding my views and broadening my understanding, to the extent possible during my stay in Japan.

Molay K. Roy,
Visiting Researcher

EVENT

Latest Announcement of the 10th JIRCAS International Symposium

As announced previously in JIRCAS Newsletter No. 35, the 10th JIRCAS International Symposium entitled" Prospects for Food Security and Agricultural Sustainability in Developing Regions - New Roles of International Collaborative Research " is being held at United Nations University Headquarters in Tokyo on November 18-19, 2003.

The organizing committee of the symposium will invite two keynote speakers. Dr. Yonosuke Hara, a distinguished Japanese development economist and Professor of both Interfaculty Initiative in Information Studies and Institute of Oriental Culture, the University of Tokyo, will give a presentation entitled' Economic development and roles of agriculture. 'And, Dr. Francisco Reifschneider, an agronomist and Director of the Consultative Group on International Agricultural Research (CGIAR) will give a presentation entitled' A decade of partnership-good news from the field. '

About 20 eminent researchers, scholars, and experts from around the world will make presentations at the 4 consecutive sessions focusing on perspectives and issues related to international development goals, sustainable development of agriculture, forestry, and fisheries in developing regions, strategies for international collaborative research activities, and strategic themes for international collaborative research activities. Detailed information appears at the website http://ss.jircas.affrc.go.jp/index.html (What's New).

You can register by downloading a form from the above-mentioned website and sending it by E-mail (jircassympo@jircas.affrc.go.jp) or facsimile (+81-29-838-6342). (only 300 seats are available for the symposium)

Also, on November 20, the follow-up workshop will be held at JIRCAS Headquarters (Tsukuba) to facilitate a deeper discussion among the major participants of the symposium for seeking feasibilities of developing a new framework for international collaborative research programs and/or projects between Japanese and foreign institutions.

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