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for

INTERNATIONAL COLLABORATION

Clockwise from top right: floating rice near Niger river, upland rice on the slash-and-burn field in Cameroon, rain-fed lowland rice in Guinea, irrigated rice in Cameroon (Photo by J-I. Sakagami)

In This Issue

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

For the Development of Sustainable Rice Cultivation in Africa

In sub-Saharan Africa, the demand for rice has increased rapidly at the annual rate of about 6% over the past three decades. It is considered that the increasing demand for rice may be due to the growing population, accelerated urbanization and change in the employment status in the urban areas. People tend to eat rice much more than in the past. Rice can be readily used and rapidly cooked and it can be stored over a long period of time and transported easily. Rice could thus become the crop that may enhance food security and alleviate poverty in Africa.

The rice cultivated area in sub-Saharan Africa expanded from 4.8 million hectares in 1987 to 8.5 million hectares in 2002. Rice production in Africa increased from 10 million ton in 1987 to 16.5 million ton in 2002. However, rice yields in Africa have not increased appreciably. For instance, the average yield of 1.8 t/ha in 1972 increased only to 2.2 t/ha in 1997 or 1.9t/ha in 2002. As a result, the importation of rice from abroad rose from one million ton in 1972 to more than six million ton in 2002 in Africa.

According to the recent statistics of FAO, rainfed lowland rice accounts for 42.6% of the total rice cultivated area in sub-Saharan Africa, followed by upland rice (37.1%), irrigated rice (13.9%), deepwater rice (4.8%) and mangrove rice (1.6%), respectively. Rice cultivation under rainfed lowland, upland and deepwater conditions is referred to as " rainfed rice. " The total rainfed rice area accounts for about 85% of the total rice lands in sub-Saharan Africa. Thus, rainfed rice in sub-Saharan Africa plays an important role in rice production in Africa.

The major constraints on upland rice cultivation are drought, weeds, diseases such as blast, pests including birds and rats, competition with other crops and low inputs. On the other hand, the constraints on rainfed lowland rice cultivation are drought, flood, iron toxicity, insect pests such as rice gall midge and diseases such as rice yellow mottle virus and blast. To promote sustainable rice cultivation in the rainfed areas of sub-Saharan Africa, various constraints depending on each rice ecosystem must be taken into account.

In 2000, the West Africa Rice Development Association (WARDA) released seven rice varieties called ' NERICA ' an abbreviation for " New Rice for Africa. " The NERICA varieties were derived from inter-specific hybridization between *Oryza sativa* and *Oryza glaberrima*. It is generally stated that NERICA varieties were released as upland rice varieties and are characterized by a high yielding ability and good grain quality derived from *Oryza sativa*, and by drought tolerance, high competitiveness with weeds and resistance to some diseases and insect pests derived from *Oryza glaberrima*. Although the NERICA varieties have exerted a strong impact worldwide, the characteristics of each NERICA variety have not always been sufficiently investigated by the world's rice scientists. Therefore, it is necessary to evaluate precisely the ability and potential of each NERICA variety for economically important characters.

The collaborative research project between JIRCAS and WARDA, " Improving food security in West Africa through the increase in the productivity of rainfed rice systems, " has been carried out since 1998 over a five-year period to increase rice production through the dissemination of rice cultivation in West Africa and improvement of varieties suitable for the region. The period covered by this project has been important in relation to the development of WARDA's research. In particular, during this period, the real potential of the NERICA varieties became more widely recognized. Research outputs from this project provided basic data and scientific information, which could contribute to further improvement and dissemination of the varieties and technologies developed by WARDA. It was pointed out by the evaluating committee for the project that further continuous research collaboration with WARDA could be considered by JIRCAS not only for basic research but also for technology development which may enable to accelerate the dissemination of NERICA varieties in Africa.

Based on the results of this preceding research project, we are currently preparing a new research project for continuing the collaboration with WARDA in order to develop sustainable and productive rice cultivation technologies for the rainfed area of West Africa. In the next project, we will reassess the potential of the NERICA varieties because now we have only limited information about NERICA. Besides, it is important to develop new rice varieties suitable for rainfed lowland areas because the rainfed lowland rice cultivation area has gradually expanded recently. There are several constraints on rice production under rainfed conditions in sub-Saharan Africa, as mentioned above. Out of such constraints, we are currently focusing on water stress tolerance, especially drought tolerance, as the most important character of rice varieties cultivated under rainfed lowland conditions. Thus, to breed new varieties suitable for the rainfed rice ecosystems effectively and efficiently, genetic studies on drought tolerance of rice are essential and the mechanisms of drought tolerance in rice should be elucidated by an analytical approach of complex traits. Firstly, the abundant germplasm of rice including not only Asian, African rice accessions and NERICA varieties but also some wild relatives of rice will be evaluated for drought tolerance.

To increase rice productivity and to maintain stable rice cultivation in such areas, we are now considering to promote a close collaboration with WARDA as well as neighboring NARs in sub-Saharan Africa countries, in addition to strengthening the relationships with JICA and some NGOs. This strategy could be referred to as " Post-NERICA Research. " It is necessary to develop low-input and sustainable rice production systems using the new improved varieties adapted to various adverse conditions. In this collaborative research project, disciplines such as genetics/breeding and plant physiology/agronomy should be closely linked to each other to develop stable, safe and sustainable rice production technologies. It is expected that the studies will enable to identify the genes involved in drought tolerance for the breeding of new rice varieties with high drought tolerance, along with the development of low-input and environmentally friendly cultivation technologies. The development of sustainable and high-yielding rice cultivation technology suitable for specific areas of sub-Saharan Africa is indeed urgently required.

We would like to contribute significantly to the development of productive and sustainable rice cultivation systems in rainfed areas of West Africa through this collaborative research project.

Ryoichi Ikeda
Director, Biological Resources Division, JIRCAS

Mapping of Hazardous Conditions of Soil Erosion Using Land Use Characteristics Obtained from Remote Sensing Data

Temperate vegetables are widely cultivated on the sloping highlands of the island of Java in Indonesia at altitudes ranging from 1,000 to 1,500 meters above sea level. These slopes are prone to soil erosion due to occasional intense rainfall (Fig. 1). It is necessary to evaluate the hazardous conditions of soil erosion in order to develop measures to protect land resources; however, it would be difficult to survey the variables contributing to soil erosion, such as land use with high spatial resolution. Therefore, we attempted to apply satellite or remote sensing data, which could survey wide areas to characterize the conditions of soil erosion at a particular site.

In this study we employed the Universal Soil Loss Equation (USLE) to estimate soil loss. This equation involves multiplication of rain (R), soil (K), slope length (L), slope inclination (S), crop management (C) and conservation practice (P) factors. First, we calculated the energy of rainfall and the peak intensity of 30-minute rainfall measured by the newly installed rain gauges at the site, and then determined the relationship between the daily rainfall and rain factor (R). The formula for this relationship was applied to existing rainfall records and provided the monthly R factor from 1990 to 2000. Soil factor (K) was calculated by the standard formula employed in Indonesia using the results of physical analysis carried out at the Center for Soil and Agro-climate Research and Development (CSARD) on soil samples taken from the site. Slope length (L) and slope inclination (S) factors were obtained from data produced from a 5-meter mesh Digital Elevation Model (DEM) by digitizing elevation contours on the 1:25,000 topographic map. The crop management factor (C) shows temporally variable values depending on density of vegetation cover. In the case of vegetable fields, the land is laid bare at seeding and harvesting times, while a certain amount of vegetation cover would exist through the year in forest areas. In this study, we attempted to discriminate land use types using data from three temporal satellites, which were obtained in February, June and December, and estimated the monthly C factor for each land use type. One of the effective components of the conservation practice factor (P) is represented by the condition of terracing on sloping lands. If the terrace is optimally constructed in terms of mitigating soil erosion, a systematic striped pattern would appear on remote sensing imagery. In this study, we calculated the (P) factor from textural feature values obtained from aerial photos, which were converted to digital form by a scanner, and classified the condition of terracing using these values.

Fig. 1. Example of agricultural land with high risk of soil erosion.

Langensari Village and its surroundings in Lembang Sub-District, Bandung District, West Java Province was selected as the study site. We estimated the potential soil loss for the period from 1990 to 2000 by the method explained above. We produced a map of the hazardous state of soil erosion using the 11-year averaged value, which was overlaid on the satellite image (Fig. 2). This figure indicates that the area prone to soil erosion is predominantly located in the southern part of the site. One advantage of the method developed in this study is that it can be used to estimate soil loss under arbitrarily assumed conditions of land use and/or other factors. For example, we could simulate the condition where all the agricultural fields were cultivated simultaneously three times per year, i.e. planted in March, July and November, under the rainfall conditions of 1994. The results exhibit the effectiveness of vegetation cover in reducing soil loss at times of intense rainfall (Fig. 3). We expect that the information provided by simulations of various patterns of land use and conservation practices would effectively support to establish optimal land use plans for the area.

Satoshi Uchida
Development Research Division, JIRCAS

Fig. 2. Map of the hazardous conditions of soil erosion overlaid on a satellite image.

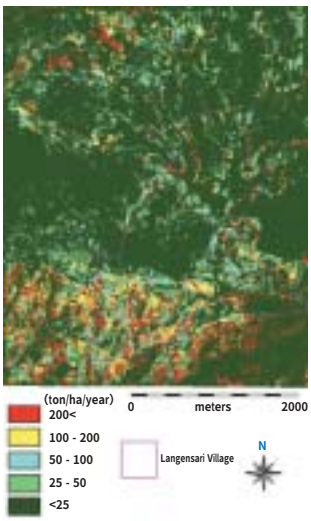

Fig. 3. Effectiveness of cropping pattern in decreasing potential soil loss .

Note 1: Simultaneous cropping 3 times per year, in March, July and November, was assumed for all the agricultural fields.
Note 2: Rainfall pattern of 1994 was applied.

Why Does Snap Bean Yield Decrease at High Temperatures?

The yields of some vegetables decrease in the tropics as a result of high temperature stresses. The reason for this decrease has not been clarified yet. In order to develop a suitable control technology, it is therefore necessary to identify the factors responsible for causing heat injury.

The production of snap bean (*Phaseolus vulgaris*), a popular temperate vegetable, is difficult at high temperatures. The yields of snap bean gradually decrease from spring until summer in Okinawa, although growth of shoots seems normal and number of flowers increase. The yield reduction was closely related to the abscission of flowers and occurrence of abnormal pods. To understand how this occurs, we investigated how the organs that maintain pollen viability, which is critical to fertilization, might be impaired by heat. It was discovered that high atmospheric temperatures alter the structure of the endoplasmic reticulum in the tapetum and prevent the tapetum from supplying nutrients to microspores in the anther (Fig. 1). The tapetum degenerates earlier than usual, resulting in high pollen sterility, and anther dehiscence does not occur when pollen stainability falls below 20 percent.

Pollen tubes were stained with aniline blue to make the ovule more observable under optimum conditions, although heat treatment still limits visibility. We were able to determine that heat stress at the flowering stage blocked pollen tube elongation in the style, particularly high temperatures exactly occurring one day before flowering (Fig. 2). Both normal pollen development in the anther and normal pollen tube elongation in the style are necessary for successful fertilization under high temperature conditions.

Abnormal pods occurred along with failure of fertilization because the pollen tubes did not reach the ovules on the peduncle side under high temperatures. Even when fertilization occurred successfully, abnormal pods appeared with poor ovule development.

The ratio of occurrence of these heat injuries was low in heat-tolerant cultivars compared with heat-sensitive cultivars in our studies. Therefore, high yields could be obtained in the heat-tolerant cultivars. We have studied the physiological and genetic aspects of heat tolerance, but the mechanism in detail has not been clarified yet.

We used a greenhouse to control air temperatures and compared the plants grown there with those grown under field conditions for this study. The abnormal effects occurred when air temperatures exceeded 28℃. The studies under field conditions were conducted in different seasons having different day lengths. It is also necessary to conduct cultivation experiments in highland and lowland areas of the tropics, where day lengths are the same but air temperatures are different.

In other vegetables exhibiting a similar phenomenon, pollen stainability, pollen tube elongation and appearance of abnormal pods are important factors to be considered when selecting heat-tolerant strains for production of new cultivars. Lowering of air temperatures in the field is difficult at present. However, we hope that our studies will form the basis to develop a new technology to decrease air temperatures during the reproductive stage in order to stabilize yields by cultural practices. Further studies are also required on the physiological factors causing heat injury, in order to enable production of vegetables at high temperatures.

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(Present address: *National Institute of Vegetable and Tea Science, NARO; **Research Planning and Coordination Division, JIRCAS)

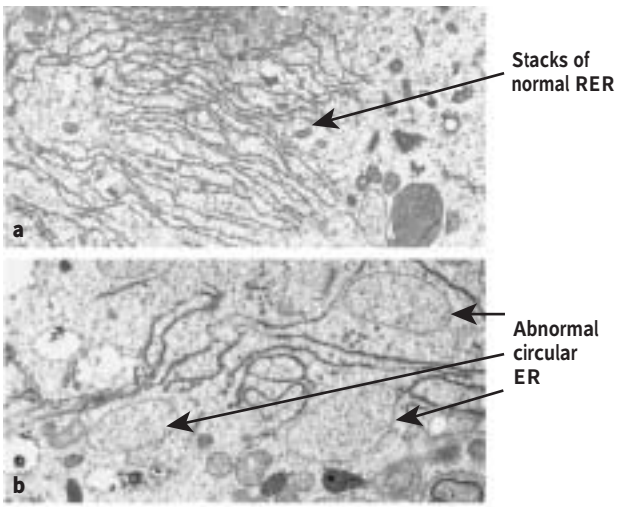

Fig. 1. Endoplasmic reticulum (ER) in tapetum at the uninucleate pollen stage.
a: normal conditions (24℃), b: high temperature conditions (29℃)

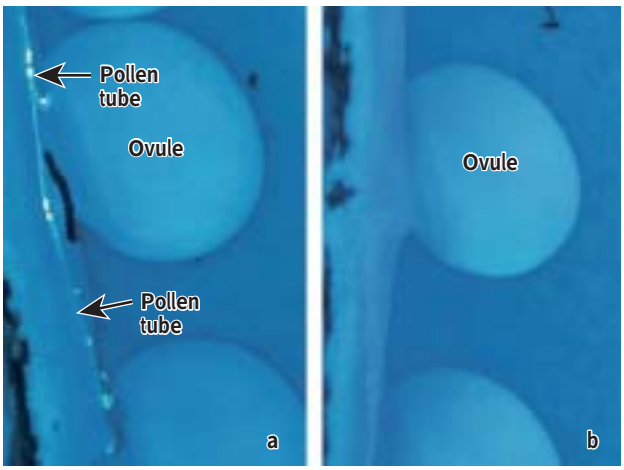

Fig. 2. Fertilized ovules (a) and non-fertilized ovules (b).

The 10th JIRCAS Symposium on Prospects for Food Security and Agricultural Sustainability in Developing Regions: New Roles of International Collaborative Research

JIRCAS has been hosting international symposiums on common issues for agricultural development in developing regions every year. In the Fiscal Year 2003, a symposium was held at U Thant Conference Hall in United Nations University in Tokyo on November 18-19 to mark the 10th anniversary of JIRCAS's reorganization from the former Tropical Agricultural Research Center. Approximately 240 participants from more than 30 developing and developed countries as well as international organizations attended and covered very broad disciplines ranging from international cooperation, collaborative research policy making, and strategy development to field work.

The symposium focused on impacts of globalization and natural resource and environmental changes on food security and agricultural sustainability in developing regions, their prospects and possible directions of international cooperation and collaborative research to cope with them. Inter- and multidisciplinary presentations and discussions were held during the symposium. First, two keynote speeches were delivered. Dr. Yonosuke Hara, Professor of Interfaculty Initiative in Information Studies and Institute of Oriental Culture, The University of Tokyo gave an impactful speech entitled 'Reconsidering the roles of agriculture in the century of sustainable development: the 21st century.' And, Dr. Francisco Reifschneider, Director of the Consultative Group for International Agricultural Research (CGIAR), Washington, DC focused on present and possible future Japan-CGIAR partnerships based on the new roles of CGIAR.

The symposium consisted of four sessions, namely, 'Perspectives for achieving the international development goals,' 'Perspectives and issues for sustainable development of agriculture, forestry and fisheries in developing regions,' 'Strategies for international collaborative research activities,' and 'Strategic themes for international collaborative research activities.' At the end of each session, additional comments were made by invited commentators, and a short discussion was also held among the speakers and general participants.

In the last session, the newly appointed CGIAR Science Council member, Dr. Keiji Kainuma chaired a two-hour discussion for integration and synthesis. The majority of the participants reached a consensus that future international collaborative research for development needs to shift from a bilateral to a more multilateral system of networking between developed countries and developing regions in order to improve its efficiency and effectiveness. And, many participants expressed strong expectations of a Japanese initiative in this regard.

Moreover, a follow-up workshop was held at JIRCAS, Tsukuba on the following day, to which the speakers and major Japanese participants in the symposium were invited. Based on three presentations on new Japanese policies on international cooperation and collaborative research and two reports of university activities for international collaboration, participants frankly exchanged ideas on the possible direction to strengthen partnerships between Japanese institutions and foreign and international institutions. And, a speaker from JIRCAS introduced various new activities to strengthen domestic partnerships, including the establishment of a Japanese forum on agricultural research for development. Every participant expressed strong support to the activities being currently implemented and agreed to maintain contact with one another for developing more sustainable partnerships.

Through the three-day activities it has become increased apparent that the international community increasingly expects scientific contribution and leadership from Japan to achieve the development goals under a situation where Japanese official assistance has some budgetary constraints.

Satoru Miyata
Development Research Division, JIRCAS

The Fourth China-Japan Joint Workshop on Development of Processing and Utilization of Freshwater Fisheries Resources

JIRCAS and Shanghai Fisheries University held the fourth China-Japan Joint Workshop, " Development of Processing and Utilization of Freshwater Fisheries Resources " at the Shanghai Fisheries University on November 26-29, 2003. This was the final year of the international research project entitled " Development of Sustainable Production and Utilization of Major Food Resources in China " that was launched in 1997. In this project, JIRCAS and Shanghai Fisheries University conducted joint studies for the development of utilization technology of freshwater fisheries resources. Production of Chinese freshwater fish in 2002 was about 20 million tons and accounted for over 10% of the world's total fish production. Most of the freshwater fish in China are cultured fish. They are widely consumed in large cities located close to culture ponds as fresh fish, but are not available as processed foods. It is expected that the production of Chinese freshwater fish will be increased in the future by the application of new aquaculture technologies. Further development of new processing technology for Chinese freshwater fish is also necessary for stabilizing this valuable food supplement in China.

The studies yielded various results, including the development of processing techniques for frozen fish meat paste, fish sauce, and fishmeal made from freshwater fish, and clarification of the fat properties of freshwater fish. The workshop served as an opportunity to summarize and present the outcomes of this joint research program.

A total of 67 people (13 from Japan and 54 from China) participated in the workshop. The Japanese participants included long-term researchers dispatched from JIRCAS, short-term researchers dispatched from the Fisheries Research Agency, and other researchers from universities, local governments and the private sector. The Chinese participants included researchers and engineers from Shanghai Fisheries University, the Ministry of Agriculture of the People's Republic of China, national and regional fisheries institutes, and the private sector.

The workshop consisted of three sessions, featuring 8 keynote speeches and 14 general speeches. In Session I, Prof. Li of Shanghai Fisheries University delivered his keynote speech on " The Status and Problems of Freshwater Aquaculture in China " based on the theme, " The Current Status of and Prospects Facing the Chinese Freshwater Aquacultural Industry. " Discussions were then held on current conditions, problems, and future prospects for Chinese freshwater aquaculture, which is expected to continue to expand.

The Library of Shanghai Fisheries University, where the workshop was held.

Session II was a forum for presentation of the results of the joint research program. Numerous questions and comments were raised by the Chinese university researchers and seafood processing industry engineers on the technology for processing frozen fish meat paste and fish sauce from freshwater fish.

In Session III, speeches were made and general discussions were held on the " Prospects for Industrialization of Freshwater Fish Use and Processing Technology. " Participants agreed that the use and processing of freshwater fish meat is a technique with great potential to assist China in solving future food problems, and discussed the need for its industrialization. It was noted that industrialization of this technique would lead to problems related to disposal of wastes such as processed residuals, which would also need to be studied. The Chinese participants stressed the need to carry out further research to solve these problems.

Masaki Kaneniwa
Fisheries Division, JIRCAS

Presentation during Session II.

General discussion during Session III.

JIRCAS Research Seminar on African Agriculture in 2002

The JIRCAS Research Seminar on African Agriculture held on November 28, 2003, focused on the issues raised by TICAD III on the development of rice production, improvement of NERICA, and the international year of rice. Furthermore, this seminar was carried out for the purpose of providing a comprehensive overview of the research and technological development on rice production in Africa achieved in the project on rice cultivation implemented by JIRCAS in West Africa from 1998 to 2002, and identifying the future direction for rice research by JIRCAS in Africa. The seminar focused on the present situation and development of rice and included two sessions, with seven invited speakers.

Limiting factors and problems, as well as the possibility of rice development for different ecosystems were discussed as main topics. The first session addressed the problems related to water and soil, which are major limiting factors to increasing the productivity in the various ecosystems. In particular, the potential of rice production in rainfed ecosystems as well as the use of appropriate varieties, in addition to the effective use of *Oryza glaberrima* which originated in Africa, were discussed. In the second session, the problem of dissemination and the development of technology and research were discussed. The results of both sessions were described during the general discussion to promote future activities of JIRCAS on rice research in Africa.

The seminar brought together about 80 specialists on African agriculture development from JICA, universities, national agricultural institutes, NGOs, consulting companies, and the Ministry of Agriculture, Forestry and Fisheries. The seminar concluded that research efforts should be focused on the rainfed lowland and small-scale irrigation systems due to their potential, and to enhance sustainable rice cultivation in Africa. With upland ecology occupying 40% of total land cultivated to rice, it was also considered important to develop this ecology along with the rainfed lowlands. The development of NERICA was highly evaluated technically in terms of the success of crosses between the different cultivated species; the 7 NERICAs are being disseminated widely in West Central Africa despite the insufficient agronomical data that might be used scientifically for their characterization. Based on this, it was suggested that careful consideration must be given

while introducing the varieties to farmers. It was also observed that the advertisements from the press in Japan exaggerated the potential of NERICA.

The promotion of research on NERICA was deemed necessary to improve the possibility of its further development. The Ministry of Foreign Affairs and JICA in the concerned countries were expected to continue to support the dissemination of NERICAs, mainly in the area of seed multiplication. A long-term project was considered necessary for the development of NERICA.

It was concluded that a short- to mid-term project on the problems relating to water and soil should be implemented, while the breeding aspect should focus on the improvement of NERICA varieties for lowland ecology. Moreover, enhancement of capability of local researchers was a major subject, and the role of Japan in this matter was acknowledged as being significant. It was hoped that the development of lowland paddy fields by the introduction of small-scale irrigation technology would lead to rural development; however it was mentioned that the introduction of farm machinery such as power tillers needs careful consideration due to the existing situation of farm management and sustainability of agriculture.

JIRCAS will have to consider the issues raised in this seminar while preparing to proceed with the research project in West Africa.

Jun-Ichi Sakagami
Development Research Division, JIRCAS

Tasting " NERICA " Produced at JIRCAS

At JIRCAS 's harvest festival celebrations, NERICA (New Rice for Africa) harvested from the experimental field at Tsukuba was served. Although it is an upland rice variety, the rice served at JIRCAS was grown in wetland paddy fields. Several varieties with wide-ranging tastes were enjoyed, suggesting the future possibility for variety improvement.

Establishment of a CGIAR Science Council

At the 2001 CGIAR Annual General Meeting (AGM), the decision to establish a Science Council was made. The formation of the Science Council (SC) to replace the Technical Advisory Committee (TAC) is as part of the general broadening of the CGIAR mandate, with increased emphasis on drawing in outside partners for planning and guiding, as well as for carrying out research.

The primary responsibilities of the Council will be a) to serve as a guardian of the relevance and quality of science in the CGIAR, and, b) to advise the CGIAR on strategic scientific issues relevant to the Group's goals and mission. It was also decided that the SC would be composed of a few high-level science policy strategists.

The working group chaired by Mohamed Hassan, completed the detailed report in August 2002, where it stated the four key functions of the SC.

1. Ensuring the relevance of science
2. Enhancing the quality of science
3. Assessing the impact of CGIAR research
4. Helping to mobilize global scientific expertise

In early 2003 the CGIAR announced to the world scientific community its decision to select the Chair and members of the CGIAR SC based on the following criteria.

"The members should be eminent scientists in the field of biological, physical, or social sciences. While solid scientific stature should be a major selection criterion, the members of the Council should have a strong science policy, development experience and understanding of science management."

Following a selection process by the SC Search Committee, seven members from Denmark, Sweden, UK, Australia, India, Kenya and Japan were selected, and later approved at the 2003 AGM.

The first informal SC meeting was held in Rome on February 4-6, 2004 chaired by Dr. Per Pinstrup-Andersen. The inaugural meeting of the SC is scheduled from May 13-15 in Aleppo, Syria and the second meeting will be in Rome on September 6-9, 2004.

Keiji Kainuma
Member of Science Council, CGIAR

Invitation to the World Rice Research Conference 2004 (WRRC2004)

rice is life
INTERNATIONAL YEAR OF RICE
2004
www.rice2004.org

This year (2004) was designated as the "International Year of Rice" at the UN General Assembly in December 2002, based on the fact that more than half the planet (as many as 2.8 billion people) consumes rice. As a result, rice is expected to contribute to one of the Millennium Development Goals, which is to reduce hunger and poverty in developing countries to half by 2015. On this occasion, we will host the rice research conference together with MAFF, IRRI, and other research institutes and universities in Japan, with the hope of eradicating poverty in developing countries and creating sustainable and affluent livelihoods based on rice culture. The conference will cover four themes, "Production," "Lifestyle," "Livelihoods," and "Sustainability." The schedule for the conference is as given below and we encourage you to visit the URL http://www.irri.org/wrrc2004 to know more about WRRC2004 and to register for the conference. JIRCAS will play an important role in this conference as a secretariat, and this symposium will be designated as the 11th JIRCAS International Symposium.

This conference will focus on new technologies for rice production, new ideas on rice and its utility for healthy living, new ideas to enhance multifunctionality and environment-friendly improvements to rice-farming livelihoods, and also food security, globalization, and global environmental issues. We hope that this conference will be the catalyst for new international collaborations on rice research for the new era.

- Opening ceremony and Symposium, November 4, 2004 at Tokyo
- World Rice Research Conference, November 5-7, 2004 at Tsukuba International Congress Center

PEOPLE

Dr. Shuichi Asanuma, formerly Head of Research Planning Section, Research Planning and Coordination Division, JIRCAS was appointed as Director of Okinawa Subtropical Station, succeeding Dr. Masaaki Suzuki who joined AVRDC (Asian Vegetable Research and Development Center) (Bangkok) as Deputy Director General.


Dr. Asanuma


Dr. Suzuki

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