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Pineapple fields on hilly land near Luang-Prabang, Laos (Photo by T. HIDAKA)

NEWSLETTER

JIRCAS

Japan International Research Center for Agricultural Sciences

For International Collaboration

September,2001

28

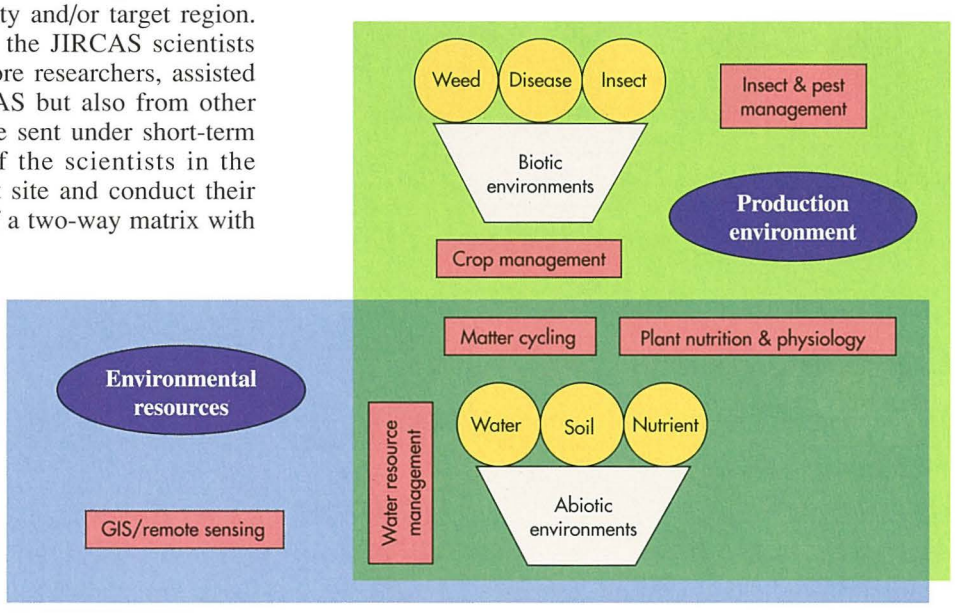
Contents

Shift in Environmental Research at JIRCAS Following Restructuring

Characterization of environmental resources has been one of the key research activities of JIRCAS and has been carried out mainly on a large scale by applying remote sensing techniques within the framework of geographic information systems (GIS). These activities are closely associated with the major comprehensive projects that JIRCAS is implementing in different parts of world. The outcome is utilized by other scientists in the projects for their own research as basic information about their study area. These activities are expected to contribute to prioritization of research needs and integrated analysis of individual results in the projects. Due to the high expectation of stronger linkages with socio-economic analysis, it was eventually decided to transfer this part of activities to the Development Research Division at the time of the reorganization of JIRCAS. This functioned as a trigger for major changes in the divisional concept of the former Environmental Resources Division from macro-analysis of environmental resources to micro-analysis of production environments including not only abiotic but also biotic components. Beside the analyses using GIS/remote sensing, the Division had been dealing with the nutrient flow in agro-ecosystems and abiotic stress management under unfavorable conditions, indicating that the main focus of the Division had been placed on abiotic components among various environmental resources relating to agricultural production. Incorporating research groups specialized in the management of crops, water resources, and pests and diseases, the new Division (Crop Production & Environment Division) is now ready to start research, focusing more on the development of integrated technologies required for the improvement of productivity and sustainability in a cropping environment.

The majority of the research themes documented in the mid-term plan of JIRCAS for the next five years will be conducted through so-called comprehensive projects as driving vehicles. The projects have been merged into five groups based on the type of activity and/or target region. The projects will be managed by the JIRCAS scientists under long-term assignments as core researchers, assisted by scientists not only from JIRCAS but also from other research organizations who will be sent under short-term assignments. More than half of the scientists in the Division are stationed at a project site and conduct their activities under the management of a two-way matrix with one axis for the Division and one for the project. The other half of the scientists in the Division carry out research mainly at the Headquarters. As long as they participate in a comprehensive project, however, they operate within the matrix frame as in the case of the scientists in secondment. In most of the cases, these scientists are under the supervision of the Division Director and the project coordinator. Although the matrix system tends to increase the complexity of the operations within the organization, it certainly contributes to enhancing the transparency of the management and the interaction among staff scientists with different backgrounds, which is necessary for multidisciplinary projects. Especially for research aiming at technology development for cropping systems in different agro-ecosystems, which should be the major task for the new Division, tighter linkage among the scientists is most important to achieve the objectives since any technologies applicable to the field conditions should result from the integration of various scientific disciplines. Through the grouping of scientists with similar disciplines and active interaction among the groups, we hope to generate more in-depth discussions on the subjects and more systematic integration of the research plan and results from different groups.

Osamu Ito
Director, Crop Production & Environment Division, JIRCAS



Shift in the divisional thrust from environmental resources to production environments

Comprehensive Studies on Soybean Improvement, Production and Utilization in South America and Mid-Term Evaluation Meeting

In 1997, the comprehensive collaborative project titled: "Comprehensive studies on soybean improvement, production and utilization in South America" was initiated in the MERCOSUR countries. The project is focusing on the development of sustainable and more efficient systems of soybean production in the MERCOSUR countries such as Brazil, Argentina and Paraguay, because soybean production in this area accounts for approximately one-third of the total world production, and unstable production of soybean in these countries may hamper the supply of soybean worldwide. However, soybean production in South America has often been carried out under environmentally vulnerable conditions in arid and acid soils characterized by a low fertility. On the other hand, since the history of soybean cultivation in this area is relatively short, there is a growing concern that continuous cropping, pest and disease outbreaks, and soil erosion may adversely affect future soybean production.

This comprehensive project focuses on research in five areas: genetics and breeding, soil management and pest control, crop management and production, postharvest technology, and socio-economic analysis. The project is executed in collaboration with several South American research organizations, such as National Center for Soybean Research (CNPSo) and National Center for Beef Cattle Research (CNPGC), Brazilian Agricultural Research Corporation (EMBRAPA), Center for Agricultural Technology in Paraguay (CETAPAR), Japan International Cooperation Agency (JICA) and Ministry of Agriculture and Livestock, Paraguay (MAG), and Marcos Juarez Agricultural Experiment Station (EEA-MJ), National Institute of Agricultural Technology, Argentina (INTA). Presently, in 2001, three researchers on a long-term basis are carrying out studies on genetics and breeding, soil management, and drought tolerance of soybean cultivars, respectively at CNPSo, Brazil. One researcher on a long-term basis is conducting studies on soybean diseases at EEA-MJ, Argentina. Studies on plant parasitic nematodes are being carried out at CETAPAR/JICA, Paraguay. In addition, one scientist currently stationed at CNPSo is in charge of the coordination of the project.

JIRCAS researcher collecting soil samples for isolation of plant parasitic nematodes in a no-tillage soybean field in Paraguay.

Greenhouse experiments for the evaluation of the micronutrient status in soybean plants at CNPSo, EMBRAPA.

The seminar on soybean research conducted between CNPSo and JIRCAS was held at CNPSo on December 11, 2000 for the preparation of the mid-term evaluation meeting. Some of the reviews and results obtained in this project were presented and discussed during the seminar.

A mid-term evaluation meeting for this project was organized on March 22, 2001 at Tsukuba by JIRCAS. The main purpose of the meeting was to evaluate the results and to examine the future research orientation of the project. Dr. Peter Kerridge, Coordinator, International Center for Tropical Agriculture (CIAT)-Asia, CIAT, Prof. Dr. Kazuo Kawano, Kobe University, and Dr. Shinji Sakai, Director of Department of Crop Breeding, Tohoku National Agricultural Experiment Station were invited as commentators for the meeting.

After the opening address given by Dr. Takahiro Inoue, Director General of JIRCAS, the researchers of JIRCAS and related institutes presented the results and future research plans for each subject as follows: 1) Genetic improvement of chemical constituents in soybean seeds, 2) Production of DNA markers, Breeding methods for insect-resistant soybean plants in South America, 3) Identification of soybean genes for resistance to *Phytophthora sojae* using molecular markers, 4) Improvement of soil management practices, 5) Improvement of methods of control of diseases and insects in Paraguay, 6) Ecology and control of major diseases of soybean in Argentina, 7) Morphological and physiological characterization of drought-tolerant soybean cultivars and identification of selection criteria for drought tolerance, 8) Analysis of soybean supply and demand, and 9) Socio-economic evaluation of new technologies.

After the presentations, several critical comments on the studies were presented and the participants discussed solution strategies and future plans for the studies. They also exchanged views on the progress of the project during the meeting. Finally, the framework, future plans and orientation of the project were approved in general. Particular issues raised by one reviewer were as follows: 1) To define more clearly how this project could contribute to overall research on soybean improvement in South America, 2) To give a high priority to the development of soybean for consumption as food as well as to carry out research common to all soybean production, 3) To continue to promote a close collaboration with national scientists.

A workshop on soybean will be held in November 2001 in Brazil during which feedback of the current studies and the future orientation of the program will be discussed.

Toshiaki Taniguchi
Director, Animal Production & Grassland Division, JIRCAS

Diagnosis and Prevention of Shrimp Viral Diseases in Southeast Asia

Southeast Asia including Thailand, Malaysia, Indonesia, and so on, is a significant area for world shrimp culture. However, in recent years, the production of cultured shrimps has markedly decreased as a result of serious viral disease outbreaks. The increased severity of widespread viral infection is the major constraint on stable aquaculture. Therefore, in order to ensure sustainable production of cultured products, it is essential to adopt preventive countermeasures against viral diseases. Therefore, the development of rapid diagnosis and inactivation methods for White Spot Syndrome Virus (WSSV), which is the most serious problem in Southeast Asia, was promoted.

Serological diagnosis using monoclonal antibodies is one of the most rapid and accurate methods, in addition to the low cost and simplicity. The use of monoclonal antibodies resulted in a higher sensitivity to the virus than the use of polyclonal antibodies, because monoclonal antibodies give a very specific reaction against a particular part of the virus. The methods of monoclonal antibody production involve four steps. First, the virus antigen to mice was prepared by artificial injection of the wild pathogen virus to healthy prawns. The hemolymph containing a large amount of virus was collected from diseased prawns, and then the virus was concentrated and purified by high speed centrifugation and ultracentrifugation. In the next step, mice were immunized. The virus antigen prepared in the previous step was injected intraperitoneally into the mice, and then a few more viral injections were performed as a booster after three weeks. In the third step, cell fusion took place. After the final immunization, the spleens of immunized mice were removed and the spleen cells were fused with myeloma cells, because the spleen cells can not survive over a long period of time, while the hybridomas (fused spleen and myeloma cells) can grow and produce antibodies. In the final step, screening and culture were performed. The cells, which produced the specific antibodies against WSSV were selected by screening from many hybridomas using the immuno-fluorescence technique (Fig. 1).

After screening, they were cultured and they produced antibodies used as monoclonal antibodies. A few strains producing virus-specific antibodies were obtained from more than 100 strains of hybridomas, which were selected by antibody production tests. Hereafter, virus-specific strains will be further selected and used for the diagnosis of the disease caused by WSSV.

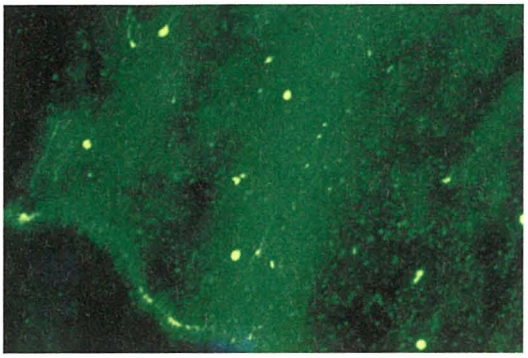


Fig. 1. Positive sample for the screening test using monoclonal antibody. (WSSV antigen was stained by FITC-labeled virus-specific monoclonal antibody).

Viral inactivation was tested using chemicals, such as formalin and halogenous disinfectants, including sodium hypochlorite and Isodine^{R} (povidone-iodine was an effective ingredient). The concentrations of formalin were 0, 0.1, 0.25, 0.5 and 1% (V/V), while 0, 0.5, 1.0, 2.5 and 5.0 ppm of effective chloride in sodium hypochlorite, and 0, 2.5, 5.0 and 10.0 ppm of effective povidone-iodine in Isodine^{R} were used for the inactivation test. These chemicals were mixed with equal volumes of the virus and then made to react together at 25℃ for 10 minutes. After the reaction, the resultant products were injected intramuscularly to 10 healthy prawns at the dose of 0.1 ml/prawn. The mortality was monitored for 2 weeks after the injection. The experiments showed that mortality was not recorded at concentrations above 0.25%, 0.5 ppm, and 2.5 ppm for formalin, effective chloride in sodium hypochlorite, and effective povidone-iodine in Isodine^{R}, respectively (Fig. 2). These data indicated that halogenous disinfectants induced an effective inactivation even at lower concentrations. It was suggested that these disinfectants were extremely useful for the inactivation of WSSV.

The studies on the diagnosis and disinfection of WSSV should enable to prevent pathogen intrusion into aquaculture farms, and, therefore, should contribute to sustainable aquaculture in Southeast Asia.

Norihisa Oseko
Fisheries Division, JIRCAS

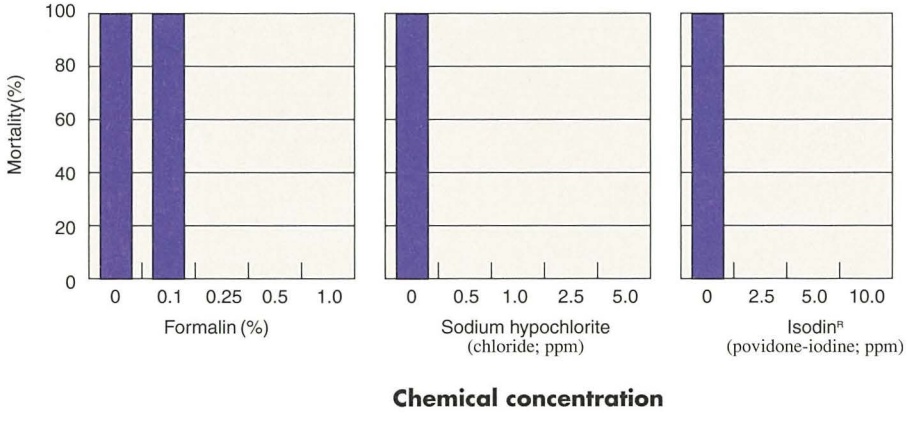


Fig. 2. Virus inactivation effects at several concentrations of chemicals: formalin, chloride, and Isodin^{R}.

Agro-Environment and Land Use in Different Farming Systems in West Java, Indonesia

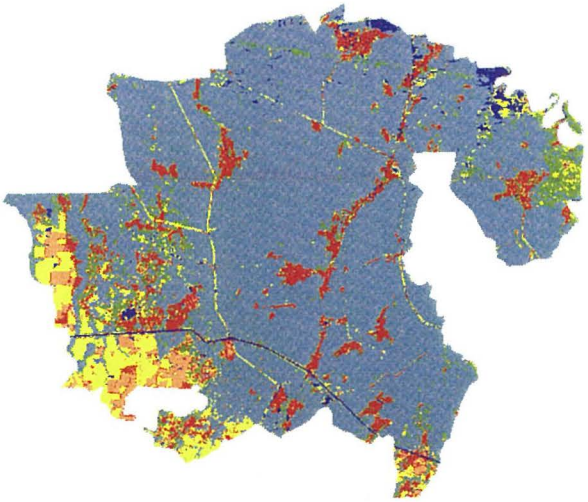
Farming Systems (FS) in Indonesia have been implemented and developed in harmony with physical and socio-economic conditions through a long history of human activities. In this country, FS comprise a variety of types associated with the great diversity in the geographic and cultural environment of more than 17,000 islands. This study focused on the spatial analysis of agro-environmental factors for typical FS in West Java in association with land use changes, by using satellite data, thematic maps and statistical data.

Two specific FS implemented in a flat area and mountainous area, Kecamatan (Sub-district) Binong in Kabupaten (Regency) Subang and Kecamatan Cibinong in Kabupaten Cianjur, respectively, were characterized in this study. In order to describe the characteristics of FS clearly, methods to quantify the distribution pattern of land use and to identify the planting time and cultivation pattern of rice fields were developed.

Land use maps in Binong and Cibinong were obtained by supervised classification of LANDSAT/TM data acquired on June 26, 1997. The map showed that most areas in Binong were occupied by paddy fields, while in Cibinong two dominant land use types characterized by upland fields and forests were observed. Entropy, which is the index of randomness of distribution, indicated that the land use in Cibinong was more dispersive than that in Binong. The value of entropy calculated for Cibinong was 1.921, whereas 1.291 for Binong. Entropy value depending on land use categories was the lowest, 0.333 for paddy fields in Binong, suggesting that the distribution of paddy fields in Binong was very concentrated. In contrast, in Cibinong, paddy fields showed the highest degree of dispersion with the highest entropy value of 2.598 (Fig. 1).

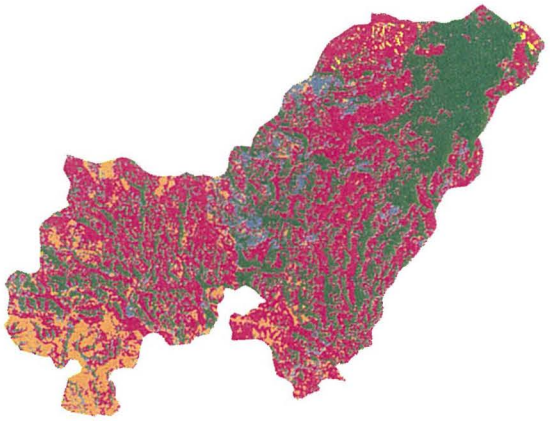
Topographic factor analysis using Digital Elevation Model indicated that Binong was very flat with a low elevation and topographically homogeneous. On the other hand, the Cibinong location showed a wide range of elevations and consisted of a steep sloping area. These topographic features affected the distribution pattern of agricultural land use at each site. Analysis of the location of land use in Cibinong showed that upland fields were mainly distributed in the area where the elevation ranged between 200 and 600 m and the soil type consisted of *Yellowish Red Podsolic soil,* while forests were located in areas around 1,000 m in elevation with two soil types; 1) a combination of *Yellowish Red Podsolic, Yellow Podsolic* and *Regosol*, and 2) an association of *Brown Andosol* and *Brown Regosol*.

In the irrigation area located in the northern plain in West Java, the cropping pattern of rice was analyzed using the Normalized Difference Vegetation Index (NDVI) data, which were provided as 10 day-composite maximum values with 1 km mesh. The analysis of the temporally sequential NDVI data set showed that the time of planting of rice, which started from the upper part to the lower part of the irrigation network, could be spatially represented. These findings suggest that the progression of planting can be estimated by the multi-temporal data obtained at



[Binong]

	Km2	%	Entropy
Paddy fields	110.5	72.0	0.333
Plantations	10.9	7.1	2.052
Mixed gardens	11.0	7.2	2.657
Bare soil	3.2	2.1	1.285
Settlement	13.7	8.9	2.210
Infrastructure	0.3	0.2	1.999
Water	3.8	2.5	1.902
Total	**153.4**	**100.0**	**1.291**



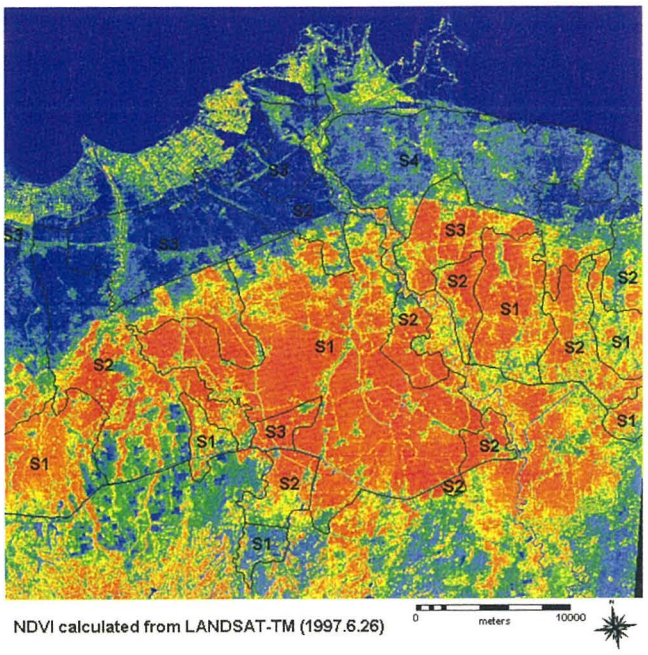
[Cibinong]

	km2	%	Entropy
Paddy fields	21.7	4.9	2.598
Upland fields	219.4	49.5	1.112
Tea gardens	1.7	0.4	1.864
Forests	161.5	36.4	1.588
Bare soil	39.2	8.8	2.039
Total	**443.4**	**100.0**	**1.921**

Fig. 1. Land use maps produced by satellite data classification.

appropriate times, although the planting time of rice changed year by year. The pattern of planting and growing of rice in Binong was analyzed in greater detail by using NDVI of LANDSAT/TM data, which showed a higher spatial resolution (30 m) and could be compared with the data from the irrigation planning map issued by the Provincial Office.The results indicated that the TM data enabled to detect the variation in cropping time in smaller land units than the units shown in the irrigation planning map (Fig. 2).

From 2001 onward, studies on vegetable-based FS will be initiated in addition to those on contrasting FS of Cibinong and Binong, to identify the constraints on sustainable and efficient production of vegetables in West Java.



NDVI calculated from LANDSAT-TM (1997.6.26)

Fig. 2. Spatial distribution of NDVI calculated from LANDSAT/TM data (colored parts) compared with land units derived from the irrigation planning map (boundaries are indicated by black solid lines) in the northern coastal area of West Java.

Note: Reddish part shows higher values of NDVI of LANDSAT/TM. Based on the irrigation planning map, the time schedule of irrigation was divided into 4 periods, S1 to S4, and the area with identical symbols should be irrigated during the same period.

Yukiyo Yamamoto and Satoshi Uchida
Development Research Division, JIRCAS

Workshop & Meeting

Economic Analyses of Agricultural Technologies and Rural Institutions in West Africa: Achievements, Challenges and Application to Rice Farming Research

The international workshop titled: "Economic Analyses of Agricultural Technologies and Rural Institutions in West Africa," with emphasis placed on rice farming research in the region, was held at JIRCAS on July 12-13, 2001.

In 1998, JIRCAS initiated a collaborative research project with the West Africa Rice Development Association (WARDA). Rapid demographic expansion and urbanization in Africa have shifted food preferences from traditional foodstuffs to rice and bread, and the demand for rice in sub-Saharan Africa is growing faster than that for any other major food staples. These patterns are especially evident in West Africa. In collaboration with WARDA, JIRCAS is conducting an economic study, focusing mainly on rice farming in lowland regions of Côte d'Ivoire and Ghana. Factors such as land tenure management through local organizations, market access and access to capital through informal financial systems are recognized to play important roles in farmers' capacity to adopt and use improved technology, including such developments as land improvement through investment in water control mechanisms, utilization of improved varieties, chemical inputs, and related cultural practices. Furthermore, it has been observed that the systems by which individuals gain access to land and capital may be discriminatory toward an individual's social origin and gender. Therefore, the objective of this project is to assess how the institutional and economic environment affects the farmers' capacity to effectively adopt new technology.

The value of economic analysis has already gained clear recognition in the field of agricultural research in developing countries. Its potential value is expected to be even greater for the assessment of the impact of technology systems as well as policy/institutions on the welfare of agricultural households and the regional economy. Session I reviewed socio-economics research activities in CGIAR Centers (i.e. ICRISAT, IITA and WARDA) and JIRCAS in West Africa and the roles of economic analyses in the field of agricultural research were discussed. Session II was focused on the rice farming-related research of the JIRCAS-WARDA project and details of the schemes and methodology of economic analysis were discussed. The workshop, with 53 participants, provided an excellent


Discussion at the workshop

opportunity to discuss the role of economic studies in addressing the problems related to agriculture and rural livelihood in West Africa. It was also pointed out that the effective interaction between economic studies and technological studies based on a multi-disciplinary approach was essential to facilitate agricultural research and development in the region.

Hiroko Takagi
Development Research Division, JIRCAS

Sixth China-Japan Annual Research Coordination Meeting

Following the 20th Annual Group Meeting on Exchange of Agricultural Science and Technology between China and Japan held in Tokyo, the Chinese delegation led by Mr. Tang Zhengping, Director-General, Department of International Cooperation, Ministry of Agriculture, PRC, visited JIRCAS on May 31, 2001 in order to attend a research coordination meeting for discussing substantial issues relating to the ongoing comprehensive research project "Development of sustainable production and utilization of major food resources in China." This coordination meeting has been organized alternatively in China and Japan and this year, the sixth annual meeting was held. Both parties appreciated the favorable evaluation of the project conducted during the mid-term research review meeting held in February 2001. JIRCAS expressed its gratitude for the appropriate procedures implemented for duty-free import of research materials sent to China and the granting of visas to the Japanese scientists. This year, the main discussions focused on the orientation of international research collaboration after the reorganization of JIRCAS into an independent administrative institution (semi-autonomous agency) and the appropriate allocation of the budget for supporting the collaborative research project. Next annual meeting will be held in Beijing in May 2002.

Participants in the meeting

Masanori Inagaki
Research Planning & Coordination Division, JIRCAS

8th JIRCAS International Symposium

Water for Sustainable Agriculture in Developing Regions - More crop for every scarce drop -

Date: 27 - 28 November 2001
Venue: Epochal Tsukuba, Tsukuba Science City, Japan

Background and Objectives

Many observers have pointed out the dangers of future food shortages and famine due to impending global water shortages. Already, one-third of the world's population faces water shortages, and this proportion is expected to rise to two-thirds by the year 2025 (report by U.N. Secretary-General Kofi Annan, March 2000). Competition for water between urban and rural areas, increased demand for water due to rising living standards, and changes in annual precipitation and rainfall patterns as a result of environmental change all indicate that water demand and supply are in the process of major change.

In the past, when water was insufficient for agricultural production, irrigation systems based on the construction of dams and canals had been put in place. However, the number of areas where new irrigation infrastructure is economically viable is becoming limited. Concerns have also increased about the negative impacts on the environment. New approaches are especially needed for water-limited semi-arid and arid environments, as well as in other environments with unreliable rainfall and uncertain water availability for agriculture.

For these reasons, development of drought-resistant and stress-tolerant crops coupled with small-scale but effective technologies to make efficient use of limited water resources on a regional basis are needed. Ecological approaches, breeding, and transgenic genetic improvement can provide crop resources to help make resource-efficient technologies go further. These technologies include farm and watershed-based water collection and storage, improved agronomic practices that use soil water more efficiently, and water-saving crop production techniques. Such technologies are adapted to both the environmental conditions and the production practices of farmers in the area for which they are developed. Development of such technologies and establishment of stable and sustainable agricultural production systems, and ultimately living environments, are essential to maintain a world environment in balance.

For this purpose, we have invited distinguished experts from within Japan and other countries, to discuss problems associated with water availability and use in developing regions, with a focus on water-limited semi-arid and arid environments, as well as other environments with unreliable rainfall and uncertain water availability, and to explore directions for research on water for sustainable agricultural production.

PROGRAM

Day 1 (Tuesday, November 27)

KEYNOTE ADDRESSES

- Global Water Resources Assessment and Future Projections
  Prof. Katumi Musiake, *Institute of Industrial Science, University of Tokyo*
- Meeting the Water Needs for Food and Environmental Security
  Dr. David Molden, *IWMI*
- Global Evolution and Future Directions of Water Use in Agriculture
  Prof. Yoshihiro Kaida, *SCEAS, Kyoto University*

SESSION I – Increasing Drought Resistance and Water Stress Tolerance through Ecological and Genetic Approaches

- Reducing Water Stress through Ecology and Crop Characteristics
  Prof. Shinobu Inanaga, *Tottori University*
- Development of Drought-Resistant and Water Stress-Tolerant Crops through Traditional Breeding
  Dr. Rodomiro Ortiz, *IITA*
- Development of Drought-Resistant and Water Stress-Tolerant Crops through Biotechnology
  Dr. Kazuko Shinozaki, *JIRCAS*

SESSION II – Agronomic Approaches for Improved Crop Water Use

- Soil Water Balance and Crop Water Use Efficiency
  Dr. Rony Wallach, *The Hebrew University of Jerusalem*
- Technologies for Improved Soil Water Use
  Prof. Shuichi Hasegawa, *Graduate School of Agriculture, Hokkaido University*
- New Water-Saving Production Technologies
  Dr. Peter Thorburn, *CSIRO Sustainable Ecosystems*

Day 2 (Wednesday, November 28)

SESSION III – Transforming Agricultural Production in Water-Stressed Areas of Developing Regions

- Improving Water Availability and Use in Rainfed Systems
  Dr. Osamu Ito, *JIRCAS*

  Commentators:
  Dr. John S. Caldwell, *JIRCAS*
  Dr. Yoshiyuki Shinogi, *NIRE*
  Dr. Chayasit Aneksamphant, *Land Development Dept., Thailand*
- Water Management and Crop Production in Semi-Arid and Arid Environments
  – Successes from technical cooperation projects –
  Mr. Ryuzo Nishimaki, *Managing Director, JICA*

  Commentators:
  Prof. Ali A. Al-Jaloud, *KACST*
  Mr. Yoshiaki Kano, *Managing Director, TBIC, JICA*

POSTER SESSION

SESSION IV – General Discussion

- Summary of major themes and issues from each session
- JIRCAS' goals and areas of contributions
- Examples of research from Thailand and Laos
- Needs and contributions of partners
- Developing collaborative partnerships with public institutions, international research institutions, non-governmental organizations, and users of research results

For further information, please contact:

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PEOPLE

Dr. Nobuyoshi Maeno, former Director General of JIRCAS, became Director of UN/ESCAP CGPTR Center located in Bogor, Indonesia on July 1, 2001.

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