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Sheep grazing in the piedmont steppe (2,000 m altitude) of Kazakhstan (Photo by K. Sato, see p6)

CONTENTS

JIRCAS

JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

≪Project Report≫

Development of Sustainable Production and Utilization of Major Food Resources in China

Akinori Noguchi


Photo 1: Signature of Comprehensive Agreement; Li Xia-fen (left), Deputy DG of Department of International Cooperation, MOA and Yoshihiko Kotaka (right), Research Councillor, AFFRC

The first comprehensive collaborative research project for China was launched on May 28, 1997 by the signature of a Comprehensive Agreement between JIRCAS, Agriculture, Forestry and Fisheries Research Council (AFFRC), Japan and Ministry of Agriculture (MOA), the People's Republic of China on the occasion of the 16th meeting of Japan-China Agricultural Science and Technology Exchange Group held in Tokyo. This project is entitled "Development of Sustainable Production and Utilization of Major Food Resources in China" and will be continued for seven years from 1997.

The report entitled "Who Will Feed China? Wake-up Call for a Small Planet" (L. Brown, 1995) triggered the increased concern about China's future food problems. Many Chinese and foreign researchers have carried out a large number of analyses and projections on China's food future, focusing most of their studies on the grain sector and they published reports. No consensus can be found in the reports on food production and demand, probably due to differences in assumptions, data and estimation approaches. Nevertheless, the following consensus is that the demand will increase continuously over the next three decades and the supply can not meet the demand, and thus ever rising import will occur.

Major factors influencing food production in China, will include cultivated land, the yield of grains and some constraints such as poor quality of farmland, weak response to fertilizer and small-scale farm structure. It is inevitable that more farmland will be diverted to non-farm uses in the process of rapid economic development and newly reclaimed land and increased cropping index do not seem to alleviate the continued tendency of a decrease of the cultivated land area. The yield is significantly lower in China than in more advanced countries. On the other hand, major factors influencing the food demand will include population expansion, population structure change due to the rural-urban migration, income growth, price of agricultural products and poor infrastructure.

This project aims to develop technologies for sustainable production and utilization of major food resources in China such as rice, soybean, corn and freshwater fishes in order to respond to the increasing expectations for high-quality dietary life caused by the development of the Chinese economy and the increase of people's purchasing power. More specific objectives of this project are; 1) to develop an effective production and distribution system of agricultural produce to cope with the changing supply and demand structure of foods, which is based on the following studies; ① evaluation of the dissemination of new technologies in selected areas and their effects on the rural and individual farmer's economy, ② modeling for the supply and demand of foods in selected areas and analysis of the structure of the corresponding farming areas and agricultural production, ③ more sustainable and effective control system designed for better supply and demand of major food products among selected areas. 2) to develop technologies for sustainable and stable production of major food resources, based on the following studies; ① evaluation of existing gene resources and development of new crop species, ② development and evaluation of environment-friendly agricultural technologies. 3) to develop food technologies for improved utilization and distribution of major food resources, based on the following studies; ① quality evaluation of major food resources and development of new food ingredients from them, ② improved preservation and distribution technologies for major food resources.

The research subjects taken up in this project will require the collaboration of each component for the progress of the project.

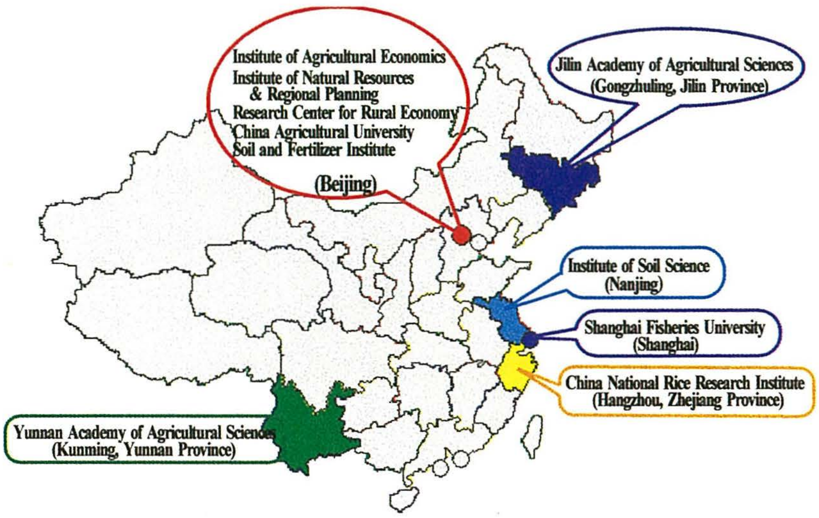

Fig. 1. The research institutes expected to participate in this project

JIRCAS Visiting Research Fellowship Program: Review of five years of operation

Shigeo Yashima

1 JIRCAS Visiting Research Fellowship Program

The International Collaboration Research Section (ICS) was established in Okinawa Subtropical Station in 1991 with the special mission to promote the Visiting Research Fellowship Program. Five Japanese researchers were engaged in the following four research projects with ten visiting researchers from developing countries invited on a one to two-year tenure.

1. Environmental control by using plants and microorganisms
2. Mechanism of heat tolerance of crops with emphasis placed on vegetable crops
3. Identification and evaluation of salt tolerance in rice varieties.
4. *In vitro* conservation of genetic resources for vegetatively propagated crops.

2 Visiting researchers

Up to date, a total of 50 visiting researchers from 14 countries have participated in the program as indicated below. Development of a research network between ICS and these researchers should be ICS's priority to further promote the program.

India (8 researchers)
China (7 researchers)
Indonesia (5 researchers)
Thailand (5 researchers)
Nigeria (5 researchers)
Philippines (5 researchers)
Vietnam (4 researchers)
Bangladesh (3 researchers)
Burkina Faso (2 researchers)
Egypt (2 researchers)
Brazil (1 researcher)
Ghana (1 researcher)
Malaysia (1 researcher)
Pakistan (1 researcher)

3 Research activities during the five-year period

1) Environmental control by using plants and microorganisms

Methane emission from paddy fields treated with rice straw and cellulose was measured by a chamber method under the subtropical climatic conditions. Ecological studies included the enumeration of population and isolation of methanogenic bacteria (MGB) and methane-oxidizing bacteria (MOB) which produce and oxidize methane, respectively in paddy fields. The findings for the studies led to the development of a model ecosystem of methane production and oxidation which should enable to elucidate the interaction between the activities of MGB and MOB in the co-culture system. Final target is the development of techniques to regulate methane emission in the rice rhizosphere by using MOB.

2) Mechanism of heat tolerance of crops with emphasis placed on vegetable crops

Physiological characteristics and genetic variability of heat tolerance were investigated. It was found that proline contents and membrane thermostability can be used as indices for the screening of heat tolerance in cabbage (*Brassica oleracea*). The effects of nitrogen and potassium concentrations under heat stress in cabbage were studied. Application of high nitrogen or potassium levels increased heat tolerance of cultivars.

Genotypic variation in reproductive responses, including gamete development and function, to heat stress in chickpea (*Cicer arietinum*) and pigeonpea (*Cajanus cajan*) was examined. The variation was limited among cultivated genotypes in both crops. However, a congenial wild relative of pigeon pea, *Atylosia scarabaeoides*, sets many pods and seeds under heat stress conditions.

3) Identification and evaluation of salt tolerance in rice varieties

The Salinity Tolerance Project aims finally to develop a breeding method to produce salinity-tolerant varieties of crops, using advanced technologies at the molecular level. Under this project, so far, genetic and geographical variations in salt tolerance in cultivated rice were investigated. Recent studies have been focused on the physiological characteristics of photosynthesis and anti-oxidative mechanisms of salt-tolerant indigenous varieties and wild relatives of cultivated rice. Molecular cloning and characterization of salt tolerance genes from rice were also investigated.

4) *In vitro* conservation of genetic resources for vegetatively propagated crops

Cryopreservation is considered to be a practical and efficient tool for long-term storage of plant germplasm. The project aims to develop techniques for the efficient and stable cryopreservation of vegetatively propagated tropical crops.

Vitrification method, a simple method using highly concentrated solution of cryoprotectants to dehydrate explants, was selected among different strategies for cryopreservation. Basic conditions of the vitrification method were investigated in detail and the cryopreservation protocols of *in vitro* grown shoot tips of taro, banana, yams and sweet potato were successfully developed with 60-100% of post-thaw survival. The shoot tips cryopreserved by these protocols resumed growth and developed shoots directly without intermediate callus formation.

Photo 1: The visiting researchers hold a meeting on their respective research fields

Mechanism of Uplifting of Saline Groundwater in Phra Yuen Area, Northeast Thailand

*Masayuki Imaizumi**

In Northeast Thailand, salt accumulation in soil is considered to be derived principally from saline groundwater. Several theories have been proposed for salinization in Northeast Thailand. All of them indicate that salinization is related mainly to the presence of a few rock salt strata of the Mahasarakham formation which are widespread in Northeast Thailand. One of the problems to be solved is how salt of the rock salt strata can reach the ground surface. The understanding of the mechanism of uplifting of saline-groundwater in Northeast Thailand should contribute to the development of technologies for the utilization of groundwater and the evaluation of water resources in Northeast Thailand.

Phra Yuen area which is a salt-affected area was selected for studying the relationship between the geological structure and groundwater flow. Piezometers were installed at every intersecting point of a regular 1 km grid. Intersecting points were set up at 16 stations in total (A1~A16). At each intersecting point, 3 investigation wells 5, 10 and 15 meter in depth were set up for monitoring the groundwater level (potential head), electric conductivity (EC), and temperature of the groundwater.

Lineament analysis, upper structure of the Mahasarakham formation, and distribution level of the gravel layer in the Quaternary laterite deposits revealed the presence of G1, F1, F2 and F3 faults. Saline groundwater at A1, A5, A9 and A13 stations was supplied from the G1 faults (Fig. 1) and that at A 11 station from the F1 fault. However, all the faults were not involved in the passage of saline groundwater.

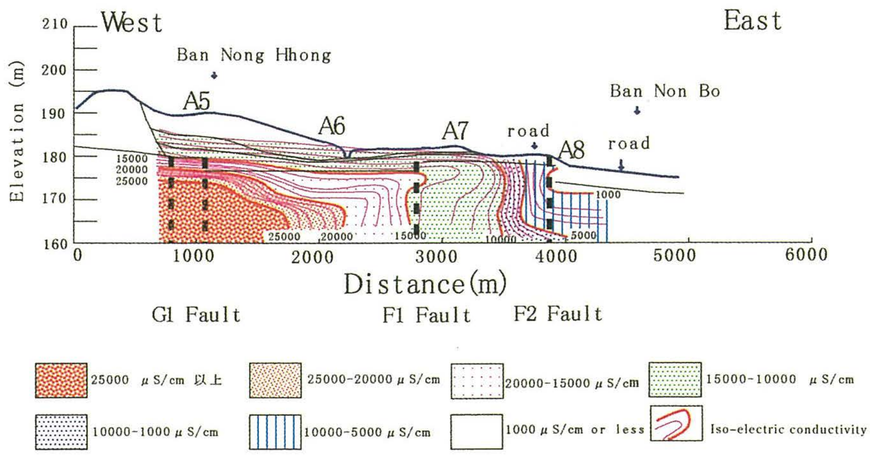

Fig. 1. Electric conductivity distribution in geological sections in April, 1995

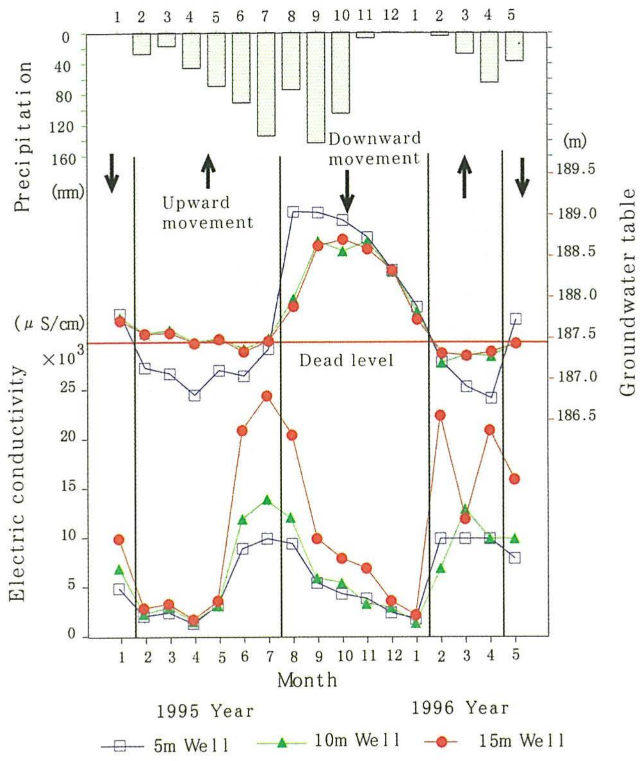

Fig. 2. Fluctuations of monthly precipitation, groundwater level, and electric conductivity at A5 station

EC value increased rapidly when the groundwater level decreased below 187.4 meter above sea level (Dead Level) at A5 (Fig. 2). The iso-potential line of 187 meter in the vicinity of A5 showed an eastward direction in April, 1995 so that the flux of the groundwater moved up. On the other hand, the equi-potential line of 189 meters showed a westward direction in September, 1995. It is suggested that the flux of the groundwater there moves down and when the groundwater level decreases below the Dead Line, the flux of upward groundwater may reach the maximum volume. Saline groundwater may rise from the underground through the fault crack.

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Wetwood of *Acacia mangium* in Malaysia

Koichi Yamamoto, Othman Sulaiman and Rokiah Hashim**

Acacia mangium Willd. is native to North Queensland, Australia. Since it was introduced to Malaysia as an exotic species in 1966, it became one of the major plantation species for timber and pulp production. *A. mangium* is a fast-growing tree of good form that grows on degraded soils. Recently the occurrence of some defects such as heart-rot and wetwood, however, has been reported. In spite of its importance for sustainable timber resources in the future, comprehensive characteristics of *A. mangium* wood have not been fully documented. In this study, the occurrence and characteristics of wetwood were examined to analyse the basic wood properties of *A. mangium*. Forty one trees from 6 sites in Malaysia were surveyed.

Most of the trees except for those in the Byram Forest Reserve had higher moisture contents in the inner heartwood than in the adjacent middle or outer heartwood and sapwood (Table 1). Presence of wetwood in tropical plantation wood species has not been reported yet. In most of the tree species the moisture content is lower in heartwood than in sapwood. An increase in moisture in the heartwood region is usually referred to as wetwood, which corresponds to an abnormal type of heartwood caused by decay or wound. In most cases in *A. mangium*, wetwood was free of decay, which was confirmed by light and scanning electron microscopy. Only one sample in Rawang displayed heart-rot in the inner heartwood.

The density of wood near the pith is lower than in the surrounding outer heartwood. These results suggest that in *A. mangium* juvenile wood occurs near the pith. The lower density in juvenile wood leads to a higher moisture content, as wood with a lower density can retain more water. Difficulty in drying *A. mangium* could be related to the high moisture content in heartwood.

As a close relationship between inorganic element concentration and moisture content in wetwood has been described in the literature, the distribution of inorganic ele-

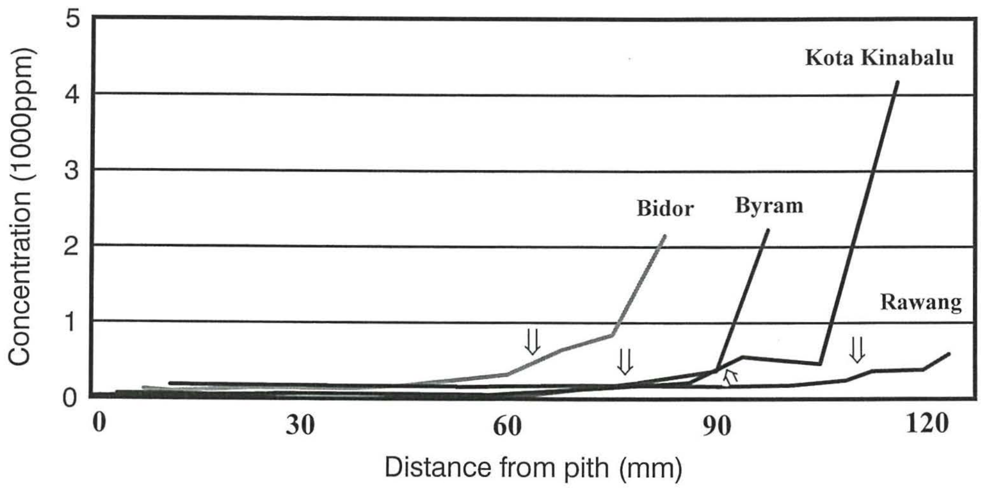

Fig. 1. Radial distribution of potassium content of *A. mangium* stem from 4 different sites (Bidor, Byram, Kota Kinabalu and Rawang). Maximum values were always detected in the outermost sapwood and then decreased toward the sapwood-heartwood boundary. No obvious variations were observed in the heartwood. Arrows show the boundary between sapwood and heartwood.

Table 1. Average moisture contents (%) of *A. mangium* at various sites

Site	Planting	Sampling time	No. of samples	Sapwood	Outer heartwood	Middle heartwood	Inner heartwood
Bidor, Perak	1990	Apr. 96	3	124	138	150	179
Byram Forest Reserve, Pulau Pinang	1996	Dec. 95	3	84	93	78	57
		Oct. 96	14	89	92	90	90
Kota Kinabalu, Sabah	1988	Oct. 96	1	113	128	127	160
		Jan. 97	1	71	77	82	87
Rawang, Selangor	1985	March 96	2	76	91	116	135
		Oct. 96	6	81	94	115	131
Sampadi Forest Reserve, Sarawak	1984	June 97	10	104	106	145	204
USM, Pulau Pinang	*	May 96	1	115	111	148	173

* unknown

ments in this species was investigated. Radial distribution of 4 major elements from alkali metals and alkaline earth metals from sapwood to heartwood in stem was analysed using inductively coupled plasma spectroscopy. Wood specimens from 4 plantation sites, showed a similar pattern of K and Mg distribution. The concentration of K and Mg decreased gradually from the outer sapwood toward the outer heartwood, and did not show significant variations within the heartwood (Fig. 1). Radial distribution of Na and Ca did not show any obvious trend. All of the samples displaying wetwood (Rawang; March 96 and Bidor) or not displaying wetwood (Byram; Dec. 95 and Kota Kinabalu; Jan. 97) generally showed a lower content of total inorganic elements in heartwood than in sapwood. The close relationship between inorganic element concentration and moisture content was described in wetwood of temperate species, but had not been recognized in *A. mangium*. The characteristics and origin of wetwood may differ between temperate and tropical species. Based on the results of decay and inorganic element concentration, wetwood occurring in *A. mangium* was considered not to be an abnormal type of heartwood. Wetwood seems to be an intrinsic characteristic of A. mangium. The origin of water in wetwood of *A. mangium* should be clarified in the future.

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The First Collaborative Research Project of JIRCAS in Central Asia
— Studies on Grassland Management in Kazakhstan —

Kenji Sato

Central Asia is one of the new research areas targeted for collaboration with JIRCAS. Kazakhstan which is a pasture (steppe) country and the largest country (about 2.71 million km^2) in Central Asia is famous for the Steppe and Oasis Silk Road. In this country, the new JIRCAS collaborative research project with the Kazakh Institute of Agriculture (KIA) started from July 1996. KIA is located in the southeastern part of Kazakhstan near the capital city of Almaty.

Our project has two objectives: 1) development of technology for sustainable management of grasslands and 2) development of technology for sustainable animal production. Research contents are as follows:

1) Development of technology for sustainable grassland management

(a) Evaluation of grassland vegetation based on vegetation maps and field surveys
(b) Monitoring of grassland production in relation to animal grazing
(c) Identification of indigenous herbages tolerant of drought and cold stress
(d) Analysis of soil characteristics related to grassland production
(e) Technology for restoring degraded grasslands by the introduction of suitable forage crops

2) Development of technology for sustainable animal production

(a) Analysis of genetic characteristics and biological function of indigenous animals
(b) Effective utilization of supplemental feeds for animals
(c) Development of methods for estimation of milk and meat quality and quantity
(d) Market survey for animal products

We are currently attempting to improve degraded areas into ecologically sound pastures using the oversowing method (including seed pellets) which does not require cultivation for the establishment of forage crops. This year, we plan to analyse the relation between soil fertility and grass production on the steppe as well as to improve the degraded steppe using seed pellets and to investigate the changes in the socio-economic structure of agriculture within the framework of our project.

Photo 1: Resting after a survey in the steppe near Kirghistan

Photo 2: Boys riding on a horse in the steppe of Kazakhstan

New Varieties of Cucumber and Strawberry Resistant to Diseases in China

*Keita Sugiyama**

Under the collaborative project on "Breeding of disease-resistant vegetable varieties in sub-tropical China, 1991-1995" between the Shanghai Academy of Agricultural Sciences, People's Republic of China and JIRCAS, new varieties of cucumber and strawberry resistant to diseases were eventually developed in China.

1) New cucumber varieties 'Hu 116' and 'Hu 119'

'Hu 116' (Photo 1) was found to display a high level of resistance to *Fusarium oxyporum* sch. f. sp. *cucumerinum* and *Pseudoperonospora cubensis* Rostowzew both in laboratory tests and in the field. 'Hu 116' bears many female flowers and its yield is about 10 to 15% higher than that of 'Sinkofushinari 11'. The fruit length is about 21 to 24 cm. The skin is deep green with few nodules and spines. 'Hu 119' exhibits a similar degree of resistance to *F. oxyporum* and *P. cubensis* to that of 'Hu 116'. Although 'Hu 119' shows a lower female flower bearing capacity than 'Hu 116', stable harvest can take place during the growing period. Like in the case of 'Hu 116', the fruit quality is good.

Photo 1: 'Hu 116'

'Hu 116' and 'Hu 119' are adapted to semi-forcing culture all over the Shanghai area as well as in the Jhejiang, Jiangsu, Shandong, Sichuan areas, etc.

2) New strawberry varieties 'Shenxu No. 1' and 'Shenxu No. 2'

The total yield of 'Shenxu No. 1' until April was higher than that of 'Toyonoka' or 'Hokouwase'. The fruit is large, about 11-14 g, conic in shape with a shiny scarlet skin. The Brix value of the soluble solids in the fruits ranged for 8 to 10. Since the flesh is firm and the skin is hard, this new variety is suitable for transportation. 'Shenxu No. 2' (Photo 2) is a very early variety. The harvesting season of 'Shenxu No. 2' is earlier than that of 'Toyonoka'. The fruit is large, about 10-11 g in weight, conic in shape with a very shiny scarlet skin color. The fruit is very sweet, moderately sour and very juicy, with a good taste.

'Shenxu No. 1' and 'Shenxu No. 2' display a higher resistance to *Colletotrichum acutatum* Immonds and *C. fragariae* Brooks than 'Hokouwase'.

'Shenxu No. 1' and 'Shenxu No. 2' are adapted to forcing culture all over the Shanghai area.

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Photo 2: 'Shenxu No. 2'

PEOPLE

Shigeo Yashima, irrigation engineer, replaced Dr. Tadaaki Yamashita as Director of JIRCAS's Okinawa Subtropical Station on July 3. He was until recently Head of International Collaboration Research Section at the Station. Dr. Yashima carried out research as international staff at the International Irrigation Management Institute (IIMI) during the period 1992-1996, after being engaged in a collaborative research project between Muda Agricultural Development Authority (MADA), Malaysia and the predecessor of JIRCAS, the Tropical Agriculture Research Center (TARC) during the periods 1971-1974 and 1979-1984 .

Kozo Fujisaki, former International Research Coordinator of JIRCAS, left JIRCAS on August 1 and became professor at Obihiro University of Agriculture and Veterinary Medicine. He was in charge of the planning and coordination of the collaborative projects involving research on grassland, animal production and health, and was instrumental in launching the project for the "Development of Sustainable Agro-pastoral Systems in the Subtropical Area of Brazil".

≪Topics≫

Dr. Maeno, DG of JIRCAS Attended CGIAR Mid-Term Meeting 1997

Dr. Nobuyoshi Maeno, Director General, JIRCAS attended the CGIAR (Consultative Group on International Agricultural Research) Mid-Term Meeting which was held in Cairo, Egypt from 26 May to 30 May.

The meeting started with opening remarks by H. E. Youssuf Wally, Deputy Prime Minister of Egypt. In the remarks, Professor Wally expressed his full support for the work of the CGIAR and its importance to developing countries.

The main theme of the meeting was the presentation of the Centers' Medium Term Research Plans (MTP) for 1998-2000. To deepen the discussion about the individual centers' MTP, each was considered in parallel sessions. In the sessions of IRRI (International Rice Research Institute) and WARDA (West Africa Rice Development Association), Dr. Maeno was designated as the chairperson and he emphasized the importance of rice production in the world and introduced the cooperation activities between both centers and JIRCAS.

During the meeting, Dr. Maeno and Dr. Pedro A. Sanchez, Director General, ICRAF (International Center for Research in Agroforestry) signed the MOU between ICRAF and JIRCAS. He also discussed future collaborative activities with the directors general of other centers.

The meeting ended with the endorsement of MTPs and reached an agreement that the centers should further promote biotechnology research.

On his way back from Cairo, Dr. Maeno stopped in Rome and visited IPGRI (International Plant Genetic Resources Institute) and FAO to exchange opinions about the possibility of collaboration in the field of preservation of plant genetic resources and prevention of cattle diseases.

Photo 1: Parallel sessions of IRRI and WARDA (The third person from left: Dr. Maeno)

JIRCAS International Symposium Was Held in Tsukuba

The 4th JIRCAS International Symposium on "Sustainable Agricultural Development Compatible with Environmental Conservation in Asia" organized by Japan International Research Center for Agricultural Sciences (JIRCAS) in cooperation with the National Agriculture Research Center (NARC), National Institute of Agro-Environmental Sciences (NIAES) and National Research Institute of Agricultural Economics (NRIAE) was held in Tsukuba during the period 26-28 August, 1997. From 15 countries, 214 scientists and administrators, including 27 from abroad, met together and exchanged views on the current situation of and future prospects for sustainable agricultural development in Asia. Mr. Sakue Matsumoto, Chairman, Agriculture, Forestry and Fisheries Research Council gave the welcome address. A keynote speech was delivered by Dr. George Rothschild, Director General of IRRI and 16 papers were presented in the three sessions. The proceedings of the symposium will be published by JIRCAS.

Photo 1: General discussion at the symposium.
From right to left: Wen S. Chern (Institute of Economics, Taiwan), chairman of session 1, Dennis Keeney (Iowa State University, USA), chairman of session 2, Osamu Ito (IRRI, The Philippines), chairman of session 3, Kunio Tsubota (JIRCAS, Japan), chairperson, William Coyle (Department of Agriculture, USA), general comments, Keiji Oga (JIRCAS, Japan), general comments

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