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City market at Asuncion, Paraguay
(Photo by M. Kokubun)

CONTENTS

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

Feature Article

Socio-Economic Studies Related to Agricultural Development in Developing Regions

Kazuyuki Tsurumi
Director, Research Information Division, JIRCAS

The Research Information Division conducts research projects on socio-economic development and promotes the implementation of comprehensive multidisciplinary research projects including studies on socio-economic aspects and natural sciences in developing regions. The comprehensive projects have been implemented by JIRCAS as a whole in order to address complex issues like poverty alleviation. Scientists belonging to several Divisions at JIRCAS join the project to carry out research related to their respective fields and develop new technologies. Up to now, eight comprehensive research projects have been implemented (Table 1). On the other hand, socio-economic studies have been mainly carried out by scientists from the Research Information Division itself (Photo). Research subjects cover the situation of the supply and demand of food worldwide and in specific developing regions, as well as the impact of agricultural policies and systems, including extension systems, on agriculture and rural development, and the relation between agricultural development and changes in the natural environment.

In the comprehensive research projects, socio-economic studies play two major roles. One is to identify issues to be addressed and the another is to evaluate the results of research activities. Prior to the implementation of the research projects, usually a kind of baseline survey mainly related to socio-economic aspects has been conducted, including agricultural production, consumption, distribution systems, foreign trade, and even social customs. From these results, several issues to be tackled for achieving sustainable agricultural development can be identified along with the technologies and systems to be newly developed. In general, the most serious problem in developing regions has been the low production of food, especially of grain. In this case, major factors should be considered, such as soil conditions, water management, cultivation technologies, farming systems, and even farmers' association structure. Once the most important technologies required have been identified, scientists can initiate research. The purpose of the baseline survey should be very clear and indicate some direction. The second role of the socio-economic studies is to evaluate the technologies newly developed. Even if some technologies and systems may contribute to the increase of agricultural production or the reduction of production costs, they must be adapted to the farmers' management level. When farmers have to invest a large amount of money in order to introduce the new technologies, the outcome may not be successful.

Apart from the role in the comprehensive research projects, socio-economic studies are closely related to policy and administration aspects. For decision-makers, it is important to evaluate the impact of the new policies and systems they plan to introduce. Econometric simulation models may enable to forecast the supply and demand situation of food, agricultural trade development and farm household economy when, for example, trade liberalization and price support policies are introduced. Moreover, through economic studies, to a certain extent, the impact of agricultural activities on the natural environment can be evaluated. Usually, since the relations between these two aspects are discussed in qualitative terms, there is a need to add a quantitative dimension. From the socio-economist viewpoint, in these simulations, for the development of methodology for estimation of impacts in more realistic terms, research results will be important.

It is important to emphasize that the socio-economists should carefully consider the scope of their studies and clearly indicate the objectives since the results are more closely linked with policies developed by decision-makers than in the case of research covering natural science disciplines. In other words, the results of socio-economic studies themselves might contribute to changes in policy direction. However, at the same time, to preserve the objectivity of the studies, the socio-economists should avoid to be too strongly influenced by the decision-makers.

Table 1. International comprehensive projects at JIRCAS

Title of the project	Target area
Comprehensive studies on soybean improvement, production and utilization	Brazil, Argentina, Paraguay
Comprehensive studies on the development of sustainable agro-pastoral systems in the subtropical area of Brazil	Brazil
Evaluation and improvement of regional farming systems	Indonesia
Improving food security through increased productivity in rainfed rice systems	West Africa
Comprehensive studies on sustainable agricultural systems in Northeast Thailand	Thailand
Development of new technologies and their practice for sustainable farming systems in the Mekong Delta	Vietnam
Development of sustainable production and utilization of major food resources	China
Productivity and sustainable utilization of brackish water mangrove ecosystems	Malaysia

Interview of farmers in a village in Kalimantan, Indonesia
(Photo by J. Gotoh)

Collaborative Research Project with CIMMYT for the Development of an Effective Selection System for Disease Resistance in Wheat by Using DNA Markers

Kazuhiro Suenaga
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The Headquarters of the International Maize and Wheat Improvement Center (CIMMYT) are located at El Batan, a suburb of Mexico City. CIMMYT focuses its activities on increasing the productivity and sustainability of maize and wheat production in developing countries in the world. Major activities include the development and worldwide distribution of improved varieties, the conservation of genetic resources, and the production of documentation related to new knowledge about these crops.

There has been a long collaboration between CIMMYT and JIRCAS (formerly Tropical Agriculture Research Center (TARC)). In 1993, a JIRCAS researcher was sent to CIMMYT on a long-term basis to carry out collaborative studies on the development of wheat × maize crosses for producing and utilizing wheat haploids for breeding purposes and genetical analyses.

Since January 1998, a JIRCAS researcher has been involved in collaborative studies on the development of an effective selection system for wheat varieties harboring resistance genes to Fusarium head blight (FHB) and yellow rust using DNA markers.

Indeed, biotic and abiotic stresses to plant production are major issues in developing countries. Although important diseases may differ depending on the region/country, Fusarium head blight (FHB) and yellow rust are among the most serious diseases in wheat production areas. In Japan, due to the high rainfall during the maturation season of wheat, wheat production often experiences serious damage by FHB, especially the southern and northern parts of Japan (Kyushu and Hokkaido). Moreover, since recent abnormal weather has caused an epidemic of FHB worldwide, it is important to develop efficient breeding systems for wheat cultivars resistant to FHB.

In order to breed disease-resistant cultivars efficiently, an appropriate system for the selection for the disease is essential. Accuracy of evaluation of the disease or the resistance genes may vary depending on the year or other environmental conditions. A considerable amount of labor may be required to evaluate certain kinds of diseases. Recently, we have developed a method in which molecular markers are used for the selection, instead of selecting resistant lines in breeding fields. That is, differences in the DNA level between resistant and susceptible lines are used for the selection. Once molecular markers for resistance genes are identified, it is possible to perform a very reliable selection, because molecular markers themselves are never affected by environmental conditions.

CIMMYT Headquarters (front)

Variation of resistance to FHB in the recombinant inbred lines derived from Emblem × Saikai 165. From left to right: susceptible to resistant.

Emphasis is currently placed on the development of molecular markers for FHB and yellow rust diseases in wheat. There are various types of resistance genes for yellow rust. The most important genes in the breeding program at CIMMYT are those which exert relatively small effects and confer a resistance at the adult plant stage. Most of these genes are considered to confer a durable resistance and they are race-non-specific. Therefore, the use of molecular markers is considered to be more effective than for major genes.

Evaluation for FHB is often affected considerably by the environmental conditions. Resistance to FHB is classified into at least three types, as follows: 1) resistance to fungal penetration into wheat tissues, 2) resistance to fungal spread within spikes and 3) ability to degrade the toxin produced by the fungi. Each type of resistance requires different and laborious evaluation systems.

Since FHB damage has been a major problem in Japan for many years, Japanese wheats are one of the several resistance sources to FHB in the world. Many highly resistant cultivars have been identified among Japanese cultivars, and we are using such resistant cultivars to tag the resistance genes in the collaborative studies at CIMMYT. As one Japanese wheat played an important role in the Green Revolution, another Japanese wheat germplasm may again contribute to the breeding of FHB-resistant wheat cultivars for developing countries.

Prediction of Pork Production Structure and Consumption in China

Chien Hsiaoping
Research Information Division, JIRCAS

Pork consumption in recent years has shown two main characteristics. The first one is that per capita pork consumption in the urban areas seems to have hit a peak already. The second one is that consumers' consumption preference has shown variations (from frozen meat to fresh meat, and from fat meat to lean meat, with a tendency to high quality consumption). These new trends have also resulted in changes in the production structure.

1 Pork production structure

1) Breeding scale

The main form of pork production is the family-scale hog raising. The average number of hogs raised in a farm is four per household (shipment + stock). Usually, one is for self-consumption. According to the data supplied by the Ministry of Agriculture, farms raising less than six hogs accounted for 94% of the total hog-raising farms in 1995. However, the number of farms raising more than six hogs has been increasing since 1986.

2) Production composition

Pork production in 1998 amounted to 38,840,000 tons, and the supply per capita was 31 kg. In the early 1980s, pork production accounted for more than 90% of the whole meat production, and now it accounts for 68%. This is partly due to the changes in consumers' preference in consumption, and partly influenced by the new policy of promoting the consumption of products derived from feed-saving-type stock raising in recent years, including herbivorous animal products (cow and sheep), poultry meat products that are produced with efficient feed-to-meat conversion rates, and marine products. At present, poultry meat and beef production accounts for 28%. However, the pork-predominant production structure will remain.

3) Regional distribution of production

A large proportion of pork production is carried out in the southern regions. In 1998, the production share of the southern regions was 65%, in contrast to the 35% share in the northern regions. In the past, pork production was heavily concentrated in Sichuan Province, but in the 1990s many provinces began to enhance their own self-supply capabilities. Among them, the northeastern region has taken the advantage of being a major grain production base and has markedly increased pork production in recent years. Also, as a result of the changes in consumers' consumption preference, it has become more difficult for Sichuan Province to adjust its production to meet the market demand, and the domestic pork production is facing a possible redistribution among provinces.

Medium-scale hog raising in Sichuan

4) Feed in hog raising

The production structure based on the family-scale hog raising has resulted in a long breeding period and a low turnover rate. The low lean-meat rate characterizes the meat thus produced, since formula feed has not yet replaced the traditional feeding method. Nevertheless, as the commercial production is expanding, large-scale hog raising has begun to emerge, which in turn has stimulated the demand for feed. The formula feed production for hog raising had been increasing at an annual rate of 12% between 1991 and 1996 (20,000,000 tons), accounting for 39% of the total formula feed production. Considering the large scale of pork production, however, the share of the formula feed for hog raising is still quite small. As the production moves rapidly to meet the needs of the commercial market, the demand for formula feed is expected to increase further.

2 Forecast for pork consumption

The future pork consumption per capita in the urban and rural areas has been analyzed, respectively. The simulation conducted from 1996 to 2010 covered a 15-year period in total, and the results are shown in Table 1. The base line of the analysis follows the average expansion rate in the past 16 years (1980 to 1995). The high and low predictions are obtained by moving the point up and down from the expansion rate of this base line. Compared with the urban areas, the income elasticity of demand in the rural areas is larger, indicating a possible future increase in pork consumption as the rural economy further develops. On the other hand, pork consumption in the rural areas is less influenced by price fluctuations, reflecting the self-supply and self-sufficiency conditions there.

Accordingly, pork consumption in the urban areas will only increase slightly, and the low prediction forecasts a decrease. The high prediction puts the amount of consumption per capita in the urban areas at 20 kg. On the other hand, a steady increase of pork consumption is predicted for the rural areas, with the amount of consumption per capita reaching 18 kg in 2010, about the same level as that in the urban areas. Taking into consideration the population trend to urbanization, the total amount of direct consumption is predicted to reach 3,540,000 tons (low prediction) or 37,000,000 tons (high prediction) in 2010, an increase of about 12,000,000 tons from 23,200,000 tons in 1996. As the population and income increase, the pork production and consumption will certainly expand further.

Table 1. Analytical results of prediction of per capita pork consumption (period 1996-2010)

	Income elasticity	Price elasticity	R^2	D.W.
Urban	0.345	-0.133	0.92	2.24
(t value)	(6.62)	(-5.15)		
Rural	0.585	-0.051	0.95	1.93
(t value)	(10.07)	(-2.05)		

Water Quality and Carbon and Nitrogen Budgets in Intensive Prawn Farms in Freshwater Areas of Thailand

Junya Higano and Phongchate Pichitkul*2*

**Fisheries Division, JIRCAS and *2Faculty of Fisheries, Kasetsart University, Thailand*

The Giant Tiger Prawn (*Penaeus monodon* Fabricius 1798) is Thailand's major export commodity: annual production exceeded 280,000 tons in 1995. However, extensive discharge of organic substances from prawn farms is causing environmental damage to surrounding areas, resulting in decreased production and increased frequency of disease outbreaks. Uneaten feed and feces are key problems since they are the major sources of organic effluent and sediments. It is necessary to evaluate the carbon and nitrogen cycles in conventional prawn farming practices to promote the development of sustainable aquaculture techniques. The purpose of this study was to analyze the changes in water quality and their correlation with the carbon and nitrogen budgets in a closed pond system.

The field survey was conducted in two earthen ponds in a private prawn farm in Bang Len District, Nakhon Pathom Province, Thailand. Pond 1 was 6,400 m^2 in area and square-shaped, and Pond 2 was 3,200 m^2 in area, with an irregular shape. The initial stocking densities for Pond 1 and Pond 2 were 52 and 69 individuals/m^2, respectively. Prawn culture period extended from mid-January to the end of May 1998. Pond water consisted of concentrated salt water transported from salt fields, diluted with fresh water from irrigation canals. The pond water was not replaced or discharged until prawn harvest.

Throughout the culture period, the water temperature, salinity, pH, amount of dissolved oxygen and turbidity were measured weekly at the center and the edge of the pond and the contents of inorganic nitrogen, phosphorus, etc. were also analyzed. Feed, prawn and sediment samples were dried and pulverized prior to chemical analysis. The carbon and nitrogen contents were measured using an NC analyzer.

The water temperature gradually increased from January - February (the cool season) to March - May (the hot season). The temperature in the afternoon was 1 - 3℃ higher than in the morning. This difference tended to decrease in the last two months. During the culture period, the highest temperature exceeded 35℃. The initial salinity of the water was 7 - 10 (psu), which decreased upon the addition of fresh water until the intended salinity level of 2 was reached. At the start, the pH value was stable at 7.5 - 7.6 in both ponds throughout the day. After two weeks, the pH in the afternoon was higher than in the morning and this trend became more pronounced after March. In the center of the ponds, fluctuation of pH was greater than at the edge, occasionally exceeding a value of 9. The changes in the dissolved oxygen level followed the same pattern as those of the pH: close to saturation in the morning and showing supersaturation in the afternoon under a working paddle wheel. Chlorophyll concentration rapidly increased after two months, ultimately exceeding 500 μ g/l. The type of phytoplankton bloom observed was strongly associated with the changes of the pH and amount of dissolved oxygen. Total ammonia concentration exceeded 1mg-N/l at the start. After the second week, the concentration decreased except for abrupt increases caused by phytoplankton mortality.

The survival rates of prawn in Pond 1 and Pond 2 were 80% and 43% and production rates were 0.75 kg/m^2 and 0.53 kg/m^2, respectively. Whereas the commonly used Feed Conversion Ratios (FCRs) expressed as wet weight were 1.58 and 1.71, the FCRs expressed as dry weight were 5.49 and 6.62 (Fig. 1). The results of the element analysis indicated that 16 - 19% of the carbon composition of feed was converted into prawn, 60 - 72% was converted into sediments, and the loss to water and air was 12 - 21%. The rate of nitrogen composition of feed was 25 - 30% converted into prawn, 46 -54% into sediments, with a loss to water and air of 21 - 24%.

These results indicated that the production of 280,000 tons of *P. monodon* also led to the production of 138 - 156,000 tons of carbon and 20 - 23,000 tons of nitrogen that were discharged into the environment as wastewater and contaminated soil. We need therefore to consider the fate of these wastes and develop effective ways of reducing them. We have started a polyculture experiment between *P. monodon* and bivalves which are assumed to act as biofilters.

Note: prawn culture in freshwater areas was banned at the end of December 1998 as a result of its damaging effects on agricultural land, specifically damage caused by salinity.

Discharge of water by pumping water when *P. monodon* was harvested

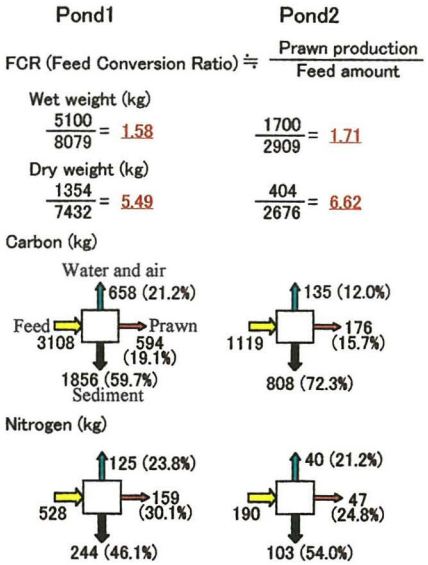

Fig. 1. FCR as wet and dry weight, carbon and nitrogen budgets in intensive culture of Giant Tiger Prawns in Pond 1 and Pond 2.

Mitigating NO Emission from Soils by Deep Application of Fertilizers

Yasukazu Hosen and Kazuyuki Yagi
Environmental Resources Division, JIRCAS

To increase food production, the rate of chemical fertilizer application to arable land has been rising rapidly in developing regions, which could lead to harmful effects on the environment. For example, China has been the largest consumer of chemical fertilizer in the world since 1989 and many environmental problems have resulted due to the excessive load of nutrients on agricultural land, in particular nitrogen. To address such problems in China, JIRCAS launched a 7-year collaborative research project entitled "Evaluation and Development of Methods for Sustainable Agriculture and Environmental Conservation" since 1997. This project covers four major agricultural regions in China and both field experiments and local analyses are conducted at representative sites of each study area.

To support this project, experiments have also been carried out at JIRCAS in Japan. The objectives of these experiments are (1) to develop methods for quantifying total nitrogen cycling in arable land, including gas exchange between the pedosphere and the atmosphere, and soluble nutrient exchange between the pedosphere and the hydrosphere, and (2) to develop key technology for minimizing the impact of agricultural activities on the environment. As for (2), the possibility of mitigating nitric oxide (NO) emission from soil was suggested.

NO is known to be a cause of photochemical atmospheric pollution, acid rain, and is linked to increased tropospheric ozone, one of the major greenhouse gases. Arable land should not be overlooked as a source of NO, because global annual NO emissions from soil are in the order of 10 Tg NO-N, about half the amount contributed by fossil fuel combustion processes to the annual global NO-x budget. We focused our studies on the effect of depth of fertilizer placement in an attempt to develop a method for mitigating NO emission from upland fields.

Firstly, a numerical model was designed based on pre-existing survey data of soil NO concentration profiles in Andisol upland fields. Based on this model analysis, the possibility of deep application of fertilizer to mitigate NO emission was pointed out. Secondly, the estimated results were verified in a laboratory experiment with soil columns. Topsoil from an Andisol whose moisture weight percentage was 49 (±0.9)% was put in cylindrical PVC tubes, 1.03 m in height and 0.194 m in internal diameter, at the bulk densities of 0.60 and 0.75 Mg m^{-3} and at the depths of 0-20 and 20-100 cm, respectively. As nitrogen fertilizer, ammonium sulfate (200 kgN ha^{-1}) was applied at the depths of 0-10, 5-15 or 10-20 cm in soil columns in duplicate. No water had been supplied to the soil columns for 15 days after fertilizer application. Then, the groundwater level was set at the depth of 100 cm. Soil gas was collected from sampling tubes installed in each soil column at intervals of 5 cm. Gas emission rate from the soil surface was determined by the closed-chamber method. This experiment was carried out in a thermostatic chamber (22.2 ± 0.6℃). The results obtained from this experiment supported well our findings from model analysis. All the NO concentration profiles in soil showed a sharp peak at each fertilized site within 29 days after fertilizer application. Fig. 1 shows that the NO concentration in soil decreased abruptly as the distance from the fertilized site increased at 15 days after fertilizer application. These findings imply that NO is produced mainly at the fertilized site, but does not diffuse widely in the soil columns, because of the high NO-uptake by soil. As a result, the NO concentration gradient near the soil surface decreased when the depth of the fertilized site

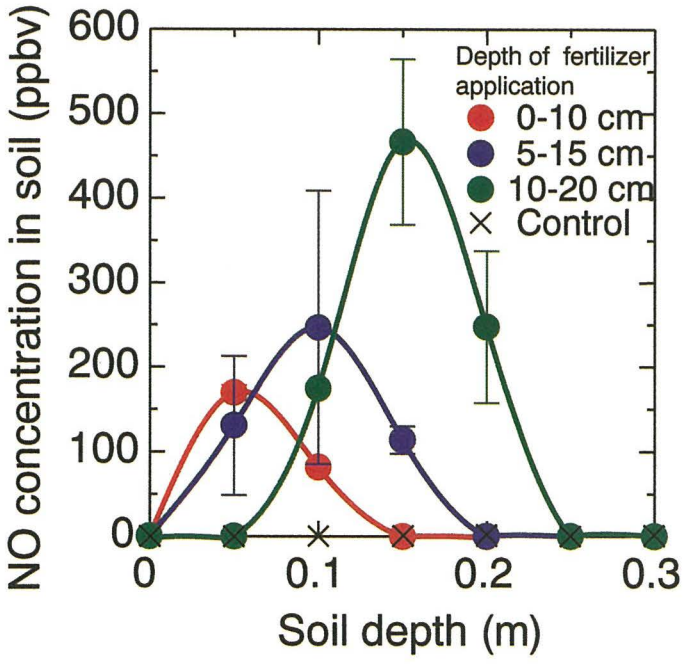

Fig. 1. Concentration profiles of soil NO at 15 days after fertilizer application at different depths.

increased (Fig. 1). Consequently, the NO emission rate from soil columns fertilized at 10-20 cm depth during a period of 29 days after fertilization was reduced to almost the same rate as that of the unfertilized one, which was equivalent to 0.9-20% of the value from the fertilized columns at the depth of 0-10 cm (Fig. 2). These results indicated that a lower amount of NO was emitted from soil when the distance between the fertilized site and the soil surface increased.

Our findings demonstrate that NO emission from arable land could be mitigated by applying fertilizer deeper into the soil, in other words, by designing an unfertilized soil layer near the soil surface. We carried out field experiments to verify our findings from the laboratory experiment and to examine the possibility of application to field management as a mitigating technology, by using a system to monitor nutrient leaching in soil as well as gas emissions. The system enables to evaluate the effects of fertilizer treatment on the impact on the environment and to develop new technologies for mitigating the impact while sustaining crop yield. The environment-friendly technologies developed in this study will be applied to agriculture in developing regions.

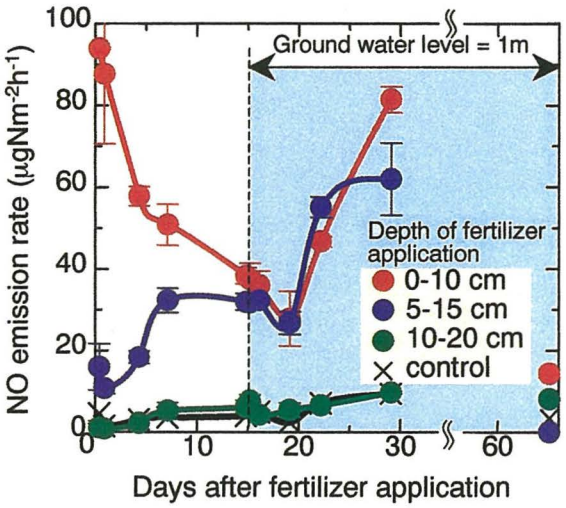

Fig. 2. Time course of NO emission rates after fertilizer application at different depths.

Workshop

EMBRAPA/JIRCAS Joint Workshop on Agro-Pastoral Systems in South America

The research project entitled "Comprehensive Studies on the Development of Sustainable Agro-Pastoral Systems in the Subtropical Area of Brazil" has been implemented since 1996. This research project is focused on the development of sustainable farming systems with high productivity in environmentally degraded areas in the subtropical zone of Brazil, with emphasis placed on land utilization through the adoption of crop-pasture rotation systems. For this purpose, the studies are being carried out in collaboration with the National Center for Beef Cattle Research (EMBRAPA-CNPGC) and Japan International Research Center for Agricultural Sciences (JIRCAS).

The workshop titled: "EMBRAPA-CNPGC/JIRCAS Joint Workshop on Agro-Pastoral Systems in South America" was held in Campo Grande, Brazil on December 7 and 8, 1999. After Dr. A. Boock, Director General of CNPGC, delivered the opening address, 10 papers were presented in research areas covering crop and pasture management, maintenance of soil fertility and economic evaluation of the systems. In a field tour which was organized during the meeting, the participants observed the experimental fields of CNPGC for the "Agro-Pastoral" project. From 5 countries, 35 scientists participated and reviewed the results obtained until now during the implementation of the project as well as other related studies, and discussed the future strategy and orientation of the project. In the closing remarks, Dr. N. Maeno, Director General of JIRCAS, reminded the participants of the potential of agro-pastoral systems to alleviate the food problem and environmental concern on a global scale and emphasized the importance of the multidisciplinary approach to achieve the objectives of this project. The proceedings of this workshop will be published this year.

Experimental fields of CNPGC for the "Agro-Pastoral" project

(Makie Kokubun)

PEOPLE

Dr. Masaaki SUZUKI, a soil scientist, became Director of JIRCAS's Okinawa Subtropical Station on March 1, succeeding Dr. Shigeo Yashima who was appointed Professor of Faculty of Bioresources, Mie University. Dr. Suzuki was in charge of JIRCAS's Thai Office at the Department of Agriculture of Thailand (DOA) from June 1, 1996.

JIRCAS Fellowship Program: Welcoming New Visiting Researchers

Eighteen Visiting Researchers are participating in the JIRCAS 2000 Visiting Research Fellowship Program to carry out collaborative research at Tsukuba and Okinawa.

Tsukuba: Short-term (5 months at National Institute for Agrobiological Resources)		
Yoon Mun Sup	National Seed Management Office, Rural Development Administration, Republic of Korea	Genetic diversity in the *Vigna angularis* complex
Badraldin Ebrahim Sayed-Tabatabaei	University of Tehran, Iran	Genetic variation of wild (*H. vulgare* ssp. *spontaneum*) and cultivated (*H. vulgare* ssp. *vulgare*) barley from Iran based on a DNA region linked to the *vrsl* locus
Liu Qingchang	China Agricultural University, P. R. China	Production of cell-induced sweet potato mutants for table and vegetable uses
Natalya V. Alpatyeva	N. I. Vavilov Research Institute of Plant Industry, Russia	Genetic diversity of cereal crops revealed by DNA polymorphism
Tsukuba: Long-term (2 years at JIRCAS HQ.)		
Malik Ashiq Rabbani	National Agricultural Research Centre, Pakistan	Analysis of plant responses to environmental stresses and gene expression
Yin Changbin	Institute of Natural Resources and Regional Planning, P. R. China	Studies on regional food production, marketing and consumption in China
Najeeb S. Alzoreky	Sanaa University, Yemen	Analysis and evaluation of biological activity of indigenous edible plants
Thanawan Boonpunt	Kasetsart University, Thailand	Studies on changes in the physicochemical properties of rice grain during post-harvest processing
Okinawa: Long-term (1 year at JIRCAS Subtropical Station)		
MD. Khalilur Rahman	University of Dhaka, Bangladesh	Subsurface drip irrigation of some vegetable crops
Lauro Gumasing Hernandez	Soils Research and Development Center, Philippines	Effect of subsurface "drip fertigation" on Chinese cabbage tipburn
Sayed Fathey El-Sayed	Cairo University, Egypt	Genetic studies on heat tolerance in snap bean (*Phaseolus vulgaris*) plants
Nguyen Thi Lang	Cuulong Delta Rice Research Institute, Vietnam	QTL mapping for rice salt tolerance genes and their evaluation
Werapon Ponragdee	Field Crops Research Institute, Thailand	Intergeneric crossing in sugarcane for higher environmental tolerance
Lin Tong-Xiang	Institute of Subtropical Pomology Fujian Agricultural University, P. R. China	Analysis of DNA markers in *Dimocarpus* longan and development of test kit
Liu Xiaochuan	China National Rice Research Institute, P. R. China	Tagging heterosis traits with molecular markers in rice
Ishwar Singh	Indian Institute of Sugarcane Research, India	Physiological and molecular characterization of heat tolerance in tomato and tobacco (transgenic of sHSP)
Maribel Regla Quintana Sanz	Institute of Pastures and Forages Research, Cuba	Sucrose phosphate synthase gene expression in sugarcane
Fan Shuguo	South China Institute of Botany, P. R. China	Molecular analysis of NaCl-tolerant and LiCl-tolerant suspensions of rice (*Oryza sativa* L. cv. Taipei 309)

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