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Street vendor selling "Kao Lam," traditional sticky rice cooked using fragments of bamboo stem in Khon Kaen, Thailand (Photo by M. Suzuki)

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JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

Steps towards a new era

Message from the JIRCAS Okinawa Subtropical Station

Masaaki Suzuki
Director, Okinawa Subtropical Station, JIRCAS

The G-8 meeting was held in Okinawa at the dawn of the 21st century. For a brief moment, the world's eyes, and the nation's eyes were turned to this group of islands in the southwestern part of the Japanese archipelago that is known as the Ryukyu Islands. In the southernmost end of the Ryukyu Islands is a group known as Yaeyama Islands. One of these islands is Ishigaki, and this is where, 30 years ago, the Okinawa Subtropical Station of JIRCAS (formerly Tropical Agriculture Research Center (TARC)) was established.

Ishigaki Island is only 230 km^2 in area, but it is a beautiful island surrounded by coral reefs and lying in the path of the Black Stream that brings warm water from the south to mainland Japan. The climate is humid subtropical with an average temperature of 24°C and an annual precipitation of 2,100 mm.

The organization of the Station consists of the International Collaborative Research Section, and the Laboratories of Crop Introduction and Cultivation, Crop Breeding and Rapid Generation Advance, Tropical Fruit Tree, Plant Protection, and Soil Fertility. The staff consists of 24 researchers and 14 members in the administration and field management sections. In addition, ten outstanding scientists are invited each year from developing countries under the "JIRCAS Visiting Research Fellowship Program at Okinawa." They work closely with each other to develop technology on optimum utilization of bio-resources and the promotion of sustainable agricultural production in the tropics and subtropics.

JIRCAS will be reorganized as an agency in April, 2001. Our Station is fortunately blessed at present with several important factors for conducting research. First is the high ability of the young staff including the highly qualified researchers from abroad. Second is the ideal environmental factors that come naturally with the location of this island. The third one is the existence of good facilities such as buildings and fields and modern laboratory equipment as well. Last, but the most important factor, is the availability of sufficient funds. I do hope that these conditions will prevail even after the reorganization.

We successfully implemented many important projects in the past 30 years and contributed to the development of agricultural technologies in the tropics and subtropics. For example, the low input hydroponics system, a new device for crop cultivation was developed at this Station. The system was applied to the efficient production of sugarcane seedlings, and has contributed to a large extent to the development of mechanization in sugarcane production in Okinawa. A procedure was developed here for successful cryopreservation of shoot meristems of taro cultured *in vitro*. A heat-tolerant variety of winged bean "Urizun" and a heat-tolerant variety of snap bean "Haibushi" were released in 1986 and in 1995, respectively from this Station. In another research project conducted here, it was revealed that soil loss from pineapple fields could be prevented by planting weeping lovegrass at the lower edge of the slope.

Next year, our projects will be much more oriented to sustainable agricultural production in small tropical and subtropical islands in order to contribute to the agricultural development of these islands. One of our major projects will be a study on the evaluation of the factors causing unstable crop production under tropical and subtropical conditions in connection with meteorological and soil conditions, and studies on the methods of control. How to minimize the use of water and fertilizers will be important issues in the project from the viewpoint of stable production and environmental protection.

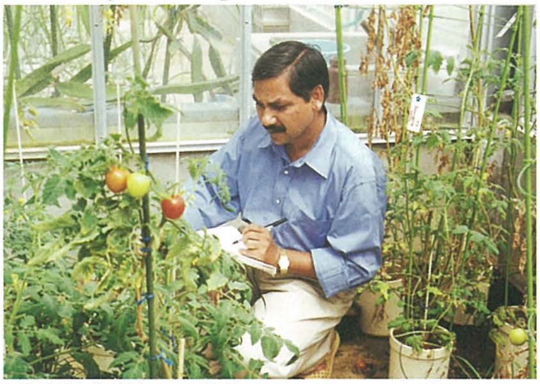
The development of crops resistant to environmental stresses such as heat and salt will be another important field of study. The demand for crop production under unfavorable conditions seems to increase due to the increase in the population of the developing countries. The project is implemented not only by the use of traditional breeding methods, but also by using biotechnology in combination with physiological analyses.

Citrus greening disease occurs widely in Thailand, Vietnam, Taiwan and also in Okinawa. The disease brings serious damage to citrus production and is very difficult to control. The Asian citrus *Psylla* is known as the vector insect and a kind of wasp is known to be its natural enemy. However, the wasp can not be utilized to control the Asian citrus *Psylla*, because the wasp is also known to have another wasp as its natural enemy. These complex ecosystems must be clarified one by one to develop the technology for controlling citrus greening disease.

Tropical fruits such as papaya and mango will be studied to enhance the quality, in terms of color, flavor and taste, etc., because fruit trees are very important in tropical countries for improving farmer's livelihood and for soil conservation.

Last, but not the least, the rapid generation advance of hybrid populations of rice and wheat, and the breeding of sugarcane using biotechnological methods, taking advantage of the subtropical conditions of Ishigaki Island, are also important projects to be continued further.

Close cooperation among the researchers, the effective utilization of the facilities of the Station in the unique environment provided by Ishigaki Island will hopefully lead to the solution of many of these problems.



JIRCAS Okinawa Fellow carrying out studies on heat tolerance of tomatoes

Collaborative Research Project

Development of Low-Input Technology for Reducing Postharvest Losses of Staples in Southeast Asia

Akinori Noguchi
Director, Crop Production and Postharvest Technology Division, JIRCAS

The first collaborative research project for the reduction of postharvest losses was launched on September 18, 2000 by the signature of a Memorandum of Understanding (MOU) among the Department of Agriculture (DOA), Institute of Food Research and Product Development (IFRPD) · Kasetsart University, School of Energy and Materials (SEM) · King Mongkut's University of Technology Thonburi (KMUTT), the Royal Thai Government and JIRCAS. This project is titled: "Development of low-input technology for reducing postharvest losses of staples in Southeast Asia" and will be continued for five years from 2000.

The increase in the world population and limited cultivated area emphasize the issue of food security as one of the global problems facing humans worldwide. While the production of food resources should increase, special attention must be paid to the reduction of postharvest losses in developing regions through the development of low-input and appropriate technologies.

Due to the fact that the climate in the Southeast Asian countries is typically hot and humid, postharvest losses have been estimated at about 30%, caused mainly by improper drying techniques and insect infestation during crop storage.

It was recognized that the widely used fumigant in the world, methyl bromide, is characterized by ecocidal and environmental disruption and contributes to the depletion of the ozone layer. Therefore, it will be strictly banned from use by 2015. On the other hand, an alternative pesticide, phosphine, induces tolerance and shows a marginal insecticide activity. As a result, developing countries have attempted to develop proper technologies for reducing postharvest losses.

Far too often the problem of feeding the world hungry is conceived in terms of producing a sufficient amount of food. Equally pressing problems related to preservation and distribution issues that affect food products between harvest and consumption, are frequently neglected.

While agriculture is obviously affected by the surrounding environmental conditions, there are many constraints on the rapid increase of food production. Therefore, it is very important to develop techniques for reducing postharvest losses as well as improving the quality and nutritional value of agricultural produce, prior to consumption.

The following technologies can be selected as appropriate solutions for common issues of postharvest losses in developing regions; drying and maintenance of freshness of products from harvest through transportation to storage. Safety assessment, product selection prior to processing and improvement and development of processing to meet the cultural food traditions should also be considered. The former two fields correspond to preventive technology for postharvest losses and the latter corresponds to technology for quality evaluation.

While harmonized development of these technologies is required to achieve a stable food supply and improve farmer's income, the infrastructure and laws relevant to food and other agricultural products have not been updated to meet new challenges in developing regions. Therefore, we must adapt selected technologies to the conditions in developing regions, keeping in mind how agricultural productivity can be enhanced through incentives to the farmers.

In this project, the objectives are to develop low-input drying technology using natural energy sources such as sunlight, husks and straw. Preservation technology will employ natural enemies and products such as neem and pheromones. Achievement of effectiveness and development of lower-cost technology systems for the reduction of postharvest losses at the farmer level or in small-scale farming, are other objectives of the present project.

The scope of the studies can be summarized as follows; 1) Survey of postharvest losses of staple crops such as rice and maize and identification of causes of quality deterioration, 2) Analysis of the dynamic status of major stored products insects and the mechanisms of damage and possible alleviation, 3) Development of low-input drying technology and biological control of stored products insects using natural enemies and products, 4) Development of environment-safe technologies for reducing postharvest losses of staples.

Signature of Memorandum of Understanding at the DOA office

Development of a Cable Logging System for Low-Impact Timber Harvest in Tropical Natural Forests

Shozo Sasaki
Forestry Division, JIRCAS

Because of its high productivity and versatility, the ground skidding system has been commonly used for timber harvest in tropical natural forests. However, since the heavy crawler tractors used in the operations can easily damage residual trees and the forest floor, it is difficult to achieve sustainable forest management with this harvesting system. This is especially true in the operations in hilly areas, where current logging activities are increasing. It is necessary for tropical forest management to develop low-impact, socially and economically acceptable logging techniques that can be used in the steep, rugged and fragile forest environment.

Cable logging system has an advantage over the ground skidding system in that it is not necessary to bring heavy machinery into forest stands. However, because a few heavy logs are scattered in a broad forest area, the cable system may not be suitable in terms of cost and benefit. Therefore, we are developing a new cable logging system that is suitable for selective cutting in tropical natural forests in many aspects.

A trial operation of the cable logging system

The cable system is a combination of standing skyline system and running skyline system. For quick installation, operations and dismantling, we selected a wire rope 20-mm in diameter for the skyline, which is rather smaller for heavy logs in tropical natural forests. To ensure safety with the smaller skyline, the cable is installed very loosely, with a maximum mid-span deflection (sag) value of 0.1. The cable tension and sag values can be controlled according to the log weight. Fig. 1 shows the results of some examinations in trial operations. For light logs less than 2 t in weight, with a sag value of 0.04, we observed that the cable system could totally lift up the logs all the way in the span. With the 0.08 sag setting, heavy logs up to 5 t could be totally lifted in the middle of the skyline over a stream buffer zone. On a slope, logs could be extracted by dragging with one side lifted up. The calculated and measured maximum cable tension values were 7,500 and 7,000 kgf, respectively, which is compatible with the skyline safety factor. Based on logging impact data, the ratio of disturbed area in the cable system is much smaller (1/10) than that of the ground system.

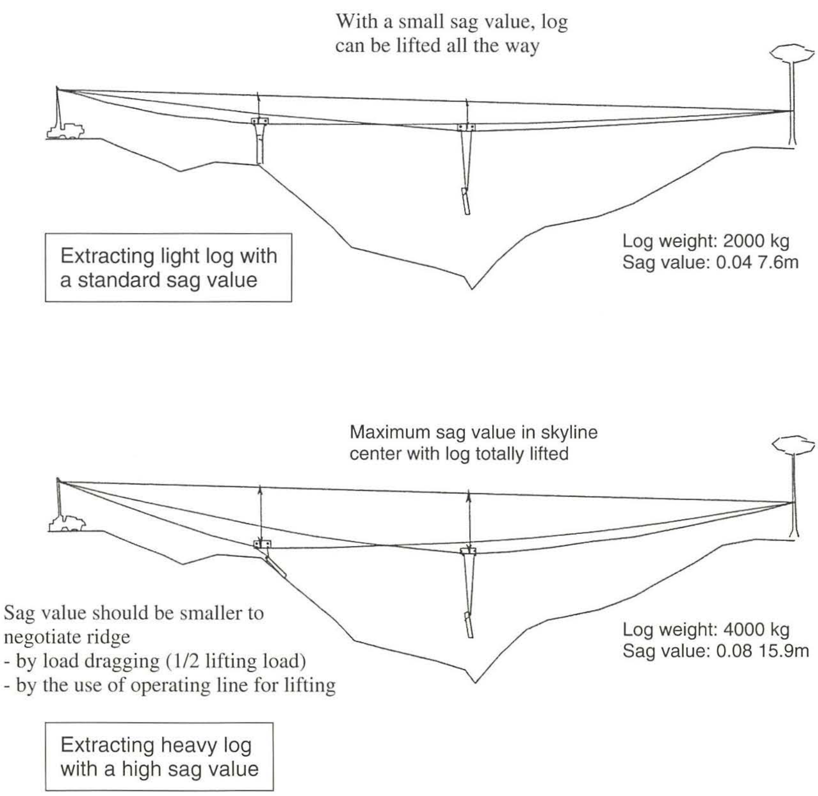


Fig. 1. Comparison of carrying load and cable sag values in trial operation.

Our target specification of the system is as follows: 6 t carrying load, 500 m working span, and 50 m lateral working range. We are currently conducting several trials in a 30 ha research plot in a hill forest in Peninsular Malaysia. Eight cable corridors are selected based on cable installation conditions, maximum accessibility to cutting trees, and minimal road construction. We plan to further improve the system, techniques, ground preparation work and operational procedures for efficient and lower-impact harvest.

Characterization of Vegetation Status in the Sub-Saharan Region Using Remote Sensing

Satoshi Uchida
Environmental Resources Division, JIRCAS

In the southern part of the Sahara desert, there are vast areas under semi-arid climatic conditions that form a belt zone. These areas are prone to a decline of the soil productivity and to desertification. Although monitoring of nutrient conditions over a long period of time would be required to estimate the soil productivity, this method can not cover areas out of experimental stations. Alternative method to estimate the soil productivity within a spatially wide range is to examine the vegetation status in relation to the soil productivity. Remote sensing is a suitable method for identifying the vegetation density at every pixel within the coverage of an observed scene and for monitoring the temporal changes. In this study, low spatial resolution (1 km) satellite data were used to characterize the vegetation status in association with physical environmental factors and high spatial resolution (20 m) satellite data were used to discriminate agricultural land use around the study site.

Normalized Difference Vegetation Index (NDVI) calculated by the combination of near infrared spectral band data and visible red spectral band data can be used to estimate the vegetation status. Fig. 1 shows the changes in the 1 km mesh 10-day composite NDVI derived from NOAA/AVHRR data during the period from October 1992 to September 1993, where 10-day composite denotes the maximum value recorded during 10 days in order to remove the effects associated with cloud cover. Each item in this figure represents averaged NDVI over land unit, which was defined by overlying soil (Regosols) and annual rainfall maps in Burkina Faso.

As the rainy season started in June, NDVI began to increase from the unit with the largest amount of annual rainfall to the unit with a smaller amount. The difference in the level of maximum NDVI was mainly caused by the proportional existence of vegetation components and not by the difference in the status of the vegetation. The Figure indicates that the landscape in the rainy season in the area with more than 700 mm annual rainfall was distinctively different from that in the area with less than 500 mm. In other words, annual rainfall in the range from 500 to 700 mm was identified as the critical level to maintain the vegetation reproductivity.

Spatially detailed information on actual land use was analyzed by using SPOT/HRV data with a spatial resolution of 20 m. Annual rainfall at the study site, Kolbila village, is about 700 mm. In terms of land use, millet was generally cultivated in the surroundings of house clusters while wide fallow areas could also be observed. In this study, the author attempted to discriminate cropped area and fallow from other land use types by applying the decision tree method for multi-temporal NDVI obtained from SPOT/HRV data. This method is based on the difference in the characteristics of the vegetation coverage depending on the land use types; i.e., both cropped area and fallow showed relatively low NDVI values compared with forest or bush during the post-rainy season and the cropped area showed a distinctively high NDVI value during the crop growing period.

Fig. 2 displays the estimated land use in 1992 and 1993 over the Kolbila village, in the center of the image, and its surroundings. Cropped area in the southeastern part was located around the river course, where the conditions of cultivation were considered to be more suitable in terms of soil moisture level than in the Kolbila village. This figure characterizes the variation of the cropped area in the Kolbila village as follows; 1) about half of the cropped area in 1992 was cropped subsequently in 1993, 2) continuously cropped area occurred mostly in the range within a distance of about 500 m from the center of the village.

Fallow shown in Fig. 2 could include the deforested area. According to the estimated land use for the extensive area around the Kolbila village, fallow appeared widely mixed with bare land. These land use features should be examined in relation to the location conditions, e.g., topography, accessibility to road or river, for the purpose of analyzing the changes in the soil productivity.

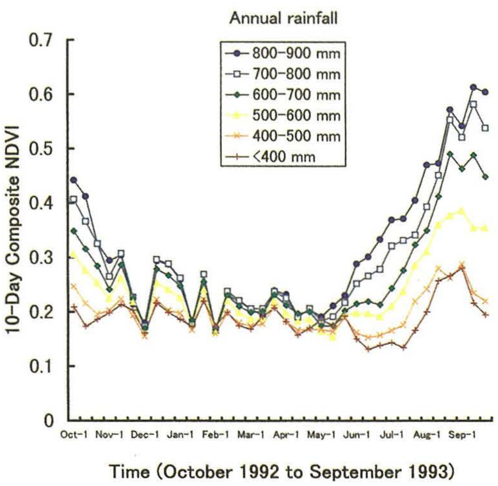


Fig. 1. Temporal changes of 10-day composite NDVI for unit area depending on annual rainfall ranges.
Areas are located on the same soil type, Regosols, in Burkina Faso.

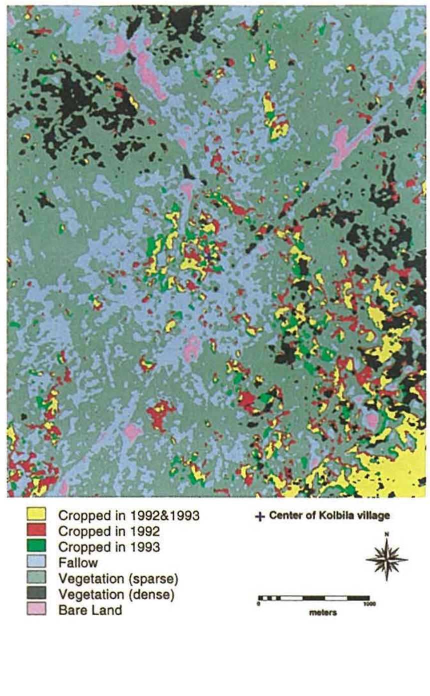


Fig. 2. Distribution of cropped area in Kolbila village and its surroundings in 1992 and 1993 estimated by using multi-temporal NDVI of SPOT/HRV data.

Characteristics of Rainfall Kinetic Energy and Raindrop Size Distribution on Ishigaki in the Subtropical Zone of Japan

Kenji Banzai
Okinawa Subtropical Station, JIRCAS

It has been recently observed that a large amount of red soils flows out from the rivers to the seacoast in the southwestern islands of Japan, particularly Okinawa. This phenomenon exerts a considerable effect on the natural ecosystems and endangers the coral reefs and seaweed habitat in this subtropical area. High rainfall intensity and large raindrop size have been known to contribute to this severe soil erosion. Using current rainfall energy equations, energy values can be calculated to predict soil loss which in turn can be very useful in formulating remedial measures. However, the distribution of the actual rainfall energy values is often wide and the characteristics of the rainfall energy in each zone have not been elucidated.

The filter paper method in which a filter paper with eosin powder is exposed to rain for several seconds to measure the raindrop diameter is not practical and prevents rapid and accurate determinations.

To gain a basic understanding of rainfall energy values, we examined the characteristics of the rainfall energy and raindrop size distribution in the subtropical area using a disdrometer. The device transforms the vertical momentum of the raindrop impact into an electric pulse, whose amplitude is a factor in the function of the drop diameter. Rainfall energy values were calculated from the observations obtained with the device, which enables to measure the raindrop size distribution continuously and automatically. The device however can not measure raindrops below 0.3 mm, hence rainfall energy values may show an error of about 2.48%.

Measured kinetic energy vs. rainfall intensity data revealed a wide distribution between the upper limit equation of Wischmeier and the lower limit equation of Mihara (Fig. 1). Kinetic energy above the Wischmeier equation which was also observed below 30 mm/h rainfall corresponded to the excess zone. On Ishigaki, there were large-sized raindrops at a rainfall intensity below 30 mm/h. The distribution of the raindrop size on the points shown in Fig. 1, was wide ranging from 1-5 mm in diameter compared with the data recorded in Tsukuba where the raindrop size was mainly in the range of 1-2 mm (Fig. 2).

This study highlights the higher rainfall kinetic energy and larger raindrop size observed in the subtropical area compared with the temperate area. Rainfall energy values derived from disdrometer measurements can also be used effectively for the calculation of the rain coefficient in the USLE equation, estimation of the amount of splash erosion and elucidation of the processes involved in soil crust formation.

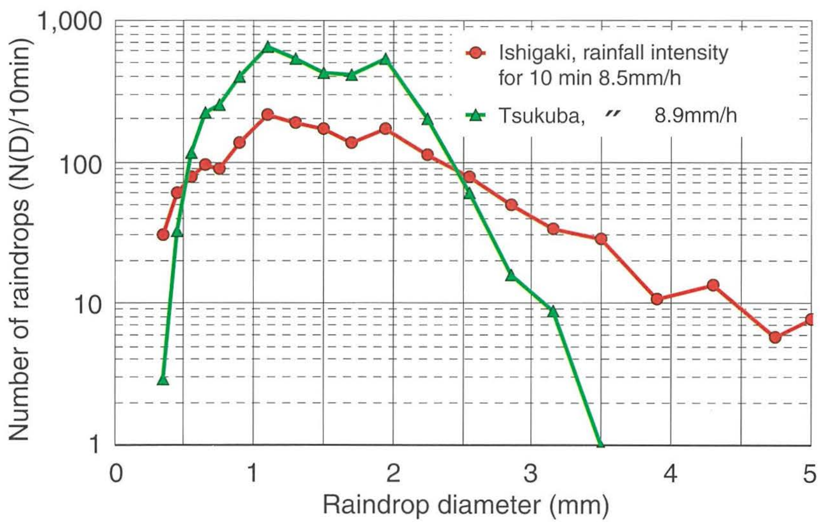


Fig. 2. Properties of raindrop diameter distribution.

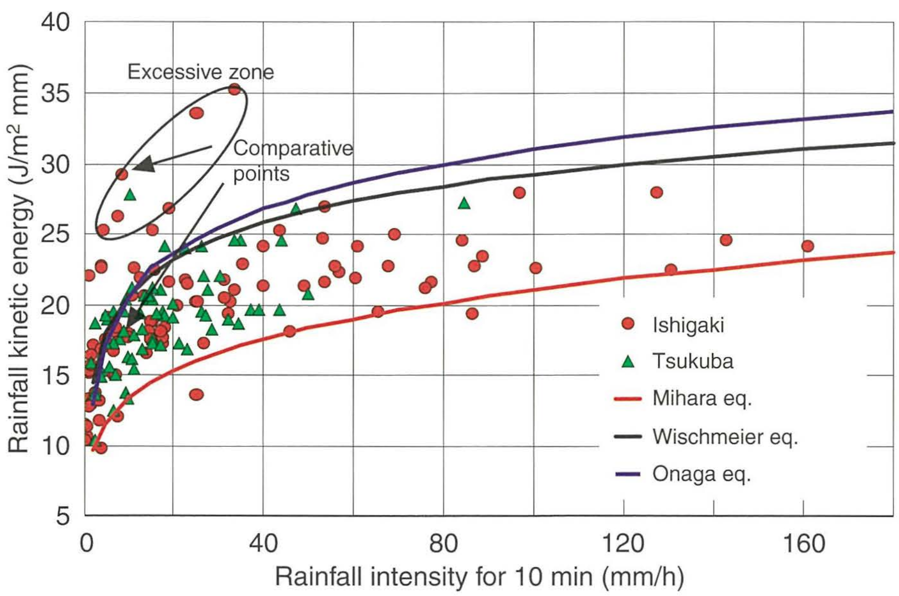


Fig. 1. Relationship between rainfall intensity and energy.

Workshop

Annual Workshop on 'Mekong II Project' Held in Cantho, Vietnam

The comprehensive project entitled "Development of new technologies and their practice for sustainable farming systems in the Mekong Delta (Mekong II)" has been implemented since last year, 1999, after a high degree of success was achieved in the phase I project entitled "Evaluation and improvement of farming systems combining agriculture, animal husbandry and fisheries in the Mekong Delta." The Mekong II project focuses on the production of commodities through the material circulation of by-products and/or wastes generated in the VACR farming systems. VACR is a Vietnamese acronym standing for fruits and vegetables, aquaculture, livestock and rice. For this purpose, the studies have been carried out in collaboration with Cantho University (CTU) and Cuu Long Delta Rice Research Institute (CLRRI) since 1999, respectively, and with the Southern Fruit Research Institute (SOFRI) since 2000.

The annual workshop on the comprehensive 'Mekong II' project was held at the Mekong Delta Farming Systems Research and Development Institute (MDFSRDI), CTU, Cantho, Vietnam during the period of November 14 - 17, 2000. The main purpose of the workshop was to review the results and to examine the future research direction of the project.

There were more than 80 participants from Vietnamese organizations, including local authorities such as agricultural extension departments and Tan Phu Thanh village representatives (the research site for the on-farm trial of the project), as well as CTU and CLRRI, in addition to 12 Japanese participants.

After the greeting address delivered by Prof. Dr. Le Quang Minh, Vice Rector of CTU, followed by the opening addresses given by Prof. Dr. Vo-Tong Xuan, Director of MDFSRDI, and by Dr. Osamu Ito, Director of Environmental Resources Division, JIRCAS, 52 reports were presented in 9 sessions during the first three days. In Session A, an outline of the on-farm trial site of the project was introduced. Technical report on rice cultivation was presented in Session B. In Session C, integrated pest management in rice cultivation was reported, and topics on upland crops such as soybean with rice cultivation and on drying technologies were discussed in Sessions D and E, respectively. After the discussion on fruit production in Session F, the results of pig production were presented in Session G. In Session H, 12 reports were presented on aquaculture production including fish and freshwater prawn. After Session I which covered the development and evaluation of farming systems, future direction and development for closer collaboration for the studies were discussed comprehensively in Session J. On the last day, November 17, a field trip to Tan Phu Thanh village was organized for all the participants. The workshop was successful due to the strong commitment of the experienced staff of the MDFSRDI, CTU. The Proceedings of the Workshop were published by JIRCAS.

Participants exchanged views on the progress of the project and confirmed the importance of such studies. During the workshop, it was eventually concluded that the development of sustainable farming systems which combine rice cultivation, fruit production, animal husbandry and aquaculture is definitely important, and may enable the organizations involved in the project to devise new strategies for developing techniques for the improvement of farming systems in the Mekong Delta.

The next annual workshop for the project will be held at CLRRI in late October, 2001. ***(Testushi Hidaka)***

Farmer house (left) and a farming system with the use of soil mounds for fruit tree cultivation in paddy fields (right) in the Mekong Delta

PEOPLE

Dr. Takahiro Inoue, a soil scientist, was appointed Director General of JIRCAS on January 6, 2001 after the retirement of Dr. Nobuyoshi Maeno. Dr. Maeno who had been assigned to CIAT from 1977 to 1981 as a TARC (predecessor of JIRCAS) member, eventually joined JIRCAS in August 1994 as Director of the Research Planning and Coordination Division and became Director General of JIRCAS in August 1996. Dr. Inoue had briefly assumed the position of Director of JIRCAS's Research Planning and Coordination Division from April 1, 1998 until August 31, 1998. He then joined Tohoku National Agricultural Experiment Station where he became Director General on April 1, 1999. As a TARC member, he had the opportunity to carry out "Studies on the Increase of Productivity of Upland Soils in Thailand" in collaboration with the researchers of the Department of Agriculture of Thailand from 1980 to 1984.

JIRCAS Fellowship Program: Welcoming New Visiting Researchers

Eighteen Visiting Researchers are participating in the JIRCAS 2001 Visiting Research Fellowship Program to carry out collaborative research at Tsukuba and Okinawa.

Tsukuba: Long-term (2 years at JIRCAS HQ.)		
Donghe Xu	Tianjin Agricultural Academy of Sciences, P. R. China	Mapping of resistance genes to fusarium head blight (FBH) in wheat
Nguyen Van Dong	Agricultural Genetics Institute, Vietnam	Fine-mapping of tms-4(t) and marker-aided selection for themosensitive genetic male sterility in rice
Nguyen Thi Thu Huong	Institute of Chemical Technology, Vietnam	Quality analysis and evaluation of food resources for better use
Subbarao V. Guntur	International Crops Research Institute for the Semi-Arid Tropical (ICRISAT), INDIA	Physiological studies on nitrification inhibition and nitrogen absorption in *Brachiaria humidicola*
Tsukuba: Short-term (5 months at National Institute of Agrobiological Resources)		
Zhenbo Tan	Beijing Academy of Agricultural and Forestry Sciences, P. R. China	Isolation of cDNAs clones encoding proteins that regulate freezing of cold-hardy plant tissues
Shahid Masood	Plant Genetic Resources Institute, Pakistan	Molecular evaluation of rice varieties collected from Pakistan
Chongjian Hong	China Agricultural University, P. R. China	Induction of high quality mutants and analysis of the mutation mechanism in sweet potato
Wong Boonsuebsakul	Kasetsart University, Thailand	Establishment of rapid and reliable method for diagnosis of bacterial wilt disease of curma, ginger and other economic crops in Solanaceae plants by immunological and molecular techniques
Okinawa: Long-term (1 year at JIRCAS Subtropical Station)		
MD. Khalilur Rahman	University of Dhaka, Bangladesh	Subsurface drip irrigation of some vegetable crops
Le Van Hoa	Can Tho University, Vietnam	Physiological and biochemical studies on aluminum-resistant pineapple
Md Abudul Awal Howlader	Bangladesh Agricultural Research Institute, Bangladesh	Molecular mechanism of biosynsthesis and metabolism of metabolites related to heat tolerance of crops
Jalal Ud din	Land Resources Research Institute, Pakistan	Physiological, biochemical and molecular basis of heat tolerance in transgenic tomato (MT-sHSP) at the reproductive growth stage
Vijay K. Yadav	Rajasthan Agricultural University, India	Cloning of salinity gene(s) in *E. coli* and characterization
Arifin N. Sugiharto	University of Brawijaya, Indonesia	Cloning of useful genes and transformation in sugarcane
Lawrence M. Aboagye	Plant Genetic Resources Center, Ghana	Characterization and evaluation of actors for early growth in sugarcane
Xiaochuan Liu	China National Rice Research Institute, P. R. China	Comparison of salt-tolerance QTLs in different RI populations of rice (*Oryza sativa* L.)
Yunxia Liu	Institute of Biological Control, P. R. China	Development of regeneration system of sweet potato for utilizing anthocyanin transcriptional activator genes
Jiang Ling	Huazhong Agricultural Institute, P. R. China	Development of genetic transformation technique in papaya plant

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