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Annual Report 2010 (Apr. 2010-Mar. 2011)

JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

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Japan International Research Center for Agricultural Sciences

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Japan International Research Center for Agricultural Sciences
1-1 Ohwashi, Tsukuba, Ibaraki 305-8686
JAPAN

EDITORIAL BOARD

Telephone	+81-29-838-6313
Facsimile	+81-29-838-6316
www	http://www.jircas.affrc.go.jp

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Annual Report JIRCAS 2010

Message from the President

President
Dr. Kenji Iiyama
(FY 2007-2010)

Here we are delivering the JIRCAS 2010 Annual Report, which is different from the usual annual report since it covers the outcomes of five year-projects and other research subjects found among our past activities, marking the final year of the Second Medium-Term Plan from FY 2006 to 2010. A new five year plan was commenced in April 2011, based on the outcomes of the previous medium-term plan. Appropriate feedbacks and understanding of the content of this annual report would be necessary to promote the success of the new medium-term plan.

While we were busy spending a great deal of energy summarizing and releasing the results of all the research projects in the final year of the Second Medium-Term Plan and closely examining the direction and proposed framework of research to achieve the objectives of the Third Medium-Term period, the Great East Japan Earthquake and tsunami struck Northeastern Japan in early March of 2011. The headquarters and main research buildings in Tsukuba convulsed violently, and many research facilities were damaged by the huge shaking, but fortunately, nobody was injured in JIRCAS.

We, the staff of JIRCAS, sincerely appreciate the kind concern and encouragement which were sent not only to us directly, but also to all Japanese people, immediately after the earthquake. On our part, we have been trying to collect all the necessary information to restore the agricultural, forestry and fishery industries of the stricken areas.

Projects of the Second Medium-Term Plan were carried out in Mongolia, China, Philippines, Vietnam, Laos, Thailand, Malaysia, Indonesia, East Timor, Marshall Islands, Bangladesh, India, Sri Lanka, Syria, Uzbekistan, Ethiopia, Kenya, Mozambique, Nigeria, Niger, Benin, Ghana, Mali, Brazil, Argentina, Paraguay, through collaborations with International Research Institutions (CGIAR Research Centers) and National Agricultural Research Organizations (NAROs) and universities in developing countries.

Our major concerns are ①Eradication of extreme poverty and hunger, ②Preservation of the global environment, and ③Institutionalizing research partnerships with CGIAR Centers, NAROs and universities in developing countries.

The United Nations set up the accomplishments of the projects for the Millennium Development Goals or MDGs as the major agendum of its Annual General Assembly in September 2010, and even organized a high level meeting just before the assembly. “Eradication of extreme poverty and hunger”, which is the first goal of the MDGs, has been cleared or nearly resolved in developing countries of Southeast Asia, as reported in the UN Annual Report of MDGs. We are proud that the activities of JIRCAS and the Tropical Agricultural Research Center (TARC), which is the predecessor of JIRCAS, have contributed to these accomplishments, especially in Southeast Asia. Furthermore, the CARD (Coalition of African Rice Development) project to develop technologies for the goal of doubling rice production in Sub-Saharan Africa by 2018 had steadily progressed during the Second Medium-Term Plan, and will be carried over to the Third Medium-Term Plan.

Reduction in the emission of greenhouse gases (GHG) was achieved through the technology of biogas production from animal excreta, and increased fixation of GHG by a forestation project as part of rural development activities for local communities. The mechanism of biological nitrification inhibition (BNI) was elucidated and exploited to promote the reduction of nitrous oxide (N_2O) emission. Technologies to reduce methane emission from

paddy fields were also developed. In addition, the process of developing cultivation techniques for beneficial indigenous tree species in Southeast Asia and of matching these with the biodiversity in tropical forests was analyzed, the sustainable management of tropical and subtropical marine resources and matching with the marine ecosystem, and the development of aquaculture technology were implemented; methane emission from ruminants were also quantitatively evaluated. Outputs from these projects are being carried over to the Third Medium-Term Plan. An economically competitive bioethanol production technology from old oil palm trunks was also advanced as a unit of a biofuel production complex.

All projects of JIRCAS in developing countries are in collaboration with NAROs, governmental departments and universities as equal partnerships based on a Memorandum of Agreement (MOA) or a Joint Research Agreement (JRA).

In December 2009, CGIAR adopted a new institutional model designed to improve its delivery of research results in a rapidly changing external environment. The new framework for international agricultural institutions was started on March 2010 as the rationale behind CGIAR reformation. The Global Rice Science Partnership (GRiSP), an initiative of the CGIAR, represents for the first time ever, a single strategic work plan for global rice research and how it can contribute more effectively toward solving developmental challenges. GRiSP was launched in November 2010, and JIRCAS is expected to play a strategic role in GRiSP, together with the International Rice Research Institute (IRRI), the Africa Rice Center (*AfricaRice*), the International Center for Tropical Agriculture (CIAT), the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), and L'Institut de Recherche pour le Développement (IRD).

JIRCAS Main Building

JIRCAS contributed to the first Global Conference on Agricultural Research for Development (GCARD) held in Montpellier, France in March 2010, which was organized by CGIAR and the Global Forum for Agricultural Research (GFAR). And it is an active member of the Asia-Pacific Association of Agricultural Institutions (APAARI), which is one of the regional fora made up of NAROs and universities in the Asia-Pacific region.

We will focus on major targets in the future, continue to develop concrete results that can be widely disseminated, and strengthen JIRCAS' role as a national focal center for international agricultural research to create "Global Public Goods". Together, we shall strive in unison towards these goals.

HIGHLIGHTS FROM 2010

International Seminar of the 'Coalition for African Rice Development' (CARD)

The "International Seminar of the Coalition for African Rice Development (CARD)", sponsored by Japan International Research Center for Agricultural Sciences (JIRCAS), was held on May 17, 2010, 1:30-6:30 PM, at Meru Hall, Ngurdoto Mountain Lodge, Arusha, Tanzania. The following is the outline of the event:

The seminar was planned and organized by JIRCAS, a core member of CARD, prior to the Third General Meeting of CARD to be held in Arusha, Tanzania. The objectives were to encourage participants of the General Meeting to exchange information in advance about their current research achievements and future challenges of institutional and technological innovation in African rice farming, which is crucial in the process of expanding rice production in Africa.

The seminar proceeded in accordance with the agenda. On the heels of the Opening Address of the President of JIRCAS, Dr. Kenji Iiyama, during the First Session, four speakers presented their research focusing on the socio-economic analysis of the agricultural extension of rice cultivation. First, Dr. Keijiro Otsuka, Professor of National Graduate Institute for Policy Studies (GRIPS), discussed that there is more room for increasing rice yield by improving the basic techniques of building bunds and puddling in Africa to be more advanced than those developed during the Green Revolution in Asia; and furthermore, by introducing modern varieties. Second, Dr. Kei Kajisa, Associate Professor, Foundation for Advanced Studies for International Development (FASID), provided similar information by presenting an overview of case studies in Tanzania. Third, Dr. Namanga Ngongi, President of the Alliance for a Green Revolution in Africa (AGRA), introduced the latest situation and activities in Ghana, Uganda and Tanzania. Lastly, Ms. Jeanne Downing, Value Chain Advisor, U.S. Agency for International Development (USAID), raised the topic on the concept of agricultural value chains from production and processing to marketing, and it was followed by a lively discussion between speakers and audiences in a panel discussion style.

In the Second Session, four speakers focused on the analysis of technological development for improved rice production. First, Dr. Seiji Yanagihara, Project Leader, JIRCAS, introduced research on rice breeding with focus on phosphorus deficiency and rice blast, conducted in collaboration with Africa Rice Center (*AfricaRice*). Second, Dr. Marco Wopereis, Deputy Director General, Africa Rice Center provided information on the Global Rice Science Partnership (GRiSP) which is one of the mega-projects of CGIAR. Third, Mr. Tatsushi Tsuboi, JICA (Japan International Cooperation Agency) Expert for NERICA, discussed the various issues actually happening in the rice cultivation fields, including the depth of transplanting and widely variable growth. Lastly, Dr. Aiou Diagne, Program Leader, *AfricaRice*, introduced data, information collection and analysis on rice in Africa and it was also followed by a lively discussion between speakers and audiences in a panel discussion style.

Each session was respectively closed with a wrap-up by each Chairperson, and Dr. Monty Jones, Executive Secretary, Forum for Agricultural Research in Africa (FARA), in his Concluding Remarks, summed up all the discussions in the seminar.

During one of the sessions in the international seminar

Dr. Monty Jones (Executive Secretary, FARA)

TARC-JIRCAS 40th Anniversary International Symposium 2010

On November 8-9, 2010, in the Tsukuba International Congress Center, Epochal, Tsukuba City, Japan, 142 participants joined in the TARC-JIRCAS 40th Anniversary International Symposium - A New Decade for International Agricultural Research for Sustainable Development, which was jointly sponsored and organized by Japan International Research Center for Agricultural Sciences (JIRCAS) and the Forum on International Agricultural Research for Sustainable Development (J-FARD). The symposium was also under the auspices of the Agriculture, Forestry and Fisheries Research Council (AFFRC) Secretariat, Ministry of Agriculture, Forestry and Fisheries (MAFF), National Agriculture and Food Research Organization (NARO), National Institute for Agro-Environmental Sciences (NIAES), Forestry and Forest Products Research Institute (FFPRI), International Cooperation Center for Agricultural Education (ICCAE), Nagoya University and the Consultative Group on International Agricultural Research (CGIAR).

In the Opening Remarks, Dr. Kenji Iiyama, JIRCAS President, noted that while commemorating the 40th anniversary of the founding of JIRCAS, this symposium aims to grasp the latest situation and trends surrounding international agricultural research, and to find a new research direction towards the coming decade.

In the Keynote Speech, "Enhancement of Japanese R&D and International Cooperation in Science and Technology", Prof. Takashi Shiraishi, Executive Member of the Council for Science and Technology Policy, Cabinet Office, noted the history of Science and Technology diplomacy strategy, transition of Japan's international political and economic position, and East Asia Science and Innovation Area initiative.

Session 1, "Trend in International Agricultural Research Networks"-GFAR and CGIAR presented the most up-to-date situation of the reorganization of CGIAR and network-based research. JIRCAS reported on its 40 years of research and development activities and new direction of cooperative research.

Session 2, "Challenges of Development-oriented Agricultural Research Institutes", was where all the institutes with similar functions to JIRCAS such as CIRAD, ARENA and ACIAR, reported their respective "Current Status and Challenges".

Participants of the TARC-JIRCAS 40th Anniversary International Symposium 2010

Session 3, "Network Formulation by Japanese Agricultural Research Bodies", discussed on the institutionalization of domestic research networks, "Global Scale Issue-oriented International Research Network Project", "Japan Intellectual Support Network in Agricultural Sciences" and "Challenges in Research Collaboration and Networking in the Asia-Pacific Region".

Then, in the Panel Discussion, "Agricultural Research for Sustainable Development - Towards a New Decade", on the role and future direction of international research networks, participants discussed about the challenges and countermeasures for formulating and strengthening the international research network, and also discussed about division of roles and linkages with mutual collaboration of the international research networks which are multi-layered and attached with different functions.

Panel discussion during the symposium

In the General Discussion session, participants exchanged their views about the Status of CGIAR reforms, activities of each research institutes and universities, and difficulty of international research consortium and research networks.

Finally, Professor Tanaka of Kyoto University, Vice President of J-FARD, delivered the Closing Remarks, summarizing the discussions of the symposium, and the expected future activities of JIRCAS.

JIRCAS is expected to expand the networking function, connecting the needs of research in developing regions with the seeds of research in domestic research institutes, which will become much more important in the future.

The Japan International Award for Young Agricultural Researchers

JIRCAS invites every year a total of some 70 researchers and research administrators from collaborative research organizations to conduct joint research projects (Collaborative Research Projects). JIRCAS also invites some 15 researchers from developing countries to stay for one year and perform collaborative experiments in the laboratories of Tsukuba Headquarters, in the Tropical Agriculture Research Front or other JIRCAS project sites to support the ongoing research activities, and to improve their research capabilities (JIRCAS Visiting Research Fellowship Program).

In 2004, JIRCAS began a new program, the Japan-CGIAR Fellowship Program, funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF), which dispatches young and promising Japanese researchers to CGIAR research centers in order to enhance their professional development in the fields of agriculture, forestry and fisheries.

Furthermore, beginning in 2007, to increase motivation among young researchers who are actively contributing to research and development in agriculture, forestry, fisheries and related industries in developing countries, JIRCAS together with MAFF, gives awards annually to three young agricultural researchers from overseas who show outstanding performance and research achievements (Japan International Award for Young Agricultural Researchers).

2010 Japan International Award for Young Agricultural Researchers

Dewpura Acharige Lilisiya LEELAMANIE
Nationality: Democratic Socialist Repuplic of Sri Lanka
Institute: University of Ruhuna
Research Achievement: Experimental study on soil water repellency and its behavior

Rettiya WAEONUKUL
Nationality: Kingdom of Thailand
Institute：King Mongkut's University of Technology, Thonbuki (KMUTT)
Research Achievement: Development of multienzyme complexes for the effective degradation of lignocellulosic biomass

Jianbing YAN
Nationality: People's Republic of China
Institute: International Maize and Wheat Improvement Center (CIMMYT)-China
Research Achievement: Provitamin A biofortification in maize grain

NEW RESEARCH COLLABORATION

JIRCAS-CTU Collaborative Research Project: Evaluation of Techniques for Reducing Greenhouse Gas Emissions from Rice Paddies in Can Tho, Vietnam

Mitigating greenhouse gas (GHG) emissions is a rational course of action to cope with the global warming issue. It has been taken into consideration that the contribution of agricultural activities to global warming through GHG emissions is around 15% and that one of its biggest sources is rice paddies. Approximately 90% of the world's paddy fields are located in Asia at higher density in monsoon lowlands like those found in the Mekong Delta Region, Vietnam. Based on the existing conditions, the Work Plan of a 3-year project entitled "Evaluation of Techniques for Reducing Greenhouse Gas Emissions from Rice Paddies in Can Tho City, Viet Nam" was signed between Dr. Osamu Ito, Director of Japan International Research Center for Agricultural Sciences (JIRCAS), Japan and Dr. Nguyen Hieu Trung, Dean of College of Environment and Natural Resources, Can Tho University (CTU), Viet Nam, on October 20, 2010 under the framework of the Memorandum of Understanding signed between both institutions on September 4, 2007. This project has been conducted as one of the 3-year activities of the research theme titled, "Development and Evaluation of Greenhouse Gas Reduction Technology from Livestock and Paddy Field in Southeast Asia" under the "International Research Network Program on Global Issues" funded by the Ministry of Agriculture, Forestry and Fisheries of Japan.

In this project, we are introducing a water-saving technique called alternate wetting and drying (AWD) to the rice paddies in Can Tho and investigating its effects on the reduction of the global warming potential of the rice paddies (under Dr. Yasukazu Hosen, Senior Researcher of JIRCAS), and researching the possibility of settling upon a plan to develop the obtained results even further into nationally appropriate mitigation actions (under Mr. Eiji Matsubara, Principal Engineer of JIRCAS). The leading scientists of the CTU side are Dr. Nguyen Huu Chiem, Associate Professor and Vice Dean of the Department of Environmental Science, College of Environment & Natural Resources and Dr. Tran Kim Tinh, Senior Lecturer and Head of Advanced Laboratory, Can Tho University, Vietnam.

IRRI-JIRCAS Collaborative Project: "Climate Change Adaptation in Rainfed Rice Areas (CCARA)"

Climate Change Adaptation in Rainfed Rice Areas (CCARA) project started in August 2010 as a five-year project from August 2010 to July 2015. To implement the project, JIRCAS and IRRI signed the Work Plan on August 15, 2010 under the MOU.

The project will focus on rainfed lowland rice production i.e., rice produced in paddy fields (bunded, flooded fields with saturated soil conditions for most of the growing season), primarily found in Asia, but the outcomes are also expected to contribute to Africa.

According to the Fourth Assessment Report of the Intergovernmental Panel for Climate Change (IPCC, 2007), global warming will result in increased variability in the onset of the rainy season, rainfall amount and rainfall distribution. The increasing variability of rainfall will increase the farmers' risk and worsen an already vicious cycle of low inputs and low outputs. Moreover, global warming is expected to increase temperatures and this may negatively affect rice growth and development as well. Therefore, it is crucial to develop rice varieties and rice management technologies that are adapted to variable rainfall and high temperatures under climate change.

The objective of the project is to improve farmers' livelihoods in rainfed environments under current and future climates through increased yield and yield stability of rice. The research themes are composed of the following :

1. Development of a seasonal weather forecasting model and analysis of water and

Annual meeting of CCARA project in IRRI

high temperature stresses caused by climate change
2. Identification of genetic factors and genetic improvement in rice genotypes adapted under rainfed lowland conditions affected by climate change
3. Development of fertilization management technologies to mitigate stresses raised by climate change
4. Development of integrated decision support system for rainfed rice farmers
5. Capacity- building for researchers in Asia and Africa

ACADEMIC PRIZES AND AWARDS

Dr. Tatsuya YURIMOTO, Senior Researcher of the Fisheries Division, received the Research Encouragement Award from the Japanese Society for Aquaculture Research in March 2011. This award was given for his research achievement on "Biological and ecological studies on the stock management of pen shell *Atrina lischkeana* in Ariake Bay, Kyushu Island, Japan."

Dr. Yurimoto has studied for almost a decade, the physiological characteristics of a high value bivalve, the pen shell in Western Japan, and the evaluation of the habitat environment of the fishery ground in Ariake Bay. His major works are the stock assessment of pen shell from the distribution of larvae and settled spats in Ariake Bay, and the elucidation of the causative factors of mass mortalities of this shellfish from field surveys, histological and physiological examinations in the laboratory.

JIRCAS received an Award of Appreciation from the Royal Forest Department, MNRE, Thailand

Japan International Research Center for Agricultural Sciences (JIRCAS) was honored with an Award of Appreciation from the Royal Forest Department, Ministry of Natural Resources and Environment, Thailand during the commemoration ceremony of the latter's 114th Anniversary held on September 18, 2010 for JIRCAS' collaboration and support to the Department's forestry research.

JIRCAS has been undertaking a collaborative research project, "Development of Techniques for Nurturing Beneficial Indigenous Tree Species and Combined Management of Agriculture and Forestry in Northeast Thailand, Tropical Monsoon Regions", as one of the Forestry Division's collaborative projects with the Royal Forest Department since 2006. The two main research subjects are the following: (1) To develop silvicultural techniques for improving plantations of fast-growing tree species such as *Acacia mangium* forests to be converted into mixed forests with indigenous economically high-value tree species while playing a role in re-greening northeast Thailand where a monsoon climate with a hard and unstable dry season threatens the livelihood of the local people and consequently induced large scale deforestation, and (2) to develop tools and affordable measures to support agroforestry or the mixed management of forestry and agriculture of newly emerging teak and other valuable indigenous tree plantation forestry organized by farmers in northeast Thailand to improve the livelihood of the local people according to the national plan. Several support and collaboration activities which JIRCAS has been carrying out are highly appreciated for their significant contribution to the forestry research of the Royal Forest Department in Thailand.

On behalf of the project, Dr. Ryuichi Tabuchi, Director of Forestry Division received a Commemorative Plaque from the Acting Minister.

Certificate of Appreciation from Khon Kaen University

A Certificate of Appreciation from Khon Kaen University was presented to JIRCAS. This certificate is for its contribution to a comprehensive agricultural research project between the Faculty of Agriculture in Khon Kaen University and JIRCAS on agricultural research in the Isan region (North East area of Thailand) for a period of several years. The presentation ceremony was held on July 19, 2010 in Khon Kaen University, and the certificate was presented to Dr. Makoto Nakatani, Director of the Research Planning and Coordination Division of JIRCAS, by Dr. Anan Polthanee, the Dean of the Faculty of Agriculture, Khon Kaen University, with the attendance of Associate Dean Dr. Kritapon Sommart and many professors who have contributed to the JIRCAS project.

Khon Kaen University Dean Dr. Anan handing over the Certificate of Appreciation to Director Nakatani during the ceremony

Presentation of certificate ceremony

Certificate of Appreciation from National University of Laos

A Certificate of Appreciation from the Faculty of Agriculture, National University of Laos, was presented to JIRCAS. This certificate is for its substantial contribution to the project, “Establishment of a feeding standard for beef cattle and a feed database for the Indochinese peninsula” in 2006 within its 5 year-plan, particularly for the installation of apparatuses and technical training on methodologies for the analyses of feed stuffs. Another major contribution of JIRCAS is the sharing and training on techniques for the classification of forage crops and other feeding resources in Laos. The presentation ceremony was held on October 16, 2010 in the Faculty of Agriculture, National University of Laos, and the certificate was presented to Dr. Kenji Iiyama, the President of JIRCAS by Associate Professor Foungsamouth Southammavong, Vice-Dean of the National University of Laos with the attendance of Dr. Mitsuto Matsumoto, President of the National Institute of Livestock and Grassland Science in Japan.

Commemorative photo of the ceremony

Certificate of Appreciation

RESEARCH OVERVIEW

OVERVIEW OF JIRCAS' RESEARCH STRUCTURE

1. History

The Japan International Research Center for Agricultural Sciences (JIRCAS) was first established in 1970 as the Tropical Agriculture Research Center (TARC), one of the research institutes of the Ministry of Agriculture and Forestry of Japan. TARC was reorganized into JIRCAS in 1993.

On April 1, 2001, JIRCAS became an Incorporated Administrative Agency (IAA) under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries (MAFF), in accordance with the administrative reforms of the Government of Japan to facilitate the reorganization of national government-affiliated research organizations.

2. Mission

Through research and development (R&D) and dissemination of information related to agriculture, forestry and fisheries in developing regions, JIRCAS contributes to the improvement of the international presence of Japan and towards a secure and stable supply of food worldwide and domestically.

3. The IAA System

An IAA is an organization responsible for key public services that the government is not required to provide, but which the private sector is likely to neglect for various reasons. The IAA system was introduced in 2001, as part of central government reforms based on the scheme that the planning sectors and the implementing sectors should be separated. Under the IAA system, MAFF defined JIRCAS' Second Medium-Term Goals in FY 2006, including the enhancement of research efficiency and the improvement of the quality of research programs and financial performance. Based on the Second Medium-Term Goals, JIRCAS drafted and began to implement a detailed five-year plan, the Second Medium-Term Plan (FY 2006 - FY 2010).

4. Evaluation

The performance and budgeting management of research activities conducted by JIRCAS undergo regular evaluation by the IAA Evaluation Committee established within MAFF. As for the activities of each fiscal year, the Committee investigates and analyzes the progress towards achieving the Medium-Term Plan, and the results of this evaluation shall be applied as deemed necessary to the modifications of the operational and financing systems for subsequent fiscal years. To meet the requirements of this rigorous evaluation, JIRCAS has modified the in-house evaluation system in the initial year of the Second Medium-Term Plan. The in-house evaluation in FY 2010 was carried out as follows.

1) Each Project evaluated its own research activity and prepared its own summary report.
2) These reports were then collectively evaluated at the meeting for the evaluation of sub-programs of the Medium-Term Plan by external reviewers (specialists from other universities or institutes) and internal reviewers (the President, the Vice-President, an Executive Advisor and Auditor, the Directors of each research division and Project Leaders) in February, 2011.
3) Comprehensive evaluation of all JIRCAS activities, which also include administrative operations, was performed through examination of official records by external reviewers of the JIRCAS External Evaluation Committee late in March, 2011

The external reviewers are listed in the Appendix. The results of the in-house evaluation and a summary of all activities were submitted to the IAA Evaluation Committee established within MAFF in June, 2011.

5. Medium-Term Plan

JIRCAS implemented four main programs for research activities under the Medium-Term Plan. Each main program had a number of sub-programs, each of which included several projects. Major accomplishments and research highlights of the main programs in FY 2010 are described in the following sections. The contents of the Medium-Term Plan are also described in the Appendix.

Table 1. Number of Programs in the Second Medium-Term Plan (FY 2006-FY 2010)

Research Approach	Main Program	Sub-program (Total)
A	A-1	7
	A-2	7
	A-3	4
B	B	3

Second Medium-Term Plan (FY 2006-FY 2010)

[Research Approach A] Research and development on agricultural, forestry and fisheries technology geared towards providing solutions to international food and environmental problems

Main Program A-1
Development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments

Sub-programs:
1. Elucidation of the mechanism of tolerance to abiotic stress and production of tolerant crops
2. Improvement of abiotic stress tolerance of rice in Africa
3. Identification of pathogenic races for important diseases and selection of resistant germplasm in major crops
4. Development of biomass utilization technology suited to Southeast Asia
5. Elucidation of the functionality and quality parameters of traditional food and agricultural products in Asia and development of effective utilization technology
6. Effective utilization of genetic resources in tropical and subtropical crops
7. Sustainable utilization of tropical and subtropical marine resources and development of aquaculture technology

Main Program A-2
Development of management technologies of environmental resources and production systems for sustainable agriculture, forestry and fisheries

Sub-programs:
1. Development of sustainable management technologies for tropical soils
2. Integrated management system for improved water utilization aiming at increasing economic options and reducing environmental impact
3. Improvement of feeding technology for livestock in the tropics and the subtropics and establishment of sustainable agropastoral systems in the Asian dry areas
4. Elucidation and exploitation of biological nitrification inhibition (BNI)
5. Development of environmental management technology for sustainable crop production in tropical and subtropical islands
6. Development of nurturing techniques for beneficial indigenous tree species in Southeast Asia
7. Development of productive low-input cultivation technology for fruit trees in the tropics

Main Program A-3
Elucidation of the impact of global environmental changes on agriculture, forestry and fisheries and development of mitigating technologies

Sub-programs:
1. Developing an impact assessment model and formulation of a food supply stabilization plan
2. Utilization of Geographic Information System (GIS) for the development of a land information monitoring technology in developing regions
3. Formulation of agricultural development methodologies to tackle the environmental changes of global warming and desertification
4. Developing pest control management technology for major pests in the tropics and subtropics

[Research Approach B]

Main Program B
Collection, analyses and dissemination of information to grasp trends related to international food, agriculture, forestry and fisheries and rural areas

Sub-programs:
1. Collection and dissemination of information

related to global food, agriculture, forestry and fisheries
2. Elucidation of the direction of technology development in developing regions and analysis of socioeconomic conditions of the development in rural areas
3. Establishment of techniques and methodologies for the reconstruction of agriculture and rural communities affected by natural disasters, etc.

6. Collaborative Research

JIRCAS is required to cover a wide range of research fields. Human resources at JIRCAS, however, are limited. This makes collaborative researches with other institutes or universities necessary towards achieving JIRCAS' project objectives. Whenever JIRCAS and its collaborators reach an agreement on the commencement of collaborative research after exchanging ideas and opinions, a Memorandum of Understanding (MOU) or a Joint Research Agreement (JRAs) is usually concluded. We developed the concept of JRAs in 2006. A JRA is a contract for collaborative research with a particular research subject and with a fixed term. A total of 110 MOUs or JRAs remained in force at the end of FY 2010.

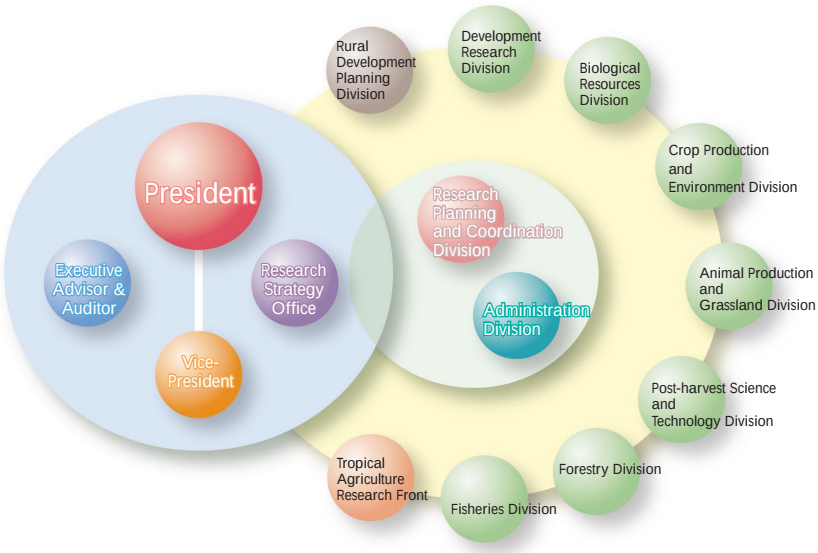
In 2004, JIRCAS was given a Certificate of Recognition by CGIAR as a key partner and as the CGIAR focal point institution in Japan. JIRCAS has been playing an important role in promoting mutual understanding and collaboration between CGIAR and the Japanese government. It has also been intensively implementing collaborative research with several CGIAR research centers.

JIRCAS has been regularly dispatching researchers and research managers to promote research in the developing regions. In FY 2010, 165 JIRCAS researchers or administrators were dispatched abroad for a total of 16,237 days. Likewise, we have been dispatching researchers from other institutes and universities to promote the effective implementation of JIRCAS' projects with the cooperation of such organizations. JIRCAS has likewise implemented several invitation programs for overseas researchers and administrators at counterpart organizations. These programs facilitate not only the promotion of international collaborative research but also related exchanges of information and opinions.

7. Organization of JIRCAS

The organizational structure of JIRCAS in the Second Medium-Term Plan period is summarized in the figure below.

The directors of each research or planning division, including the Research Strategy Office and the Tropical Agriculture Research Front, held the responsibility for the management of individual sub-programs in the Second Medium-Term Plan. JIRCAS' Tropical Agriculture Research Front (formerly the Okinawa Subtropical Station) focuses on agricultural, forestry, and fisheries research being carried out in overseas regions with highly similar climatic and geographic conditions as Okinawa, taking full advantage of its subtropical weather and geographic location in Ishigaki Island, in the southernmost part of Japan.



Organization of JIRCAS

MAIN RESEARCH PROGRAMS

Theme A-1
"Development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments"

In developing regions where abiotic stresses such as drought and salinity, and biotic stresses caused by pests and diseases act as major constraints on agricultural production, there is an increasingly urgent need to develop technologies that enable not only stable but also sustainable production.

Theme A-1 aims at the stable production of various agricultural products encompassing agriculture, forestry and fisheries. In this theme, research projects that include the elucidation of mechanisms of stress tolerance in plants, development of abiotic stress-tolerant crops using both conventional and molecular approaches, and development of technologies to utilize various biological resources in tropical and sub-tropical regions have been conducted.

The following items can be listed as the highlights among the many outputs of this research theme in the year 2010.

1. Research on genes for transcription factors in Arabidopsis and rice, such as AREB and *NAC*, has been advanced and is now leading to applied collaborative research to improve environmental stress tolerance of crop plants. We have revealed the activity and tissue specificity of the stress-responsive *Oshox24* promoter, which is highly useful in rice. We have also succeeded in isolating stress responsive promoters in soybeans.
   In rice, a candidate gene of phosphorous-deficiency tolerance was identified. Regarding tolerance of zinc deficiency and ozone toxicity, physiological studies were performed to elucidate the mechanism of each identified QTL. Materials were selected for the genetic analysis of iron toxicity tolerance. We isolated the gene which increases yield by enhancing source capacity. Furthermore, it is indicated that the gene is effective for breeding program geared toward improving high yielding rice.
   A major QTL was identified for drought tolerance in wheat based on yield data in the field. In soybean, a candidate gene for salt tolerance was identified and the region of candidate genes for alkali tolerance was narrowed down for further gene isolation.

2. While increasing the collection of rice blast races from Africa and investigating their pathogenicity, a total of 12 races were selected for a preliminary version of an Africa-oriented standard differential system.
   Meanwhile, the phosphorous deficiency tolerance detected in upland NERICAs was analyzed genetically, and novel QTLs were mapped on chromosomes 3 and 11 in addition to a previous QTL on chromosome 6.
   The candidate genes for drought tolerance were introduced into upland NERICA and fixed single-copy transgenic lines were produced in advanced generations. Drought tolerance and gene expression of fixed lines were evaluated in a greenhouse experiment. Then, seeds of transgenic lines were sent to CIAT for further evaluation in the field.

3. Two new differential variety sets, Lijiangxintuanheigu (LTH) near isogenic lines (NILs) and CO 39 NILs were developed. These NILs with LTH and CO 39 genetic backgrounds are targeting 11 and 14 kinds of resistance genes, respectively. And differential systems consisting of mono-isogenic lines as the other differential varieties targeting 23 resistance genes and several selected standard differential blast isolates, were developed in Indonesia, Vietnam, China, Laos, and Philippines.
   Monitoring of variation in the pathogenicity of soybean rust in Brazil, Paraguay and Argentina was continued. The QTL of soybean rust tolerance, which inhibits leaf yellowing after infection, was identified to be located on the linkage group O. Development of resistant varieties using DNA markers and backcrossing has been commenced in Paraguay. Breeding materials such as resistant lines with multiple resistant genes and those produced by transformation have been developed.

4. In the area of biofuel research, JIRCAS scientists developed innovative technologies such as recycle saccharification system using cellulases-hemicellulases complex for cellulosic biomass, thermotolerance, ethanol fermentable yeasts and efficient hydrolysis system for squeezing residues from oil palm trunks. Furthermore, in order to promote a

utilization technology for oil palm trunk, JIRCAS also carried out research to optimize the capacity of the 'Parenchyma-separator equipment' and the development of biodegradable composites using empty fruit bunches from oil palm industries.

5. Model functional food products using local tropical vegetables that are highly antioxidative were invented. New functional intermediate materials for food processing that contain water-soluble polysaccharides from rice were developed. And, new technologies of food processing were established. These model products, intermediate materials and technologies are expected to be applied in food industries. Therefore, it is assumed that the plan of this project has been mostly attained already.

6. We have succeeded in breeding promising 'Multi-Purpose Sugarcane' clones with high sugar content and excellent fiber-yielding abilities. Likewise, we have succeeded in the breeding of elite F1 hybrids with high adaptability to drought. Both of them were bred by inter-specific crossing between sugarcane varieties and wild-species *Saccharum spontaneum*. Moreover, we have classified our *Erianthus* germplasm (149 accessions) and succeeded to generate intergeneric hybrids between sugarcane varieties and *Erianthus* by improving crossing techniques.
   JIRCAS is preparing to commence a new collaborative research project on "Use of genomic information and molecular tools for yam germplasm utilization and improvement for West Africa" with the International Institute of Tropical Agriculture (IITA) from Fiscal Year 2011. Whole genome sequencing by next generation sequencer (Illumina GA) has been in progress already for the new project with the collaboration of the Iwate Biotechnology Research Center (IBRC), Japan. In addition, during the feasibility study of the project in 2010, 90 SSR markers were isolated from *Dioscorea cayenensis*. It was confirmed that these markers were polymorphic not only for *D. cayenensis* but also for the other *Dioscorea* species cultivated in Africa.

7. Stable isotope analyses were carried out to investigate the migration of John's snapper *Lutijanus johnii* and its dependence on the food resources provided within the Matang Mangrove Forest Reserve, Malaysia. It showed the importance of the complex interconnected mangrove waterways and associated prey aquatic animals in the large mangrove system to juvenile John's snapper. Laotian indigenous species *Hypsibarbus malcomi* is a common fish in the market, but it has not yet been applied to aquaculture to date. Examination of the artificial seed production showed high fecundity of the adult female and high survival rate in larval and juvenile stages, and consequently it indicated that this species could be applicable to aquaculture. Free amino acids (FAAs) in the muscle of *Litopenaeus vannamei* (whiteleg shrimp) produced by the Indoor Shrimp Production System (ISPS) and other commercially cultured shrimp species were analyzed by high performance liquid chromatography (HPLC). ISPS-produced whiteleg shrimp showed high levels of some FAAs. The levels were similar to those of Kuruma prawn produced in Japan, and higher than those of imported shrimp species. This indicates a successful high-value shrimp production by ISPS.

TOPIC1

Identification of a major QTL allele from wild soybean (Glycine soja Sieb. & Zucc.) for increasing alkaline salt tolerance in soybean

Salt-affected soils are generally classified into three main categories depending on the amounts and kinds of salts present. They are saline, sodic (alkaline), and saline-sodic. Both saline and sodic problems are reported to threaten soybean (*Glycine max* (L.) Merr.) production's sustainability. Development of soybean cultivars with high salt tolerance will be an effective way to maintain sustainable production of soybean in a salt stress-environment. However, the development of salt-tolerant soybean cultivars in a soybean breeding practice is hampered by the lack of precise evaluation of salt tolerance for breeding lines during the selection process. Therefore, DNA marker-assisted selection (MAS) will be particularly useful in the selection and breeding for salt tolerance. Several studies of quantitative trait locus (QTL) mapping for saline tolerance have been reported, and some DNA markers have been proposed for use in a soybean breeding program to select for salt tolerance. However, little is known about the heredity of alkaline salt tolerance in

soybean. In this study, we identified a QTL allele for alkaline salt tolerance in soybean from a wild soybean accession JWS156-1 (*G. soja* Sieb. & Zucc.), and developed DNA markers that might be used in a soybean breeding program for alkaline salt tolerance.

Under alkaline salt treatment with 180 mM $NaHCO_3$ for about three weeks, the wild soybean accession JWS156-1 showed the highest alkaline salt tolerance in terms of salt tolerance rating (STR) and leaf chlorophyll content (SPAD value) among 53 soybean germplasm, including 51 cultivated soybean cultivars and two wild soybean accessions (Fig. 1, 2). To identify the QTL for alkaline salt tolerance in soybean, an F_6 recombinant inbred line (RIL) mapping population (n = 112) and an F_2 population (n = 149) derived from crosses between a cultivated soybean cultivar Jackson and JWS156-1 were used. Evaluation of soybean alkaline salt tolerance was carried out based on salt tolerance rating (STR) and leaf chlorophyll content (SPAD value) after treatment with 180 mM NaHCO3 for about three weeks under greenhouse conditions. In both populations, a significant QTL for alkaline salt tolerance was detected on chromosome 17, which accounted for 50.2 and 13.0% of the total variation for STR in the F_6 and the F_2 populations, respectively (Fig. 3). The wild soybean contributed the tolerance allele in the progenies. Our results suggest that QTL for alkaline salt tolerance is different from the QTL located on chromosome 3 for NaCl salt tolerance found previously in this wild soybean genotype. The DNA markers closely associated with the QTLs, such as Satt669、Satt447 and Sat_292, might be used for MAS to pyramid the tolerance genes in soybean for both saline and alkaline stresses.

(D. H. Xu and D. D. Tuyen)

Fig. 1. Comparison of alkaline salt tolerance between the wild soybean accession JWS156-1 (right) and the soybean cultivar Jackson (left) after alkaline salt treatment with 180 mM $NaHCO_3$ for about three weeks.

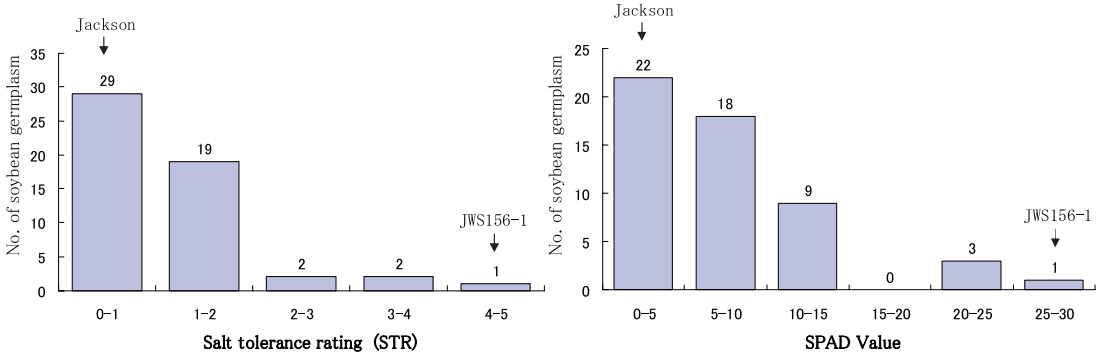


Fig. 2. Frequency distribution of salt tolerance rating (STR) and SPAD value of the 53 soybean germplasm.
The STR was classified on a scale of one to five, ranging from 1 (complete death) to 5 (normal health leaves). Leaf chlorophyll content (SPAD value) was measured using a chlorophyll meter.

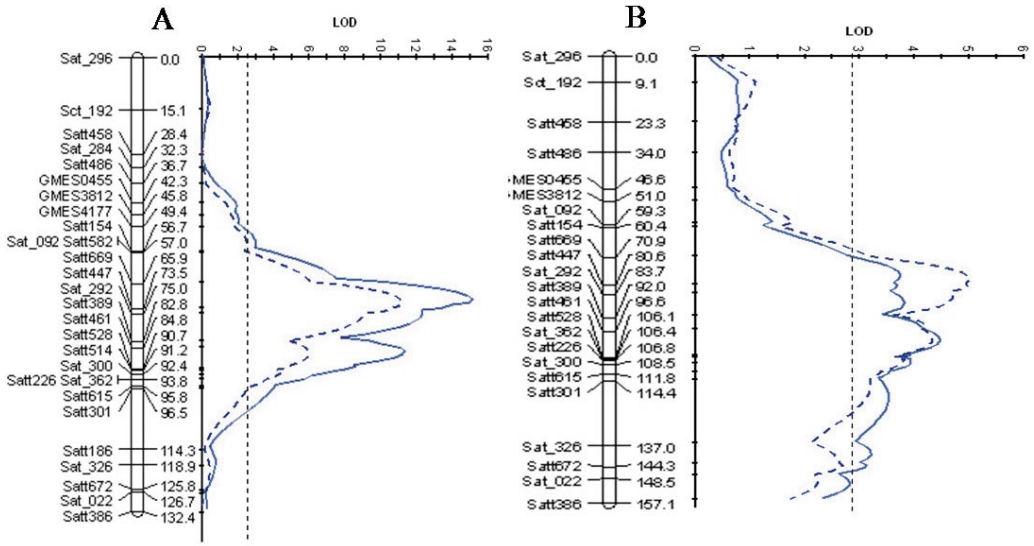


Fig. 3. Genetic map of chromosome 17 and QTL LOD (score for salt tolerance rating (STR, blue solid line) and leaf chlorophyll content (SPAD, blue dotted line) values in the F6 (A) and the F2 (B) populations derived from the crosses between soybean cultivar Jackson and the wild soybean accession JWS156-1. The vertical dotted lines indicate QTL significant levels ($p < 0.01$) estimated from a 2000-permutation test by random sampling of phenotypic data.

Three kinds of AREB transcription factors cooperatively regulate ABA-mediated drought stress tolerance

Drought has been seriously damaging agriculture, and the damage is more severe in developing countries. An important strategy to meet food demands with less water is to develop crop varieties with increased tolerance to drought. Under drought stress, abscisic acid (ABA) levels increase in plants, thereby triggering the expression of many genes that function in stress tolerance. In this study, using molecular analyses in model *Arabidopsis* plants and rice, we have revealed that multiple AREB-type transcription factors cooperatively regulate ABA-mediated drought stress tolerance. Our elucidation of the genetic mechanisms underlying drought tolerance establishes the technical platform essential toward advancing drought-tolerant crops in developing countries.

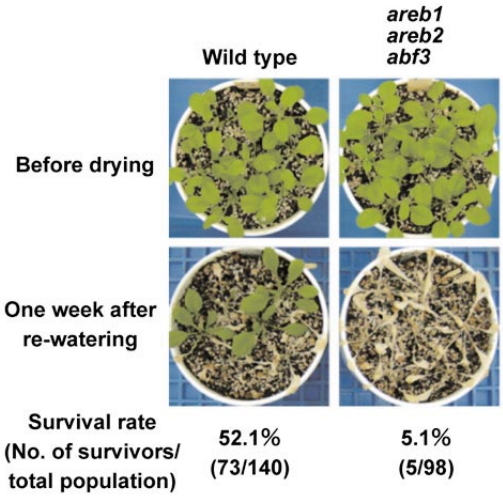


Fig. 1. Drought-tolerance phenotype of triple knock-out mutants for AREB-type transcription factors (AREB1, AREB2 and ABF3) in *Arabidopsis*. Photographs show plants before and after stress treatment. Watering was withheld from 3-week old plants for 11 days, and then watering was resumed for 1 week before the photograph was taken. Survival rates were calculated from the results of five independent experiments.

In *Arabidopsis*, three members of the AREB-type transcription factors, AREB1, AREB2 and ABF3, cooperatively regulate the plant response to water stress. (Fig. 1 and 2) These factors control the expression of many regulatory genes, e.g., encoding transcription factors, protein kinases and phosphatases, as well as the expression of functional genes, such as encoding LEA class proteins. While AREB1, AREB2 and ABF3 have largely overlapping functions, our results also show that each of them may play a specific role (Fig. 2). AREB1 has higher transactivation ability induced by ABA, *AREB2* is induced more highly by salt stress, and ABF3 retains greater transactivation ability than the other two even without ABA. Similar to AREB1, AREB2 and ABF3 in Arabidopsis, three AREB-type transcription factors, OsAREB1, OsAREB2 and OsAREB8 are involved in transcriptional activation of drought-tolerance related genes in rice. Moreover, our phylogenetic analysis revealed that the AREB-type transcription factors are conserved not only in *Arabidopsis*, rice and soybeans, but rather universally throughout all land plants, including mosses and ferns.

Our findings support the idea that the drought tolerance system regulated by AREB-type transcriptional factors is well conserved not just in *Arabidopsis* but also in crops, like rice and soybeans. This functional conservation makes this system an important target for crop improvement with respect to drought tolerance. Furthermore, the findings of functional characteristics among AREB-type transcription factors can be put to the development of appropriate drought-tolerant crops. Considering both the overlapping and specific functions of these three AREB-type transcription factors, the combinations of genes and promoters can be optimized to appropriately meet the various needs of different crop varieties or according to levels of drought (Fig. 2).

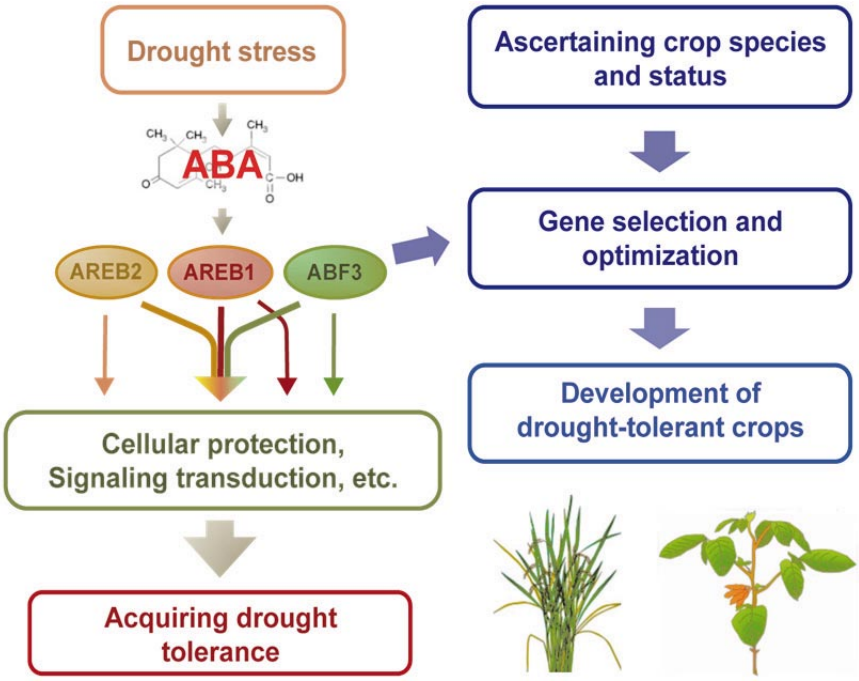


Fig. 2. Model for the development of abiotic stress-tolerant crops using three kinds of AREB-type transcription factors that cooperatively regulate ABA-mediated drought stress tolerance. AREB1, AREB2 and ABF3 cooperatively regulate the ability of plants related to drought tolerance. While the transcription factors have overlapping functions, each of them has its own specific roles

(Y. Fujita, T. Yoshida, and K. Yamaguchi-Shinozaki)

Development of gene transfer technology to generate stress-tolerant rice plants utilizing the OsNAC5 gene

In recent years, droughts and other extreme weather events occur frequently around the world and have a huge negative impact on crop yields. More particularly in developing regions, frequent droughts have caused severe damages to agriculture. When plants are exposed to adverse environmental conditions such as drought, through the function of genes involved in promoting tolerance to many environmental stresses, plants adapt to adverse environments. By causing overexpression of the transcription factor that regulates the function of these environmental stress tolerance genes, it is possible to improve environmental stress tolerance. However, in overexpressing the transcription factor genes involved in environmental stress tolerance, growth inhibition often occurs. This study is aimed to develop rice plants with improved tolerance to environmental stresses such as drought and salt stress without inhibiting the growth, using environmental stress-inducible NAC-type transcription factor genes in rice.

The transcription factor OsNAC5 in rice is a member of the plant-specific NAC family that regulates stress responses. Expression of *OsNAC5*, as well as OsNAC6, is induced by abiotic stresses such as drought, cold, high salinity, abscisic acid and methyl jasmonic acid. Transactivation assays using rice protoplasts demonstrated that OsNAC5 is a transcriptional activator, and subcellular localization studies using OsNAC5-GFP fusion proteins showed that it is localized to the nucleus. Pull-down assays revealed that OsNAC5 interacts with OsNAC5, OsNAC6 and SNAC1. To analyze the function of OsNAC5 in rice plants, we generated transgenic rice plants (Nipponbare) that overexpressed *OsNAC5*. The growth of T2 and T3 of the transgenic plants was similar to that of control plants, whereas the growth of OsNAC6-overexpressing transgenic plants was retarded (Fig. 1A). T2 and T3 of OsNAC5-overexpressing transgenic plants also had significantly improved tolerance to high salinity compared to control plants (Fig. 1B and 1C). Many stress-inducible genes, including the “late embryogenesis abundant” gene OsLEA3, were up regulated in rice plants that overexpressed OsNAC5. By gel mobility shift assay, OsNAC5 and OsNAC6 were shown to bind to the OsLEA3 promoter. Collectively, our results indicate that the stress-responsive proteins OsNAC5 and OsNAC6 are transcriptional activators that enhance stress tolerance by upregulating the expression of stress-inducible rice genes such as OsLEA3, although the effects of these proteins on growth are different. OsNAC5 may therefore be a useful gene that can improve the stress tolerance of rice without affecting growth.

Application of this technology is expected to decrease the damages caused by drought and salt in developing regions. In the future, it is necessary to verify the tolerance of the plants overexpressing OsNAC5 to hostile environments such as drought and high salinity at the field level.

(Hironori Takasaki [The University of Tokyo], Kyonoshin Maruyama, Satoshi Kidokoro [The University of Tokyo], Yusuke Ito, Yasunari Fujita, Kazuo Shinozaki [RIKEN Plant Science Center], Kazuko Yamaguchi-Shinozaki [The University of Tokyo] and Kazuo Nakashima)

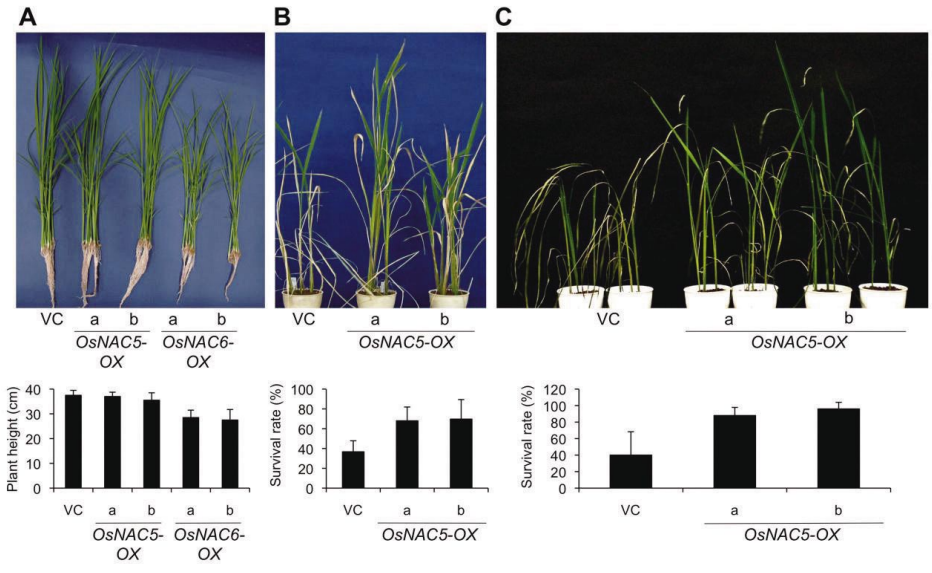


Fig. 1. Growth and stress tolerance of transgenic rice plants overexpressing *OsNAC5*. (A) Height of transgenic rice plants overexpressing *OsNAC5 (OsNAC5-OX)* and *OsNAC6 (OsNAC6-OX)*, and vector control plants (VC). (B) High-salinity stress tolerance of transgenic rice plants overexpressing *OsNAC5*. (C) Drought stress tolerance of transgenic rice plants overexpressing *OsNAC5*.

Near isogenic lines of rice for blast resistance genes as differential varieties

Rice blast caused by a highly variable pathogen, *Magnaporthe oryzae* B. Couch, is one of the most important diseases that reduce rice productivity worldwide. The use of resistant varieties is the most practical and economical approach to control this disease. As a useful tool to develop resistant varieties, the IRRI—Japan Collaborative Research Project released monogenic lines (MLs) for blast resistance with the genetic background of a Japonica-type rice variety, Lijiangxintuanheigu (LTH) as the first set of international standard differential varieties (DVs). However, many of the MLs showed significant differences from LTH for several agronomic traits. This may be due to the introgression of large chromosomal segments from the donor varieties, because the MLs were derived after only one to three backcrosses. Here, we developed near isogenic lines (NILs) containing single blast resistance genes by performing six backcrosses of the donors to LTH and an Indica-type variety, CO 39.

Twenty NILs containing 11 blast resistance genes derived from 19 donor varieties and 27 NILs containing 14 genes from 26 varieties were developed with the genetic backgrounds of LTH and CO 39, respectively (Table 1). The NILs showed similar reaction patterns to those of the corresponding resistance-containing monogenic lines (MLs) when challenged with 20 standard blast isolates from the Philippines, suggesting that the target resistance genes were successfully introduced. The introgression of the targeted resistance genes was further confirmed by SSR markers that were located within the chromosome regions where the resistance genes had previously been mapped. Genome surveys using SSR markers showed that the NILs had genetic compositions more similar to that of the recurrent parents than did the MLs. The morphological characteristics of each NIL were generally similar to those of the respective recurrent parents (Fig.1).

These NILs are expected to be valuable genetic tools for research and breeding programs for blast resistance. Seeds of these lines can be obtained from JIRCAS and IRRI.

(Nobuya Kobayashi, Mary Jeanie Telebanco-Yanoria [IRRI], Yoshimichi Fukuta, Yohei Koide, Hiroshi Kato [NICS], Tokio Imbe [KO-NARC])

Table 1. Target genes and donor parents of blast differential varieties with the genetic background of LTH and CO 39

Resistance genes		Genetic background	
	Chromosome no.	Lijiangxintuanheigu (LTH)	CO 39
Pish	1	–	IRBLsh-S[CO], IRBLsh-B[CO], IRBLsh-Ku[CO], IRBLsh-Fu[CO]
Pib	2	IRBLb-B[LT]	IRBLb-IT13[CO]
Piz-5	6	IRBLz5-CA[LT]	IRBLz5-CA[CO]
Piz-t	6	–	IRBLzt-T[CO]
Pi9	6	IRBL9-W[LT]	–
Pi3	9	IRBL3-CP4[LT]	–
Pi5	9	–	IRBL5-M[CO]
Pia	11	IRBLa-Ze[LT]	–
Pik	11	IRBLk-Ka[LT]	IRBLk-Ka[CO], IRBLk-Ku[CO]
*Pik**	11	IRBLk*-DU[LT], IRBLk*-NP[LT], IRBLk*-F14[LT], IRBLk*-F25[LT], IRBLk*-F66[LT]	IRBLk*-F14[CO], IRBLk*-F21[CO], IRBLk*-F25[CO], IRBLk*-F40[CO], IRBLk*-F66[CO]. IRBLk*-K86[CO]
Pik-h	11	IRBLkh-K3[LT]	IRBLkh-K3[CO]
Pik-m	11	–	IRBLkm-Ts[CO]
Pik-p	11	–	IRBLkp-K60[CO]
Pik-s	11	IRBLks-S[LT], IRBLks-B40[LT], IRBLks-Zh[LT]	IRBLks-CO[CO]
Pi1	11	–	IRBL1-LA[CO]
Pi7	11	IRBL7-M[LT]	IRBL7-M[CO]
Pita	12	IRBLta-K1[LT], IRBLta-CT2[LT], IRBLta-Zh[LT]	IRBLta-Ya[CO], IRBLta-Me[CO]
Pita-2	12	IRBLta2-Pi[LT]	IRBLta2-Pi[CO], IRBLta2-Re[CO], IRBLta2-IR64[CO]

Legend: -: Under development. Pik*: one of the Pik alleles judging from its reaction pattern.
Abbreviation of donor varieties: B: BL1, B40: B40, CA: C101A51, CO: Caloro, CP4: C104PKT, CT2: C105TTP2L9, Du: Dular, Fu: Fukunishiki, NP: NP125, F14: F-14-3, F21: F-21-6, F25: F-25-3, F40: F-40-3, F66: F-66-1, IR64: IR64, IT13: IRAT 13, K1: K1, K3: K3, K60: K60, K86: KU86, Ka: Kanto 51, Ku: Kusabue, LA: C101LAC, M: Moroberekan, Me: Metica1, Pi: Pi No.4, Re: Reiho, S: Shin2, T: Toride 1, Ts: Tsuyuake, W: WHD-1S-75-1-127, Ya: Yashiromochi, Ze: Zenith, Zh: Zhaiyeqing8

Fig.1. Donor variety of resistance gene (Upper), Near-isogenic line, IRBL9-W[LT] (Middle), and recurrent parent LTH (Lower).

TOPIC 5

Parenchyma-separator equipment for felled old oil palm trunks for efficient ethanol production

The parenchyma of old oil palm trunks, which has accumulated starch, as well as the squeezed sap from oil palm trunks, is extremely promising as feedstocks for fuel ethanol production. For the advancement of efficient ethanol production, we have developed a new equipment which prepares the parenchyma tissues by utilizing the differences in density of the squeezed sap residues which are a mix of parenchyma and vascular bundles. We conducted a separation trial of the parenchyma using this equipment with cooperation from the Forest Research Institute Malaysia (FRIM). Then, we set out on the technology transfer or extension of fuel ethanol production technology from felled old oil palm trunks and its expansion locally.

We developed the parenchyma-separator equipment for efficient ethanol production from felled oil palm trunks. This system consists of a screw conveyor with paddle and separator with cyclone mode. A parenchyma-separator equipment is used in combination with an oil palm squeezing system that was developed previously.

This equipment consists of a screw conveyor and cyclone, and it separates the parenchyma, which accounts for approximately half of the total bulk, from the residues after the squeezing of the sap (Fig.1). Sap-squeezed residues which enter into slots of the separator are stirred in the screw conveyor, and the parenchyma bound to the vascular bundles is detached in the process. The parenchyma with light specific gravity is aspirated by the exhaust blower, while vascular bundles with heavy specific gravity are transferred in the opposite direction of the air flow from the exhaust blower by a paddle mixer located in the screw conveyor, and then are discharged from there (Fig.1 right, green arrow). Parenchyma aspirated by the exhaust blower is separated by means of a spiral air flow that spans around the cylinder of the cyclone. The isolated parenchyma is then collected from the rotary valve under the cylinder of the cyclone (Fig.1 right, red arrow). The quality of the parenchyma which is isolated from the cyclone is expressed as purity of the parenchyma fraction.

We changed the rotation frequency of the screw conveyor, paddle mixer, and the flow rate of the exhaust blower in order to optimize conditions for separation in this separator equipment. When the rotation of the screw conveyor or paddle mixer was 23 rpm or 70 rpm, respectively, the purity and collection of parenchyma fraction were increased until 1,420

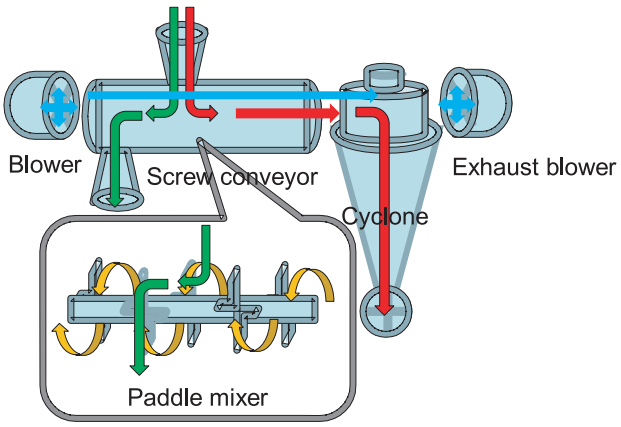


Fig. 1. Picture (left) and diagram (right) of parenchyma-separator equipment for felled oil palm trunks. Red arrow: flow of parenchyma, Green arrow: flow of vascular bundles, Blue arrow: Direction of air flow, Yellow arrow: Rotation of paddle mixer.

rpm of the exhaust blower. However, the purity of parenchyma was decreased at over 1,700 rpm of the exhaust blower (Fig.2). We could obtain a parenchyma fraction with higher purity when the rotation of the paddle was up to 70 rpm, and when the rotation of the screw conveyor and exhaust blower was 23 rpm or 1,144 rpm, respectively (Fig. 3). Purity of parenchyma at ≧ 85%, and a collection yield of 80% of parenchyma were achievable with this system.

The moisture that is contained in the sap-squeezed residues has an effect on the purity and collection rate of the parenchyma. But this equipment is able to separate oil palm residues with different specific gravity by changing some operational parameters of this equipment (ex. rounds per minute of the screw conveyor and paddle mixer, and air flow rate from the exhaust blower).

(Y. Murata, A. Kosugi, T. Arai, Y. Mori, K. Fujimoto [Forestry and Forest Products Research Institute (FFPRI)], M. N. Mohd Yusoff, W. A. Ibrahim, Puad Elham [Forest Research Institute Malaysia (FRIM)]), Othman Sulaiman, Rokiah Hashim [Universiti Sains Malaysia (USM)])

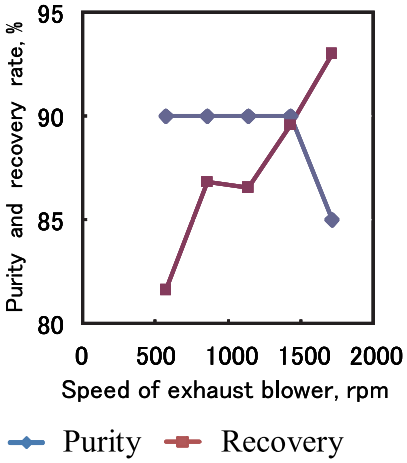


Fig.2. Effect of exhaust blower on purity and recovery rate of parenchyma.

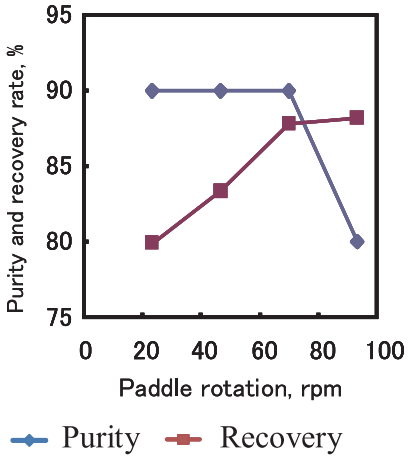


Fig.3. Effect of paddle rotation, rounds per minute (rpm) on the purity and parenchyma.

TOPIC6

Development of innovative enzyme technology for cellulosic biomass degradation

Among the cellulosome-producing microorganisms, *Clostridium thermocellum*, an anaerobic, thermophilic and spore-forming bacterium, has the most potent cellulose-degrading ability, and thus it attracted wide attention as a source of cellulolytic enzymes to hydrolyze lignocelluloses into glucose and other sugars which then can be converted into useful substances such as ethanol. The cellulosome (2-3.5 MDa) of *C. thermocellum* consists of a large (197 kDa), non-catalytic, multi-modular scaffolding protein named CipA that includes nine cohesins, four hydrophilic modules and a family III cellulose-binding module (CBM). The catalytic units are non-covalently attached to the scaffoldin via high affinity-type I interactions between the dockerin domains of the catalytic units with the cohesins on the scaffoldin. We isolated the *C. thermocellum* strain S14 (NITE P-627), which was originally isolated from bagasse paper sludge in Thailand, and which produces cellulosome with strong cellulolytic activity.

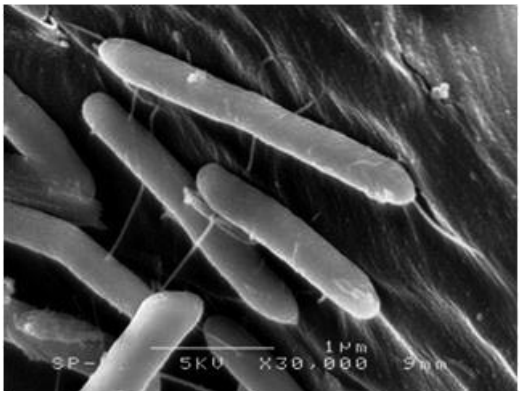


Fig.1. SEM picture of isolated *C. thermocellum* S14

To bring out the cellulolytic abilities of the cellulosome, it is necessary to eliminate inhibition against it by the major end product, cellobiose. Combining recombinant

β-glucosidase from Thermoanaerobacter with the cellulosome from *C. thermocellum* S14, accumulated cellobiose was hydrolyzed thereby resulting in significant enhancement of the microcrystalline cellulose degradation. On the other hand, when rice straw treated by soaking with aqueous-ammonia (28%) solution for 1 week at 60˚C was hydrolyzed by a combination of 10 units of β-glucosidase and cellulosome loading of 2 mg protein/g glucan, the maximum saccharification rate was achieved up to 91%. Hydrolysates from rice straw through the combination of β-glucosidase and cellulosome also could be fermented to ethanol by using the yeast, *Saccharomyces cerevisiae*, without any inhibitions up to a theoretical yield of approximately 95%. These results strongly suggest that the combination of β-glucosidase and cellulosome has a great potential as a new effective lignocellulose degradation system.

(Akihiko Kosugi, Chakrit Tachaapaikoon [KMUTT], Rattiya Waeonukul [KMUTT]

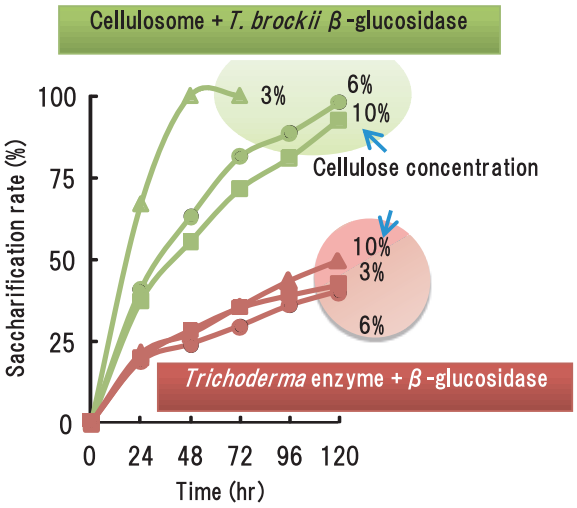


Fig. 2. Saccharification of microcrystalline cellulose using the enzyme combination of cellulosome and *T. brockii* β-glucosidase. β-glycosidase of *Aspergillus niger* was used in the case of fungi cellulase. The enzyme concentration used is 1 mg per 1 g for 3% and 6% of cellulose substrate and 2 mg per 1 g at 10%.

Table 1. Growth and enzyme properties of *C. thermocellum* S14 strain.

Growth properties	ATCC27405	S14
Growth temperature (˚C)	55 ～ 65	45 ～ 70
Growth pH	6.0 ～ 7.5	6.0 ～ 9.0
Enzyme activities (U/mg protein)		
Microcrystalline degradation	0.56±0.26	1.93±0.29
Filter paper degradation	0.037±0.01	0.068±0.02
CMCase	1.10±0.12	1.50±0.42
β-glycosidase	<0.001	<0.003
Xylanase	1.70±0.24	3.60±0.9
Pectinase	0.05±0.01	0.16±0.09

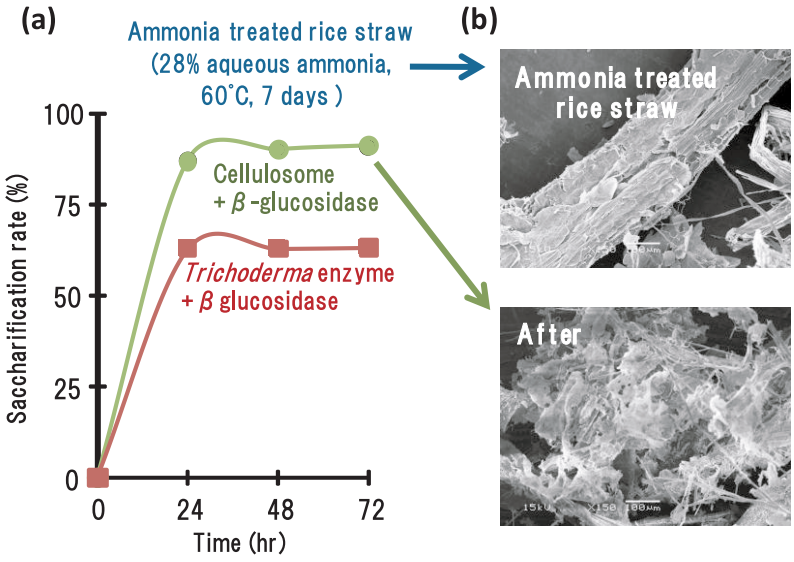


Fig. 3. Saccharification of ammonia-treated rice straw using the enzyme combination of cellulosome and *T. brockii* β-glucosidase.
(a) Saccharification profile of ammonia-treated rice straw
(b) SEM pictures after saccharification.

Manufacturing method of functional foods that has alpha-glucosidase inhibitory activity using *Bacillus amyloliquefaciens*

The demand for functional foods has also increased in developing countries because of the rise in health concerns. Therefore, we performed screening of functional substances from the same species of bacteria that had been isolated from fermented foods in East and Southeast Asia. As a result, *Bacillus amyloliquefaciens*, which had been isolated from a Thai fermented food, Thua nao and similar foods, was found to produce alpha-glucosidase inhibitory substances. Therefore, we developed a manufacturing method for functional foods that had alpha-glucosidase inhibitory activity using *B. amyloliquefaciens*.

B. amyloliquefaciens strains, NBRC3022, NBRC14141, NBRC15535, and *Bacillus subtilis* NBRC13719 were obtained from the Biological Resource Center, National Institute of Technology and Evaluation, Japan. Commercial natto bacterium was isolated from a natto purchased from a Japanese market. Rice, wheat, corn and soybean were fermented by these bacteria (Fig. 1). Fermentation extracts of *B. amyloliquefaciens* showed alpha-glucosidase inhibitory activity, while those of *B. subtilis* and commercial natto bacterium showed no activity (Fig. 2). Alpha-glucosidase inhibitory activity of the culture extracts using LB media was also similar to that of the fermentation extracts (Fig. 2).

These results showed that newly functional food materials with alpha-glucosidase inhibitory activity could be produced using the bacteria, *B. amyloliquefaciens*. These food materials may be utilizable for the manufacture of nutrition foods with inhibitory effect on elevated blood sugar levels.

(S. Nirasawa, T. Yoshihashi, L. Li [China Agricultural University] and Y. Mori)

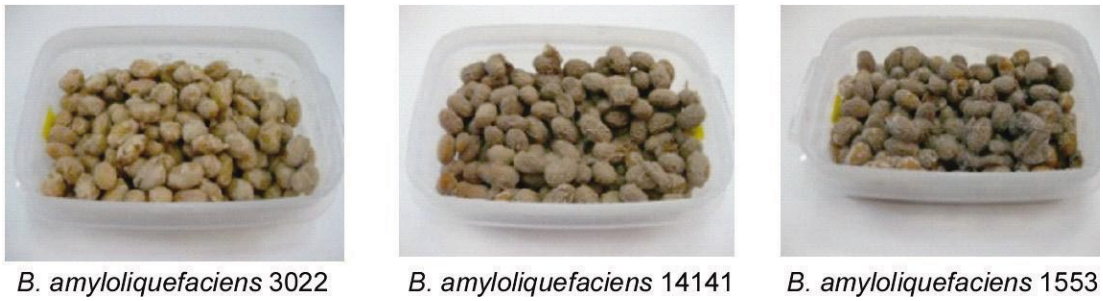


Fig. 1. Soybeans fermented with several strains of B. amyloliquefaciens.

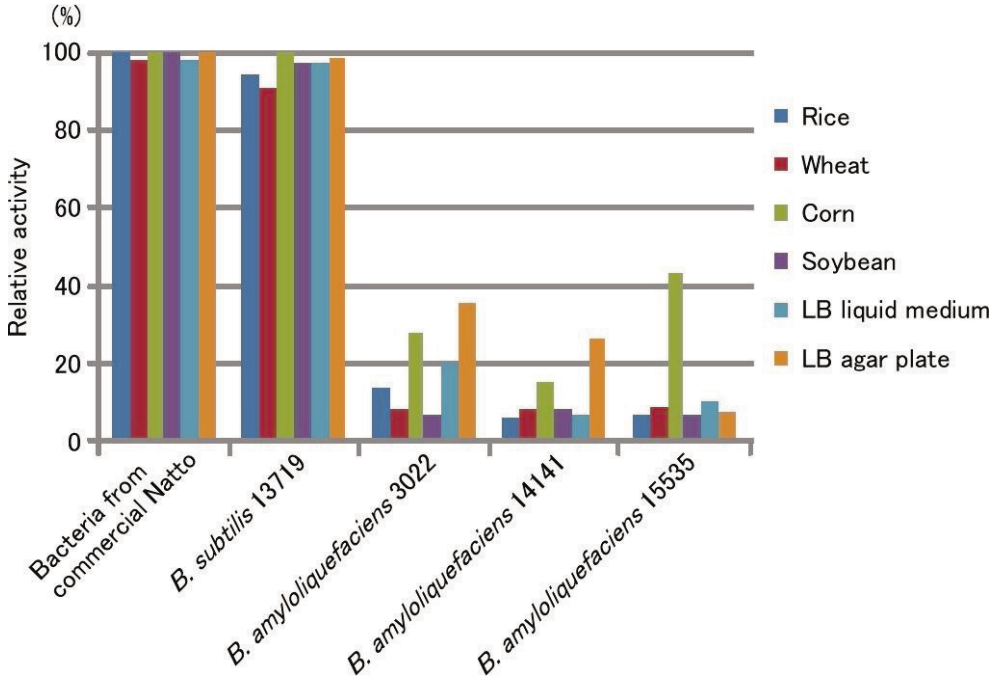


Fig. 2. The alpha-glucosidase inhibitory activities of fermented foods and culture extracts. The vertical axis indicates alpha-glucosidase relative activity (%). The value of 100% means perfect alpha-glucosidase activity without the presence of any inhibitor.

Evaluation and classification of *Erianthus* germplasm in Thailand

To relieve the tight supply of food and energy in the world, it is important to develop high biomass crops for sugar and fiber, which also exhibit higher productivity in adverse environment. The genus *Erianthus*, one of the '*Saccharum* complex', has been paid a lot of attention as a breeding material for sugarcane improvement and as raw material for cellulose production since it has high adaptability to adverse environments, especially drought. From 1997 to 2010, JIRCAS and the Khon Kaen Field Crops Research Center (KKFCRC) in Thailand collected 151 *Erianthus* accessions from all over Thailand and preserved these in the KKFCRC field. In this project, we evaluated and classified our collection of Thai *Erianthus* accessions for effective utilization in sugarcane breeding.

A total of 21 morphological characteristics, flowering phenology and cytological and biogeographical data were examined on 108 Thai *Erianthus* accessions, which were collected from 1997 to 2003. In the viewpoint of the present plant taxonomy, *Erianthus* accessions are classified into two species, *E. arundinaceus* and *E. procerus*. Further, *E. arundinaceus* is observed to be divided into three types (namely, Type I, II and III) (Fig. 1, Table 1).

E. procerus is distributed west to north and in the northern parts of northeast Thailand. Chromosome number is 2n=40, and it mainly grows on the open slopes of hills and mountains, field sides, roadsides, etc. It is difficult to propagate vegetatively because of its small buds and none to a few number of root primordia. There's too much wax and no hair on the leaf sheath except the ridges of the leaf sheath and around the ligule. Flowering time starts from December to January (Fig. 1, Table 1).

E. arundinaceus Type I is widely distributed in the Indochina peninsula. Chromosome number is 2n=60, and it also grows on the open slopes of hills and mountains, field sides, roadsides, etc. It shows a wider variation in the quantity of hair and wax at the back of the leaf sheath, but there is no accession without hair. Germination of bud is not so bad, but some accessions show poor ability in vegetative propagation. Flowering time occurs in November to January (Fig. 1, Table 1).

On the other hand, *E. arundinaceus* Type II is distributed in the southern part of Thailand. Chromosome number is 2n=60, and it grows along river banks, stream beds and swamps. It

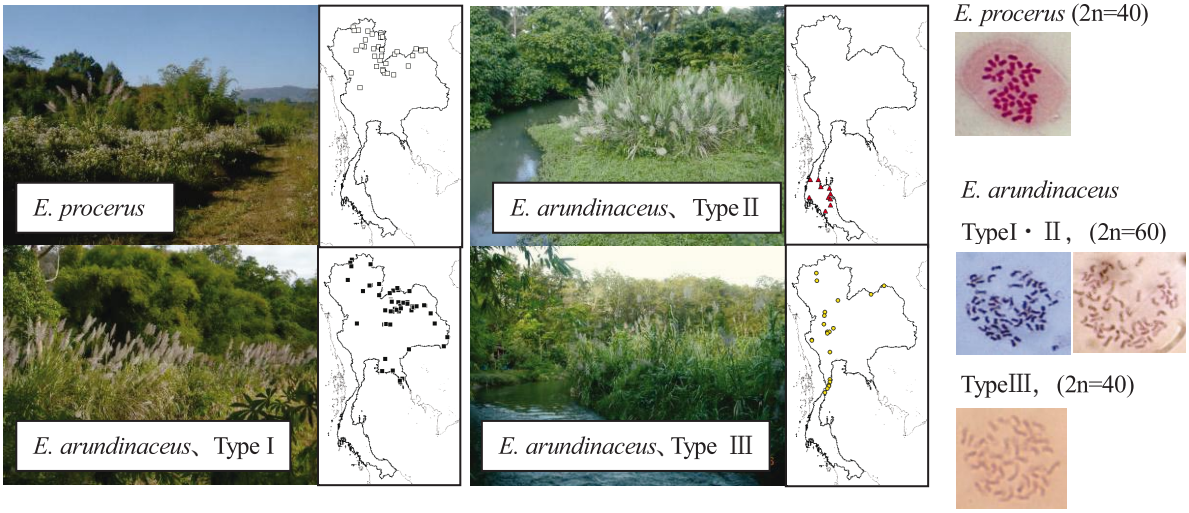


Fig. 1. Photos of natural habitats in Thailand, geographical distribution and chromosomes of *E. procerus* and three types of *E. arundinaceus*.

Table 1. Characteristics of *E. procerus* and three types of *E. arundinaceus*

Species /Type	Habitat	Flowering time	Chromosome No.	Leaf sheath		Size of buds	No. of root primordia	Collection No.
				Hair	Wax			
E. procerus	hills and mountains, field sides, roadsides	Dec. - Jan.	40	none	much	very small	none - few	43
E. arundinaceus								
Type I	hills and mountains, field sides, roadsides	Nov. - Jan.	60	few - many	none - much	small	none - few	64
Type II	riverbanks, stream beds, swamps	Dec.	60	none - few	much	big	many	15
Type III	riverbanks, stream beds	Oct. - Nov.	40	none	none	big	many	28

has big buds and a higher number of root primordia. There's none to a few hair and a lot of wax present on the leaf sheath. Flowering time occurs in December (Fig. 1, Table 1).

And, *E. arundinaceus* Type III is distributed in the western to northern parts of Thailand and along the Mekong River in the northeast. Chromosome number is 2n=40, and it grows along the riverbanks and stream beds. It is easily propagated vegetatively due to well-developed buds and root primordia. No hair and wax on leaf. Flowering time occurs in September and lasts until October (Fig. 1, Table 1). Dry matter yield of some *E. arundinaceus* accessions at the 3rd ratooning were higher than in conventional sugarcane varieties and napier grass (Fig. 2).

Erianthus is a promising material for sugarcane improvement and as a raw material for cellulose production. These results will contribute to the *Erianthus* collection, preservation and effective utilization efforts in Thailand.

(S. Tagane, A. Sugimoto, Y. Terajima, Y. Egawa, H. Ishiki, M. Sato[Kagoshima Prefectural Institute for Agricultural Development], S. Irei [Okinawa Prefectural Agricultural Research Center], W. Ponragdee, T. Sansayawichai and A. Tippayawat [Khon Kaen Field Crops Research Center, Thailand])

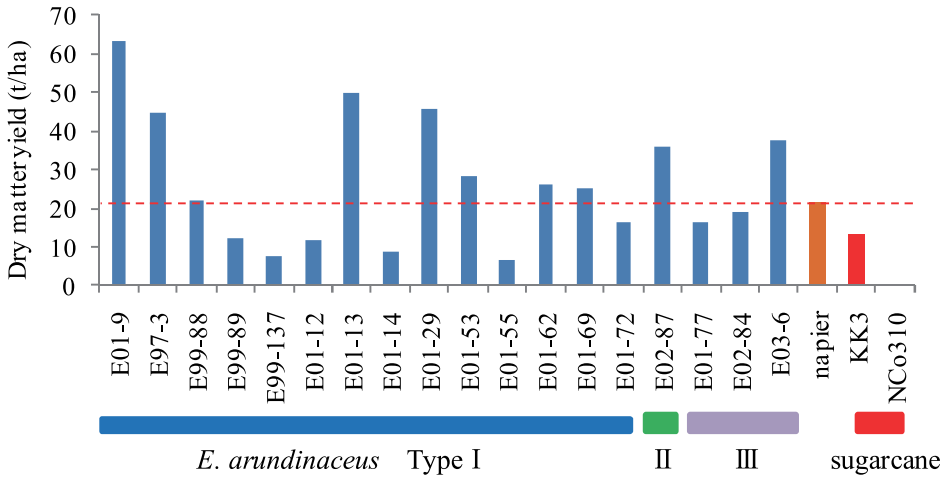


Fig. 2. Dry matter yield of some *E. arundinaceus* accessions (Type I, II, III) at 3rd rationing in the KKFCRC field.

TOPIC 9

Free amino acids in the muscle of whiteleg shrimp, *Litopenaeus vannamei*, reared under a closed, recirculating production system

The world's total production of marine shrimp has increased drastically in recent years. However, in Asian countries which produce approximately 75% of the total amount, coastal shrimp farming has brought about environmental problems such as the destruction of mangroves due to large-scale construction of shrimp ponds, or pollution of the water and soil because of the massive use of chemicals intended to prevent disease outbreaks. In order to address these problems and establish sustainable shrimp production, JIRCAS and International Mariculture Technology Co. Ltd. have developed the novel "Indoor Shrimp Production System (ISPS)" using land-based recirculating aquaculture technology. In ISPS, whiteleg shrimp (*Litopenaeus vannamei*) are reared to market size in low salinity water (5 ppt) in order to reduce rearing costs. However, in general, crustaceans show decreased free amino acid (FAA) levels in the muscles under low salinity conditions, which may thereby lower their value as a food product, as FAAs are important factors influencing the taste of the marine products. In the present study, FAAs were analyzed in the muscles of L. vannamei produced by ISPS (ISPS-whiteleg shrimp), and in other commercially cultured shrimp species, e.g., kuruma prawn (*Marsupenaeus japonicus*) produced domestically in Japan, giant tiger prawn (*Penaeus monodon*) imported from Vietnam, Indian prawn (*Fenneropenaeus indicus*) from the Kingdom of Saudi Arabia, Pacific blue shrimp (*L. stylirostris*) from New Caledonia, and whiteleg shrimp (*L. vannamei*) imported from Indonesia.

Analysis using high performance liquid chromatography (HPLC) revealed that ISPS-whiteleg shrimp (Fig. 1) showed high levels of total free amino acids (the sum of 19 free amino acids examined in this study), and key FAAs

including glycine and glutamine. These levels were similar to those of the kuruma prawn produced domestically in Japan, but higher than those of imported shrimp species (Fig. 2). These results demonstrate that a high-value shrimp destined for human consumption can be produced by ISPS. In addition, the ISPS-whiteleg shrimp has been highly evaluated on the domestic market.

Based on the fact that ISPS can be established inland without using chemicals and depending on the use of fresh seawater, ISPS can minimize impact to the environment. Moreover, the present study shows that ISPS can produce a high-value product for the market. Though some modifications may be necessary to adopt it for use overseas, including the developing regions, the advantages of ISPS as discussed above have great promise to contribute to the establishment of sustainable shrimp production industries.

(T. Okutsu, J. Shinji [International Mariculture Technology Co. Ltd.], S. Nohara, T. Nomura, Y. Maeno, M. N. Wilder)

Fig. 1. *Litopenaeus vannamei* produced by ISPS

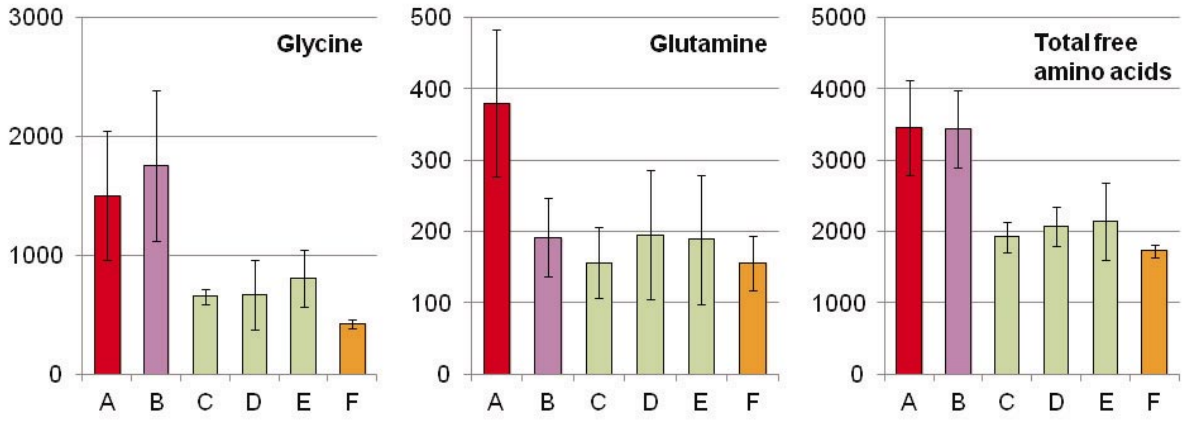


Fig. 2. Free amino acids (glycine, glutamine, and total free amino acids) in the muscles of shrimps of the Penaeidae family (mg/ 100g)
A. ISPS-whiteleg shrimp (Litopenaeus vannamei)
B. Kuruma prawn (Marsupenaeus japonicus) produced in Japan
C. Giant tiger prawn (Penaeus monodon) imported from Vietnam
D. Indian prawn (Fenneropenaeus indicus) imported from the Kingdom of Saudi Arabia
E. Pacific blue shrimp (L. stylirostris) imported from New Caledonia, France
F. Whiteleg shrimp (L. vannamei) imported from Indonesia

TOPIC 10

Seed production and growth of Laotian cyprinid *Hypsibarbus malcolmi*, a high-potential aquaculture target species

In Laos, aquaculture has been promoted in recent years due to necessity arising from the increase of fish demand as a recent development of the expanding national population. However, the aquaculture production of the country at present is largely dependent on alien fishes (> 80%), e.g., the tilapia *Oreochromis niloticus*. In consequence, the invasive settlement of such species in the region has progressed, this settlement leading to a concern of possible disruption /decline in indigenous fish fauna, although total aquaculture production has rapidly increased due to the aquacultural utilization of such alien species. Considering this situation, further development of indigenous fish aquaculture in the region is now required. *Hypsibarbus malcolmi* (Cyprinidae, Fig. 1) is widely distributed in the Indochinese Peninsula, including Laos, and is a common marketable fish species, but it has not been used for aquaculture so far. In this study, therefore, we attempted artificial seed production, examined its productivity, and described the growth and morphological development of the species.

Through the experimental trial on seed production of *Hypsibarbus malcolmi*, the following results were obtained: (1) ca. 100,000

fertilized eggs per female (600—1,000g) were obtainable by means of an LH-RH analogue hormone injection. (2) The larvae consumed the yolk completely on Day 2 after hatching at the average size of 3.3 mm in body length (BL) (Figs. 2, 3), and started feeding. (3) Artificially produced rotifers (*Brachionus* spp.) were sufficient initial diet, and high feeding incidence rate was observed (100% on Day 3). (4) Fish shifted from the larval to juvenile stages at 10.4 mm BL with completion of aggregated fin rays (Fig. 4). (5) No cannibalism took place and high survival (> 90%) rate was observed within 30 days of rearing since hatching.

As shown above, the high fecundity of adult *Hypsibarbus malcolmi* and high survival during the early developmental period (larval and juvenile stages) represent the exceptional applicability of the species for seed production and aquaculture; these features being sufficient for technical transfer to private seed producers. In addition, the morphological information obtained here is contributory to species identification of *Hypsibarbus malcolmi* among various sympatrically distributed cyprinids. On the other hand, other factors adequate for aquacultural operation (e.g., feed conversion rate, disease tolerance), growth under aquacultural conditions until harvest and their extension to private farmers are still to be investigated not only for *Hypsibarbus malcolmi* but for the other species (total of nine species) in which seed production trials have so far been experimentally successful with the cooperation of JIRCAS.

(Shinsuke Morioka, Yuka Ogata [The University of Tokyo], Kosuke Sano [The University of Tokyo], Bounsong Vongvichith [Living Aquatic Resources Research Centre (LARReC), NAFRI], Hiroki Eda [IC Net Ltd.], Hisashi Kurokura [The University of Tokyo] and Thongkhoun Khonglaliane [Department of Livestocks and Fisheries])

Fig. 1. *Hypsibarbus malcolmi* (110 mm BL). Scale bar: 10 mm.

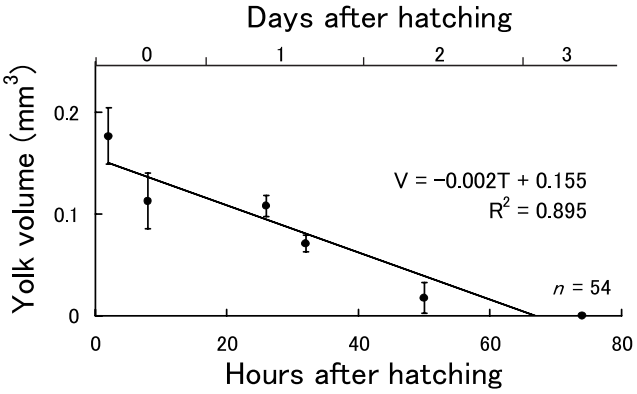


Fig. 2. Growth of *Hypsibarbus malcolmi* larvae and juveniles (dotted line: complete absorption of yolk, error bars: standard deviations.

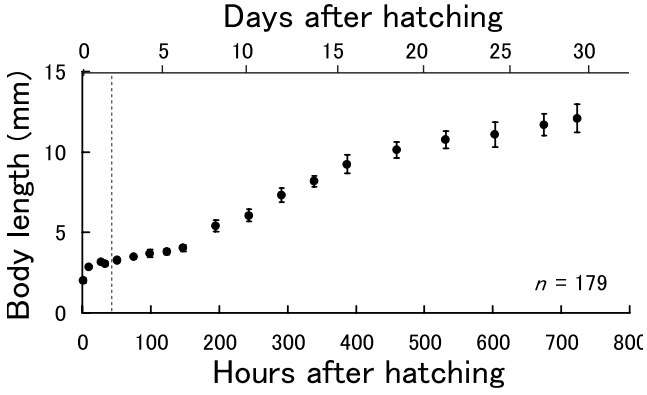


Fig. 3. Yolk absorption pattern in *Hypsibarbus malcolmi* larvae (error bars: standard deviations, V: yolk volume, T: hours after hatching.

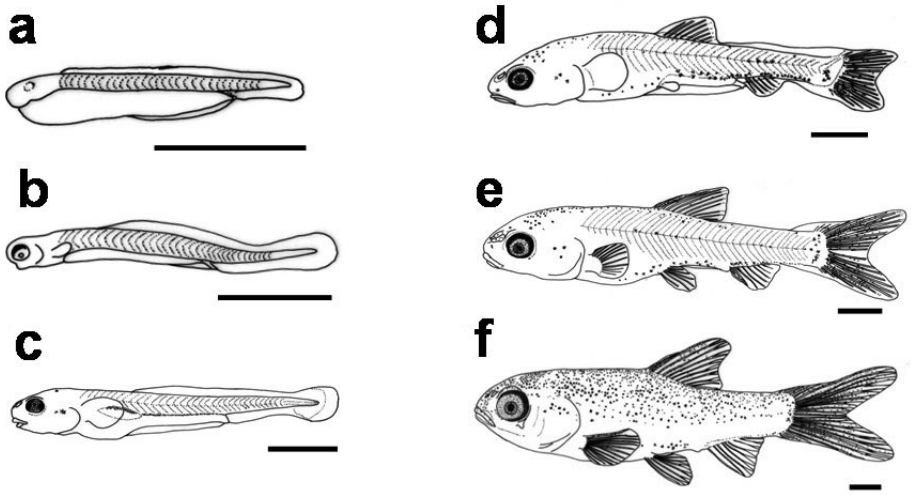


Fig. 4. *Hypsibarbus malcolmi* larvae and juveniles. **a** larva at hatching (yolksac period, 1.9 mm BL), **b Day** 1 larva (yolk sac period, 3.0 mm BL, **c Day** 6 larva (flexion period, 4.4 mm BL), **d Day** 12 larva (flexion period, 7.3 mm BL, **e Day** 16 larva (post flexion period, 9.1mm BL), **f** Day 30 juvenile (12.9 mm BL). Scale bar: 1 mm.

Diversity and characterization of oxytetracycline-resistant bacteria associated with white-leg shrimp and giant tiger shrimp which are intensively cultured in Thailand

Shrimp is a globally popular seafood and is traded worldwide. Significant increase in demand has encouraged the aquaculture industry in the developing countries of South Asia and Latin America, and world production reached almost 3.3 million metric tonnes in 2007, with exports exceeding US$14 billion in that year (FAO, 2007). Thailand is one of the major producers of shrimp and is the largest exporter in the world (Tanticharoen *et al.*, 2008). Shrimps in aquaculture are intensively grown and vulnerable to various infectious diseases. Hence, antibiotics are used extensively as therapeutic and prophylactic agents in shrimp cultures. This use has increased the antibiotic resistance of shrimp pathogens, as has also occurred in fish farming. Oxytetracycline is frequently used as a therapeutic and prophylactic agent in aquaculture industries, and many studies have reported OTC resistance in fish pathogens (Aoki *et al.*, 1974; Chopra and Roberts, 2001). Few studies, however, have investigated the prevalence of drug resistance in commensal bacteria associated with cultured fish and shrimps, including those species related to human pathogens (Schmidt *et al.*, 2000, Boinapally and Jiang, 2007). Our previous

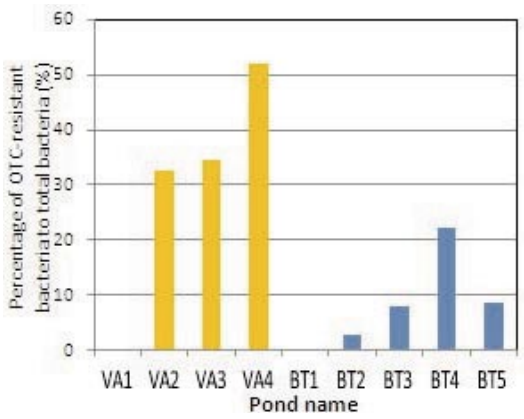


Fig. 1. Ratio of viable counts of oxytetracycline (OTC)-resistant bacteria to total bacteria associated with shrimps intensively cultured at brackish water ponds in Thailand.
VA1-4: White leg shrimp (*L. vannamei*) ponds
BT1-5: Black tiger shrimp (*P. monodon*) ponds

Table 1. Minimum inhibitory concentration of oxytetracycline (OTC) to bacterial isolates using Tryptic soy agar with and without OTC from intensively cultured shrimps in Thailand

Plate for isolation	Bacterial group	No. of strains	Minimum inhibitory concentration (μg/ml)												
			<0.5	0.5	1	2	4	8	16	32	64	128	256	512	512<
TSA	*Aeromonas* spp.	52	0	0	0	0	2	2	11	16	11	10	0	0	0
with OTC	*Shewanella* spp.	4	0	0	0	0	0	0	0	0	4	0	0	0	0
	Lactococcus spp.	27	0	0	0	0	0	0	0	0	0	3	24	0	0
TSA	*Aeromonas* spp.	8	5	0	0	0	0	0	0	3	0	0	0	0	0
	Shewanella spp.	3	3	0	0	0	0	0	0	0	0	0	0	0	0
	Lactococcus spp.	3	3	0	0	0	0	0	0	0	0	0	0	0	0
	Vibrio spp.	21	21	0	0	0	0	0	0	0	0	0	0	0	0

TSA: Trypticase soy agar plate

Table 2. Multiple antibiotic resistance profile of OTC-resistant isolates from intensively cultured shrimp in Thailand

Plate for isolation	Group of strains	No. of strains	Antibiotics resistance profile
TSA	*Aeromonas* spp.	18	OTC(6), OTC/EM(2), OTC/ABP/NA(10),
with OTC	*Shewanella* spp.	3	OTC(1), OTC/SM(1), OTC/NA(1)
	Lactococcus spp.	8	OTC/SM/NA(8)
TSA	*Aeromonas* spp.	8	EM(3), NA(1), OTC/ABP/NA(3), OTC/ABP/EM/NA(1)
	Shewanella spp.	4	ABP(1), SM(1), SM/NA(1), no(1)
	Lactococcus spp.	4	SM/NA(3), OTC/SM/NA(1)
	Vibrio spp.	9	ABP(4), SM(2), EM(1), no(2)

Legend:
Numbers in parentheses mean the number of isolates resistant to the antibiotics OTC (oxytetracycline), ABP (ampicillin), CAZ (ceftazidime), IPM (imipenem), SM (streptomycin), EM (erythromycin), NA (nalidixic acid), CP (chloramphenicol).
No of strains: the total number of strains susceptible to the antibiotics tested.

studies found that live cultured shrimps sold at markets often contain high levels of bacteria including human pathogens (Yano *et al.*, 2004; Yano *et al.*, 2006).

Black tiger shrimp, a native species, was farmed intensively for several decades in Thailand. During the early 2000s, the white-leg shrimp, native to Latin America, was transferred to shrimp industries in Thailand following a decrease of black tiger shrimp culture due to infectious disease (Szuster, 2006). Currently, white-leg shrimp accounts for 98% of the total shrimp production entering the shrimp auction in this area, although black tiger shrimps are still cultured on a small scale (Wyban, 2007). Little is known about the commensal bacteria and their possible drug resistance in either the newly transported shrimp species, or in the endemic black tiger shrimps. This study aimed to survey the prevalence of oxytetracycline (OTC)-resistant bacteria in the white-leg shrimp *Litopenaeus vannamei* (a non-native species), and the black tiger shrimp *Penaeus monodon* (a native species), intensively cultured in Thailand.

We investigated the phylogenetic diversity of the OTC-resistant bacterial isolates, as well as the minimum inhibitory concentration (MIC) of OTC, the occurrence of major OTC-resistant genes and multiple antibiotic resistance in the isolates. Shrimps were collected and plated on Tryptic soy agar supplemented with or without oxytetracycline. Percentages of OTC-resistant bacteria were 0.3—52.1% in white-leg samples, and 0.008—22.3% in black tiger samples. Analyses of 16S rDNA sequences indicated that most OTC-resistant isolates were closely related to *Aeromonas* spp., *Shewanella* spp., and *Lactococcus garvieae*. MICs of OTC were 4—128 μg/ml in the OTC-resistant Aeromonads, and 128—256 μg/ml in OTC-resistant *L. garvieae*. OTC resistance was found to be conferred by the genes *tet*(A), *tet*(C), *tet*(D), *tet*(E), *tet*(M), and *tet*(S), detected either singly or in pairs. No resistance to ceftazidime, imipenem or chloramphenicol was observed in any isolate. Both species of shrimp are associated with OTC-resistant bacteria at high densities (occasionally exceeding 10^6 cfu/g). The associated bacteria, predominantly *Lactococcus* and *Aeromonas* genera, are potential pathogens, and are reservoirs of a variety of OTC-resistant genes.

(Y. Yano, K. Hamano, M. Satomi, I Tsutsui and D. Aue-umneoy [King Mongkut's Institute of Technology])

Theme A-2 Development of management technologies of environmental resources and production systems for sustainable agriculture, forestry and fisheries

Natural resources that are the foundation of agriculture and forestry have begun to show signs of deterioration worldwide due to inadequate management and excessive use of agricultural inputs. Therefore, we need to develop production management systems which focus more on socioeconomic conditions, enabling the same systems to be adopted and utilized in the target countries; control technologies for soil nutrients and water conditions suitable for sustainable production in tropical, subtropical, arid or semi-arid regions; and production management systems combining agriculture and animal husbandry in various ways to be achieved by improving individual production methods.

To accomplish the effective use of natural resources and the development of systems for sustainable production management by combining various practices in agriculture, animal husbandry and forestry, we have engaged in researches on the optimization of soil, water and crop management for agricultural, grazing and forested lands as well as islands.

The following items can be listed as major outcomes accomplished in 2010:

- **In the semi-arid regions of Africa with infertile sandy soils**, various possibilities to disseminate the soil fertility management techniques were evaluated utilizing the Mother-Baby method. The model field is called the mother plot and farmers' fields are called baby fields. The results indicated that management techniques such as intercropping of cowpea and pearl millet, application of threshing residues of pearl millet or animal droppings, and combined use of chemical fertilizers have a higher possibility of dissemination. These techniques have a common factor for their adoption in that the effects could be grasped easily by the farmers themselves in terms of yield-related factors. The soil fertility of rice fields in Ghana was surveyed and the local application of organic matters increased rice yield up to 150% of the control. Direct application of phosphate rocks significantly increased rice yield in on-station experiments.
- **In rainfed agriculture area in Southeast Asia**, a management manual for diversified

cropping of main crops through the effective use of water resources was released and the dissemination of the techniques has been started through the farmers' participatory method. For mountainous areas, a soil fertility map, water resources distribution characteristics and suitable location map for paddy fields were drawn based on the data on outflow, soil erosion and nutrient loss. These outputs enable a sustainable and stable manner of farm management. The book which introduces the research activities and the results of the water-saving agriculture study in Laos and Thailand was published afterwards.

- **In a flood plain of Volta River in northern Ghana**, a possibility to introduce rice cultivation was revealed through the intensive survey on location environment, hydrological environment, vegetation and farm management. The database, "Plants in lowland savanna of West Africa", which includes rice fields was released in the JIRCAS homepage. The database describes the physiological characteristics and exhibits images of plants, academic names, origin and ecological information of the about 110 species found in the area.
- **In the water-saving rice cultivation project**, Rice (*Oryza sativa* L.) breeding materials, Chromosome Segment Substitution Lines (CSSLs) with IR64 genetic backgrounds, were developed. The materials have diversified traits related to heading dates, yield, etc., which could be exploited for genetic analysis and breeding materials and could contribute to the water-saving rice cultivation. Alternate wetting and drying (AWD) rice cultivation, which was proven to be effective in the reduction of greenhouse gas emission through significant CH_4 reduction, was assessed in terms of soil fertility. After successive eight cropping cultivation, AWD did not cause deterioration to the soil C and N, and the addition of straw even played a significant role in enhancing their contents.
- **Regarding animal husbandry in Indochina Peninsula**, a feeding standard for beef cattle and the standard table of feed composition were published and delivered to the related universities and research institutes, and training for extension workers on using these materials were done extensively in Thailand.
- **In research on measures to prevent desertification in Northeast Asia**, a model prediction based on a grazing experiment revealed the possibility of being able to estimate the optimum grazing pressure in Mongolian forest-steppe grasslands. A method for the rapid drawing-up of grassland biomass map covering a large area spanning several hundreds of square kilometers using satellite data was developed. The method is based on the regression formula between the measured grass biomass and the detailed spectrometric data on the same site, which could be used to predict the carrying capacity of grasslands to indicate the ideal sites for grazing of livestock, which could also contribute toward preventing damage to animals arising from shortage of grasses, especially in severe winter. Scenario prediction using a vegetation-grazing model was performed; a coordinated control of the number of animals among herders could facilitate the conservation of grasslands together with the provision of a stable income for herders in the long run.
- **In research on biological nitrification inhibition (BNI)**, the excretion patterns of BNI-inducing substances, both hydrophilic and hydrophobic ones were clarified, and the mechanism elucidated. A rice variety with relatively high BNI activity was selected and *in situ* activity was verified in rhizosphere soil. Previous knowledge on the effect of NH_4^+ on ammonium-oxidizing bacteria and archaea was verified by monitoring gene (*amoA*) expression of ammonium mono-oxygenase.
- **In research on the proper management of the farming environment,** a no-till cultivation with mulching technique, utilizing legume as a cover crop, which was proven effective in reducing soil erosion in Africa was found to be as efficient in the no-till maize cultivation undertaken after planting pigeon pea as cover crop in the Philippines. On the research on the exploitation of freshwater lens in the atoll, the boundary between salt water and freshwater was determined by a groundwater survey at Marshall Islands using electromagnetic probe and an on-site survey, which revealed the gradual upward shrinking of the freshwater lens after a period of drought in 1998. It is difficult to replenish and restore the freshwater in the freshwater lens once it is salinized. A denitrification and decomposition (DNDC) model was applied to the Todoroki River in Ishigaki Island, and a watershed model which can evaluate the combined effect of cultivation methods on soil erosion and nitrogen run-off was established.

- **In research on the technique for nurturing indigenous tree species**, tree growth was simulated virtually on the computer and the optimum condition was elucidated based on the light environment after thinning. Measures for better and sustainable farm management in introducing teak plantation was proposed through a profitability analysis. Dynamics of the selective logging implemented over *Shorea curtisii* stands on the hill Dipterocarp forest in Malay Peninsula revealed that adult trees of 60 cm to 100 cm in diameter at breast height (dbh) should be retained at a higher density within 50 m, so that the rate of reproduction and regeneration could be maintained at a high level. If such precaution is not taken, the forest can only regain its biomass to the same level as the original natural forest 110 years after logging at the earliest time possible under the present harvesting system. Thus, adult trees should be maintained at higher density compared to the current level and the gap between logging periods needs to be lengthened as well.
- **In tropical fruit tree research**, a daytime pollination technique for durian tree was developed because pollinators of durian trees (bats) are rarely found in Thailand. Thus, pollens gathered the previous night are stored and used for artificial pollination the next day after 4 PM when the stigmas of durians are exposed. As for mangosteen trees, a physiological disorder of the fruits called "glass fruit" was alleviated by soil amelioration through the addition of barks and manure into the soil combined with treatment by ester of oleic acid to enhance evaporation from the fruit's skin.

TOPIC 1

Combination effect of planting density and 4:4 crop design in the system of millet/cowpea rotation in the Sahel, West Africa

Integrated soil fertility management is not only intended to add nutrients but also to include appropriate legume crops, density and crop design. In the Sahel of West Africa, poor farmers cannot afford to buy enough chemical fertilizers, organic manure or both. An alternative such as rotation with optimized planting density of selected varieties of legumes in an intercropping system with cereals would be a low-cost input technology.

An improved cowpea (*Vigna unguiculata*) variety, TN256-87, has been selected in the project (JIRCAS Research Highlights, 2006). It is a dual-purpose (both for grains and fodder) and high density-tolerant cultivar compared to local ones. For crop design, one row of the local variety of pearl millet (Hini Kirey, *Pennisetum glaucum*) followed by one row of local cowpea (1:1) represented the farmers' traditional method in the Sahel. In this study, four rows of local millet followed by four rows of improved cowpea (4:4) would be proposed as a new method to assist farmers in conducting the rotation more simply and easily (Fig. 1). The combination effect of three cropping densities of the improved cowpea with one cropping density (5882-6275 plants/ha as low) of the local pearl millet, two crop rotations (with or without rotation) and two crop designs (1:1 and 4:4) were evaluated in the experimental station at Sadore, ICRISAT, West and Central Africa, Niger, for three years. The results indicate that the crop rotation significantly increased total biomass by 39%, millet yield by 50% (Fig. 2, 3). And on the other hand, the 4:4 crop design didn't adversely reduce total biomass and millet yield. The crop density also didn't affect the millet biomass and yield owing to the high density-tolerant variety of cowpea.

In conclusion, the combination of four rows of local millet with low density (6,300 plants/ha) followed by four rows of cowpea with low to high densities (6,300 — 32,000 plants/ha, depending on the variety) is highly recommended for farmers to be able to carry out a cereal-legume rotation more simply and effectively in their fields.

(Addam Kiari Saidou [Institut National de Recherche Agronomique du Niger], Hide Omae, Satoshi Tobita)

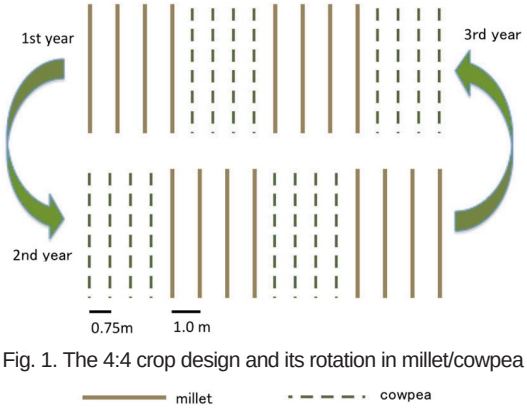


Fig. 1. The 4:4 crop design and its rotation in millet/cowpea

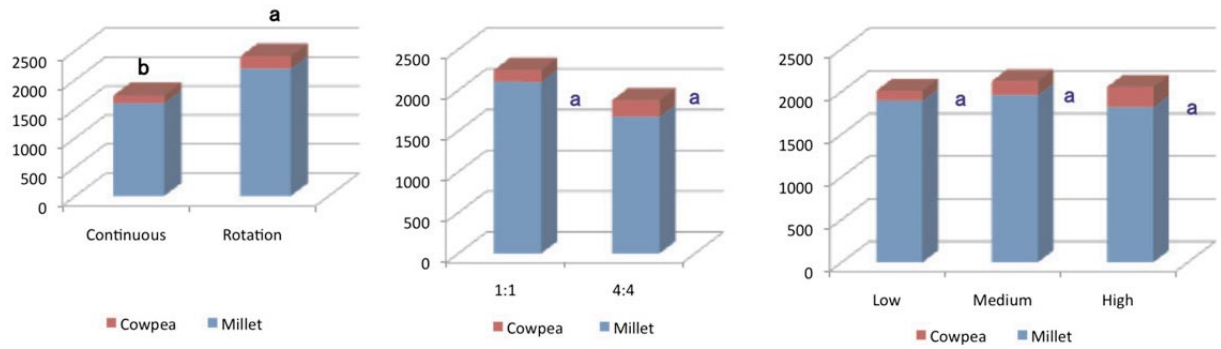


Fig. 2. Effects of crop rotation (left), crop design (middle), and crop density (right) on crop biomass.
A dual-purpose cowpea variety, TN256-87, was used. Crop densities for cowpea consisted of low (5,900 – 6,300 plants/ha), medium (11,000 – 12,000 plants/ha) and high (29,000 – 32,000 plants/ha) densities, while low (5,900 – 6,300 plants/ha) density only for millet. Different alphabets indicate results are statistically significant at 5% level (Student t).

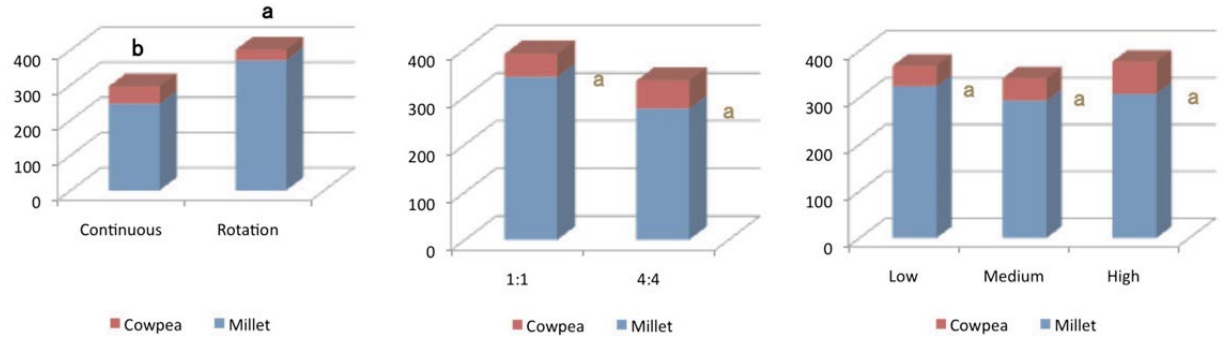


Fig. 3. Effects of crop rotation (left), crop design (middle), and crop density (right) on crop yield.
The cowpea variety and crop densities are the same as Fig. 1. Different alphabets indicate results are statistically significant at 5% level (Student's t-test).

TOPIC2

On-farm evaluation of the acceptability of the sustainable millet production technologies in the Sahel, West Africa

Evaluation of the local farmers' acceptability of the new cultivation technologies is very important especially in Sahel, West Africa, where their dissemination is constrained by many factors: namely, poor infrastructure, lack of materials for agriculture, possible adverse reaction to the new technologies and so on. JIRCAS has carried out a project in the Sahel on soil fertility management with utilization of natural organic resources since 2003, and has clarified the effects and developed several focal technologies as intensive management (JIRCAS Research Highlights, 2006 and 2008). In this study, the acceptability level of those technologies was evaluated, and factors which determined the acceptability were identified through participatory approach (Mother-Baby trials with some modifications according to the objective).

The effectiveness of the technologies was demonstrated at "mother" fields of four villages in the Fakara region, Republic of Niger, West Africa for two years. The local "baby" farmers, at the same time, freely selected the technologies based on their own interests, and practiced them at their own "baby" fields. Within the three year-activities, they learned, became convinced and took ownership of those technologies through modification processes (Fig.1). During the activities, the percentages of trials with sole application of chemical fertilizers and sole cultivation of millet (*Pennisetum glaucum*) decreased drastically. On the contrary, trials with millet/cowpea (*Vigna unguiculata*) intercrops, applied crop residues, livestock excreta, and combination with chemical fertilizers increased year by year (Fig. 2). The technologies which increased in the number of trials could be regarded as highly acceptable technologies. The determinant analysis on the acceptability level indicates that: 1) Lack of money could constrain application of chemical fertilizers; 2) The distance between deposit points of organic matters and field

location is important for the technology's application, as 100% of "baby" fields applied with crop residues are located about 500 m within the threshing points;

3) Possession of livestock causes easier availability of excreta; and 4) Awareness of the effectiveness of the application, as 72% of "baby" farmers became aware of the positive effect of the application of crop residues and livestock excreta, and 79% recognized that the amounts of resources, money and means of transportation could accelerate the dissemination of new technologies.

In conclusion, the acceptability level of the technologies could be increased by the process of allowing the farmers to do their own practical application of the technology, their becoming convinced of the effectiveness of the technologies on their own, and guarantee of the availability of organic materials such as livestock excreta and crop residues.

(Hide Omae, Keiichi Hayashi, Ibro Germaine [Institut National de Recherche Agronomique du Niger])

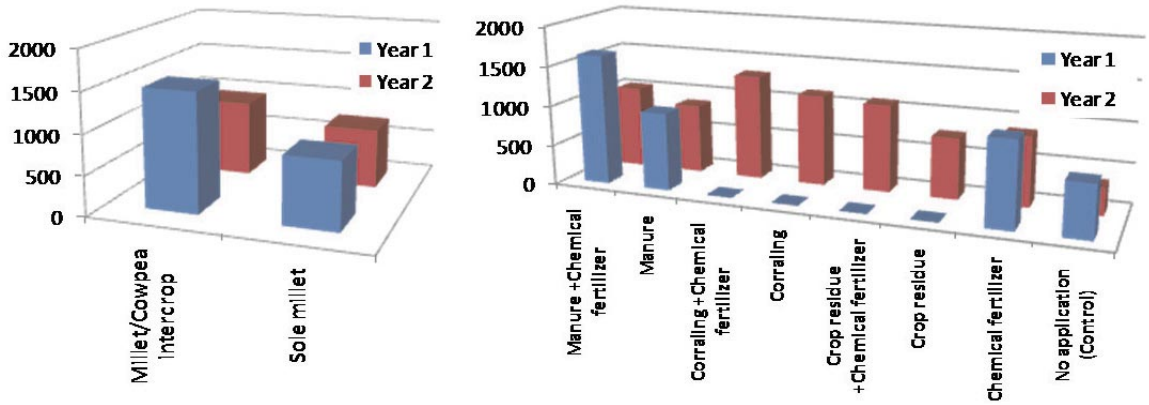


Fig. 1. Results of farmers' "baby" trials indicate the effects of intercropping (left) and fertilizer application (right) on millet yield (kg/ha) in their "baby" fields.

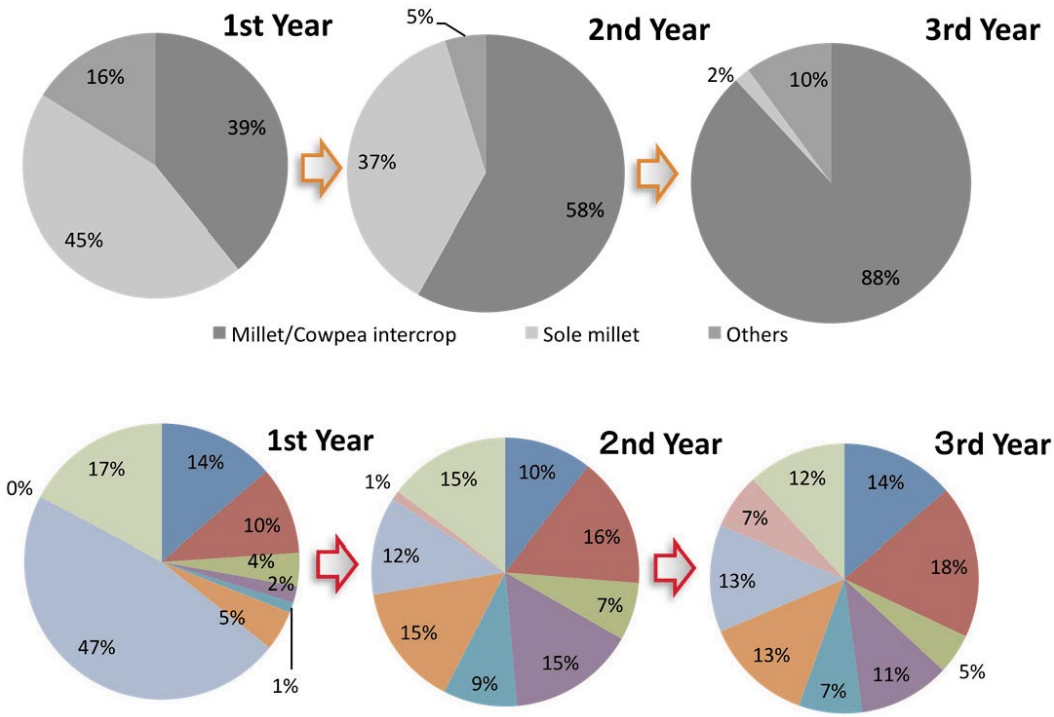


Fig. 2. Changes of farmers' "baby" selection and trials in the cropping systems (above) and fertilizer application (below) in their "baby" fields.

Introgression lines of an Indica-type rice variety IR64 with unique agronomic traits

IR64 was released by the International Rice Research Institute (IRRI) in 1985, and has been widely accepted as a high quality rice variety in many countries. In the late 1980s, a breeding program to develop a new plant type (NPT) of rice was launched at IRRI with the goal of increasing yield potential under tropical environments. In this study, the NPT varieties were chosen for experiments designed to improve the yield potential of IR64.

A total of 334 introgression lines (INLs) derived from crosses between IR64 and ten donor varieties (mostly NPT varieties) have been developed as breeding materials for rice yield enhancement under the IRRI-Japan Collaborative Research Project Phases III and IV. The agronomic traits of the 334 INLs were evaluated in IRRI during Phase V of the project from 2005 to 2007 and the genotypes of the 334 INLs were clarified using more than 400 SSR markers. Based on the data of phenotype and genotype for these INLs, a total of 54 regions were detected to be associated with the eight traits: 7 regions for days to heading, 8 for culm length, 8 for leaf width, 4 for leaf length, 6 for panicle length, 3 for panicle number per plant, 7 for 100-grain weight, and 11 for total spikelet number per panicle. The developed 334 INLs with the IR64 genetic background will be useful materials for genetic analysis of agronomic traits as well as breeding for genetic enhancement of the yield potential of rice varieties.

(Nobuya Kobayashi, Daisuke Fujita [IRRI], Tokio Imbe [KO-NARC], Hiroshi Kato [NICS], Yoshimichi Fukuta)

Table 1. Donor parents, no. of developed lines and no. of polymorphic DNA markers between the parents of IR64 introgression lines

Sib line group	Donor parent	No.of lines	No. of polymorphic markers
YP1-INL	IR65600-87-2-2-3	36	247
YP3-INL	IR65598-112-2	23	248
YP4-INL	IR65564-2-2-3	45	261
YP5-INL	IR69093-41-2-3-2	56	262
YP6-INL	IR69125-25-3-1-1	29	260
YP7-INL	Hoshiaoba	21	238
YP8-INL	IR66215-44-2-3	29	224
YP9-INL	IR68522-10-2-2	16	266
YP10-INL	IR71195-AC1	39	280
YP11-INL	IR66750-6-2-1	40	276

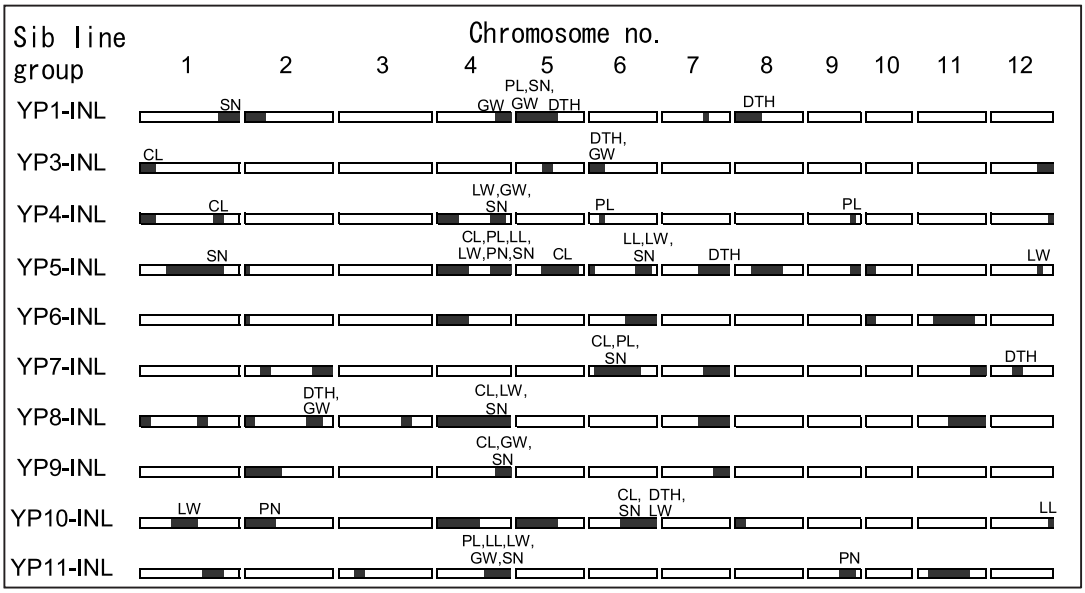


Fig. 1. Graphical genotype of IR64 introgression lines bulked by sib line group derived from the same cross combination.
■: Introgressed chromosome segment from donor variety detected by SSR markers. Associated with DTH: days to heading, CL: culm length, PL: panicle length, LL: leaf length, LW: leaf width, PN: panicle number, GW: grain weight, SN: spikelet number per panicle.

Guidelines for water-saving vegetable production by Northeast Thailand farmers

The “dry sand layer effect” enables the storage of a certain amount of excess rainfall from the rainy season which remains until almost the end of the dry season in northeast Thailand. Using the saved soil moisture for use during the dry season, a water-saving vegetable production method was developed through farmer participatory approach.

The guidelines (Fig. 1) were created as follows. From 2004-2005, a water-saving tomato cultivation method utilizing local resources was developed in Nong Saeng Village, Khon Kaen Province, Thailand. Within the period spanning 2006-2007, the method proved its adaptability and it improved yield level when used in conjunction with the local farmers' technique of returning plant residues to the soil. The technique was applied by 58 farmers out of 22 villages in two provinces (Khon Kaen and Mahasarakham). For the period 2009-2010, suitability of the method for several crops, such as leafy vegetables, fruit vegetables and beans, was evaluated through experimental application by 15 learning-center farmers in four provinces (Khon Kaen, Mahasarakham, Mukdahan, Sakhon Nakhon) (Fig. 2).

The guidelines were formulated in cooperation with the JIRCAS Rainfed Agriculture Project (RAP) and the Thai Agricultural Land Reform Office Project for Revitalization of Degraded Environment in Land Reform Areas through Integrated Agricultural Development (Pro-IAD). The protocol for establishing the guidelines was as follows: At first, RAP and Pro-IAD discussed and decided the making of two types of guidelines. One is the no-watering cultivation for paddy fields after harvesting; the other is a water-saving cultivation technique for general conditions. Both of them are for leafy vegetables, fruit vegetables and legumes. Then, volunteer farmers were selected from four provinces of the Pro-IAD area. Farmers chose the test crops on their own. After the experiment, all the farmers assembled, discussed their results and formulated the guidelines.

The first water-saving cultivation guideline for major crops reduced watering from twice a day to once every five days. This will be useful for both organic and chemical agriculture. Watering is essential to dissolve fertilizers in the soil. On the other hand, the no-watering cultivation technique is recommended for groundnut, water melon, melon and eggplant. This second water-saving cultivation method does not require special materials or other equipment.

The two guidelines have been disseminated through farmer-to-farmer extension method since December 2010, and because not everything could be covered by the guidelines, techniques based on their own experiences and farming environments were shared by experienced farmers to neophyte farmers

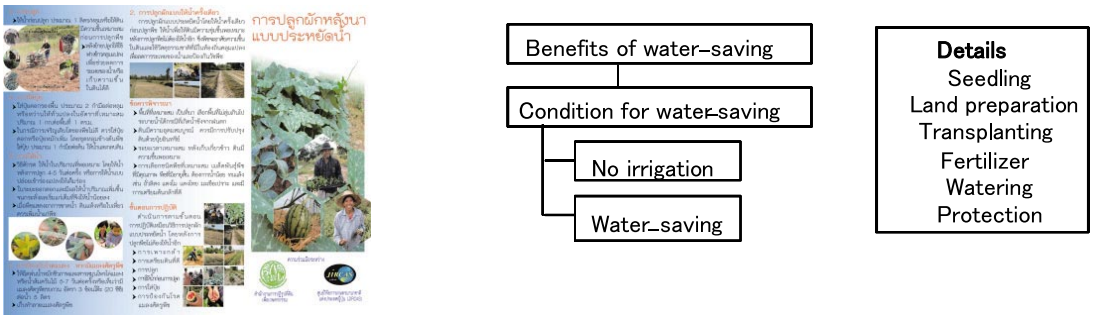


Fig.1. Contents of Guidelines for Water-saving Vegetable Production.

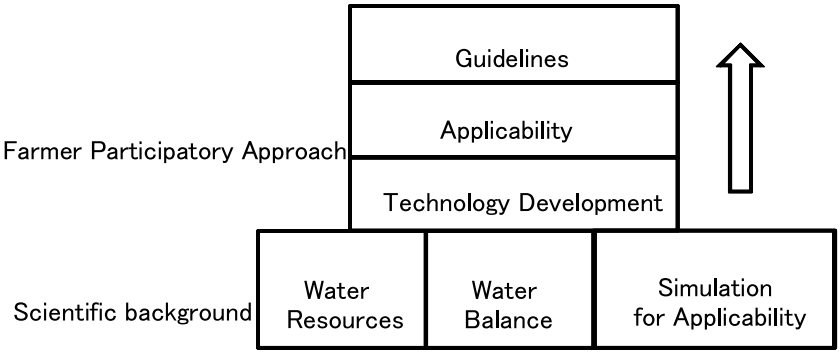


Fig. 2. Protocol of Establishing the Guidelines for Water-saving Vegetable Production.

through training.

(Masato Oda, J. S. Caldwell, Praphasri Chongpraditnum [DOA, Thailand], Uchada Sukchan [DOA, Thailand], Nongluck Suphanchaimat [Khon Kaen Univ. (KKU), Thailand], Krailert Taweekul [KKU, Thailand], Yupa Hanboonsong [KKU, Thailand], Tasanee Jamjanya [KKU, Thailand], Kasem Srichompoo [KKU, Thailand], Toyomi Kotaki [NIAS], Tetsuro Oda [Sanyu Consultants Inc.], Werachai Narkwiboonwong [ALRO, Thailand], Toshitsugu Moroizumi [Okayama Univ.], and Ken Nakamura [NIAES])

TOPIC 5

Establishment of a database on weed species in lowland Savanna in West Africa

Practical information on identification of weeds and wild plants occurring in lowland conditions has become even more essential for the development of an effective weed management system geared towards the improvement of rice production in the flood-plains of West Africa, because WEEDS OF RICE in West Africa (D. E. Johnson 1997), which had been a valuable source on identification and biology of rice weeds in West Africa, had been out of print for a long time. Therefore, the establishment of a database on the weeds and plants in the abovementioned environment where a JIRCAS Project "Development of low input, sustainable rice cultivation system in flood plains in Africa" has been carried out, was needed to provide correct information to the project.

Major weed species, including wild native plants collected in/around ricefields of lowland savanna in the northern part of the Republic of Ghana, were identified based on plant specimens and photographic images reproduced by a high resolution scanner. Each species was classified, based on its origin as given in the literatures, into four groups: 1) Upland pan-tropical weeds naturalized mainly from tropical America or Asia, 2) Rice weeds of lowland savanna, and also common in Southeast Asia, 3) Plants growing in seasonally flooded lowland savanna, and 4) Weeds and plants of upland fields in the savanna zone, as shown in Fig. 1, with representative species. The weed species distribution, which was differentiated from field to field, reflects the history and management practices in each rice field (data not shown).

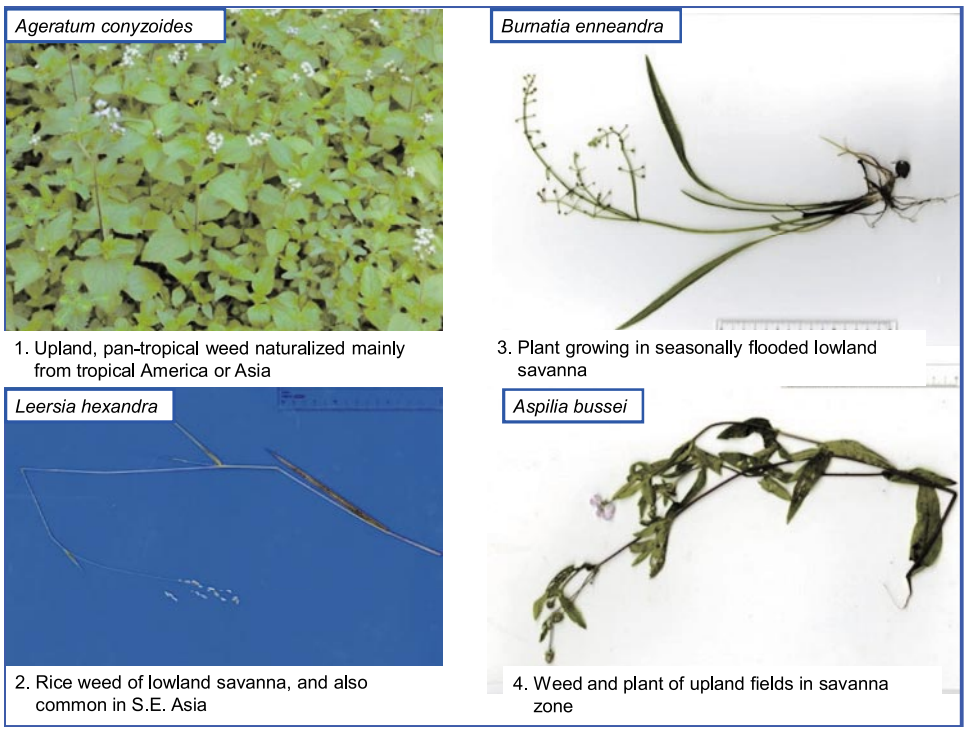


Fig. 1. Groups with representative species of weeds from different origins.

A database, "Plants in lowland savanna of West Africa", with images, scientific names, classified origin and biological information of approximately 110 species had been uploaded to the website of JIRCAS (http://www.jircas.affrc.go.jp/DB/DB06/index.html) (Fig. 2 and Table 1). Considering the frequency of occurrence, plant size, possible flood tolerance and so on, species such as *Paspalum scrobiculatum*, *Arcoceras zizanioides*, *Aspilia paludosa* and *Melochia corchorifolia* were nominated as noxious rice weeds in the Project site. A wild rice, *Oryza longistaminata* should be treated with caution because it was found to have grown in conventional rice fields in northern Ghana. A semi-parasitic species, *Rhamphicarpa fistulosa*, growing under flooded conditions and reported as a parasite to Gramineous plants including rice, was likewise discovered in the Project site (Fig. 3). This species is also a possible threat.

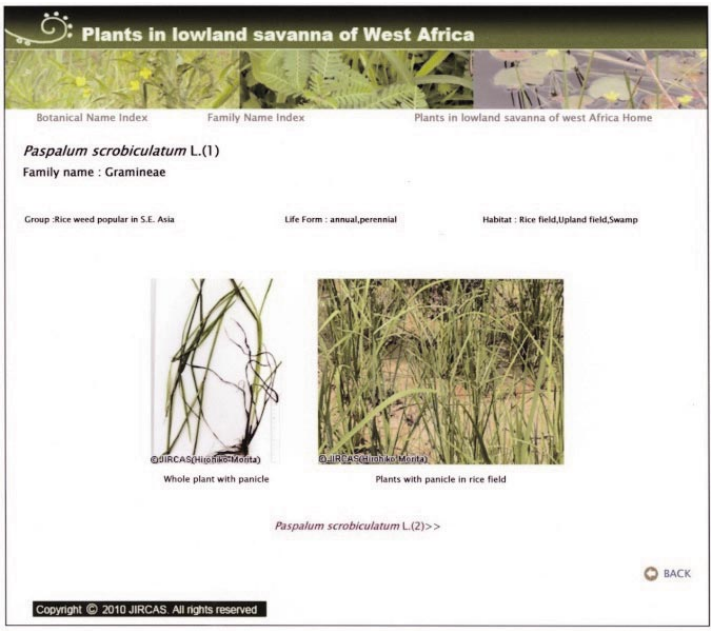


Fig. 2. A page from the database, "Plants in lowland savanna of West Africa", showing *Paspalum scrobiculatum*, a possible noxious grass weed in rice fields.

The results can be utilized as basic information on changes of weeds and natural vegetation for the development of rice cultivation in the flood plains of West Africa. Though weed species can be searched by scientific names, these are searchable as well among images belonging to one family if the user could identify the family name of the species. This database will be further revised and enlarged through further investigations on the weed flora and weed biology in the ricefields of lowland savanna of West Africa.

(Junichi Sakagami, Hirohiko Morita [Akita Prefectural University] and Akira Uchino [National Agricultural Research Center])

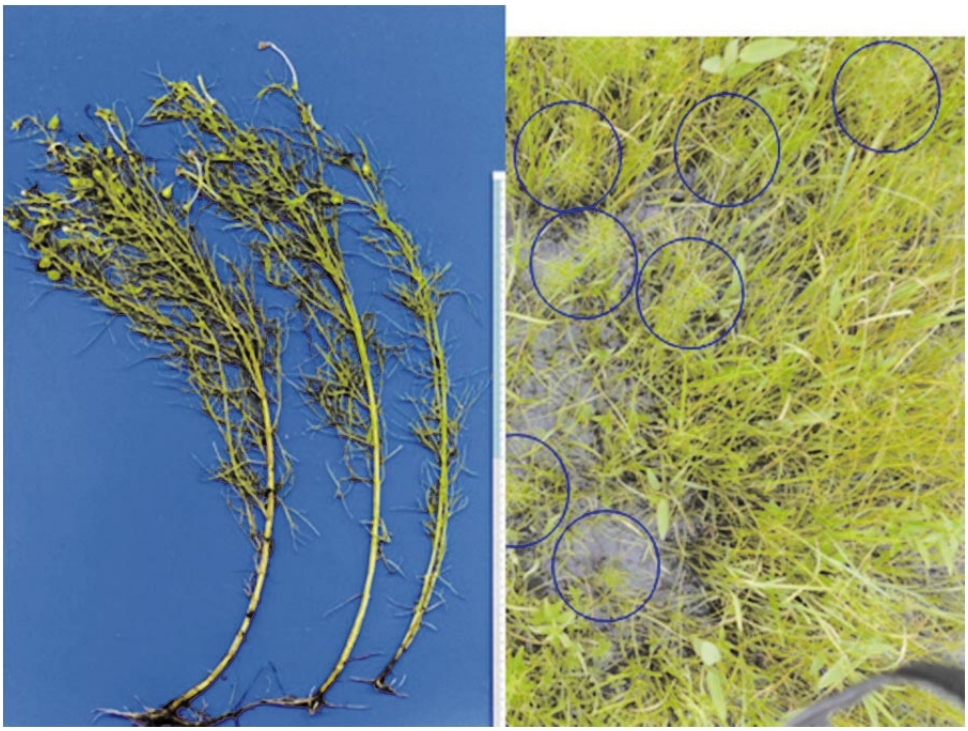


Fig. 3. A semi-parasitic weed *Rhamphicarpa fistulosa*, growing under a flooded field (Right: in circles) and flowering plants (Left).

Table 1. Family, number of species and representative species in the database

Family	No. of species included	Representative Species
Acanthaceae	1	*Nelsonia canescens* Spreng.
Alismataceae	1	*Burnatia enneandra* Micheli
Amaranthaceae	4	*Celosia trigyna* L.
Amaryllidaceae	1	*Crinum ornatum* Bury
Araceae	3	*Anchomanes difformis* Engl.
Boraginoceae	1	*Coldenia procumbens* L.
Butomaceae	1	*Limnocharis flava* Buchenau
Capparidaceae	1	*Cleome viscosa* L.
Commelinaceae	1	*Commelina africana* L.
Compositae	5	*Aspilia bussei* O.Hoffm. & Muschler
Cyperaceae	14	*Cyperus pustulatus* Vahl
Euphorbiaceae	3	*Phyllanthus amarus* Schum. & Thonn.
Gentianaceae	1	*Nymphoides peltata* O.Kuntze
Gramineae	27	*Paspalum scrobiculatum* L.
Hydrophyllaceae	1	*Hydrolea glabra* Schum. & Thonn.
Labiatae	2	*Hyptis spicigera* Lam.
Leguminosae	2	*Calopogonium mucunoides* Desv.
Luguminosae	5	*Indigofera nigritana* Hook.f.
Malvaceae	3	*Sida rhombifolia* L.
Marantaceae	1	*Thalia geniculata* L.
Molluginaceae	1	*Mollugo nudicaulis* Lam.
Moraceae	1	*Cannabis sativa* L.
Nymphaeaceae	1	*Nymphaea nouchali* Brum. f.
Onagraceae	2	*Ludwigia octovalvis* Raven
Oxalidaceae	1	*Biophytum umbraculum* Welw.
Parkeriaceae	1	*Ceratopteris comuta* Lepr.
Pontederiaceae	1	*Heteranthera callifolia* Rchb. ex Kunth
Rubiaceae	7	*Spermacoce ruelliae* DC.
Scrophulariaceae	5	*Striga hermonthica* Benth.
Solanaceae	1	*Physalis angulata* L.
Sphenocleaceae	1	*Sphenoclea zeylanica* Gaertn.
Sterculiaceae	2	*Melochia corchorifolia* L.
Tiliaceae	1	*Corchorus tridens* L.
Urticaceae	1	*Fleurya aestuans* Gaudich.
Verbenaceae	1	*Stachytarpheta angustifolia* Vahl
Zygophyllaceae	1	*Kallstroemia pubescens* Dandy

Establishment of feeding standards for beef cattle and feedstuff database for the Indochinese peninsula

Consumption of beef products is expanding in the Indochinese peninsula nations because of changes in lifestyle. Hence, there is a need to establish a cost-effective and efficient feeding method for the expansion of beef production. The feeding standards used in tropical countries for local beef cattle are based on data obtained from the cattle breeds raised in temperate zones such as NRC in the USA (National Research Council, 2000). The nutrient requirements of tropical cattle breeds and the climatic conditions for measurements in tropical environments are different from those of temperate areas. Therefore, JIRCAS, Japan; Department of Livestock Development, Thailand (DLD); and Khon Kaen University, Thailand (KKU) have started a project, "Establishment of a feeding standard for beef cattle and a feedstuff database for the Indochinese Peninsula". Since it is essential to construct a regional research cooperation network for the efficient achievement of the targets, other eight research organizations in Thailand, Lao PDR, and Cambodia have also become involved in this project.

This project has released two versions of the feeding standards written in English and Thai (Fig. 1). These feeding standards comprise of two parts. Part 1 provides information on feed intake, feeding recommendations and nutrient requirements of the local beef cattle based on the results of this project. Moreover, the following equations for predicting feed intake, and energy and protein requirements of local beef cattle are also estimated based on the results of this project (Table 1). Part 2 provides tables of chemical composition and energy contents of most feedstuffs available in Thailand. The details of feeds i.e., portions, parts, nutrients necessary for growth and maintenance and preparation of those feedstuffs are indicated in the tables. Moreover, the 'beef cattle ration formulation software' (BRATION) was developed to assist users on feed formulation (Fig. 2). This software performs a process in which various feed ingredients are combined in different proportions to get the desired amount of nutrients. This software consist of four parts; feed database, animal data and nutrient requirements, ration formulation and nutrient balance, and mineral mixture formulation with report. This software calculates and shows the feed composition, nutrients value and feed costs if the inputs such as quantity, rate and cost of ingredients are entered into as factors.

These feeding standards which are meant to contribute to the efficient feed formulation and management of local beef cattle in Indochinese peninsular nations, are likewise applicable in other tropical areas, such as in Sub-Saharan African nations. However, there are many kinds of local beef cattle in their regions which may have different characteristics and requirements. Therefore, it must be duly noted that these feeding standards are based on data obtained from cattle breeds raised in Thailand. Moreover, BRATION is a free software for feed formulation. It will be available for download from the JIRCAS homepage. Please feel free to use it after gaining complete understanding and assuming responsibility for your own use.

(Makoto Otsuka, Keisuke Hayashi, Kritapon Sommart [Khon Kaen University], Pramote Paengkoum [Suranaree University of Technology], Somkid Promma [Department of Livestock Development] and Akio Takenaka)

Fig. 1. Two feeding standards written in English and Thai.

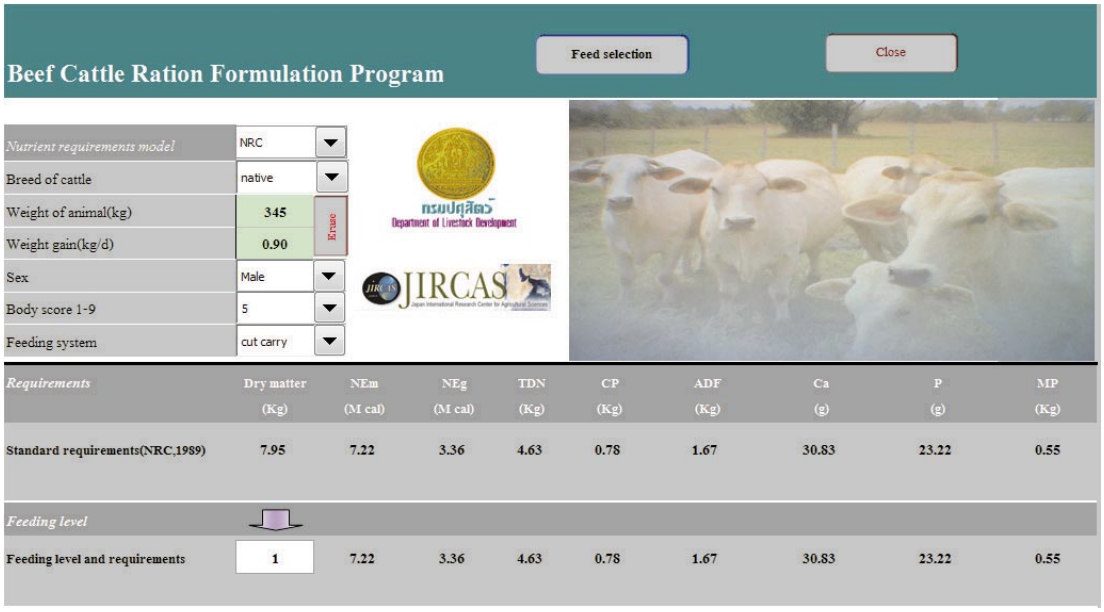


Fig. 2. Feed formulation program (Animal data and nutrient requirement page).

Table 1. Calculation equations for nutrient requirements

Feed Intake:
DMI(kg/d)=0.028878BW(kg)-0.5778
Energy requirement for Thai Native cattle:
MEI(kJ/kgBW$^{0.75}$/d)=31.37ADG(g/kgBW$^{0.75}$/d)+483.60
Energy requirement for Brahman cattle:
MEI(kJ/kgBW$^{0.75}$/d)=22.67ADG(g/kgBW$^{0.75}$/d)+486.19
Protein requirement for Thai Native cattle:
CPI(gCP/kgBW$^{0.75}$/d)=0.38ADG(g/kgBW$^{0.75}$/d)+5.03
Protein requirement for Brahman cattle:
CPI(gCP/kgBW$^{0.75}$/d)=0.56ADG(g/kgBW$^{0.75}$/d)+4.52
Protein requirement for Brahman crossbred cattle:
CPI(gCP/kgBW$^{0.75}$/d)=0.59ADG(g/kgBW$^{0.75}$/d)+5.47

DMI : Dry Matter Intake. Dry Matter Intake, BW : Body Weight,
MEI : Metabolizable Energy Intake, BW0.75 : Metabolic Body Weight,
ADG : Average Daily Gain, CPI : Crude Protein Intake

TOPIC7

Validation and characteristics of long interval rotation of the agropastoral system

In the subtropical savanna of South America, vast areas of cerrados have been cultivated since the 1970s. However, the deterioration of crop productivity in these fields due to continuous cropping poses a dilemma. In addition, as an international commodity crop, the price fluctuation of soybean is huge and acts as a destabilizing factor in management.

The project improved local soybean productivity by introducing an agropastoral system. Moreover, farm operation was stabilized by introducing livestock with lesser price fluctuation in the markets. Hence, the introduction of an agropastoral system was aimed at providing solutions to these problems, and it has been achieving results. Then, the project conducted a comprehensive evaluation of the agropastoral system undertaken in Paraguay by evaluating the concentration of dissolved chemical components of fertilizers at the soil surfaces and organic matter accumulation, and by clarifying the characteristics of an “agropastoral system”.

In Experiment 1, which had a 7-year rotation or conversion interval from pasture back to soybean cultivation, the soybean yield in the

agropastoral field was 2.35 times higher than that of the control field (Table 1). In Experiment 2, which had a 4-year interval before being converted back to soybean cultivation from pasture, the soybean yield from the agropastoral field was 1.03 times higher than that of the control field. The former (Exp. 1) exhibited higher benefits than the latter (Exp. 2). Therefore, soybean productivity is boosted if the rotation interval in converting back to soybean field from grazing pasture is longer.

An extensive grazing system experiment in which Zebu cattle were grazed at low density from one to two months during the dry season without artificial feeding was conducted in the test pasture of Experiment 1. The intensive grazing system in which cattle were grazed at high density throughout all seasons and fed soybean and hay in the dry season was conducted in the pasture of Experiment 2. The former has recovered better than the latter (Table 1).

Shorter grazing period and intensive grazing lower the beneficial effect on soybean production, because they inhibit organic matter accumulation and soil condition does not improve (Fig. 1). However, since dissolution of the phosphates which have accumulated on the soil surface progresses even if the conversion interval is shortened, the livestock's positive effect on soybean productivity is still possible (Fig. 2). This is because the large difference in the concentration of phosphates between the soil surface and deep layers inhibits the deeper penetration and growth of soybean roots on the soil thus soybean is not so negatively affected during drought (Table 1).

In South America, where conversion to agropastoral system is spreading, the results of this experiment will serve as reference to soybean farmers who need to choose a suitable soybean system. Since crop yields and prices of soybean fluctuate a lot, it is difficult to obtain comparison of the profits between those of soybean farmers and agropastoral farmers. However, in the intensive grazing system which was conducted in Experiment 2, when the soybean market price did not climb high enough (at 20US$/60kg in 2004) and drought happened, livestock was able to compensate for the inadequate profits of soybean cultivation. Therefore, the introduction of the agropastoral system led to the stabilization of farm operation.

(Katsuhisa Shimoda, Toshiyuki Horita [Fundation Nikkei-Cetapar])

Table 1. Study site profile, soybean production and soil chemical properties at soil surface (0-10 cm in depth)

	Experiment 1 (Exp. 1) [1]	Experiment 2 (Exp. 2) [2]
Pasture condition		
Period as soybean field before rotation	More than 3 years	More than 10 years
Period as pasture after rotation	7 years	4 years
Introduced grass species	*P. maxmum* cv. Tanzania	*P. maxmum* cv. Monbasa
Grazing intensity	Extensive	Intensive
Weight gain per hectare	Little (unknown)	1.34 ton/ha
Soybean production (Agropastoral/continuous cropping)		
First year of soybean production after re-rotation	1.48 ton/ha (2.35 times)[a]	3.71 ton/ha (1.02 times)
Second year of soybean production after re-rotation	3.56 ton/ha (1.86 times)[a]	1.24 ton/ha (1.42 times)[a]
Third year of soybean production after re-rotation	2.84 ton/ha (1.45 times)[a]	-
Fourth year of soybean production after re-rotation	2.74 ton/ha (1.11 times)	
Chemical properties	**7th year pasture/Control plot**	**3rd year pasture/Control plot**
Organic matters	1.20 times***	1.04 times
Phosphate	0.28 times***	0.19 times**

Sources: [1] Shimoda et.al. (2010), and [2] Shimoda et al. (In press).

[a]:Drought year. **:P<0.01. ***:P<0.001

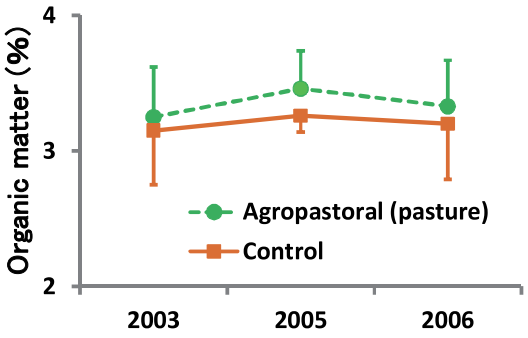


Fig. 1. Changes in percentage of organic matter contents (%) on the soil surface (At a depth of 0-10 cm) of Experiment 2.

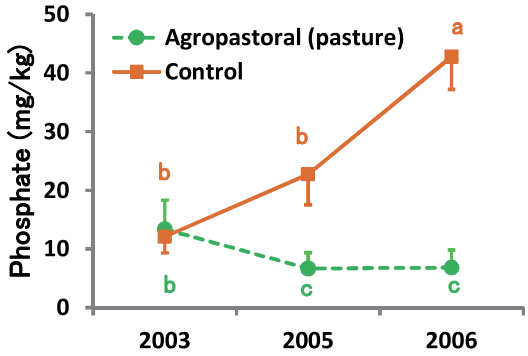


Fig. 2. Changes in phosphate concentration (mg/kg) of Experiment 2 on the soil surface (At a depth of 0-10cm); Different letters indicate significant difference.

TOPIC 8

Nitrification inhibition activity, a novel trait in root exudates of rice

Nitrification, in which ammonia (NH_3) is converted to nitrate (NO_3^-), is an important process in soil-plant systems for providing plant-available nitrate (NO_3^-). However, when nitrification occurs rapidly, NO_3^- supply may exceed plant demand; thus NO_3^-, which is less stable in soils compared to ammonium (NH_4^+) is easily lost through leaching, runoff or denitrification. Recent research suggest that root exudates from *Brachiaria humidicola* can inhibit nitrification in soil, which opens possibilities for using biological nitrification inhibition (BNI) as a low-cost *in situ* biological alternative. We have tested whether BNI activity is present in the root exudates of rice (*Oryza sativa* L.), tested the extent of its variation among different genotypes, and its potential effect on nitrification inhibition in soil.

In an initial screening experiment, the BNI activity in the root exudates of 36 different rice genotypes (cultivated, traditional and wild relatives) was evaluated for two consecutive years using a bioassay based on a recombinant *Nitrosomonas* strain. This strain carries a luciferase gene (*luxAB*) that produces bioluminescence under normal growing conditions; reduced bioluminescence indicates decrease of reducing power in the cell due to the inactivation of ammonia monooxygenase (an effect of known nitrification inhibitors). Significant genotypic variation was detected with the upland cultivar IAC25 demonstrating consistently high BNI activity, whilst modern lowland varieties like Nipponbare or IR64 exhibited lower activity (Fig.1).

A confirmation whether the activity of root exudates remains functional in soil then followed. The effect of a single application of concentrated root exudates was tested on BNI using standard soil incubation and shaken slurry

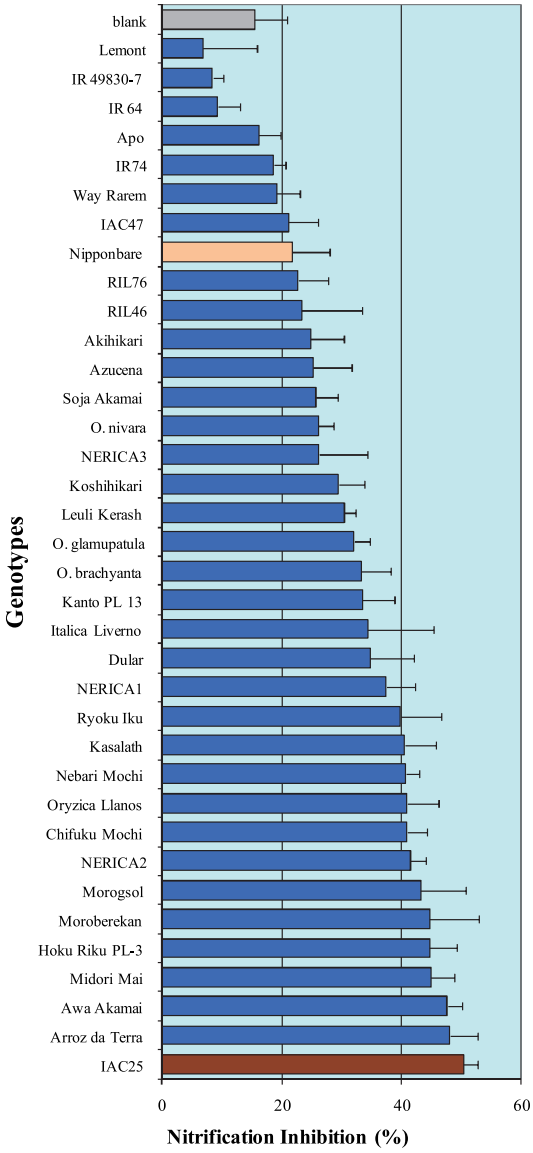


Fig. 1. Percentage of nitrification inhibition in the root exudates of rice genotypes.
Data correspond to the average of three independent replicates for two consecutive years.
Four readings were taken for each replicate.

method. For the standard method, soil was amended with root exudates, $(NH_4)2SO_4$ and water in order to reach 60% of the water-holding capacity and incubated at 30˚C. For the slurry method, soil was added with root exudates, NH_4^+ and PO_4^{3-}, and shaken constantly to maintain aerobic condition. Aliquots were taken at different points of time. NH_4^+ and NO_3^- were determined using a continuous flow auto-analyzer. Soil incubated with added exudates from IAC25 had lower NO_3^- concentrations after 7 days of incubation compared to soil incubated with water. In addition, soil amended with the root exudates of IAC25 had lower NO_3^- concentrations using the slurry method, confirming the potential of IAC25 for BNI (Fig.2).

Subsequently, rhizosphere soil containing deposited exudates from the rice roots was obtained by stripping off the soil from the roots of 50 day-old rice plants grown in small pots. This rhizosphere soil was incubated using the standard incubation method for different periods of time. After 7 days of incubation, a small but significant reduction in NO_3^- formation was seen in IAC25 relative to a low NI-genotype Nipponbare, and this difference increased after 14 days (Fig.3). Therefore, the potential of IAC25 was once again confirmed by detecting lower NO_3^- levels in incubation experiments.

Our results provide the first evidence that the root exudates of rice can reduce nitrification rates in soil. Having proven this for rice, a model crop, offers possibilities for further exploitation of this phenomenon through molecular and genetic tools.

(Juan Pariasca Tanaka, Matthias Wissuwa and Takayuki Ishikawa)

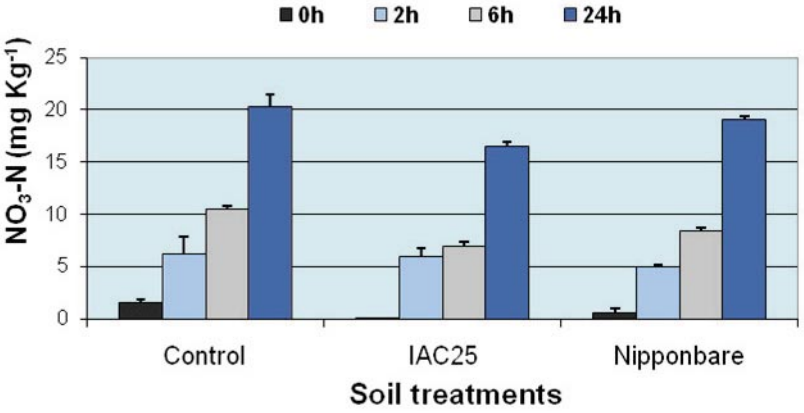


Fig. 2. Nitrate accumulation in soil incubated with the root exudates of two rice genotypes for several hours. Soil was incubated following the standard soil incubation and shaken slurry method. Control refers to soil incubated without exudates.

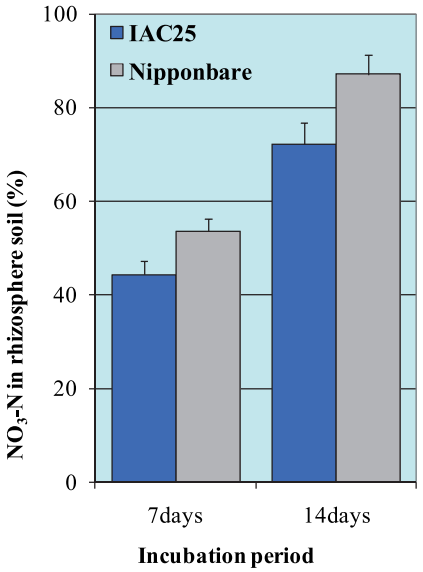


Fig. 3. Percent of total N in nitrate form in the rhizosphere soil of two rice genotypes after incubation for 7 and14 days. The initial nitrate in the untreated soil was 20%.

TOPIC 9

Difficulty in restoring salinized freshwater lens, a valuable water resource of atoll islands

There are approximately 30,000 islands in the Pacific Ocean, in which about 1,000 islands are populated and are mostly located in developing regions. Among the islands of these small islands countries which are mainly low-lying atoll islands with small areas, with an elevation of a few meters on average, water resources are very fragile. The freshwater lens is defined as the freshwater area which floats, due to the differences in the density of freshwater and seawater, in the upper part of the aquifer layer over seawater in the lower layer in small islands, as shown in Fig.1. Water resources in low-lying small islands, where the water source depends on the freshwater lens, are considered to be susceptible to the reduced amount of recharge caused by the increased intake and drought etc., as well as further salinization due to the sea level rise resulting from global warming. It has become necessary to develop a conservation technology for the freshwater lens. Thus, we investigated the situation of groundwater salinization through a field survey in Laura Island, Majuro Atoll, the Republic of the Marshall Islands (RMI), where the freshwater lens has evolved, as a test case example.

In October, 2009, we observed the electric conductivity of the groundwater at existing groundwater monitoring wells by means of electro-magnetic survey along the survey line. We also estimated the boundary depth between the freshwater lens and the saltwater along the central survey line of the freshwater lens in Laura as well. The freshwater lens in Laura was shaped in the form of a lens according to the survey conducted by USGS (United States Geological Survey) in 1985 (Fig.2). Then, the partial rise on the boundary between the freshwater lens and the saltwater (up-corning) was observed by a groundwater survey conducted after the drought in 1998 (Fig. 3). The rainfall amount during the drought period (from January to April) was 71.7 mm, and the maximum number of consecutive dry days was 95, which means that there was scarce rainfall. The water sources for the residents during the drought period were the water obtained from the seawater desalination plant and the groundwater taken from the freshwater lens. This intake caused the up-corning from the bottom around the intake facilities in Laura. The cross-sectional shape of the freshwater lens which was identified as a result of the survey is shown in Fig.4. Thick lens at both sides and the up-corning at the central part can be seen. The results of the electromagnetic survey indicated that the whole shape of the freshwater lens is almost the same as the one in 1998.

We made use of the field weather observation

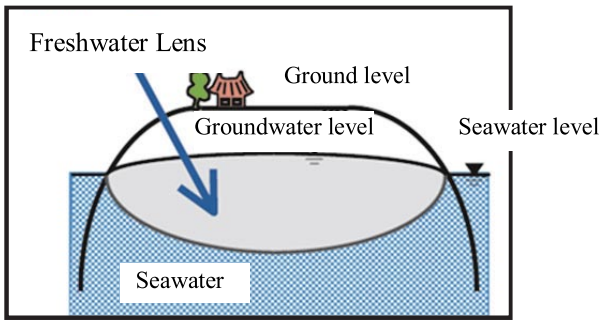


Fig. 1. Schematic view of the freshwater lens (Reference: MAFF)

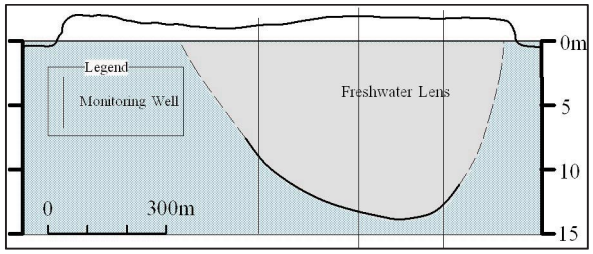


Fig. 2 Cross-sectional view of the freshwater area in 1985 (Reference : USGS[1])

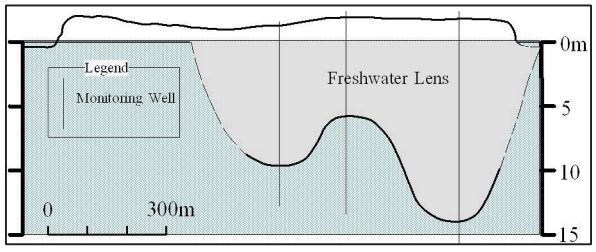
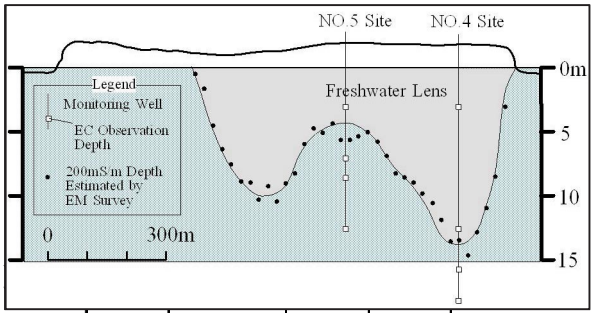


Fig.3. Cross-sectional view of the freshwater area in 1998 (Reference : USGS[1])



4	14.6m 17.7m 20.7m	123ms/m 413ms/m 659ms/m	5	8.5m 10.1m 14.6m	639ms/m 1,430ms/m 564ms/m

October in 2009

Fig. 4. Cross-sectional view of the freshwater area in 2009

data etc. to calculate the water balance. By assuming the annual average rainfall for the past four years (2006 to 2009) to be 2,900 mm, evapotranspiration of 1,260 mm/year derived by the use of Linacre equation, average annual intake of 62,000 tons/year, and the surface runoff of 0, the annual average rainfall infiltration to the underground is approximately 3.4 million tons. The storage volume of the freshwater lens is roughly estimated to be 1.86 million tons based on the result of the electromagnetic survey. Although the groundwater accounting for about 1.8 times the storage volume of the freshwater lens was supplied on an average annual basis, the up-corning of seawater which was observed in 1998, is being observed in 2009 as well. It has been proven to be difficult to restore a salinized freshwater lens. We confirmed that the salinized freshwater lens in Laura could not be restored from the up-corning despite a large amount of rainfall.

The situation of the continuous up-corning was provided a visible form on occasions such as seminars in which concerned administrative officers of the RMI government took part, so that the importance of the conservation of the freshwater lens was clearly recognized. To achieve the sustainable use of groundwater without salinizing it in the future, it is necessary to establish a stable intake method based on a calculation of available intake volume after modeling the groundwater flow, and to establish a groundwater monitoring system, etc. under the adequate management of the RMI government.

(Tsutomu Kobayashi, Kazuhisa Koda, and Yuzo Manpuku (JIRCAS), Satoshi Ishida [National Institute of Rural Engineering; NIRE] and Syuhei Yoshimoto [NIRE])

TOPIC 10

Group selection thinning is effective for the conversion of fast-growing tree plantations into indigenous tree forest

There had been attempts to restore degraded lands into forests using local tree species around the world. However, the planting of local tree species in an open site often ended in failure in tropical areas due to the strong sunlight and high temperature. We have improved the silvicultural system in which local tree species can be introduced after establishing a fast-growing tree plantation under a tropical monsoon climate in northeast Thailand. We evaluated what thinning pattern is best suitable for the survival rate and growth of local tree species that are planted beneath a fast-growing tree plantation.

Free selection thinning (1/3 and 2/3 at basal area base) and group selection thinning (50m x 60m in size) were applied to 23 year-old A. mangium plantation. Seedlings of three local tree species (*Hopea odorata*, *H. ferrea* and *Xylia xylocarpa* var. *kerrii*) were planted at each experimental site with a spacing of 2 m x 3 m. The survival rate and growth of the seedlings were surveyed every two months. Relative light intensity was highest in the group selection thinning plot (gap plot) followed by the 2/3 free selection thinning plot, 1/3 free selection thinning plot and control plot (no thinning). The light condition tended to return to the initial level in the free thinning plots as canopy was

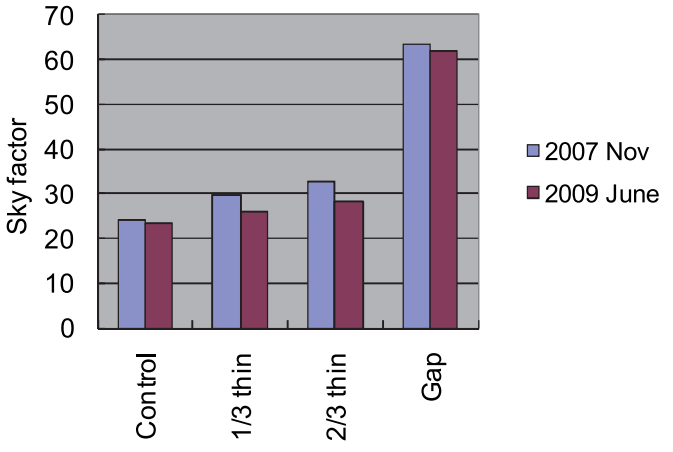


Fig. 1. Light conditions in each experimental plot. “Sky factor” indicates relative light intensity against the completely open site ranging from 0 to 100.

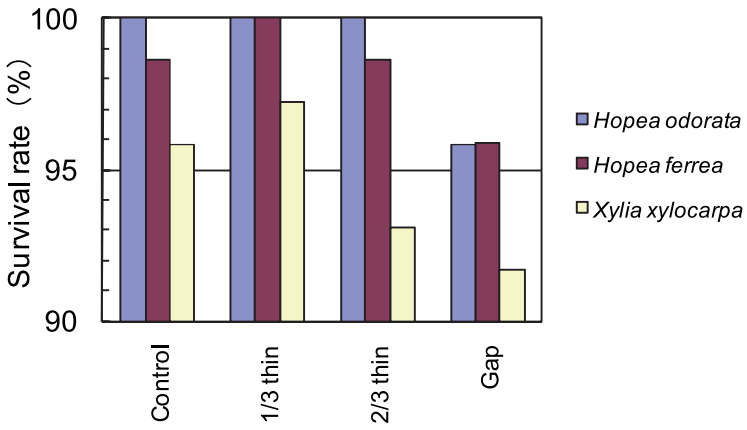


Fig. 2. Survival rates of local tree seedlings at 30 months after planting in each plot.

recovered, while it kept to a high level in the gap plot (Fig. 1). The seedlings showed high survival rate (>90%) across all species and treatment (Fig. 2). It seems that the fast-growing trees mitigate strong sunlight for the seedlings, because the survival rate of the seedlings was generally low (60-80%) in the open site. The seedlings showed seasonal growth pattern in which their growth was inhibited during the dry season (from Dec. to next Feb.) and improved during the rainy season (Fig. 3). Height growth was promoted in all species as the light condition improved: exhibiting best growth in the group selection thinning plot and worst in the control plot (Fig. 4). *H. ferrea* achieved better growth with increased height even in dark conditions, suggesting that this species is considerably shade-tolerant. In contrast, *X. xylocarpa* var. *kerrii* was considered to be light-demanding. These growth performances seem to be associated with the regeneration patterns in their natural habitats.

These findings suggest that group selection thinning is the most suitable technique in terms of providing the ideal light conditions (60-65% of open site) for the local tree seedlings. Young plantations would not be suitable for this method because their canopies will recover quickly, shading the local tree seedlings. In order to avoid competition with the weeds and lianas in such a bright condition, weed cutting must be carried out at least three times a year.

(A. Sakai, T. Visaratana and T. Vacharangkura [Royal Forest Department])

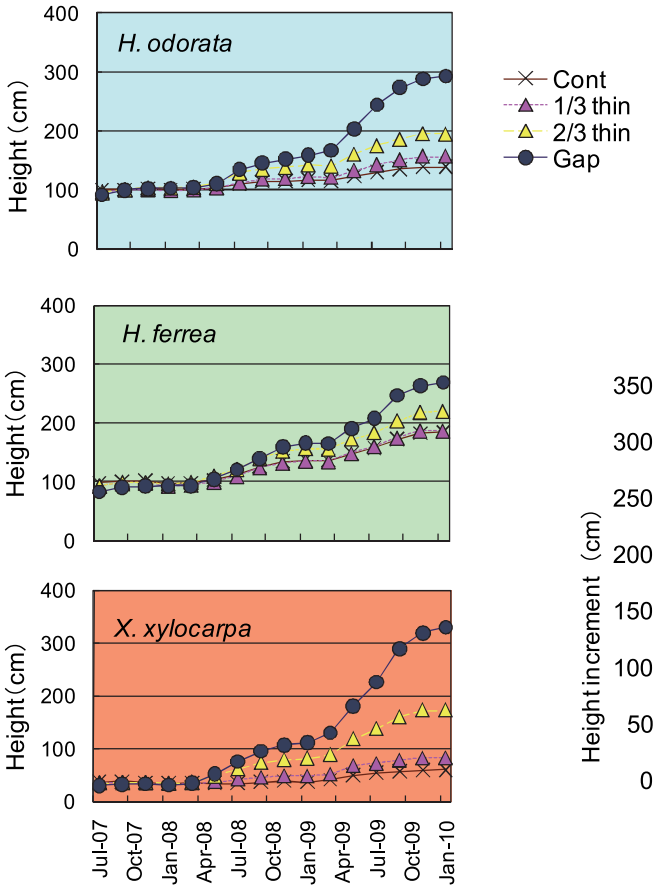


Fig. 3. Height growth profiles of the local tree seedlings.

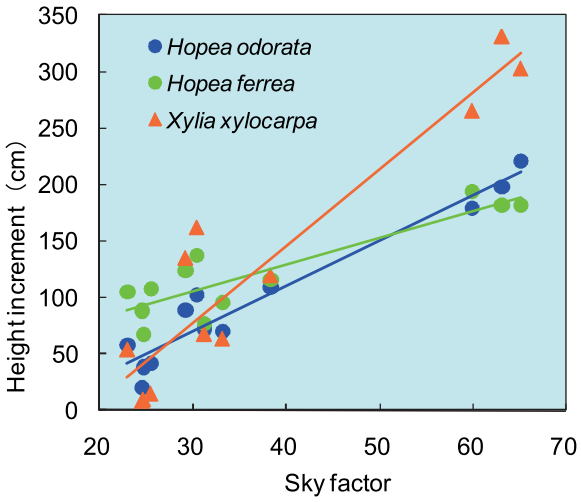


Fig. 4. Relationship between light conditions and height increments of the seedlings.

TOPIC 11

Guideline for selective logging techniques for Shorea curtisii, a dominant species of hill dipterocarp forests in Peninsular Malaysia

In Peninsular Malaysia, active logging sites and deforestation are recently spreading into the hills and mountain areas, and it is expected that the next logging operation will only be possible after 40 to 60 years with the natural recovery of forests. However, some degraded hill forests can be observed after selective logging in the peninsula. Improvement of selective logging techniques is required to promote the natural process of forest recovery after logging and to achieve sustainable use of timber resources. The limiting factors for regeneration and distribution of dominant tree species are essential

information to understand the process of forest establishment. The aim of this research is to determine the factors affecting the spatial distribution of saplings of *Shorea curtisii* (Dipterocarpaceae), a dominant species in lower hill dipterocarp forest, and to suggest a new guideline for selective logging.

Saplings of *Shorea curtisii* (>30 cm in height and <5 cm in diameter at breast height) show aggregated distribution on ridged sites and occur exclusively within a 40 m distance from mother trees which remained at the last selective logging area in the Semangkok study site (Fig. 1). The Markov Chain Monte Carlo method with the Bayesian approach illustrates that the number of *S. curtisii* saplings per 5 m-grid is explained by three parameters, i.e. distance from mother trees (m), relative light intensity (%), and topographic index (Fig. 1 & Table 1). Here, the topographic index represents the concavity and convexity of the ground surface, and is related to soil humidity. Within the above three parameters, distance from mother trees and topographic index have powerful adverse effects (Table 1); that is, the sapling density is higher on sites closer to mother trees and more convex such as in areas found in ridges. It is necessary to retain mother trees of *S. curtisii* with spatial interval of less than 50 m to obtain a widespread sufficient number of saplings in a logged forest compartment. Trees of *S. curtisii* standing on the slope and valley parts, where a few number of *S. curtisii* can be found, should be conserved. The current manner of operation that retains mother trees in patches would result in skewed distribution and species composition in the next generation forest.

Careful operations are required for the selection of cutting trees, felling direction and design of forest roads in order to minimize the disturbance on the forest floor by selective logging with certain intervals between mother trees. A simple manual for logging operators is needed to expand use of the new criterion.

(T. Yagihashi [FFRPI], T. Otan and N. Tani)

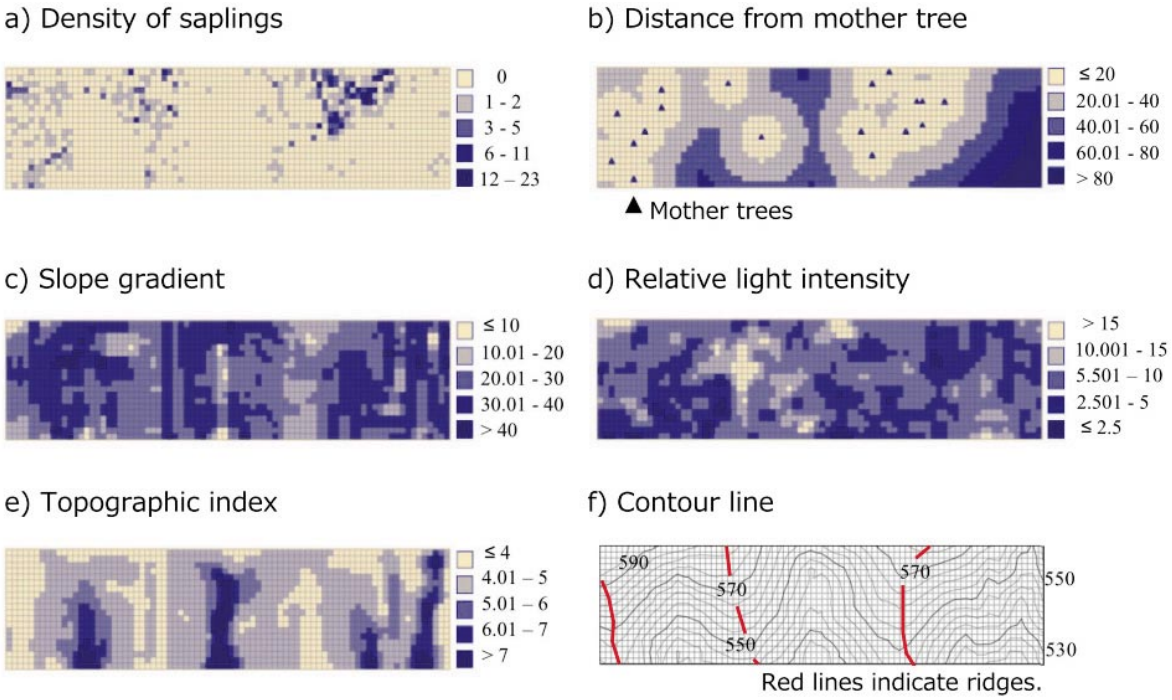


Fig. 1. a) Density of *S. curtisii* saplings (/25m2), b) Distance from mother trees (m), c) Slope gradient (degree), d) Relative light intensity on forest floor (%), and e) Topographic index representing surface concavity and convexity in the logged Semangkok forest plot of 4 hectares. Grid size is 5 m by 5 m.

Table 1. Parameters affecting spatial distribution of S. curtisii saplings in the logged Semangkok forest plot.

Parameters	Mean±SD	Errors	Lower limit	Median	Upper limit
Distance from mother trees	-0.866±0.066	0.00056	-0.998	-0.865	-0.739
Topographic index	-0.718±0.080	0.00064	-0.874	-0.718	-0.562
Relative light intensity	-0.144±0.042	0.00047	-0.227	-0.144	-0.062

Theme A-3 Elucidation of the impact of global environmental changes on agriculture, forestry and fisheries, and development of mitigating technologies

Global warming is predicted to cause disasters due to the ensuing climatic changes and the spread of insect pests. There is also the risk of undermining the stability of agricultural production and shifting of suitable agricultural areas. This theme aims to clarify the phenomena of interdependence between global environmental changes such as water cycle changes and agricultural production activities, to enhance the methodologies for estimating their influences on agriculture, as well as to clarify the damages caused to agricultural and forestry products by insect pests resulting from global warming, and to develop technologies to prevent them. In FY 2010, six projects were launched to study the interdependent impacts of environmental changes on agricultural production, to develop GIS methodologies for land use monitoring, to establish rural development methods for vital communities, and to develop institutional and technical measures for alleviating the detrimental effects on agriculture by climate change and harmful insect pests. The main results are as follows:

Development of analytical methods on the mutual relationship between global climate change and agricultural production

■ A model for the prediction of rice production using seven kinds of geographical attributes such as slope or soil types in Bangladesh was developed. Cultivation area and production of rice for each 1 ha were obtained from the model. In substituting the results of the geographical model into a rice supply and demand model in Bangladesh, the results show that shorter growth period and high temperature injury of rice will affect the food security of the whole country more than the rise in sea level. Furthermore, simulations of a world food model created through JIRCAS research were conducted using climatic and macroeconomic data of each IPCC socio-economic scenario. The results indicated that rice productions in India, Brazil, and the U.S. will decrease and those in Vietnam, Laos, and Cambodia will increase due to global warming. Meanwhile, the results also showed that rice production in China, Thailand, Indonesia, Bangladesh, and Philippines will not be affected by global warming.

■ Studies on the enhancement of remote sensing and GIS technology have achieved the following results this fiscal year:

Firstly, we examined the robustness of the method for monitoring the planting time of paddy rice using the MODIS data output of the previous year. This method, using a temporal resolution of 16 day-composite periods and spatial components of 250 by 250 meters, could estimate the ideal planting time of rice for sites located in the western part of Java Island in Indonesia from April 2000 to the present. One constraint is the coarse spatial resolution which might misrepresent mixed land use classes. The study concluded that planting time could be estimated properly by pixel in case the ratio of paddy fields exceeded 30 percent in a pixel and if rice was planted simultaneously. We then analyzed the relationship between rainfall pattern and the timing of rice planting estimated through this method for the period 2000 to 2009. It discovered a tendency wherein less amount of recorded rainfall during the early rainy season, i.e. September to December, caused a delay in the first planting time of rice. It also noted that this tendency was more obvious in the lower stream of the irrigation network.

Second was an examination of object-based classification applied to plantation areas located in the southern part of Sumatra in Indonesia. We tested the parameters of “shape”, “compactness” and “scale parameter”, which were variable and arbitrarily set by users, in order to perform optimal segmentation of the study site using QuickBird data. Then, we compared the accuracy of the classification between a method using the proposed combination of parameters and a method utilizing software default values. The results showed 3 to 32 percent improvement of the accuracy of classification by the proposed method of a combination of parameters. It was also noted that this method effectively classified the features of field boundaries and growth uniformity.

Third research subject was the evaluation of the applicability of the “decision tree” method in classifying coffee plantation areas in Lampung Province of Sumatra, Indonesia. The researchers produced a coffee plantation map from ALOS/AVNIR2 data by applying a “decision tree” tool provided by a commercial software and a summarized process of determining parameters.

Establishment of agricultural development methodology responding to environmental change

■ In Paraguay, a set of manuals relevant to rural development applying reforestation CDM (Clean Development Mechanism) was prepared, which includes a general guideline, manuals on

methodologies and procedures to formulate reforestation CDM project, as well as technical manuals for farmers. So far, pre-monitoring activities to obtain carbon credit from developed forests in the project area were also conducted to facilitate full scale monitoring as scheduled in 2012. In Vietnam, a baseline study manual for the formulation of a rural development project was developed, based on the efficient use of available local resources and CDM project of GHG emission reduction. The technical manuals on pig raising, aquaculture, orchard management and installation of the biogas digester (BD) were prepared to establish a sustainable farming system by recycling use of resources. The CDM project of GHG emission reduction through the substitution of non-renewable cooking fuel with renewable biogas from BD has been further advanced through the completion of a project design document (PDD) and by finishing an on-site validation activity conducted by DOE (designated operational entity), which is registered with the Executive Board of CDM (EB-CDM), UNFCCC. The registration of the CDM project of BD in EB-CDM, as an official recognition in the international community, is expected to be realized at the end of 2011.

■ In Niger, methods to promote vegetable cultivation in the dry season using natural swamp water resources have been developed in the areas of "organizing farmers' support", "the prevention of animal damage" and "the improvement of farming techniques". Likewise, a "Manual for Establishing and Operating Cooperatives" has been developed and distributed in cooperation with the division for the promotion of farmers' organizations and cooperative activities, Ministry of Agriculture and Livestock of Niger, in order that the administrative officials and the staff of donors and NGOs may be able to apply it.

Development of management techniques for serious diseases in tropical and subtropical areas

■ Citrus greening (CG) is the most serious problem of citrus cultivation in Southeast Asia. In this project, “Integrated Pest Management of Citrus Greening Disease in Mekong Delta for Sustainable Production of Citrus under Severely Infested Conditions”, the countermeasures established are as follows, 1) Use of disease-free seedlings, 2) Regular spraying of agrochemicals, and 3) Regular use of fertilizers. Although the countermeasures need more investments, such as the purchase of disease-free seedlings and large expenses for agrochemicals, it is more profitable for the farmers in the long run than traditional cultivation methods because they can realize higher prices and longer harvest periods as well as higher yields. The countermeasures in the project have been published as the “IPM manual for the control of greening disease in southern Vietnam”. In addition, the output of this project is being followed in a JICA project being implemented in wider areas in Mekong Delta.

■ We were able to verify, according to the data of our own field survey, that the wasp, *Asecodes hispinarum*, introduced by FAO in 2003, has succeeded in controlling the coconut hispine beetle, *Brontispa longissima*.. However, we recently discovered two monophyletic groups which exist within the coconut hispine beetle, and found that *A. hispinarum* is not a natural enemy of the beetle currently invading Southeast Asia. Following the principle of classical biological control, which introduces natural enemies from the same area where the pests originated, the introduction of a "real" natural enemy (*Tetrastichus brontispae*) into Southeast Asia should be recommended. We also suggested that *T. brontispae* could be more efficient for controlling the beetle, as this species is more tolerant to high temperature than *A. hispinarum*.

TOPIC 1

Necessary conditions for long-term food security in Bangladesh under the influence of climate change

Bangladesh, where rice is important as a staple, has achieved self-sufficiency in rice by introducing irrigation and high-yield varieties. However, it is not clear whether the country can produce enough rice in the future when high population growth and climate change will have more impacts on the country. Therefore, using a rice supply-demand model integrated with other models of environmental impacts on rice, we project future rice production, per capita consumption, and necessary conditions for long-term food security.

Comparison on the significance of impact on production between two factors such as increases in sea level and temperature rise shows that high temperature has a more serious effect than sea level rise from the viewpoint of national food security (Fig. 1). This implies that adaptation strategies should be taken for local food security in the coastal regions and for national food security in interior rice-producing

regions. Comparison of the technical levels of rice production shows that moderate yield increase rates (1% for rainy seasons and 2% for dry season) cannot maintain per capita consumption under a heavy climate change scenario (Fig. 2 (a)). On the other hand, a high yield growth can help avoid reduction in per capita consumption even under a heavy climate change scenario (Fig. 2 (b)). This implies that sustainable high yield growth will be necessary to ensure national food security in this era of climate change, and annual growth rates of 1.5% for rainy seasons and 3% for dry season are identified as the ideal targets for research and development.

The analysis above is based on climate change impact projections supplied by other models, CERES-Rice (rice yield), MIKE21 (sea level rise) and MIKE11-GIS (flood). The supply-demand model developed for this analysis can be used for simulating the effects of research and development for rice production. Quantification of the CO_2 fertilization effect and implementation of stochastic analysis will be the next tasks for model development.

(S. Kobayashi, J. Furuya, Y. Yamamoto, M. R. Islam [Bangladesh Rice Research Institute] and A. B. Siddique [Bangladesh Rice Research Institute]

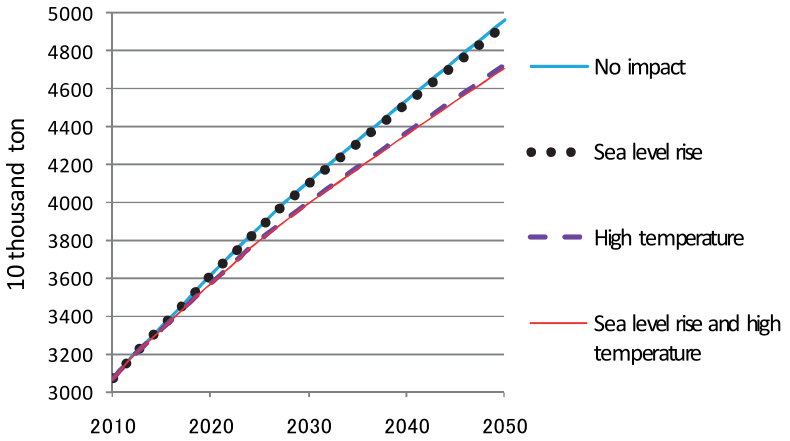


Fig. 1. Rice production by type of impacts.
Temperature rise has a larger impact than increase in sea level on the national production level.

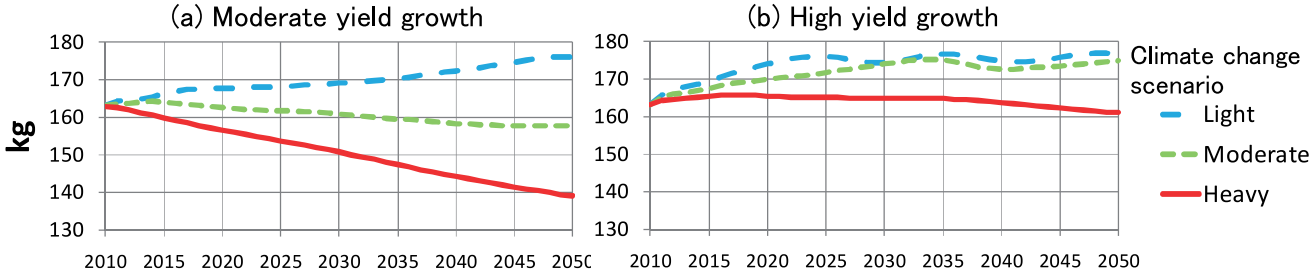


Fig. 2. Per capita rice consumption by yield scenario and climate change scenario.
Under moderate yield growth (a), consumption decreases due to heavy climate change.
High yield growth (b) can avoid the reduction even in heavy climate change scenario.

TOPIC2

Feature abstraction of field boundaries and crop conditions by object-based classification using satellite imagery

Along with the dissemination of high-resolution satellite imagery, object-based classification has attracted attention over the years. Object-based classification is accomplished by two steps, i.e. segmentation and classification. Segmentation is a process used to divide pixels into homogeneous spatial groups, and classification is a process utilized to determine the class of the group based on their feature values. It is a major advantage that various feature values representing texture and shape are available for classification. However, segmentation prior to classification is also important to produce a precise land use map. We proposed a manner to assign parameters for segmentation to identify agricultural land features, i.e. 1) field boundaries 2) growth uniformity, and 3) sowing/planting way, represented by QuickBird image observed in plantation area in Sumatra, Indonesia.

Segmentation was defined by three parameters. "*Shape*" defines homogeneity of the objects in term of morphological features and "compactness" is in irregularity. "*Scale parameter*" defines the size of objects. Values 0.1, 0.5, and 0.9 were respectively assigned to "*shape*" and "*compactness*", then the best combination was selected by visual comparison through the nine pair-trials. Following the selection, the "*scale parameter*" coinciding with the size of the target was determined by exploratory trials. By this method, several

heuristics for segmentation were obtained. For instance, it is appropriate to weigh "*shape*" and reduce "*compactness*" to classify road features representing field boundaries, and the assignment of intermediate values for "shape" and "*compactness*" in both is effective to show vegetation patches representing growth uniformity. By segmentation using the proposed method, classification accuracy was improved 3-32 points as compared with the results from segmentation with unadjusted parameters substituted by default values for multi-spectral satellite imagery.

Since the suitable form and size of objects are different per target, parameters have to be determined in each image. In this proposed manner, parameters are efficiently determined and they contribute toward improving classification accuracy. In addition, our results show that object-based classification is particularly suitable for identification of field boundaries and growth uniformity.

(Yukiyo YAMAMOTO, Akira HIRANO, Satoshi UCHIDA, Wahyunto [ICALRD] and M. Zainal Abidin [ICALRD])

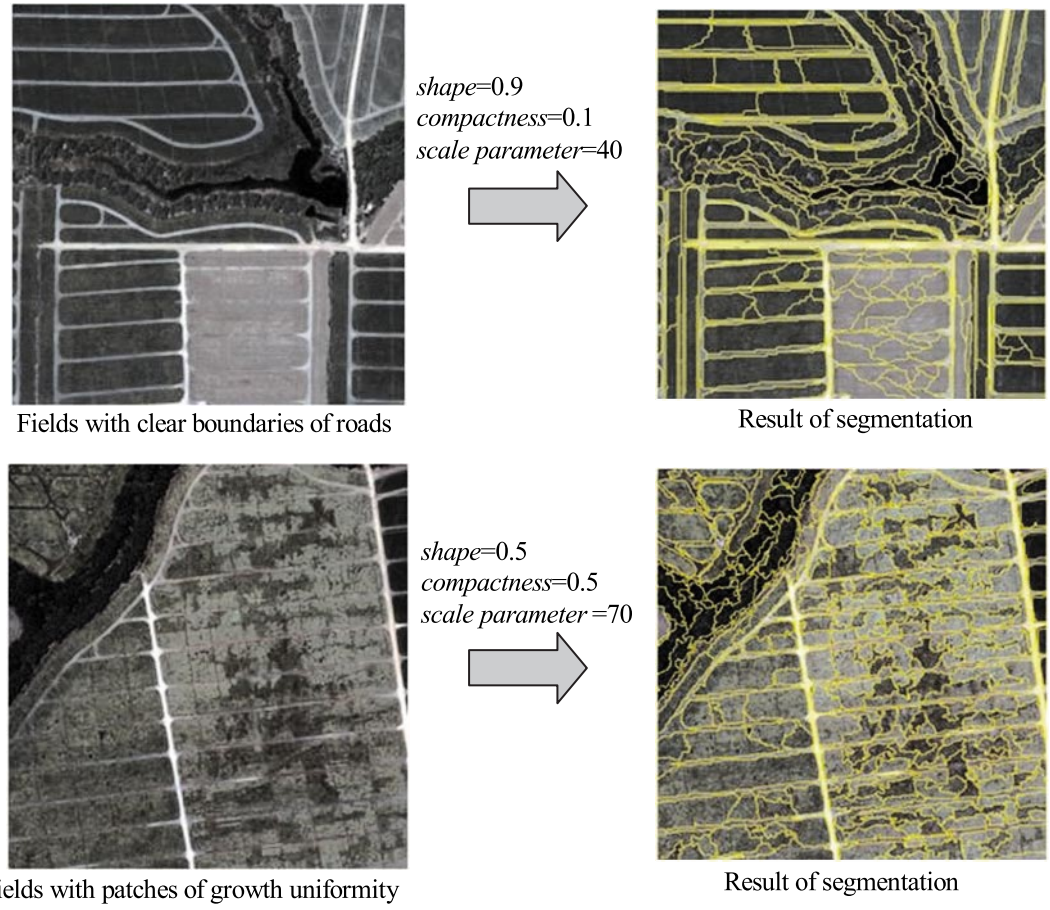


Fig.1. Sample images (Left) and the results of segmentation with adjusted parameters (Right).

Table 1. Effect of parameter adjustment in classification accuracy

	Accuracy (%)※	
	By proposed method	By unadjusted parameters
Field boundaries	**85**	81
Growth uniformity	**92**	60
Sowing/planting way	**73**	70

※*Ratio of coincident pixels with image interpretation*

Manual for establishing and operating cooperatives

In Niger, government ordinances concerning the establishment of cooperatives were previously the only formal rules. Therefore, project leaders had to check with the Direction de l'Action Coopérative et de la Promotion des Organisations Rurales (DACPOR) every time a cooperative was to be organized according to the purpose of the respective project activity. In addition, since cooperative establishment support manuals formulated for these projects were specific only for the respective project activities, they were inadequate to serve as reference to support the establishment of cooperatives of projects in other fields. And furthermore, in many cases, those who applied for the administrative registration of cooperatives or administrative officials of city offices who accepted such applications were not familiar with the requirements that cooperatives must meet or with the registration procedures. Therefore, DACPOR intended to develop a versatile and practical cooperative establishment manual based on laws and regulations concerning the establishment of cooperatives.
JIRCAS and DACPOR have developed a manual which contains versatile and practical information based on laws and regulations concerning the establishment of cooperatives. The purpose of this manual is to be extensively utilized for cooperative formation support for central and local administrative officials in charge of the creation of cooperatives in Niger, as well as donors or NGOs (see Fig. 1). This manual has been deliberated among representatives from agricultural offices and other related organizations from all the Niger regions through a review seminar held on June 25, 2010 and in other conferences between the parties concerned, and has finally been approved by the Nigerian government. This manual contains not only the procedures for organizing cooperatives, but also the process for formulating action plans of the cooperatives and techniques in operation and management while providing examples, and is therefore versatile and practical.

This manual explains the following items in French, which is the official language of Niger (see Fig. 2): (1) Purpose and significance of establishing cooperatives as defined by the International Cooperative Alliance; (2) Procedures for preparing or filing of articles of incorporation, by-laws and approval application for cooperatives, which are prescribed formalities required for establishing cooperatives, and formats of documents for setting up cooperatives, such as general meeting minutes, roster of participants in establishment and action plans, as well as methods for submitting these documents to city offices; (3) Necessity of maintaining transparency and

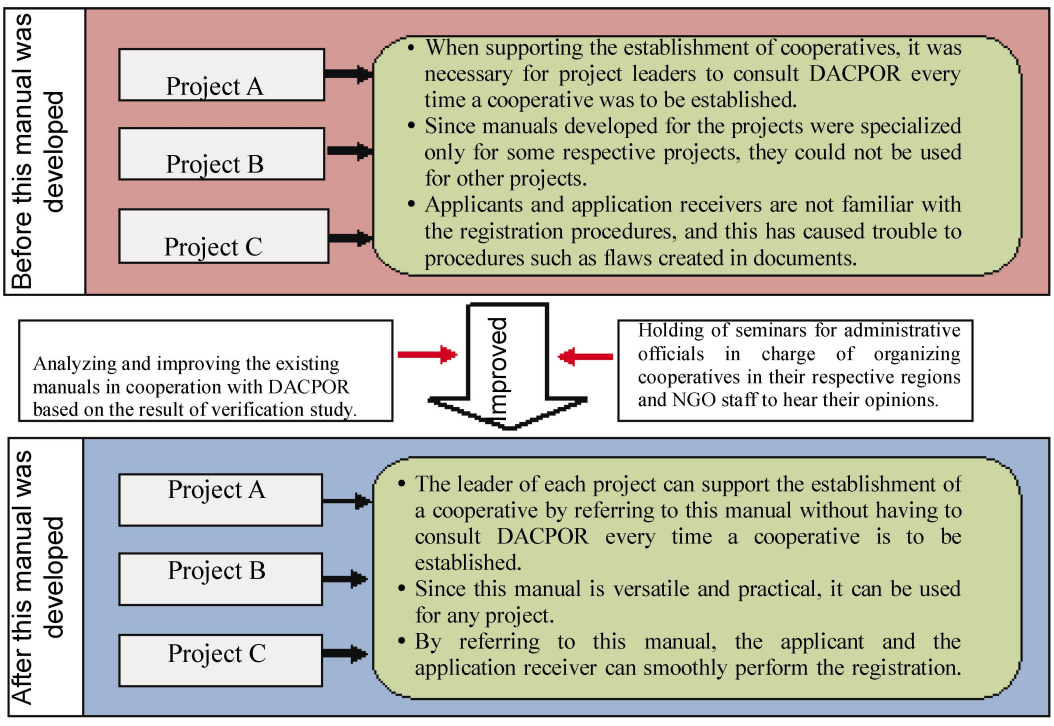


Fig. 1. Purpose of developing the manual.

Section I: Establishment of a Cooperative

1. Identity of a Cooperative
1.1 Definition of a cooperative
1.2 Values of a cooperative
1.3 Principles of a cooperative
1.4 Characteristics of a cooperative
1.5 Education of cooperative members
1.6 Difference between a cooperative and other forms of entities
1.7 Number of founding members
1.8 Rights and obligations of a cooperative member
1.9 Management method
1.10 Conditions essential for the development of a cooperative organization

2. Formulation of Regulations and Rules

3. Bodies of a Cooperative and their Authorities
3.1 General meeting
3.2 Board of Directors
3.3 Auditing body
3.4 Cooperative administrator (administrator or cooperative director)
3.5 Experts' committee
3.6 Criteria for selecting the cooperative's administrative members
3.7 Various methods for selecting the cooperative's administrative members
3.8 Process for public or official recognition of the cooperative
3.9 Dissolution of a cooperative

4. Overview of Operation of Meetings

Section II: General Affairs, Financing and Accounting Management

5. Assets of a Cooperative and its Management
5.1 Funding source of a cooperative
5.2 Cooperation through provision of articles or manual labor
5.3 Strategy for mobilization of funds, labor and equipment
5.4 Management

Section III: Formulation of a Project Program/Action Plan

6. Cooperative Project Program/Action Plan
6.1 Project Program
6.2 Action Plan

Annex

Fig. 2. Contents of the Manual

fairness in electing executives such as a representative, deputy representative, accountant, secretary and person in charge of the organization, and characteristics of multiple election methods including democratic executive election; and (4) Duties of executives of the cooperatives, process for facilitating meetings, management of finances and equipment, and methods for formulating, monitoring and evaluating action plans.

Project leaders can easily understand essential concepts and procedures for the establishment and operation of cooperatives with this manual alone. The laws and regulations in that country will be given priority when this manual is applied in countries outside of Niger.

(Jotaro Yasuhisa, Kimio Osuga, M. Gado Maouna [Direction de l'Action Coopérative et de la Promotion des Organisations Rurales; DACPOR])

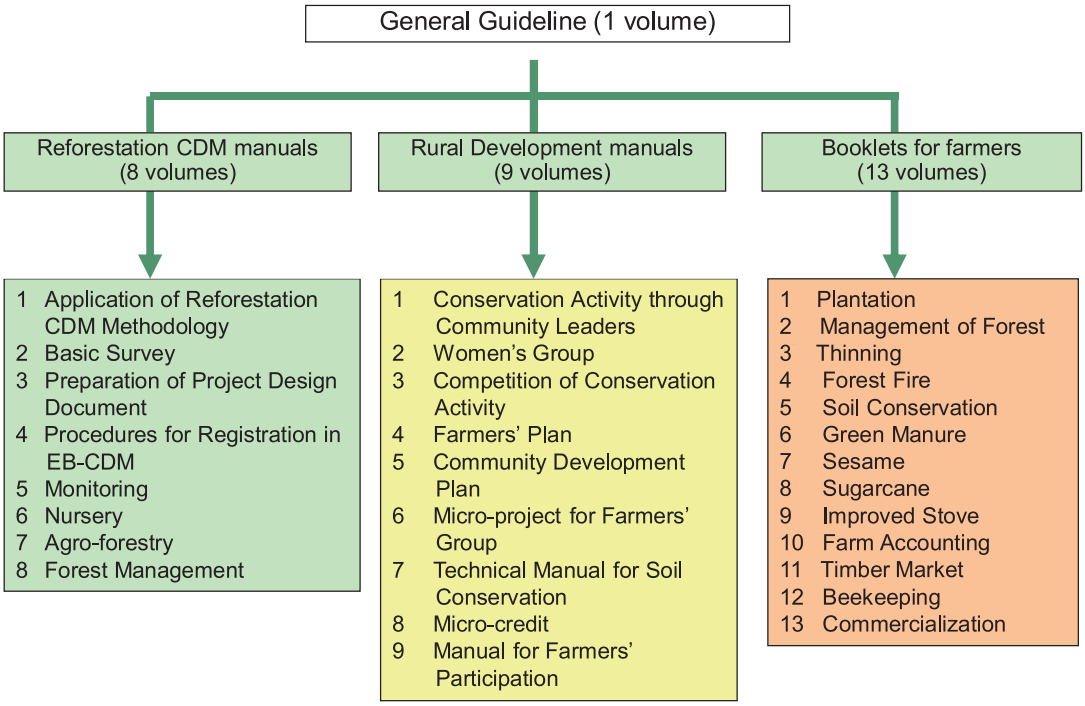
TOPIC4

Manuals on rural development applying reforestation projects under the Clean Development Mechanism (CDM)

In low income rural communities, where soil erosion and soil degradation have caused deteriorating fertility, conservation activities and improvement of farming technologies with low-input methods such as the construction of contour ridges, planting of hedges on contours, and introducing green manure, as well as introducing reforestation and agroforestry in abandoned lands, are effective means in order to recover land resources and augment the landowners' livelihood. Reforestation CDM is a system enabling project promoters to obtain carbon credits (CERs or Certified Emission Reductions) from CO_2 which is accumulated in trees, as additional income, and is adaptable to soil degraded-areas suitable for planting trees, although the requirements to formulate the CDM project are too stringent to comply with. JIRCAS prepared the manuals for formulating and implementing rural development projects in low income communities in Paraguay, which include soil conservation, soil restoration and reforestation CDM, based on the results of a study jointly conducted with the National University of Asunción, Ministry of Agriculture and Livestock, etc.

The manuals consist of 1) a General

Guideline, describing the processes and main points for rural development using reforestation CDM, 2) Rural development manuals based on soil conservation and restoration of soil fertility, 3) Reforestation CDM manuals to formulate and implement small-scale reforestation CDM



Language:
Spanish (all)
Japanese (Guideline and Reforestation CDM manuals)

Fig.1. Composition of manuals for rural development applying reforestation CDM

Table 1. Process of rural development applying reforestation CDM

Process	Contents
1	Selection of communities and leaders
2	Awareness promotion for farmers through workshop and capacity-building activities
3	Establishment of demonstration and experimental farm (nursery in the future), as a center of project activity, and demonstration of farming techniques
4	Establishment of farmers' demonstration farm in each community, and demonstration of improved farming techniques
5	Preparation of resource map and future improvement plan (farmer's plan) of each farm household, using the results of the baseline survey
6	Implementation of competition among communities on techniques of soil conservation and soil fertility restoration
7	Organization of farmers' groups in each community, and training as well as implementation of farming techniques for each group
8	Confirmation of farmers' intention for reforestation as a measure of soil conservation and additional income generation
9	Decision-making on which tree species to introduce
10	Introduction of agro-forestry techniques to maintain agricultural production
11	Workshop for reforestation CDM
12	Implementation of a questionnaire survey for potential reforestation farmers on the location of planned reforestation areas, scale of reforestation, tree species, etc.
13	Collection of basic data necessary for reforestation CDM (scenario of tree growth and basic density of each species, etc.) and on-site survey of planned reforestation areas
14	Preparation of project design document (PDD)
15	Registration of Reforestation CDM project in the Executive Board of CDM (EB-CDM of UNFCCC)
16	Acquisition of carbon credits or CERs (Certified Emission Reduction)

projects, and 4) booklets for farmers, simply explaining individual farming techniques. (Fig. 1)

The objectives of the rural development process that JIRCAS established (Table 1) are to ensure motivation of participant farmers and strengthen their activities for soil conservation, improvement of farming, agro-forestry and reforestation under their own responsibility, by means of implementing awareness-heightening activities at the very initial stages of the project. Farmers with high awareness and independence are able to appropriately manage their crop fields and forested areas, to increase CO2 stock in reforested areas, to obtain carbon credits, and to realize the recovery of land resources and improvement of livelihood, by continuing the learned improved technologies.

The manuals are of highly practical use, since their effectiveness was confirmed through a verification of this unprecedented rural development model, which was implemented by combining low-input soil conservation, agro-forestry and reforestation CDM in low income communities. The manuals, prepared in Spanish and Japanese, are applicable to rural development in areas in South America, under similar natural and socio-economic conditions, and available for engineers and extension workers of governments, donor agencies, NGOs, etc. It takes around 5 years for the project promoter to achieve the objectives if the project targets unorganized small-scale farmers, though shortening of the project period is possible if cooperatives or farmers' group are the principal beneficiaries.

(E. Matsubara, S. Hirouchi, M. Watanabe, H. Ikeura)

TOPIC 5

Citrus greening management for king mandarin cultivation in southern Vietnam

Citrus greening (CG) has destroyed extensive citrus areas in Asian countries. Recent studies have revealed that the control of the psyllid vector, *Diaphorina citri*, using systemic insecticides such as imidacloprid, thiamethoxam or clothianidin, effectively reduces the occurrence of this disease. These insecticides are grouped as neonicotinoids. However, economic evaluation of this control has not been done yet, making farmers reluctant to follow it. Furthermore, even if this control is carried out, orchards would have to be abandoned under some special circumstances. Hence, our studies were attempted 1) to analyse the impact of risk factors on the occurrence of this disease, 2) to evaluate the efficacy of the above management, and 3) to estimate the contribution of the management to the farmers' economy.

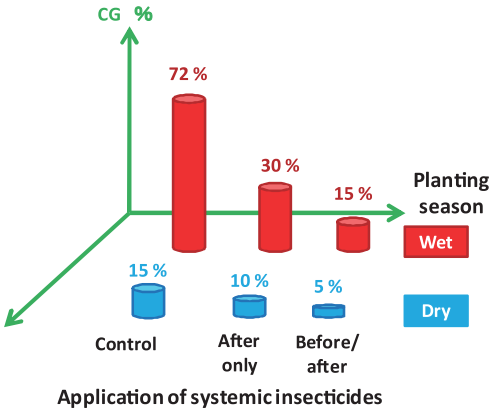


Fig. 1. The proportion of king mandarin trees infected by citrus greening 1.5 year after planting. These trees were planted either in the dry season, (May 2007) when the psyllid density was high in the year or in the wet season, (November 2007) when the density was low. Seedlings were treated either with no neonicotinoids designated as control or by these insecticides. The insecticide applications were either performed only after planting or both before and after planting.

Field assessment in which the cultivation of king mandarin was surveyed among farmers in southern Vietnam revealed that more than 70% of the orchards had been infected by CG. Covariance structure analysis was applied to the data of the study for the extraction of factors that were effectively linked with the occurrence of CG. The analysis revealed that the ambient influence was two to three times stronger than control efforts within the orchard. Thus, orchards located less than 50 m from infected orchards would be facing a higher risk of the disease invasion. In other words, if there are no infected trees within this distance from an orchard, the effort required for disease management would be effectively reduced.

The efficacy of neonicotinoids with the changes in the planting seasons was evaluated. Seedlings planted in the season when psyllids increased, usually from April to July corresponding to the wet season, would be infected 70% by CG in one and a half years if no neonicotinoids were used, and 30% with the use of any of these insecticides (Fig. 1). The infection proportion was effectively reduced to 15% if seedlings were treated with neonicotinoids both 10 days before planting and every two months after planting. On the other hand, the CG infection proportion was surprisingly reduced if seedlings were planted in the season when the psyllid density was decreased. Seedlings were infected only 15% without the use of neonicotinoids, 10% with the application of neonicotinoid only after planting,

and 5% with the insecticide application, both before and after planting.

Based on these results, a diagram for decision-making on the cultivation of king mandarin was devised (Fig. 2). On this diagram, a farmer first has to observe the distance from his new orchard to the nearest neighbouring orchard. If the distance is more than 50 m, he can plant seedlings anytime in the year without the pre-planting application of insecticides, although the use of insecticides would promise better yields. If an infected old orchard is located within 50 m, seedlings should be planted in the season when psyllid densities are low. In this case, there is no need to apply neonicotinoids before planting. If seedlings are planted in the season when the psyllid density is high, neonicotinoids should be applied both before and after planting.

Finally, the efficiency of the management on the farmers' household economy was evaluated from studies, in which both CG infection and farm households' economy were investigated. The first crop of king mandarin is expected one and a half years after planting in southern Vietnam. In other word, farmers who cultivate this cultivar must wait for a couple of years until they can gain enough income from the cultivation for their livelihood. In this region, 20 thousand dong per year would be required for their basic subsistence. The average acreage of farms in southern Vietnam is about five thousand square metres, indicating that the minimal annual yield should be four million dong per one thousand square metres for the average farmers. This amount is equivalent to an annual yield of 400 to 500 kg/1000 m^2. Our model farmers attained this level of fruit production in the third year (Fig. 3). In fact, some farmers who were suffering from indebtedness before this project repaid their debts in full and started to earn more income to purchase new furniture or repair their houses. This indicates that the developed management could be extended to other farmers in southern Vietnam.

After completion of the project, the techniques developed have been further continued in the JICA project which is attempting to facilitate the economic independence of farmers in southern Vietnam. This project will help the farmers to follow the techniques successfully in the cultivation of king mandarin. We hope that the CG management developed in our project would be extended over southern Vietnam and the production of king mandarin would be further raised for the farmers' economic independence.

(K. Ichinose; K. Sekino [NARCT]; N. V. Hoa [SOFRI] and D. H. Tuan [SOFRI])

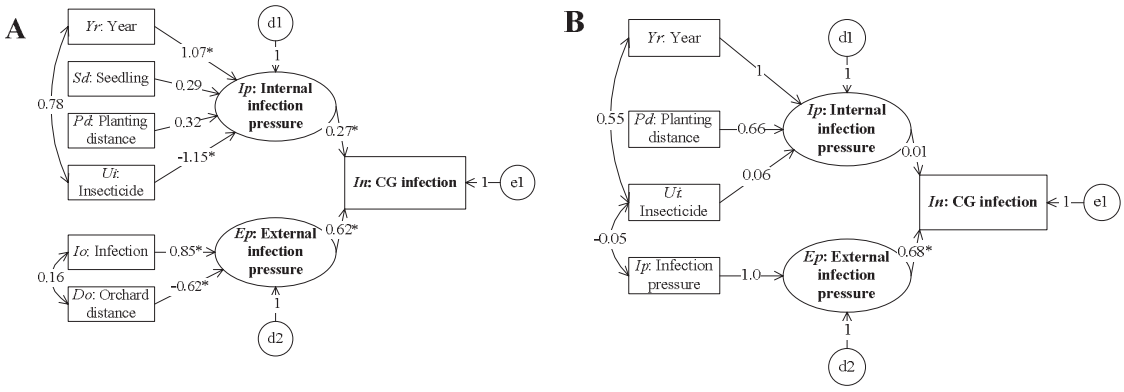


Fig. 2. Model examined by covariance structure analysis of data obtained in 2008 in southern Vietnam (A) and in 2009 in Vinh Long (B). Observed variables are designated by rectangles and latent variables by ellipses. Error terms and disturbance variables are shown by circles. The data were standardized for these analyses and coefficients of dependent variables are shown as numerals on the arrows. Asterisks indicate significant coefficients at $P < 0.05$.

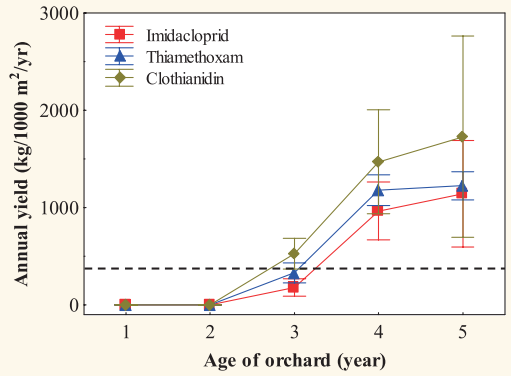


Fig. 3. The proportion of king mandarin trees infected by citrus greening 1.5 year after planting. These trees were planted either in the dry season, (May 2007) when the psyllid density was high in the year or in the wet season, (November 2007) when the density was low. Seedlings were treated either with no neonicotinoids designated as control or by these insecticides. The insecticide applications were either performed only after planting or both before and after planting.

First report of the root-knot nematode, *Meloidogyne enterolobii*, isolated from decaying guava roots in the Mekong Delta, Vietnam

Guava is a very important crop in the Mekong Delta of Vietnam. It yields fruits for several months after transplantation of the seedlings, providing faster income to farmers than other fruit crops. Recently, the joint research studies for citrus greening between JIRCAS and Southern Horticultural Research Institute of Vietnam (SOFRI) revealed that guava interplanted with citrus trees reduced the infection of citrus trees by citrus greening, which is one of the most serious citrus diseases. However, many guava seedlings declined showing yellowing to browning of leaves several months after planting in guava-interplanted citrus groves. In particular, the "Khong hat" variety which was recommended by SOFRI for interplanting has been discovered to be more vulnerable to this problem than other traditionally cultivated varieties. Since diseased seedlings die in a couple of months after the onset of symptoms, it is urgent to establish a control method for this problem.

First symptom of the guava decline was yellowing of the leaves, followed by the expansion of yellowed parts and further browning of leaves (Fig. 1A) until defoliation. The growth of diseased trees was retarded and these trees usually die in a couple of months to one year after expression of the first symptom. Many root knots were observed on the roots of diseased trees even in the early stages of symptom development (Fig. 1B) and root-knot nematodes were taken as specimen from these root knots (Fig. 1C). This problem has widely occurred in southern Vietnam, and nematode juveniles in the second stage were extracted from soil samples collected within the root system of diseased trees (Table 1).

DNA sequence analyses were performed using juveniles which had been hatched from egg masses laid by the nematodes collected from the root knots of diseased trees. The mitochondrial DNA region of COII-16SrDNA of the nematode was amplified by PCR (1). An approximate 700-bp fragment of PCR product was obtained and analyzed, revealing more than 99.6% homology to *M. mayaguensis*, a synonym of *M. enterolobii* (2), when aligned with sequence data of isolates from France [(*GenBank Accession No. AJ421396*), United States (*GenBank Accession No. AY446978*) and China (*GenBank Accession No. AY831967*) (Table 2)]. The nematode in guava root knot was formerly identified as *M. mayaguensis* in other reports, but recently this nematode has been identified as identical to *M.*

Fig. 1. Yellowing and discoloration of leaves of guava seedlings (A), root knots observed in the diseased seedlings (B) and a second stage juvenile solated from the soil around the root knot (C).

Table 1. Population density of nematodes in fields in Mekong Delta where the severe decline of guava seedlings was observed.

Date of sampling	Location	Sample No. in a location	Number of 2nd stage juveniles per 20g of soil	Root knot presence (+) and absence (-)
2008.7.27	Dong Thap	1	1	-
		2	191	+
		3	24	+
2008.7.28	Cai Be	1	30	+
		2	12	-
2008.7.31	My Luong	1	318	+
		2	2	+
		3	0	+

enterolobii. Hence, we use the latter's species name for the nematode problem.

The nematodes which were taken from the root knots of the diseased guavas were inoculated into five intact guavas, the roots of which were infected by the egg masses of nematodes. Juveniles obtained from these egg masses were examined and compared morphologically and genetically with the above nematodes. The results gave the same conclusion: these nematode specimens are *M. enterolobii*. This is the first confirmation of the incidence of this nematode from Vietnam (3), and the results imply that the pathogen of the guava decline in Southern Vietnam is a nematode of this species.

Interestingly, few or no symptoms of this disease can be detected on the other local variety, "Xa ly nghe", even though planted next to the diseased "Khong hat" guavas. This suggests that the former variety is either resistant or tolerant to the nematode. If this can be confirmed further, "Xa ly nghe" may be used as a resistant root stock for the breeding and cultivation of "Khong hat".

(H. Iwahori [National Agriculture and Food Research Organization], N. T. N. Truc and D. V. Ban [Southern Horticultural Research Institute] and K. Ichinose)

Table 2. Identification of mitochondrial DNA COII-16SrDNA region sequences between a Vietnamese isolate from diseased guava and *Meloidogyne enterolobii* isolates from three other different regions

Isolates	Vietnamese isolate	*M. enterolobii*		
		Chinese isolate (GenBank Accession No. AY831967)	The U.S. isolate (GenBank Accession No. AY446978)	French isolate (GenBank Accession No. AJ421396)
Vietnamese isolate	—	99.9	99.9	99.7
Chinese isolate		—	99.7	99.6
U.S. isolate			—	99.6
French isolate				—

TOPIC7

Development of individual based-model for simulating the spread of Citrus greening disease by the vector insects

Citrus greening disease (Huanglongbing, HLB) is an untreatable disease that makes trees wither and die. Therefore, in order to prevent HLB spread in citrus orchards, especially in the severely affected areas such as Southern Vietnam, a vector insect management strategy based on infection risk is required. To estimate the HLB infection risk by the vector in an orchard, we developed a simulation model following a framework of individual-based model (IBM).

As a basis for developing IBM, the C language technology of simulated individuals was electronically published on "http://gi.ics.narawu.ac.jp/ ~ takasu / research / IBM / ibm.html". IBM differs from existing models such as the lattice model. Our IBM is able to provide parameters for each individual citrus tree and the vector (Table 1). Therefore, it is able to examine the disease spread dynamics in the simulation field, by calculating the cumulative results of the individual behaviors. In our model, the process was divided into the following four periods (Fig. 1) [a) Some of the citrus trees which were fed on by the virulent vector insects changed their status to the latency or incubation period; b) After the latent period, the trees exhibited the symptoms of HLB and c) The virulent insects emerged from the infected trees. d) Then, the virulent individuals started dispersing.]. The result of the simulation in the newly planted citrus orchards in southern Vietnam near the infected field showed a similar trend with the actual survey (Fig. 2). In our model, by changing the parameters of each individual vector insect and the host trees, it was possible to quickly and reasonably examine the synergistic effect of the combination of each of the control techniques.

A validation test is necessary before an extension of the simulation results can be performed. It is possible to develop new management techniques by estimating the effective parameters to prevent the spread of HLB. By changing the parameters of this model, we can simulate the spread dynamics of other diseases which are likewise infected through vector insects.

(Y. Kobori, Y. Ohto, T. Nakata K. and F. Takasu [Nara Women's University])

Table 1 Parameters of developed model.

a) Citrus tree

Factors	Parameters
Position	Point in the simulated area
Physiological condition	Healthy, latent, infectious and death period
Time progress from infection	Duration till infected and dead

b) Vector insect

Factors	Parameters
Migration	Position before movement
	Direction
	Distance
	Mortality in migration
Disease transmission	Probability of virulence when it grows on the infected tree
	Transmission probability to healthy tree by a virulent individual
Reproduction and death	Reproduction number of offspring by an individual
	Longevity

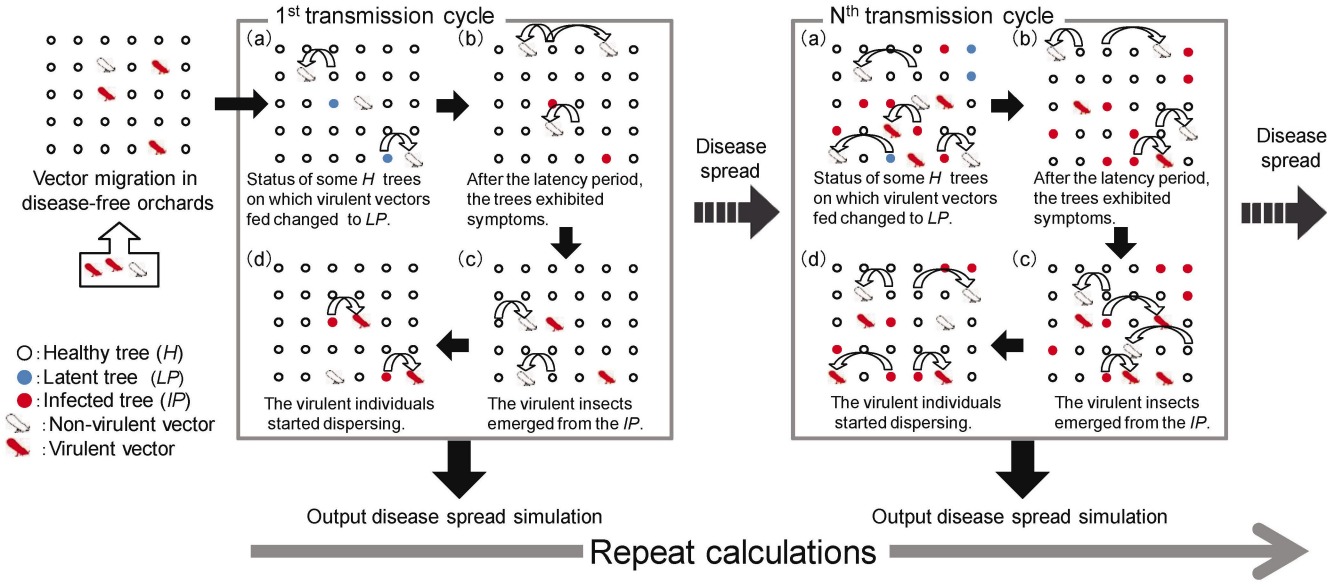
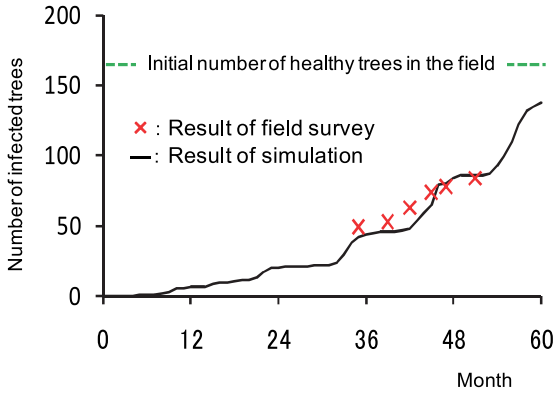


Fig. 1. Mortality of psyllids on seedlings of king mandarin applied with neonicotinoids
Error bars show standard errors of the mean.
Broken and solid lines show the culturing periods in a nursery and in an orchard, respectively.
* Corrected with the Abbott's formula



		Results of actual survey	Conditions of the simulation
Newly planted orchard focus of on the estimation	Distance between plants	2.5m	2.5m
	Orchard scale	20plants X 9rows Total: 180plants	20plants X 9rows Total: 180plants
	HLB	None	None
	Vector insect	None	None
	Distance from infection source	c.a. 13m	12.5m
Orchard of infection source	Distance between plants	2.5m	2.5m
	Orchard scale	20plants X 5 rows Total: 100plants	20plants X 5 rows Total: 100plants
	HLB	Spread	All plants infected
	Vector insect	2500-4000 adults	4000 adults
Migration of vector insect	Direction	Random	Random
	Distance	The distance of a movement r approximated r (m) = $0.8\times e^{-0.8\times r}$	The distance of a movement r approximated r (m) = $0.8\times e^{-0.8\times r}$

Fig. 2 Comparison between the results of the simulation and results of the actual survey.
The simulation conditions are referred to in the table to the right.

B. Collection, analysis and dissemination of information to grasp trends related to international food, agriculture, forestry, fisheries and rural areas

Different information relating to the middle- to long-term trends of the global food market and the research situation in the area of rural development such as African rice development were collected and examined through international meetings and surveys. Then, a system was established with dedicated staff and local offices for grasping needs and seeds for collaborative researches in the regions of Southeast Asia and Africa. The TARC-JIRCAS 40th Anniversary International Symposium: ' A New Decade for International Agricultural Research for Sustainable Development ' was organized and useful suggestions on the future directions of international agricultural research were obtained.

Impacts of newly adopted technologies such as gravity irrigation system and alternative wet-and-dry water-saving irrigation were studied by conducting village surveys and social experiments. The studies revealed several conditions for technology diffusion as well as their impacts on the communities.

In some regions of Sri Lanka, which were ravaged and suffered huge damages from the Indian Ocean Tsunami, the processes of re-building villages through capacity development of farmers ' associations and extension workers were identified and tested. A guideline based on the trial results was made.

Likewise, methods of participatory development assistance were evaluated in some villages in East Timor through the conduct of pilot field projects. A guideline for the methods was formulated and handed to the local authorities for their further use to advance rural development.

TOPIC1

Role of social network in the diffusion of water-saving irrigation technology in the Philippines

A water-saving technology is required for cost reduction of deep well-irrigated rice cultivation. AWD (Alternate Wetting and Drying) is an intermittent scheme of irrigation and this method can save water up to 15-30% in comparison with the regular flooding method, although entailing additional labor for water management and weeding, rodent damage and risk of yield loss due to improper irrigation timing. Thus, transferring correct technical information is crucial for effective technology transfer. The International Rice Research Institute (IRRI) carried out a pilot project on AWD dissemination for the deep well irrigation system in Tarlac, Luzon for the period 2002-2003. However, diffusion of the technology has not progressed well after the project. Aimed at clarifying the formation of the social network regarding AWD, a farmer survey was conducted for a total of 35 members of the pilot project irrigation association from September, 2006 to February, 2007.

The farmer-cooperators of the project mostly understand the advantages of AWD, although some misunderstanding on technical considerations for cultivation methods, which required attention, occurred within the farmer-to-farmer communication process. If the farmers practice AWD with defective knowledge, not only yield loss but also some distrust in the leading farmers and extension workers may arise. Even if a farmer understands AWD correctly, there is such a case wherein he is too passive to communicate with other farmers, fearing that he might stand out or that any problem might occur later among neighbor-farmers who adopted AWD based on his advice.

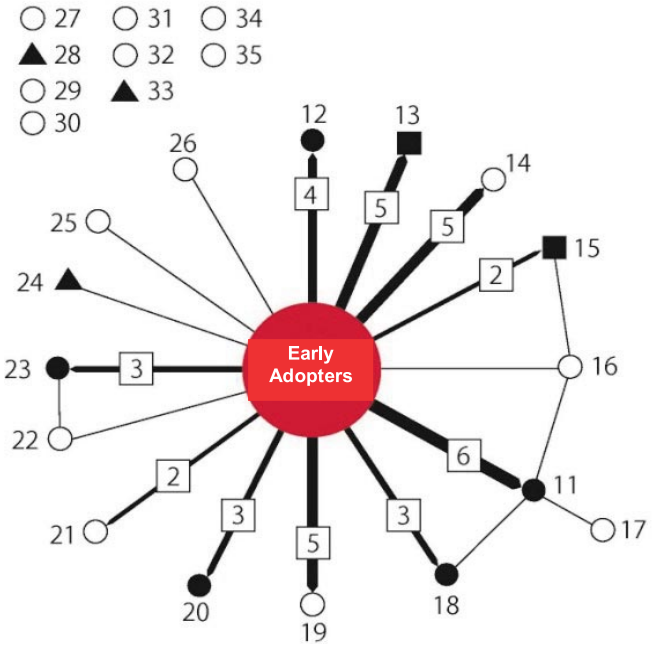


Fig. 1. Social network of water users association related to AWD. Each dot represents a member with a farmer number on the right. The central red large circle represents the ten early adopters (farmer numbers 1-10) who have continuously practiced AWD since 2002. Lines between the dots symbolize information flow related to AWD. Degree of AWD adoption is indicated as _ High, _ Middle, _ Low, _ None. Figures in _ indicate links to the ten early adopters. Example: No. 12 farmer exchanges information with four early adopters.

So after this project was finished, the spontaneous adoption of AWD was very limited. When we treat the ten early adopters as one actor, the network of AWD becomes a typical star-shaped network. The early adopters are located in the center and influence the surrounding farmers directly, but the network formation from these first-contact farmers to other farmers was extremely restrictive (Figure 1). The ten early adopters are categorized by position and role in the network as the following three types. The "gatekeeper" conveys technical information from the outside resource persons into the community. The "coordinator" is positioned in the center of the network, and closely tied with the community members but less with outsiders. As an opinion leader or focal person, he consults and coordinates with the community members. The "transmitter" holds a similar position to that of a "gatekeeper" between insiders and outsiders, but plays an opposite role. This person gains knowledge from community members and transfers it to outsiders (Table 1).

The communication between farmers is quick and efficient, but entails a risk of misunderstanding. Group formation involving both AWD adopters and expected adopters (showing interest but have not yet confirmed to adopt) is recommended. At these gatherings, it is necessary to clarify the remaining misunderstandings and skepticisms related to the technology among non-adopters in a relaxed friendly atmosphere.

(Shigeki Yokoyama, Ma Victoria C. Rodriguez [IRRI] and Kumi Yasunobu [Tottori University])

Table 1. Personal ties of the ten early adopters.

Ten early adopters		Ties with		
Category	Farmer number	Extension workers	Member farmers	Non-members
Gatekeeper	1	2[b]	6	0
	2	1[b]	9	0
Coordinator	3	0	15	0
	7	0	7	0
	8	0	10	0
	9	0	7	0
	10	0	1	0
Transmitter	4	0	13	2[ab]
	5	0	10	1[ab]
	6	0	13	1[ab]

Legend: No.1 farmer exchanges information with 2 extension workers and 6 member farmers.
[a] Officials of neighboring villages.
[b] No corresponding dots are shown in Fig. 1.

Demonstration of the Rural Reconstruction Method in Sri Lanka and formulation of Guidelines

The Indian Ocean Tsunami, which occurred in December 2004, also caused extensive damages to Sri Lanka. Although the restoration of living infrastructures and public facilities has progressed, the restoration of agricultural production infrastructures such as paddy fields and irrigation and drainage facilities has not progressed as much. This is because these damages are not easily recognized, and factors that prevent restoration such as too much financial dependence of farmers are complexly interrelated. Therefore, this guideline puts together the results of the study on methods for facilitating the restoration of agricultural production infrastructure while utilizing farmer organizations, and of verifying an agricultural support system utilizing the support of local administrative officials, as well as lessons learned, in the local language (Sinhalese).

A method for continuous paddy field restoration by implementing restoration activities of paddy fields left untreated after the tsunami disaster, by contributing part of the earnings from rice production at restored paddy fields to a paddy field restoration foundation, and advancing the paddy field restoration work using the foundation has been proposed in the guideline (Fig. 1). The result of the demonstration of the method performed in Thalalla South Village indicates that paddy fields of 8.3 ha were restored first, then a second paddy field restoration work was undertaken using the acquired funding, and thus paddy fields of up to 3.0 ha were further restored. The yields have been recovered up to 2.7 t/ha, which accounts for 70% of the provincial average, from no yield at all in the past years. In Sri Lanka, many paddy fields have been left untreated and are covered in weeds after being damaged by floods or the like due to the tsunami disaster. If the administration or support agencies could use this method, it would be possible to effectively restore these farmlands with a limited budget while increasing the independence of farmer organizations.

An Agrarian Service Center has functions from which one-stop administrative services related to agricultural and rural areas are expected. However, collaboration between each sector in the center is insufficient, and comprehensive support for residents has not been provided. In addition, only one agricultural instructor is deployed to take care of 30 to 40 villages in one or two divisions, which means that human resources for supporting the residents are insufficient (Fig. 2).

Therefore, this guideline presents a system in which agricultural research and production assistants (ARPAs) are trained as facilitators, and they can engage in supporting the reconstruction of agricultural and rural areas in cooperation with other officers, while showing an example by demonstrating through a small-scale gardening activity. Utilizing this system would raise the awareness of ARPAs and the residents' feeling of trust, and enable the provision of generous support to the residents.

(T. Higashimaki, K, Takenaka, K. Kouda and S. Shiraki)

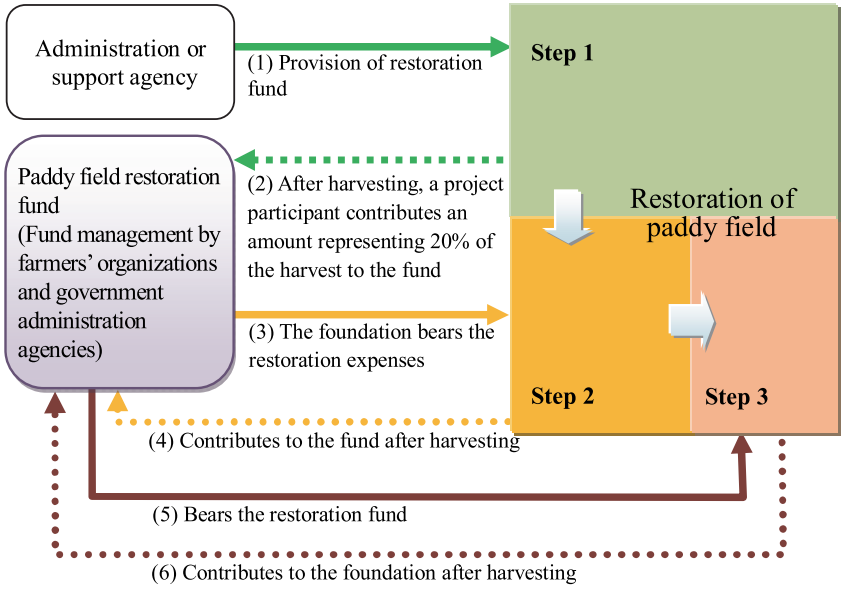
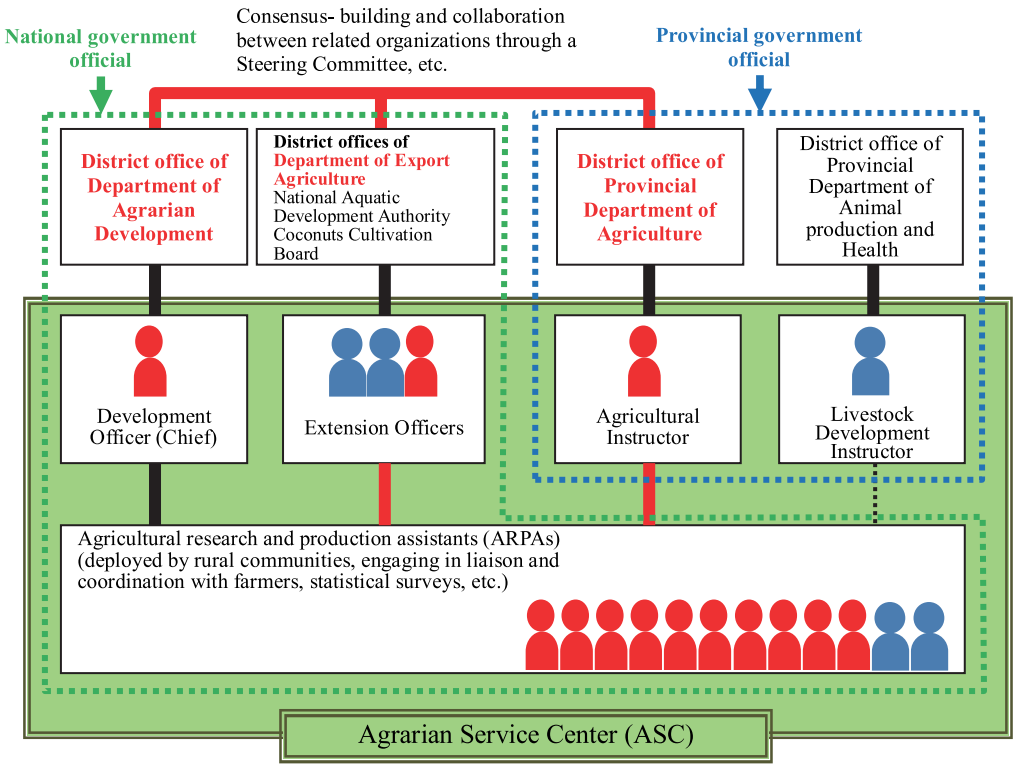


Fig. 1. Diagram of the paddy field restoration project utilizing the paddy field restoration fund.



[Tasks]

- Each Agricultural Instructor and Extension Officer takes care of 30 to 40 villages (understaffed). Meanwhile, Agricultural Research and Production Assistants (ARPAs), each taking care of 1 to 3 villages, have limited expertise on agriculture.
- To achieve mid- to long-term restoration, it is necessary to build a trusting relationship between villagers and the administration.

[Achievements]

- ➢ Collaborative work between ARPAs and promoters enables the ARPAs to support the duties of promoters, and the promoters to supplement the inadequate capabilities of ARPAs, and thus, a relationship advantageous to both can be established.
- ➢ Residents' trust in ARPAs is increased, and the relationship between residents and the administration becomes closer.

Fig. 2. New collaboration within the Agrarian Service Center

TOPIC3

Guideline for Rural Reconstruction in East Timor

East Timor became independent in May 2002, and has been working on nation-building with support from the international community which includes international organizations, governments of other countries and NGOs. However, its economic and societal conditions still remain stagnant, and one indication was a domestic conflict which occurred in 2006. In particular, administrative functions have been downgraded due to the outflow of human resources resulting from the conflict, and the number of officials at the Ministry of Agriculture, Forestry and Fisheries has been decreased to approximately 300, accounting for one tenth of the number before independence. Thus, it has been difficult to provide favorable administrative services. In the meantime, over 70% of the population live in rural areas and engage in agriculture, which is the main industry of the country. However, the productivity is low, and the country depends on imports for staple food such as rice. Therefore, it is urgently required for the country to secure food, increase agricultural productivity and work on sustainable agricultural development through human resource cultivation, etc. In the country, it is hoped that prompt preparation of training materials, etc. for the improvement of the abilities of agricultural promoters, who were first appointed in large numbers in 2008 with the aim of establishing a system of one promoter per village (309 promoters by 2010, to be increased by approximately 190 in the future) will be made.

In this research, a rural reconstruction guideline (in English and in the local language Tetung) has been formulated so that a method

for effectively utilizing farmers and the human resources of local administrative organizations can be used by administrative officials to solve the problems of East Timor. In formulating the guideline, workshops were held with senior agricultural promoters across the nation to check the contents and to gather the opinions of all bureau chiefs of the Ministry of Agriculture and Fisheries. The guideline reflects these opinions, and is approved as a training textbook for agricultural promoters of the country.

The characteristics of this guideline in comparison to ordinary, participatory agricultural and rural development methods are as follows: 1) It provides more prompt support amidst the significant shortage of human resources, and it is necessary to select and concentrate activities. This guideline introduces examples of efforts with focused activities, and presents methods that allow the selection and concentration processes to lead to vitalization of habitation communities (Fig. 1). 2) As a factor for the success of recovery support, it is important to produce a clear achievement fast. This guideline introduces an example of support activities conducted in collaboration with WFP (World Food Program) and GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH — German Technical Cooperation), and present a method for promptly creating an achievement by efficiently utilizing funds and human resources of various organizations. 3) Given the present state of shortage of administrative officials, this guideline introduces a method for adopting an agricultural promotion mechanism based on collaboration between communities without excessively relying on the administration and allowing the promotion by farmers to function among the habitation communities (Fig. 2).

(T.Higashimaki, M.Watanabe, H.Dan, K.Omor and K.Iwasaki)

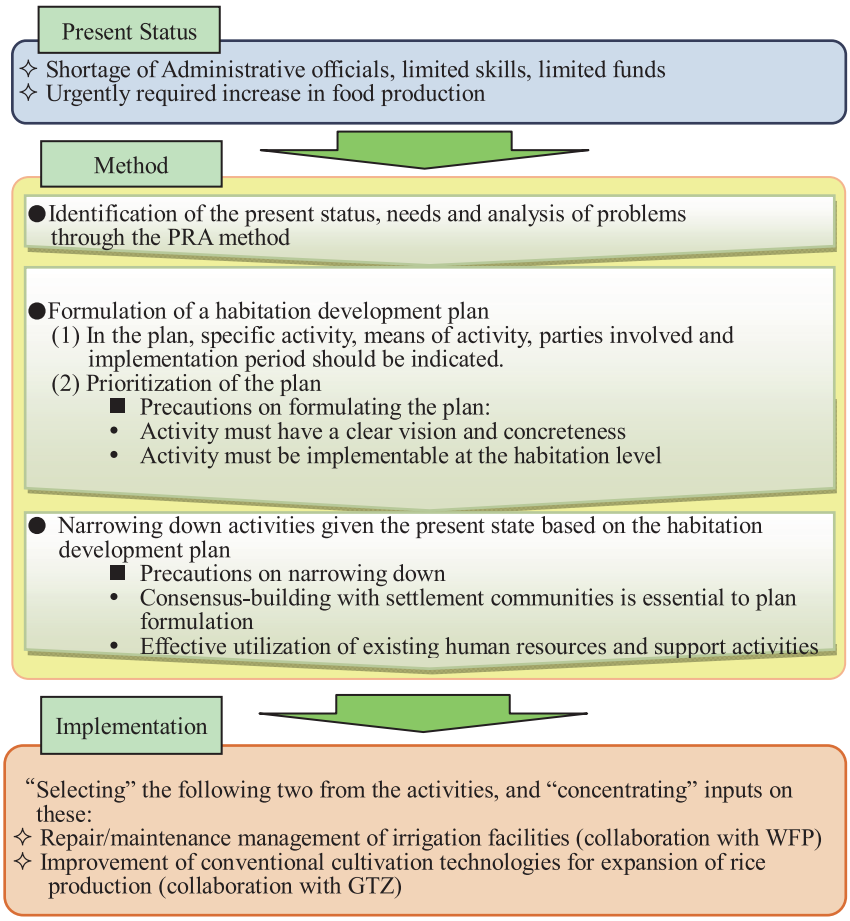


Fig. 1. Selection and concentration processes.

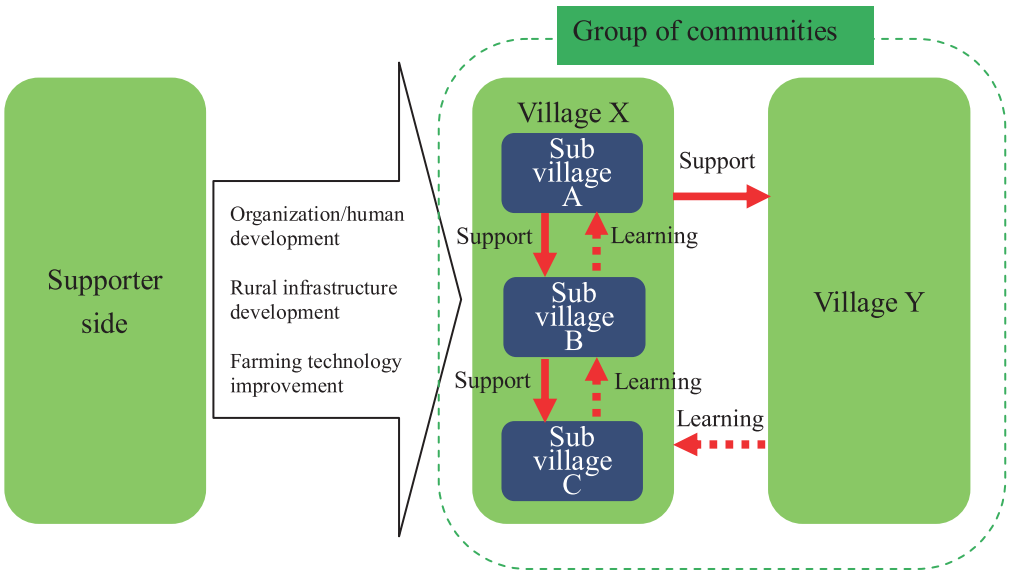


Fig. 2. Procedure of the promotion mechanism based on inter-community collaboration between farmers and settlement communities.

TRAINING AND INVITATION PROGRAMS

AND INFORMATION EVENTS

INVITATION PROGRAMS AT JIRCAS

In keeping with its role as an international research center, JIRCAS has implemented several invitation programs for foreign researchers and administrators at counterpart organizations. These programs facilitate the exchange of information and opinions on agriculture, forestry, and fisheries research, and their implementation and administration, and at the same time serve as an opportunity to strengthen research ties among scientists and administrators in participating countries, mostly in the developing regions. Current programs are described in detail below.

Administrative Invitation Program

Under the Administrative Invitation Program, JIRCAS invites administrators from counterpart organizations to its Tsukuba premises to engage in discussions and reviews of ongoing researches to ensure that collaborative projects run smoothly. In addition, the program exposes administrators to the current activities at JIRCAS and other MAFF-affiliated Incorporated Administrative Agencies (IAAs). Furthermore, the program provides opportunities for the exchange of information and opinions concerning policy-making and project design at the administrative level, thereby contributing to deeper mutual understanding and international collaboration. Sixty individual visits to JIRCAS were made during FY 2010 under the Administrative Invitation Program. Invited administrators and their home institutions are listed below.

Administrative Invitations, FY 2010

Chen Yongfu	Center for Rural Development Policy, College of Economics and Management, China Agricultural University, P. R. China	May 10-14, 2010
Si Wei	Center for Rural Development Policy, College of Economics and Management, China Agricultural University, P. R. China	May 10-14, 2010
Wayne Jones	Agro-Food Trade and Markets Division, Trade and Agriculture Directorate, Organization for Economic Co-operation and Development, France	May 10-15, 2010
Pavel Vavra	Agro-Food Trade and Markets Division, Trade and Agriculture Directorate, Organization for Economic Co-operation and Development, France	May 10-16, 2010
Mathias Fosu	Savanna Agricultural Research Institute, Ghana	Jun. 4-14, 2010
Stephen Kwasi Nutsugah	Savanna Agricultural Research Institute, Ghana	Jun. 4-14, 2010
Joseph Awuni	Faculty of Agriculture, University for Development Studies, Ghana	Jun. 6-13, 2010
Raphael Kwame Bam	Crops Research Institute, Ghana	Jun. 5-18, 2010
Mohammad Moro Buri	Soil Research Institute, Ghana	Jun. 5-18, 2010
Kwaku Nicol	Directorate of Crop Services, Ministry of Food and Agriculture, Ghana	Jun. 5-18, 2010
Abdul Rasid Malik	Forest Research Institute Malaysia, Malaysia	Jun. 1-5, 2010
Mohamed Nor B. Mohd Yusoff	Forest Research Institute Malaysia, Malaysia	Jun. 1-5, 2010
Qiu Jianjun	Institute of Natural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, P. R. China	Jul. 25-Aug. 3, 2010

Yin Changbin	Institute of Natural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, P. R. China	Jul. 25-Aug. 3, 2010
Alexandre Lima Nepomuceno	Embrapa Soybean, Brazil	Jul. 16-22, 2010
Li Lite	College of Food Science & Nutritional Engineering, China Agricultural University, P. R. China	Aug. 30-Sep. 3, 2010
Chen Minghai	College of Food Science & Nutritional Engineering, China Agricultural University, P. R. China	Aug. 30-Sep. 3, 2010
Xue Wentong	College of Food Science & Nutritional Engineering, China Agricultural University, P. R. China	Aug. 30-Sep.3, 2010
Cheng Yongqiang	College of Food Science & Nutritional Engineering, China Agricultural University, P. R. China	Aug. 30-Sep.3, 2010
Yin Lijun	College of Food Science & Nutritional Engineering, China Agricultural University, P. R. China	Aug. 30-Sep.3, 2010
Liu Haijie	College of Food Science & Nutritional Engineering, China Agricultural University, P. R. China	Aug. 30-Sep.3, 2010
Nguyen Loc Hien	College of Agriculture and Applied Biology, Can Tho University, Vietnam	Aug. 27-Sep. 5, 2010
Gassinee Trakoontivakorn	Institute of Food Research and Product Development, Kasetsart University, Thailand	Aug. 29-Sep. 4, 2010
Plernchai Tangkanakul	Institute of Food Research and Product Development, Kasetsart University, Thailand	Aug. 29-Sep. 4, 2010
Ray-Yu Yang	AVRDC _ The World Vegetable Center, Taiwan	Aug. 30-Sep. 2, 2010
Robert Josef Holmer	AVRDC _ The World Vegetable Center, Thailand	Aug. 30-Sep. 1, 2010
Patcharee Tungtrakul	Institute of Food Research and Product Development, Kasetsart University, Thailand	Aug. 29-Sep. 4, 2010
Vipa Surojanametakul	Institute of Food Research and Product Development, Kasetsart University, Thailand	Aug. 29-Sep. 4, 2010
Ahamad Sabki Bin Mahmood	Department of Fisheries Malaysia, Malaysia	Dec. 6-11, 2010
Albert Chuan Gambang	Pusat Penyelidikan Perikanan Bintawa (Bintawa Fisheries Research Centre), Malaysia	Dec. 6-11, 2010
Kaharudin Md. Salleh	Bahagian Penyelidikan Perikanan Air Tawar (Freshwater Fisheries Research Division), Malaysia	Dec. 6-11, 2010
Chong Ving Ching	Institute of Biological Science, Marine Living Resources, Biotechnology & Ecosystems, Institute of Ocean and Earth Sciences, University of Malaya, Malaysia	Dec. 6-11, 2010
Lieng Khamsivilay	Living Aquatic Resources Research Center, Lao PDR	Dec. 5-11, 2010
Sinthavong Viravong	Living Aquatic Resources Research Center, Lao PDR	Dec. 5-11, 2010
Suriyan Tunkijjanukij	Faculty of Fisheries, Kasetsart University, Thailand	Dec. 6-11, 2010
Evelyn Grace de Jesus Ayson	Aquaculture Department, Southeast Asian Fisheries Development Center, Philippines	Dec. 6-13, 2010

Pannee Panyawattanaporn	National Research Council of Thailand, Thailand	Dec. 6-11, 2010
Sim Heoh Choh	Forest Research Institute Malaysia, Malaysia	Nov. 7-11, 2010
Robert Asiedu	International Institute of Tropical Agriculture, Nigeria	Nov. 6-14, 2010
Ma Zhigang	Foreign Economic Cooperation Center, Ministry of Agriculture, P. R. China	Nov. 21-26, 2010
Qian Zhang	Foreign Economic Cooperation Center, Ministry of Agriculture, P. R. China	Nov. 21-26, 2010
Li Ninghui	Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences, P. R. China	Nov. 21-26, 2010
Li Liyuan	Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences, P. R. China	Nov. 21-26, 2010
Suyamto	Indonesian Center for Agricultural Land Resources Research and Development, Indonesia	Dec. 13-17, 2010
Irsal Las	Indonesian Center for Agricultural Land Resources Research and Development, Indonesia	Dec. 13-17,2010
Hoste Christian	CIRAD Agricultural Research for Development, France	Nov. 8-9, 2010
Ganesan Balachander	Science Task Group, Consultative Group on International Agricultural Research, India	Nov. 7-10, 2010
Dilip Nandwani	Cooperative Research, Extension and Education Service, Northern Marianas College, USA	Nov. 21-25, 2010
Ram Badan Singh	Indian Farmers Fertilizer Cooperative Limited, India	Nov. 6-10, 2010
Beata Dedicova	International Center for Tropical Agriculture, Colombia	Jan. 10-13, 2011
Manabu Ishitani	International Center for Tropical Agriculture, Colombia	Jan. 10-20, 2011
Jagadish Rane	International Center for Tropical Agriculture, Colombia	Jan. 9-15, 2011
David Bonnett	Centro International de Mejoramiento de Maiz y Trigo, Mexico	Jan. 9-14, 2011
Mario Pacheco Velazquez	Centro International de Mejoramiento de Maiz y Trigo, Mexico	Jan. 10-13, 2011
Carolina Saint Pierre	Centro International de Mejoramiento de Maiz y Trigo, Mexico	Jan. 10-13, 2011
Inez Hortense Slamet-Loed	International Rice Research Institute, Philippines	Jan. 10-13, 2011
Amelia Henry	International Rice Research Institute, Philippines	Jan. 10-13, 2011
Rolando Torres	International Rice Research Institute, Philippines	Jan. 10-13, 2011
Zhenfu Jin	School of Engineering, Zhejiang A & F University, P. R. China	Mar. 15-25, 2011
Lingfei Ma	School of Engineering, Zhejiang A & F University, P. R. China	Mar. 15-25, 2011

Counterpart Researcher Invitation Program

The Counterpart Researcher Invitation Program provides invitations for periods of up to six months to researchers engaged in collaborative work with JIRCAS research staff. Counterparts conduct in-depth research at JIRCAS, at other MAFF-affiliated IAAs, at prefectural research institutes, or at national universities. This invitation program aims both to enhance the quality of research conducted overseas and to facilitate exchanges of individual research staff between JIRCAS and the counterpart institutions. Forty-there researchers were invited under this program during FY 2010. Invited researchers, their affiliated research organizations, and their research activities are summarized below.

Counterpart Researcher Invitations, FY 2010

Batbileg Bayaraa	School of Agrobiology, Mongolian State University of Agriculture, Mongolia	Study on the use of high frequency satellite data for quantitative estimation of existing pasture vegetation in Mongolia	May 10-Jun. 30, 2010
Kannalli Paramashivaiah Viswanatha	University of Agricultural Sciences, India	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Rajeev Kumar Varshney	Applied Genomics Subprogram, International Crops Research Institute for the Semi-Arid Tropics, India	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Pooran Mal Gaur	GT-Crop Improvement and Management, International Crops Research Institute for the Semi-Arid Tropics, India	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Partha Saratha Basu	Indian Institute of Pulse Research, India	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Lakshmanan Krishnamurthy	GT-Biotechnology, International Crops Research Institute for the Semi-Arid Tropics, India	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Madavalam Sreeman Sheshshayee	University of Agricultural Sciences, India	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Hari Deo Upadhyaya	Gene Bank, International Crops Research Institute for the Semi-Arid Tropics, India	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Asnake Fikre Woldemedhin	Ethiopian Institute of Agricultural Research, Ethiopia	Physiological characterization of reference collection for $\Delta^{13}C$	May 24-29, 2010
Pilanee Vaithanomsat	Kasetsart Agriculture and Agro-Industrial Product Improvement Institute (KAPI), Kasetsart University, Thailand	Research on efficient saccharification of starch-containing cellulosic biomass by using a combination of cellulosome and thermophilic amylases	Jun. 1-Aug 27,2010
Pason Patthra	Pilot Plant Development and Training Institute, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (Bangkhuntien Campus), Thailand	Elucidation of function and structure of the xylanosome, a multicomponent enzyme (cellulase/hemicellulase) complex	Nov. 1-Mar. 16, 2011
Amornrat Watthanalamloet	School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (Bangkhuntien Campus), Thailand	Study of functions and structures of cellulolytic enzyme complexes produced by thermophilic and alkaliphilic bacterium, *Clostridium thermoalkalicellum*	Oct. 2-Mar. 16, 2011
Rattiya Waeonukul	School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (Bangkhuntien Campus), Thailand	Study of efficient lignocellulose degradation technology using cellulosome	Nov. 29-Mar. 16, 2011
Phetmanyseng Xangsayasane	Rice & Cash Crop Research Center, Lao PDR	Development of differential system for rice blast resistance in Laos	Aug. 11-Oct. 29, 2010

Mark Edward R. Fabreag	Philippines Rice Research Institute, Philippines	Development of differential system for rice blast resistance in the Philippines	Aug. 11-Oct. 30, 2010
Md. Ansar Ali	Bangladesh Rice Research Institute, Bangladesh	Development of differential system for rice blast resistance in Bangladesh	Aug. 30-Nov. 20, 2010
S.M.A. Jabbar	On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Bangladesh	Evaluation of impacts of continuous rice cultivation under alternate wetting and drying (AWD) irrigation managements on the soil environment	Aug. 8-Sep. 30,2010
Amarawan Tippayawat	Khon Kaen Field Crops Research Center, Department of Agriculture, Thailand	Development of efficient methods for evaluation of important characteristics of inter-specific and generic hybrids between sugarcane and its wild relatives	Oct. 1-Feb. 28, 2011
Silvana Regina Rockenbach Marin	Embrapa Soybean, Brazil	Isolation of promoters related to soybean stress-responsive genes	Aug. 22-Nov. 11, 2010
Theerawut Chutinanthakun	Chanthaburi Horticultural Research Center, Thailand	Development of techniques for fruit quality improvement of durian and mangosteen	Sep. 20-30, 2010
Silvino Q. Tejada	Bureau of Soils and Water Management, Philippines	Development of techniques to save water use, reduce soil erosion using combined system between cowpea cover crop and non-tillage, and reduce nitrogen leaching using fertilizer application methods in the Philippines.	Sep. 13-18, 2010
Samuel M. Contreras	Soil Conservation Division, Bureau of Soils and Water Management, Philippines	Development of techniques to save water use, reduce soil erosion using combined system between cowpea cover crop and non-tillage, and reduce nitrogen leaching using fertilizer application methods in the Philippines	Sep. 13-18, 2010
Arnulfo B. Gesite	Water Management Division, Bureau of Soils and Water Management, Philippines	Development of techniques to save water use, reduce soil erosion using combined system between cowpea cover crop and non-tillage, and reduce nitrogen leaching using fertilizer application methods in the Philippines	Sep. 13-18, 2010
Alias bin Man	FRI Kampung Acheh, Fisheries Research Institute, Malaysia	Studies on ecosystem modeling of mangrove estuary	Nov. 28-Dec. 9, 2010
Sin Yin Chai	Institute of Biological Sciences, Marine Living Resources, Biotechnology & Ecosystems, Institute of Ocean and Earth Sciences, University of Malaya, Malaysia	Research on suitable stock management in tropical/subtropical areas	Dec. 6-11, 2010
Bounsong Vongvichith	Living Aquatic Resource Research Center, Lao PDR	Development of sustainable freshwater aquaculture technology suitable for Southeast Asia	Dec. 5-11, 2010
Aloun Khounthongbang	Living Aquatic Resource Research Center, Lao PDR	Development of sustainable freshwater aquaculture technology suitable for Southeast Asia	Dec. 5-11, 2010
Kenechanh Pinethip	Living Aquatic Resource Research Center, Lao PDR	Development of sustainable freshwater aquaculture technology suitable for Southeast Asia	Dec. 5-11, 2010
Prapansak Srisapoome	Faculty of Fisheries, Kasetsart University, Thailand	To attend JIRCAS International Workshop in Tsukuba and to visit fisheries research institutes and the latest shrimp culture facility, and to discuss with core researchers	Dec. 6-11, 2010

Dusit Aue-umneoy	King Mongkut's Institute of Technology Ladkrabang, Thailand	To attend JIRCAS International Workshop in Tsukuba and to visit fisheries research institutes and the latest shrimp culture facility, and to discuss with core researchers	Dec. 6-11, 2010
Jaruwan Songphatkaew	King Mongkut's Institute of Technology Ladkrabang, Thailand	To attend JIRCAS International Workshop in Tsukuba and to visit fisheries research institutes and the latest shrimp culture facility, and to discuss with core researchers	Dec. 6-11, 2010
Isao Tutui	Faculty of Fisheries, Kasetsart University, Thailand	To attend JIRCAS International Workshop in Tsukuba and to visit fisheries research institutes and the latest shrimp culture facility, and to discuss with core researchers	Dec. 6-11, 2010
Jacques Martin Morales Zarate	Aquaculture Department, Southeast Asian Fisheries Development Center, Philippines	To attend JIRCAS International Workshop in Tsukuba and to visit fisheries research institutes and the latest shrimp culture facility, and to discuss with core researchers	Dec. 6-16, 2010
Antonio-Jose Lopez-Montes	R4D (Research for Development), International Institute of Tropical Agriculture, Nigeria	Nutrient use efficiency in yam-based systems	Nov. 6-15, 2010
Hidehiko Kikuno	R4D (Research for Development), International Institute of Tropical Agriculture, Nigeria	1. Development of meristem culture protocol for yam germplasm management 2. Off-season yam production based on rice-yam cropping system	Nov. 6-16, 2010
Suphakarn Luanmanee	Soil Science Research Group, Department of Agriculture, Thailand	Good Soil Care (GSC) project final workshop	Dec. 15-18, 2010
Somrutai Tancharoen	Soil Science Research Group, Department of Agriculture, Thailand	Good Soil Care (GSC) project final workshop	Dec. 15-18, 2010
Diah Setyorini	Indonesian Soil Research Institute, Indonesia	Good Soil Care (GSC) project final workshop	Dec. 14-18, 2010
Nani Sumarni	Indonesian Vegetable Research Institute, Indonesia	Good Soil Care (GSC) project final workshop	Dec. 14-18, 2010
Vu Tien Khang	Soil Microbiology Division, Cuu Long Rice Research Insitute, Vietnam	Good Soil Care (GSC) project final workshop	Dec. 14-18, 2010
Dwinita Wikan Utami	Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, Indonesia	Genetic and pathological study on rice blast disease based on differential system	Jan. 4-Mar. 16, 2011
Krailert Taweekul	Department of Agricultural Extension, Faculty of Agriculture, Khon Kaen University, Thailand	Expansion of technology development through farmer exchange	Feb. 6-25, 2011
Lee Soon Leong	Forestry Biotechnology Division, Forest Research Institute Malaysia, Malaysia	Genetic diversity study of dipterocarp to improve selective logging	Feb. 26-Mar. 15, 2011

Project Site Invitation Program

In FY 2007, JIRCAS launched this invitation program to invite researchers from developing countries to the project sites in developing countries where JIRCAS researchers are engaged in JIRCAS-funded collaborative research activities on various research themes relevant to the projects on site, and other countries where workshops or planning meetings are held. Under this program, forty-nine researchers were invited and implemented their programs during FY2010 as listed below.

Project Site Invitations, FY 2010

Ramadjita Tabo	Alliance for a Green Revolution in Africa, Accra Ghana Office, Ghana	Workshop on "Fertility Improvement of Sandy Soils in the Sahel," organized by JIRCAS and ICRISAT in Niamey, Niger	Jun. 21-25, 2010
André Bationo	Alliance for a Green Revolution in Africa, Accra Office Ghana, Ghana	Workshop on "Fertility Improvement of Sandy Soils in the Sahel," organized by JIRCAS and ICRISAT in Niamey, Niger	Jun. 21-27, 2010
Diah Setyorini	Indonesian Soil Research Institute, Indonesian Agency for Agricultural Research and Development, Indonesia	Good Soil Care Project-DSSAT Workshop held in Bangkok, Thailand	Jun. 28-Jul. 3, 2010
Rini Rosliani	Soil Division, Indonesian Vegetable Research Insitute, Indonesia	Good Soil Care Project-DSSAT Workshop held in Bangkok, Thailand	Jun. 28-Jul. 3, 2010
Vu Tien Khang	Soil Department, Cuu Long Rice Research Institute, Vietnam	Good Soil Care Project-DSSAT Workshop held in Bangkok, Thailand	Jun. 28-Jul. 3, 2010
Ravdansuren Chantsaldulam	School of Economics and Management, Mongolian State University of Agriculture, Mongolia	JIRCAS International Symposium in Hohhot, and survey of pastoral management in Inner Mongolia, P. R. China	Jul. 23-31, 2010
Ruijun Long	International Centre for Tibetan Plateau Ecosystem Management, Lanzhou University, P. R. China	Greenhouse Gases and Animal Agriculture (GGAA2010) Conference, Satellite workshop, and Global Research Alliance (GRA) meeting held in Banff, Canada	Oct. 2-11, 2010
Nguyen Van Thu	Department of Animal Science, Faculty of Agriculture, Can Tho University, Vietnam	Greenhouse Gases and Animal Agriculture (GGAA2010) Conference, Satellite workshop, and Global Research Alliance (GRA) meeting held in Banff, Canada	Oct. 2-11, 2010
Vu Chi Cuong	Department of Animal Feeds, Nutrition and Pasture, National Institute of Animal Husbandry, Vietnam	Greenhouse Gases and Animal Agriculture (GGAA2010) Conference, satellite workshop, and Global Research Alliance (GRA) meeting held in Banff, Canada	Oct. 2-10, 2010
Raghavendra Bhatta	Bioenergetics and Environmental Sciences Division, National Institute of Animal Nutrition and Physiology, Indian Council of Agricultural Research, India	Greenhouse Gases and Animal Agriculture (GGAA2010) Conference, satellite workshop, and Global Research Alliance (GRA) meeting held in Banff, Canada	Oct. 2-11, 2010
Kritapon Sommart	Department of Animal Science, Khon Kaen University, Thailand	Greenhouse Gases and Animal Agriculture (GGAA2010) Conference, Satellite Workshop, and Global Research Alliance (GRA) meeting held in Banff, Canada	Oct. 2-11, 2010
Agung Purnomoadi	Faculty of Animal Agriculture, Diponegoro University, Indonesia	Greenhouse Gases and Animal Agriculture (GGAA2010) Conference, Satellite Workshop, and Global Research Alliance (GRA) Meeting held in Banff, Canada	Oct. 2-11, 2010

Juan Boo Liang	Laboratory of Industrial Biotechnology, Universiti Putra Malaysia, Malaysia	Greenhouse Gases and Animal Agriculture (GGAA2010) Conference, Satellite Workshop, and Global Research Alliance (GRA) Meeting held in Banff, Canada	Oct. 2-14, 2010
Hong-Ji Su	Department of Plant Pathology & Microbiology, National Taiwan University, Taiwan	JIRCAS/SOFRI Workshop on Integrated Management of Citrus Greening Disease in Severely Infested Areas held in Ho Chi Minh, Vietnam	Oct. 18-21, 2010
Vung Setha	Facutly of Land Management and Land Administration, Royal University of Agriculture, Cambodia	JIRCAS/SOFRI Workshop on Integrated Management of Citrus Greening Disease in Severely Infested Areas held in Ho Chi Minh, Vietnam	Oct. 18-21, 2010
Lily Eng	Agriculture Research Centre, Department of Agriculture, Sarawak, Malaysia	JIRCAS/SOFRI Workshop on Integrated Management of Citrus Greening Disease in Severely Infested Areas held in Ho Chi Minh, Vietnam	Oct. 18-21, 2010
Chhum Phith Loan	Faculty of Animal Science and Veterinary Medicine, Royal University of Agriculture, Cambodia	JIRCAS/SOFRI Workshop on Integrated Management of Citrus Greening Disease in Severely Infested Areas held in Ho Chi Minh, Vietnam	Oct. 18-21, 2010
Thelma F. Padolina	Plant Breeding and Biotechnology Division, Phlippine Rice Research Institute, Philippines	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-9, 2010
Loida M. Perez	Plant Breeding and Biotechnology Division, Phlippine Rice Research Institute, Philippines	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-9, 2010
Suwarno	Indonesian Center for Rice Research, Indonesia	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-9, 2010
Anggiani Nasution	Indonesian Center for Rice Research, Indonesia	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-9, 2010
Cailin Lei	Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, P. R. China	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-8, 2010
Nguyen Thi Lang	Department of Genetics and Plant Breeding, Cuu Long Delta Rice Research Institute, Vietnam	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-9, 2010
Luong Minh Chau	Department of Entomology, Cuu Long Delta Rice Research Institute, Vietnam	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. Chinaa	Oct. 1-9, 2010

Phoumy Inthapanya	Rice and Cash Crop Research Centre, Lao PDR	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-8, 2010
Mohammad Ashik Iqbal Khan	Plant Pathology Division, Bangladesh Rice Research Institute, Bangladesh	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-8, 2010
Yacouba Sere	Africa Rice Center, Benin	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. Chinaa	Oct. 1-8, 2010
Fongsamout Southammavong	Department of Livestock and Fisheries, Faculty of Agriculture, National University of Laos, Laos P.D.R.	Results and Planning Meeting for the research project, "Establishment of Feeding Standard of Beef Cattle and Feedstuff Database in Indochina", held in Khon Kaen, Thailand	Oct. 13-16, 2010
Viengsakoun Napasirth	Department of Livestock and Fisheries, Faculty of Agriculture, National University of Laos, Laos P.D.R.	Results and Planning Meeting for the research project, "Establishment of Feeding Standard of Beef Cattle and Feedstuff Database in Indochina", held in Khon Kaen, Thailand	Oct. 13-16, 2010
Daovy Kongmanila	Department of Livestock and Fisheries, Faculty of Agriculture, National University of Laos, Laos P.D.R.	Results and Planning Meeting for the research project, "Establishment of Feeding Standard of Beef Cattle and Feedstuff Database in Indochina", held in Khon Kaen, Thailand	Oct. 13-16, 2010
Ho Quang Do	Department of Animal Siences, Faculty of Agriculture and Applied Biology, Can Tho University, Vietnam	Results and Planning Meeting for the research project, "Establishment of Feeding Standard of Beef Cattle and Feedstuff Database in Indochina", held in Khon Kaen, Thailand	Oct. 13-17, 2010
Antonio Juan Gerardo Ivancovich	Estación Experimental Agropecuaria Pergamino, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA Pergamino), Argentina	Project Annual Meeting on "Evaluation of Soybean Rust Resistance" held at CNPSo in Londrina, Brazil	Oct. 17-21, 2010
Hernán Russian	Estación Experimental Agropecuaria Pergamino, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA Pergamino), Argentina	Project Annual Meeting on "Evaluation of Soybean Rust Resistance" held at CNPSo in Londrina, Brazil	Oct. 17-21, 2010
Adrian Dario de Lucia	Estación Experimental Agropecuaria Pergamino, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA Pergamino), Argentina	Project Annual Meeting on "Evaluation of Soybean Rust Resistance" held at CNPSo in Londrina, Brazil	Oct. 17-21, 2010
Wilfrido Morel Paiva	Former Senior Researcher of Centro Regional de Investigación Agrícola (CRIA), and Former Project Counterpart, Paraguay	Project Annual Meeting on "Evaluation of Soybean Rust Resistance" held at CNPSo in Londrina, Brazil	Oct. 17-21, 2010
Alicia Noelia Bogado	Centro Regional de Investigación Agrícola (CRIA), Ministerio de Agricultura y Ganaderia, Paraguay	Project Annual Meeting on "Evaluation of Soybean Rust Resistance" held at CNPSo in Londrina, Brazil	Oct. 17-21, 2010
Poonsak Mekwatanakarn	Ubon Rice Research Center,Thailand	Annual Meeting for JIRCAS research project, "Blast Research Network for Stable Rice Production", and workshop at the international conference "Managing Biodiversity for Sustainable Development" held in Kunming, P. R. China	Oct. 1-9, 2010

Wan Zahari Bin Mohamed	Strategic Livestock Research Centre, Malaysia Agricultural Research and Development Institute, Malaysia	Results and Planning Meeting for the research project, "Establishment of Feeding Standard of Beef Cattle and Feedstuff Database in Indochina", held in Khon Kaen, Thailand	Oct. 14-16, 2010
Batbileg Bayaraa	School of Agrobiology, Mongolian State University of Agriculture, Mongolia	Asian Conference on Remote Sensing 2010 (ACRS2010) held in Hanoi, Vietnam	Oct. 28-Nov. 8, 2010
Sopon Uraichuen	Department of Entomology, Faculty of Agriculture, Kasetsart University, Thailand	Workshop on Biological Control of the Invasive Coconut Pest, *Brontispa longissima* held in Hue, Vietnam	Nov. 22-25, 2010
Rut Morakote	School of Crop Production Technology, Institute of Agricultural Technology, Suranaree University of Technology, Thailand	Workshop on Biological Control of the Invasive Coconut Pest, *Brontispa* longissima held in Hue, Vietnam	Nov. 22-25, 2010
Ravdansuren Chantsaldulam	School of Economics and Management, Mongolian State University of Agriculture, Mongolia	JIRCAS Workshop held in Ulaanbaatar, and Survey of dairy farms in Mongolia	Feb. 26-Mar. 5, 2011
Wale Berhanu Yilma	South Gonder Zone Agricutlure and Rural Development, Ethiopia	Operation Meeting for the research project,"Study on Development of Improved Infrastructure and Technologies for Rice Production in Africa", held in Kumasi, Ghana	Feb. 19-27, 2011
Tesfaye Molla Desta	Woreta College of Agriculture, Ethiopia	Operation Meeting for the research project,"Study on Development of Improved Infrastructure and Technologies for Rice Production in Africa", held in Kumasi, Ghana	Feb. 19-27, 2011
Hailemariam Kibret Mamo	Agricultural Investement Support Directorate, Ministry of Agriculuture, Ethiopian	Operation Meeting for the research project,"Study on Development of Improved Infrastructure and Technologies for Rice Production in Africa", held in Kumasi, Ghana	Feb. 20-26, 2011
Martín Marcó	Instituto Nacional de Tecnologia Agropecuaria, Concordia Research Station, Argentina	Mejoramiento genético del Eucalipto sp. para usos de alto valor, Argentine Asuncion	Nov. 25-27, 2010
Carlos Ruiz	INIA Quilamapu, Chile	Desarrollo agroforestal sustentable en el secano mediterráneo de Chile, Argentine Asuncion	Nov. 25-29, 2010
Rafael Fuente	Instituto Agronômico do Paraná, Brazil	Desarrollo rural y forestal basado en la conservación del suelo en pequeñas fincas en el Estado de Paraná, Brasil, Argentine Asuncion	Nov. 25-28, 2010
Miguel Davalos	Universidad Mayor, Real y Pontificia de San Francisco Xavier de Chuquisaca, Bolivia	Desarrollo rural y forestal con pequeños productores en Chuquisaca, Bolivia, Argentine Asuncion	Nov. 24-28, 2010

FELLOWSHIP PROGRAMS AT JIRCAS

JIRCAS Visiting Research Fellowship Program at Tsukuba and Okinawa

The current JIRCAS Visiting Research Fellowship Program has its beginnings in FY 1992 with the launching of the JIRCAS Visiting Research Fellowship Program at Okinawa under which researchers are invited to conduct research on topics relating to tropical agriculture for a period of one year at the Tropical Agriculture Research Front (formerly Okinawa Subtropical Station). Since October 1995, a similar program (JIRCAS Visiting Research Fellowship Program at Tsukuba) has been implemented at JIRCAS's Tsukuba premises, which aims to promote collaborative research that address various problems confronting countries in the developing regions. In FY 2006, these fellowship programs were modified and merged into one. In FY 2010, a total of twelve researchers were invited to conduct research at JIRCAS HQ.

JIRCAS Visiting Research Fellowships at Tsukuba and Okinawa (October 2010 to September 2011)

Tsukuba

Thitaporn Phumichai	Rubber Production Unit, Rubber Research Institute, Department of Agriculture, Thailand	Development of DNA markers associated with tolerance to environmental stresses in soybean
Nang Myint Phyu Sin Htwe	Plant Biotechnology Center, Myanmar Agriculture Service, Ministry of Agriculture and Irrigation, Myanmar	Identification of useful genes that function in abiotic stress tolerance in soybean and maize
Jinbin Li	Agricultural Environment and Resources Research Institute, Yunnan Academy of Agricultural Sciences, P. R. China	Breeding and pathological studies on blast resistance of rice
Noelle Giacomini Lemos Torres	Agronomy Department, Maringa State University, Brazil	Genetic analysis of the control of leaf yellowing caused by soybean rust infection
Salah El-Hendawy	Agronomy Department, Faculty of Agriculture, Suez Canal University, Egypt	Eco-physiological characterization of rice with better adaptation to low-input conditions in Africa's rainfed lowlands
Houqing Zeng	Department of Biochemistry & Molecular Biology, College of Life Science, Nanjing Agricultural University, P. R. China	Characterization of sweet-sorghums for BNI capacity _ Regulation of BNI compound release in sorghum
Oslan Jumadi	Department of Biology, Makassar State University, Indonesia	Development of evaluation methodology for biological nitrification inhibition using nitrous oxide emission
Ah Nge Htwe	Department of Entomology and Zoology, Yezin Agricultural University, Myanmar	Ecological and behavioural studies on parasitoids for biological control
Chatchai Kaewpila	Department of Animal Science, Faculty of Agriculture, Khon Kaen University,Thailand	Establishment of a feeding standard of beef cattle and a feed database for Indochinese peninsula
Prapassorn Rugthaworn	Biomass and Bio-energy Technology Division, Kasetsart Agricultural and Agro-industrial Product Improvement Institute, Thailand	Development of yeast to produce bio-ethanol from tropical crop residues
Paripok Phitsuwan	Enzyme Technology Laboratory, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (Bangkhuntien Campus), Thailand	Development of efficient saccharification of lignocellulose using highly active cellulosomes
Tnah Lee Hong	Forestry Biotechnology Division, Forest Research Institute Malaysia, Malaysia	Population genetic study on species diversification and adaptation of dipterocarp species related to environmental heterogeneity

JIRCAS Visiting Research Fellowship Program at Project Sites

This fellowship program has been implemented since May 2006 at collaborating research institutions located in developing countries where collaborative researches are being carried out by JIRCAS researchers. It aims to promote the effective implementation of ongoing collaborative researches at the project sites through the participation of local research staff. Furthermore, through this fellowship program, JIRCAS intends to contribute to capacity-building of the collaborating research institutions. In FY2010, two researchers were invited, one to Thailand and the other to the Philippines. The fellows and their research subjects are listed below.

For inquiries on the JIRCAS Visiting Research Fellowship Program, please contact the International Relations Section (Tel. +81-29-838-6335; Fax +81-29-838-6337; e-mail: irs-jircas@ml.affrc.go.jp)

JIRCAS Visiting Research Fellowships at the Project Site (October 2010 to September 2011)

Jacques M. Zarate	Aquaculture Department, Southeast Asian Fisheries Development Center, Philippines	Developing methods for assessing nutritional condition of the sea cucumber, *Holothuria scabra*
Jaruwan Songphatkaew	Fisheries Division, King Mongkut's Institute of Technology Ladkrabang, Thailand	The impact of the physical environment peculiar to shrimp-seaweed co-culture on *Penaeus monodon* development

Other Fellowships for Visiting Scientists

The Government of Japan sponsors a postdoctoral fellowship program and a researcher exchange program for foreign scientists through the Japan Society for the Promotion of Science (JSPS). The program places post-doctoral and sabbatical fellows in national research institutes throughout Japan according to research theme and prior arrangement with host scientists, for terms of generally one month to three years. Fellowships can be undertaken in any of the ministries, and many fellows are currently working at various IAAs affiliated with MAFF. The visiting scientists that resided at JIRCAS in FY 2010 are listed below.

JSPS Postdoctoral Fellowships for Foreign Researchers (April 2010 to September 2011)

Terry James Rose	University of Western Australia, Australia	Investigation into physiological mechanisms and molecular biology of P-deficiency tolerance in rice	Oct. 13, 2008 - Apr. 15, 2010
Charles P. Chen	University of Illinois, USA	Characterization of the physiological mechanism and genetic basis of ozone tolerance in rice	Nov. 1, 2008 - Oct. 31, 2010
Michael Timothy Rose	University of Sydney, Australia	Investigation into biological nitrification inhibition to improve nitrogen-use efficiency in forage and biofuel crops	Sep. 1, 2009 - Dec. 16, 2010
Pierfrancesco Nardi	Regional Agency of Agriculture Improvement and Innovation in Latium, Italy	Inhibition of soil nitrification from root exudates	Sep. 1, 2009 - May 26, 2011

JSPS Researcher Exchange Program for Foreign Researchers（April 2010 to September 2011）

Thanumalaya Perumal Subramoniam	Indian National Science Academy, India	Reproductive endocrinology of crustaceans, Mechanism of vitellogenesis in crustaceans, Evolution of yolk proteins	Oct. 13, 2010 - Nov. 4, 2010

WORKSHOP

JIRCAS-IMAU-MSUA Joint Workshop for the Development of Sustainable Agro-Pastoral System in Northeast Asia

The workshop was organized by JIRCAS, in cooperation with the Inner Mongolian Agricultural University (IMAU), at Jinsui Hotel, Hohhot, Inner Mongolia on July 25, 2010. A total of 60 researchers, teachers and students from IMAU, Mongolian State University of Agriculture (MSUA), Inner Mongolia University (IMU), Inner Mongolian Normal University (IMNU), Inner Mongolia Finance and Economics College (IMFEC) and other institutes attended the event.

The main objectives of this workshop were to present the socio-economic research outputs of the JIRCAS' project which was carried out in Mongolia and Inner Mongolia, China, and to facilitate the exchange of opinions among the participants in order to explore possible options for the sustainable development of the herders' household economy and the livestock industries in the Mongolian Plateau.

The workshop consisted of four sessions: Labor force and the income of the livestock sector, Structure of agriculture and the livestock sector in Mongolia and Inner Mongolia, Distribution of products and its development, and Dairy farming and prices of milk. There were many discussions on these subject matters presented at the workshop and it appeared that researchers and policymakers have shown great interest in our research topics. Therefore, we plan to publish the proceedings of this meeting to share our research outputs with the public.

Presentations:

1. Empirical Analysis of Factors Influencing Herder Income in Grassland Areas: Baoyin Dureng (IMAU)
2. Characteristics and Trends of the Transfer of Surplus Labor in Animal Husbandry in Inner Mongolia: Ba Tu (IMU)
3. Research on Intensive Farming of the Livestock Sector in Inner Mongolia: Hugejiletu (IMNU))
4. Business Circumstances and Problems of Grassland Stockbreeding - The Case of Xilingol: Dagula (IMNU)
5. Comparing Pastoral Management in China and Mongolia: S. Oniki (JIRCAS)
6. The Future Direction of Animal Husbandry in Mongolia: H. Komiyama (JIRCAS)
7. Policy Analysis on the Effects on the Economic Structure of the Livestock Sector in Xilinguole League: Gensuo (IMAU)
8. Selection of a Development Model in Rural Pastoral Areas in Inner Mongolia: Shuangxi (IMFEC)
9. Marketing Channels and Countermeasures of Animal Products in Xilinguole League: Xu Lili (IMAU)
10. Analysis of Milk Prices at Mongolian Dairy Farms: Ravdansuren Chantsaldulam (MSUA)
11. The Study of the Transformation of Inner Mongolia Dairy Management Model and Its Concomitant Problems: Du Fulin (IMAU)
12. The Determination of Raw Milk Prices: Yao Fengtong (IMAU)

Fifth Seminar on Rural Development based on Clean Development Mechanism (CDM) in Mekong Delta, Viet Nam

On October 22, 2010, the "Fifth Seminar on Rural Development based on Clean Development Mechanism (CDM) in Mekong Delta, Viet Nam" which was jointly organized by JIRCAS and Can Tho University (CTU) was held at the auditorium of CTU in Can Tho City. This is the one of the seminars regularly held twice every year since 2008. The purpose of the seminar is to discuss and share information between relevant stakeholders on the progress of the joint research project for rural development which applies CDM methodology to the activities using renewable biogas produced by the biogas digesters, which will be introduced to several hundred low income farm households. Around 80 people, including Dr. Iiyama, President of JIRCAS, representatives of People's Committee of Can Tho City and relevant districts, heads of beneficiary communities and key farmers, lecturers and researchers of CTU, etc. participated in the seminar.

After a keynote speech titled, “Behavior of Plant Residues and their Roles in Agriculture and Global Environment” by Dr. Iiyama, JIRCAS researchers explained the outline and progress of the project, followed by a presentation by CTU researchers on the outputs of the pilot project achieved during the research period for a farming system with recycling of resources composed of pig farming, aquaculture, orchard management, biogas digester, etc. Finally, Mr. Matsubara, the project leader, elucidated the formulated CDM project covering 3 districts in Can Tho City, which is aimed to reduce greenhouse gas emission by substituting nonrenewable firewood and fossil gas used for cooking with renewable biogas produced from the biogas digester being introduced by the CDM project, to increase the income of beneficiary households, and to improve the environment in the rural community. At the last session, various opinions and ideas were exchanged among the participants in order to promote the CDM project. This seminar raised high interest in the city through its special coverage in a newspaper.

Keynote Address by President Iiyama

5th Seminar Commemorative photo

Closing Seminar on the “Support for Reconstruction of Rural Villages in Timor-Leste” Project

A final seminar on the project, “Support for Reconstruction of Rural Villages in Timor-Leste”, was held on December 15, 2010 at the Conference Hall of the Ministry of Agriculture and Fisheries (MAF) of the Democratic Republic of Timor-Leste, under the joint sponsorship of JIRCAS and MAFF.

This seminar was organized to disseminate and present the Guideline to the MAF for rural reconstruction in Timor-Leste. About 80 people participated in this seminar, mostly those who will be ultimately utilizing the guideline, including the minister and directors of MAF, and other officers attached to the government, such as agricultural extension workers. The village chief and his deputies from Bucoli, the pilot project village in Baucau District also participated along with the panel of staff from the World Food Programme (WFP), Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), and other NGOs that supported the above project. H.E. Mr. Iwao Kitahara, the Ambassador of Japan and Mr. Hiroshi Enomoto, the JICA Representative in Timor-Leste attended the event to represent the Japanese government.

The Deputy Minister of MAF expressed his appreciation that JIRCAS has compiled a very useful guideline, which they are hoping to utilize as a guide for the development of agriculture in Timor-Leste. The deputy director of WFP expressed intention to extend the know-how adopted by JIRCAS, who handled the technical aspects in the construction of the irrigation canals whereas WFP provided food for the project’s beneficiaries in other districts as well.

According to the report on the activities of JIRCAS as prepared by the participants, it was verified among the participants that the project promoted farmers’ autonomy as carried out through cooperation among the organizations concerned.

During a session in the seminar, the first copy of the Guideline was presented to the Minister of MAF by Dr. Kenji Iiyama, President of JIRCAS. It is expected that this guideline will be used toward rural revitalization and human resource development of extension workers and onwards.

International Symposiums and Workshops, FY2010			
1	Coalition for African Rice Development (CARD) Satellite Seminar	May 17, 2010	Arusha, Tanzania
2	JIRCAS Workshop "Development of rice production for lowland in Africa" - JIRCAS Contribution in Rice Research to CARD -	June 9-10, 2010	Tsukuba, Japan
3	JIRCAS/ICRISAT Workshop on Fertility Improvement of Sandy Soils in the Sahel	June 23-24, 2010	Niamey, Niger
4	Kick-off Meeting of the JST/JICA Project on "Development of Production Technologies of Environmental Stress-Tolerant Crops to cope with Environmental Degradation"	July 20, 2010	Tsukuba, Japan
5	Development of Sustainable Agro-pastoral System in Northeast Asia	July 25, 2010	Hohhot, China
6	Laboratory Training: DNA marker analysis for marker-assisted selection in soybean	July 28-August 6, 2010	Yguazu, Paraguay
7	JIRCAS-LARReC Workshop on the Indigenous Shrimp Fishery in Northern Laos "Development of Stock Management Technology for Sustainable Use of Shrimp Resources"	August 5-6, 2010	Luang Prabang, Laos
8	International Research Workshop on "Value-addition to Asian agricultural products"	August 31-Sep.1, 2010	Tsukuba, Japan
9	Introduction of Activities of JIRCAS Southeast Asian Office and JST Singapore Office	September 7, 2010	Bangkok, Thailand
10	Evaluation Meeting on "Development of Environmental Management Technology for Sustainable Crop Cultivation in Tropical and Sub-tropical Islands"	September 15-16, 2010	Ishigaki Island
11	Rice Cultivation Workshop	September 28, 2010	Amhara Region, Ethiopia
12	International Workshop on the "Establishment of feeding standards for beef cattle and feedstuff database for the Indochinese peninsula"	October 15, 2010	Khon Kaen, Thailand
13	Freshwater Lens Management Seminar	October 15, 2010	Majuro Atoll, Marshall Islands
14	Annual Meeting 2010, Soybean Rust Project	October 19-20, 2010	Londrina, Brazil
15	International Workshop on Integrated Management of Citrus Greening Disease in Severely Infected Areas	October 19-20, 2010	Ho Chi Minh, Vietnam
16	Fifth Seminar on Rural Development Based on Clean Development Mechanism in Mekong Delta	October 22, 2010	Can Tho, Viet Nam
17	Japan-China Collaborative Research Workshop for the Establishment of Environment-Friendly Agricultural Systems	October 29, 2010	Beijing, China

18	TARC-JIRCAS 40th Anniversary International Symposium [A New Decade for International Agricultural Research for Sustainable Development]	November 8-9, 2010	Tsukuba, Japan
19	Workshop for Biological control of invasive coconut pest, *Brontispa longissima*	November 23, 2010	Hue, Vietnam
20	International Seminar — Rural development based on clean development mechanism of small scale reforestation	November 26, 2010	San Lorenzo, Paraguay
21	Workshop on "Development of environmental management technology for sustainable crop production in tropical and subtropical islands"	December 2-7, 2010	Iligan (Dec. 2) Negros (Dec. 7) Philippines
22	Presentation of the Achievements and Evaluation of Outputs of the Rainfed Agriculture Project	December 6, 2010	Vientiane, Laos
23	JIRCAS International Workshop: Sustainable Stock Management and Aquaculture Technology Suitable for Southeast Asia	December 7-8, 2010	Tsukuba, Japan
24	Development of Breeding Materials for Multi-purpose Sugarcane with Higher Biomass Production	December 13-15, 2010	Khon Kaen, Thailand
25	Seminar on Rural Reconstruction in East Timor: Presentation of Final Results of JIRCAS Survey and Formulation of Guidelines	December 15, 2010	Dili, East Timor
26	Enhancement of Remote Sensing and GIS Technology JIRCAS-IAARD (Indonesian Agency for Agricultural Research and Development) Collaborative Research Workshop	December 15, 2010	Tsukuba, Japan
27	Workshop on Development of Techniques for Nurturing Beneficial Indigenous Tree Species and Combined Management of Agriculture and Forestry in the Northeast of Thailand, Tropical Monsoon Regions	December 21, 2010	Bangkok, Thailand
28	Annual Meeting 2010, MAFF-funded DREB Project (Development of Abiotic Stress Tolerant Crops by DREB Genes, Genomics for Agricultural Innovation)	January 11-12, 2011	Tsukuba, Japan
29	3rd Seminar on Participatory Method Strategy for Rural Development	January 11-14, 2011	Matala, Colombo, Malaysia
30	4th USM-JIRCAS Joint International Symposium: "Biomass: Sustainable natural resource and innovation for a greener future"	January 18-20, 2011	Penang,Malaysia
31	Report on Accomplishments of the Project on Eco-environment Rehabilitation and Poverty Reduction in Yanmenguan Region, Shanxi Province	January 18, 2011	Shanxi, China

32	Research Collaboration Guideline and Dissemination Seminar on "Development of methods for promoting technology transfer and cooperation in agriculture and rural development in developing regions" (Indonesia)	January 24, 2011	Kandari, Malaysia
33	Workshop of JIRCAS/FRIM joint research project, “Ecology of dipterocarps and its application to sustainable selective logging”	January 25-26, 2011	Kuala Lumpur, Malaysia
34	JIRCAS-MSUA Joint Workshop for the Development of Sustainable Agro-pastoral system in Northeast Asia	March 2, 2011	Ulan Bator, Mongolia

APPENDIX

PUBLISHING AT JIRCAS

OFFICIAL JIRCAS PUBLICATIONS

In English

1) JARQ (Japan Agricultural Research Quarterly)
Vol. 44 No. 3, No. 4
Vol. 45 No. 1, No.2

2) Annual Report 2009

3) JIRCAS Newsletter
No.58, No.59, No. 60

4) JIRCAS Working Report Series
No. 70 Next Challenges in Rice Development for Africa: Workshop for new Collaboration between JIRCAS and *AfricaRice*
No. 71 Development of Crops Tolerant to Adverse Environments
No. 72 Integrated Pest Management of Citrus Greening Disease in Mekong Delta for the Sustainable Production of Citrus under Severely Infested Conditions

In Japanese

1) JIRCAS News
No.58, No.59, No. 60

2) JIRCAS International Agriculture Series
No.18

RESEARCH STAFF ACTIVITY 2010-2011

Refereed journal articles, book chapters, and monographs

Abiko, T., Wakayama, M., Kawakami, A., Obara, M., Kisaka, H., Miwa, T., Aoki, N. and Ohsugi, R. (2010) Changes in nitrogen assimilation, metabolism, and growth in transgenic rice plants expressing a fungal NADP(H)-dependent glutamate dehydrogenase (gdhA). Planta, 232(2): 299-311.

Akamatsu, H. O., Chilvers, M. I., Stewart, J. E. and Peever, T. L. (2010) Identification and function of a polyketide synthase gene responsible for 1,8-dihydroxynaphthalene-melanin pigment biosynthesis in *Ascochyta rabiei*. Current Genetics, 56(4): 349-360.

Ando, M., Sato, M., Sugimoto, T., Hashim, R. and Sulaiman, O. (2010) Manufacture and Properties of Plywood from Oil Palm. Wood industry, 65(6): 261-265. (J)

Anugroho, F., Kitou, M., Nagumo, F., Kinjyo, K. and Jayasinghe, G.Y. (2010) Potential growth of hairy vetch as a winter legume cover crop in subtropical soil conditions. Soil Science and Plant Nutrition, 56(2): 254-262.

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Second Medium-Term Plan of the Japan International Research Center for Agricultural Sciences

The Japan International Research Center for Agricultural Sciences (JIRCAS) was established in April, 2001 as an Independent Administrative Agency (IAA) of the Ministry of Agriculture, Forestry and Fisheries (MAFF), for the purpose of contributing to the improvement of technologies related to agriculture, forestry and fisheries in tropical and subtropical areas as well as other overseas developing regions (hereinafter referred to as "developing regions") by conducting research and development in these areas.

During the First Medium-Term Goal period, JIRCAS worked on research and development (R&D) for the sustainable development of agriculture, forestry, and fisheries as well as on the expansion of international research exchanges and networks by taking both domestic and overseas situations into account, such as the adoption of the U.N. Millennium Development Goals and the announcement of the Policy for the Promotion of International Agricultural Research (decided by the Agriculture, Forestry and Fisheries Research Council in September 2003). In managing its operations, JIRCAS took advantage of its new status as an IAA and embarked on making flexible changes in its organization and system, and promoted the improvement of the quality of research and support work and their efficiency.

Within the Second Medium-Term Goal period, JIRCAS plans to contribute to improving technologies for agriculture, forestry and fisheries in the developing regions through "Research and development on agricultural, forestry, and fisheries technology geared towards providing solutions to international food and environmental problems" and "Collection, analysis and dissemination of information to grasp trends related to international food, agriculture, forestry, fisheries and rural areas." To make these global contributions smooth and stable, JIRCAS further promotes operations such as the creation of a multilateral collaborative research system, promotion of collaborative research with world-class research organizations led by the Consultative Group on International Agricultural Research (CGIAR), establishment of a dynamic research system, strategic development of human resources, and enhancement of public relations.

Optimized allocation of research resources and improvement of various systems are implemented to carry out these activities efficiently and effectively, and to generate high-quality outputs for the international community. Major researches at JIRCAS are implemented as projects, and all the necessary budgets for achieving results are allocated on a project basis. Efforts will also be made to improve the system for overseas activities and to simplify administrative procedures.

For efficient and effective promotion of these operations, exchange activities are enhanced by utilizing the Japan Forum for International Agricultural Research for Sustainable Development (J-FARD), which was initiated by JIRCAS and others in 2004 to build a new partnership between Japan's international researchers and organizations in agriculture, forestry and fisheries, and to promote cross-organizational cooperation and collaboration nationwide. JIRCAS also aims to build flexible personnel and business management systems.

With the dissolution of the Japan Green Resources Agency on April 1, 2008, its international activities were transferred to JIRCAS which is smoothly executing these activities.

Through this series of activities, JIRCAS is committed to making international contributions and promoting national interests by fulfilling its responsibilities as Japan's only research institution mandated to carry out international researches in agriculture, forestry, and fisheries comprehensively.

I. Measures to be taken to achieve our goal of efficient business management

As for administrative operations implemented by operational grants, operations are reviewed and efficiency is further promoted. General and administrative expenditures are cut by at least 3% from the previous year and research expenditures by at least 1% from the previous year during the Medium-Term Goal period each year.

In line with the key policy of administrative reform (decided at the Cabinet meeting on December 24, 2005), personnel expenditures will be cut by more than 5% over the next five years (except for retirement allowances and welfare expenditures (but not applying to legal and non-legal welfare expenditures) and part of salaries revised in accordance with the recommendation by the National Personnel Authority). Necessary reviews of salaries of personnel in managerial positions are also made by taking into account the structural reform of salaries of government officials.

1. Implementation and feedback from evaluations and checks

(1) JIRCAS will use external specialists and experts to ensure its objectivity and reliability; and operations and research are evaluated and reviewed by JIRCAS itself prior to releasing its Annual Report to the IAA Evaluation Committee established within the Ministry of Agriculture, Forestry and Fisheries (MAFF).

(2) Numerical goals and indicators for major research projects are set as concretely as possible, and inputs of research resources and obtained results are analyzed from the viewpoint of ensuring their contribution to the improvement of technologies concerning agriculture, forestry, and fisheries in the developing regions. JIRCAS will also make efforts to diffuse its research achievements and monitor the status of their utilization.

(3) JIRCAS will endeavor to streamline and upgrade its evaluation methods by ensuring the mutual utilization of data needed for a multiple evaluation system. It will also improve this evaluation system when necessary.

(4) To allocate research resources on a priority basis, JIRCAS will clarify basic ideas and concrete methods of feeding evaluation and feedback the results of the in-house evaluation to the administrative management along with the evaluation results from the IAA Evaluation Committee.

(5) JIRCAS will make comprehensive performance evaluations of its research personnel, all the while ensuring the fairness and transparency of the evaluation items and standards. The results will be appropriately fed into the priority allocation of research resources and the treatment of research personnel.

(6) A new evaluation system will be introduced to assess the performance of general administrators in light of the need to revitalize the organization and achieve better results.

2. Effective use of research resources and their improvement and upgrading

(1) Research funds

1) Evaluation results are appropriately fed through to budget allocations, and the effective use of operational grants for administration is promoted.

2) The planning system for acquiring competitive funds is enhanced. Efforts will be made to increase research funds and accelerate research activities by positively applying for external funds useful for achieving our Medium-Term Goals.

(2) Research facilities and equipment

1) Research facilities and equipment will be shared to ensure their efficient utilization. Information on machinery available for joint use and open laboratories will be widely disclosed via the internet.

2) Planned renovation and upgrading of old facilities essential for research promotion laid out in the Medium-Term Plan will be implemented in line with JIRCAS's research prioritization.

(3) Organization

1) JIRCAS will be reorganized as necessary to gain optimal insight into problems in the developing regions.

2) A leader will be assigned to each research project. Responsibility and authority is given to the leader concerning the management of the progress of the research and the allocation of research resources in the project.

3) The functions of the local offices are strengthened in regions such as Southeast Asia where research activities are concentrated.

(4) Improvement of staff qualifications and development of human resources

1) We will create a program aimed at developing human resources, including young researchers, to enable us to nurture personnel and improve their qualifications in a well-planned manner.

2) Efforts will be made to improve the qualifications of researchers who play a key role in international collaborative research through their dispatch abroad or by collaborative studies with invited overseas researchers.

3) We will create a competitive and cooperative environment for research personnel, provide them with effective incentives, develop their career path by utilizing a range of employment systems and conduct smooth personnel exchanges with research organizations, including other IAAs.

4) We will make efforts to improve our personnel's qualifications by having the administrative and technical staff actively participate in various training sessions needed for the pursuit of their duties and help them acquire qualifications useful for their jobs. Efforts will also be made to improve the system that allows technical staff to engage positively in research support.

5) The management ability and leadership of research project leaders will be improved utilizing

various training systems.

3. Promotion of efficiency, improvement, and upgrading of research support sector
(1) Maintenance of facilities and machinery will be outsourced depending on the type of job.
(2) Details of work at the General Affairs Section will be reviewed to ensure an efficient implementation system and to promote the efficiency of clerical management work by speeding up and simplifying clerical procedures.
(3) JIRCAS will provide efficient local support to researchers dispatched abroad for their experimental and accounting work.
(4) Efforts will be made to streamline, upgrade, and enhance research support by reviewing and focusing the jobs of the technical personnel onto areas that require highly specialized technology and knowledge to meet needs for advanced experimental and research work.
(5) Efforts will also be made to rationalize staffing for research support by reviewing overall support work and promoting outsourcing as much as possible.
(6) The Ministry of Agriculture, Forestry and Fisheries Research Network (MAFFIN) will be utilized to streamline, upgrade, and enhance work on the collection and provision of research information along with efforts to promote information-sharing across JIRCAS and streamline operations by utilizing groupware.

4. Promotion and enhancement of collaboration and cooperation between industry, academia, and government
(1) While taking into account our sharing of roles with other IAAs, we will positively pursue collaborative research and alliances, including personnel exchanges and cooperation(1) between other IAAs and JIRCAS.
(2) To promote collaborative research and researcher exchange more actively, efforts will be made by utilizing J-FARD to improve information exchanges and alliances with national and public research organizations, universities, the private sector, overseas organizations,international organizations, and the Japan International Cooperation Agency (JICA).
(3) Opinions will be exchanged with related IAAs, the government departments concerned, and national and public research institutes concerning the forms that alliances and cooperation should ideally take in carrying out research projects undertaken by JIRCAS.
(4) To move ahead with research projects efficiently, we will seek alliances with the government.
(5) Cooperation will be provided to the National Agriculture and Food Research Organization (NARO) as necessary in implementing comprehensive research that features a fusion of expert knowledge in diversified fields.

II. Measures to achieve the goals of improving the quality of services and other duties provided to the public

1. Research and investigations
(1) Promotion of international collaborative research and international contributions
1) To promote collaborative research and researcher exchange more actively, efforts will be made by utilizing J-FARD to improve information exchange and alliances with national and public research organizations, universities, the private sector, overseas organizations, international organizations, and JICA.
2) To contribute to problem-solving in developing regions and the improvement of technologies for agriculture, forestry, and fisheries, more than 1,000 researchers and research managers, mainly from JIRCAS but including those from other IAAs and universities, will be dispatched to research organizations in the developing and developed countries and international research organizations affiliated with the CGIAR during the Second Medium-Term Goal period to promote smooth international collaborative research and to actively participate in international contributions.
3) Research managers will be invited from research organizations in the developing regions to enhance collaboration and cooperation through consultation on the course of collaborative research promotion.
4) More than 500 collaborative researchers and research managers will be invited from agricultural, forestry, and fisheries research organizations in the developing regions during the Second Medium-Term Goal period to conduct collaborative research or improve the capacity of the researchers concerned.

5) At least 80 effective Memoranda of Understanding (MOUs) and other similar contracts on research implementation between JIRCAS and overseas research organizations will be constantly maintained during the Second Medium-Term Goal period.

6) In an effort to contribute to the promotion of international collaborative research in agriculture, forestry, and fisheries, a project will be launched through tie-ups with the government sector to provide financial incentives to researchers at agricultural, forestry, and fisheries research organizations in the developing regions.

(2) Direction of research promotion

In line with the course of research indicated in "the Promotion Policy of International Agricultural Research" and the "Basic Plan for Agriculture, Forestry and Fisheries Research" (decided at the meeting of the Agriculture, Forestry and Fisheries Research Council on March 30, 2005), JIRCAS will carry out the following priority research projects by utilizing J-FARD and taking into account the "Strategy for International Collaborative Research [JIRCAS's role]", summarizing the results of JIRCAS international symposia and researches with overseas research organizations, and the opinions of external experts.

1) Research projects targeting the developing regions will be launched to help reduce by half the world's hungry population, as indicated in the U.N. Millennium Development Goals. For this purpose, crops tolerant to unfavorable environmental conditions that make crop production unstable, such as drought, salinity, and disease, will be jointly developed by research organizations affiliated with CGIAR.

2) Many problem-solving research projects will be enhanced, with a focus on the utilization of biological resources, environmental resources management, and measures to address environmental and food problems in Asia, designated as an area in which the strategic alliance in science and technology needs to be strengthened according to a new "Science and Technology Basic Plan."

3) JIRCAS will support international contributions to Africa as indicated in the Progress Report by the G8 Africa Personal Representatives on implementation of the Africa Action Plan at the Gleneagles G8 summit (held in July 2005) in the field of research and development. Technologies related to crops and the soil will be developed to increase crop production in Africa.

4) To contribute towards achieving the target of CO2 reductions imposed by the Kyoto Protocol, research into biomass will be undertaken by JIRCAS in Southeast Asia as a research institute capable of developing a technology for biomass utilization on-site.

5) There are many large and small islands in the Asia-Pacific area. They are vulnerable to environmental changes, and production activities tend to affect their surrounding environment. Concerning the protection and sustainable utilization of environmental resources on the islands, JIRCAS will also tackle problems with the production environment on such islands by making the most of the geographical advantages of the Tropical Agriculture Research Front and by working in line with the collaborative action plan adopted at the Third Pacific Islands Leaders' Meeting (PALM) (held in May 2003).

A. Research and development on agricultural, forestry and fisheries technology geared towards providing solutions to international food and environmental problems

(1) Development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments

1) Elucidation of the mechanism of tolerance to abiotic stress and production of tolerant crops This project aims at developing an evaluation method for tolerance to abiotic stress such as drought, screening of a wide range of germplasms of rice, wheat, and soybean to identify tolerant germplasms, and acquiring DNA markers linked to this tolerance that can be efficiently used in breeding programs. In parallel with these conventional approaches, we will search for new genes through elucidation of the molecular mechanisms of stress tolerance, and will introduce these candidate genes into crops. The resultant transformants will be evaluated for their adaptability to adverse environments and their agronomic performance.

2) Improvement of drought and submergence tolerance of rice in Africa, including NERICA

To improve the drought and submergence tolerance of rice varieties in Africa such as NERICA (New Rice for Africa), a wide range of rice germplasm will be evaluated for tolerance in order to select tolerant types, and then from these, DNA markers linked to the tolerance will hopefully be acquired. The selected tolerant germplasm and the DNA markers can be used in breeding

programs to improve their tolerance. As a molecular approach to drought tolerance, genes which confer abiotic stress tolerance, such as DREB, will be introduced into a NERICA variety.

3) Identification of pathogenic races of important diseases and selection of resistant germplasm in major crops

To deal with rice blast, which is extensive in tropical Asia; Fusarium head blight of wheat and soybean rust, which is currently spreading in South America, a system to identify the predominant races of each pathogen and sources of resistance in the host crops will be built, novel resistant germplasms will be identified, and breeding materials will be developed.

4) Development of biomass utilization technology suited to Southeast Asia

We will develop a system to efficiently produce ethanol fuel from unutilized biomass, such as cassava residues and the wastes of oil palm trees mass grown in East Asia, as well as a technology for producing useful material such as biodegradable composites.

5) Elucidation of the functionality and quality parameters of traditional food and agricultural products in Asia and development of effective utilization technology

We will clarify the functionality of the antioxidization and antimutagenic characteristics of traditional Asian foods and tropical farm products such as vegetables and their quality factors, including texture. We will also develop a process technology that allows the improvement and effective utilization of such functionality and quality.

6) Effective utilization of genetic resources in tropical and subtropical crops

To improve the productivity of crops in tropical and subtropical areas such as sugarcane and beans, and to promote their diverse utilization, we will evaluate the characteristics of extensive crop genetic resources, including wild relatives, and develop a technology to utilize valuable genetic resources and produce breeding materials. We will also cooperate with the project of the National Institute of Agrobiological Sciences Genebank, which has been set up as the central national gene bank.

7) Sustainable utilization of tropical and subtropical marine resources and development of aquaculture technology

In Southeast Asian waters, we will make a trophodynamic analysis, clarify the biological characteristics of target fish species such as their maturity and growth, as well as their interaction with other living organisms; estimate stock abundance of commercially important fish and propose stock management policies suited to the region. We will also develop aquaculture technologies for fish, crustaceans, and algae suitable for current conditions in the developing regions.

(2)Development of management technologies of environmental resources and production systems for sustainable agriculture, forestry and fisheries

1) Development of sustainable management technologies for tropical soils

We will analyze the main materials applied to soils such as organic matters and fertilizers in the agropastoral areas in the Sahel region of West Africa, where production of organic matters is low, and will clarify the dynamics of key elements such as nitrogen in the soil-plant ecosystem. In Southeast Asia, which has a higher production of organic matters, we will also clarify soil nutrient dynamics, physical properties and changes in the biota of soil in response to the input of organic materials. Based on the results of this analysis and clarification, we will develop a technology for improving the fertility of tropical soils through proper management of organic matter.

2) Integrated management system for improved water utilization aiming at increasing economic options for farmers' incomes

In the rain-fed farming areas of Indochina, we will develop a management technology for catchment and drainage that can be adopted efficiently and widely in existing cultivation systems for cash crops through a farmer-participatory approach. We will also propose technical guidelines for increasing farmers' incomes by diversifying and combining farming business operations through the efficient utilization of water resources and effective application of local resources. In addition, we will develop rice breeding materials suitable for water-saving cultivation in the irrigated paddy fields that stretch across Asia, and propose an environmentally sound technology for soil and crop management under conditions of reduced water availability.

3) Improvement of feeding technology for livestock in the tropics and the subtropics and the establishment of sustainable agro-pastoral systems in Asian dry areas

We will identify the nutrient demand of beef cattle in tropical and subtropical areas and develop

rational management technologies for feeding aimed at the effective utilization of local feed resources. We will also shed light on land degradation and the actual conditions of farming to prevent the advance of desertification due to excessive cultivation and overgrazing in the arid and semi-arid regions from Northeast Asia to West Asia, and create a sustainable agro-pastoral production system. We will also develop technologies for sustainable management of farmland and grassland, effective utilization of water resources, and advanced utilization of little-used feed resources. A model of sustainable farming will be produced by combining all these efforts to raise farmers' incomes. A study will likewise be conducted to establish adaptable and effective technologies for water resource utilization and vegetation restoration and to present a method to enhance the capacities of local government personnel and the local people to formulate a management plan for rangelands, as countermeasures for yellow sand in Southeast Asia.

4) Elucidation and exploitation of biological nitrification inhibition (BNI)
Biological nitrification inhibition (BNI) is a natural phenomenon in which certain plant species have the capability to control nitrification in soils by releasing inhibitory compounds from their roots. The development of next-generation crop/pasture varieties that have a built-in ability to self-regulate nitrification through inhibition will have a dramatic impact on minimizing nitrogen losses that are associated with nitrification. We aim to (a) develop the genetic and physiological tools necessary for genetically exploiting the BNI attribute in crops and pastures and assess inter- and intra-specific variability of BNI, (b) characterize the physiological and biochemical mechanisms of BNI and isolate BNI compounds followed by the elucidation of their biosynthetic pathways, and (c) clarify their interaction with environmental factors, particularly soil conditions, and its effect on modulating the functionality of BNI.

5) Development of environmental management technology for sustainable crop production in tropical and subtropical islands
We will develop a technology for effective utilization of water resources and fertilizer and an environmental management technology for reducing soil loss. These technologies are essential for sustainable crop production in the context of the environmental systems on tropical and subtropical islands. We will also produce prediction models of environmental pollution such as those of river soil loss and nutrient salt loss, and then evaluate the effectiveness of the environmental management technology scheduled for development.

6) Development of nurturing techniques for beneficial indigenous tree species in Southeast Asia
We will propose a combined management of agricultural and forestry operations based on the utilization of useful indigenous tree species, while at the same time developing a technology for tree cultivation needed to promote the production of timber from useful indigenous trees in the tropical monsoon regions of Southeast Asia where forests have decreased sharply. We will also propose a method for selective logging while maintaining the genetic diversity of useful indigenous tree species in natural dipterocarp forests on tropical hills.

7) Development of productive low-input cultivation technology for fruit trees in the tropics
We will develop a cultivation technology for low-tree-height cultivation aimed at low input and effective prevention of diseases such as rot disease in the production of tropical fruits, including durian, in Southeast Asia. We will also develop a technology for high-quality, high-yield production, including improved pollination efficiency and fertilizer management.

(3) Elucidation of the impact of global environmental changes on agriculture, forestry, and fisheries and development of mitigating technologies

1) Developing an impact assessment model and formulation of a food supply stabilization plan
To conduct medium- and long-term evaluations of how environmental changes, such as changes in water supply and global warming, affect the supply and demand of major agricultural products in East and Southeast Asia, we will improve the world food supply and demand model, and create a scenario of measures for food production such as rice aimed at minimizing the impact of such environmental changes. We will also develop early warning systems to mitigate damage to agriculture from meteorological disasters and clarify specific measures to stabilize food supply.

2) Utilization of Geographic Information System (GIS) for the development of a land information monitoring technology in developing regions
We will obtain past history data on land utilization, cropping, and growth patterns of agricultural products, land degradation, and the occurrence of disasters to gain an understanding of spatial environmental changes in the developing regions and to quantitatively clarify the relationship between such changes and agricultural production. We will also develop technologies to monitor

the phenomena of various spatial scales using geographic information such as satellite data to gain a better understanding of environmental changes in quasi-real time.

3) Formulation of agricultural development methodologies to tackle the environmental changes of global warming and desertification.We will conduct a field study and develop a methodology that combines different techniques of soil erosion prevention on farmlands or hillsides as well as techniques of water use and management to prevent desertification by soil degradation or salt accumulation in developing areas. Likewise, we will establish a methodology for rural development in a guideline that will meet the needs of rural people in developing countries such as livelihood improvement by applying the international mechanism of greenhouse gas emission reduction trading.

4) Development of management technology for major pests of tropical and subtropical crops. We will develop management techniques for major pests to stabilize crop production in the tropics and subtropics. We will focus our efforts on the development of a control technology to prevent citrus greening disease, which hampers sustainable production of citrus fruits in Southeast Asia and other regions.

B. Collection, analyses and dissemination of information to grasp trends related to international food, agriculture, forestry and fisheries and rural areas

(1) Collection and dissemination of information related to global food, agriculture, forestry, and fisheries.

By strengthening ties with related organizations at home and abroad and through on-site investigations, we will collect extensive information on supply and demand trends in food and agricultural, forestry, and fisheries products worldwide, including the developing regions; and on research and development, institutions, and policies, as well as industrial structures, relating to agriculture, forestry, fisheries, and their associated industries. The information collected will be provided to the public through the expansion of databases, symposia and other means.

(2) Elucidation of the direction of technological development in developing regions and analysis of socioeconomic conditions influencing development in rural areas

We will clarify the direction of technology development necessary for developing regions through managerial and social evaluation of the selection, introduction, and establishment of technologies such as those for rice cultivation in Asia. We will also clarify the socioeconomic conditions and development methods that will encourage effective rural development in Asian countries where rapid changes are taking place in trade and distribution.

(3) Establishment of techniques and methodologies for the reconstruction of agriculture and rural communities affected by natural disasters, etc.

We will undertake a farmers' participatory study on techniques and methodologies for the reconstruction of agricultural and rural communities affected by natural disasters, etc, and present the supporting reconstruction method as a guideline.

2. Promotion of the release and dissemination of research results

(1) Securing interactive communication with the public

1) We will hold wherever possible open seminars and workshops on international collaborative research projects, disclose research results collected and analyzed through multi-media information , publish the results of research evaluations, engage in interactive communication with the public regarding collaboration on international research projects implemented by JIRCAS, and ensure public understanding and transparency of JIRCAS' activities.

2) The research staff will work positively on outreach activities via open lectures for citizens. Their efforts will be conscientiously evaluated.

3) We will establish a system for receiving and answering questions from the public on our website.

4) We will conduct questionnaire-based surveys of our collaborative research partners to identify research needs and exchange information.

5) We will adopt a participatory approach in international collaborative research projects to incorporate the needs of local residents and seek their understanding of and cooperation with our research activities.

(2) Promotion of utilization of research results

1) To ensure the prompt and practical application of research results, we will make efforts to encourage the beneficiaries of technologies and research results to participate in research projects from the planning stages, and to conduct such research activities by focusing on the utilization,

diffusion, and commercialization of research results.

2) To promote the dissemination of our research achievements, we will hold symposia related to the research projects on site.

3) To implement agricultural development effectively and efficiently in developing areas, we will establish and publish the method of collaborative technology transfer performed by local government organizations, local and international NGOs, universities, etc.

4) Of the research results concerned with international research on agriculture, forestry and fisheries, we will select at least 20 research results that can be transferred to the developing regions for diffusion based on external evaluations within the period covered by the Second Medium-Term Goals.

(3) Public relations and the release of research results

1) Research results will be released at academic meetings and symposia in Japan and overseas. At least 560 refereed papers will also be published in academic journals and bulletins during the period covered by the Medium-Term Goals. At least 30 international symposiums and workshops will also be held during that period, and research results will be widely released in Japan and overseas.

2) Details of research results will be released on Web sites and through exhibitions. To publicize the roles of JIRCAS in solving problems facing world food and agriculture, we will also actively take advantage of the mass media by making more than 30 press releases of major research results during the period covered by the Medium-Term Goals.

3) We will prepare various manuals and brochures for research results, and conduct public relations on such research achievements in the developing regions through international collaborative research activities.

(4) Acquisition of intellectual property rights and promotion of their utilization

1) In our efforts to acquire intellectual property rights, we will file at least 20 patent applications in Japan and abroad during the period covered by the Second Medium-Term Goals, and will aim to win patent rights in consideration of the potential for patent licensing. We will also endeavor to widen the scope of patent licensing, stressing the practicality and utility of intellectual property such as patents.

2) We will review registered patents as needed in the light of licensing revenue, and the development and invention of alternative technologies. If necessary, we will waive the patent rights.

3) Breeding research results which are applicable in Japan will be positively applied to the registration of varieties based on the Seed and Seedling Law to promote their dissemination and utilization.

4) We will provide information on the intellectual property rights of JIRCAS through the internet, and promote their utilization through the Technology Licensing Organization (TLO) certified by the Ministry of Agriculture, Forestry and Fisheries.

3. Other social contributions in specialized fields

(1) Analysis and appraisal

1) On request from the government, various organizations, and universities, JIRCAS will perform analyses and appraisals that will require the highly specialized knowledge it possesses and which are difficult for other organizations to carry out.

(2) Training sessions and seminars

1) We will hold training sessions and seminars as often as possible, and actively cooperate in events sponsored by the government and other organizations.

2) We will actively welcome trainees from other IAAs, universities, national and public institutions, as well as the private sector to develop human resources, raise technical standards, and transfer technical information. We will also actively welcome trainees from abroad.

3) We will, when commissioned by the government, promote the nurturing of researchers engaged in international agriculture, forestry, and fisheries research.

(3) Collaboration with the government

We will send our staff to government committee meetings and conferences, and provide domestic and overseas technical information upon request. We will also help with international cooperation and exchanges on scientific technology provided by the government.

(4) Cooperation with international organizations and academic societies

As an organization that carries out comprehensive research on agriculture, forestry, and fisheries,

JIRCAS will dispatch its staff to committee meetings and conferences held by related international organizations and academic associations. It will also provide domestic and overseas technical information on request.

FINANCIAL OVERVIEW

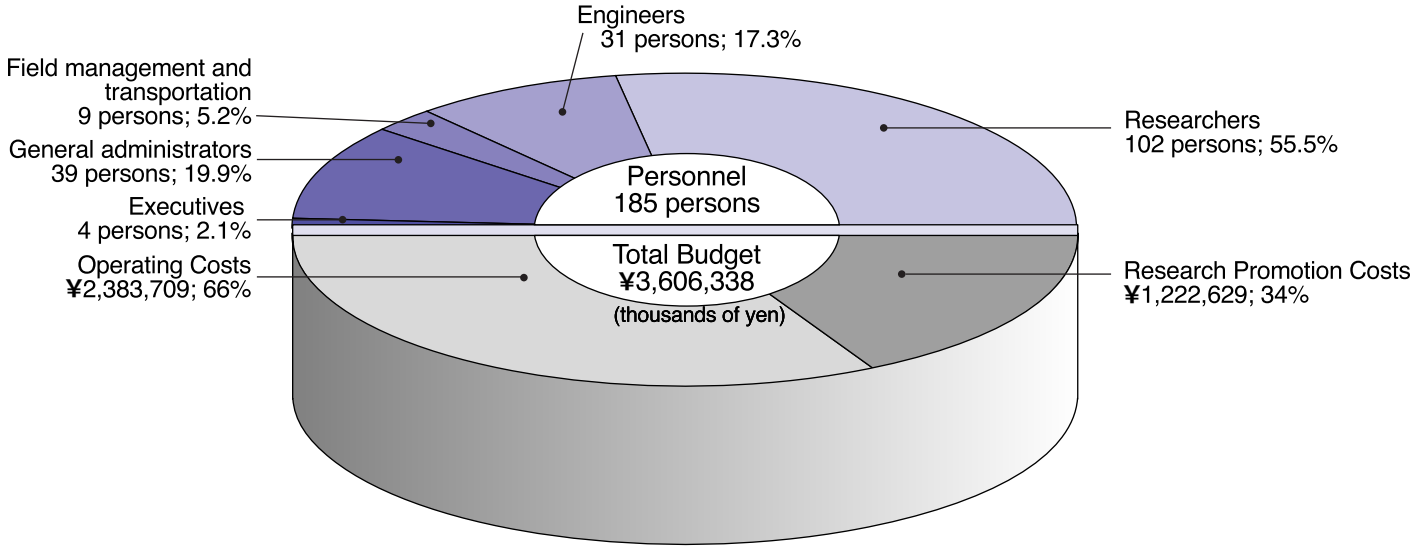
Fiscal Year 2010

(thousands of yen)

TOTAL BUDGET	**3,606,338**
OPERATING COSTS	**2,383,709**
Personnel (185)	2,035,386
President (1), Vice-President (1), Executive Advisor & Auditor (2)	
General administrators (39)	
Field management and transportation (9)	
Engineers(31)	
Researchers (102)	
* Number of persons shown in ( )	
Administrative Costs	348,323

RESEARCH PROMOTION COSTS	**1,222,629**
Research and development	525,462
Overseas dispatches	196,391
Research exchanges/invitations	21,067
Collection of research information	85,558
International collaborative projects	354,779
Fellowship programs	39,373

Budget FY 2010 (Graph)



MEMBERS OF THE EXTERNAL EVALUATION COMMITTEE AND PROGRAM REVIEW MEETINGS

Members of the JIRCAS External Evaluation Committee

Hiroto ARAKAWA	Senior Special Advisor, Japan International Cooperation Agency
Toshihiko KOMARI	Vice President, Corporate Strategy Division, Japan Tobacco Inc.
Toru MITSUNO	Professor, Department of Environmental Management, Tottori University of Environmental Studies
Hajime NAKAMURA	Adviser, Meiken Lamwood Corporation, Ltd.
Keiko NATSUAKI	Professor, Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture
Shin-ichi SHOGENJI	Professor, Graduate School of Agricultural and Life Sciences, University of Tokyo

External Reviewers for the JIRCAS Program Review Meetings

[Agro-environment]

Toshiaki IMAGAWA	Director, Department of Planning and General Administration, National Agricultural Research Center for Western Region, National Agriculture and Food Research Organization
Nobuyuki KURAUCHI	Associate Professor, College of Bioresource Sciences, Nihon University
Takashi NISHIO	Director, Soil Environment Division, National Institute for Agro-Environmental Sciences
Kenji HATA	Professor, Center of Field Education and Research, Faculty of Bioresource Sciences, Akita Prefectural University

[Crop Production]

Hiroaki INOUE	Professor, College of Bioresource Sciences, Nihon University
Masaaki NAKANO	Research Manager, National Institute of Fruit Tree Science, National Agriculture and Food Research Organization

[Agro-biological Resources]

Tatsuhito FUJIMURA	Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba
Kyuya HARADA	Former Team Leader, Soybean Genome Research Team, Division of Genome and Biodiversity Research, National Institute of Agrobiological Sciences
Hitoshi NAKAGAWA	Director, Biomass Research and Development Center, National Agriculture and Food Research Organization

[Animal Production & Grassland]

Hitoshi NAKAGAWA	Director, Biomass Research and Development Center, National Agriculture and Food Research Organization

Fuminori TERADA	Director, Department of Planning and General Administration, National Institute of Livestock and Grassland Science, National Agriculture and Food Research Organization
Kunihiko YOSHINO	Professor, Graduate School of Systems and Information Engineering, University of Tsukuba

[Fisheries]

Yukimasa ISHIDA	Director, Tohoku National Fisheries Research Institute, Fisheries Research Agency
Takashi MINAMI	Former Professor, Graduate School of Agricultural Sciences, Tohoku University
Toshio TAKEUCHI	Vice President, Tokyo University of Marine Science and Technology

[Development Research]

Masao TSUJI	Professor, Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture
Ryuichi SHIGENO	Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba
Masaki UMEMOTO	Research Manager, National Agriculture Research Center, National Agriculture and Food Research Organization

[Post-harvest Science & Technology]

Yoshiaki KITAMURA	Director, Applied Microbiology Division, National Food Research Institute, National Agriculture and Food Research Organization
Tohjiro TSUSHIDA	Professor, School of Food, Agricultural and Environmental Sciences, Miyagi University

[Biomass Utilization]

Mitsutoshi NAKAJIMA	Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba
Koichi YAMAMOTO	Director, Tohoku Research Center, Forestry and Forest Products Research Institute

[Forestry]

Naoto MATSUMURA	Professor, Graduate School of Bioresources, Mie University
Akira SATO	Professor, Faculty of Regional Environment Science, Tokyo University of Agriculture

[Rural Development]

Tetsuro MIYAZATO	Principal Research Coordinator, Japanese Institute of Irrigation and Drainage
Yoshihiko NISHIMURA	Professor, Faculty of Tourism Sciences and Industrial Management, University of the Ryukyus

JIRCAS STAFF in FY 2010

President

Kenji Iiyama

Vice-President

Masami Yasunaka

Executive Advisor & Auditor

Shigeo Matsui
Hitoshi Yonekura

Research Strategy Office

Osamu Koyama, Director
Hiroko Watanabe, Project Leader
Kazumi Yamaoka

Regional Research Coordinators
Tomohide Sugino, Representative of Southeast Asia Office (Thailand)
Tetsuji Oya, Representative of Africa Office

Research Planning and Coordination Division

Makoto Nakatani, Director

Research Planning and Evaluation Office
Takeshi Kano, Head
Research Planning Section
Naruo Matsumoto, Head
Mie Kasuga, Senior Researcher
Hiroshi Ikeura
Research Evaluation Section
Koshun Ishiki, Head
Kazuo Ise, Senior Researcher
Junya Onishi
Field Management Section
Takashi Komatsu, Field Operator

Research Support Office
Kenichi Hatsuse, Head

Research Coordination Section
Takahiro Sato, Head
Kazunari Iwafuchi, Assistant Head
Yoshihiko Sumomozawa, Coordination Subsection Head
Junichi Irino, International Relations Subsection Head
Research Support Section
Hatsui Yashiro, Head
Takeshi Usuku, Budget Subsection Head
Takao Oga, Support Subsection 1 Head
Genichiro Hanaoka, Support Subsection 2 Officer
Akira Hirokawa, Intellectual Property Expert

Public Relations Office
Masanobu Ohura, Head

Public Relations Section
Tadashi Hayakawa, Head
Kenichiro Kimura
International Relations Section
Satoshi Uchida, Head
Kunimasa Kawabe, Senior Researcher
Publications and Documentation Section
Misako Nakao, Head
Noriko Yatabe, Managing Subsection Head (Librarian)
Hiromi Miura, Network Subsection Head

Executive Chief Researcher
Satoru Miyata

Administration Division

Tomoichi Mitomi, Director

General Affairs Section
Harumi Yakushiji, Head
Koichi Iioka, General Affairs Assistant Head
Keiji Tanaka, Personnel Management Assistant Head
Katsunori Kanno, General Affairs Subsection Head
Kazuyo Kadowaki, Welfare Subsection Head
Gaku Takeda, Personnel Subsection 1 Head
Akemi Nomiya, Personnel Subsection 2 Head

Accounting Section
Toshinori Baba, Head
Kazuo Miyajima, Accounting and Examination Assistant Head
Hiroshi Mizufune, Procurement and Asset Managing Assistant Head
Koichi Fuse, Financial Subsection Head
Tetsuya Hirono, Accounting Subsection Head
Toshiki Kikuchi, Overseas Expenditures Subsection 1 Head
Ryoichi Mise, Overseas Expenditures Subsection 2 Head
Yoshinori Kawasaki, Audit Subsection Head
Yasuhiro Onozaki, Procurement Subsection Head
Takashi Kitami, Procurement Officer
Tsuneyoshi Sasaki, Supplies/Equipment Subsection Head
Kuniaki Katsuyama, Facilities Subsection Head

Administration Section (Tropical Agriculture Research Front)

Hiroshi Jutori, Head
Tomohiro Yumiza, General Affairs Subsection Head
Shuji Hirose, Accounting Subsection Head
Masafumi Sato, Accounting Officer

Audit Office

Hideo Azechi, Head

Rural Development Planning Division

Takeshi Ohta, Director

Project Leader
Naoya Fujimoto

Senior Researcher
Kazumi Yamaoka, Research Coordinator

Principal Engineers
Takeru Higashimaki
Hirofumi Iga
Tsutomu Kobayashi
Eiji Matsubara
Ryo Miyazaki
Kimio Osuga
Hiroshi Suzuki
Yukio Okuda

Senior Engineers
Shinji Hirouchi
Kazuhisa Kouda
Takeshi Matsumoto
Yasuyuki Nakanishi
Michio Naruoka
Koichi Takenaka
Akihiko Sato
Taro Izumi
Masakazu Yamada
Mamoru Watanabe

Chief Engineers
Haruyuki Dan
Katsumi Hasada
Chikako Hirose
Hiroshi Ikeura
Kenichiro Kimura
Yuzo Manpuku
Masaki Morishita
Naoko Oka
Keisuke Omori
Junya Onishi
Shutaro Shiraki
Toshihide Takeuchi

Development Research Division

Masuo Ando, Director

Project Leaders
Jun Furuya, Agricultural Economics
Kazuo Nakamoto, Agricultural Economics
Satoshi Uchida, Geographic Information Systems
Shigeki Yokoyama, Agricultural Economics

Senior Researchers
Fumika Chien, Agricultural Economics
Akira Hirano, Geographic Information Systems
Hiroshi Komiyama, Development Economics
Shunji Oniki, Agricultural Economics
Ryuichi Yamada, Agricultural Economics
Toru Hisazome, Agricultural Economics
Yukiyo Yamamoto, Geographic Information Systems

Researcher
Shintaro Kobayashi, Agricultural Economics

Biological Resources Division

Kazuhiro Suenaga, Director

Project Leaders
Yoshimichi Fukuta, Rice Breeding
Seiji Yanagihara (Tropical Agriculture Research Front)

Senior Researchers
Hajime Akamatsu, Plant Pathology
Xu Donghe, Plant Molecular Genetics
Yasunari Fujita, Plant Molecular Biology
Takuma Ishizaki, Plant Molecular Biology (Tropical Agriculture Research Front)
Norihito Kanamori, Plant Molecular Biology
Nobuya Kobayashi, Physiology and Breeding
Kyonoshin Maruyama, Plant Molecular Biology
Kazuo Nakashima, Plant Molecular Biology
Naoki Yamanaka, Plant Molecular Genetics
Tsutomu Ishimaru, Plant Breeder

Researchers
Mitsuhiro Obara, Plant Physiology and Genetics

(Kazuko Yamaguchi-Shinozaki, Plant Molecular Biology)

Crop Production and Environment Division

Osamu Ito, Director

Project Leaders
Satoshi Nakamura, Insect Ecology
Masato Oda, Crop Management
Junichi Sakagami, Crop Improvement
Satoshi Tobita, Plant Physiology and Nutrition
Hideto Fujii, Agricultural Hydrology

Senior Researchers
Keiichi Hayashi, Soil Management
Yasukazu Hosen, Environmental Soil Science
Takayuki Ishikawa, Plant Physiology
Hide Omae, Crop Science
Guntur V. Subbarao, Crop Physiology and Nutrition
Takeshi Watanabe, Soil Chemistry
Matthias Wissuwa, Physiology and Genetics
Yoshiko Iizumi, Hydrological Science
Yoichi Fujihara, Agricultural Hydrology

Researcher
Yasuhiro Tsujimoto, Crop Science

Animal Production and Grassland Division

Akio Takenaka, Director

Project Leader
Kazunobu Toriyama, Soil Science

Senior Researchers
Yasuo Ando, Plant Microbiology
Makoto Otsuka, Animal Nutrition
Kazumasa Shindo, Pasture Management
Seishi Yamasaki, Animal Nutrition

Post-harvest Science and Technology Division

Yutaka Mori, Director

Project Leader
Kazuhiko Nakahara, Food Chemistry

Senior Researchers
Takamitsu Arai, Molecular Microbiology
Tamao Hatta, Mineralogy and Geology
Akihiko Kosugi, Molecular Microbiology
Yoshinori Murata, Applied Microbiology
Satoru Nirasawa, Food Functionality
Eizo Tatsumi, Food Chemistry

Forestry Division

Ryuichi Tabuchi, Director

Senior Researchers
Naoyuki Furuya, Forest Management
Iwao Noda, Forest Chemistry
Tatsuya Otani, Forest Ecology
Tomoko Sugimoto, Forest Soil Science
Naoki Tani, Forest Genetics
Akihiko Yokota, Forest Products

Fisheries Division

Yukio Maeno, Director

Project Leader
Marcy N. Wilder, Crustacean Biochemistry

Senior Researchers
Kaoru Hamano, Aquatic Animal Physiology
Sayaka Ito, Aquatic Ecology
Shinsuke Morioka, Fish Biology
Katsuhisa Tanaka, Marine Chemistry
Satoshi Watanabe, Marine Ecology
Tatsuya Yurimoto, Aquatic Biology

Researcher
Tomoyuki Okutsu, Aquatic Animal Physiology

Tropical Agriculture Research Front

Yoshinobu Egawa, Director
Yoshimitsu Katsuda, Public Relations Officer

Islands Environment Management Group
Group Head, Project Leader
Kiyoshi Ozawa, Agrometeorology

Senior Researchers
Shinkichi Gotoh, Soil Science
Fujio Nagumo, Soil Science

Crop Genetic Resources Group
Stress-Tolerant Vigna Project Team
Group Head
Mariko Shono, Plant Physiology

Sugarcane Improvement Project Team
Senior Researcher
Yoshifumi Terajima, Sugarcane Breeding

Crop Production and Protection Group
Tropical Fruits Production Project Team
Group Head, Project Leader
Tatsushi Ogata, Pomology

Senior Researcher
Shinsuke Yamanaka, Molecular Biology

Citrus Greening Disease Management Project Team
Project Leader
Yasuo Ohto, Plant Pathology

Senior Researcher
Katsuya Ichinose, Entomology

Researchers
Youichi Kobori, Entomology
Naoko Kozai, Pomology

Technical Support Section
Tsutomu Fushimi, Head
Masakazu Hirata, Machine Operator
Hirokazu Ikema, Machine Operator
Masahide Maetsu, Machine Operator

Yuho Maetsu, Machine Operator
Yasuteru Shikina, Machine Operator
Masato Shimajiri, Machine Operator
Masashi Takahashi, Machine Operator
Koji Yamato, Machine Operator

THE JAPANESE FISCAL YEAR AND MISCELLANEOUS DATA

The Japanese Fiscal Year and the Annual Report 2010

The Japanese fiscal year is defined as the period of fiscal activity occurring from April 1 through March 31 of the following year. Thus, Fiscal Year (FY) 2010 covers the period from April 1, 2010 through March 31, 2011. The Annual Report 2010 summarizes the full extent of JIRCAS activities that occurred during this period. The subsequent Annual Report will detail events and programs from April 1, 2011, through March 31, 2012 (FY 2011).

Buildings and campus data

Land	(units: m^2)
Tsukuba premises	109,538
Okinawa Tropical Agriculture Research Front	294,912
Total	404,450

Buildings	(units: m^2)
Tsukuba premises	10,749
Okinawa Tropical Agriculture Research Front	9,485
Total	20,234

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Japan International Research Center for Agricultural Sciences (JIRCAS)

1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, JAPAN

Website http://www.jircas.affrc.go.jp

Tel. +81-29-838-6313

Fax. +81-29-838-6316

About JIRCAS' symbol mark (shown on front/back cover): The mark was conceived by Takayuki Ishikawa of the Crop Production and Environment Division, and Toshifumi Murakami, former Senior Researcher in the Research Planning and Coordination Division. The Earth enveloped in a revolving swirl of clouds represents the dynamics of international research and JIRCAS' aim to target all world areas. The star was added to serve as a polestar for international agricultural research and to represent the importance of cooperation.

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理事長　岩永　勝

〒305-8686 茨城県つくば市大わし1番地1

電話：029-838-6313

FAX：029-838-6316

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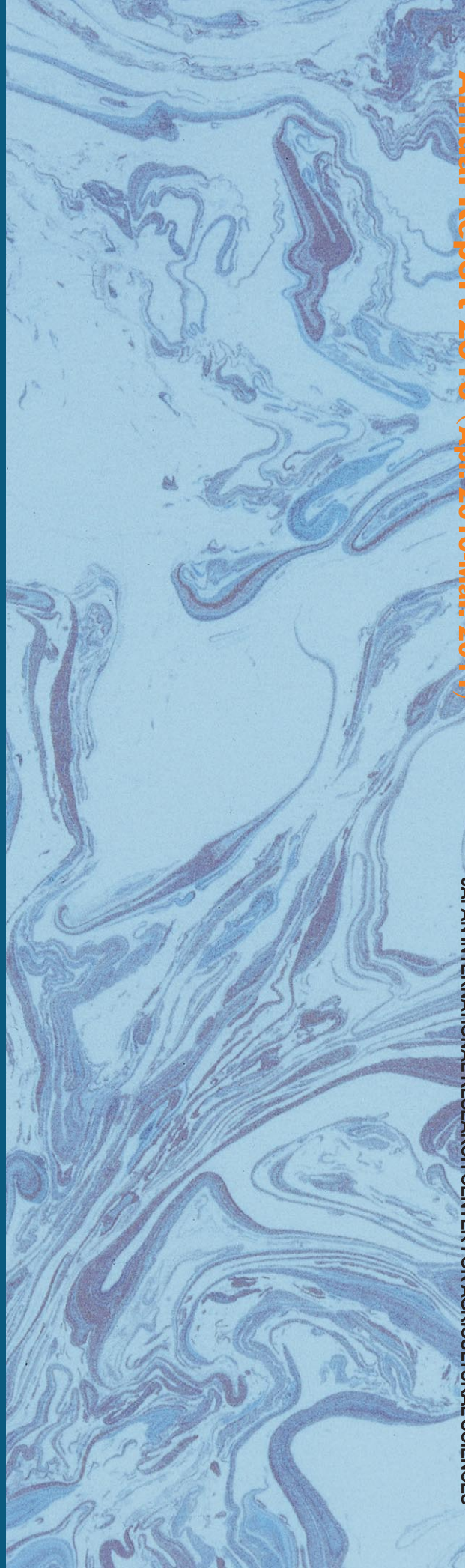
〒305-0046 茨城県つくば市東2-11-15



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