ISSN 0919-8822

A typical local market in Ghana, West Africa (Photo by J. Furuya)

NEWSLETTER

JIRCAS

Japan International Research Center for Agricultural Sciences

For International Collaboration

March 2002
30

Contents

Distribution Systems and Rural Development

In West Africa

A few years ago, I had the opportunity to visit several countries in West Africa. As generally known, West Africa is an area where the income level is very low and where essential food products are in short supply, especially, compared to other developing areas. In addition, these countries are facing many problems such as limited water resources, degradation of soil, difficulty in increasing the production of foods, etc.

During my visit there, I was able to observe a farming village where farmers were actively tackling the production of farm products, especially, the production of vegetables under such difficult conditions. Actually, only part of the farmers were working actively in the village. However, they not only dug wells for themselves to ensure the water supply for their own use but also installed a fence neatly around the village to protect themselves from wild animals. Furthermore, their farmland was well-managed and they appeared to be full of life. According to them, very recently, an open market had been set up near the village and they began to deliver their products to the market. It is obvious that when cash income is readily available, farmers are strongly motivated to produce farm commodities. Although I heard that there was only one TV set in the village, it seemed that the TV supplied a great deal of information as well as a means of entertainment in the village. It is no exaggeration to say that the example of the village in West Africa described above suggests that the presence of markets strongly affects the regional economy and this is common throughout the world. Still, I would like to emphasize that the vitality I observed in the village I visited was remarkable, compared with other villages in the vicinity.

Agricultural promotion measures

Not only in Africa but also in many other regions, agricultural promotion measures are being implemented based on some development programs managed by each country or each region. Besides, international agencies and institutes in advanced and developing countries also have long been carrying out on a large scale studies on the development of new varieties of crops, pest control measures, effective policy and systems, etc. as well as conducting surveys on social and cultural trends. Moreover, these countries and institutes have been making utmost efforts to disseminate the newly developed technology by dispatching specialists or advisors. However, I must admit that the results of these efforts are not satisfactory when I see the actual situation of farmers working on their farmland. Although there must be many reasons for the poor results, one of the major reasons is that it is difficult to give an incentive to farmers only by introducing new technology and/or constructing facilities. Actually, even though the activities seem to be successful at the beginning while they are supported with subsidies and by advisors, these activities are likely to revert to the original state upon termination of the said support. From a short-range view, there must be, at least, a tangible output for the benefit of producers to some extent in order for producers to maintain the incentive. In other words, cash income from markets and purchase of assets must be greatly attractive for them. Of course, only the existence of markets will not solve all of the problems. Needless to say, the production activities are indispensable. At the same time, it is important to ensure means of distribution of crops for sale. In order to improve the income level of all of the farmers, in this case, monetary distribution in a wide area which involves as many regions as possible is necessary, because the transfer or return of wealth in a limited region will not enable to improve the standard of living of all.

Rice from Thailand, China, Vietnam, Bangladesh, and the U.S. for sale in Ghana, West Africa

Distribution systems

The existing distribution systems in developing regions have their own background based on traditions and social and economic conditions, respectively. In fact, the activities of official agencies and private distributors are closely related to support these distribution systems, and many actors operate between producers and retailers. What is important for agricultural promotion and the development of farming villages is not to totally remove the existing systems but to carefully review their advantages and disadvantages and to make full use of the existing advantages for necessary reforms. By maintaining fairness as a whole, it is more important in particular to orient private distributors toward a direction to let them play their role to their full capacity. In some countries and regions, due to the migration of populations to large cities, changes in food habits, etc., changes have already taken place in the distribution network and in the process of price formation.

Together with the reform of systems, it is important to construct well-organized infrastructures for the distribution systems since basic infrastructures are often rudimentary in many developing regions. Because of the lack of adequate infrastructures, transportation of the crops produced takes a long time, resulting in losses of large quantities of crops and deterioration in quality during the transportation, which are serious problems. To address these problems, development of wholesale markets, transportation networks, storage facilities, etc. are urgently required in addition to technological development for processing the crops and preservation of the crops in the distribution system. Obviously, technological development varies with the environment, economic conditions, etc. of each country, starting from the development of techniques to prevent losses of the harvested crops and drying, and extending to the

development of techniques to process crops to products with value added, provided that these commodities can be purchased at a low price and are acceptable to most of the people in the country or the region.

For the development of efficient distribution systems

Since the distribution systems play an important role in the improvement of the income of farmers and the enhancement of the regional economy, development of distribution systems is required along with technological development and its dissemination. Therefore, approaches from both aspects are suggested for the development of an efficient distribution system: one from the view point of system or institution, and the other from the technology perspective. As for the former, it is necessary to identify the existing constraints in the current system, taking into account the social background, and for the latter, to determine the current technological level and the objectives. Then, it is essential to implement a policy related to the reform and improvement of the distribution system as well as to determine the need for the introduction of newly developed technologies and to consider the possible impact on farmers' economy and regional economy. Since a considerably large amount of investment, however, is required for the development of infrastructures for the distribution systems, plans for the promotion of distribution systems in the respective regions should be drafted carefully by setting up clearly priorities for the implementation of the programs.

The example in West Africa introduced at the beginning of this article shows only one aspect of the distribution systems in that region. However, such a trend certainly offers a good opportunity for more efficient rural development, even though in some cases, how to maintain a market in itself is a problem. Furthermore, I would like to underline the fact that due to the changes in the technologies and systems for the distribution of products, the structure of producing areas for many kinds of foods has changed a great deal even in Japan. Now, I do hope that studies on technologies and structure for the development of more efficient distribution systems will be promoted to accelerate rural development in the developing regions, which requires a close collaboration among related researchers in many fields.

Kazuyuki Tsurumi
Director, Development Research Division, JIRCAS

Collaborative Research Project

Development of Technology for the Diagnosis and Prevention of Shrimp Viral Diseases in Malaysia

The collaborative project titled: "Development of technology for the diagnosis and prevention of shrimp viral diseases" was conducted for five years from 1996 until 2002 in Malaysia. This JIRCAS project was planned to target Southeast Asia which is a major area for prawn production. The fisheries industry is extremely important for many Southeast Asian countries surrounded by the sea. Especially, the prawn industry is the key of all fisheries, because of the high value to obtain foreign exchange. Recently, prawn culture has expanded rapidly in these areas because of the development of culture technology (Fig. 1). At the beginning of the 1990s, prawn production in the world amounted to about 700,000 MT, with Southeast Asia accounting for the major part. However, the production of cultured prawns markedly decreased as a result of serious viral disease outbreaks in the first part of the 1990s. Yellow Head Virus (YHV) and White Spot Syndrome Virus (WSSV) were the main viral pathogens. At present, WSSV is the most serious problem for the prawn industry in Southeast Asia. This viral disease has occurred in most of the prawn farms in Malaysia since 1996. The increased severity of widespread viral infection is the most significant threat to stable aquacultural production. Therefore, in order to ensure stable production of cultured products, it is essential to adopt preventive measures against viral diseases. The aim of this project is the development of serological diagnosis, disinfection, and other control methods for the prevention of prawn viral diseases.

Fig. 1. Harvest of black tiger prawns from culture ponds.

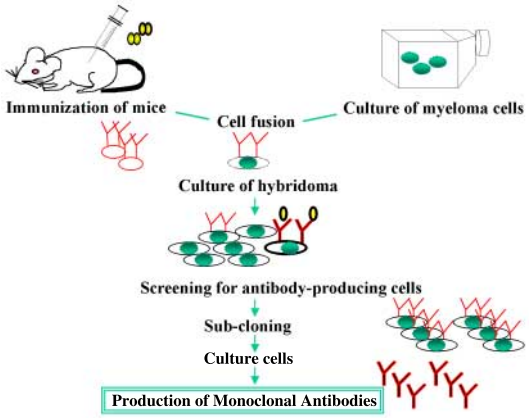

Fig. 2. Process of monoclonal antibody production.

Research was executed according to a four-phase plan. In the first phase, investigations of the present conditions and problems associated with shrimp viral diseases were carried out. In these studies, field work was conducted based on the collection of accurate epidemiological data. In the second phase, the pathogens were identified by polymerase chain reaction (PCR) and other methods, and concentrated and purified in the next step. In the third

phase, methods for rapid diagnosis were designed, including the production of monoclonal antibodies to develop serological diagnostic methods (Fig. 2). In the last phase, disinfection methods for disease control were developed. Sterilization of facilities using disinfectants was used, and attempts will be made to prevent the occurrence of prawn viral diseases. For this project, JIRCAS collaborated with the Fisheries Research Institute (FRI), Department of Fisheries, Ministry of Agriculture of Malaysia. The institute consists of four research divisions, namely Aquaculture, Fish resources, Marine ecology, and Food processing. Fish health section belonging to the Aquaculture division was selected as the counterpart of the project. This laboratory had just initiated fish virological research because of the increase in the incidence of many fish viral diseases during the development of marine fish aquaculture. As a result, the required equipment had been already provided for virological studies. The Pathology division, National Research Institute of Aquaculture (NRIA), Ministry of Agriculture Forestry and Fisheries of Japan, supported this project by sending experts in 1998 and in 2000. As a result of this project, a few clones of virus-specific monoclonal antibodies were obtained. Hereafter, these monoclonal antibodies will be used for the diagnosis of WSSV. On the other hand, the WSSV inactivation test indicated that halogenous disinfectants induced effective inactivation even at lower concentrations. In future, the application of effective methods of diagnosis and disinfection of WSSV should enable to achieve sustainable aquaculture in Southeast Asia.

Norihisa Oseko
Fisheries Division, JIRCAS
Present, National Research Institute of Aquaculture, Fisheries Research Agency

JIRCAS Research Highlight

Quantitative Analysis of 2-Acetyl-1-Pyrroline, a Strong Flavor Compound of an Aromatic Rice Variety, Khao Dawk Mali 105

A large quantity of rice is produced in many areas worldwide to meet the demand of consumers. In fact, aromatic rice varieties are very popular in Southeast Asia. Recently, they have gained a wide acceptance in Europe and the U.S.A. One of the major aromatic varieties, Khao Dawk Mali 105, is mainly produced in Northeast Thailand. The demand for this variety is increasing in both domestic and international markets due to the recognition of its good quality, i.e. pleasant aroma. Although an increase in production is urgently needed, cultivation is limited due to infertile and drought-stricken sandy soils. Erratic rainfall at the beginning of the rainy season and labor shortage for transplanting are other constraints on the production of this variety in Northeast Thailand. Since rice production is the most important activity in Northeast Thailand, where Khao Dawk Mali 105 is the main variety, it is essential to maintain the quality of this variety. It is assumed that the aroma quality depends on cultivation conditions and postharvest practices. However, there is no agreement with regard to factors controlling the aroma, and this could probably be related to the lack of objective methods for aroma evaluation of rice. Empirical methods include biting kernels, smelling tissue after warming, soaking in potassium hydroxide solution and organoleptic evaluations

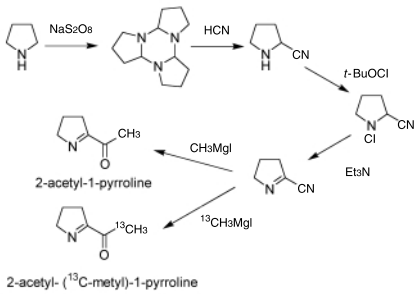

Fig. 1. Synthetic route leading to 2-acetyl-1-pyrroline and its labeled analog.

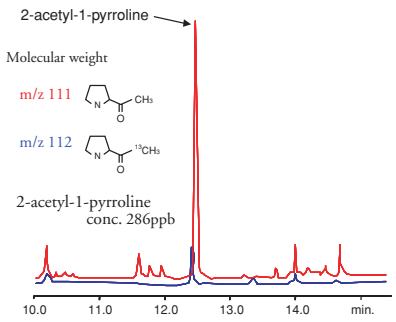

Fig. 2. GC-MS-SIM chromatogram of the Khao Dawk Mali 105 milled rice extract.

of cooked rice.

A "popcorn"-like flavor compound, 2-acetyl-1-pyrroline (AcPy) (Fig. 1), has been reported to be an important flavor component of aromatic rice, which has a lower odor threshold than other volatile compounds in aromatic rice varieties. This compound also has been isolated and identified from pandan (*Pandanus amaryllifolius* Roxb.) leaves and popcorn. Moreover, this compound contributed to the aroma of roasted beef and crusts of wheat and rye breads. Quantification of this flavor compound in rice has been performed using a simultaneous steam distillation and solvent extraction. However, it is known that distillation leads to the loss of components during volatilization and also requires large amounts of samples. Consequently, quantification of AcPy in rice varied among the reports. Therefore, it is necessary to develop a method for quantification of AcPy in aromatic rice varieties using smaller samples and not employing steam distillation for extraction.

Isotope dilution method, the method using isotope-labeled compounds as an internal standard, is an ideal method for quantification of AcPy using gas chromatography-mass spectrometry-selective ion monitoring (GC-MS-SIM). In our laboratory, we synthesized its Carbon 13 analog, 2-acetyl-(^{13}C-methyl)-1-

pyrroline, for an internal standard following a straightforward synthetic route (Fig. 1). AcPy in rice was extracted with hot ethanol containing the standard compound, and analyzed by GC-MS-SIM. This improved method can enhance the sensitivity for quantification of AcPy in aromatic rice samples using small quantities (0.5 g) with a high specificity, linearity and reproducibility.

Market samples, including KDML 105 (known as "Jasmine") were analyzed to demonstrate the applicability of this method. In milled rice of Khao Dawk Mali 105, the concentration of AcPy was 286 ± 4.2 ppb (Fig. 2). Concentration of AcPy in brown rice, rice bran, husk and seedlings samples was relatively higher than in milled rice.

We hope that the quantitative analysis method for AcPy we have developed will facilitate the studies on the elucidation of the AcPy formation pathway, and will eventually lead to the identification of the factors controlling the flavor of aromatic rice.

Tadashi Yoshihashi
Food Science & Technology Division, JIRCAS

Evaluation of Rainfall Station Network in Tropical Monsoon Area

When a field plot receives rainfall during the irrigation season, rainfall becomes effective for crop production if the water requirement can be properly estimated and water storage in reservoirs can be properly managed. For this purpose, it is necessary to monitor the average amount of rainfall over an irrigation system using a rainfall station network. The spatial variability of precipitation and accuracy of rainfall observation for water management should determine the rainfall station density. This study aims at proposing a method to evaluate the rainfall station density.

The study was carried out in the Muda Irrigation Scheme that is located in the northwestern part of peninsular Malaysia. It covers an area of 126,000 ha, of which 96,000 ha consist of rice fields.

First, spatial variability of rainfall should be investigated. It is expected that in a large area the depth of rainfall tends to decrease. Depth Area (DA) analysis deals with the relationship between the rainfall amount and area. The Depth Area relationship can be described by many empirical equations. In this study the simplified Horton method was used.

$$P_l = P_0 \exp(-k \bullet l)$$

P_0 : Maximum rainfall in one rainfall area
P_l : Rainfall at the point l km apart from a rainfall center
k : Coefficient (km^{-1})
l : Distance (km)

Values of coefficient k were obtained using 385 one-day rainfall events in a part of the target area with 10 rainfall stations. The location of the center for each rainfall event should be estimated at the same time. The coefficient of correlation between observed and estimated rainfall for each rainfall event was calculated. The average value of the correlation coefficients was 0.78. Although the equation is very simple, it describes the spatial variability of rainfall well because rainfall caused by convective lifting predominates in the tropical monsoon area. Application of the equation to rainfall caused by frontal lifting or orographic lifting remains to be tested.

Values of coefficient k for 95% of the rainfall events ranged from 0 to 0.6, while in 5% of the rainfall events extreme values of coefficient k exceeding 2.0 were recorded. DA analysis results showed that the average amount of rainfall decreased rapidly when the area increased.

Rainfall station with VHF radio

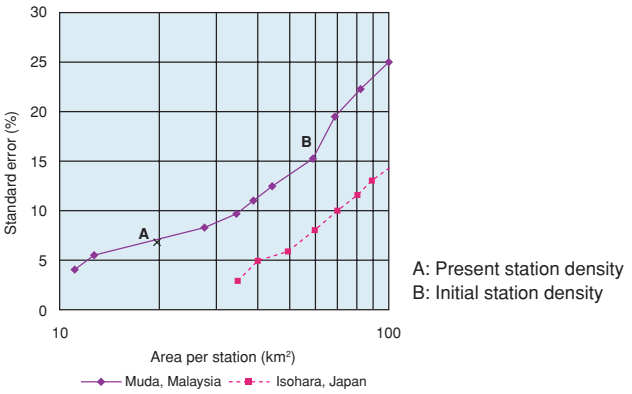

Fig. 1. Standard error of rainfall events as a function of station density.

Next, rainfall events with specified coefficient k over an area in which rainfall stations were evenly scattered were simulated. Accuracy of observation for simulated rainfall events under the given station density was calculated. Relationship between the accuracy of observed rainfall and rainfall station density was obtained for the coefficient k of rainfall after appropriate simulations.

Finally, the rainfall station network was evaluated by combining the distribution of the coefficient k with the results of simulations. Standard error of rainfall events as a function of the station density in the Muda Irrigation Scheme is shown in Fig. 1. The evaluation of the rainfall station network implemented in Isohara by the Meteorological Agency of Japan is shown in the same Figure. It was considered that the rainfall station density in the Muda area should be higher because of the larger spatial variability of rainfall.

Rainfall data acquisition system began with 20 stations and has expanded to 61 stations in the Muda area. The effect of this improvement and further investment was not apparent. The Figure shows that the expansion of the rainfall station network improved the accuracy of rainfall observations. However, a large number of rainfall stations are necessary for further improvements.

Traditional evaluation methods require many rainfall stations. In this study attempts were made to combine the evaluation of the rainfall station network with Depth Area analysis to reduce the number of rainfall stations for evaluation. The evaluation method proposed could be applied to irrigation systems in the flat plains of the tropical monsoon area.

Naoki Horikawa
Crop Production & Environment Division, JIRCAS

JIRCAS Fellowship Program: Welcoming New Visiting Researchers

Nineteen Visiting Researchers are participating in the 2001-2002 JIRCAS Visiting Research Fellowship Program to carry out collaborative research at Tsukuba and Okinawa.

Tsukuba (1 year at JIRCAS HQ.)		
Ketut Wikantika	Bandung Institute of Technology, Indonesia	Diversification of vegetable type mapping in mountainous area using remote sensing and GIS data
Lam-Son Phan Tran	Nara Institute of Science and Technology, Japan (from Vietnam)	Functional analysis of drought-inducible genes for transcription factors containing a NAC DNA binding domain
Pang Xin	Chinese Academy of Sciences, China	Physiological mechanisms of nutrient acquisition by crops from low-fertility tropical soils
Rowena H. Oane	International Rice Research Institute, Philippines	Studies on the ecology and physiology of endophytic micro-organisms (nitrogen-fixing bacteria, chitinase-producing bacteria, etc.) in plants
Molay Kumar Roy	Ehime University, Japan (from Bangladesh)	Studies on the mechanism of apoptotic cell death induced by some dietary components in human cancer cell lines
Tsukuba (5 months at National Institute of Agrobiological Resources)		
Muhammad Ayub Khan	National Agricultural Research Center, Pakistan	Analysis of relationship between bruchid resistance and mungbean seed protein
Zong Xuxiao	Institute of Crop Germplasm Resources, China	Analysis of genetic diversity in the *Vigna angularis* complex and related species in East Asia
Nguyen Van Hau	National Institute of Animal Husbandry, Vietnam	Study on the methods for evaluation and characterization of Vietnamese pig genetic resources by using DNA markers
Enda Y. Ardales	University of the Philippines, Los Banos, Philippines	Characterization of the *aur Bs2* gene homolog in *Xanthomonas oryzae* pv. *oryzae*
Okinawa (1 year at JIRCAS Subtropical Station)		
Nur Ahamed Khondaker	Bangladesh Agricultural Research Council, Bangladesh	Maximizing water use efficiency by micro-irrigation at different irrigation depths and with different amounts of water
Wan Abdullah Wan Yusoff	Malaysia Agricultural Research and Development Institute, Malaysia	Evaluation of soil erosion and nutrient flux in Ishigaki Island
Tarlan Mamedov	Azerbaijan Academy of Sciences, Azerbaijan	Characterization of heat tolerance in transgenic tobacco (ER-sHSP)
Sabaruddin Zakaria	Syiah Kuala University, Indonesia	Pollen tube growth and accumulation of reserve substances under high temperature stress in snap bean
Mohamed Koronfel	Cairo University, Egypt	Genetic engineering of salt tolerance in rice plants
Arifin Noor Sugiharto	Brawijaya University, Indonesia	Development of transformation methods and suitable tissue culture procedures for generating a high survival rate of sugarcane regenerants
Yunxia Liu	Chinese Academy of Agricultural Sciences, China	Differential screening of anthocyanin transcriptional activator genes of sweet potato
Muchdar Soedarjo	Research Institute for Legume and Tuber Crops, Indonesia	Cloning of anthocyanin transcriptional activator genes from cDNA library of sweet potato
Jiang Ling	Huazhong Agriculture University, China	Development of genetic transformation technique in papaya plant
Bui Thi Ngan	Cotton Research Center, Vietnam	Evaluation and utilization of natural predator, *Antilochus coqueberti* against the cotton stainer

NEWSLETTER
JIRCAS
Japan International Research Center for Agricultural Sciences (JIRCAS)

March 2002-No.30
Editor : Yutaka MORI

1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, JAPAN
Phone. +81-298-38-6313 Fax. +81-298-38-6342
letter@ml.affrc.go.jp
http://www.jircas.affrc.go.jp/