Trip Report (8-13 April, 2002, IRRI, Philippines)

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Purpose of visit: The main purpose was to attend the water-wise rice production workshop at IRRI, Los Banos, Philippines. While doing so, a further objective was to develop/strengthen contacts and networking with rice and/or rice-wheat (RW) scientists in Asia and developed countries.

Objectives of the workshop: The workshop was jointly organised by IRRI (B Bouman and TP Tuong) and Plant Research International of Wageningen University and Research Centre (P Bindraban and H Hengsdijk). The workshop dealt with the problems caused by water shortage in rice production in Asia, and was represented by delegates from Water Workgroup of the Irrigated Rice Research Consortium, Water-less Rice Project, ACIAR project on Growing More Rice With Less water, Ground Cover Rice Production Systems, Rice-Wheat Consortium, System for Rice Intensification (SRI) Network, and the ACIAR Project on Permanent Beds for RW Systems (Timsina and Thompson). There were about 60 scientists from 11 countries, including about 10 from IRRI, with the largest numbers from China and Philippines.

The objectives of the workshop were to:

1. present and discuss state-of-the-art practices in the development, dissemination, and adoption of water-saving technologies in rice production at scale levels ranging from the field to the farm, irrigation system, and sub basin;
2. identify research gaps and opportunities (in management technologies at the field level, implications for varietal development, adaptation and adoption, and upscaling issues); and
3. plan and refine workshops of the various projects and consortia and identify opportunities for developing new proposals.

Major highlights of the workshop: The workshop, formally opened at 8:30 am on 8 April by R Wang (DDG, Research, IRRI), was organised around several thematic issues ranging from field-level technologies to up-scaling issues.

On Day 1 (8 April), papers focused on resource-use efficiency and aerobic rice in China, Indonesia, and Philippines. The paper by Weixing Cao et al. (Physiological characterisation of water-deficit tolerance and water-saving management of rice) dealt with the preliminary results from 3 experiments. One experiment compared conventional shallow-water system, SRI, plastic membrane coverage, and intermittent irrigation system, each with 2 N rates (150 and 300 kg N/ha). Both yield and water-use efficiency (WUE) were highest for SRI. The other 2 experiments dealt with response of japonica rice to short-term water deficits and a greenhouse experiment on rice response to various soil moisture contents. The paper by Qinghua Shi et al. (Effects of different water management practices on rice growth) also has 3 experiments. Experiment 1 deals with comparing response of several rice varieties (indica and hybrid) to various water-management treatments (continuous flooding

with 5 cm, intermittent irrigation, and drought). The intermittent irrigation treatment resulted in highest yield and highest WUE, while the lowest WUE was found with flooding. The other 2 experiments dealt with root growth under different watertable regimes, and field demonstration of water-saving techniques/technologies (WST) in Nanchang and Taihe agricultural experiment stations. P Belder (Paper: Water and the nitrogen economy of alternately submerged/nonsubmerged irrigated lowland rice) reported the results of field experiments in China (Hubei) and the Philippines (Nueva Ecija), with 2 water regimes (continuously submerged, CS, and alternately submerged/nonsubmerged regime, ASNS, or midseason drainage) and 2 N rates (0 and 180 kg N/ha). The ASNS did not reduce yield in China and even increased the grain yield by 7% in the Philippines, with 13-16% irrigation water savings across the 2 countries. Uptake and recovery of fertilizer-N was, however, smaller in ASNS than in CS regimes, suggesting that more N was lost in ASNS due to denitrification and leaching. Gani et al.'s paper (Results of water-saving experiments in Fe-toxic soil in Riau Province, Sumatra, Indonesia) reported results from several field experiments on a recently reclaimed lowland rice area in Riau province with acid soils (pH 4.1) and high Fe content (Fe 165 ppm). Water (flooded, intermittent, etc.), nutrient (fertilizer, lime, and manure, etc.), and seedling age treatments were studied. The conclusion was that intermittent irrigation and the use of younger seedlings saved water and produced more yield in Fe-toxic rice soils.

Wang Huaqi and Yang Xiaoguang presented papers on aerobic rice in north China. Wang et al.'s paper (Aerobic rice in north China) discussed the importance of aerobic rice in China and presented results from two pilot sites of on-farm participatory research in Anhui Province and Beijing. Yang et al.'s paper (Crop-water relations in aerobic rice in north China) consisted of 2 experiments, one with response of rice varieties (aerobic and lowland rice) to 5 irrigation regimes and, another with response of same varieties to 2 water regimes (puddled and continuously flooded). Though yields of aerobic rices were slightly smaller than the traditional lowland check variety, WUE was much greater for the aerobic than for the flooded rice. Lu et al.'s paper compared the effects of irrigation regimes (CS, alternating wetting and drying or AWD, flush irrigation, saturated culture on raised beds or RB, and rainfed, RF) on yields, water balance and water productivity of aerobic and conventional rice varieties on a clayey soil in Tuanlin, Hubei Province in Yangtse River Basin and on a sandy loam soils in Kaifeng, Henan Province in Yellow River Basin. At both sites, there was no water and variety interaction on rice yield and productivity. CS treatment had the highest water input, followed by AWD, RB, FI, and RF, while CS and AWD had greater yields than the other water treatments. Thus CS had smallest water productivity, while FI and RF had the greatest water productivity. Nieuwenhuis presented results from pot experiments in greenhouses at IRRI in wet and dry seasons of 2001. Treatments consisted of various combinations of flooded and aerobic soil in the vegetative, reproductive, and grain-filling phases of a high-yielding upland rice cultivar "Apo".

Lin Shan presented a paper (The ground cover rice production system (GCRPS): a successful new approach to save water and increase N fertilizer efficiency) consisting of data from 3 field experiments at 3 locations (Beijing, Nanjing, and Guangzhou) in China. The experiments included GCRPS with different covers (plastic film mulch, straw mulch) and conventional paddy rice (no cover) as a control. Water and N balances and greenhouse gas emissions (N_2O, CH_4, and CO_2) were also determined.

Results showed that GCRPS (with no standing water) reduced water use by up to 60% compared with paddy rice, depending on soil conditions. Yields in GCRPS were reduced by 9-30% in Beijing and Nanjing. K Dittert also presented a paper (Saving water with ground cover rice production systems at the cost of increased greenhouse gas emissions?) based on the same locations. In Beijing and Nanjing, CH_4 emissions from GCRPS were negligible, and soil water contents of 70-90% of water-holding capacity in GCRPS seems to be suitable to reduce CH_4 emissions to a great extent. N_2O emissions, on the other hand, were increased slightly in Beijing, but greatly in Nanjing and Guangzhou, with plastic film and straw mulch. Along this geographical gradient, the general flux rates of CH_4 and N_2O was up to 50-fold higher in south China. Preliminary results suggest that, in Beijing and Nanjing, GCRPS seems to be almost neutral in its effect on global warming, while in Guanzhou, the increased CH_4 and N_2O suggest an increase in the effect of lowland rice production on climate change.

In the evening of Day 1, discussions were held on the formation of a platform of projects/consortia for water saving techniques in rice and rice-based systems. It was decided that any project/network/consortium working in at least 2 countries, involving at least one Asian country, could become the member of the platform. The platform was formally approved on the last day of the workshop, and our ACIAR project (CSIRO/PAU/NSW Agriculture/RWC) is now a founding member of the platform.

On Day 2 (9 April), papers focused on water savings in rice-wheat (RW) systems, and water use and water savings in rice in the Philippines. PK Sharma under the ADB RW project from Meerut, India, presented preliminary findings on "Crop-water relations in rice under different tillage systems and water management practices in a nonsaline sodic soil" based on the first year data from RW experiment on a silty loam soil (pH 8.1) at Meerut. AK Singh presented a paper "The effect of rice establishment techniques and water management on crop-water relations" based on experiment on a sandy loam soil at the Indian Agricultural Research Institute (IARI) Farm in New Delhi. Both of these papers compared responses of rice cultivars on raised beds and on flats to various water regimes (irrigation applied when soil moisture potential reached –10 kPa and –20 kPa at 15-cm depth at Meerut and when it reached –20 kPa and –40 kPa at IARI, DSR irrigated when soil moisture potential reached –10 kPa, and continuously flooded). At Meerut, grain yield was greatest in TPR (10 t/ha), followed by (DSR 6 t/ha), and was smallest in raised beds (4.9 t/ha), while the water productivity was greatest in DSR (0.31 g grain per kg water), followed by TPR (0.24 g/kg) and raised beds (0.22 g/kg). At IARI also, grain yields were greatest for TPR and smallest for DSR on raised and flat beds, with greatest water productivity for DSR (0.75 g/kg) and smallest for DSR on flats (0.65 g/kg). Both these experiments showed inferior performance of rice on raised beds over the conventionally-grown TPR, and was mainly attributed to selection of less favourable soils for rice as well as due to some unavoidable management practices. RK Naresh, on contrary, presented encouraging results from several farmer-participatory on-farm trials involving rice and non-rice crops at Ghaziabad, India, where he showed great success of growing rice on raised beds, particularly growing TPR on beds. RK Gupta presented a paper on "Adopting conservation agriculture in rice-wheat systems of the IGP: new opportunities for saving water", where he discussed the relative potential of improved technologies across the IGP by thematic issue.

PF Moya presented a paper "The conjunctive use of surface water and groundwater in a diversion irrigation systems in Central Luzon, Philippines: an economic assessment" in which she reported socio-economic and farm-level water management data from the farmers using both surface and groundwater under Upper Pampanga River Irrigation System (UPRIIS) in Nueva Ecija, Philippines. RV Cuyno presented a paper "Technology transfer or transformation process? Initial insights from the Technology Transfer for Water Savings (TTWS), Project in Central Luzon, Philippines" based on the findings from the TTWS Project. The pilot project began in 2001 to transfer and promote WSTs among farmers, and it seems that the process is now 'transformation' rather than 'transfer' because of the joint venture among various partners (farmers, Philippine Rice Research Institute, National Irrigation Administration, National Irrigators Cooperative, a local Deep Well Irrigators' Association, and IRRI) of the project.

In the afternoon, there was video demonstration on the impact of WSTs in a pilot area in Central Luzon, Philippines, followed by a field tour to IRRI Farm on aerobic rice and SRI, and a demonstration on laser-levelling at IRRI Farm.

On Day 3 (10 April), papers focussed on SRI, varietal development for aerobic rice, and up-scaling and cross-scale issues. There were 5 papers on SRI. N. Uphoff described in general the concept and principles of SRI and requirements for success of it. SRI generally consists of five components: (1) the use of young seedlings at the 2-leaf stage (8-15 d), (2) wide spacing (25*25 cm to 50*50 cm), (3) a minimum of 3 weedings starting from the early stage, (4) intermittent drainage and drying during the vegetative stage, and (5) addition of organic matter, i.e manure and compost. PR Randriamiharisoa presented agronomic results of SRI from Madagascar, while CM Moser explained the reasons for low farmer adoption and high "disadoption" (abandonment) using both participatory research methods and household surveys, also in Madagascar. AK Makarim and V Balasubramaniam presented the SRI efforts in Indonesia. Makarim presented findings on the interaction between seedling age and number of seedlings per hill, plant spacing, rates and types of organic matter addition, and intermittent irrigation. TM Thiyagrajan compared the selected components of SRI with conventional practices for TPR at Tamil Nadu Agricultural University, Coimbatore, India. He reported that there was a water saving of 56% with the SRI with no loss in grain yield as compared to TPR.

GN Atlin and HR Lafitte from IRRI presented papers on the progress on the varietal requirements for water saving irrigation systems and physiological and molecular considerations for aerobic rice.

J Thompson presented a paper on water management practices and issues for rice in southern NSW. S Khan presented a case on upscaling WUE in groundwater dominant irrigation systems at Rechna Doab in Pakistan. Van der Krogt presented on options for water savings and reallocation at the regional scale. R Loeve from IWMI presented a paper "Field-level water savings in the Zhange Irrigation (Hubei Province, China) System (ZIS) and their Effect on System Level". The paper explores water savings and water productivity on different scales to see if and how farm-level practices scale up to system-level water savings in the ZIS. Lastly, Hafeez presented a case on estimation of ET through remote sensing in the UPRIIS, Central Luzon, Philippines. The study reported a close relationship between the ET values derived

from remote-sensing data using the Surface Energy Balance Algorithm for Land (SEBAL) and the values calculated from the weather data, and concluded that Landsat ETM+ data can be used to compute actual ET rates at different scales for lowland rice in the tropics.

Day 4 (11 April) was mainly devoted to summary session on gaps and opportunities under each theme (field-level technologies, varietal development, impact and adoption, and up-scaling issues), breaking up in project groups for planning, and final presentation of work plan. The platform for water-saving techniques in rice was formally announced and approved. The workshop was formally closed at 4:30 pm by James Hill, the then Head, Crop, Soil, and Water Sciences Division, IRRI, and currently Professor of Agronomy, University of California at Davis.

On the same day (11 april) I visited the GIS and Statistics Labs and Genetic Resources and Evaluation Unit of IRRI together with J Thompson.

On Day 5 (12 April), I arranged appointments with various scientists from IRRI (R Buresh, JK Ladha, S Pandey, TW Mew, L Wade), academicians from the Agronomy Department of the University of the Philippines at Los Banos - UPLB (RP Robles, TC Mendoza, AL Carpena), and discussed the thesis proposals of three Nepalese post-graduate students studying at the UPLB. One student (SK Sah) is interested to study the plant and soil water relations of post-rice crops (maize and mungbean) in rice-based cropping systems in Philippines for his Ph.D. work; the other (B Bhattachan) is interested to evaluate SRI on upland rice in Philippines for M.S. work, while the third (DP Ghimire) will be working on Water Users' Participation in Operation and Maintenance of Selected Irrigation Systems in the East Rapti River Basin of Nepal for his Ph.D. work. Also briefly met D Dawe and C. Witt of IRRI.

Implications/conclusions of visit: The visit provided an opportunity to keep abreast with the emerging issues related to water scarcity in world and new water-saving techniques/technologies being used in Asia. More importantly, it provided an opportunity to catch up and further develop contacts/ne tworking with scientists from IRRI, CIMMYT/RWC (Raj Gupta), IWMI (R Barker and D Molden), NARS, and developed countries (H van Kuelen and JHJ Spiertz from Wageningen University and N Uphoff from Cornell University). All this will eventually contribute significantly to the new ACIAR project with Punjab Agricultural University in India as well as to the Cooperative Research Centre for Rice and rice industry in Australia.

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