TECHNICAL ASSISTANCE COMPLETION REPORT

Division: RSAN

TA No. and Name TA 5812-REG: Third Agriculture and Natural Resources Research at CGIAR Centers: Asian Rice Biotechnology Network: Achieving Impact and Sustainability		**Amount Approved:** $1,000,000.00 **Revised Amount:** N/A	
Executing Agency: International Rice Research Institute	**Source of Funding:** TASF	**TA Amount Undisbursed** $0	**TA Amount Utilized** $1,000,000.00

Date			Completion Date	
Approval	**Signing**	**Fielding of Consultants**	**Original**	**Actual**
22 Oct 1998	26 Dec 1998	01 Jan 1999	31 Dec 2001	31 Dec 2002
			Closing Date	
			Original	**Actual**
			31 Dec 2001	(closing of TA account being arranged)

Description

Biotechnology encompasses a variety of tools useful for increasing crop productivity. The availability of rice genome sequences has led to the development of novel tools for rice improvement. Known DNA sequences coding for putative function can now be used as molecular markers in varietal development. Breeding and selection methods can be integrated in the national agricultural research and extension systems (NARES) to identify beneficial traits in germplasm and to transfer them into elite commercial lines. Through local breeding efforts, varieties with multiple stress resistance can be produced that are directly useful to farmers. Recognizing that investment in breeding modern crop varieties offers a high rate of return, the Asian Development Bank (ADB) funded the Asian Rice Biotechnology Network (ARBN) since 1993. The ARBN aims to build and support the capacity of NARES to use molecular tools to accelerate development of improved cultivars. Two technical assistance projects were completed in 1997: Phase 1 (RETA No. 5510: Establishment of the Asian Rice Biotechnology Network) and Phase 2 (RETA No. 5667, Asian Rice Biotechnology Network—from Products to Impact). The first phase of the ARBN program focused on building infrastructure at three NARES institutes in India, Indonesia, and the Philippines. The second phase focused on research solving disease and insect problems and the membership was expanded from the original three to seven NARES teams in six of ADB's developing member countries (DMCs): the People's Republic of China (PRC), India, Indonesia, the Philippines, Thailand, and Viet Nam. To sustain the significant research results of the first two phases, ADB continued its support for a third phase of ARBN (RETA No. 5812: Asian Rice Biotechnology Network: Achieving Impact and Sustainability). Started in January 1999, ARBN Phase 3 focused on biotechnology research and variety development in 10 NARES institutions in the six countries to intensify the application of biotechnology tools. The emphasis was on producing locally adapted high-yielding rice varieties with durable resistance against diseases and insects and making them available to farmers.

Objectives and Scope

The overall objective of ARBN is to advance biotechnology research and variety development in 10 participating NARES institutions in Asia. Under the ARBN Phase 3, the RETA focused on developing locally adapted high-yielding cultivars with durable resistance to diseases and insects. Special emphasis has been on the evaluation and delivery of marker-aided selection (MAS) products to farmers. The scope consisted of: (i) developing varieties resistant to major diseases (blast, bacterial blight, tungro), and insect problems (gall midge); (ii) developing strategies for deployment of resistant varieties region-wide to conserve the effectiveness of germplasm; (iii) developing simple markers for NARES laboratories to practice selection; (iv) deployment of new methods for identifying useful traits for transfer to elite lines; (v) conducting workshops on (a) proposal development and seeking funding to sustain ARBN future activities and (b) dissemination of scientific advances in biotechnology to NARES scientists; and (vi) providing training of NARES scientists through shuttle research and on-site technical backstopping to streamline NARES laboratory operations

Evaluation of Inputs

The TA was adequately formulated with comprehensive TOR and relevant input outlined. The Executing Agency (EA), IRRI, established a Memorandum of Agreement with each of the 10 participating NARES institutions to develop workplan with delineated responsibilities. The operation of ARBN was guided by a Steering Committee consisting of senior NARES leaders, representatives of donors with special interests in ARBN (Rockefeller Foundation, ADB). IRRI managed and upgraded the ARBN Training and Shuttle Research Laboratory (TSRL) to support shuttle research by NARES teams. The Network Coordinator provided strong leadership and guidance in all activities of the Network, from human resource development to development and release of improved varieties by NARES partners. Short-term consultants and IRRI scientists provided effective on-site technical backstopping and conducted workshops at IRRI and NARES institutions to discuss new methodologies and to examine specific problems of individual ARBN teams. Field visits were made to observe the performance of improved varieties. Workshops were conducted efficiently to disseminate IRRI's new advances in technologies relevant to all ARBN teams. To build sustainable support to the Network, IRRI assisted NARES teams in preparing proposals for funding from national and international programs, resulting in 15 grants (totaling >$500,000.00) as matching support for TA activities. A special Training Workshop on Microarray and Bioinformatics was jointly organized by ARBN and McKnight Foundation's Collaborative Crop Research Program (providing a matching grant of $30,000 to support the training activities). This event represented the culmination of ARBN training activities and provided an excellent opportunity to discuss the mechanisms of bringing new tools in genomics to the Network. Quarterly and semi-annual progress reports concerning accomplishments were submitted to ADB covering the period January 1999-September 2002. ADB, through its representative on the Steering Committee, provided useful guidance on the implementation of the TA with an emphasis on building NARES capacity and delivering impact at the farm level. ADB also attended training and progress review workshops to directly engage with NARES participants. On average, ADB met with network coordinator at least two times a year to assess progress. The degree of participation and coordination provided by EA and ADB is highly satisfactory. The teamwork demonstrated by NARES and the EA is considered exemplary that contributed to the effective implementation of the TA. The approach of using the Network to leverage funds and support from national and international funding agencies has proved to be successful.

Evaluation of Outputs

ARBN collaboration has enhanced the capacity of NARES to apply biotechnology products and marker-aided breeding. Through local breeding efforts, pest-resistant germplasm and varieties have been produced that are directly useful to farmers. Furthermore, the network has promoted collaboration among institutions within and between countries. Improved genetic materials developed by each research team are shared to maximize the return from the research effort.

Varietal products: By 2002, 9 elite lines and 2 varieties with bacterial blight resistance were produced. These lines are used in PRC, India, Indonesia, and the Philippines. Over 32 elite lines were tested by ARBN teams in farmers' fields. Bacterial blight-resistant lines with grain quality comparable to that of existing popular varieties and a yield advantage of 20.6% (range from 11% to 31%) were disseminated to farmers. Additional elite lines (approximately 20) with resistance to blast, tungro, and gall midge are expected by 2006. Because the new varieties are value-added local popular varieties, wide acceptance by farmers is expected. The Minister of Agriculture of Indonesia recognized such an achievement during the National Rice Week in March 2002 by presenting a special award to the Indonesian ARBN team for being a pioneer in using molecular markers to develop superior rice varieties. This exemplifies NARES's recognition of the Network's contribution to national rice improvement programs.

Scientific outputs: Research results were disseminated through 10 journal publications and 11 meeting proceedings produced from ARBN activities. A large collection of molecular markers and genes (>1,000) has been established at ARBN and made available for use. Advances in genomics are disseminated via Internet; workshop information consolidated in IRRI's Knowledge Bank accessible through the Web.

Training and capacity building: A total of nine workshops and four on-site backstopping activities were effectively conducted to help NARES to acquire new tools and knowledge in biotechnology. Approximately 325 researchers received training or participated in ARBN-sponsored research and training workshops. All ARBN teams are fully operational in the use of molecular markers and are practicing some forms of marker-aided breeding strategy.

Sustainability: The TA has been a catalyst for a wide range of activities initiated by the NARES. ARBN teams initiated national network (e.g., in India) to support each other's activities. Eight of the 10 ARBN teams received grants from national governments or international donors to link research with ARBN. After completion of ARBN Phase 3, five ARBN teams initiated renewal of Memorandum of Agreement with IRRI to collaborate under the ARBN framework with own national support. Due to demand from NARES, an annual ARBN training course in genomic technologies is now in place with support from IRRI training program and matching funds for other donors. In sum, all performance targets of the TA were met, and in some cases, the outputs exceeded expectation (e.g., the number of people trained, the matching grant support generated). Because of the widespread nature of diseases and insects, the magnitude of impact provided by pest-resistant varieties will continue to multiply in the next five years through linkage with other projects (e.g. Hybrid Rice). The benefit of overcoming a single disease (bacterial blight) alone is estimated to be more than $20 million per cropping season in PRC, India, Indonesia, and the Philippines. Thus, the projected impact of varietal products with enhanced biotic resistance is significant.

Overall Assessment and Rating

The TA is considered successful in view of the achieved outputs that are relevant to ADB priorities across different regions in Asia. ARBN has contributed to NARES rice improvement programs in three key areas: (i) infrastructure development in rice-breeding institutions of six developing countries, (ii) human resource development through research training and workshops, and (iii) development and release of improved varieties. The successful development of new varietal products through ARBN demonstrates an effective model of applying strategic research and promoting NARES collaboration to solve local problems. Such a model of collaboration can be extended to solve other pressing problems in rice production. ARBN has become a regional network for resource sharing and training in rice biotechnology. In essence, ARBN has become a "brand" name among NARES that enables many NARES institutions to use ARBN collaboration to leverage national and international support to sustain their work and to mobilize resources for rice improvement.

Major Lessons Learned

- Although ARBN investment is small relative to the overall needs of NARES in biotechnology, the TA has played a much-needed catalytic role for many NARES to leverage national and international funding to support their work.
- Human resource development through research training and workshops has empowered researchers in rice breeding in Asia, providing spill-over benefits for solving other difficult problems.
- The level of success in the development and release of improved varieties differs among NARES. It depends on the commitment of NARES institutions as well as strong leadership of team leaders.
- Despite sufficient NARES capacity to integrate DNA technology into breeding programs, a limiting factor for continued success in breeding, especially for difficult traits, is the lack of access to new science.

Recommendations and Follow-Up Actions

As human resources and infrastructure are basically established at many NARES breeding institutions, future demand from NARES will be for knowledge-intensive technologies. The rapid advances in genomic technologies and recent completion of the rice genome sequence provide timely opportunities to engage the NARES in capitalizing on the new tools and knowledge of genomics. The NARES need broad access to more genes and technologies that will enable them to increase the efficiency of breeding and to solve intractable problems in rice production. Failure to support NARES to participate actively in gene discovery would impair their future capacity to freely choose and use technologies due to barriers in intellectual property rights for genetic materials and procedures that are important to achieving sustainable food security. Furthermore, solving the difficult and complex problems is often beyond the means of an individual institution, but requires the pooling of information and resources from all stakeholders. The challenges ahead are to expand NARES partnerships to discover and use genes essential for adaptation on unfavorable land and to provide NARES researchers with the skills to use new tools and products derived from genomics research. The ARBN has provided a collaborative framework that will play an even larger role in achieving this goal in the genomics era. Continued support to a "consortium" and collective approach to access and leverage new tools from advances in science will have large dividends at the regional level.

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