

WARDA
The Africa Rice Center



Annual Report 2002–2003



About WARDA – The Africa Rice Center

WARDA – The Africa Rice Center is an autonomous intergovernmental agricultural research association of African member states and one of the 16 international agricultural research centers supported by the Consultative Group on International Agricultural Research (CGIAR).

It's mission is “to contribute to poverty alleviation and food security in Africa, through research, development and partnership activities aimed at increasing the productivity and profitability of the rice sector in ways that ensure the sustainability of the farming environment.”

The *modus operandi* of WARDA is partnership at all levels. WARDA's research and development activities are conducted in collaboration with various stakeholders—primarily the national agricultural research systems (NARS), academic institutions, advanced research institutions, farmers' organizations, non-governmental organizations (NGOs) and donors—for the benefit of African farmers, mostly small-scale producers, as well as the millions of African families for whom rice means food.

The development of the 'New Rice(s) for Africa,' or NERICA(s), for which WARDA was conferred the CGIAR King Baudouin Award, is bringing hope to millions of poor people in Africa. This scientific breakthrough of crossing African with Asian rice species has helped to shape the Center's future direction, extending its horizon beyond West and Central Africa into Eastern and Southern Africa. The creation of NERICA rice and its expected contribution to food security and income generation in Sub-Saharan Africa are in harmony with the spirit and sustainable-development aspirations of the World Summit on Sustainable Development (WSSD), the Tokyo International Conference on Africa's Development (TICAD), the Millennium Development Goals (MDGs), and the New Partnership for Africa's Development (NEPAD).

WARDA hosts four networks and consortia—the African Rice Initiative (ARI), the Inland Valley Consortium (IVC), the International Network for Genetic Evaluation of Rice in Africa (INGER-Africa), and the West and Central Africa Rice Research and Development Network (ROCARIZ)—all charged with ensuring the widespread and rapid dissemination, adoption and diffusion of new rice cultivars across the various rice ecologies found in Africa.

WARDA has its headquarters in Côte d'Ivoire and three regional research stations—one covering the Sahel and located near St-Louis, Senegal, one at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, and one at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) research station at Samanko near Bamako, Mali.

For more information, please visit www.warda.org

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Annual Report

2002–2003



WARDA – The Africa Rice Center
ADRAO – Le Centre du riz pour l'Afrique

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Message from the Director General and the Chairman of the Board of Trustees

WARDA IS growing! While that may not be strictly true in terms of staff complement, it is certainly true from the viewpoint of WARDA's influence across the continent of Africa. Originally conceived as the West Africa Rice Development Association and being made up of 11 member states, within a few years of its creation WARDA spread to encompass 17 member states, including two Central African States (Cameroon and Chad), and its technologies have since spread even further abroad into Eastern and Southern Africa. In recognition of WARDA's continental impact, the Center is now known as 'The Africa Rice Center' (since January 2003). The new name was ratified by WARDA's Council of Ministers at its September 2003 meeting. The story behind the new appellation and expanding influence of WARDA technologies in the region is presented in this year's first feature (*see* page 7).

The latter part of 2002 will forever be etched on the memories of everyone who was living in or visiting Côte d'Ivoire at that fateful time. WARDA's own story of the unfolding events and their impact on life and work in our host country are given in our second feature, 'Crisis in Côte d'Ivoire: WARDA "under fire"' (*see* page 13). WARDA's partnership *modus operandi* was the key to our survival and the continuation of WARDA-led rice research and development in the region. We want to take this opportunity to praise the efforts of those staff who remained in, or returned to, the country and helped in the relocation of the main body of researchers to Bamako, Mali. While Management will continue to be headquartered in Abidjan with frequent visits to Bouaké and M'Bé, we look forward to a full crop season and maintaining the continuity of our research activities from the safety of the Samanko research station of fellow CGIAR Center ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) in our member state of Mali. In reality, we have turned the adversity of the Ivorian situation into an opportunity for increased collaboration with our partners in Mali and elsewhere.

Meanwhile, activities led by staff in our Nigeria and Sahel Stations went on unabated. One particular highlight has been the on-going work to develop a rice-sector strategy for Nigeria, which has drawn on expertise from both the Main Research Center and the Sahel Station. This is perhaps the first opportunity that WARDA has had to get involved in discussions ranging from grass-roots level to the top echelons of government on the issue of policies affecting rice. This wide-ranging work seeks to present proposals to the Nigerian Federal Government promoting policies that will increase the competitiveness of domestic rice, hopefully without recourse to large injections of public money into the production and marketing sectors. (*See* Box 'Rice sector strategy for Nigeria,' page 18, for details.)

With the Ivorian situation affecting departures and recruitment, there was a lower intake of staff during this period than in recent years. However, it is our pleasure to welcome the following, who joined the WARDA family during the reporting period: Mamery Camara (Agronomist, Visiting Scientist), Paul Kiepe (Inland Valley

Consortium Research Coordinator and Natural-Resource Management Scientist), Savitri Mohapatra (Assistant to the DG and Public-Awareness Assistant), May-Guri Sæthre (Entomologist) and James Sumberg (Rice Policy and Development Program Leader).

In 2001, our technology transfer team started a program of farmer participatory learning and action research for communities in two inland valleys in Côte d'Ivoire. The program proved a success, with farmers learning to identify problems on their farms and devising their own solutions. In fact, several participating farmers went on to become trainers in their own right. The story is taken up in our third feature (page 23). Meanwhile, other participatory techniques were proving equally successful in Benin and Nigeria. The 'Participatory Technology Development' project's first phase drew to a close in 2003 and we report some of its highlights (page 30).

Impact assessment featured high among the recommendations of the External Program and Management Review of WARDA in 2000. Subsequently, WARDA recruited an Impact Assessment Economist, who has been working on the thorny issue of enumerating the impact of the NERICA varieties (page 33).

Much of the impact-assessment ground-work reported in the previous feature was conducted as part of a project on biodiversity of rice supported by the UK Department for International Development. The biodiversity aspects of the project are reported in the next feature (page 42).

This year's *Donor Country Profile* focuses on France—a nation with a big stake in the West and Central Africa region, both historically and in terms of on-going collaboration. The feature looks at WARDA and France, from seconded specialists to training, and from participation in the Board of Trustees to informal collaboration in Mauritania and Senegal (page 46).

As we go to press, two exciting events were unfolding. The Ivorian crisis was on the path of a negotiated peace settlement. Both sides in the conflict had declared cessation of hostilities, we had made several trips to our campus, confirming that facilities were still intact and had deployed a 'maintenance team' to begin the process of 'gradual return.' NERICA (New Rice for Africa)—now the flagship of the CGIAR—was on the move and spreading across Africa. Negotiations, on behalf of our national partners, with the African Development Bank for an initial five-year dissemination project were close to completion and several donors and institutions were committing support. These developments and others will constitute major features in our next report.

Finally, the WARDA Board, Management and Staff are grateful to our donors and partners for their strong support and encouragement during the difficult months of the Ivorian crisis. WARDA looks forward to continuing its dedicated service to the millions of Africa's population for whom rice is life.



Kanayo F. Nwanze
Director General



Richard Musangi
Chairman, Board of Trustees

Out of Adversity

The 2002–2003 period was marked by a military upset that shook the host country of Côte d'Ivoire in September 2002, which forced WARDA out of its headquarters in M'Bé and brought a new range of challenges to the program of research of the institution. The crisis resulted in the departure of several staff starting with the Director of Research, creating a void in the leadership of the Programs Division; the Policy Economist and our two JIRCAS staff, an economist and a breeder. Despite these events, WARDA has succeeded in maintaining the momentum of its research programs. Trials installed at M'Bé and Gagnoa in Côte d'Ivoire before the crisis were almost all completed and harvested by the few WARDA staff who continued to work in the field and take care of the experiments during the crisis. Thanks to the efforts of these brave staff, the 2002 experiments in Côte d'Ivoire were not all lost as might have been expected. Data were collected and exploited. Likewise, seed multiplication for the Genetic Resource Unit continued at M'Bé during the same period to ensure that enough good-quality seeds are available for the next season. Activities at WARDA's stations in Senegal and Nigeria were essentially unaffected by the crisis and, with the temporary relocation of the majority of research staff to Bamako, Mali, enabling most research activities to be conducted according to plan, the Programs Division was again positioned to vigorously pursue its important and exciting research agenda. In addition to Samanko station for upland experiments, scientists are also using research plots at the *Institut d'économie rurale* (IER) sub-stations of Baguenida, Sélingué and Kléla for lowland rice experiments. The quality of experiments conducted in Bamako testifies to the commitment of the research and farm-operations staff. Diagnostic studies at Samanko, Baguenida and Kléla will provide valuable information on the soil-fertility status of research sites in Mali and will enable scientists to fine-tune their field experiments in the future.

Agronomic trials continued at various sites in Mali, Nigeria and Côte d'Ivoire. New NERICA lines, as well as new iron-toxicity-tolerant lines, have been identified. A large number of fixed and segregating lines for upland and rainfed lowlands were multiplied to provide seeds for future participatory varietal selection (PVS) activities. In the meantime, PVS activities continued in Ghana, Mali and Nigeria. Studies on biological control of, and host-plant resistance to African rice gall midge (AfRGM) continued in Nigeria and significant results are in the pipeline.

For irrigated systems, research efforts were targeted at improving the performance of the rice sector through the development and adaptation of improved technologies to a range of irrigated rice-based production systems, and the development of appropriate land and water management options to prevent and control soil degradation. Components and options for rice integrated crop management were evaluated in different agro-ecologies under various levels of water control with large numbers of farmers in Burkina Faso, The Gambia, Mali, Mauritania and Senegal. Activities in 2002–2003 were developed and implemented in collaboration with national research

and development partners in the various countries. The search for more productive and profitable germplasm for irrigated ecosystems continues and very promising new genetic materials—both intraspecific and interspecific—have been identified.

Collaborative work on the assessment of the environmental impacts of the World Trade Organization (WTO) agreement on rice production systems in Côte d'Ivoire continued, as well as work in Guinea to assess the various impacts of the NERICA varieties. Baseline surveys at household and plot levels will allow an assessment of the impact of rice technologies introduced in the past; and will serve as a benchmark against which the impact of rice technologies introduced in the future can be measured. Follow-up surveys are to be conducted on a regular basis. The ultimate aim is the development of a system that generates regularly updated information on selected behavioral, welfare and environmental outcomes at the household, community, national and regional levels.

Studies of adoption of modern rice varieties in Côte d'Ivoire showed relatively low uptake of varieties released by the NARS and WARDA. Lack of knowledge about these varieties was found to be the major constraint in their adoption (*see* 'Assessing the Impact of NERICA rice varieties: Not Just Surveys and Simple Mathematics,' pages 33–41). The implication is that greater effort should be put into making modern varieties known to farmers.

Several training workshops and meetings were organized in the region. As part of its strategy to revitalize the Nigerian rice sector, WARDA held a two-day technical workshop on the rice sector project, entitled 'The Nigerian rice economy in a competitive world: Constraints, opportunities and strategic choices.' The project was implemented by WARDA in collaboration with the Nigeria Institute for Social and Economic Research (NISER), and is funded by USAID. Various stakeholders in the Nigerian rice economy, including farmers' organizations, private-sector representatives, government and non-governmental organizations, and research and development agents attended the workshop. The participants of the workshop recognized the need to enhance the competitiveness of the Nigerian rice sector by improving the quality of local rice and the efficiency of operators at the production, processing and marketing levels within a comprehensive approach. With rice now high on the development and policy agendas in Nigeria, WARDA and its collaborators are particularly well placed to contribute to the policy dialog and strategy development (*see* Box 'Rice sector strategy for Nigeria,' pages 18–19).

The crisis in Côte d'Ivoire put WARDA's invaluable genebank collection in jeopardy, but appropriate actions were taken in time to safeguard all genebank accessions. These were packaged in two duplicate batches, with one sent to IITA for regeneration and storage. A small team of WARDA staff was deployed for this activity. Another batch is stored in deep freezers in Abidjan. Seed multiplication for regional germplasm exchange as part of our International Network for Genetic Evaluation of Rice in Africa (INGER-Africa) program was done at the Sahel Station in Senegal, and seeds are now ready for distribution next year. A new data management system, including the CGIAR-wide SINGER, is being put in place.

As a contribution to the rehabilitation of agricultural activities, 5 tonnes of foundation seeds were provided to development agencies operating in western Côte d'Ivoire as part of the 'Seeds for Life' project of WARDA for the restoration of rice production in the post-conflict era. The 'Seeds for Life' ceremony was organized under the aegis of the Ministry of Scientific Research, Government of Cote d'Ivoire in partnership with NARS (CNRA, ANADER and PNR).

The annual research planning meeting, called 'Research Days,' was held at Samanko from 28 April to 2 May 2003. Over four days, research staff participated in wide-ranging discussions covering strategic directions, research priorities, methods and collaborative models. These discussions were valuable for research planning and provided important input to the Strategic Plan.

The support provided through WARDA's networks for regional collaboration was a major factor in allowing the Association to maintain the broad scope of its research activity. WARDA scientists are again well positioned to make their contribution to poverty alleviation and food security in Africa through original research and innovative development approaches within the rice sector. Networking and regional collaboration remain indeed the bedrock of WARDA's research and, since the move to Bamako, important events demonstrate that these regional activities continue apace. The recruitment of the Coordinator of the African Rice Initiative (ARI) has kicked-off a number of activities that had not materialized during the interim period. Steering Committee meetings of ROCARIZ, Participatory Adaptation and Diffusion of Technologies in Rice-based Systems in West Africa (PADS), the Inland Valley Consortium (IVC) and ARI have all been held in Bamako.



The Africa Rice Center—Recognizing WARDA's Role in Sub-Saharan Africa

RECOGNIZING ITS increasing role and relevance throughout Sub-Saharan Africa, the West Africa Rice Development Association was renamed 'WARDA – The Africa Rice Center' in January 2003.

"Over the past six years or so, WARDA's influence has been spreading out from its traditional mandate region of West and Central Africa," explains WARDA Director General Kanayo F. Nwanze. Until the activities of the International Network for Genetic Evaluation of Rice in Africa (INGER-Africa) were transferred wholesale to WARDA Headquarters in 1997, WARDA's work had been highly focused on its Member States—17 countries in West and Central Africa who joined the Association at various times since its constitution in 1970. With the arrival of INGER-Africa, the flood-gates were open for WARDA's services to spread to other parts of the continent, and for partners and potential partners to discover the relevance of indigenous African technology for rice farming.

"INGER is still leading the way in advancing WARDA's geographical borders," enthuses INGER-Africa Coordinator Gouantoueu Guei, who was recently appointed Head of WARDA's new Genetic Resources Unit. "Anyone interested in testing rice varieties in the region [Sub-Saharan Africa] is entitled to contact us at INGER-Africa, and we will do our best to accommodate them," he continues. "To date, INGER-

Africa is collaborating with some 35 countries in Sub-Saharan Africa." Several of these countries are also members of ROCARIZ and others should be hosting activities under the African Rice Initiative (*see* Figure 1). "Given that there are only eight Sub-Saharan countries with which WARDA has no direct linkages, it seems fair to declare WARDA's geographical mandate truly Africa-wide," announces Nwanze.

All-inclusive West and Central Africa

As we approached the end of the second millennium, the horizons were also expanding for other WARDA activities.

After a recommendation from a major donor, WARDA and the West and Central African Council for Agricultural Research and Development (WECARD/CORAF) began discussions in 1998 that eventually led to the merger of the WARDA–NARS Task Forces and the CORAF Rice Network into a single rice research and development network for West and Central Africa, ROCARIZ. "As hosting and coordinating institution, WARDA inherited a relationship with the WECARD/CORAF-member countries at the creation of ROCARIZ in 1999,"

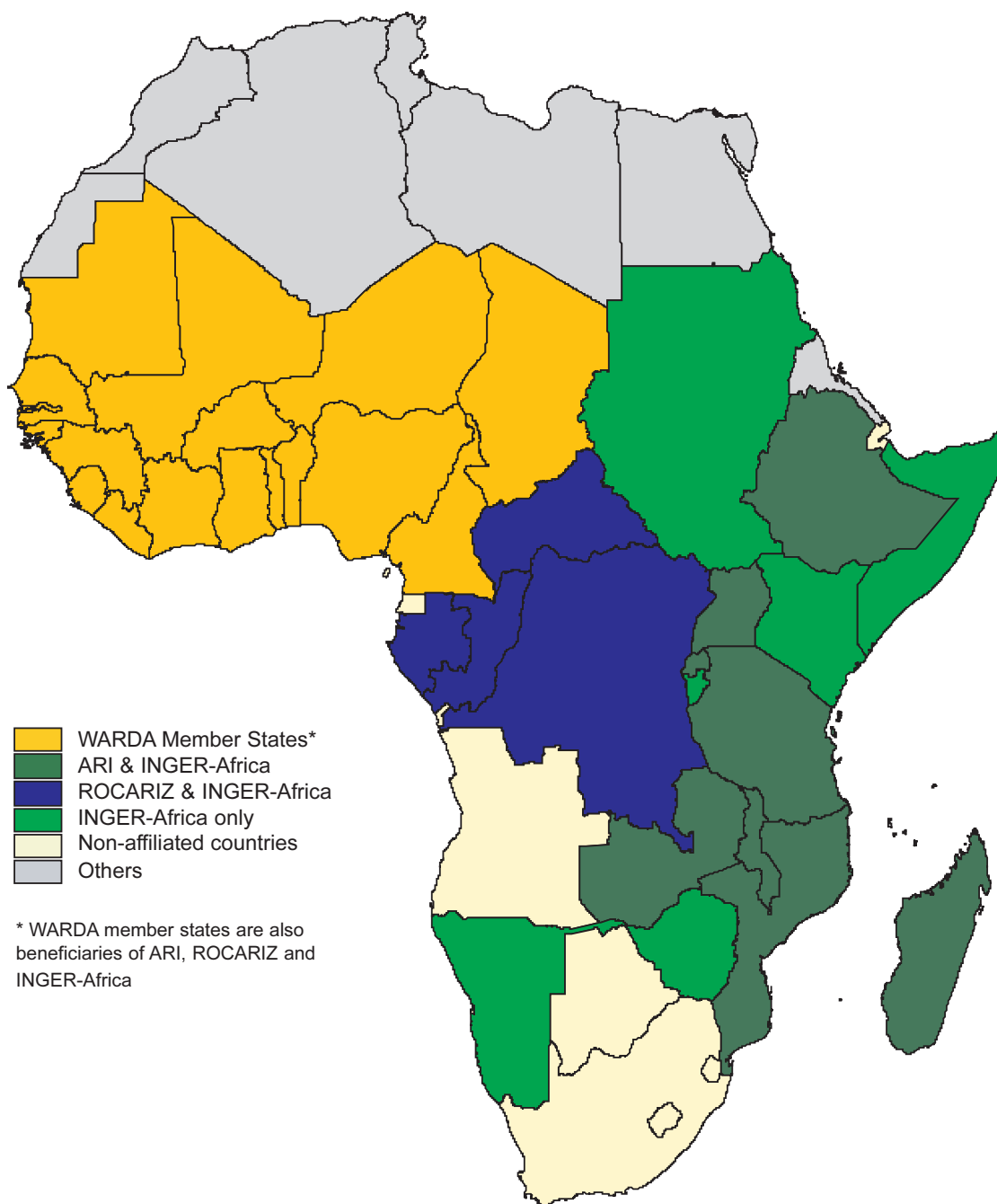


Figure 1. WARDA activities throughout Sub-Saharan Africa

explains ROCARIZ Coordinator Sidi Sanyang. WECARD/CORAF is what is known as a Sub-Regional Organization, of which there are three covering Sub-Saharan Africa. WECARD/CORAF has the mandate for West and Central Africa. “Consequently,” Sanyang continues, “Central African Republic, Congo (Brazzaville), the Democratic Republic of Congo and Gabon are now members of ROCARIZ and therefore WARDA partners. To be really precise, we should also say that Cap Verde is also a member, but there is no known rice cultivation there and so no involvement in the network. Technically, only Gabon is ‘active’ in ROCARIZ as a researcher from its national program (*Institut de recherches agronomiques et forestières*, IRAF) received small-grant funding for the first time in 2002.”

Expanding south and east

Rice farming has not been popular in Uganda: it is not a traditional crop, and introduction of paddy rice farming met with minimal success as a result of poor yields and very long maturity cycle (up to six months). However, interest in WARDA-promoted rice varieties began in Uganda in 1998, when Tilda Uganda Limited contacted INGER-Africa for material resistant to rice yellow mottle virus (RYMV), which had devastated rice trials in 1997. Subsequently, Tilda Uganda’s General Manager, Lakis Papastavrou visited WARDA and collected 25 kg of seed of each of five promising varieties (WITAs 7, 8, 9, 10 and 11). These, along with six upland varieties, were tested at Tilda Uganda’s Kibimba farm in 1998. WITA 9 was particularly promising, and was grown over 765 ha in 2002; however, that year it suffered bacterial leaf streak attack, and was subsequently restricted to 26 ha in 2003.

In 1999, former WARDA/IITA Research Assistant Robert Anyang joined Tilda Uganda and obtained 30 upland-rice entries from WARDA. Subsequently,

interest spread to Japan-headquartered Sasakawa Global 2000 and USAID-funded project Uganda’s Investment in Developing Export Agriculture (IDEA). IDEA focuses on non-traditional agricultural exports, and was particularly interested in upland rice as a potentially more profitable crop than the traditional maize, and as a replacement for the unsuccessful paddy rice. With additional seed from WARDA, these three organizations embarked on an ambitious program of extensive multi-location and on-farm trials. IDEA and Tilda Uganda worked together on training field workers and farmers, and establishing on-farm demonstration plots in three districts. The 260 demonstration plots (of 0.25 acres each [*ca.* 0.1 ha]) generated a lot of interest in the eastern districts of Uganda, and IDEA encouraged the demonstration-farmers to sell some of their paddy to other interested farmers to use as seed, while retaining some to plant their own extended areas. For the second rainy season, IDEA expanded the demonstrations to a further seven districts. In November 2002, Uganda officially released two upland-rice varieties from these activities—WAB165 and WAB450-I-B-P-91-HB [NERICA 4], making the latter only the third NERICA to be officially released anywhere.

“There was a spontaneous development after the successful demonstrations,” explains IDEA Commodity Specialist Fred Muhhuku, who is taking the lead in the upland-rice activities, “in that a businessman-cum-farmer in Hoima, mid-north Uganda, had set up a rice mill and mobilized local farmers to grow these varieties over a wide area. And this before the onset of the first season of 2003.” Meanwhile, seeds have been passed on to NGOs and found their way into the hands of private seed companies. Nearly 100 tonnes of seed of the two varieties was available for sale in early 2003.

“WARDA may only have acted as seed provider, but those who ‘ran with the baton’ certainly give credit

to us for helping in this rice-production boom outside of our traditional mandate region,” says Information Officer Guy Manners.

In 2000, the Participatory Rice Improvement and Gender/user Analysis (PRIGA) Network received its first observer from the south and east, a rice researcher from Mozambique. “In mid-2001, we had a request for training from the national program in Rwanda,” says former Deputy Director for Research Monty P. Jones. “Consequently, they sent three participants to our Headquarters course on rice participatory research in the October of that year.”

Former Technology Transfer Officer Myra Wopereis-Pura takes up the story: “The Rwandans were so keen that they invited three of us to Kigali in November 2001. There we trained 31 personnel in participatory rice research and seed production.” During the same trip, the WARDA team was able to help the Rwandans develop a five-year work plan for participatory rice research.

Through their contact with WARDA, the UK Natural Resources Institute (NRI) and the Zimbabwean national program have been testing WARDA varieties in the Masvingo Province of Zimbabwe since 2000. Rice is an important staple in the province, but little research has been conducted on the crop in Zimbabwe, and farmers rely on saving their own seed of local landraces. The landraces are prone to shattering, especially during maize harvest (rice is intercropped with maize), but the farmers were unaware of improved varieties. Two seasons of trials with farmers have included some 38 ‘varieties’ from WARDA, mostly NERICA lines. “Farmers would prefer to grow cultivars that tiller vigorously, are high yielding, drought tolerant, tall in stature and which are resistant to shattering and bird damage,” explains NRI researcher Charlie Riches. “A number of the introduced lines tested during this study have potential for replacing *muchecheni* [the landrace grown by the farmers involved in the trial] as



Farmer research group at Chatsworth, Masvingo Province, Zimbabwe assessing crop vigor in NRI–Zimbabwe Participatory Variety Selection trial of WARDA rice lines under hydromorphic conditions (2001)

they are high yielding and possess the traits preferred by farmers.” In fact, of the 13 lines selected for further study, 11 are NERICAs and all but one came from WARDA. Unfortunately, the work has been disrupted by depletion of seed stocks, the severe southern African drought and political instability in Zimbabwe. “I do think that there is a demand for the new lines,” concludes Riches, “but we may need to wait for a change of circumstances in Zimbabwe before we can really do anything significant.”

In almost every respect, the African Rice Initiative, launched in 2002 (*see* ‘The African Rice Initiative: Taking the NERICAs to Sub-Saharan Africa,’ *WARDA Annual Report 2001–2002*, pages 9–14), builds on the earlier successes of WARDA varieties outside of WARDA’s traditional mandate region. In the first phase, eight eastern and southern African countries (Ethiopia, Uganda, Tanzania, Rwanda, Zambia, Malawi, Mozambique and Madagascar) will host NERICA activities as non-pilot countries (*see* Figure 1).

Managing expansion

Historically, WARDA has its roots firmly in West Africa. As this became ‘West Africa broadly defined,’ it became increasingly apparent that its real mandate region was West and Central Africa. Equally historically, the International Rice Research Institute (IRRI) has the mandate for rice research world-wide. In fact, until the late 1990s, IRRI had a major project based in Madagascar. However, as funding for international agricultural research has been drastically reduced, IRRI was unable to implement a regional network for Eastern and Southern Africa (ESA) as it had hoped.

“It would, of course, be totally unethical for WARDA to claim a wider mandate without consultation with IRRI,” says Nwanze. “However, due to the very reduced presence of IRRI in Africa, we have in fact been encouraged to provide the much needed support beyond West Africa.”

The process perhaps all started with the Review that recommended the complete transfer of INGER-Africa activities to WARDA. “That, combined with the complexity of the African situation responding better to indigenous products than to imported ones, put WARDA in a position to better serve the continent,” says Nwanze.

Given that WARDA’s *modus operandi* is partnership, it does not see IRRI as an onlooker or even as a back-seat passenger, but rather sitting up-front, working together to help the poor rice farmers of the region. “What has been agreed,” Nwanze continues, “is that, in general, WARDA will take a lead on the continent.” It is likely, however—given its historical presence—that IRRI will be approached first in some instances. “IRRI will keep us informed of any requests for assistance that they receive, with an option for us to become involved if we have the resources.”

In many respects, WARDA’s emerging role will provide a more cost-effective outlet for IRRI’s inputs.

IRRI clearly has the lead in rice genetics and genomics research, but not the resources to devote to Africa.

But, what about WARDA itself, isn’t it the *West Africa* Rice Development Association—an association of member states, all of which are in West and Central Africa? “That’s quite right!” responds Nwanze, “but our founder members were not so narrow-minded. WARDA’s Constitution, in fact, states that membership is open to *any* African nation! Any country on the continent is entitled to apply for membership of WARDA.”

But, won’t existing member states suffer if there is a flood of members from the rest of the region and new demands on the Center’s resources? “This is potentially true,” says Nwanze, “which is why we have stipulated that any expansion outside of our traditional mandate region should be done gradually, at minimal cost to WARDA itself and, preferably, with new funds.”

“Meanwhile,” says Guei, “there is minimal cost involved in sending seed to our partners, which is INGER-Africa’s mandate anyway.”

This is where WARDA’s partnership mode comes in. Sanyang: “at this year’s [2003] Steering Committee meeting, the possibility of expanding ROCARIZ into Eastern and Southern Africa was mooted. It received general acceptance. However, the ideal situation would be first to activate the Rice Network of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA—the sub-regional organizations of Eastern and Southern Africa), and support it through a joint ASARECA–WARDA Collaborative Agreement. We could eventually envisage close links between ROCARIZ and the ASARECA Network.”

Satisfaction and support

“Renaming an institution is a bold step,” says Nwanze, “and suggesting by such a name-change that an institution is increasing its sphere of influence even

bolder! But we believe that the trend that was started by INGER-Africa, and then capitalized upon by the NERICAs and other WARDA varieties is a positive and irreversible step. I am satisfied that this is the right move.”

The idea of calling WARDA ‘The Africa Rice Center’ was first raised at the 2002 meeting of the National Experts Committee (the technical wing of WARDA’s Council of Ministers). There it was warmly recommended. Next, the name was floated with the Board of Trustees, who also endorsed it. “The Forum

for Agricultural Research in Africa (FARA), ASARECA and WECARD/CORAF have all welcomed this development,” enthuses Nwanze.

“This development calls for the full support of national, regional and international agricultural communities to WARDA, so that it can move forward in providing the needed expertise and support to rice research and development in Sub-Saharan Africa,” declares Nwanze. “It is only then that we can deliver the promise of the NERICAs and other new technologies to the poor across Sub-Saharan Africa.”

Crisis in Côte d'Ivoire: WARDA 'Under Fire'

The events of the second half of September 2002 caught most of the world by surprise, not least among them WARDA Headquarters staff and Management. Here we recount the events of those fateful days and WARDA's response to the unfolding Ivorian crisis.

Unfolding events

In the pre-dawn darkness of Thursday, 19 September there is a sudden feeling that something is going on *again* in Côte d'Ivoire. Telephones are ringing and there is eerie silence in the world outside, broken only by members of the local security company trying to get word to residents and watchmen alike.

Not that this is anything new for residents of Bouaké, including the majority of WARDA employees from Headquarters. Anyone who had been there for three years or more had already lived through the coup d'état of December 1999, the army mutiny of July 2000, post-election riots in October 2000, and increasing insecurity in the form of armed robberies. "Since 1998, WARDA itself had lost seven vehicles in the country, and several staff had been aggressed in armed robberies at homes, restaurants, clubs and in car-jackings," says WARDA Head of Human Resources and Administrative Services, Gabriel Dao. "The worst of these being when four gunmen took two new Nissan Terranos at WARDA's main gate, shooting a researcher in the process. That was back in April 2000."

"Being not unfamiliar with socio-political disturbances, we had certain contingency plans already in place," explains Director of Administration and

Finance Michel Dubé. "For one, staff had been encouraged over the past four years to keep a stock of at least a week's worth of food and water in their houses." Such precautions were to prove invaluable over the coming week, as the situation could change on an hourly basis and it was not considered safe for staff to be out on the streets.

Most of those who were there would tell you that the ensuing week was the most frightening experience of their lives, none moreso than the two battles for the residential area in which most senior staff lived. Just after dark on Monday 23 September, at about 7:15 p.m., heavy fighting broke out in the Kennedy area. At this point, most people found themselves somewhere within their houses out of sight and reach of windows. The feeling was that little could be done about a direct hit from a mortar-shell, but one near a window might well send glass flying inwards with unpleasant effects. In the morning, those bold enough to venture onto the streets said that government soldiers had taken control of the Kennedy area in that battle. However, this was not to last long, and even heavier fighting broke out at about 2:30 p.m. on Tuesday and lasted a lot longer. By the end of it, however, rebels were securely in control of Kennedy once again.

Obtaining news became problematic, as different sources started telling only parts of the story and it was a jigsaw puzzle to put the pieces together. WARDA staff were variously in contact with their own embassies, while Management was busy discussing details with the UN, the French Embassy and other international bodies.

At about 4 p.m. on Thursday, 26 September, the first vehicles of a WARDA convoy rolled away from WARDA's Bouaké Liaison Office on the journey south to government-held territory in Yamoussoukro. This exit route was made available by intense negotiations with the rebels on the part of French military forces, and WARDA's position in it was brokered through the UN and the then French Ministry of International Cooperation. "We are grateful to both groups—the French Government and UN officials—for our safe departure from Bouaké," says WARDA Director General, Kanayo F. Nwanze.

Once in Yamoussoukro, accommodation was at a premium, and most WARDA evacuees spent the night in the compound of one of the many missions in the city—seriously overcrowded. Not that many of them minded, of course, they were just thankful to be alive and out of the battle zone.

On Friday morning, 27 September, the WARDA convoy rolled on south towards the commercial capital Abidjan. "Even before we got to Abidjan, several senior staff had decided to evacuate the country with their families," says Nwanze. "So, it was an already reduced group that met for a senior staff meeting the following Monday. My main concern at that time was to emphasize the fact that WARDA had not evacuated from Côte d'Ivoire. Rather, it had temporarily relocated its headquarters from Bouaké to Abidjan."

Temporary accommodation in Abidjan

Nwanze continues the story: "Upon arrival in Abidjan, our main concerns were to find accommodation for displaced staff and to find some temporary office accommodation."

26 September 2002: Three days earlier, Bouaké was declared Type 4 Security Alert by the UN Security System; WARDA evacuated from Bouaké under the protection of French troops



Housing came in the form of apartment-hotels, in particular those in the district II Plateaux near WARDA's Abidjan Liaison Office. The Liaison Office itself was soon filled with displaced staff from Bouaké, but was clearly not big enough to accommodate everyone. The decision was made to retain Executive Management, Administration and Finance, and TILS in the Liaison Office and to look for more appropriate accommodation for those research staff who had faithfully stayed in Côte d'Ivoire. "Our first temporary set-up for research was in the offices of the United Nations Office for Project Services (UNOPS), to whom we are extremely grateful for space to 'camp,' albeit in cramped conditions," says Nwanze.

"UNOPS? Yes, I remember that," recalls Lowland Rice Breeder Howard Gridley, with a wry smile. "That was where we were squashed in a small space with one line for Internet. You got to spend one to two hours on-line, then one of your colleagues said



WARDA staff with Board Vice Chairman Richard Musangi (front center) at a get-together in Abidjan, December 2002

‘time’s up!’ and duly unplugged the cable from your machine!”

Later, a vacant apartment block was rented for the research staff, where conditions were less cramped, and a local computer network could be installed to facilitate access to the Internet and e-mail.

Planning for the future

Early in October, WARDA’s Executive Management put in place short-, medium- and long-term strategies for managing the Ivorian crisis. At the same time, a consolidated staffing plan was initiated for regionally recruited staff. Initially, all regular staff were placed on full pay. “We could not possibly hope to keep all support staff gainfully occupied in Abidjan,” explains Dubé, “so we divided them into three categories, which we called skeleton, essential and others.” ‘Skeleton’ staff initially comprised a few secretaries, drivers and IT staff—these were actually working. ‘Essential’ staff were those filling positions that Management considered essential to the continued viability of WARDA itself, but who were not (at that time) actually working—“these people were placed on technical leave at half salary for an initial period of three months,” explains Dubé. Remaining staff were placed on unpaid technical leave—“these people were unlikely to be recalled in the short, or even medium, term,” says Dubé. “However, by placing them on technical leave (rather than simply laying them off), we continue to maintain their health insurance cover, and they retain their rights as employees of an organization in Côte d’Ivoire.”

“Senior staff who evacuated with their families in September and early October were also initially placed on a form of technical leave,” says Nwanze—in this case on full pay.

As part of the medium-term strategy—to be implemented if it was not possible to return to Bouaké and M’Bé before January 2003—discussions were held with another CG Center, ICRISAT, which has a station in Bamako, Mali. By 1 November, ICRISAT had agreed in principle to allocate offices, laboratories and

farmland at its Mali Station, and negotiations with the Malian Government commenced. In mid-December, a small team visited Bamako to evaluate the facilities and interact with the Malian authorities and ICRISAT staff. That visit resulted in the drafting of a temporary relocation plan.

“The vast majority of senior staff who had left the country returned to Abidjan during the first week of January,” Nwanze says. So, the first signs of full regrouping were visible in time for the implementation of the medium-term strategy.

On the weekend of 25–26 January, acting Director of Research James Sumberg led the first group of researchers to Bamako to establish a temporary research station at the ICRISAT facilities at Samanko, Bamako. Most of the remaining researchers, research-support staff and a cadre of administration and finance staff relocated over the coming weeks, so that a full ‘skeleton’ complement was in place by the end of April.

Land preparation for rice at ICRISAT’s Samanko Research Station, early 2003



In the meantime, the WARDA Board of Trustees met in Bamako from 24 to 28 February, where the decision was taken that research staff should remain in Bamako for up to two years, so as to allow them time to plan and implement their activities under the new climate. This signaled the triggering of the long-term strategy. A worst-case scenario of return to Bouaké becoming unforeseeable was mooted at one point; however, this “is not envisaged and is therefore not in our present framework,” Nwanze proclaims confidently.

“As we look to the future,” continues Nwanze, “I am confident. A joint team of WARDA staff and host-country tutelary Ministry of Scientific Research personnel will visit Bouaké and M’Bé for a thorough assessment of losses, damages and repairs to property and living conditions. This will be followed by a joint mission involving WARDA Management and high-level government officials to Headquarters. Media coverage will alert the public to the imminent return of WARDA personnel to Bouaké and M’Bé. A progressive return plan will be implemented with the first step being the return of a core team of maintenance staff led by a senior manager to Bouaké. Return of the first batch of other senior staff will be dependent on satisfactory developments thereafter.”

Heroism and getting behind the lines

As early as October, information reached Abidjan of local staff reporting for duty at M’Bé and at the key-sites of Danané and Gagnoa. “It is entirely due to the heroic acts of these staff that the 2002 experimental work was not lost in its entirety,” says Nwanze. “Not only were experiments maintained, but they were also harvested and the data recorded via telephone communication with scientists in Abidjan!”

“With data in hand, scientists were then able to continue some of their normal activities, such as analyzing the data, writing reports and preparing articles for publication,” says Yacouba Séré, who was acting Director of Research at that time. He added that the heroic acts of WARDA were possible because, “like in an army, with the General and most of his Colonels in place, the troops are encouraged to carry on their role.”

“Despite the open communication channels, we continued to fret about the condition and safety of our Bouaké campus,” says Nwanze. It was going to be two months after the crisis started before anyone could get to M’Bé from Abidjan.

“Since the start of hostilities, WARDA has maintained excellent relations with the Ivorian

Sahel Station highlights

While WARDA’s Headquarters and Main Research Center suffered under the Ivorian crisis, WARDA’s decentralized operational mode meant that for many it was ‘business as usual.’ This was particularly the case for staff based at the Sahel and Nigeria Stations.

Integrated crop management for irrigated-rice systems in the Sahel and savanna zones

After the initial success of encouraging farmers to adopt integrated crop management (ICM) options in the Senegal River valley in Mauritania and Senegal (see ‘Integrated Crop Management: Getting it Right on the Farm on a Wide Scale,’ *WARDA Annual Report 2000*, pages 9–19), and the workshop in 2001 on scaling up, activities in 2002 and early 2003 aimed to consolidate and expand the work. In Senegal, a first draft of a technical leaflet was being evaluated with farmers at two sites, where farmer discussion groups had been set up specifically to address the issue of ICM. Meanwhile, farmers and researchers at two sites in The Gambia were making preliminary evaluations of ICM options in the form of socio-economic and agronomic trials. Completion of the agronomic trials at the end of 2003 should pave the way for large-scale demonstrations in that country.

Sites for ICM work in Burkina Faso and Mali were identified during the Irrigated Rice Review and Planning Workshop in November 2002 (see page 62). Activities looking particularly at ICM of irrigated rice on problem soils will start during the wet season in the *Office du Niger*, Mali, in collaboration with *Institut d’économie rurale* (IER), and at the Sourou Valley, Burkina Faso, with *Institut de l’environnement et des recherches agricoles* (INERA). The options to be tested were identified in the recently completed DFID project on soil degradation in Burkina Faso and Mauritania (see ‘A Holistic Approach to Irrigated Rice Farming Problems Uncovers More Than Just Soil Degradation,’ *WARDA Annual Report 1999*, pages 30–37, and ‘Donor Country Profile: The Netherlands—Soil degradation in irrigated rice fields in the Sahel,’ *WARDA Annual Report 2001–2002*, pages 57–60).

National research and extension partners in Mauritania have recently asked WARDA to assist in impact and adoption studies at the sites where ICM has been encouraged over the past few years.

A mid-year rapid appraisal survey of the irrigated-rice sector in Nigeria in 2002 demonstrated enormous similarities in constraints facing irrigated-rice farmers in the northern Guinea and Sudan savannas of Nigeria with those common in the Sahel. It should, therefore, be possible to adapt and test ICM options in these areas of northern Nigeria.

Sahel Station highlights (cont'd)

Preliminary ICM testing in rainfed lowlands of Senegal

In 2002, WARDA was approached by the Fatick Regional Directorate of the *Agence nationale du conseil agricole et rural* (ANCAR) to establish variety and ICM trials in the region of Fatick, southwest Senegal. Trials were planned in collaboration with ANCAR agents and farmers groups in five sites in Fatick; however, poor rains intervened to annul the trials at four of the sites.

At the remaining site, Djilor, trials were established in the wet season of 2002 on a farm selected by the women-farmers' group for the valley. The trials themselves were jointly managed by WARDA, ANCAR and the farm-owner. For the first season, five varieties (WAS 47-B-B-194-4-2, WAS 63-22-5-9-10-1, WAS 63-22-1-1-3-3, WAS 164-B-5-2 and WAS 33-B-15-1-4-5) were tested for their adaptation to the ecology, and agronomic trials tested three varieties (Sahel 108, WAS 47-B-B-194-4-2 and one local variety) against three levels of fertilizer application and weed control. Farmers from the valley were invited to formal visits of the trials at crop maturity and post-harvest, in order to get their impressions of the varieties and treatments.

"Despite the lack of rain, four of the five varieties tested were able to produce some grain (with yields ranging from 2 tonnes per hectare for WAS 47-B-B-194-4-2 to 3.7 tonnes per hectare for WAS 63-22-5-9-10-1)," says Research Assistant Soulayeman Gaye, "and these were appreciated by the farmers for their production under difficult conditions."

Meanwhile, Research Assistant Abdoulaye Sow was in charge of the agronomic trials. "We were quite surprised at the initial findings," he explains. "The two modern varieties not only substantially out-performed the local varieties, but they also produced as much grain with no fertilizer as they did with the full recommended fertilizer dose for that area!"

"Of course, no researcher is going to put too much weight on one season's results," says Irrigated Rice Program Leader Kouamé Miézan. "We have formed a partnership with ANCAR and the farmers of Djilor and elsewhere in Fatick region. If the rains are better in 2003, we will go ahead with a full round of trials in the five sites as originally planned. The main interest in reporting this now is that we have achieved a measure of success in an inland valley that is essentially rainfed, therefore somewhat outside our usual mandate of strictly irrigated rice. This begins to tie in with our evolving concept of the lowland intensification continuum."

continued on page 20

Government in Abidjan and cordial relations with the occupying force in Bouaké," says Nwanze. "This has meant frequent contacts and interactions at the highest levels of the military and civilian arms of government. The official missions that were made to Bouaké and M'Bé were completed with full authorization from the government and cooperation of the occupying forces. The UNDP facilitated these missions with the necessary paperwork."

The first official mission from Abidjan to Bouaké and M'Bé was run on 18–20 November. Head of Operations Nurdin Katuli was among those who went. "We were very pleased to see that all the installations, communications, electricity and water-works were functioning," he says. "The offices and labs were intact, and genebank operations were continuing uninterrupted." In fact, the only major let-down had been disruption of the anther-culture laboratory due to a localized power outage.

"An important aspect of the first mission for those of us in Abidjan was the computer equipment that we rescued," says Information and Communications Technology Manager Péfery Coulibaly. To be more precise, all the servers and 25 desktop computers were retrieved during that trip, along with important documents and some personal effects.

It was almost another month before the next mission could be organized. "We were beginning to get very concerned about the risks to our seed collection by that time," explains Head of Genetic Resources Unit Gouanteou Guei. "Failure of the cold-storage facilities, or theft, could easily have robbed us of priceless germplasm." The mission was a resounding success in this respect, as over 6000 accessions were retrieved, including the most recent material from collections in Côte d'Ivoire and Guinea in 2000, and breeding lines. The rescued material constituted 80% of the total germplasm collection.

"In addition to collecting the seed, we also put in place some fire-prevention measures," adds Katuli.

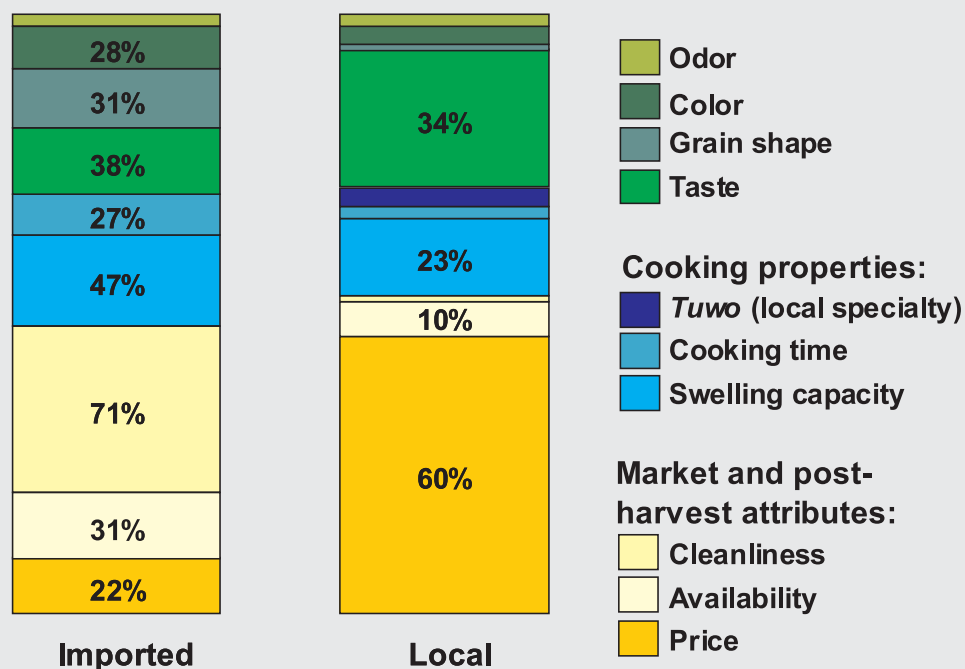
Rice sector strategy for Nigeria

Activities and preliminary results from the first year of the USAID-funded rice-sector study in Nigeria were reported last year (see Box 'Case study: Nigeria,' *WARDA Annual Report 2001–2002*, pages 44–45). The Ivorian crisis introduced some delays into the project, which is now set to be finalized mid-2003, rather than in December 2002 as initially planned.

"From the state-of-the-art paper and the stakeholder workshop in November 2001, we identified areas for further study," explains Production Economist Olaf Erenstein. "Thus, we conducted three surveys of rice producers, rice millers and rice consumers, and also a rapid appraisal survey of irrigated rice schemes in the country." The first survey covered 252 rice producers (farmers) in five rice-growing states—four (Benue, Kaduna, Niger and Taraba States) selected for their importance to national production and diversity of rice-cropping systems, and one (Ekiti State) specifically to include upland rice. The second survey addressed rice-processing in the same five states and two major rice-processing centers elsewhere in the country. Some 80 processors were selected with emphasis on millers, since milling had been identified as a key factor in the issue of rice quality. The third survey targeted 600 rice-consumers at 21 markets in eight state capitals (namely, those of the five states used in the earlier surveys, plus Abuja, Ibadan and Lagos). "The main questions in the consumer survey were why respondents chose to buy imported rice in preference to local rice, and whether they ever used local rice," Erenstein explains.

"The survey results are still in the process of being analyzed," says Erenstein, "but the important issues are already clear." For example, 80% of overall rice production is destined for sale; consequently, farmers are prepared to invest in inputs (such as fertilizer and herbicide) to improve their production. However, imported rice was available on the local market in two-thirds of the rural rice-producing areas studied, and is the rice of choice for many consumers because of its quality (whereas local rice is chosen for its price—see Figure 2).

Figure 2. Relative importance of consumers' criteria for selecting rice (Nigeria, 2002)



Percentages reported sum greater than 100% as most respondents cited more than one criterion. For imported rice, 954 consumers provided an average of 2.99 responses, while for local rice, 325 consumers provided an average of 1.43 responses.

Results from the four studies are being fed into a strategy for the development of the rice sector—the ultimate goal of the project. Preliminary propositions were presented to project collaborators in Nigeria in March 2003, and also to the Federal Ministry of Agriculture, represented by the Minister and Permanent Secretary.

In September 2002, President Obasanjo instituted a Presidential Committee on Increased Rice Production and Export to prepare a plan for the development of the rice sector in Nigeria. “WARDA was invited to join as a key member of this Standing Committee,” says WARDA Liaison Scientist in Nigeria Olu Osiname. “In particular, the Committee is relying on WARDA’s data on rice production in the country.” Some members of this committee were present at the presentation to the Ministry of Agriculture. “We viewed this meeting as a timely opportunity for input to the committee of a broader perspective on the rice sector than focusing purely on the irrigated sub-sector,” concludes Osiname.

“The feedback generated by the interactions with our collaborators and the Ministry is helping us to finalize the strategy,” says Erenstein. “The details will be discussed at a two-day technical workshop in Ibadan this summer [2003], and then there will be a half-day ceremony in Abuja, where the final document will be handed over to the Ministry of Agriculture.”

Elements of a strategy for revitalizing the rice sector in Nigeria

So much for the means, but what exactly is WARDA likely to be proposing to the Nigerian Government?

First, the strategy has two objectives:

- To increase the capacity of the rice sector to compete with imported rice in terms of quality and price;
- To enhance the market share of local rice in the national rice market.

“In formulating a strategy to reach these objectives, we are being guided by ‘strategic elements’,” explains Erenstein. “In order to be viable, the strategy should respond to consumer needs and, therefore, the strategy should give priority to quality enhancement of local rice rather than simply increasing domestic production.”

The following strategic priorities have been set.

- *Improving quality management along the commodity chain* comprising sensitization of stakeholders on quality issues; improvement of rice-processing technology for parboiling, destoning, milling and packaging; and, improvement of the quality and homogeneity of paddy at farm level by reducing mixing of varieties and improving threshing and cleaning.
- *Increasing market efficiency* by supporting local rice retailing and trade expansion through access to working capital, which should enable larger operations, improve regularity of supply, and help new operators to enter the market and thereby increase competition; and, reducing transaction costs by promoting standardization of units, quality grades and terminology, and disseminating information on prices and the price premium on quality rice to farmers and traders.
- *Increasing efficiency at the producer level* through improved varieties, external input use and its efficiency, crop management practices, and mechanization; priority to be given to improved efficiency of existing operational irrigation infrastructure before rehabilitating or building new structures.

“As we look into implementing the strategy, we want to be sure that the development is sustainable,” explains former Policy Economist Frédéric Lançon. “For this reason, we believe that it is important to work with an institutional set-up of four entities. First, we do not want to establish new institutions, but rather strengthen existing ones. Second, we foresee a continued role for stakeholder platforms as established within the project framework. Third, we believe that a coordination body should be established independent of those actually conducting activities related to the strategy. Fourth, a monitoring system is needed to provide feedback on the effects of the development, to support the policy debate of the coordinating body, and to measure the impact of sector development.”

Furthermore, the WARDA team prefers a ‘softly-softly’ approach to implementation rather than a ‘big bang’ version. “We think there is more chance of success if we opt for phased implementation,” says Erenstein. “We should expand gradually both in terms of locations and number of interventions. The development process is incredibly complex and will need on-going fine-tuning and a learning period for all the stakeholders.” The team will propose that implementation start with certain rice-sector-specific interventions (e.g. quality). They fear that focus on non-rice specific interventions may distract attention away from the rice focus. Rather, they see a role for the coordinating body in lobbying for non-rice interventions within the framework of general agricultural policy development.

“As with so many potentially big programs, we feel a need to run pilot studies at a number of sites, in order to test the feasibility of the recommendations and fine-tune them,” explains Erenstein. “Pilot ‘projects’ would also enable those involved in the implementation to gain experience and ‘learn by doing’ ready for the scaling up stage.” The team is most likely to suggest pilot phases in Abuja, Benue, Kaduna and Niger States, because of their role in overall rice production and their relative proximity to each other.

A third mission was run near the end of February to retrieve yet more data and personal effects, then a fourth mission went at the end of March to retrieve harvested seed, data and personal effects. “At least now that we have the last season’s seed, we can move forward,” says Lowland Breeder Gridley. “Before that found its way to Bamako, I was merely looking at repeating all of last year’s trials at new locations.”

More on germplasm

WARDA’s long-term storage of its rice germplasm has traditionally been maintained at IITA under a long-standing agreement between the two centers. Consequently, it was the material not duplicated at IITA that was the focus of the second Bouaké–M’Bé mission in December. However, the achievement was even greater, with the complete recovery of all of WARDA’s germplasm by the end of the fourth mission.

The material is being held in deep freezers in Abidjan, but further security measures have also been taken. “At the end of February,” says Guei, “we sent a shipment of recovered germplasm to IITA to add to what is already there. This is a duplicate set of what we are holding in Abidjan.”

Head of Genetic
Resources Unit
Gouanteou Guei
overseeing packaging
of seed shipment bound
for IITA, Nigeria



For some years, some duplicates of WARDA’s material have also been held at IRRI in The Philippines. “We were moving along with a process to establish long-term storage at M’Bé,” muses Guei. “This was being funded by the Japanese Government, with a contribution from the World Bank.”

Subsequent to the Ivorian crisis and the fragility of germplasm collections being highlighted, WARDA is

Sahel Station highlights (cont’d)

Refining the intensified lowland – irrigated continuum concept

The ‘intensified lowland continuum’ was mentioned in last year’s report (‘Breeding Rice for the High-Potential Irrigated Systems—Looking south’ and Figure 3, *WARDA Annual Report 2001–2002*, pages 24 and 26). As mentioned last year, the concept arises from the fact that outside of the Sahel, farmers in ‘irrigated’ systems may or may not be able to maintain full water control, either from one season to the next or even within a season. In addition to this, however, there are a number of other factors that support coordination and integration of research and technology-transfer efforts for both rainfed and irrigated lowlands outside of the Sahel.

- Dominant weed species in lowland rice cropping with partial water control are similar along the whole (water-control) gradient (though different between agro-ecological zones), and markedly different from those in rainfed uplands.
- The same applies to soil types, and consequently soil fertility and soil-based constraints.
- The reduced production risk in lowlands with partial water control (compared to purely rainfed systems) makes the use of inputs a profitable option, giving a market orientation to formerly subsistence farming.
- Varieties developed for irrigated systems have been shown to perform well in rainfed lowlands with partial water control, although a wider diversity of characteristics is needed to address such stresses as flooding and drought (absent from purely irrigated systems).

“This continuum concept opens up more options for lowland development,” says Miézan. “Technologies developed for the Sahel and strictly irrigated systems now have the potential for adaptation to the non-Saharan lowlands.”

“Thus, the door is now wide open for increased assistance to rice farmers throughout the lowlands of Sub-Saharan Africa,” concludes Miézan.

exploring with Fort Collins, Colorado, USA to store a duplicate set of material there under a ‘black box’ arrangement; this will be done during 2003 and 2004.

“For this season [2003], we are multiplying material at WARDA’s Sahel Station in Senegal,” says Guei. “Thus, we hope to have at least some material available for distribution to our partners within the International Network on Genetic Evaluation of Rice for Africa.”

“We sounded alarm-bells across the world in October,” says Nwanze, “by issuing a press release highlighting the plight of the valuable seed at M’Bé. We are delighted that it has all been rescued and our fears of a worst-case scenario alleviated!”

Moral and material support from many quarters

“During this whole period, we have received messages of support from around the world,” says Nwanze. “We are very grateful for all such support that is helping us through this difficult time.”

“We also received material support in the form of an emergency grant from the CGIAR and World Bank,” says Dubé. “Without that, we could have been in serious financial trouble.”

In mid-December, Board of Trustees Vice Chairman Richard Musangi visited Abidjan on behalf of the Board’s Executive and Finance Committee. “Other Board members were prevented from coming by travel restrictions imposed upon them by their home countries,” says Musangi. “However, we felt that it was vitally important to show solidarity with staff and Management, and to endeavor to boost morale with a visit. I was the one with the opportunity.”

Along with newly-appointed Ivorian Board Member Bamba Gué, Musangi reviewed Management decisions on crisis management, recommended decisions and actions to be taken, met with government authorities and the diplomatic community, and held a televised press conference.

In February, the full Board met in Bamako and saw first-hand how things had been arranged and how staff were settling. During the Board meetings, the Director of the CGIAR Francisco Reifschneider also visited Bamako and Samanko. He had planned to visit WARDA before the crisis, and then Abidjan in late 2002, but had been one of those affected by the World Bank moratorium on travel to Côte d’Ivoire. He took the opportunity to address the staff and congratulated WARDA personnel on their fortitude under stress.

Consolidated and brighter future

“WARDA is unique among the CG centers,” says Nwanze, “in that it is first an association of member states.” As such, WARDA was born in 1971 out of a desire of governments to collaborate for the greater good. “Partnership remains our *modus operandi*,” continues Nwanze. “In fact, without it WARDA may well have disappeared as a result of the Ivorian crisis.”

“The crisis has given us a unique opportunity,” says Sumberg. “I would never want to lessen anyone’s understanding of how traumatic this has all been for all of the individuals concerned, but for WARDA as a whole, the situation may yet have positive results.” Sumberg arrived in Abidjan in November 2002 to take up the position of Program Leader for Rice Policy and Development; in January, he was made acting Director of Research. “WARDA now has to consolidate. We have the key staff working again and we have currently little access to our principal research station. We are now looking at even more ways of networking—seeing how we can work with our partners to produce even more synergies than before.”

“It has been a difficult seven months,” says Nwanze, “but we have survived, we have regrouped, and WARDA is moving on. The sustaining power of the personal moral support from a host of individuals cannot be fully or adequately documented!”

Participatory Learning and Action Research for Integrated Crop Management in Inland Valleys

IN DIVERSE systems like inland valleys, off-the-shelf technologies rarely provide farmers with what they need and so are all-too-frequently ignored. In 2001, WARDA started a program to support farmers to help themselves, teaching them to observe, exchange ideas, analyze and think things through in preparation for taking action to improve their farming techniques. The system fired the imaginations of the farmers and now some of them are using what they have learnt to help their neighbors and earn extra income!

Learning from experience, building on success

There can be no doubt that over the last half century, agricultural research and development has achieved some notable successes, not least of which was the Green Revolution of the 1970s. There is also little doubt that the majority of ‘simple’ technological solutions have had minimal impact in Sub-Saharan Africa.

“The advantage of Green-Revolution technologies lies in their target audience,” explains WARDA Technology Transfer Agronomist Toon Defoer. The success of the Green Revolution was due in large measure to standardizing the farming environment—providing adequate water control for irrigation, plus inputs like fertilizers and herbicides. “Unfortunately,” continues Defoer, “the options for standardizing African farming environments are few and far between. What we have learnt is that the more diverse

the environment, the more site-specific a technology needs to be and the earlier that farmers need to become involved in the technology development and adaptation process.” (See Box ‘Research paradigms and farmer participation.’)

Defoer had achieved a measure of success in soil-fertility management for such diverse environments with an approach called ‘Participatory Learning and Action Research’ (PLAR), during an assignment with the Dutch Royal Tropical Institute (KIT) in Mali. It was in part because of his innovative approaches that WARDA ‘snapped him up’ when the Technology Transfer Agronomist position needed to be filled in 2001. Defoer has brought a whole new way of thinking and working to WARDA’s technology-transfer team.

At the time of Defoer’s recruitment, WARDA’s successful integrated crop management (ICM) program from the Sahel was ready to be adapted for inland valleys outside of the Sahel.

Research paradigms and farmer participation

In this context, a paradigm may be reasonably defined as “a conceptual framework within which scientific theories are developed, which is consistent within itself, but which may need completely revising as evidence challenging the factual accuracy of some aspects of it accumulates.”

“I believe that the whole philosophy of participatory learning and action research (PLAR) is fundamentally different from that of traditional research and development, and also from that of most participatory research,” explains Toon Defoer, WARDA Technology Transfer Agronomist and driving force behind WARDA’s PLAR activities. “We call it ‘constructivism’ in contrast to ‘positivism’.”

Positivist paradigm

1. *‘Conventional’ research and development*

- Researchers develop technologies, primarily on a research station, and these are then ‘transferred’ to farmers.
- Successful in relatively homogeneous environments, with little diversity, and that are not complex.
- Research can imitate the on-farm situation on-station.
- Works best where farmers have access to relevant information, water management and inputs, e.g. the Green Revolution.

2. *Farming systems research*

- First consideration of diversity within farming systems and the need to adapt technologies to farm realities (1970s).
- Technologies are generated, still primarily on research stations, with target ‘recommendation domains,’ where they are then tested and adapted with farmers.

3. *Participatory research*

- Seeking to use farmers’ knowledge (and experience) to improve research outputs, i.e. to help the researchers do a better job.
- Still involves ‘finished’ or ‘completed’ technologies (e.g. varieties) being given to farmers to see if they are adaptable or adoptable.
- Examples include WARDA participatory varietal selection (PVS) and the Sahelian ICM program.

Constructivist paradigm

- Constructivism assumes that reality is not absolute, but it is rather actively constructed by people from their experience and social interaction.
- Constructivism is especially relevant to natural-resource management in diverse and complex farming environments, where positivism does not work.
- Typically, farmers have no (or limited) control of water and no (or limited) access to inputs, such as fertilizers, herbicides and credit.
- Action research—learning by doing, or perhaps learning by trying.
- Social learning—farmers encouraged to observe, analyze, discuss, suggest solutions; farmers test ideas on their own fields, then observe and reflect, perhaps to develop better solutions.
- Philosophy: communication—helping farmers to help themselves, rather than using farmers to help the researchers.
- Focus is not so much on the *technology*, but on the *process*.
- New role for research: translating scientific principles and technologies into something usable by farmers; developing training aids for farmers.
- New role of facilitation to guide the process.
- Farmer-to-farmer training/learning, with a role for farmers’ organizations.

WARDA has recognized the potential of the inland valleys of Sub-Saharan Africa for many years (*see*, for example, ‘Technology Generation and Dissemination: The Role of Agro-ecological Characterization,’ *WARDA Annual Report 1998*, pages 23–31). “After a recent re-evaluation of the FAO data, we now have a more realistic figure for inland-valley area in Sub-Saharan Africa of 190 million hectares,” declares Paul Kiepe, Scientific Coordinator of the Inland Valley Consortium (IVC). “With improved lowland rice cropping, intensification and diversification, that gives a lot of scope for increasing food production throughout the continent.”

With the successes of PLAR for soil-fertility management and ICM for Sahelian systems behind them, and the potential for inland valleys ahead, in 2001 Defoer and the technology-transfer and IVC teams embarked on a program to introduce PLAR for ICM into inland valleys with rice-based cropping systems.

A new way of thinking, a new way of doing

“I am a different man!” exclaims farmer Kouamé Dembélé of Bamoro, Côte d’Ivoire. “When I saw a problem in my rice field, I used to wait around for the extension agents to come and help me. WARDA has taught me to look at my rice, think about what I see, show it to my neighbors and discuss with them how we might tackle it. It is a new way of thinking, and it leads to action on my part—and concerted action with my neighbors!” What is more, Dembélé and his fellow rice-farmers increased their rice production by over half a tonne per hectare in the first year of PLAR-ICM.

“What we are trying to achieve,” explains Defoer, “is not so much the adoption of technologies that we researchers have developed, but rather to help the farmers to think for themselves, to interact and to decide how *they* might try to solve their own problems.” And a certain amount of success can be claimed even after the first year. “After the nine months of training, we presented hypothetical problems to a selection of

participant and non-participant farmers,” Defoer says. “Presented with a new problem, participants responded with statements like ‘I would look closely at the plant, maybe open it up to see what is inside,’ ‘I would show it to my neighbors and see if they have ever seen anything like it.’ While non-participants showed a continued reliance on outside help, like extension services, or immediate intervention, for example with pesticides.”

Dembélé and three other farmers from the pilot sites were also trained to be farmer-trainers, so that they can form the core of a farmer-to-farmer training effort to help PLAR-ICM spread. The pilot communities now form a ‘Rural Knowledge Center,’ where farmers can bring their problems to discuss with the likes of Dembélé, or else request training in PLAR for their own communities. “If farmers are to act effectively as trainers, they need some compensation for the time they invest,” says Tom Kadisha Kat Lombo, Research and Development Specialist of the *Agence nationale d’appui au développement rural* (ANADER), the extension service involved in the PLAR program in Côte d’Ivoire. The pilot project introduced the idea of ‘learning-coupons,’ which entitle a group of farmers to a single training session. “ANADER and WARDA sell the coupons at 2000 CFA [about US\$ 3, or 3 euros] to the farmer groups, who give one learning-coupon to the farmer-trainer for each training session,” explains Lombo. “The farmer-trainer then submits the coupon to ANADER or WARDA and receives the 2000 CFA in return.” For the new Rural Knowledge Center, WARDA subsidized the first 30 learning-coupons, but subsequent sessions are paid in full by the groups requesting the training. The scheme has sparked interest—and participation—in four villages neighboring the pilot inland valleys.

How it works

“In 2001, we took PLAR-ICM to two inland-valley settings close to WARDA’s Headquarters,” explains Defoer, “namely, Bamoro and Lokapli. In each setting,

Outline of a typical PLAR session

Introduction

One facilitator introduces the day's subject and gives the objectives.

Active discussion

Another facilitator starts the process with questions designed to open up farmer discussion of the subject.

Farmers discuss experiences and personal practices.

Subject-matter facilitator 'presents' scientific view through learning tools, questions and elaboration.

Farmers work out most of the answers for themselves.

Field visit

Mini-groups, each with farmer-animator, farmer-rapporteur and facilitator.

Pre-selected fields to demonstrate 'good' and 'bad' aspects of subject.

Farmers observe, analyze, make decisions for action.

Reporting back (plenary session)

Mini-group rapporteurs report to group.

Different groups have different ideas, leading to expanded horizons.

One facilitator helps summarize ideas.

Evaluation

Farmers encouraged to say what they learnt and what they will put into practice.

Wrap-up summary

Volunteer farmer or facilitator summarizes whole day: objectives; farmers' observations; scientific basis; best bets for action.

explains IVC Research Assistant Philip Idinoba. Typically, the facilitation team will meet ahead of the PLAR session to prepare. Usually, one of the facilitators will be a specialist in the subject matter of the particular session; alternatively, one facilitator is specifically designated to do some detailed subject-matter background reading, although all the facilitators will seek to be versed in the subject to some degree.

At the start of the session, one facilitator will introduce the topic for the day, and state the objective. In other words, tell the participants what the facilitators expect them to learn, or retain, from the day's session. Next, another facilitator starts the 'procedure' by asking the farmers what they know about the subject of the day. Farmers are encouraged to share and discuss their own practices and experience. The subject-matter facilitator will then build on the farmers' discussion to present the scientific view of the topic. This facilitator will ask open questions and elaborate on farmers' statements with a view to giving them insight into why things are the way they are, or what is behind the farmers' observations. "But, the facilitator is not teaching in the conventional sense," says Idinoba, "rather, he (or she) is facilitating discussion, and in most cases the farmers will answer their own questions."

"This whole section is very active," explains Defoer. "It is where the learning tools come in, such as diagrams and practical activities." And it is not necessarily the facilitator who makes the diagrams. For example, if a cropping calendar is required, the facilitator might provide the materials, but the farmers will construct the calendar themselves from their own knowledge of the rice production cycle.

we ran weekly sessions with about 30 farmers for a period of nine months."

"A typical weekly PLAR session involves about 30 farmers from the inland valley concerned, plus a few facilitators, representing research and development (extension, NGO or other development organization),"

Learning tools in action: Philip Idinoba (WARDA-IVC Research Assistant) pours water into a funnel containing soil as part of a demonstration of differing rates of drainage in different soil types





Farmers construct a cropping calendar thereby giving themselves a clearer idea of just what is going on throughout the season in their rice crops

Once the active discussion is over, the farmers typically split into four mini-groups for a field visit. Each mini-group has a farmer-animater to guide group discussion and a farmer-rapporteur; it also has one of the facilitators to help the farmer-animater in case he/she goes off track. “The fields are pre-selected by the facilitators,” says Idinoba, “to illustrate a diversity of the problem in question and how it is addressed. Then the groups move around so that they each see all the fields.” In the field, the farmers are encouraged to observe and analyze—especially to think about causes and effects—and then to suggest actions and make decisions as a group.



Observe, record, analyze, learn: Field observations and discussion form a key part of weekly sessions

The mini-group rapporteurs then report back to the whole group. “The value of reporting back lies in the fact that different mini-groups will often have different ideas and therefore different conclusions,” says Idinoba. “This interaction gives the farmers insight into other ways of thinking, maybe encouraging them to broader horizons on the next field visit.” One of the facilitators

will assist in helping to summarize the groups’ findings and conclusions.

This debate then moves into an evaluation of the day’s training. Farmers are encouraged to say what they have learnt and how that knowledge will help them in their rice farming; specifically, farmers are asked which idea, or ideas, they intend to put into practise on their own farms. Finally, either a volunteer farmer or one of the facilitators will summarize the whole day’s proceedings: objectives; farmers’ observations; scientific basis; decisions for action.

“When I look at a PLAR session,” says Idinoba, “what I see is farmers’ knowledge coupled with scientific knowledge, and everybody learning!”

Site-specificity—different results in different settings

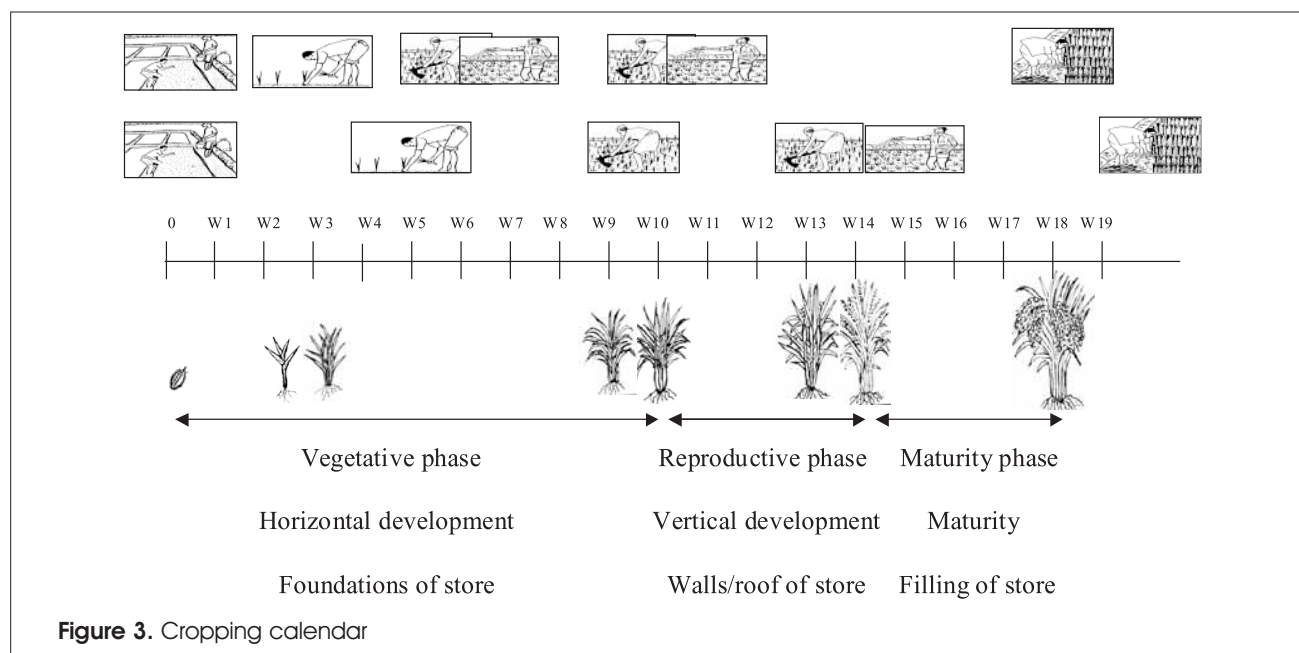
Part of the attraction of the two pilot sites was not only their proximity to WARDA Headquarters, but also their markedly different social settings and water-management practices, giving the opportunity to demonstrate the flexibility of the PLAR approach.

Bamoro inland valley is farmed by members of a single village with strong family-based ties. The narrow valley has a single, central stream that acts as both source and drain for water for the crop; there is no irrigation structure. Farmers there can only grow rice during the rainy season, and typically use no fertilizers.

In contrast, the Lokakpli valley is used by farmers from several villages with no strong social cohesion among them. The site was constructed in 1998 as an irrigation scheme with two lateral (source) canals and a central drainage canal. Farmers grow two crops a year and apply substantial amounts of mineral fertilizer.

“In both contexts, the cropping calendar provided useful, if differing, insights,” says Defoer.

With the aid of the cropping calendar, farmers in Bamoro learnt that tillering (vegetative growth) of rice ends at about nine weeks. Consequently, their practice of transplanting seedlings as late as eight-weeks old meant that almost no further tillering could occur in



the field. Since tillering has a direct effect on yield, they realized that they had a problem. They transplant late because of the risk of flooding—tall plants survive better in deep water than do short ones. Farmers deduced that the only solution was to improve water management, and to do it as a community rather than as individuals. It took four days to excavate the drainage canal and the results are more options for improving their rice-farming. With water control, it is easier to control weeds and less risky to use fertilizers. Now the farmers are using a contractor to plow their land before the season, so that they have a basis for draining the fields and doing other activities as needed. Without community action, individual farmers could not afford for the contractor to come for them alone.

In Lokakpli, farmers learnt that the efficiency of nitrogen-fertilizer application depends on the roots' ability to absorb nutrients and on the plants' development stage. Thus, applying nitrogen just after transplanting is almost useless, as damaged roots do not absorb nutrients well. By waiting for a week after

Concerted action was required at Bamoro to improve water management



transplanting, much more of the nitrogen ends up in the plant. They also learnt that critical periods for nutrients are tillering and panicle-initiation—all from the cropping calendar.

Expanding the work

In February–March 2002, WARDA held a training workshop on PLAR-ICM, for 40 researchers, extension agents and NGO representatives from Benin, Burkina Faso, Côte d'Ivoire, Guinea, Mali, Senegal and Togo. Dembélé and his fellow farmer-trainers also attended to give first-hand accounts of the pilot work in Côte d'Ivoire.

Subsequently, PLAR-ICM activities were started in Benin, Burkina Faso, Guinea, Mali and Togo. “There were also five additional sites in Côte d’Ivoire,” Defoer says, “namely, Daloa, Gagnoa, Korhogo, Sakassou and Yamoussoukro. There were also the four inland valleys in the vicinity of the pilot sites, where communities had actually *asked* for PLAR-ICM training. However, the Ivorian civil war intervened and so there is currently no follow-up at these sites.”

In April 2003, two representatives from PLAR teams in each of Benin, Mali and Togo met together with the WARDA team for a mini-workshop. The teams reported back on progress in the four selected sites and prepared plans for the 2003 season.

Curriculum for farmer learning

“The learning tools are the basis of the learning modules,” explains Defoer, “and together they form a curriculum for farmer learning. The learning modules help change-agents to master adult-learning principles based on farmers’ knowledge and experiences, and to bring in new insights at the right moment during the learning process.” The PLAR-ICM curriculum for farmer learning is a major outcome of the pilot project and the follow-up training workshop. The curriculum is made up of 28 modules that address relevant issues throughout the growing season (*see* Box ‘The PLAR-ICM curriculum for farmer learning’).

Two publications have been drafted by Defoer and colleagues: A facilitator’s guide and a technical manual. These will be published in both English and French in 2003.

Bright future for PLAR-ICM and inland-valley farmers

“With the publication of the two books in 2003, the way will be open for PLAR to spread beyond WARDA,” explains Information Officer Guy Manners. “In fact, interest has already been expressed by the Technical Centre for Agricultural and Rural

The PLAR-ICM curriculum for farmer learning

Start of PLAR-ICM

- Identification of the site
- Module 1: Starting the PLAR-ICM curriculum

Before the growing season

- Module 2: Making a map of the inland valley
- Module 3: Making a transect walk
- Module 4: Managing water in the valley
- Module 5: Using good seed and varieties
- Module 6: Planning good management practices

During the growing season

- Module 7: Preparing the land for rice transplanting
- Module 8: Making a nursery
- Module 9: Planning and time management
- Module 10: For a healthy soil
- Module 11: Making field observations: Land preparation (nursery)
- Module 12: Good transplantation and setting up experiments
- Module 13: Evaluation: Knowledge test
- Module 14: Making field observations: Transplanting and vegetative stage
- Module 15: Recognizing weeds
- Module 16: Managing weeds in an integrated way
- Module 17: Using herbicides efficiently
- Module 18: Making field observations: The vegetative stage
- Module 19: Managing experiments and making field observations
- Module 20: Knowing the insects in rice cultivation
- Module 21: Managing insects in an integrated way: Stem borers
- Module 22: Managing insects in an integrated way: Rice gall midge
- Module 23: Making field observations: Reproductive phase
- Module 24: Managing experiments and making field observations

After the growing season

- Module 25: Harvesting and post-harvest operations
- Module 26: Making the balance of the cropping season
- Module 27: Evaluating the PLAR-ICM

End of PLAR-ICM

- Module 28: Closing PLAR-ICM

More than one way to crack an egg: Participatory technology development in Benin and Nigeria

In terms described elsewhere in this Report, WARDA's project 'Farmer Participatory Improvement and Adaptation of Production Technology for Rainfed Rice-based Systems' comes under the 'positivist paradigm' (see Box 'Research paradigms and farmer participation,' page 24). But then, PLAR-ICM itself is still very much in the research phase, not yet ready for wide-scale adoption, and that is according to its principal proponent at WARDA, Technology Transfer Agronomist Toon Defoer. "WARDA is not in the business of putting all its eggs in one basket," explains James Sumberg, Program Leader, Rice Policy and Development Program. "If there are other ways of doing things efficiently, we are prepared to try them."

From a review of existing literature and discussions with partner institutions (especially research institutes, universities and government agencies), four key-sites were selected—one each in Ogun State, Kogi State and Eboyi State in Nigeria, and one comprising two *sous-prefectures* (Dassa and Glazoue) in Benin.

"The first field activities for the project started in April 2000," explains Participatory Technology Development (PTD) Scientist Augustin Munyemana. "These were the establishment of demonstration farms in each of the key-sites." From among the farms available in each key-site, one was chosen for the WARDA demonstrations on the basis of its representativeness of the other farms in the key-site, and its accessibility to the target population of key-site farmers (and other visitors). "All available technologies—both modern and traditional—are established and demonstrated by WARDA staff," explains Munyemana, "so that the various stakeholders (especially the farmers themselves) can see the potential of each technology and decide whether or not to try it out." The demonstration farms form the focus of field days, where they provide a forum for interaction among researchers, extension agents and farmers. "We see the demonstration farm as providing an interface between technology generation, adaptation and dissemination," explains Munyemana.

At each key-site, rice stakeholders were invited to planning meetings in June and July 2000, and subsequently at the end of each crop season. "A typical stakeholder meeting has about 100 participants," says Munyemana, "of which, about 80% are farmers; the rest being made up from rice-consumers, marketers, researchers, development and extension agencies, and NGOs." The initial stakeholder meeting seeks to identify the main constraints to increased productivity (often achieved with the aid of a 'problem tree'), identify possible solutions, and decide which of the technologies 'on offer' should be tested and who will do the testing.

Before each crop season, a smaller group, known as the 'technology group' and comprising 10–20 nominees from the stakeholder meeting, meets to determine the practicalities—for example, layout of the field-trials, what data should be collected by the farmers—and establish a calendar of events including the timing of a mid-season field day.

Each village then organizes its own (on-farm) trials. The choice of farmers to host and manage each trial is determined by the community of farmers among themselves. Community members and project staff work together to determine the technologies and trial-layouts to be used; however, each trial is managed by the farmer whose field is hosting it. Evaluation of each trial is done at community level, and the community also decides on any adjustments.

"Around the middle of the season, each key-site holds a field day," says Munyemana. "All the collaborators and stakeholders are invited and the technologies are evaluated on site. The focus is usually the research-managed demonstration farm, but opportunity is also given for 'real-world' evaluation of the on-farm trials.

"In addition to the field days, we have had many farmers requesting the opportunity to visit trials on other farms. These are really farmer-to-farmer visits, but WARDA and its partners are happy to facilitate such activities."

After harvest, each village holds a feedback meeting, where the demonstration and season's activities are critically assessed. Focus is on what the participants think about the results and what problems were encountered through the season. It is at this meeting that the community decides which activities to continue with and whether any other activities should be introduced (and, if so, which ones). The feedback meeting elects farmers' representatives to the technology group for the next season, and provides input (feedback) into the next stakeholders meeting.

"Thus, the whole exercise is a cycle," explains Munyemana, "from stakeholder planning, through technology group decisions, establishment of trials, mid-season field day and post-harvest feedback meeting, back to the next stakeholder meeting."

Testing, testing

So much for the logistics, but what are the farmers in the key-sites actually testing and what results are being generated? "We have to remember," says Munyemana, "that farmers are all different: one may face a completely different problem in his field from his neighbor, while another may simply look at the same problem in a completely different way."

Let's look, for example, at what happened when one community was offered a new rice variety. Some farmers wanted to grow the rice with other crops, others were concerned about making the most of the quantity of fertilizer they could afford, and one was concerned about the division of time between farming and fishing! In the experimental set-up, farmers were assigned trials so that the various combinations could be tested: one intercropped rice with cassava, and then planted a rotation crop of cowpea; another intercropped the rice with maize, and then rotated with a legume crop; a third tested the idea of combining rice and fish in the same field. "We at WARDA had no experience of aquaculture before this project," says Munyemana, "so we called in outside expertise to advise on setting up the trial. So far, it has been successful—fancy scooping your fish-dinner out the same field where you have been busy working your rice crop all day long!"

In addition, each of the trials mentioned above could be combined with alternative soil-fertility management options, such as mineral fertilizer, rock-phosphate and green fertilizer or compost.

Results from the first phase

WARDA monitors progress at each site throughout the season with an extensive questionnaire, different from the one the technology group establishes for the farmers to use for their monitoring.

"I see positive results from the first phase in four areas," says Munyemana. "First, the methodology itself, which has been adopted by the Nigerian Agricultural Development Projects for planning and executing of a range of crop-related activities, not just for rice. Second, we have clearly determined the variety needs by location in each key-site. Third, we have identified good complementary technologies to help improve the profitability of systems where rice is not the dominant component; for example, the rice–fish system, and a rice-specific compound-fertilizer that we helped develop and test. And finally, but by no means least, in training." The project is funded by the German Government (BMZ) through its agency GTZ and, and it has a big training component. Across four key-sites, six students are working towards obtaining PhD degrees in 2004. In addition, four first-degree students each conducted a three-month field study with the project, and some 300 or so national research and extension partners have been trained in various aspects of participatory technology development.

Future

The donors visited project and partner sites—Ibadan, Ikenne, Abeokuta and Lokoja in Nigeria, and Dassa and Glazoue in Benin—from 23 February to 9 March 2003 to evaluate the project, concluding:

"The project has successfully operated for three years. The PTD approach has been implemented with relevant partners and in a coherent way. A wealth of data on bio-physical and socio-economic aspects of rice production [has] been collected. ... A second project phase is justified."

The evaluation team recommend that the second phase should have a 'utilization' focus (what will be produced, who will use it, what benefit is expected); strengthen research on principles and processes of PTD; broaden the project scope; clarify the concept of knowledge-broker; and explore a stronger role for farmers' organizations.

"One aspect that may contribute to the success of the methodology is its potential to become self-sustaining," enthuses Munyemana. "We have seen that where technologies benefit the stakeholders, those stakeholders are willing to pay back some of the profit to improve the advisory service." Munyemana and his team have devised what they call a 'knowledge-broker system,' whereby extension agents will sell what they have to offer (in terms of knowledge) to the communities that are interested. Testing this system is going to be a major innovation in the second phase of the project (due to start in 2003). "If the system works," Munyemana says, "we will have found a way for extension agencies to become partly self-financing, which may in time even lead to privatization!"

Cooperation (CTA), the UK Department for International Development (DFID) and the International Fertilizer Development Center (IFDC)."

"PLAR is a living process," says Defoer. "The PLAR that has been developed for inland-valley rice-based systems is not the same as that for integrated soil-fertility management, and the adaptations of PLAR in individual settings will show its dynamic nature and ability to cope with diverse situations." Defoer might be the driving force behind WARDA's PLAR projects, but "everyone who comes into contact with the program contributes to its development," he says. "That's part of the beauty of the system!"

Having proved its value with integrated soil-fertility management and ICM, "the PLAR approach will gradually be extended to other crops and deal with diverse aspects of inland-valley systems," says Kiepe. He goes further: "As inland valleys have other

important social and ecological functions, PLAR will likely become the approach to deal with integrated natural-resource management in general."

Perhaps the ultimate objective is for PLAR to become the extension approach and that the process will be scaled up to all zones where inland-valley rice-based systems are important. This has already started with the first Rural Knowledge Center in Bamoro–Lokakpli, and farmer-trainers like Dembélé selling their services to other farmers' groups. On a larger scale, making PLAR the extension method of choice will require serious commitment from all research and development bodies involved in these systems. "One critical aspect," says Defoer, "is to determine the optimal density of Rural Knowledge Centers that the national extension service can handle and that will allow sufficient coverage of the area for farmer-to-farmer exchange and learning."

Assessing the Impact of NERICA Rice Varieties: Not Just Surveys and Simple Mathematics

IM-PACT ASSESSMENT' has been a 'buzz-word' among donors for some years now. It has become so important that WARDA hired its own Impact Assessment Economist in 2000. Does that seem like a lot of money to spend on simply measuring how well we're doing our job? After all, it's only a matter of a little survey work and some simple calculations, isn't it?

Why does WARDA carry out rice research and development? Surely one answer might be: To improve rice production and rice productivity in its member states. Perhaps a more general answer might be: To improve 'something.'

Much of WARDA's funding comes from 'public funds,' either from donor countries or from the member states themselves. For some years now, there has been an onus on governments to show their citizens what they do with their taxes. Consequently, there has been the knock-on effect that donor agencies ask organizations like WARDA to show what they have achieved with the money that they have been given. Thus, WARDA (and many other organizations worldwide) has to assess its impact or, put another way, conduct impact assessment.

After a strong recommendation from WARDA's External Program and Management Review in early 2000, Aliou Diagne was recruited as Impact Assessment Economist in mid-2000. In particular, WARDA wanted to know the real impact of its technologies rather than relying on anecdotal data. This

was especially so in relation to the NERICA rice varieties that 'took the world by storm' as their fame spread after the Millennium CGIAR King Baudouin Award was presented to WARDA for the NERICA work.

What do we improve, what do we measure?

"One of the crucial aspects," explains Diagne, "is adapting impact-assessment techniques to modern demands." In the past, researchers had been satisfied with a simplistic approach to impact, they wanted answers to questions like: "How many farmers have adopted the technology?" and "How much of the rice area is under the influence of my technology?"

"Like other CG Centers, WARDA now has a mission to reduce poverty, so our stakeholders rightly want to know how well we are doing," explains Diagne. "Now, we have to ask questions related to social welfare—for example, do the farmers have an 'easier' life as a result of adopting our technology? Do

consumers have cheaper rice on the market? Do farming families have cash to spend on improving their lives in general, like investing in health-care? And then there are broader issues of the overall benefit to communities, questions of equity, gender and environmental impact.” WARDA Management also needs such information to improve the relevance, effectiveness and efficiency of the Center’s research.

Given these complexities, Diagne has invested some time working on methodology—in other words, what is the best way of making such impact assessments. “What one has to bear in mind,” explains Diagne, “is that there is a fundamental problem to all evaluation work, namely that it is impossible to observe the counter-factual outcome corresponding to any technological, institutional or policy change being considered. In other words, if the change does occur, one cannot observe what would have happened to the outcomes in the absence of the change, and vice versa.” In addition to developing methodology, Diagne and his team also spent a lot of time collecting plot and household data (such as income and consumption) to provide a baseline from which to assess impact on poverty and livelihoods.

So, what about those varieties?

“We have made strong claims about our NERICA varieties,” says Director General Kanayo F. Nwanze. “Now we need some hard evidence on how well they are doing in the farmers’ fields.”

Varieties in Côte d'Ivoire

“Before we look at the NERICAs in particular, it is necessary to have a broader look at variety use on farm in general,” says Diagne. “What is more, we still have to start with adoption studies—after all, how can we determine the effects of, say, new varieties on poverty if we don’t know how widespread those varieties are within farming communities?” To this end, surveys were conducted in 2000, within the framework of a

project, funded by the UK Department for International Development (DFID), on rice biodiversity and the history of variety use and diffusion, in and around four sites that had been exposed to new varieties. Some 1500 farmers in 50 villages were sampled covering both those where WARDA had been active and neighboring villages that had not previously been visited by WARDA staff.

“The results are shocking!” exclaims Head of WARDA’s Genetic Resources Unit Gouantoueu Guei, “especially for those who expect instant adoption and impact.”

The average village community knows about 25 varieties, of which 21 are traditional varieties and four modern. The four modern varieties comprise three extended by the national program and one from WARDA.

Meanwhile, the average individual farmer knows 14 varieties—typically 12 traditional and two modern. However, from those that he knows, he only grows four in any one season—three traditional and one modern. Overall, 75% of farmers surveyed knew at least one modern variety, while 28% knew at least one WARDA variety.

Over the five years 1996 to 2000, average farmer portfolio (of cultivated varieties) increased from 3.4 to 4, with increases in all classes (i.e. traditional, NARS and WARDA)—see Figure 4. Over the same period, the proportion of farmers growing each type of variety also increased (Fig. 5).

What does this low level of adoption of WARDA varieties mean for WARDA? Has it failed in its mission? “By no means!” says Diagne. “What we are seeing here is typical of variety adoption patterns—there is a long time-lag between development of a variety, its release and subsequent wide-scale adoption.”

Ivorian student Yao Djea was brought in to study this very issue as part of his DEA [like Master’s] degree.

Figure 4. Type and average number of rice varieties cultivated by a farmer

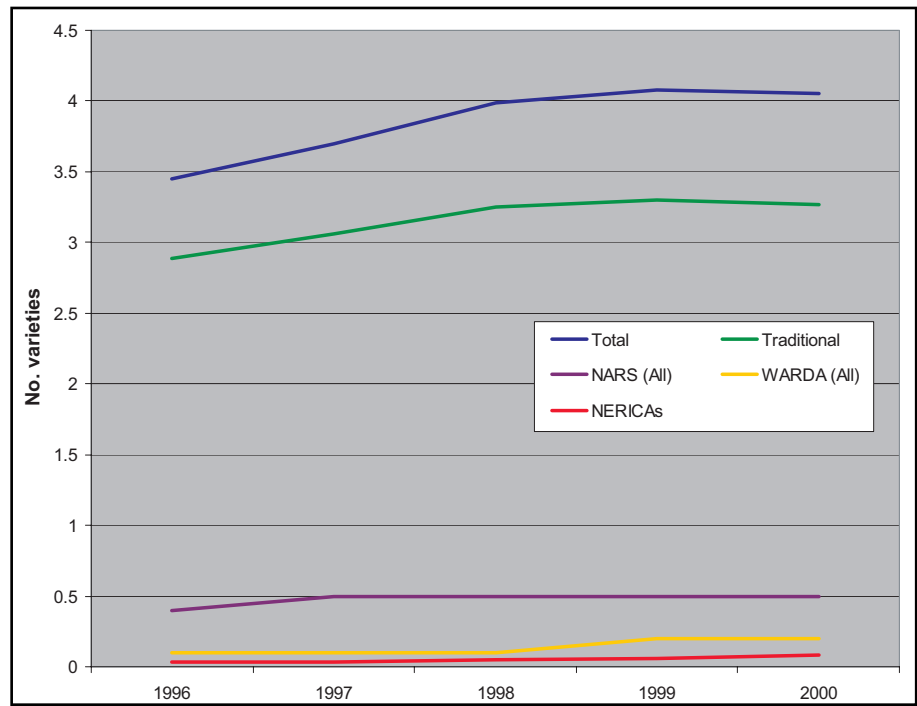
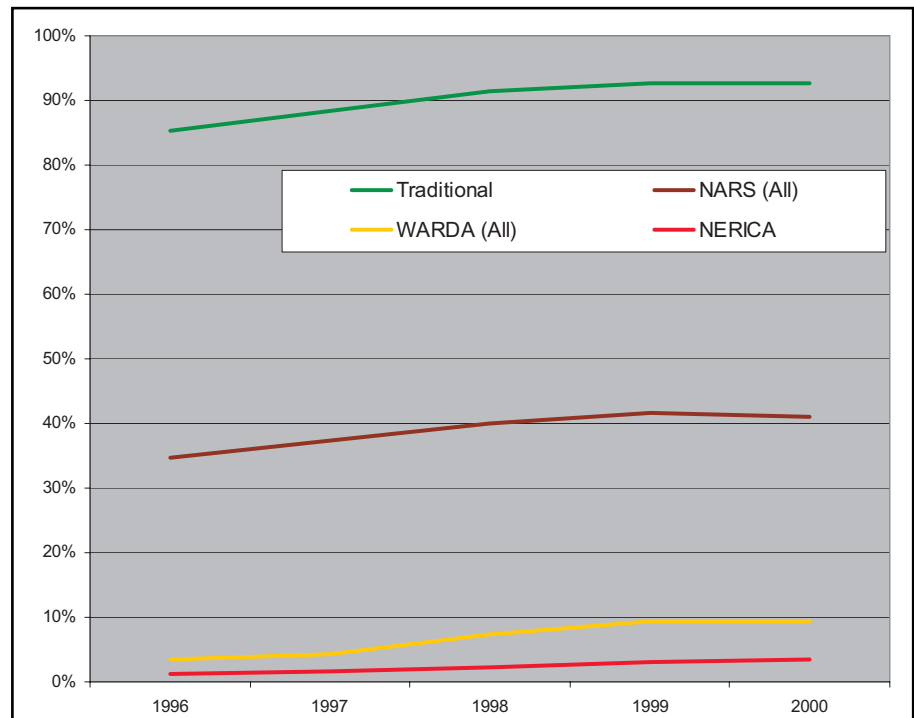


Figure 5. Proportion of farmers cultivating each type of variety



“The dates and figures really speak for themselves,” he explains. “The national program started introducing modern varieties in 1973—though some of them had been introduced by the French and Chinese in the early 1960s. After 27 years, they can claim up to a 14% stake in the average farmer’s variety knowledge and up to a 25% stake in his portfolio per year. WARDA varieties were not available in Côte d’Ivoire until 1989, and none was actually officially released until 1998, so we should not expect them to have had much impact by 2000.”

So, what we are saying is that it is perhaps too early to measure the impact of WARDA varieties in Côte d’Ivoire.

Similar studies are being conducted in Guinea. “The results are not yet available from Guinea,” explains Diagne, “but I would expect some differences in adoption rates of, especially, WARDA varieties, because of the Government program to revitalize the upland-rice sector with support from Sasakawa Global 2000, and using WARDA varieties. The main constraint to the adoption of modern varieties of all types is the diffusion rate and its consequent effect on farmer knowledge about such varieties.”

A closer look at the NERICAs and their adoption

Having said that it is too early to assess the overall impact of NERICAs to date, it is perhaps only fair to look at their impact on those communities that have been exposed to them, and thence estimate their potential impact if they were widely disseminated (as proposed by the African Rice Initiative, ARI).

Let us first take a closer look at the NERICAs themselves. Anyone familiar with WARDA’s work over the last decade is sure to know about NERICA, but let us recap for the newcomers.

NERICA—New Rice for Africa—was developed at WARDA by the crossing of ‘Asian’ rice *Oryza sativa* with indigenous African rice *O. glaberrima*. The goal of the breeding program was to combine the yield-related attributes of the Asian (e.g. non-shattering heads,

The problem of identification

“One of the principal problems to variety impact work is collecting quality data,” says Impact Assessment Economist Aliou Diagne. “This is especially a problem when we want data separated out for something special, such as the NERICA varieties.”

Key to collecting data specifically on NERICAs, is the ability of everyone involved to be able to identify the varieties concerned. One issue here is naming: “WARDA did not help itself in the early days,” says Diagne, “because it distributed large numbers of varieties for participatory varietal selection (PVS) trials under complex code-names developed by breeders. Names like WAB450-11-1-P31-1-HB and WAB450-11-1-1-P31-HB were simply asking for clerical errors to creep in!” The names also caused problems for the farmers, who tend not to relate well to the abstract ideas of letters and numbers for their varieties.

“Farmers tend to give varieties that they adopt their own names,” explains Head of Genetic Resources Unit Gouantoueu Guei. WARDA has reported before that varieties adopted from PVS trials have been dubbed ‘ADRAO rice,’ with no further distinction.

Once we start looking at farmers who have not participated in WARDA-led trials, naming gets even more complicated. Farmers may name a variety after the neighbor or village they obtained the seed from, and may have no idea what a NERICA is compared to any other modern variety.

“If the naming issue is not bad enough, even participating farmers have difficulty in distinguishing some varieties from each other,” explains Diagne. “To help overcome this problem, later survey teams took seed samples of the varieties known to be in each community for direct comparison with the farmers’ grain and consequent identification of varieties.”

“Astonishing as it may seem given the level of exposure to WARDA varieties there, farmers and researchers in Guinea experience exactly the same problems with names and variety identification!” exclaims Director General Kanayo F. Nwanze.

A related issue was raised when surveyors tried to determine the area planted to each variety. “Given the complication of naming and identification, and the irregular shape of upland rice fields, it is not surprising that farmers cannot provide area data by variety,” explains Diagne. “To overcome this, we are combining in-the-field identification with field measurement and global position satellite (GPS) technology.”

resistance to lodging, yield potential) with the local adaptation of the African (e.g. pest resistance, drought tolerance, weed-suppression). “As with any hybridization, what we should expect from the offspring is some sort of middle ground between the parents,” says Diagne, “and if we achieve that, we should say that we have succeeded.”

Regular readers of these Reports will be aware that some NERICA lines in fact out-perform their parents. For example, some lines have significantly more protein than the parent with the highest protein content, and some lines have considerably more grains in their panicles than either parent.

“The main drawbacks to NERICA adoption to date,” explains Diagne, “are the relatively few farmers who have been exposed to them and seed supply. Côte d’Ivoire released the first two NERICAs late in 2000, but still could not meet demand for seed for the 2002 [pre-war] planting season.” Prior to 2000, and starting as recently as 1996, NERICA diffusion was entirely through research activities, such as participatory varietal selection (PVS) and on-farm trials. “In our survey, only 139 of the 1500 farmers questioned had even *heard* about NERICAs—that is only 9% of the sample population!”

With only 9% of the sample having been exposed to NERICAs, it is no surprise that we find that the proportion of sample farmers who have adopted them is a mere 4%. But, according to Diagne, this commonly calculated ‘sample adoption rate’ (i.e. the proportion of the sample that has adopted) is a very biased estimate of the true *population* adoption rate, because it suffers from what he calls ‘non-exposure’ bias.

The ‘non-exposure’ bias results from the fact that farmers who have not been exposed to a variety cannot adopt it *even if they might have done so had they known about it*. This results in the *population* adoption rate being underestimated; however, this underestimation decreases and eventually disappears as the exposure

of the population to the new variety increases (*see* Fig. 8, page 40).

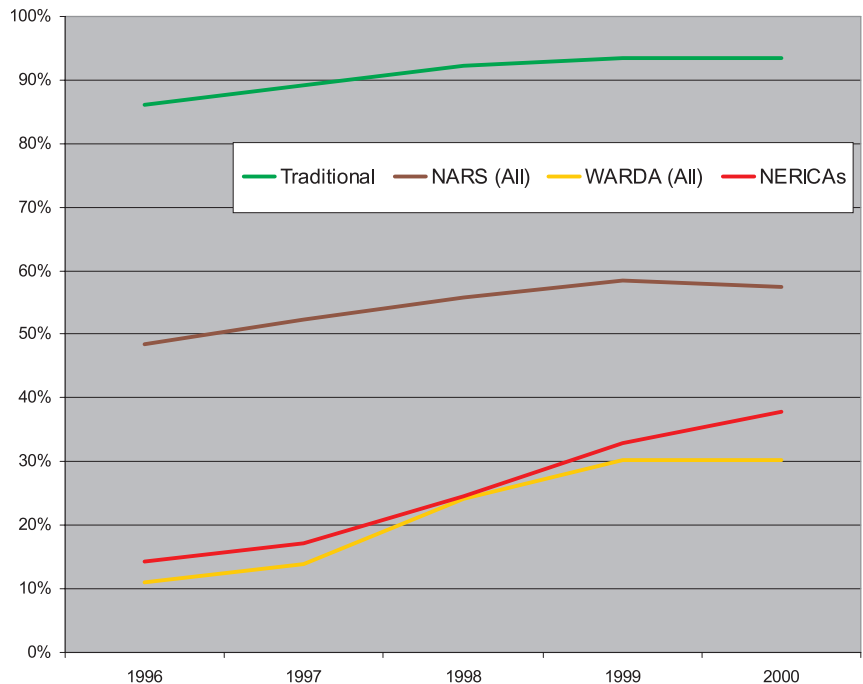
In fact, the sample adoption rate is an estimate of population exposure *and* adoption rate, namely, the proportion of farmers in the total population who have been exposed to the variety *and* who have adopted it. However, the question we are interested in (in an adoption study) is the extent to which farmers *like* a given variety and not the extent to which they *know* about it. Indeed, it is the answer to the question “how much is a variety liked?” that provides feedback to researchers about the suitability of their research in meeting the needs of the target population—in our context, it also provides the feedback to donors and research managers on whether the NERICAs are living up to their reputation as being well liked by farmers. The answer to the question “how well-known is the variety?” is most useful for extension purposes.

Thus, our 4% adoption rate of NERICAs provides little information on the population adoption rate because exposure is so low.

“If we look only at those farmers who have been exposed to NERICAs, however, and given the short time since their initial exposure to them, the adoption rates are impressive,” says Diagne (*see* Fig. 6). Some 38% of farmers in the study area who had been exposed to NERICAs had adopted them by 2000. So, potential impact is merely a matter of extrapolating from that figure? “Not exactly,” says Diagne. “We have to bear in mind that there is a certain selection bias of those exposed that is reflected in the sample, even if the sample is randomly selected from the population.”

Those who adopt NERICA have first to have heard about NERICA. The first group of those who know about NERICA is those who have been involved in some sort of trials—on-farm, PVS or community-based seed production. “Here we see a bias in targeting by the research and extension agencies,” explains Diagne, “toward progressive farmers, who are more likely to adopt new technologies than the ‘average’ farmer.”

Figure 6. Proportion of farmers cultivating each type of variety among those exposed to those variety types



Then there is the self-selection process of non-participant farmers who learn about and subsequently adopt NERICAs. “Those farmers that actively seek out improved technologies are more likely to find out about the NERICAs first *and* are more likely to adopt them,” explains Diagne.

These biases affecting the exposure of farmers lead to an overestimation of impact, as adoption rate among those exposed to date is greater than what is expected once the whole population is exposed (*see* Box ‘The problem of selection bias’).

How then, under partial exposure, can one obtain a good estimate of the true population adoption rate if the only two adoption rates that can be calculated are excluded on the basis of their inherent biases? “This is where modern impact-assessment methodology based on what we call ‘the counterfactual setting framework,’ comes to the rescue,” explains Diagne.

The true population adoption rate corresponds to what is defined as the ‘average treatment effect’ (or ATE), which is the effect of ‘treatment’ (in our case, exposure) on an outcome (in our case, adoption) of a person randomly selected from the population. In addition, impact-assessment researchers define ‘average treatment effect on the treated’ (ATE1)—the effect of treatment on the sub-population of those actually treated. In the NERICA studies, this amounts to the adoption rate among those exposed.

Consistent estimation of ATE requires appropriate control for exposure status and for the demographic, institutional and socio-economic factors that influence both exposure and adoption. The exception to this is when treatment is randomly applied across the population, in which case ATE equals ATE1 and equates to true population adoption rate.

The problem of selection bias

The overall farmer population can be divided into two groups: the 'adopter types,' who will adopt the particular variety once they have been exposed to it, and the 'non-adopter types,' who will not adopt the variety even after they have been exposed to it. In our analyses, it is assumed that any particular farmer's type is not evident until such time as he or she is exposed to the variety in question. Thus, until the whole population has been exposed to the variety, the overall ratio of 'adopter types' to 'non-adopter types'—which would give us the population adoption rate—is unknown.

We illustrate this in Figure 7. 'Adopter types' are indicated by ⊕, and 'non-adopter types' by ⊗. The general situation is illustrated in A, where 'adopter types' and 'non-adopter' types are randomly distributed through the population. At the time of the impact-assessment survey, some farmers have been exposed to the variety; their type is now known and they are shown by color-reversed symbols (B). The survey sample itself is made up of a random sample from the whole population, comprising a mixture of adopters (exposed), exposed non-adopters, unexposed non-adopters and unexposed 'adopter types.' It is only when the ratio of adopter types to non-adopter types is the same among exposed farmers as it is in the whole population that the sample adoption rate among exposed farmers represents the population adoption rate (scenario C in Fig. 8). However, when the proportion of adopter types is higher among the exposed group (as is expected to be the case for the NERICAs), the sample (Fig. 7C) adoption rate among the exposed will exceed that of the population (see Box 'The effects of non-exposure and selection biases on estimations of population adoption level,' page 40).

The sample adoption rate itself is always lower than the true population rate when exposure of the population is not complete (scenarios A, B and C in Fig. 8).

Figure 7.
Population non-exposure and selection biases—the effect of partial non-random exposure among 'adopter type' (⊕) and 'non-adopter type' (⊗) farmers (see text above)

| | | |
|-----------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A Population before exposure | | Total population size = 100 Adopter types = 40 Non-adopter types = 60 Expected population adoption rate = 40/100 = 40% |
| B Population after partial exposure | | Exposed subpopulation size = 20 Number of adopters among the exposed = 12 Population exposure and adoption rate = 12/100 = 12% Adoption rate among the exposed = 12/20 = 60% |
| C Random sample from the partially exposed population | | Random sample size = 25 Sample number of exposed = 5 Sample number of (revealed) adopters = 3 Sample adoption rate = 3/25 = 12% Sample adoption rate among the exposed = 3/5 = 60% |

The effects of non-exposure and selection biases on estimations of population adoption level

The targeting of dissemination activities for new varieties (and other technologies) has a direct impact on the applicability of sample adoption rate to population adoption rate. As discussed in the main text, the NERICA program is still in its early days, and exposure is strongly influenced by selection biases favoring the exposure of 'adopter type' farmers in the early years. Figure 8 illustrates the effects of non-exposure and selection biases on estimates of population adoption; scenario A best represents the current situation in assessing the adoption impact of NERICAs.

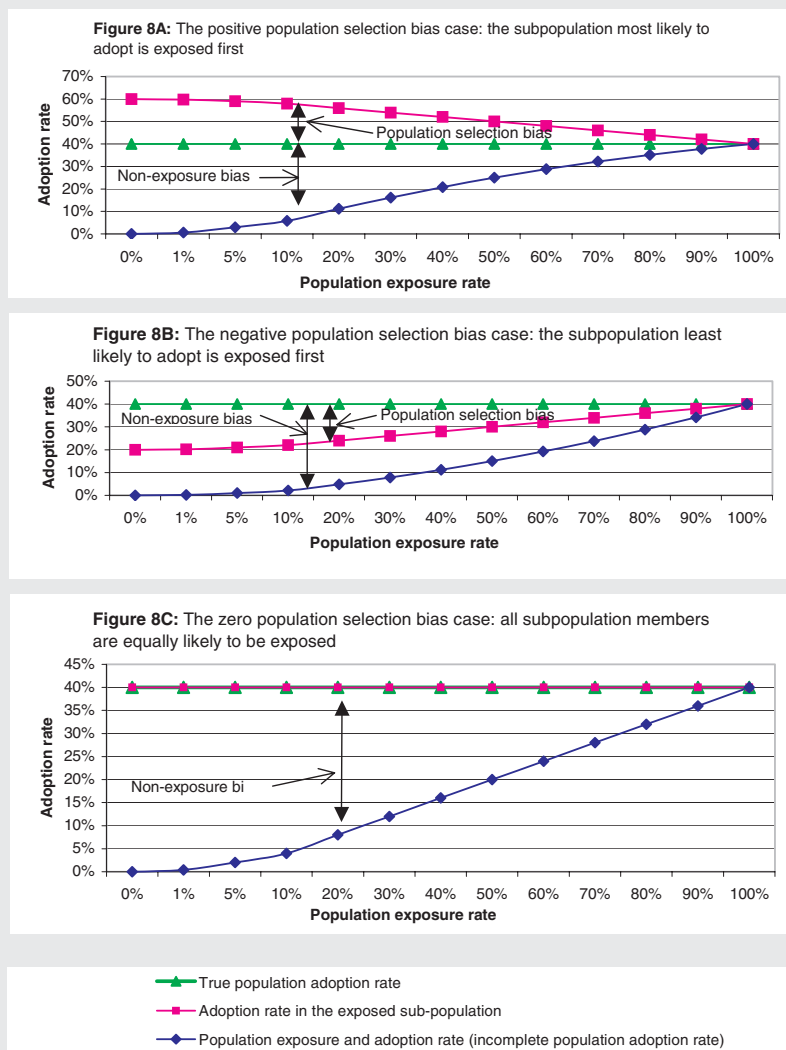


Figure 8. Population adoption rates and non-exposure and selection biases as function of exposure rate

The potential of the NERICAs

At the end of the day, Diagne determined that *if* the whole rice-farming population had been exposed to NERICAs in or before 2000, then the adoption rate in 2000 would have been 27%. Thus, we can see a significant and large effect of ‘non-exposure bias’ in the ‘sample adoption rate’ of 4%. In other words, 23% (= 27 – 4) of the total farmer population is determined as being ‘adopter types’ who had not been exposed to NERICAs at the time of the survey.

There is also a positive effect of past adoption. For example, the effect of adoption in 1999 on adoption in 2000. This can be compounded and projected as in Fig. 9 (page 41). The projection shows a long-term adoption rate of 76%; however, there is a long time-lag of about 25 years to this point of ‘maximum’ adoption. Nevertheless, NERICA adoption is projected to rise rapidly from the 2000 level, reaching 68% as early as 2006. So, we can say that about two-thirds of the population would have adopted NERICAs by 2006, if the whole population had been exposed in or by 2000.

This indicates a large potential impact for any large-scale NERICA dissemination project.

“This does not mean that we expect two-thirds of the farming population to have adopted NERICAs by 2006,” Diagne says, “but it is the nearest estimate that we can generate at this time, in terms of the extent to which NERICAs will be liked (or demanded) by the rice-farming population at that time.

“Ultimately, actual adoption will be influenced by new and external factors and may be either greater than or less than the estimate we have today.” One such new factor is the drive to promote NERICAs through the African Rice Initiative throughout Sub-Saharan Africa, the aim of which is to encourage even greater diffusion and adoption of NERICAs. Another factor is the ongoing generation of NERICAs, which may play a significant role in the future adoption figures.

“NERICA is a technology, not simply a product,” explains Rice Breeder Howard Gridley. “The technology is in place to generate new NERICA lines and these should be fitted to farmers’ needs and introduced into the variety portfolios as needed.”

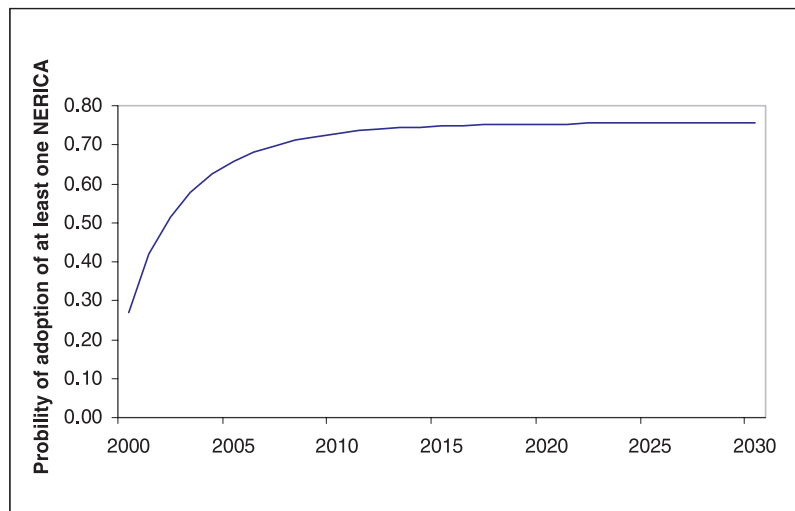


Figure 9. Projected NERICA adoption over time

On-farm and Community Management of Rice Biodiversity

For some years, there has been growing concern about the potential loss of biodiversity as research world-wide generates more and more crop varieties, each one reportedly better than the last. WARDA has, therefore, been assessing farmers' management of their rice biodiversity and the impact of modern varieties in Côte d'Ivoire.

"Talk to any rice farmer in west-central or western Côte d'Ivoire, and he (or she) will most likely tell you that he/she grows between five and ten rice varieties in any one year," says Head of WARDA's Genetic Resources Unit, Gouantoueu Guei. "But how do farmers decide which varieties they are going to grow this year, and how do they ensure that the varieties they choose not to grow will still be available next year should they decide to go back to them? How and why are landraces—or old varieties—kept from generation to generation by farmers and what determines farmers' choice of varieties to grow?"

To answer these questions, WARDA conducted surveys over two growing seasons in four areas of Côte d'Ivoire—Danané and Gagnoa in the forest zone, and Boundiali and Touba in the savanna zone. "We visited farmers' fields and their seed stores," explains Yoboué N'guéssan, former Visiting Scientist at WARDA, who conducted the surveys with Guei, "to collect seeds of each variety identified by the farmer, along with details on location, origin of seed, why the farmer uses that particular variety, and so on." At the end of two seasons, the team had plenty to work on—1673 seed samples from 306 farmers in 57 villages, and all the related data!

The value of varieties

"Farmers' handling of rice varieties is a complex issue," Guei says, "but essentially it seems that individual farmers manage biodiversity and conserve varieties in the short term, while the community—either by conscious collective effort or simply as the sum of individuals' actions—does the same over the long term." After analysis of the survey results, Guei developed a model of rice biodiversity management at the community level (Fig. 10), which shows farmers

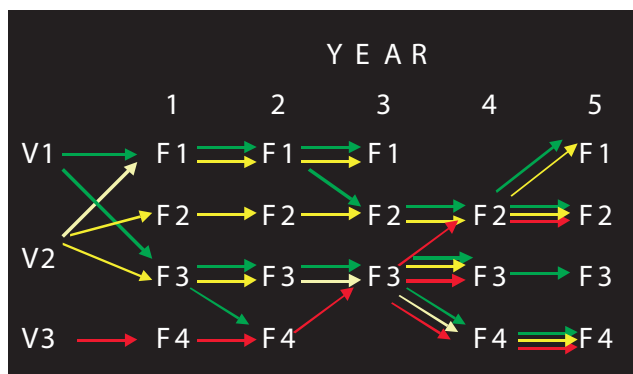


Figure 10. Model of rice biodiversity management at the community level

making deliberate decisions about which varieties to continue growing and which they want preserved within the community for future use. “Not every variety is grown by every farmer,” explains Guei. “So if, for example, a farmer has to travel during a season and is not going to be growing rice that year; if that farmer has a variety that he, or she, wants to keep, but that is not commonly grown by anyone else in the community, he (or she) may give some seed to a neighbor and ask them to grow it for that season, so that they will have seed for the next season. A variety may be abandoned in a village for some reason, but will not suddenly disappear in the farming community as farmers in neighboring villages may still keep it for other reasons.”

Individual varieties ‘mean’ different things to different farmers. There is of course the scientific—or rather, economic—value, which may be measured in terms of variety characteristics, such as yield, grain quality, cooking quality and processing quality, in other words, those things that breeders generally look at. However, there are also social and cultural values attached to specific varieties. For example, a variety may be part of a family’s heritage, because they have grown it over several generations of the family. Another variety might be valued for medicinal properties, like being good when someone has stomach problems. Yet another might carry a certain amount of prestige, as it is the traditional, or favored, variety at certain types of ceremony. “On top of all of these,” concludes Guei, “some varieties appear to have a certain mystic-spiritual value in certain communities.”

Related to the whole issue of value, is the farmers’ naming system for varieties. “What we found,” says N’guéssan, “is that farmers use a single name for what we might recognize as more than one variety; however, the name clusters varieties that have specific characteristics that the farmer is interested in.” Thus, the surveys found *Mlitti* and *Lognini*, both names for dark-grained rice; *Totoman*, which can be eaten without sauce; *Mlinkin*, for long-, fine-grained rice; *Guissi* for varieties that produce lots of tillers; *Mokossi* for tall,

vigorous varieties that suppress weeds; and, *Gaman* (Cowboy) for high-yielding, weed-suppressing varieties. Other typical naming systems are to adopt the name of the person who provided the farmer with the original seed, or the name of the village where the farmer discovered the variety.

“Farmers are opportunists,” Guei says, “always on the lookout for something new that might prove to be of interest.” It is not surprising, therefore, that each farmer has potential sources of seed. The most obvious source, perhaps, is the farmer’s own field, from which he (or she) may save the best grains as seed for next-year’s crop. In addition, seed may be bought on the local market, may be given as a gift, may be exchanged between farmers, may constitute payment (for example, for labor), or may come direct from research or extension services.

Scientific assessment of biodiversity

As we have seen, what farmers call a ‘variety’ does not coincide exactly with what science calls a variety. If we want to know about the real state of rice biodiversity, we need to separate variety from ‘variety.’

“Crop varieties are recognized by their characteristics,” explains Guei, “primarily morphological—what they look like—and agronomic—how they grow. For most crops, descriptors have been identified that, when taken in combination, give a good picture of any particular variety.” The team used 29 of the descriptors for rice published by the International Plant Genetic Resources Institute (IPGRI). “In order to have plants to characterize, we grew all the ‘varieties’ in irrigated lowland at WARDA’s research farm at M’Bé in 2001 to generate enough seed for further study. We then conducted a simple laboratory test to differentiate upland (*japonica*) varieties from lowland (*indica*) varieties. The following year, we re-grew the *japonica* varieties in upland at M’Bé, and the *indica* varieties in Danané.” These plants grown in their ‘correct’ habitat were duly scored for the 29 descriptors.

A rather complex statistical technique (known as ‘principal component analysis’) was then used to generate two-dimensional graphs of diversity within the samples. Figure 11 shows one such graph. Major findings were as follows.

- Across Côte d’Ivoire, *indicas* are more diverse than *japonicas*, both in terms of number of groups (3 v. 2) and relatedness within the identified groups.
- Within the *indicas*, diversity is most marked in plant height, cycle length, number of fertile tillers, and resistance to lodging.
- Most *indicas* from the savanna are short-to-medium duration and short-to-medium stature, while those from Gagnoa in the forest are mostly short duration and short stature. However, *indicas* from Danané (forest) are more diverse

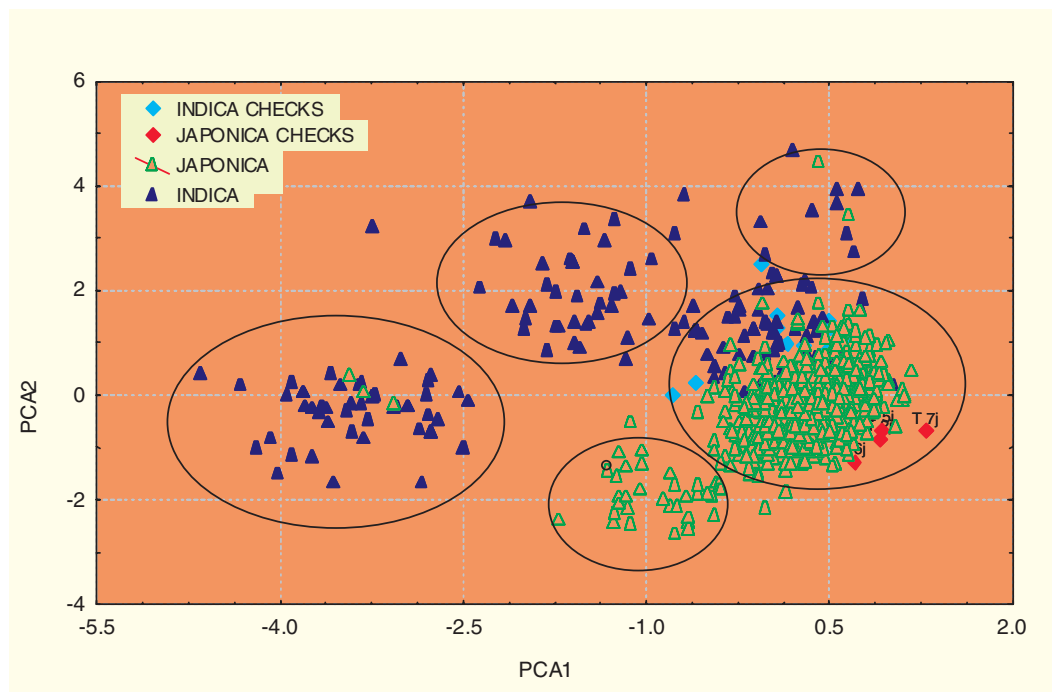
in both cycle and stature. It is suggested that growing rice in the short rainy season in Gagnoa has favored short-cycle types, while the single long rainy season in Danané allows time for long-duration types to mature.

- Most of the diversity in the *japonicas* is expressed in cycle length, plant height and leaf-width. All of the *japonicas* are medium-to-long duration, and tall.

“The next step in the process is molecular characterization,” explains Guei. “With biotechnology tools, it is possible to assess diversity at the gene level, and so really determine which samples are valid varieties and which duplicates.”

The WARDA genetic-resources team also wants to be able to offer breeders more options for traits like yield potential, grain quality and disease resistance.

Figure 11. ‘Principal component analysis’ graph of rice biodiversity in Côte d’Ivoire



“Some of the traits that our breeders are interested in are not included in the IPGRI characters,” says Guei, “so we will have to conduct more specific experiments targeting these traits.” The results reported here are only from Côte d’Ivoire; with 17 member states alone, there is plenty of scope for diversity studies in rice on a much broader scale.

“The value that we place on genetic resources was shown in the establishment of the Genetic Resources Unit in 1998,” concludes Director General Kanayo F. Nwanze. “With the appointment of Dr Guei as the head of that unit in 2003, we hope to see a growing contribution to WARDA’s activities, especially in plant breeding.”

Donor Country Profile: France

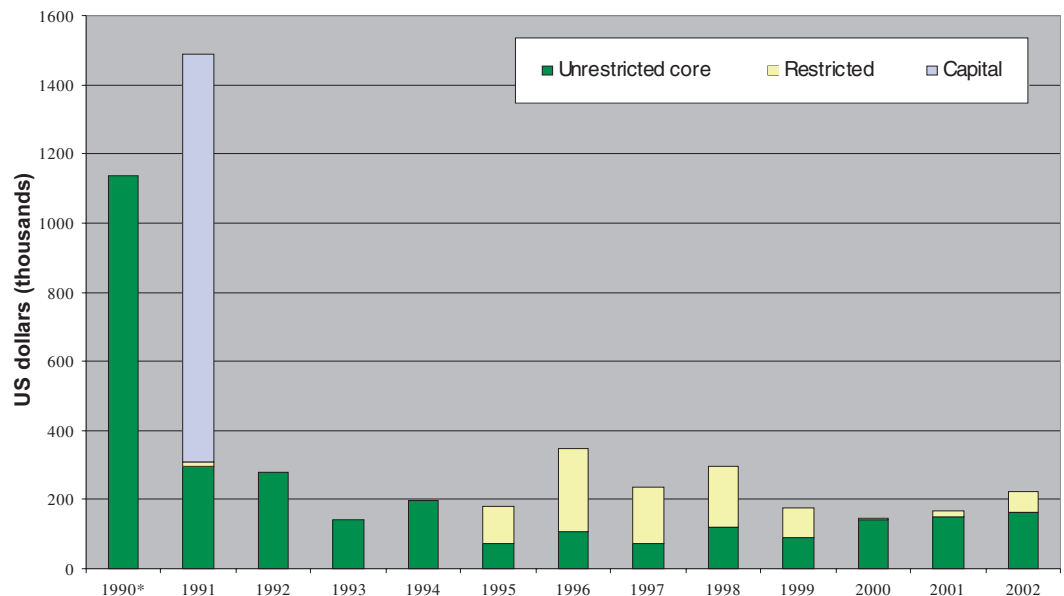
Perhaps among all the former pre-independence authorities, France has maintained the strongest links with its former colonies. With 11 of its 17 member states being former French colonies, it is not therefore surprising that WARDA has had cause to work closely with various French institutions. In this year's *Donor Country Profile*, we give a flavor of our collaborative work with France.

France has a long history of agricultural research in West Africa, and long-standing relationships with WARDA. The level of French funding to WARDA since 1990 is shown in Figure 12. “France’s contribution to WARDA has been across the spectrum,” explains Director General Kanayo F. Nwanze, “from unrestricted core funding, through special projects and

seconded specialists to capital investment in the major building works of the early 1990s.”

France has high expectations from its own research and development activities, including its collaboration with organizations like WARDA. The French research organizations have established a platform to review on-going collaborative activities and coordinate new

Figure 12. French contributions to WARDA’s budget, 1990–2002



*Data for 1990 combines unrestricted core and restricted funds.

directions—the *Commission Inter-Organismes* (CIO) involving *Centre de coopération internationale en recherche agronomique pour le développement* (CIRAD), *Institut national de recherches agronomiques* (INRA) and *Institut de recherche pour le développement* (IRD, formerly ORSTOM). As a rule, CIO and WARDA meet every two years. “These meetings serve a primary purpose for reviewing collaboration between WARDA and French research institutions,” explains Nwanze, “developing programs of work, and establishing modalities for the secondment of French scientists to WARDA and short-term exchange of staff.”

The last WARDA–CIO meeting was held in Montpellier, France, in June 1998. In 2000, WARDA and its French partners initiated discussions toward the next WARDA–CIO consultation in 2002. WARDA’s Director General and then Director of Research visited *Pôle international de recherche et d’enseignement supérieur agronomiques* (AGROPOLIS) in Montpellier in early July 2002 in preparation for the meeting. Extensive discussions were held at that time with a large number of research scientists and technicians. Major areas of research, programs and activities were identified, and it was agreed that an umbrella ‘Memorandum of Understanding’ (MOU) should be developed as a framework for future collaboration. A final discussion with senior administration of *Commission pour la recherche agronomique internationale* (CRAI) called for stronger international linkages and encouraged scientists to add value to their results through joint publications. The meeting scheduled for November 2002 had to be postponed as a result of the Ivorian crisis, and is expected to be rescheduled for the first quarter of 2004.

Plant physiology

Alain Audebert was seconded from CIRAD to WARDA in 1994, where he served as Plant Physiologist until 2002. In addition to his coming from a French

institution, much of Audebert’s work at WARDA was also funded by France. In eight years, the physiology team at WARDA, headed by Audebert, addressed three principal issues: iron toxicity in the lowlands, drought in rainfed systems, and physiological characteristics of NERICAs.

Audebert’s work on iron toxicity was reported in detail in last year’s report (*see* ‘Painting the Rice Red: Iron Toxicity in the Lowlands,’ *WARDA Annual Report 2001–2002*, pages 29–37). In March 2003, the iron-toxicity work was the subject of a regional workshop, held in Cotonou, Benin. The findings of the WARDA–CIRAD project were the main emphasis. Iron toxicity is present throughout the West Africa region, and the national agricultural research systems (NARS) are generally focusing on two approaches, namely breeding and fertilizer management. Meanwhile, the WARDA–CIRAD iron-toxicity project researched the iron-toxicity mechanism in rice.

The general discussion at the workshop raised the needs for: an integrated iron-toxicity research program covering all the NARS; management of multilocal trials; increased iron-toxicity surveys in the sub-region; harmonization of iron-toxicity evaluation criteria for rice; harmonization of screening methodology; and, continued basic research at WARDA.

When asked about drought, Audebert says: “Water stress is one of the most important production constraints to rainfed rice—lowland, hydromorphic and upland. Drought period is characterized by timing (during cropping season), duration and intensity. Depending on these parameters, drought resistance in rice is a complex of interacting physiological, phenological and morphological mechanisms for escape, avoidance, resistance and recovery, with different cultivars exhibiting different combinations of mechanisms.” However complex, drought resistance is exactly what one has to study if one wants to help in the efforts to breed varieties that will survive under drought conditions.

Typical effects of drought on a rice plant are: reduced height, reduced leaf area, reduced biomass (that is, total plant weight), changed rooting pattern, and delayed development. In addition, rice has the ability to abort some of its tillers in order to maintain minimum physiological activity in the remaining tillers. Drought stress during tillering stage prevents the appearance of new tillers, but at recovery a large number may appear at the same time; these, however, do not grow and develop. The extent of these reactions is dependant on the severity of the stress, so if the plants are subjected to a long period of drought they will be shorter, smaller and develop slower than plants subjected to a short period of drought.

In uplands, the team noted that plants under vegetative-stage drought stress had deeper roots than normal. This led to a careful study on the effects of drought on the distribution of growth patterns between droughted and non-droughted plants. The results showed that drought had no effect on the percentage growth of roots and above-ground parts. “We therefore deduced that the deeper roots were the result of growth following the moisture gradient in the soil, with the aim of tapping more water resources at lower depths,” explains Audebert.

One of the traits of African cultivated rice that breeders want to transfer into NERICA varieties is the species’ good adaptation to drought. In particular, *Oryza glaberrima* has ‘interesting’ leaf morphology: its leaves are thinner and have a low density of stomata—these are like pores or depressions in the leaf surface that enable the exchange of oxygen and carbon dioxide. A plant controls stomata apertures according to its water status (stomatal conductance). The stomata are also a route for plant evapo-transpiration—a process that needs to be minimized in drought conditions. In addition, the thin leaves of *O. glaberrima* roll faster than those of *O. sativa*—thereby reducing the exposed water-losing surface area. Finally, the species maintains good plant-water status through evapo-transpiration by

stomata. “From our studies,” says Audebert, “it seems that the physiological mechanisms for drought avoidance are different in *O. sativa* and *O. glaberrima*. It is, thus, important to determine the mechanisms in *glaberrima* for the NERICA work.”

Detailed studies on stomatal conductance and leaf-rolling concluded that stomatal conductance is controlled by a soil-moisture-dependent root signal, while leaf-rolling is controlled directly by the water status of the leaf.

Locating genes that contribute in a quantitative way to drought resistance should enable these genes to be used in breeding through marker-assisted selection. To this end, a ‘mapping population’ for drought avoidance was developed at WARDA, in collaboration with Aberdeen University, and is undergoing extensive testing at WARDA and IRRI to identify quantitative trait loci, or QTLs. Several QTLs have already been identified for leaf-drying, leaf-rolling, relative water content, and root growth (particularly root penetration ability). Results indicate that rooting behavior can influence drought avoidance, and so there is potential value in screening for root traits under controlled conditions.

For part of the second-half of the 1990s, WARDA also had a nematologist—Daniel Coyne, seconded from the UK Natural Resources Institute (NRI). “We did a short study in 1997 on the cross-effects between drought and infestation by cyst nematodes,” says Coyne. “What we found was that nematode infestation on rice induced similar symptoms on plant water status as does drought. Consequently, the presence of a large population of nematodes presented symptoms of water stress equivalent to those observed under drought conditions, but also exacerbated the effects of drought.”

For each of the drought-related traits discussed above, the NERICAs have an intermediate value between that of *O. glaberrima* and that of *O. sativa*. Hence, the on-going need to characterize the influence of the various traits on the drought-coping mechanisms

of rice, so as to be able to characterize NERICA lines for drought tolerance.

Economics of water use options in the Middle Valley of the Senegal River

Pierrick Fraval was the second (successive) senior staff to be posted at WARDA from fellow CG Center the International Water Management Institute (IWMI). In addition, Fraval was a staff member of *Cemagref* under the French Ministry of Agriculture (see Box ‘Cemagref’). This three-way collaborative arrangement may sound like a recipe for administrative confusion, but it afforded the opportunity to look at the ‘big picture’ of potentially conflicting water-use options in the Senegal River valley.

“For some time, donors have expressed concern about investments, water management and incentives for productive and sustainable agricultural development, along with the roles of the various stakeholders in the valley,” explains Fraval. “They—and we—were also interested in possible future scenarios for the upstream Manantali reservoir, in the light of past performance and events.” Fraval reviewed and analyzed 20 years of hydraulic, agronomic, financial and organizational data on river-water-dependent crop-production systems to derive an *ex-post* (after-the-event) economic analysis. He also conducted modeling of dam management, and used remote-sensing and GIS technologies (both based on satellite imagery) to explore linkages between hydraulic and socio-economic determinants of performance. The work was done in collaboration with IRD, *Société d’aménagement et d’exploitation des terres du Delta du Fleuve Sénégal et des vallées du Fleuve Sénégal et de la Falémé* (SAED), CIRAD and *Institut sénégalais de recherches agricoles* (ISRA).

Of particular concern to Fraval was the ‘most satisfactory’ way to release water from the Manantali dam to accommodate conflicting water uses (primarily

Cemagref

Cemagref is a French public research institute, whose work focuses on sustainable development in non-urban areas. It contributes to the conservation and acceptable management of land and water systems, the prevention of associated risks and the development of sustainable economic activity.

Cemagref has four areas of research:

- Hydrosystem functioning
- Water use and waste
- Rural land use and landscapes
- Agricultural and food technology.

The institute has about 1000 employees, of whom almost half are professional engineers and scientists. *Cemagref*’s training role is evident in the presence of PhD students (about 150 at any one time) and long-term trainees (500).

Around 40 scientists belonging to three research units deal with irrigation and drainage issues in France and overseas. A collaborative program called PCSI (*Programme Commun de recherches sur les Systèmes Irrigués*) has been put in place with CIRAD and IRD to reinforce their scientific production.

Cemagref has been collaborating with the International Water Management Institute (IWMI) for more than 15 years in different locations around the world. This scientific collaboration is supported by the French departments of Agriculture and Foreign Affairs. At present, this collaboration is focusing in West and Southern Africa and involves three scientists posted at IWMI and WARDA.

agriculture and planned hydro-electric power generation); the relative economic importance of modern irrigated and traditional flood-recession agriculture; and, the capacity of irrigated agriculture to generate enough income to sustain itself.

The Manantali dam in the upper valley (in Mali) was completed in 1987 and controls 40–60% of the water flow of the Senegal River, the rest coming from

uncontrolled tributaries. The dam can hold up to 11 billion cubic-meters of water, so its management has direct consequences on downstream users, especially farmers in Senegal and Mauritania. Management of the dammed water is in the hands of a joint venture of the three countries, known as the *Organisation pour la Mise en Valeur du Fleuve Sénégal* (OMVS). From 2002, management was supposed to be carried out with a view to generating 800 Gigawatts of electrical power per year for the urban centers of the countries involved.

Over 125,000 ha of land on the banks of the river in Mauritania and Senegal have been developed for pump-based irrigated agriculture over the past 30 years. Most are small, village-based schemes of less than 50 ha. Much has been done by WARDA in relation to irrigated rice production in the Senegal River valley, and much of it is reported in the pages of these Reports. In summary, rice is the main crop and is grown primarily in the rainy season, although dry-season vegetable (onion and tomato) production is increasing. Average rice yields are 4–5 tonnes/ha, but highly variable among farmers and schemes. Especially in Senegal, the State has withdrawn from subsidizing irrigation schemes, which are now managed by farmers' organizations. Many schemes are now run at an economic loss, because of high management costs, but they are also plagued by unsustainable practices and generally poor management. Domestic rice is also beset by marketing problems in the liberal world trade market. Cropping intensity (land cropped per year) is consequently low, at about 60% compared to a potential of 200%. "However, irrigated agriculture is by far the major agricultural activity in terms of production value and global revenues," says Fraval.

Meanwhile, flood-recession agriculture (i.e. growing crops after the river floods and recedes) in the depressions of the floodplain is practised by 70% of rural households, who have been growing sorghum and other crops for centuries (rice is a relatively recent crop in the Sahel). "This production system is highly

irregular," explains Fraval, "as the flood has covered anywhere between 20,000 and 300,000 ha of the floodplain annually between 1950 and 2000." However, this type of agriculture is profitable for the farmers, since they apply no external inputs and use seeds from the past season.

So, what—in Fraval's opinion—is the best management option for the Manantali dam? "As can be seen," he says, "it is a highly complex issue, with the three main options being hydro-electric power, irrigated and flood-recession agriculture." The first question is perhaps to look at the irrigated versus recession agriculture. With best cropping practices, farmers can produce 7.5 t/ha in one season with irrigation, giving a net income of US\$ 470 per hectare—clearly, on paper, this is by far the most profitable use of the river valley. "However," says Fraval, "the residents of the floodplain are extremely averse to risk. They will invest time in something that will not cost them anything other than time but guarantees food for the family, rather than invest in potentially profitable farming." An analysis of 25 years of flood and recession-farming data showed the area of the latter directly related to the area of the former. "It is apparent," Fraval continues, "that when there is enough water, the first choice of very many farmers is to grow sorghum after the flood."

In addition, the team showed that it would be very difficult to successfully promote irrigated rice production in the current set-up of schemes managed by farmers' cooperatives. "Sustainability is crucial to the long-term viability of irrigation schemes," says Fraval. "With present non-sustainable practices, 99% of schemes make a profit on average; however, when we modeled using sustainable practices, we came up with a figure 31% of schemes making a loss!"

So, the team considers that, given the risk of lack of sustainability of irrigated agriculture, it is a wise option to release water from the Manantali dam with a view of enabling floods and the associated flood-recession

agriculture. The next question is: how does hydropower come into the picture? It seems that the main question comes down to whether OMVS will insist on maximizing hydro-electric power. The team's report says, "maximizing hydro-power (or hydro-electric power) would require keeping a relatively high water-table in the reservoir, which is not compatible with releasing a lot of water in the middle of the rainy season, when the reservoir is filling." Reservoir management simulation has been difficult in the past, but IRD developed a computer model in 2001. On the historical data of 1970 to 2000, the model predicted that water for recession agriculture on 45,000 ha could be guaranteed every year, while generating 96% of the desired hydro-electric power. So, it seems that flood-recession agriculture and hydro-electric power generation are not incompatible, so long as one does not try to maximize the hydro-electric output.

OMVS only makes money from hydro-electric power and irrigated agriculture. Without state intervention or a complete reversal of attitude from the farmers, irrigated agriculture is not going to expand. Thus, it will be tempting for OMVS to maximize its revenues from hydro-electricity. "Without a flood, recession agriculture cannot occur," explains Fraval. "If the flood is prevented, it is likely that many farmers will move away from the area. Conversely, if farmers could be encouraged to invest in some inputs in the recession crop, then their profit margins could be significantly improved! In conclusion, with a balanced approach based primarily on actual and not just potential (on paper) performance, it is possible to achieve real integrated water management in the Senegal River valley."

Informal collaboration in the Senegal River valley

Marco Wopereis took up the position of Agronomist in WARDA's Sahel Irrigated Rice Program in October 1994. As part of his opening gambit, he visited the

offices of the then *Institut français de recherche scientifique pour le développement en coopération* (ORSTOM, now IRD) in Dakar, where he met Pascal Boivin. Discussions quickly turned to soil degradation in the Senegal River delta, and possible collaboration.

"Even though no common project was ever defined, the collaboration with ORSTOM/IRD was highly productive, especially in terms of journal articles," says Wopereis, now Program Leader with the International Fertilizer Development Center (IFDC-Lomé).

"We went on a tour of the Senegal River valley," continues Wopereis, "including a memorable trip to Fouta Djallon—this place is really in the middle of nowhere, a moon landscape, then about 4 hours rocky drive from Kaedi, and Kaedi at least 11 hours from St-Louis!" Despite the distance, the two decided that the site would make a good field laboratory for soil-degradation work, mainly because of signs of alkalinity in the field—described by Wopereis as "soapy-tasting white salts on the soil surface." Wopereis then wrote a project proposal that was funded by the UK Department for International Development (DFID), and Piet van Asten was sent as Associate Expert by the Netherlands Directorate General for International Cooperation (DGIS).

"The collaboration itself took the form of joint field and laboratory trials on both sides of the Senegal River—that is, Senegal and Mauritania," continues Wopereis. The teams also collaborated on simulation modeling of soil-degradation processes under irrigation. "We particularly investigated the types and rate of the processes involved, and the buffering capacity of the soils," Wopereis concludes.

After the departure of both Boivin and Wopereis from Senegal, van Asten and Claude Hamecker continued the informal WARDA–IRD collaboration at Fouta Djallon, with some extra input from IRD's Laurent Barbiero. The rest, as they say, is history—see 'A Holistic Approach to Irrigated Rice Farming Problems

Uncovers More Than Just Soil Degradation,’ *WARDA Annual Report 1999*, pages 30–37, and ‘Donor Country Profile: The Netherlands — Soil degradation in irrigated rice fields in the Sahel,’ *WARDA Annual Report 2001–2002*, pages 57–60.

Interspecific hybridization research

At the turn of the Millennium, WARDA’s biggest project—both in terms of funding and media attention—was the Interspecific Hybridization Project (IHP) that boosted the development and dissemination of the ‘New Rice for Africa,’ or NERICA, varieties. This project involved a broad range of partners, among which may be numbered IRD. The team leader at IRD was (and is) Alain Ghesquière.

One major achievement of the WARDA–IRD collaboration was the establishment of a molecular biology laboratory at WARDA’s headquarters at M’Bé (see ‘Molecular Biology Facilities at WARDA,’ *WARDA Annual Report 1999*, pages 16–21).

IRD has been developing a population of NERICA lines based on a single cross between an *Oryza glaberrima* and released *O. sativa* variety IR64. “The idea,” explains Ghesquière, “is to provide a permanent resource for the evaluation of variation provided by *glaberrima*.” One extremely useful outcome was the discovery that among 52 lines tested, fragments of almost the entire *glaberrima* genome were conserved in NERICA lines (one extremity of chromosome 10 was *not* represented)—this shows the value of the exercise in providing full *glaberrima* representation in the NERICA material. In 2001, initial field evaluations were conducted at WARDA’s Sahel Station for plant architecture, plant type, panicle structure and precocity. Recently, IRD–IHP project staff M. Lorieux was outposted to *Centro Internacional de Agricultura Tropical* (CIAT) in Colombia, where he will evaluate the material under Latin American conditions.

A major problem for lowland-rice farmers in the sub-region is rice yellow mottle virus (RYMV). Achieving good resistance to this disease is a high priority for both the NERICA work and the biotechnology work in general. Back in 1999, Marie-Noëlle Ndjiondjop finished her PhD at IRD having identified a genetic marker associated with high resistance to RYMV in *sativa* variety Gigante. Since then, Ndjiondjop has become WARDA’s Molecular Biologist and the work has continued at both IRD and WARDA to pave the way for efficient marker-assisted selection of RYMV-resistant material. The subsequent identification of additional markers even closer to the target resistance gene helped confirm that the resistance in Gigante and that in several *glaberrima* lines are the result of different alleles (genes at the same site in different individuals). Other sources of RYMV resistance and associated markers have been identified on other chromosomes.

The next stage is for markers to be used to speed the breeding process. In fact, the work began at IRD almost as soon as the Gigante resistance was characterized and had an available marker. “There are some obviously favorite varieties among lowland-rice farmers in the various countries of the region,” explains WARDA Lowland Rice Breeder Howard Gridley. “For example, Bouaké 189 in Côte d’Ivoire, and Jaya in Senegal.” For this reason, WARDA and IRD are targeting three of the most popular lowland varieties with the aim of incorporating RYMV resistance into plants that are otherwise identical to the current released versions. As time goes on, the new markers are introduced into the system to improve the efficiency of selection. In 2002, lines carrying various combinations of resistance genes were available for testing. The proposal is to release such material to the national programs for in-country evaluation, with the prospect of increased diversity being introduced into the varietal portfolio.

Nematodes

Several *glaberrimas* are highly resistant to nematodes, while all tested *sativas* have proven susceptible. Preliminary studies of first-backcross NERICA lines have shown that nematode resistance is conferred by a single gene. Mapping of the gene and an associated marker are opening up opportunities for marker-assisted selection for nematode resistance. The International Rice Research Institute (IRRI) is working with the same material to test for resistance to another species of nematode under Asian conditions.

Inland Valley Consortium

“France is a very faithful donor to IVC [the Inland Valley Consortium],” says former IVC Scientific Coordinator Marco Wopereis, who left WARDA in 2002, “they form part of the core group with The Netherlands that has supported IVC since the start.”

The IVC has featured regularly in the pages of WARDA’s annual reports, including a section in last year’s *Donor Country Profile* on The Netherlands (see Box ‘IVC in the *WARDA Annual Report*’).

Like The Netherlands, French funding to IVC used to be through a special project, but has recently become an ‘attributed’ allocation from France’s core contribution to WARDA. Also like The Netherlands, French money has been used rather as ‘core’ funds for the IVC itself. Former IVC Regional Coordinator

IVC in the *WARDA Annual Report*

‘Tooling Up for Inland Valley Development,’ *WARDA Annual Report 1996*, pages 39–43.

‘Technology Generation and Dissemination: The Role of Agro-ecological Characterization,’ *WARDA Annual Report 1998*, pages 23–31.

‘Donor Country Profile: The Netherlands — Inland Valley Consortium—A long-standing partnership,’ *WARDA Annual Report 2001–2002*, pages 54–57.

Marie-Jo Dugué (2000–2002) explains: “French funding has been mainly used to support facilitation, communication, exchanges between members ... particularly for RCU [Regional Coordination Unit, hosted at WARDA] operating costs, annual workshops, publication and translation expenses, and training for IVC members.” Dugué’s position as Regional Coordinator is funded directly by France; it is a seconded position from *Coopération française*, as it was in the time of Dugué’s predecessor, Jean-Yves Jamin (1995–1999).

Both Dugué and Wopereis are firm believers that the Dutch–French combination in the Regional Coordination Unit works well. Wopereis says: “In the two years we worked together in the IVC, we were able to move the Consortium to a second phase.” Meanwhile, Dugué propounds the partnership

Members of the IVC National Coordination Units of Benin and Togo discuss the diversity of inland-valley characteristics in Togo, July 2001



Scene from an IVC monitoring tour, Gagnoa, Côte d'Ivoire, November 2001





Members of the IVC National Coordination Unit of Burkina Faso at the inland valley of Bletou, November 2001

Former IVC Regional Coordinator visiting a local radio station in Benin: local radio is a good means of communicating development messages to rural communities. This radio station is close to IVC key sites Gankpetin and Gomè, July 2001



facilitation brought by an Anglophone Dutch Scientific Coordinator (!) and a French Regional Coordinator: “IVC is an efficient Anglophone–Francophone network, covering both south–south and north–south exchanges.”

Major developments within the Consortium in 2002 comprise the first annual Consortium meeting to be held outside of Côte d’Ivoire (at Abomey, Benin, in March) and the adoption of Participatory Learning and Action Research (PLAR) as the farmer-learning and extension methodology of choice for the whole of IVC (see ‘Participatory Learning and Action Research for Integrated Crop Management in Inland Valleys,’ pages 23–32 for further details).

“Dugué left WARDA in December 2002,” says Director General Kanayo F. Nwanze, “leaving a hole in IVC and WARDA. However, we have assurances from the French Government that they wish to continue

Geographical Information Systems and other Information Technology: Training Program at CIRAD

Geographical Information Systems (GIS) Research Assistant Mahaman Moussa visited France as part of CIRAD’s training program in 1998–99 and again in May–June 2001. The training came at an ideal time for the IVC, as it moved towards standardizing and disseminating results from agro-ecological characterization work conducted during its first phase. “The training covered two main topics,” explains Mahaman, “first, remote-sensing and, second, development of an information system for inland valleys in the sub-region.” (Additional details of the work were presented as part of the ‘Donor Country Profile’ on The Netherlands in the 2001–2002 Annual Report.)

“The training activities gave me the opportunity to learn more about a rapidly advancing science,” explains Mahaman, “and additional skills with which to assist WARDA and its partners.” Direct beneficiaries of Mahaman’s training to date have been the IVC National Coordination Units of Benin, Mali and Togo; Guinea will also benefit later in 2003. The opportunity thus provided by Mahaman’s training has resulted in continued GIS collaboration between WARDA, IVC and CIRAD. Writing in a 1999 issue of CIRAD’s newsletter, supervisor Michel Passouant said, “For CIRAD, this type of project is very interesting. It is a framework for mutual exchange of expertise. Our experiences and competencies in the fields of GIS, database management and multimedia have contributed [to the project’s] success. In addition, this sets up a new collaboration with IVC and the subject could be of interest to other countries.”

funding—and filling—this post. So, we are looking forward to our third IVC Regional Coordinator with anticipation!”

Training

WARDA has a long history of training collaboration with France, no doubt fuelled in part by the fact that so many people in the region are Francophones. In the early 1990s, at least six students pursued postgraduate training at the then *Institut supérieur technique d’outre-mer* (now *Ecole supérieure de Cergy-Pontoise*,

ISTOM) in subjects as diverse as agronomy, pathology, physiology and varietal improvement. WARDA also has a track record for training long-term collaborators and staff through French institutions.

In 1993, WARDA Pedologist (soil scientist) Sitapha Diatta began his PhD research with the University Henri Poincaré Nancy I on ‘soil and hydrology in two topographical sequences in Côte d’Ivoire.’ The research was sponsored by the African Development Bank. In 1995, Diatta took a year’s sabbatical to complete studies and write-up in France, and then submitted and defended his thesis in 1996. The value to WARDA was clear and Diatta was duly promoted to associate principal staff Soil Physicist in 1997.

Yacouba Séré joined WARDA as Plant Pathologist in September 1997. By then, he already had quite a history of French-based training. After his *Maîtrise en Biologie Végétale* at Dijon University in France in 1973, he received a two-year fellowship from his country (Burkina Faso) for a post-graduate diploma in plant pathology. He then received a special extension for him to complete his *Doctorat 3^e cycle* (PhD equivalent) in ‘*Amélioration des Plantes – Option Phytopathologie*’ in 1977. While he was still with his national program in Burkina Faso in 1994, WARDA assisted in obtaining funding from the African Development Bank to allow him to conduct a bio-ecological study of rice blast fungus in Burkina Faso as the last part of his *Doctorat d’Etat es Sciences*, which he successfully defended at Abidjan University in 1999.

National partners have also benefited from WARDA collaboration with France. In particular, Souleymane Nacro studied African rice gall midge at the University of Rennes I, N’Guessan Placide studied rice yellow mottle virus (RYMV) at the University of Montpellier (with African Development Bank funding), and Sié Moussa studied the effects of thermal constants on irrigated-rice varieties also at the University of

Montpellier (again with African Development Bank funding). Sié’s work was mentioned in last year’s Report (see ‘Breeding Rice for the High-Potential Irrigated Areas — Working together: WARDA and Burkina Faso,’ *WARDA Annual Report 2001–2002*, page 23).

More recently, CIRAD sent Violaine Bousquet from the *Institut national polytechnique de Nancy* to work with Alain Audebert on root penetration in rainfed-rice cultivars. WARDA and IWMI supported Frédéric Larbaigt’s study of sustainability and maintenance of irrigated rice schemes in the Senegal River floodplain at the *Ecole nationale Génie de l’eau et de l’environnement de Strasbourg*. Meanwhile, Séré is supervising student Sorho Fatogoma, who is conducting RYMV research at IRD, Montpellier.

Core staff and people in high places

Thierry Cadalan served WARDA as Molecular Biologist from 1997 to 1999 (see ‘Molecular Biology Facilities at WARDA,’ *WARDA Annual Report 1999*, pages 16–21). Frédéric Lançon was WARDA’s Policy Economist from 1999 to 2003 (see ‘Policy Dialog in Rice Food-Security in West and Central Africa,’ *WARDA Annual Report 2001–2002*, pages 38–45). In 2002, WARDA recruited French-national Aline Lisette-Vidal as Head of Training, Information and Library Services. Lisette-Vidal has had a couple of busy years [doesn’t everyone in WARDA?—Ed.] bringing training activities into a coherent system after several years of staff and other resource shortages. “It was only in 2001 that the decision was made to combine the three disparate support units under a single head,” explains Director General Nwanze. Previously, the units had reported through the Program Division, but their mandates clearly extended beyond research alone. Lisette-Vidal has brought much-needed order, particularly to the training side, and WARDA can look

forward to renewed energy as it seeks to upgrade the capacities of its various partners.

Henri Carsalade, Assistant Director General, Food and Agriculture Organization of the United Nations (FAO), was Chairman of the Board of Trustees from 1992 to 1993, then Remi Pochat, *Directeur Scientifique, Laboratoire Central des Ponts et Chaussées* (LCPC), joined the Board in 2001.

Future

The relationship between WARDA and France is perhaps one of the longest between the Association and a donor institution. With a membership of 17 West and Central African countries, 11 of which are Francophone, it is not surprising that WARDA capitalizes on the rich human resources within French institutions with wide-ranging experience in

agricultural research and development in the sub-region.

Apart from secondment of scientists to call on, special project activities, collaboration between ‘north’ and ‘south,’ and joint supervision of research scholars, WARDA has also tapped the French pool of experience as evident in the number of core staff that have been with the Center since the early 1990s. The continued support by the French Government for the position of the IVC Regional Coordinator testifies to this long relationship and the assurances that in spite of the temporary dislocation due to the Ivorian crisis, the new coordinator has been identified and should be on board later in 2003. Thus, the hole in the IVC created by the departure of Marie-Jo Dugué in December 2002, is about to be filled and, in the words of Director General Nwanze, “nature allows no vacuum.”

The Period in Review: January 2002 to April 2003

Last year, we changed the reporting period for the *WARDA Annual Report* from a calendar year to one covering May through April; however, that reporting period was not reflected in the annex ‘The Year in Review.’ This year, we are bringing the activities report in line with the reporting period for the Report as a whole by covering the period from January 2002 through April 2003.

A team from the WARDA Sahel Station undertook a **diagnostic evaluation of the LANASOL laboratory** in Nouakchott, Mauritania from 9 to 11 January 2002, in order to assess the status of the lab and determine the requirements for soil and water analysis.

The **Participatory Technology Development (PTD) Project** Steering Committee met in Ibadan, Nigeria, from 12 to 16 January 2002. Partners from NARS (broadly defined, i.e. including development agencies, NGOs and universities), Hohenheim University and WARDA appraised field activities, re-charted the project focus, and developed a logical-framework for the second phase.

The Annual Review and Planning Meetings in 2002, ‘**WARDA Science Days**,’ were held at Headquarters from 22 to 25 January.

Members of the ROCARIZ Economics Task Force attended a **Training Course on Methodology of Impact Assessment of Agricultural Technologies** at Headquarters from 18 to 23 February. This was the first activity in WARDA’s drive to build up regional capacity in impact assessment. The 10 participants

represented nine WARDA/ROCARIZ member states. Topics covered included concepts and methods of impact assessment, estimation of production, consumption and social-welfare impact, econometric methodology, and an introduction to SPSS software.

A **training course on Participatory Learning and Action Research for Integrated Rice Crop Management (PLAR-ICM)** was held at Headquarters from 25 February to 8 March. The workshop came at the end of a nine-month program of PLAR-ICM in two inland valleys in Côte d’Ivoire. Participants included partners from *Agence nationale d’appui au développement rural* (ANADER), *Projet national riz* (PNR) and four farmers from the pilot study villages of Bamoro and Lokakpli. (For more details of the work on PLAR-ICM, see ‘Participatory Learning and Action Research for Integrated Crop Management in Inland Valleys,’ pages 23–32.)

In March, the technology transfer team went from WARDA Headquarters to Grand Lahou, southern Côte d’Ivoire to run a three-week **Workshop on the Construction of the Thresher–Cleaner**. The 18 machinists were divided into four groups, each of which

worked on constructing their own thresher–cleaner. Despite the fact that Côte d'Ivoire is a Francophone country, the Ivorian incarnation of the machine has been named 'ANWAR,' for ANADER–WARDA. The machinists duly trained then returned to their home towns. A few weeks later, the new machines were brought to WARDA Headquarters for demonstration. Machinist Camara Mamadou from Katiola constructed a prototype that was sold to a member of a farmers' cooperative and used by farmers at the irrigated perimeter of Lope.



Camara Mamdou with his prototype ANWAR (BV 001), Katiola, June 2002—he has subsequently made and sold two more thresher–cleaners

The Inland Valley Consortium (IVC) Annual Workshop and CFC Project Meeting were held in Bohicon, Benin from 11 to 15 March. As usual, progress from the past year was reviewed and work-plans developed for the coming year.

End-of-project feedback workshops for the DFID project 'Preventing soil degradation in irrigated rice-based cropping systems in Burkina Faso and Mauritania' were held at Niassa, Sourou valley, Burkina Faso, 14–15 March, and at Foum Gleita, Mauritania, 11–12 April. Workshops were attended by NARES partners and farmers. During the workshops,



ANWAR thresher–cleaner demonstration, M'Bé, June 2002



Proud owner of ANWAR BV 001, Lamine Coulibaly, operating the thresher–cleaner for farmers in the Lope perimeter

recommendations were made on research and development interventions for the prevention and mitigation of soil degradation. These recommendations form the basis for integrated crop management options for problem soils that will be evaluated by WARDA, farmer groups and NARES partners over the next three years.

On 25 and 26 March 2002, the **PTD Project** held a **Scientific Workshop** at Ibadan, Nigeria. The 24 participants comprised WARDA scientists, project students and their supervisors, and national researchers,

who reviewed the 2001 season results, in particular the progress made by the PhD students.

The 2002 ‘crazy season’ started at WARDA Headquarters on 26 March, when delegates gathered at Headquarters to discuss and finalize the project document for the **African Rice Initiative (ARI)**, in advance of the official launch of the Initiative at the Houphouët-Boigny Foundation for Peace in Yamoussoukro, Côte d’Ivoire on 27 March. The Initiative was launched by HE Pascal Affi N’Guéssan, Prime Minister of Côte d’Ivoire, on behalf of HE Laurent Gbagbo, President of the Republic. Full details were given in last year’s feature ‘The African Rice Initiative: Taking the NERICAs to Sub-Saharan Africa’ (*WARDA Annual Report 2001–2002*, pages 7–12).

On 27 March 2002, participants from the Nigerian Agricultural Development Projects (ADPs), universities of agriculture, NGOs, National Cereals Research Institute (NCRI), National Seeds Service (NSS), National Rice/Maize Centre and WARDA met at Ibadan, Nigeria, to discuss the on-going **PVS activities in Nigeria. Six Nigerian states**—Ogun, Kwara, Nasarawa, Kaduna, Ekiti and Niger—were considered ready for the implementation of PVS-extension. Participants were informed that PVS trials in 2002 had helped three varieties on the road to official release in Nigeria—NERICA 1, WAB189-B-B-B-8-HB and ITA 321. The next meeting of the Nigerian Variety Release Committee, and therefore the release of these varieties, has been fixed for 16 July 2003.

The **Participatory Adaptation and Diffusion of technologies for rice-based Systems (PADS)** project held its annual Steering Committee meeting at Headquarters on 4–6 April. PADS is the umbrella project for the PLAR-ICM activities (*see above*, and pages 23–32). The project is active in Côte d’Ivoire, The Gambia, Ghana and Guinea.

On 8 April, NRI Weed Scientist David Johnson returned to WARDA Headquarters to chair a **Wrap-up workshop for the DFID Wild Rice Control Project**. The timing—just before 4Rs (*see next item*)—enabled interested researchers who had not been involved in the DFID project to attend the meeting to hear about the project outcomes and recommendations. An awareness folder on wild rice is being prepared for publication by DFID and WARDA.

Then on 9–12 April, WARDA hosted the **Second Regional Rice Research Review (4Rs)**, the biennial meeting of the ROCARIZ Task Force members and other rice stakeholders from the region and beyond. About 150 participants attended from Africa, Europe and the USA. Three-quarters of participants were NARES scientists, development agents and farmer-group representatives from member countries. This year saw the introduction of a ‘National Scientist Award’ for ‘Best Paper’ (won by Dona Dakouo and co-workers from INERA, Burkina Faso), ‘Best Presentation’ (won by Babou O. Jobe, NARI, The Gambia) and ‘Outstanding Contribution to rice research and development’ (won by Mamadou M’Baré Coulibaly, IER, Mali). The 4Rs was followed by a meeting of the ROCARIZ Steering Committee on 13–15 April.



Participants at the 4Rs meeting held in M'Bé from 9 to 12 April

The **Second INGER-Africa Review and Planning Meeting** was held at Headquarters on 15–17 April. INGER is the ‘leading light’ in making WARDA truly Africa-wide in its field of influence (*see* feature ‘The Africa Rice Center—Recognizing WARDA’s Role in Sub-Saharan Africa,’ pages 7–12). This year, the workshop drew breeders and genetic-resource staff from 24 countries, including Burundi, DR Congo, Kenya, Mozambique, Namibia and Zimbabwe, as well as all 17 WARDA member states. The issue of intellectual property rights was given some prominence, with speakers from the CGIAR, IRRI, UPOV and WARDA.

Next, the **Participatory Rice Improvement and Gender/user Analysis (PRIGA) Network** met for its **annual meeting** at Headquarters from 18 to 23 April. Of particular note this year was the inclusion of a **training workshop on PVS-extension** during the first two days. As usual, the proceedings of the meeting will be published; however, this year they have been delayed by staff departures and the intervention of the Ivorian crisis.

The year’s run of back-to-back meetings came to a close with a **Workshop on Seed Priming** on 24–25 April, chaired by David Harris, who represents DFID on the PRIGA Network. The seed-priming activity has ‘piggy-backed’ on the participatory varietal selection (PVS) of the PRIGA Network, and been reported in the annual summary proceedings of the same. However, seed priming is likely to ‘take on a life of its own’ from 2002.

Meanwhile, the full **WARDA Board of Trustees** met (again at Headquarters) from 22 to 26 April.

The **PTD Project** held a **Training Workshop** at Abakaliki, Nigeria, from 26 April to 10 May. Participants—comprising farmers, extension agents, NGO representatives, researchers from national

research institutes and universities—learnt more about the PTD approach and technology dissemination, including limitations in its role in enhancing rice production in Nigeria.

On 16 May, the Director General was invited to a **breakfast meeting with the President of the Federal Republic of Nigeria** in Abuja. Dr Nwanze made a presentation on the NERICA rices and the prospects for rice in Nigeria. Taking the opportunity offered by the presence at the same meeting of a delegation from the Government of Japan, he also thanked Japan for its support to the NERICA work at WARDA. During the three-day visit to the Nigerian capital, Dr Nwanze also met with the Federal Minister of Agriculture and the Special Adviser on Food Production; he also held a press conference.

The **Third WARDA/National Experts Committee Meeting** was held at Headquarters from 11 to 13 June. Among the many items on the agenda was the first airing of the possibility of referring to WARDA as ‘The Africa Rice Center.’

WARDA Sahel Station staff participated as trainers in a four-month **training of extension officers for irrigated-rice cultivation**, organized by the Food and Agriculture Organization of the United Nations (FAO), from 15 June to 15 October. One of WARDA’s rice fields at Ndiaye (Sahel Station) was also used for practical sessions.

The new **ARI Consortium Management Committee** met for the first time at Headquarters on 27 and 28 June. Particular focus was on the need to encourage the committed donors to ‘pay up’ and on the need to move quickly with the recruitment of the General Coordinator.

A **rapid appraisal survey** of the irrigated-rice sector in **Nigeria** was conducted by WARDA between 28 June

and 13 July. The two-person WARDA team initiated fieldwork to assess opportunities and constraints to improving irrigated-rice productivity in Nigeria, and to identify irrigated-rice research and development priorities in Nigeria. This study complements WARDA's on-going assessment of the Nigerian rice sector, and is being supported by USAID (*see* Box 'Rice sector strategy for Nigeria' on page 18–19).

The **General Assembly of WECARD/CORAF** took place in Yamoussoukro, Côte d'Ivoire, from 23 to 26 July. The location within our host country enabled WARDA to show a 'presence,' with display of publications and posters.

As part of its on-going program, the **PTD Project** held four **Field Days** during August, September and October, to demonstrate, discuss and evaluate various technologies (both indigenous and modern) with farmers at the project sites. The field days also afforded opportunities for rice-production stakeholders to discuss the season's progress, and to discuss management problems encountered in the trials and other field-related difficulties faced during the season. A total of 327 farmers, extension agents, national research partners and staff from development projects (88 of them women) participated in the events at (1) Ogun, Nigeria, on 22 August, (2) Dassa and Glazoue, Benin, on 24–25 August, (3) Ebonyi, Nigeria, on 26 September, and (4) Kogi, Nigeria, on 24 October.

The CGIAR in general, and WARDA in particular, were well represented at the **UN World Summit on Sustainable Development (WSSD)** in Johannesburg, South Africa, from 26 August to 4 September. In particular, Japan, the United Nations Development Programme (UNDP) and the CGIAR sponsored a Special Event on NERICA Rice on 31 August.

A **Farmers' Field Day** was held on 27 August at Kaswan Magani village, Kaduna State, Nigeria, to mark

the 'handing over' of a new rice-farmers' association to the State ADP. The group, comprised of about 100 farmers, derived from WARDA's PVS work, which had completed its three-year cycle of PVS-research. Some of the farmers were already growing between 2 and 5 ha of WARDA varieties (including NERICAs). As part of the official recognition ceremony, a Kajuru local government official was in attendance.

Subsequent to the WSSD, UNDP organized a **Press Visit** to WARDA Headquarters and Abidjan on 4 September. Journalists came from *Agence France Presse*, the BBC, *Jeune Afrique Economie*, *Radio France Internationale* (RFI), regional press and a media production team.

From 18 to 28 September, a multi-disciplinary **monitoring tour** of NARES and WARDA scientists visited activities of WARDA outreach programs **ROCARIZ**, **INGER-Africa** and **PRIGA** in the upland, lowland and mangrove-swamp rice ecologies of Guinea (*Guinée Maritime*, *Moyenne Guinée* and *Haute Guinée*). The team found that NERICA 3 is widely cultivated as Guineans prefer its short bold grains. In *Moyenne Guinée*, this variety suffered 15–20% stem-borer attack. Recommendations from the team, particularly on communication and information



NERICA 3 in the acid soils of *Moyenne Guinée*

channels, were submitted to WARDA and Guinean NARES.



Planting of iron-toxicity-tolerant variety in the associated mangrove swamp of Guinea

The **Executive and Finance Committee of WARDA's Board of Trustees** (EFC) met at Headquarters on 16–18 September, where it approved the 2003 budget proposal and resolved several policy matters.

On 19 September, events in Côte d'Ivoire conspired to leave Headquarters and Main Research Center staff trapped in their homes in Bouaké, as well as four EFC members in a hotel in the center of town. A week later, senior staff and others were able to relocate to Abidjan. The full story of WARDA's 'survival under fire' is reported elsewhere in this Report (pages 13–22). Although WARDA continued to operate from Abidjan, all events scheduled to take place at Headquarters had to be rescheduled, relocated or both.

On 4 October, a meeting was held with representatives from **Japan International Cooperation Agency (JICA)** in Ibadan, Nigeria, on a proposal for **in-country training of Agricultural Development Project (ADP) personnel in seed production**. The JICA seed expert expected to be hosted at WARDA Headquarters should be available to help with project implementation. Discussions also covered the topic of the improvement of farm implements.

The first **CGIAR/World Bank McNamara Seminar**, held on 25 October in Tokyo, Japan, fielded WARDA's successful story of NERICA development and its potential in Africa's food-security dilemma. The Director General made a presentation, held several interviews and met members of the press.

Essentially unaffected by the Ivorian crisis, the **Irrigated Rice Program** and **NARES partners** in Mauritania organized, on 5 November, a final review and evaluation workshop in Nouakchott to present results, experiences and lessons from the **collaborative program 'Improving Irrigated Rice Productivity in Mauritania: Participatory evaluation, adaptation and transfer of improved irrigated rice technologies.'** The workshop brought together the different partners who participated in the implementation of the program (WARDA, SONADER, CNRADA and farmer groups). The collaborative program was funded through a grant to SONADER from the World Bank.

From 13 to 16 November, the **Irrigated Rice Program** held a **Review and Planning Workshop** with NARES partners at the Sahel Station (Ndiaye, Senegal). Participants comprised agronomists and economists from Burkina Faso (INERA), The Gambia (NARI), Mali (IER) and Senegal (ISRA and SAED), along with WARDA personnel from the Sahel Station and Headquarters. The participants reviewed past and on-going activities in rice research and development for irrigated systems, and then defined joint strategies and activities for the period 2003–2005. This led to a follow-up tour by the irrigated-rice economics team to finalize modalities for implementation of the 2003 work-plan.

Because of a World Bank moratorium on travel to Côte d'Ivoire, a visit from the CGIAR Chairman and Director to Abidjan had to be cancelled. The visit had been planned to coincide with a meeting of the Board of Trustees Executive and Finance (EFC). Most members

of the EFC were also prevented from visiting Abidjan at that time, because of travel limitations imposed by various embassies. However, **Board of Trustees Vice-Chairman** Richard Musangi insisted on visiting WARDA at its temporary headquarters in Abidjan in December. While there, he met up with new Ivorian Board member Bamba Gué, met with Management to discuss issues related to the management of the Ivorian crisis, and held a meeting with staff working in Abidjan. Prof. Musangi and Dr Gué also held meetings with several Ivorian ministers, donor representatives and ambassadors of WARDA member states, which culminated in a diplomatic luncheon and press conference. Prof. Musangi's visit was a gesture of support and encouragement from the Board in general.

The first batch of WARDA Main Research Center staff relocated to occupy temporary accommodation at ICRISAT's Research Station at Samanko in Bamako, Mali, during the weekend of 25–26 January 2003. Remaining research and research-support staff relocated over the following weeks, leaving staff from the Director General's Office, Administration and Finance Division, Corporate Services Division, and Training, Information and Library Services to maintain headquarters activities from Abidjan. From the research side, the African Rice Initiative (ARI), genetic-resources activities and HIV/AIDS initiative continued to be coordinated from Abidjan. (*See also* 'Crisis in Côte d'Ivoire: WARDA "Under Fire",' pages 13–22.)

During the *Journée porte-ouverte* (open day) organized by ISRA in Dakar from 7 to 12 February 2003, WARDA Sahel demonstrated varieties and the thresher-cleaner, and displayed several posters highlighting results from irrigated-rice research and development in the Senegal River valley. The WARDA stand was visited by a wide range of participants, including the Head of State HE President Abdoulaye Wade, senior government officials, NGO groups and civil society representatives.

Rather than going ahead with the planned wrap-up workshop for the end of phase 1, the donors supporting the **PTD Project**—GTZ and BEAF (BMZ)—visited project and partner sites—Ibadan, Ikenne, Abeokuta and Lokoja in Nigeria, and Dassa and Glazoue in Benin—from 23 February to 9 March 2003 to evaluate the project, concluding that "A second project phase is justified" in order for the users and stakeholders—farmers' organizations—to achieve the full benefits of the PTD approach. (For more details on PTD phase 1, *see* Box 'More than one way to crack an egg: Participatory technology development in Benin and Nigeria,' pages 30–31.)

Senegalese President HE Abdoulaye Wade (center, red tie) visiting the WARDA stand at ISRA's *Journée porte-ouverte*



WARDA stand and visitors reviewing display, *Journée porte-ouverte*, Dakar, February 2003



The WARDA **Board of Trustees** met for its annual meeting Bamako, Mali, from 24 to 28 February. This year saw a reshuffling of responsibilities, with Richard Musangi taking over as Board Chairman and Edwin Price as Vice Chairman and Chairman of the Nominating Committee. Board members took time to visit WARDA's temporary research facilities in the ICRISAT Research Station, Samanko, and to address the staff. (*See also* 'Crisis in Côte d'Ivoire: WARDA "Under Fire"', pages 13–22.)

Coincident with the Board meeting, the **Director of the CGIAR**, Francisco Reifschneider, visited WARDA's temporary research station in Samanko, Bamako, where he addressed senior staff, management and Board on 27 February. He expressed his pleasure at finally being able to visit WARDA staff in their temporary facilities after travel restrictions blocked his planned visit in December 2002. He conveyed the CG's gratitude for the fortitude that WARDA staff and management had shown during the Ivorian crisis to date, commending the "heroic effort to sustain operations." He assured everyone of the System's concern over staff security, and of their continued support, as well as that of the donors. Subsequently, Dr Reifschneider, outgoing Board Chairman Lindsay Innes and Director General Nwanze met with the Prime Minister of Mali and key Malian authorities.

On 3–7 March, WARDA hosted a **wrap-up workshop for the WARDA/DFID Rice Blast Project** at Accra, Ghana. Project personnel from Horticulture Research International (HRI, UK), WARDA and NARS scientists

from Burkina Faso (2), The Gambia (1), Ghana (11) and Nigeria (1), along with representatives from DFID and FAO. The project has developed molecular tools for characterizing blast lineages, and successfully analyzed pathogen diversity through a novel field-trapping technique (WARDA) and laboratory pathotyping (HRI). These tools are ready for transfer to other NARS to expand this work. After the workshop, a discussion was held on the possibility of a follow-on project to promote the molecular and characterization tools, and to utilize the characterization data in the development of durable blast resistance.

On 7 March, a WARDA team presented some preliminary propositions for a '**Strategy for rice sector revitalization in Nigeria**' at the Federal Ministry of Agriculture in Abuja, Nigeria. The strategy is the proposed major outcome of the USAID-funded project 'The Nigerian Rice Economy in a Competitive World: Constraints, Opportunities and Strategic Choices.' At the meeting, WARDA researchers were able to present a summary of the project's main findings to the Minister of Agriculture himself, then a more detailed report to a selection of policy-makers from the Ministry, including the Permanent Secretary, with question-and-answer session. For a summary of the project findings and elements of the strategy, *see* Box 'Rice sector strategy for Nigeria' (page 18–19).

From 17 to 21 March, CIRAD Plant Physiologist Alain Audebert returned to co-organize the **First Workshop on Iron Toxicity in Rice-based Systems in West Africa**. Having been originally scheduled for November 2002 at WARDA Headquarters, the workshop finally took place in Cotonou, Benin. The workshop assessed the state-of-the-art of research and development activities aimed at mitigating iron toxicity in rice-based farming systems in the region. Some 19 researchers attended the workshop from Belgium, Benin, Burkina Faso, France, The Gambia, Ghana, Guinea, Mali, Senegal, Sierra Leone, Togo and WARDA.

CGIAR Director Francisco Reifschneider (left) with former WARDA Board Chairman Lindsay Innes at the 23rd Meeting of the Board of Trustees, Bamako



The findings of this workshop are summarized elsewhere in this Report (*see* ‘Donor Country Profile: France — Plant physiology,’ pages 47–49).

On 28 March, the Director General held a **Press Conference** at the Hotel Sofitel in Abidjan, Côte d’Ivoire. He restated that WARDA was continuing to function in Côte d’Ivoire, as it had done since the beginning of the Ivorian crisis, and despite rumors to the contrary. In particular, WARDA was continuing to maintain its Headquarters in Côte d’Ivoire with headquarters staff and several others temporarily working from offices in Abidjan. He also gave an update on the perceived situation in Bouaké and at WARDA’s property in M’Bé.

From 9 to 11 April, **PADS Project** partners from Benin, Mali, Togo and WARDA met at Samanko, Bamako, to review project (PLAR-ICM) activities at the four project sites, including presentation of results and

planning for the 2003 season. This partially overlapped with a visit from **NRI/DFID** personnel (10–18 April) to discuss various projects and activities on integrated pest management (IPM).

The **ROCARIZ Steering Committee** met at Samanko on 22 April to review progress on small-grant projects funded in 2002; to discuss the 2002 and 2003 monitoring tours; potential modes of operation in relation to WARDA’s emerging new Strategic Plan; expansion of activities (especially small-grant projects) within Central Africa, and preliminary ideas for the 2004 Regional Rice Research Review (4Rs).

The 2003 annual review and planning meeting, ‘**Research Days 2003**,’ took place from 28 April to 2 May at Samanko. Research presentations were based on thematic groups, designed to encourage greater interaction among researchers and promote interdisciplinarity.

Financial Statement

1. Position for the years ended 31 December 2002 and 2001 (in US\$)

| | 2002 | 2001 |
|-----------------------------------------|-------------------------|-------------------------|
| ASSETS | | |
| Current Assets | | |
| Cash and Cash Equivalent | 3 631 562 | 2 855 982 |
| Accounts Receivable: | | |
| Donors | 1 259 707 | 613 403 |
| Employees | 298 038 | 343 307 |
| Others | 632 778 | 482 118 |
| Inventories | 574 536 | 572 629 |
| Prepaid Expenses | 98 494 | 35 017 |
| Total Current Assets | <u>6 495 115</u> | <u>4 902 455</u> |
| Property and Equipment | | |
| Property and Equipment | 8 029 696 | 8 691 576 |
| Less: Accumulated Depreciation | (6 320 987) | (6 597 764) |
| Total Property and Equipment-Net | <u>1 708 710</u> | <u>2 093 812</u> |
| TOTAL ASSETS | <u>8 203 825</u> | <u>6 996 267</u> |
| LIABILITIES AND NET ASSETS | | |
| Current Liabilities | | |
| Bank Balances (Overdraft) | 150 504 | 138 561 |
| Accounts Payable: | | |
| Donors | 2 050 613 | 3 188 905 |
| Employees | 433 531 | 276 019 |
| Others | 2 646 228 | 1 219 627 |
| Provisions and Accruals | 1 298 712 | 877 298 |
| Total Current Liabilities | <u>6 579 589</u> | <u>5 700 410</u> |
| TOTAL LIABILITIES | <u>6 579 589</u> | <u>5 700 410</u> |
| Net Assets | | |
| Unrestricted Net Assets | 1 624 236 | 1 295 857 |
| Total Net Assets | <u>1 624 236</u> | <u>1 295 857</u> |
| TOTAL LIABILITIES AND NET ASSETS | <u>8 203 825</u> | <u>6 996 267</u> |

2. Statement of activities by funding for the years ended 31 December 2002 and 2001 (in US\$)

| | Unrestricted | Restricted | Total | |
|------------------------------------------------------------------------|-------------------------------|------------------------|-------------------|-------------------|
| | | | 2002 | 2001 |
| REVENUE, GAINS AND OTHER SUPPORT | | | | |
| Grants | 4 426 755 | 5 158 657 | 9 585 412 | 9 069 461 |
| Member States—Operating Income | 119 172 | | 119 172 | 147 505 |
| Member States—Capital Development Income | 15 945 | | 15 945 | |
| Transfer of Restricted Assets—Income | 88 269 | | 88 269 | 211 567 |
| World Bank Special Grant—Income | 180 087 | | 180 087 | |
| Other Income | 286 573 | | 286 573 | 354 763 |
| TOTAL REVENUE GAINS AND OTHER SUPPORT | 5 116 800 | 5 158 657 | 10 275 457 | 9 783 296 |
| EXPENSES AND LOSSES | | | | |
| Program Related Expenses | 1 822 914 | 5 158 657 | 6 981 571 | 6 917 599 |
| Management and General Expenses | 4 370 491 | | 4 370 491 | 4 039 265 |
| Total Expenses and Losses | 6 193 405 | 5 158 657 | 11 352 062 | 10 956 863 |
| Indirect Cost Recovery | (1 526 369) | | (1 526 369) | (1 322 907) |
| Total expenses and losses | 4 667 036 | 5 158 657 | 9 825 693 | 9 633 956 |
| EXCESS/(DEFICIT) OF REVENUE OVER EXPENSES | | | | |
| Change in Net Assets | 449 764 | | 449 764 | 149 339 |
| Net Assets at Beginning of Year | 1 295 857 | | 1 295 857 | 1 239 496 |
| Change in Net Assets before Cumulative Effect of Refunds Due to Donors | 449 764 | | 449 764 | 149 339 |
| Reversal of GTZ-Soil Nitrogen Over-Expenditure | (100 000) | | (100 000) | |
| Cumulative Effect of Change in Accounting Policy | (21 385) | | (21 385) | (92 979) |
| Change in Net Assets | 328 379 | | 328 379 | 56 360 |
| Net Assets at End of Year | 1 624 236 | | 1 624 236 | 1 295 857 |
| MEMO ITEM | <i>Management and General</i> | <i>Program related</i> | <i>Total</i> | |
| | | | 2002 | 2001 |
| <i>Total Expenses by Natural Classification</i> | | | | |
| <i>Personnel Costs</i> | 1 722 728 | 2 632 263 | 4 354 990 | 3 949 828 |
| <i>Supplies and Services</i> | 1 991 729 | 3 617 813 | 5 609 543 | 5 294 573 |
| <i>Operational Travel</i> | 212 399 | 387 718 | 600 117 | 741 110 |
| <i>Depreciation</i> | 441 674 | | 441 674 | 683 696 |
| <i>Capital Expenditures</i> | 1 961 | 343 777 | 345 738 | 287 657 |
| Gross Operating Expenses | 4 370 491 | 6 981 571 | 11 352 062 | 10 956 863 |

3. Grants for the year ended 31 December 2002 and 2001 (in US\$)

| UNRESTRICTED | 2002 | 2001 |
|----------------------------------------------|------------------|------------------|
| Belgium | 147 565 | 131 780 |
| Canada | 442 655 | 452 828 |
| Denmark | | 109 311 |
| France* | 161 385 | 148 000 |
| Germany | 140 655 | 140 403 |
| Japan | 804 762 | 412 990 |
| Netherlands | 665 731 | 642 008 |
| Norway | 360 000 | 241 434 |
| Sweden | 357 916 | 319 041 |
| USAID | 225 000 | 224 991 |
| World Bank** | 1 080 000 | 1 390 000 |
| Côte d'Ivoire | 41 086 | 59 836 |
| Total unrestricted grants | 4 426 755 | 4 272 622 |
| TEMPORARILY RESTRICTED | | |
| AfDB I (Institutional Support) | 9 867 | 99 148 |
| CFC/FAO-Spirivwa Project | 51 162 | 88 060 |
| Denmark (Phytosanitary & Seed Health) | 33 062 | 34 405 |
| European Union (Crop & Resources Management) | 14 | 207 295 |
| European Union/CORAF Project | 440 676 | 74 978 |
| France (Collaboration IRD) | 63 270 | 20 181 |
| Gatsby Foundation (Containment Facility) | 6 023 | 48 625 |
| Gatsby Foundation (Dissemination) | 217 580 | 98 431 |
| GTZ (Projet riz nord) | | 6 472 |
| GTZ (Improved Nutrient Management) | | 95 066 |
| GTZ (PTDP) | 387 420 | 358 903 |
| GTZ (Periurban Project) | 103 730 | 61 665 |
| IFAD (PADS Project) | 272 277 | 388 098 |
| UNDP/TCDC-IHP Phase 2 | 257 078 | 161 371 |
| Collaboration-NTR/HRI | 20 785 | 10 519 |
| Japan (Ecophysiology Project) | 48 973 | 48 845 |
| Japan (Grain Quality)* | 12 810 | |
| Japan (Interspecific Hybridization Project) | 505 365 | 606 640 |
| Japan/MAFF WARDA Project | 252 648 | 318 889 |
| Japan (RYMV Project)* | 185 310 | 250 281 |
| Japan (Blast Project)* | 46 907 | 183 227 |
| Japan (Project 1.3)* | 534 | |

*The use of these Grants has been restricted towards selected projects in CGIAR Approved Agenda for WARDA.

**Excluded from this amount is the World Bank Special Grant Income accrued against extraordinary expenditure incurred during the year as a result the crisis being experienced in Côte d'Ivoire. This amount (US\$ 180,087) has been disclosed separately in the Statement of Activities.

TEMPORARILY RESTRICTED (continued)

| | 2002 | 2001 |
|------------------------------------------------------------|------------------|------------------|
| Japan (Project 3.4)* | | 106 233 |
| Japan (Vegetable Production Project) | | 25 000 |
| Japan (Genebank Project) | 400 000 | |
| Japan (Project 2.1) | | 98 817 |
| Norway (Training Project) | 290 501 | 180 533 |
| Norway (SWIHA HIV/AIDS Project) | 102 831 | |
| Rockfeller (Anther Culture Project) | 12 796 | 161 900 |
| Rockfeller (Post Doc) | 60 054 | 38 898 |
| Rockfeller (Capacity Building) | 89 919 | 26 642 |
| Rockfeller (FPATDD-Mali/Nigeria) | 55 569 | 39 445 |
| United Kingdom (Weeds Project) | 4 828 | 6 313 |
| United Kingdom (RYMV Attributed)* | 74 260 | 139 578 |
| United Kingdom (RYMV CRF Project) | 5 039 | 47 321 |
| United Kingdom (Soil Degradation CRF Project) | 491 | 52 871 |
| United Kingdom (Seed Priming Project) | | 25 454 |
| United Kingdom (INGER-Africa Phase 2) | 291 593 | 299 009 |
| United Kingdom (Wild Rice Project) | 2 919 | 13 584 |
| United Kingdom (Root Penetration – University of Aberdeen) | | 4 707 |
| United Kingdom (Blast Attributed)* | 29 911 | 59 539 |
| United Kingdom (Rice Functional Diversity) | 17 727 | 12 236 |
| United Kingdom (Attributed Project 2.1)* | 116 641 | |
| United Kingdom (Attributed Project 2.2)* | 243 633 | |
| USAID (Network Project) | 232 374 | 195 918 |
| USAID (Impact Assessment Project) | 40 974 | 9 026 |
| USAID (Nigeria Rice Economy Project) | 145 824 | 92 718 |
| UNEP (Farmer Stakeholders Project) | 4 686 | |
| Miscellaneous Small Projects | 20 595 | |
| Total Restricted Grants | 5 158 657 | 4 796 839 |
| TOTAL GRANTS | 9 585 412 | 9 069 461 |

*The use of these Grants has been restricted towards selected projects in CGIAR Approved Agenda for WARDA.

Board of Trustees

[1 January 2002 to 30 April 2003]

Chairman

Richard Musangi (Kenya) (from 1 March 2003)
N. Lindsay Innes (UK) (to 28 February 2003)

Members

Jacob Ayuk-Takem (Cameroon)
Clémentine Dabiré (Burkina Faso)
Mamadou Diomandé (Côte d'Ivoire)**
Bamba Gué (Côte d'Ivoire)*
Takeshi Horie (Japan)
Mary Uzo B. Mokuwunye (Nigeria)
Remi Pochat (France)
Edwin C. Price (USA)
Dunstan C.S. Spencer (Sierra Leone)††

Ex-officio: **Director General, WARDA**

Kanayo F. Nwanze (Nigeria)

* Joined in 2002

** Left in 2002

†† Left in 2003

Senior Staff and Associates

1 May 2002 to 30 April 2003

Office of the Director General

Kanayo F. Nwanze
Frank Abamu

Mohamed Mouhidiny Abdou
Péféry Idrissa Coulibaly
Savitri Mohapatra*
R. Raman*

Director General
HIV Focal Point
Agronomist/Crop Modeler
Internal Auditor
Information and Communications Technology Manager
Assistant to the Director General and Public Awareness Officer
Web-master

Training, Information and Library Services

Aline Lisette-Vidal
Thomas Adigun*
Marijke Loosvelt**
Aboubacar Madougou
Guy Manners
Fassouma Sanogo
Aïssata Sylla

Head of Training, Information and Library Services
Librarian
Editor/Translator
Translator
Information Officer
Translator
Desktop-publishing Assistant
Acting Secretary to the Director of Research†

Corporate Services Division

P.-Justin Kouka
Safiatou Yabré
Guézi Norberte Zézé

Assistant Director for Corporate Services
Travel and Administrative Assistant
Senior Liaison Officer (Abidjan)

Administration and Finance Division

Michel P. Dubé
Jean-Baptiste Adjovi
Klana Dagnogo
Gabriel Dao
Mark Etsibah
Chaka Barakissa Fofana*
Guétin Gogbé**

Director of Administration and Finance
Senior Accountant (Budgetary Control & Projects)
Mechanical Maintenance Manager
Head of Human Resources and Administrative Services
Senior Accountant
Purchasing and Supplies Manager
Purchasing and Supplies Manager

Stanislas Hachemé
 Gilbert Kato
 Nurdin S. Katuli
 Fansu Vatogoma Koné**
 Lhet Olivier Magnan
 George Maina
 Olusegun Olubowale**
 Gaston Sangaré
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Programs Division

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 James Sumberg*

Monty P. Jones**
 Emmanuel Abo**
 Enoch Boateng**
 Anne Bouma
 Maméri Camara†
 Toon Defoer

Aliou Diagne
 Sitapha Diatta
 Olaf Erenstein
 Koichi Futakuchi
 Howard Gridley
 R. Gouantoueu Guei

Stephan Haefele**
 Monica Idinoba
 Mohamed Kebbeh
 Paul Kiepe*

Harouna Koré**
 Frédéric Lançon††
 Kouamé Miézan
 Augustin Munyemana
 Marie-Noëlle Ndjiondjop
 Francis Nwilene
 Olumuyiwa Osiname
 Andreas Oswald

Administrative Officer for Logistic Services
 Transport Officer
 Head of Operations
 Personnel Officer
 Physical Plant Services Manager
 Head of Finance
 Senior Accountant
 Farm Manager
 Information Systems Administrator (Finance)
 Personnel Officer

Director of Research
 Rice Policy and Development Program Leader
 Acting Director of Research†
 Deputy Director of Research and Rainfed Rice Program Leader
 Virologist (Visiting Scientist)
 GIS Specialist (Visiting Scientist)
 Research Support Officer
 Agronomist (Visiting Scientist, Sahel)
 Technology Transfer Agronomist
 Acting Rice Policy and Development Program Leader**
 Impact Assessment Economist
 Soil Physicist
 Production Economist
 Crop Ecophysicologist
 Lowland Rice Breeder
 Head of Genetic Resources Unit†
 INGER-Africa Coordinator††
 Agronomist for Irrigated Systems (Sahel)
 Agro-climatologist (Visiting Research Fellow)
 Production Economist (Sahel)
 Inland Valley Consortium Scientific Coordinator and
 Natural-Resource Management Scientist
 Vegetable Economist (Visiting Scientist)
 Policy Economist
 Irrigated Rice Program Leader (Sahel)
 Participatory Technology Development Scientist (Nigeria)
 Molecular Biologist/Biotechnologist*
 Entomologist
 WARDA Coordinator in Nigeria (Nigeria)
 Cropping Systems Agronomist

Sidi Sanyang
Yacouba Séré

Aïssata Sobia Camara**

Collaborating Scientists

Alain Audebert**
Kouassi Soumaila Bredoumy†
Marie-Josèphe Dugué**

Pierrick Fraval**
May-Guri Sæthre*
Takeshi Sakurai
Abdoul Aziz Sy*, **
Hiroshi Tsunematsu
Petrus van Asten**

ROCARIZ Coordinator
Pathologist
Acting Rainfed Rice Program Leader*
Agricultural Economist (Visiting Scientist)

Physiologist (CIRAD)
Interim Coordinator of the African Rice Initiative (ARI)
Inland Valley Consortium Regional Coordinator (*Coopération française*)
Water Management Economist (Sahel, IWMI/Cemagref)
Entomologist (Nigeria, Norwegian Crop Research Institute)
Agricultural Economist (JIRCAS)
Interim Coordinator of the African Rice Initiative (ARI)
Associate Upland Rice Breeder (JIRCAS)
Associate Soil Scientist (Sahel, DGIS)

* Joined or changed title in 2002

** Left or changed title in 2002

† Joined or changed title in 2003

†† Left or changed title in 2003

Training

Courses Given between 1 January 2002 and 30 March 2003

| Title and dates | Location | Language | Participants | | |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------|-----------------|--------|-------|
| | | | Male | Female | Total |
| Training in Biotechnology and Anther-culture January–May 2002 | M'Bé, Bouaké, Côte d'Ivoire (WARDA) | French, English | 3 | 0 | 3 |
| Methodology of Impact Assessment of Agricultural Technologies (Economics Task Force) 18–23 February 2002 | M'Bé, Bouaké, Côte d'Ivoire (WARDA) | French, English | 10 | 0 | 10 |
| Participatory Learning and Action Research on Integrated Rice Management (PLAR/IRM) 25 February to 8 March 2002 | M'Bé, Bouaké, Côte d'Ivoire (WARDA) | French | 30 | 10 | 40 |
| Workshop on constructing thresher–cleaner 6–29 March 2002 | Grand Lahou, Côte d'Ivoire (CGMAG) | French | 18 | 0 | 18 |
| Training workshop on Extension-led Participatory Varietal Selection (PVS-E) 18–19 April 2002 | M'Bé, Bouaké, Côte d'Ivoire (WARDA) | French, English | 21 | 4 | 25 |
| Training of trainers in participatory adaptation and transfer of technologies 22–26 April 2002 | Rosso, Mauritania | French | 15 | 0 | 15 |
| Participatory adaptation and transfer of technologies for field staff 13–18 May 2002 | Rosso & Boghe, Mauritania | French | 30 (15 + 15) | 0 | 30 |

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|--------------------------------------------------------------------------------------------------------|-------------------------------------------|--------|------------|-----------|------------|
| Formatting agricultural information for media publication 27–31 May 2002 | M'Bé, Bouaké, Côte d'Ivoire (WARDA) | French | 15 | 2 | 17 |
| <i>Formation à l'analyse et à l'interprétation statistiques des données</i> 4–13 September 2002 | M'Bé, Bouaké, Côte d'Ivoire (WARDA) | French | 19 | 0 | 19 |
| Total | | | 161 | 16 | 177 |

Postgraduate Trainees in 2002–03

| Name and thesis topic/subject | Institution | Sponsor | Degree |
|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------|---------|
| <i>Adesanwo, O.O.</i> Legume/phosphate rock combination for sustainable rice production in southwestern Nigeria | University of Agriculture, Abeokuta, Nigeria | WARDA/ University of Hohenheim | PhD |
| <i>Afolabi, Aboladi††</i> Development and understanding of a new clean gene (marker-free) technology for rice | University of East Anglia/John Innes Centre, UK | DFID/Rockefeller Foundation | PhD |
| <i>Aluko, Kiodé Gabriel</i> Genetic studies of soil acidity tolerance in rice | Louisiana State University | Rockefeller Foundation | PhD |
| <i>Amoussou, Pierre-Louis</i> Genomics of rice yellow mottle virus | University of East Anglia, UK | Rockefeller Foundation/DFID | PhD |
| <i>Assingbé, Paulin</i> <i>Intégration des légumineuses dans la rotation des cultures du riz pluvial au Bénin</i> | University of Cocody-Abidjan | BMZ/GTZ | PhD |
| <i>Awoh, Akué Sylvette*</i> Cropping systems and their production characteristics in peri-urban agriculture | Université Nationale de Côte d'Ivoire, Abidjan | BMZ/GTZ/ WARDA | DEA |
| <i>Bissouma, Laurence</i> <i>Criblage de variétés locales de riz pour la résistance à la pyriculariose</i> | Institut national polytechnique Houphouët-Boigny (INP-HB) Ecole supérieure d'agronomie (ESA) | MESRS/ WARDA | DAA/MSc |
| <i>Bognonkpe, Jean Pierre Irénée</i> The influence of land use on the dynamics of native soil nitrogen at watershed scale in West Africa | University of Bonn | DAAD/ Volkswagen Foundation | PhD |
| <i>Bolou, Bi Bolou Emile*</i> Cropping systems and their production characteristics in peri-urban agriculture | Université Nationale de Côte d'Ivoire, Abidjan | BMZ/GTZ/ WARDA | DEA |
| <i>Chérif, Mamadou</i> <i>Effet de la toxicité ferreuse sur l'activité photo-synthétique du riz : étude de la variabilité génétique</i> | Université d'Abidjan | AfDB | PhD |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------|------------------|
| <i>Chovwen, Anthony</i> Evaluation of participatory research approaches in Nigeria | University of Agriculture, Abeokuta, Nigeria | BMZ/GTZ | PhD |
| <i>Clark, Cary</i> Rural finance systems and related constraints for lowland rice intensification | University of Reading | Private/ WARDA | PhD |
| <i>Comoe, Hermann Daisy††</i> <i>Analyse de l'aspect institutionnel de la diffusion des variétés améliorées de riz et de la gestion des semences en milieu paysan</i> | INP-HB/ESA | WARDA/ DFID | DEA |
| <i>Djadjaglo, David</i> <i>Détermination des facteurs influençant la productivité des systèmes de production à base de riz au sud du Bénin</i> | Hohenheim University | BMZ/GTZ | PhD |
| <i>Djea, Yao Franck Armel††</i> <i>Estimation des fonctions d'offre et de demande de riz en Côte d'Ivoire</i> | INP-HB/ESA | WARDA/DFID/ UNEP | DEA |
| <i>Dudnik, Nina</i> Molecular biology | — | Fulbright | — |
| <i>Efisue, Andrew*</i> Developing durable resistant upland rice for the tropics of Africa | University of Natal | Rockefeller | PhD |
| <i>Gnagadjomon, Koné*</i> Socio-economics of peri-urban agriculture | Université de Bouaké | BMZ/GTZ | DEA |
| <i>Gnamien, N'Goran**</i> <i>Technique de dosage du phosphore assimilable par la méthode Bray I</i> | Private | <i>Enseignant</i> | <i>Recyclage</i> |
| <i>Guèye, Talla</i> Nitrogen use efficiency in irrigated rice | University of Göttingen | DAAD | PhD |
| <i>Horna, Daniela</i> Brokering of knowledge and information in the rice production system in Southern Nigeria and Benin Republic | Hohenheim University | BMZ/GTZ | PhD |
| <i>Keijzer, Pieter</i> Plant science | Wageningen University | Wageningen University/ WARDA | MSc |

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|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|------------------------|-----------------------------------------------------------------|
| <i>Koffi, Marie-Chantal*</i> Cropping systems and their production characteristics in peri-urban agriculture | Université Nationale de Côte d'Ivoire, Abidjan | BMZ/GTZ/ WARDA | DEA |
| <i>Konaté, Karidiatou**</i> <i>Effets de l'application des éléments nutritifs sur la toxicité ferreuse</i> | INP-HB | INP-HB | <i>BTS Chimie industrielle</i> <i>Diplôme de fin d'étude</i> |
| <i>Koné, Fahiraman K.*</i> Socio-economics of peri-urban lowland agriculture | Université de Bouaké | BMZ/GTZ | DEA |
| <i>Kotchi, Valère</i> <i>Dynamique du phosphore dans les sols en région tropicale : le cas de la Côte d'Ivoire</i> | Université d'Abidjan | AfDB | PhD |
| <i>Kouassi Niankan, Aubin</i> <i>Evaluation de la résistance à la Panachure jaune du riz de 297 variétés locales de riz de la région de Gagnoa</i> | INP-HB/ESA | MESRS/WARDA | DAA/MSc |
| <i>Macaire, Dobo*</i> Enhance uniformity and stability of rice grain quality through genetic transformation and marker assisted breeding | Texas A&M University | Rockefeller Foundation | PhD |
| <i>Maji, Alhassan Tswako</i> Genetics of resistance to African rice gall midge in <i>Oryza glaberrima</i> | University of Ibadan | Rockefeller Foundation | PhD |
| <i>Mandé, Sémon</i> Assessment of biodiversity in <i>Oryza glaberrima</i> using microsatellite markers | Cornell University | Rockefeller Foundation | PhD |
| <i>Mesmin, Meye Mella</i> Influence of spatial variability on fertilizer recommendations | Technical School Bambey | — | Agronomic engineer |
| <i>Mulder, Linda</i> Effect of straw application on yield and on plant availability of N and P for alkaline irrigated rice soils | Wageningen University | DFID | MSc |
| <i>Rawande, Zaer**</i> <i>Effet résiduel du TSP sur cinq variétés de riz pluvial sur un sol acide de forêt à Man</i> | INP-HB | INP-HB | <i>BTS Chimie industrielle</i> <i>Diplôme de fin d'étude</i> |

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------|---------|
| <i>Sédia, N'Da Amenan Gisèle*</i> Socio-economics of peri-urban lowland agriculture | Université de Bouaké | BMZ/GTZ | PhD |
| <i>Soko, Faustin Dago</i> <i>Epidémiologie du RYMV : Etude des conditions d'établissement et de déroulement des épidémies pour une gestion intégrée de la panachure jaune du riz en Côte d'Ivoire</i> | Université d'Abidjan | Japan | PhD |
| <i>Sorho, Fatogoma</i> Assessment of rice yellow mottle virus pathogeny as a prerequisite of the deployment and the durability of the natural genetic resistance to rice yellow mottle disease | Université d'Abidjan | WARDA/IRD/ AGROPOLIS | PhD |
| <i>Soro, Koundieletia</i> <i>Analyse sanitaire des semences de riz</i> | Ecole nationale supérieure d'agriculture (ENSA) | WARDA | DAA |
| <i>Thuweba, Diwani*</i> Improving productivity of peri-urban lowland cropping systems | University of Bonn | BMZ/GTZ/WARDA | PhD |
| <i>Tia, Dro Daniel</i> <i>Caractérisation morphologique de la biodiversité du riz local de la région de Gagnoa</i> | INP-HB/ESA | WARDA | DAA |
| <i>Tiemele, Delees Edmond</i> <i>Etude de la résistance des variétés à la panachure jaune</i> | ENSA | WARDA | DAA |
| <i>Tonessia, Dolou Charlotte††</i> <i>Identification de la flore bactérienne et fongique hébergée par les semences de riz et tentative de lutte contre ces pathogènes</i> | Université de Cocodi-Abidjan | MESRS/WARDA | DEA/MSc |
| <i>Traoré, Karim</i> Marker-assisted selection for improving drought resistance in rice root traits and osmotic adjustment | University of Texas | Rockefeller Foundation | PhD |
| <i>Tveteraas, Astrid</i> The impact of AIDS on livelihood security in rural areas of Côte d'Ivoire | Agricultural University of Norway | Agricultural University of Norway/WARDA | MSc |
| <i>van Asten, Petrus</i> Salt-related soil degradation in irrigated rice-based cropping systems in the Sahel | Wageningen University | DGIS | PhD |

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|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------|-----|
| <i>van't Zelfde, Arjan</i> Identification and quantification of processes contributing to alkalinization in irrigated rice soils | Wageningen University | DFID | MSc |
| <i>Yao, Kouadio Nasser</i> <i>Androgène in vitro chez le riz Oryza glaberrima et</i> <i>d'hybrides interspecifiques sativa-glaberrima</i> | Université d'Abidjan | AfDB | PhD |
| <i>Zamble, Lout T. Corinne</i> <i>Caractérisation morphologique de la biodiversité du</i> <i>riz local de la région de Danané</i> | INP-HB/ESA | WARDA | DAA |
| <i>Zekre, Sylvestre</i> <i>Caractérisation morphologique de la biodiversité du</i> <i>riz local des régions de Boundiali et Touba</i> | INP-HB/ESA | WARDA | DAA |
| <i>Zeller, Heiko</i> Characterization of rainfed upland rice production systems in southern Nigeria | Hohenheim University | BMZ/GTZ | PhD |

* Started in 2002

** Completed in 2002

†† Completed in 2003

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- Adigun, T.A., 2002. Analysis of the publications of scientists at the West Africa Rice Development Association, Bouaké, Côte d'Ivoire. *IAALD Quarterly Bulletin* 47(2): 43–46.
- Becker, M., M.C.S. Wopereis and D.E. Johnson, 2002. The role of N nutrition on lowland rice yields along an agro-ecological gradient in West Africa. *Developments in Plant and Soil Science* 92: 970–972. [Also published in: Horst *et al.* (ed.) *Food Security and Sustainable Agro-ecosystems Through Basic and Applied Research*. Kluwer Academic Publishers, Dordrecht, The Netherlands.]
- Boivin, P., F. Favre, C. Hammecker, J.L. Maeght, J. Delarivière, J.C. Poussin and M.C.S. Wopereis, 2002. Processes driving soil solution chemistry in a flooded rice-cropped vertisol: analysis of long-time monitoring data. *Geoderma* 110: 87–107.
- Caldwell, J.S., H. Kanno, A. Berthé, A. Yoroté, K. Sasaki, M. Doumbia, K. Ozawa and T. Sakurai, 2002. Climatic variability in cereal-based cropping systems in Mali, West Africa. *Farming Japan* 36(4): 35–41.
- Defoer, T., 2002. Social learning for integrated soil fertility management in sub-Saharan Africa. In: C. Leeuwis and R. Pyburn (ed.) *Wheelbarrows Full of Frogs*. International Research and Reflections. Koninklijke van Gorcum, Assen, The Netherlands.
- Defoer, T., 2002. Learning about methodology development for integrated soil fertility management. *Agricultural Systems* 73: 57–81.
- Diagne, A., 2002. Impact of access to credit on maize and tobacco productivity in Malawi. In: Manfred Zeller and Richard L. Meyer (ed.) *The Triangle of Microfinance: Financial Sustainability, Outreach and Impact*. The John Hopkins University Press, Baltimore and London.
- Diagne, A., 2002. Impact assessment: A synthesis of recent methodological developments. *Proceedings of the CORAF/WECARD Workshop on the Institutionalization of Impact Assessment in Agricultural Research in West and Central Africa*. Somone, Senegal, 26–29 March 2002. CORAF/WECARD.
- Erenstein, O., 2002. Crop residue mulching in tropical and semi-tropical countries: An evaluation of residue availability and other basic technological implications. *Soil and Tillage Research* 67(2): 115–133.

- Guei, R.G., A. Adam and K. Traoré, 2002. Comparative studies of seed dormancy characteristics of two *Oryza* species and their progenies. *Seed Science and Technology* 30(3): 499–505.
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- Idinoba, M.E., P.A. Idinoba and A.S. Gbadegesin, 2002. Radiation interception and its efficiency for dry matter production in three crop species in the transitional humid zone of Nigeria. *Agronomie* 22(1): 87–95.
- Kebbeh, M., F. Aïfa, N. Niane and M. Ndour, 2002. Protocole de collaboration ADRAO-SONADER-CNRADA pour l'amélioration de la productivité et de la production du riz en Mauritanie. *Rapport Activités Contre Saison 2001*, 32 p.
- Kebbeh, M., F. Aïfa, N. Niane, M. Ndour and K. Miezán, 2002. Amélioration de la productivité et de la production du riz en Mauritanie : Evaluation, adaptation et transfert de technologies améliorées en milieu paysan. *Rapport Final*, août 2002.
- Nwilene, F.E., C.T. Williams, M.N. Ukwungwu, D. Dakouo, S. Nacro, A. Hamadoun, S.I. Kamara, O. Okhidievbie, F.J. Abamu and A. Adam, 2002. Reactions of differential rice genotypes to African rice gall midge in West Africa. *International Journal of Pest Management* 48(3): 195–201.
- Sahrawat, K.L. and L.T. Narteh, 2002. A fertility index for submerged rice soils. *Communications in Soil Science and Plant Analysis* 33(1&2): 229–236.
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- Segda, Z., F. Lompo, M.C.S. Wopereis and P.M. Sedogo, 2001. Amélioration de la fertilité du sol par l'utilisation du compost en riziculture irriguée dans la Vallée du Kou au Burkina Faso. *Agronomie Africaine* 13(2): 45–58.
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- Watanabe, H., K. Futakuchi, M.P. Jones, I. Teslim and B.A. Sobambo, 2002. Brabender Viscogram characteristics of interspecific progenies of *Oryza glaberrima* Steud and *O. sativa* L. *Nippon Shokuhin Kagaku Kogaku Kaishi* (Japanese Journal of Food Science and Technology) 49(3): 155–165.
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WARDA titles

[1 May 2002 to 30 April 2003]

- Annual Report 2001–2002*. 2002. WARDA, Bouaké, Côte d’Ivoire, 103 p. ISBN 92 9113 239 X.
- Bintou et son nouveau riz africain – A video summary*. 2002. ADRAO, Bouaké, Côte d’Ivoire, and AGCOM International, USA, 10 min. 42 sec.
- Bintu and Her New African Rice—A Video Summary*. 2002. WARDA, Bouaké, Côte d’Ivoire, and AGCOM International, USA, 10 min. 42 sec.
- Bintu and Her New African Rice—A Video Summary – Japanese*. 2002. WARDA, Bouaké, Côte d’Ivoire, and AGCOM International, USA, 10 min. 42 sec.
- Current Contents at WARDA* (Monthly issue).
- Describing Hydrological Characteristics for Inland Valley Development / Présentation des caractéristiques hydrologiques de la mise en valeur des bas-fonds*. Proceedings of the second scientific workshop of the Inland Valley Consortium / Compte rendu du deuxième atelier scientifique du Consortium bas-fonds, 4–6 June/juin 1997, Bouaké, Côte d’Ivoire. P.N. Windmeijer, M.J. Dugué, J.Y. Jamin and N. van de Giesen (Ed.), 2002. WARDA/ADRAO, Bouaké, Côte d’Ivoire, 64 p. ISBN 92 9113 134 2.
- Impact of Participatory Rice Improvement Research and Gender Analysis in West Africa: Institutional Analysis*. N. Lilja and O. Erenstein, 2002. Participatory Research and Gender Analysis (PRGA) Working Document no. 20. PRGA–CIAT, Cali, Colombia, and WARDA, Bouaké, Côte d’Ivoire, 28 p. http://www.prgaprogram.org/publica.htm#ppb_wd

INGER-Africa: The Vital Link in the Chain. 2002. WARDA, Bouaké, Côte d'Ivoire, 18 p. ISBN 92 9113 227 6.

NERICA Rice: Hope for Food Security in Africa. WSSD Special Event on NERICA Rice, 31 August 2002. Organized by: The Government of Japan, United Nations Development Programme (UNDP), West Africa Rice Development Association (WARDA); in collaboration with Consultative Group on International Agricultural Research (CGIAR), [4] p.

NERICA Rice: Hope for Food Security in Africa. WSSD Special Event on NERICA Rice, 31 August 2002. Organized by: The Government of Japan, United Nations Development Programme (UNDP), West Africa Rice Development Association (WARDA); in collaboration with Consultative Group on International Agricultural Research (CGIAR) [in Japanese], [4] p.

Le nouveau riz pour l'Afrique, NERICA : Espoir pour assurer l'alimentation en Afrique. Evènement spécial de la CNUED sur le riz NERICA, 31 Août 2002. Organisé par : le Gouvernement du Japon, le Programme des Nations Unies pour le développement (PNUD), l'Association pour le développement de la riziculture en Afrique de l'Ouest (ADRAO) ; en collaboration avec le Groupe consultatif pour la recherche agricole internationale (GCRAI), [4] p.

Rice Almanac. Source Book for the Most Important Economic Activity on Earth (3rd edition). J.L. Maclean, D.C. Dawe, B. Hardy and G.P. Hettel (Ed.), 2002. IRRI, Los Baños, The Philippines; WARDA, Bouaké, Côte d'Ivoire; CIAT, Cali, Colombia; and FAO, Rome, Italy, 253 p. ISBN 971 22 0172 4.

Abbreviations and Acronyms

| | |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4Rs | Regional Rice Research Review (biennial meeting of ROCARIZ) |
| ADP | Agricultural Development Project (Nigeria) |
| ADRAO | <i>Association pour le développement de la riziculture en Afrique de l'Ouest</i> (former French name of WARDA) |
| AfDB | African Development Bank |
| AfRGM | African rice gall midge |
| AGROPOLIS | <i>Pôle international de recherche et d'enseignement supérieur agronomiques</i> (International Complex for Research and Higher Education in Agriculture, France) |
| AIDS | Acquired Immune Deficiency Syndrome |
| ANADER | <i>Agence nationale d'appui au développement rural</i> (Côte d'Ivoire) |
| ANCAR | <i>Agence nationale du conseil agricole et rurale</i> (Senegal) |
| ANWAR | ANADER–WARDA thresher–cleaner (Côte d'Ivoire) |
| ARI | African Rice Initiative |
| ASARECA | Association for Strengthening Agricultural Research in Eastern and Central Africa |
| ATE | average treatment effect |
| ATE1 | average treatment effect on the treated |
| BBC | British Broadcasting Company (UK) |
| BEAF | <i>Beratungsgruppe Entwicklungsorientierte Agrarforschung</i> (Germany) |
| BMZ | <i>Bundesministerium für Wirtschaftliche Zusammenarbeit</i> (Germany) |
| BTS | <i>Brevet de Technicien Supérieur</i> (postgraduate degree) |
| CFA | <i>Communauté financière africaine</i> |
| CFC | Common Fund for Commodities [donor] |
| CG | Consultative Group on International Agricultural Research |
| CGIAR | Consultative Group on International Agricultural Research |
| CIAT | <i>Centro Internacional de Agricultura Tropical</i> |
| CIFOR | Center for International Forestry Research |
| CIMMYT | <i>Centro Internacional de Mejoramiento de Maiz y Trigo</i> |
| CIO | <i>Commission Inter-Organismes</i> (CIRAD, INRA & IRD, France) |
| CIP | <i>Centro Internacional de la Papa</i> |
| CIRAD | <i>Centre de coopération internationale en recherche agronomique pour le développement</i> (France) |
| CNRA | <i>Centre national de recherche agronomique</i> (Côte d'Ivoire) |
| CNRADA | <i>Centre national de recherche agronomique et de développement agricole</i> (Mauritania) |
| cont'd | continued |
| CORAF | <i>Conseil Ouest et Centre Africain pour la recherche et le développement agricole</i> (formerly, <i>Conférence des responsables de la recherche agronomique africaine</i>) |
| CRAI | <i>Commission pour la recherche agronomique internationale</i> (France) |
| CRF | Competitive Research Funds (DFID) |
| CTA | Technical Centre for Agricultural and Rural Cooperation (the Netherlands) |
| DAA | <i>Diplôme d'agronomie appliquée</i> |
| DAAD | Deutscher Akademischer Austauschdienst |
| DEA | <i>Diplôme d'études approfondies</i> (degree) |
| Dev. | Development |

| | |
|-----------|--------------------------------------------------------------------------------------------------|
| DFID | Department for International Development (<i>formerly</i> ODA, UK) |
| DG | Director General |
| DGIS | Directorate General for International Cooperation (The Netherlands) |
| Dr | Doctor |
| DR | Democratic Republic |
| Ed. / ed. | editor(s) |
| EFC | Executive and Finance Committee (WARDA Board of Trustees) |
| e.g. | for example |
| ENSA | <i>Ecole nationale supérieure d'agriculture</i> (Côte d'Ivoire) |
| ESA | (1) Eastern and Southern Africa; (2) <i>Ecole supérieure d'agronomie</i> (INP-HB) |
| FAO | Food and Agriculture Organization of the United Nations |
| FARA | Forum for Agricultural Research in Africa |
| Fig. | Figure |
| FPATDD | Farmer Participatory Approaches to Technology Development and Dissemination (WARDA Project) |
| GCRAI | <i>Groupe consultatif pour la recherche agricole</i> (French of CGIAR) |
| GIS | geographical information system(s) |
| GPS | global position satellite |
| GTZ | <i>Gesellschaft für Technische Zusammenarbeit</i> (Germany) |
| ha | hectare(s) |
| HE | His Excellency |
| HIV | Human Immunodeficiency Virus |
| HRI | Horticultural Research International (UK) |
| IAALD | International Association of Agricultural Information Specialists |
| IAEG | Impact Assessment and Evaluation Group (CGIAR) |
| ICARDA | International Center for Agricultural Research in the Dry Areas |
| ICLARM | WorldFish Center (<i>formerly</i> , International Center for Living Aquatic Resources) |
| ICM | integrated crop management |
| ICRAF | World Agroforestry Centre (<i>formerly</i> , International Centre for Research in Agroforestry) |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| IDEA | Investment in Developing Export Agriculture (Uganda) |
| i.e. | that is |
| IER | <i>Institut d'économie rurale</i> (Mali) |
| IFAD | International Fund for Agricultural Development |
| IFDC | International Fertilizer Development Corporation |
| IFPRI | International Food Policy Research Institute (Washington, DC, USA) |
| IHP | Interspecific Hybridization Project (WARDA) |
| IITA | International Institute of Tropical Agriculture (Ibadan, Nigeria) |
| ILRI | International Livestock Research Institute (Nairobi, Kenya and Addis Ababa, Ethiopia) |
| INERA | <i>Institut de l'environnement et des recherches agricoles</i> (Burkina Faso) |
| INGER | International Network for Genetic Evaluation of Rice |
| INP-HB | <i>Institut national polytechnique Houphouët-Boigny</i> (Yamoussoukro, Côte d'Ivoire) |
| INRA | <i>Institut National de Recherches Agronomiques</i> (France) |
| IPGRI | International Plant Genetic Resources Institute (Rome, Italy) |
| IPM | integrated pest management |
| IRD | <i>Institut de recherche pour le développement</i> (<i>formerly</i> ORSTOM, France) |
| IRM | integrated rice management |
| IRRI | International Rice Research Institute (Los Baños, The Philippines) |
| ISBN | International Standard Book Number |
| ISNAR | International Service for National Agricultural Research (The Hague, The Netherlands) |
| ISRA | <i>Institut sénégalais de recherches agricoles</i> (Senegal) |

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|---------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| ISTOM | <i>Ecole supérieure de Cergy-Pontoise (formerly, Institut supérieure technique d'outre-mer, France)</i> |
| ITA | rice varieties developed by IITA |
| IVC | Inland Valley Consortium (WARDA) |
| IWMI | International Water Management Institute |
| JICA | Japan International Cooperation Agency |
| JIRCAS | Japan International Research Center for Agricultural Sciences |
| KIT | Royal Tropical Institute (the Netherlands) |
| LANASOL | <i>Laboratoire National d'Analyse des Sols et de l'Eau (Mauritania)</i> |
| LCPC | <i>Laboratoire Central des Ponts et Chaussées (France)</i> |
| MAFF | Ministry of Agriculture, Forestry and Fisheries (Japan) |
| MDGs | Millennium Development Goals (of the UN) |
| MESRS | <i>Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (Ministry of Higher Education and Scientific Research, Côte d'Ivoire)</i> |
| min. | minute(s) |
| MOU | Memorandum of Understanding |
| MSc | Master of Science (degree) |
| NARES | national agricultural research and extension system |
| NARI | National Agricultural Research Institute (The Gambia) |
| NARS | national agricultural research system(s) |
| NCRI | National Cereals Research Institute (Nigeria) |
| NEPAD | New Partnership for Africa's Development |
| NERICA | New Rice for Africa |
| NGO | non-governmental organization |
| NISER | Nigerian Institute of Social and Economic Research |
| No. | number |
| NRI | Natural Resources Institute (UK) |
| NSS | National Seed Service (Nigeria) |
| OECD | Organisation for Economic Co-operation and Development |
| OMVS | <i>Organisation pour la Mise en Valeur du Fleuve Sénégal</i> |
| ORSTOM | <i>Institut français de recherche scientifique pour le développement en coopération (now IRD, France)</i> |
| p./pp. | page(s)/pages |
| PADS | Participatory Adaptation and Diffusion of technologies for rice-based Systems (WARDA project) |
| PCSI | <i>Programme Commun de recherches sur les Systèmes Irrigués (Cemagref, CIRAD, IRD, France)</i> |
| PhD | Doctor of Philosophy (doctorate) |
| PLAR | participatory learning and action research |
| p.m. | <i>post meridiem</i> (afternoon) |
| PNR | <i>Projet national riz (Côte d'Ivoire)</i> |
| PNUD | <i>Programme des Nations Unies pour le Développement (French of UNDP)</i> |
| PRGA | System-wide Programme on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (CGIAR) |
| PRIGA | Participatory Rice Improvement and Gender/user Analysis (WARDA) |
| PTD | participatory technology development |
| PVS | participatory varietal selection |
| PVS-e | extension-led PVS |
| QTL(s) | quantitative trait locus (loci) |
| RCU | Regional Coordination Unit (IVC) |
| RFI | <i>Radio France Internationale</i> |
| ROCARIZ | <i>Réseau Ouest et Centre Africain du Riz (West and Central Africa Rice Research and Development Network) [WARDA–WECARD/CORAF]</i> |
| RYMV | rice yellow mottle virus |

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|---------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| SAED | <i>Société d'aménagement et d'exploitation des terres du Delta du Fleuve Sénégal et des vallées du Fleuve Sénégal et de la Falémé (Senegal)</i> |
| sec. | second(s) |
| SINGER | System-wide Information Network for Genetic Resources (CGIAR) |
| SONADER | <i>Société nationale pour le développement rural (Mauritania)</i> |
| SRI | system of rice intensification |
| SSA | Sub-Saharan Africa |
| SWIHA | System-Wide Initiative on HIV/AIDS and Agriculture (CGIAR) |
| t | tonne(s) |
| TCDC | Technical Cooperation among Developing Countries (UNDP) |
| Tel. | telephone number |
| TICAD | Tokyo International Conference on Africa's Development |
| TILS | Training, Information and Library Services (WARDA) |
| TSP | triple super phosphate |
| UK | United Kingdom |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNOPS | United Nations Office for Project Services (UNDP) |
| UPOV | International Union for the Protection of New Varieties of Plants |
| US | United States |
| USA | United States of America |
| USAID | United States Agency for International Development |
| v. | versus |
| WAB | WARDA/ADRAO-Bouaké rice varieties |
| WARDA | The Africa Rice Center (<i>formerly</i> , West Africa Rice Development Association) |
| WAS | WARDA/ADRAO-Sahel rice varieties |
| WECARD | West and Central African Council for Research and Development (English of CORAF) |
| WITA | ' WARDA at IITA ' rice varieties developed by WARDA in Nigeria |
| WSSD | World Summit on Sustainable Development |
| WTO | World Trade Organization |

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About the Consultative Group on International Agricultural Research (CGIAR)

The Consultative Group on International Agricultural Research (CGIAR) was founded in 1971 as a global endeavor of cooperation and goodwill. The CGIAR's mission is to contribute to food security and poverty eradication in developing countries through research, partnership, capacity building and policy support, promoting sustainable agricultural development based on the environmentally sound management of natural resources. The CGIAR works to help ensure food security for the twenty-first century through its network of 16 international and autonomous research centers, including WARDA. Together, the centers conduct research on crops, livestock, fisheries and forests, develop policy initiatives, strengthen national agricultural organizations, and promote sustainable resource management practices that help provide people world-wide with better livelihoods.

The CGIAR works in partnership with national governmental and non-governmental organizations, universities and private industry. The United Nations Development Programme, the United Nations Environment Programme, the World Bank, and the Food and Agriculture Organization of the United Nations sponsor the CGIAR. The CGIAR's over 50 members include developing and developed countries, private foundations, and international and regional organizations. Developing world participation has doubled in recent years. All members of the OECD (Organisation for Economic Co-operation and Development) Development Assistance Committee belong to the CGIAR.

The CGIAR is actively planning for the world's food needs well into the twenty-first century. It will continue to do so with its mission always in mind and with its constant allegiance to scientific excellence.

CGIAR Centers

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| CIAT | Centro Internacional de Agricultura Tropical (Cali, Colombia) |
| CIFOR | Center for International Forestry Research (Bogor, Indonesia) |
| CIMMYT | Centro Internacional de Mejoramiento de Maiz y Trigo (Mexico, DF, Mexico) |
| CIP | Centro Internacional de la Papa (Lima, Peru) |
| ICARDA | International Center for Agricultural Research in the Dry Areas (Aleppo, Syria) |
| ICLARM | WorldFish Center (Penang, Malaysia) |
| ICRAF | World Agroforestry Centre (Nairobi, Kenya) |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics (Patancheru, India) |
| IFPRI | International Food Policy Research Institute (Washington, DC, USA) |
| IITA | International Institute of Tropical Agriculture (Ibadan, Nigeria) |
| ILRI | International Livestock Research Institute (Nairobi, Kenya) |
| IPGRI | International Plant Genetic Resources Institute (Rome, Italy) |
| IRRI | International Rice Research Institute (Los Baños, Philippines) |
| ISNAR | International Service for National Agricultural Research (The Hague, Netherlands) |
| IWMI | International Water Management Institute (Colombo, Sri Lanka) |
| WARDA | The Africa Rice Center (Bouaké, Côte d'Ivoire) |



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