Africa Rice Center (WARDA) Annual Report 2004–2005

Forward in partnership

CGIAR

About Africa Rice Center (WARDA)

Africa Rice Center (WARDA) is an autonomous intergovernmental research association of African member states. WARDA is also one of the 15 international agricultural research Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

WARDA'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 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 *New Rice for Africa* (NERICA), which is bringing hope to millions of poor people in Africa, was developed by WARDA and its partners. The success of the NERICAs has helped shape the Center's future direction, extending its horizon beyond West Africa into Eastern, Central and Southern Africa.

WARDA hosts the African Rice Initiative (ARI), the West and Central Africa Rice Research and Development Network (ROCARIZ) and the Inland Valley Consortium (IVC). It also supports the Coordination Unit of the Eastern and Central African Rice Research Network (ECARRN) based in Tanzania.

Since January 2005, WARDA has been working out of the International Institute of Tropical Agriculture (IITA) Benin station in Cotonou, having relocated from its headquarters in Bouaké, Côte d'Ivoire, because of the Ivorian crisis. WARDA has regional research stations near St Louis, Senegal and at IITA in Ibadan, Nigeria.

For more information, please visit www.warda.org

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"Bintu" (Mme Delphine Koudou), NERICA's most popular champion, inspects a typically healthy crop with one of her granddaughters.

Contents

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

Yet another dramatic 12 months of progress and change in the history of the Africa Rice Center has underlined the true value of WARDA's cornerstone philosophy – partnership.

How else to explain another remarkable achievement for the Africa Rice Center. That's how most people outside the center saw the transition from a geographically-divided organization in Mali and war-torn Côte d'Ivoire at the end of 2004 to a fully-functioning research and development nexus for sub-Saharan Africa just a few weeks later in Cotonou, Benin.

The deep and underlying layers of partnership that bind the Africa Rice Center (WARDA) with the administrators of its member countries, with national research and extension organizations, with universities and other academic establishments, with the private sector companies involved in agriculture, with NGOs, with farmer organizations and with fellow international centers more than responded to the test of shifting center operations swiftly to Cotonou.

The successful research days staged in Cotonou less than three months into 2005 are just one testament to the smooth way in which the move took place. Present at those Research Days were just a few of the partners whose facilitation and intervention meant that WARDA was fully operational without there ever having been any real threat of disruption to the research program working on the next generation of NERICAs, to the center's networks or to its smooth administration. It is thanks to the exceptional response of the Republic of Benin to WARDA's search for a temporary headquarters that within a few weeks of the exploratory visit to the buildings offered by IITA in Cotonou, an agreement had been signed with the Government and modification work had started on-site. Particular thanks go to the Director General of INRAB, Dr David Arodokoum, whose personal intervention on several occasions ensured that the importance of bringing WARDA to Benin was not lost on the State's official departments.

Foreword

WARDA's arrival and progress in Benin has been featured many times on local television and in the press.

INRAB also welcomed WARDA to its Niaouli trials site where, within a few weeks of arrival in Benin, WARDA scientists in a number of disciplines were already planning and implementing new trials programs. All now look forward to a fruitful and mutually beneficial relationship with our Beninois and IITA partners who responded so swiftly and warmly when WARDA called on them. By their actions they demonstrated that partnerships work when based on true commitment. This Annual Report takes partnership as its theme in the knowledge that old alliances work and new relationships are being built in the same spirit as WARDA embraces all of sub-Saharan Africa.

Two Center-commissioned External Reviews were carried out during 2004–2005, one on partnerships and the other on the second phase of the Inland Valley Consortium (IVC), and both of which commended WARDA's efforts in these areas. The continuing relevance of the IVC to improving agricultural production and fighting poverty in the inland valleys was confirmed by the review mission, which also made useful recommendations for the consortium's third phase which has now started.

The CCER on partnerships was carried out by a multinational team from Nigeria, Uganda and France. Their report described the quality and relevance of science and technologies developed and promoted through WARDA-NARES partnerships as "impressive" with useful outcomes and visible impacts. This partnership model should be maintained for developing 'Lowland NERICAs' towards more efficient use of irrigated lowlands and inland valleys for expanded production and increased productivity of rice, the team declared.

On the scientific level, 2004 will, of course, be remembered for the singular honor awarded as a result of a breakthrough at WARDA – the World Food Prize presented in October to Dr Monty Jones, former senior rice breeder with WARDA, in recognition of the development of the NERICA. This joint award, with another rice scientist from China, is particularly fitting as it fell during the International Year of Rice.

Two donor-commissioned evaluations were also carried out: on ROCARIZ as part of USAID WARP's review of Networks and on the MTP 2004–2006 project 1.4 "Creating Low Management Plant Types". ROCARIZ was adjudged the best of the four cereal networks reviewed by USAID WARP. Three major recommendations

made by the review panel stress the desirability of forging closer linkages with universities, addressing post-harvest issues and paying greater attention to the seed sector.

An EU evaluation team undertook the Project 1.4 review in 2004 and produced a number of recommendations and conclusions after visiting Mali and Burkina Faso. We are confident this important project will confirm WARDA's strategic approach to the development of promising new plant material and its field assessment through PVS methodology.

The Director General took the chair of the prestigious Center Directors Committee (CDC) during 2004 at a time when the CGIAR was being increasingly reflective and minded towards constructive and effective change. The dynamic of collaboration is a key force in meeting real world challenges. One of the highlights of his stewardship of the CDC was a successful retreat during which it was agreed the thrust of collaboration will be collective programs around common goals with national partners, regional and sub-regional organizations, etc. This will allow the deployment of collective Center resources more strategically and efficiently and meet the articulated demands of our partners, as well as emerging opportunities and responsibilities. A key step taken by the CDC along the path to improved collaboration for impact was the decision to create a formal Future Harvest Alliance of all 15 CGIAR Centers.

Sub-Saharan Africa came very much to the fore during Dr Nwanze's chairmanship. The concept of 'Quick Wins' was developed, particularly with SSA in mind. To this end, Africa is piloting the sub-regional Medium Term Plans which will incorporate key elements from all the CGIAR Centers operating in SSA but also take heed of the strategies and goals of sub-regional organizations such as FARA, CORAF/WECARD and ASARECA, as well as the NARS and advanced research institutions. WARDA is leading the process of building a West and Central Africa integrated sub-regional MTP.

The extension of WARDA's rice development strategies from West Africa to Eastern and Central Africa continues to roll out. Later in this report, the ongoing collaboration with partners in the Democratic Republic of the Congo is featured. A further collaboration with the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) led to the development of a joint proposal for a rice research network in East and Central Africa (ECARRN). A memorandum of understanding signed in April 2004 by WARDA and ASARECA paved the way for the recruitment of the coordinator and hosting of the Secretariat at the Mikocheni Agricultural Research Institute, near Dar es Salaam, Tanzania. Thanks to the support of the European Union and the Canada Fund for Africa for this project, the Coordinator, Dr Ashura Luzi-Kihupi reported on January 2005.

Private sector companies and organizations were particularly influential in the introduction and rapid spread of NERICAs in Uganda (WARDA Annual Report, 2003–2004), and WARDA is actively pursuing further potential partnerships with appropriate private sector contacts in several countries. An innovator in Sierra Leone, Marika Farm, was one of the winners of the 2004 ROCARIZ Awards; in this case for an 'Outstanding contribution to the rice private sector filière'. In Benin, strong links are being forged with the Songhaï organization, which is fostering a mode of development based on a thoroughly scientific approach to agriculture and small-scale industry but one grounded in advanced ecological principles.

Africa Rice Center continued to attract high-caliber scientists and support staff, mostly young and dynamic individuals, with the overall profile reflecting a diversity of nationalities. Mr Long T. Nguyen took up his

duties as ADG Corporate services in June 2004. Other June arrivals were Annemarie Kormawa, HIV/AIDS Focal Point, Mr Randrihamahonina Victorien, UN Volunteer, who joined WARDA/ARI, and Mr David Millar, science writer. Five Dutch-sponsored APOs joined in 2004: Mr Marcel Meijs, GIS Specialist; Mr Jonne Rodenberg, Agronomist/IVC; Mr Tia Dro, Germplasm Specialist; Ms Bianca Beks, French editor; and Mr Michiel de Vries, Agronomist/Irrigated Rice, who joined WARDA Sahel Station. Dr Ryoichi Ikeda, Plant Breeder, and Dr Yoshimi Sokei, Agronomist, both from the Japan International Cooperation Agency (JICA), joined the African Rice Initiative (ARI) in October, 2004. Dr Attiogbevi-Somado Eklou, Post-doctoral Fellow (PDF), Genetic Resources Unit (GRU), joined WARDA in September and Dr Vincent Boubié Bado, Sahel Agronomist, joined WARDA Sahel team in November.

The most recent arrivals in 2005 were: Dr Paul Van Mele, Technology Transfer Agronomist; Dr Lawrence Narteh, ROCARIZ Coordinator; Dr Ashura Luzi-Kihupi, Coordinator for ECARRN, based in Dar es Salaam, Tanzania; and Dr Mande Semon, PDF Molecular Biologist.

Among the departures were: Dr Olaf Erenstein, Production Economist; Dr Sidi Sanyang, ROCARIZ Coordinator; Dr Robert Guei, Head of GRU; and Mr Frank Abamu, GRU germplasm specialist.

Dr Robert J. Carsky, Cropping Services Agronomist, died in the Ivorian crisis on November 6, 2004.

The departure of many GSS precipitated by the Ivorian crisis is regretted. However, the essential support staff complement is being rebuilt in accordance with the prevailing host country agreement.

Now firmly established in Cotonou, WARDA is fully participating with other CGIAR centers operating in Africa in identifying a general framework for collective action towards programmatic integration. Steps are also being taken to achieve greater programmatic and operational alignments of both WARDA and IITA as recommended by the CGIAR. It should be emphasized, however, that WARDA's member States have resolved that the Association should remain as an independently functioning research center and the focal point for rice research in Africa.

Kanayo F. Nwanze
Director General

Gaston Grenier
Chair, Board of Trustees

Lowland rice can only get better

One of the first of the new Lowland NERICAs to gain release in Mali and Burkina Faso.

When are we going to get the lowland NERICAs? That was the question on everyone's lips as the success of the original NERICA varieties for the uplands grew to take in country after country in sub-Saharan Africa, and word spread to the lowlands of how yields were being transformed.

Even with the startling success of the upland NERICAs as proof of what sceptics said could not be done, Africa Rice Center's breeders still wanted to deploy the traditional caution of the scientist before unveiling the new generation of rice varieties that could bring hope to resource-poor farmers cultivating in the lowland ecology.

Of course, WARDA's insistence in involving the NARS and other partners in research projects meant that the word was already out that lowland types were already under development long before the first official lowland NERICAs were released in Mali (2) and Burkina Faso (4) in 2005.

In fact, about 60 of the new varieties for the lowlands have already received the stamp of approval from farmers in several African countries through the participatory varietal selection (PVS) process – an approach that was used successfully in accelerating the dissemination of the upland NERICAs. Scaling-up took place in both 2004 and 2005 to ensure that farmers get the seeds for which they have been clamoring since Dr Monty Jones' first NERICAs unleashed the potential of the uplands five years earlier.

Another scientific breakthrough for the Africa Rice Center, with yield potential of 6-7 tonnes per ha and good resistance to major lowland stresses, the lowland NERICA varieties have been developed for the African lowlands, one of the most complex rice ecologies in the world. Eventual impact is expected to be even greater than for the upland NERICA varieties that are vastly outyielding the disease- and pest-susceptible local varieties previously grown.

From the outset, the scientists involved – including Sahel Station team leader Dr Kouamé Miézan and Dr Moussa Sié (then a visiting scientist with WARDA in St-Louis but now WARDA's lowland rice breeder) – wanted to ensure selections were carried out in countries other than Senegal where many of the early crosses were made.

The search for new varieties of rice adapted to the lowland ecology is necessary because of the multiple constraints that slow down the development of rice cultivation in this environment, says Dr Sié. To get suitable varieties quickly, a program of varietal selection was initiated with intra- and interspecific crosses available in the WARDA germplasm collection. Initial NARS partners were INERA in Burkina Faso for early identification of promising material, then Togo's ITRA, with Mali's IER and the ARI coordinator coming on-board for collaborative selection of promising lines in visits to each other's countries.

A study at the Banfora Research Station in Burkina Faso – to which Dr Sié had returned as head of INERA's rice improvement division – identified ideotypes suitable for lowland conditions, starting with the agromorphological characterization of more than 400 interspecific lines *(O. glaberrima* x *O. sativa)* or NERICAs. They were tested in valley bottom conditions in the Banfora lowland during the 2000 and 2001 wet seasons. From the first year trial, 96 lines were retained (14 intraspecifics and 77 interspecifics) for assessment under the same conditions in the 2001 wet season. Actual selection was carried out over two years following a collaborative approach in the first year and a multi-site approach in the second year in the 'Plateau' area in the west of Togo and in Burkina Faso.

"In Togo, we started in 2002 with 205 descendants and selected 29 lines with characteristics of interest for lowland rice cultivation," adds Dr Sié.

PCR analysis with 10 variables gave an agromorphological evaluation of the material. Two types of lines were identified: the strictly upland type *(O. glaberrima* x *O. sativa japonica* or upland NERICA) and the rainfed lowland type *(O. glaberrima* x *O. sativa indica* or lowland NERICA and *O. sativa* x *O. sativa).*

Getting quality traits right in the new Lowland NERICAs will be particularly important for women who are dominant in post-harvest handling.

The lines showed the low susceptibility to disease and insect attack, which is vital if they are to succeed in the hard-pressed lowland ecology. The scores obtained in the 2000 wet season at Banfora for the lines were mostly lower than 5 for leaf blast and yellow mottle virus on a 1–9 scale.

The new NERICAs exhibited less than 2% damage from insects (onion tubes, dead hearts and white panicles) for the two sites (valley fringe and valley bottom). Although the interspecific *O. glaberrima* x *O. sativa indica* crosses proved to provide the best Lowland NERICAs suited to irrigated or lowland conditions, they also seemed to be more susceptible to some pest attacks (more than 2% of attack for silver shoot) but still at much improved levels over varieties currently in use in these environments.

The potential of these new crosses was not lost on the NARS partners, whose breeders took part in the selections that led to the official release of two lowland varieties (WAS 161-IDSA-1-WAS-B-FKR-B-IER-2-4 as N1, WAS 122-IDSA-1-WAS-B-FKR-B-IER-18-B as N2) in Mali, and four varieties in Burkina Faso (WAS 122-IDSA-1-WAS-B-FKR-1 as FKR 60N2, WAS 122-IDSA-1-WAS-6-1-FKR-B-1 as FKR 62N3, WAS 161-B-9-3 as FKR 56N4, and WAS-191-9-3-FKR-1 as FKR 58N0).

Of course, this is only the beginning of the Lowland NERICA story, says Dr Sié whose detailed studies into what makes the Lowland NERICAs tick are continuing at the same time as PVS involving farmers speeds the introduction of the new types in a number of countries. The typology of the new lines was examined in 2003 and 2004 with a study of 61 interspecific (*O. sativa glaberrima* x *O. sativa indica*) and nine intraspecific (*O. sativa indica* x *O. sativa indica*) lines. All were multiplied in the 2003 wet season at Banfora and planted in the 2004 wet season in nine countries (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, Senegal and Togo). Depending on the country, the lines were planted in a range of environments (valley slope, valley bottom and irrigated).

In the analysis of the results from this study, the varieties were placed in three groups according to their performance. This demonstrated clearly that the interspecific crosses of the African glaberrima rice with Asian japonica rice far outstripped the intraspecifics in their earliness, tillering, yield and better height characteristics.

Dr Sié explains there is much more to do as the Lowland NERICAs extend into WARDA member countries and others in Eastern, Central and Southern Africa. This includes evaluating the interspecifics for different water regimes, in different integrated crop management scenarios, characterizing more glaberrima germplasm in lowland ecosystems to allow better 'targeted' crosses, and molecular characterization of elite and promising characteristics.

"We must place the accent on quality traits because we should never forget that glaberrima is an African rice, appreciated for its quality, and no progress can be made if we lose that quality as a result of our varietal creations," he adds. Concentrating on post-harvest quality for the new rices will direct the benefits of improved varieties towards women who are key participants in the post-harvest markets. It is also important to enlarge the genetic base of new varieties by using more glaberrima and sativa parents and by bringing in other African rice species such as *O. barthii* and *O. longistaminata.*

Parboiling improves the nutritional quality of rice, and is increasingly being adopted to add value to the end product.

A new dawn for rice in the east

Manual harvesting of rice in Tanzania.

Just a few months into 2005 and already the Eastern and Central Africa Rice Research Network (ECARRN) was making a difference to rice-related research in geographical areas relatively new to WARDA but not to rice nor to the constraints that can dog production using unimproved varieties.

Network coordinator Dr Ashura Luzi-Kihupi took up her appointment in an office at the Mikocheni Agricultural Research Institute, Dar-Es-Salaam, Tanzania in January and, although funding was delayed for several months, steps were taken to ensure that trials with improved rice varieties were not held up. NERICAs from Africa Rice Center are being evaluated on a number of sites in ECA countries, including Congo DRC (see p19), while in Tanzania seeds of 90 upland rice varieties were multiplied at the Ifakara Research Institute, formerly known as Kilombero Agricultural Research and Training Institute (KATRIN). The seeds obtained from this multiplication – probably 2-3 kg per variety – are to be distributed to further collaborators in the region.

ECARRN, which comes under the wing of ASARECA, the Association for Strengthening Agricultural Research in East and Central Africa, has as its mission to contribute to enhanced productivity, value addition and competitiveness of the rice sector in the ECA sub-region through the development and dissemination of demand-driven knowledge and technologies, says Dr Sylvester Oikeh, the WARDA scientist acting as the Center's focal point for eastern Africa. Four main results are expected:

- Demand-driven rice technologies/innovations generated and promoted
- Regional and national policy options for enhancing rice systems are facilitated
- Regional and national capacity for integrated agricultural research for development of the rice sector strengthened
- Availability of information on rice research and development enhanced

The potential for increased rice production in the ECARRN mandate area is evident from current production figures (Table 1) which show that where rice production has been longer established the average yields are not much more than one tonne a hectare. In countries such as Uganda, which was an early adopter of NERICA technology while rice was relatively little-grown, the acceleration in the growth of the rice area has been rapid and average yields are nearly 50 percent higher than in those countries with predominantly unimproved varieties. Rice is now a cash crop for Ugandan growers.

"We see Uganda as a model country in showing what can be done if you have the backing and will of the Government to help you achieve a lot of things," says Dr Oikeh.

An Executive Committee of four people (coordinator, chairperson, vice-chairperson and a member) was appointed by the Regional Steering Committee. Dr George Bigirwa from Uganda is ECARRN's first chairperson, with Dr Getachew Alemayehu from Ethiopia as the vice-chair. The member countries are divided into three groups: East (Kenya, Tanzania and Uganda), French (Burundi, Congo DRC, Madagascar and Rwanda) and the Horn (Ethiopia, Eritrea and Sudan).

Dr Oikeh explains that ECARRN will play a crucial role over the coming years in East and Central Africa in much the same way as ROCARIZ has transformed the prospects for resource-poor rice farmers in West Africa. "In most cases, although they have been receiving samples of improved germplasm on request from INGER-Africa for multiplication, the NARS scientists have been mostly working on their own. Now they will have more ready access to the accompanying rice technologies. In the past they have been getting the seed but have not benefited from a conscious effort to move the technologies from West to East."

Table 1: Major rice production systems and area cropped in eastern Africa

Country	Major ecology (%)	Rice area 2004 (ha)	Production (tonnes)
Eastern Africa		1 874 050	4 136 222
Madagascar	Rainfed lowland (85) Rainfed upland (15)	1 222 700	3 030 000
Tanzania	Rainfed lowland (70) Rainfed upland (20)	330 000	650 000
Mozambique	Rainfed lowland (90) Rainfed upland (7)	179 000	201 000
Uganda	Irrigated lowland (60) Rainfed upland (30)	93 000	140 000
Malawi	Rainfed rice (88) Irrigated lowland (12)	30 000	49 722
Kenya	Irrigated lowland (75) Rainfed upland (15)	11 000	50 000
Ethiopia	Potential staple	8 350	15 500

Source: FAOSTAT, 2004.

First steps to improve the rice-growing infrastructure include a WARDA and ECARRN workshop next year to introduce middle-level scientists to rice production training techniques.

It is hoped that the African Development Bank will support a multi-country project in the ECARRN area similar to the seven-country scheme being facilitated by ARI in West Africa.

Another early partnership benefit of WARDA's involvement in eastern Africa through ECARRN is a strengthening of the Center's relationship with IRRI, which had previously been somewhat weak in this region. IRRI and WARDA are now developing joint projects in ECA using ECARRN as a platform.

A partnership is also being forged with CIAT, which has a specialist tropical soil biology unit based in Nairobi, to develop natural resource management options for NERICAs under eastern and central African conditions.

Rwanda bounces back with rice as a staple food priority

INGER-Africa supplied Rwanda with seeds.

Post-conflict Rwanda is focusing on rice as one of the key agricultural commodities the country must grow intensively to feed its population and make the best use of available land.

About 900 rice varieties, including upland NERICAs from WARDA, have been evaluated there since 2002 and the Africa Rice Center hopes to build further partnerships that will help in rebuilding the seed sector in this once war-torn highland country in Central Africa where annual production of rice is now among the lowest in Central Africa (Table 2).

The development of rapid-response strategies to revive agriculture in post-conflict countries is part of project 6 in WARDA's 2005–2007 MTP. No agriculture rehabilitation program is likely to be viable unless an enabling nationwide seed policy is developed, so a two-person WARDA team visited Rwanda to conduct a rapid appraisal of the seed sector. Drs Eklou A. Somado and Rita Agboh Noameshie carried out focused group interviews with NARS and Government officials, with NGOs, with farmers' groups and with the private sector, as well as making field trips to major rice producing areas where WARDA-developed varieties are being grown.

Ample water is available on this site in Rwanda for rice production, but the country remains short of seed of improved varieties.

Rice is favored by the Government because it performs well in flood-prone valleys and can absorb some of the increasing pressure on hillside land for food production. It is also of shorter duration than, say, cassava, is easy to handle and store, and has by-products that can be used to feed animals, as a source of energy supply and as a substrate in mushroom production.

Table 2: Rice area and production in Central Africa

Country	Rice area 2004 (ha)	Production (tonnes)
Central Africa	449 500	427 353
Congo DRC	415 000	315 130
Burundi	19 500	64 532
Rwanda	13 000	46 191
Congo-Brazzaville	2 000	1 500
West Africa	5 969 192	7 886 075

Source: FAOSTAT, 2004.

Rwanda's hilly terrain does not favor the upland NERICAs but several other WARDA varieties showed good adaptation with yield potential up to 10 t/ha, and with good grain type and resistance or tolerance to the major biotic and abiotic stresses in Rwanda. Although varieties selected for their tolerance to cold in the Sahel were initially sent to Rwanda along with upland types, they also did not yield satisfactorily. It is intended to screen more varieties for cold tolerance but WARDA may also assist Rwanda in initiating a domestic breeding program to develop materials that adapt to local bio-physical constraints.

Farmers selected lowland varieties and they have been given local names. TOX 4331-WAT 91-3-1-1-1 has been named 'Gakire', meaning 'rich', while TOX 4331-WAT 86-3-4-2-1 is 'Intsinzi' or 'Victory', and WAT 1395-B-24-2 became 'Tsindagirabigega' or 'Full storage'. Interest is very high because rice is a highly profitable crop in Rwanda thanks to relatively low production costs of 100 Rwandan francs (RWF) per kg of paddy produced and a milled rice value of about 300 RWF per kg (100 RWF=0.18US$). Although not previously a staple crop, rice is now being eaten almost every day by Rwandans.

The WARDA team discovered that poor water control is the most limiting factor to full exploitation of the potential rice production area in Rwanda, together with a lack of high yielding, short-duration varieties adapted to local production conditions and poor knowledge of crop management. A number of recommendations have been made which could lead to the development of suitable varieties for Rwandan conditions and to the introduction of proven rice technologies, as well as capacity building.

Finding seed that suits. Rwanda's highland terrain makes it difficult to find rice seed adapted to the cold temperatures that may occur during the growing season.

How partnership built ASI and ISA

Local craftsman working on the prototype ISA harvester.

Manual labour may be the cornerstone of most African agriculture but it often falls disproportionately on women and children.

A partnership between WARDA, NARS and private sector organisations in Senegal is lessening the load of drudgery and improving the usable yield and marketability of rice.

But, not only is this partnership, stemming from pioneering work at the Sahel Station in St-Louis, already benefiting five other West African countries with thresher-cleaner technology, it is the foundation of new developments in low-cost harvesting.

Haphazard harvesting and rudimentary post-harvest handling were identified in the mid-1990s as major problems in the Senegal River Valley by field surveys which attributed post-harvest crop losses of up to 35% to the inefficiency of manual threshing. Poor harvesting means not all grain or potentially useful straw is harvested. Such losses are compounded if threshing is inefficient at separating the grain or it produces damaged and split grains susceptible to storage damage and of lower marketable value.

Manual threshing is labor-intensive and backbreaking and mainly carried out by women rice farmers. Expensive and unreliable combined harvesters failed to provide an answer and the only available small-scale thresher in Senegal was not very efficient as it could not properly separate grains from straw after threshing.

Partnership, first between WARDA and IRRI in the Philippines, identified a prototype Asian rice thresher-cleaner, and then embraced national researchers in ISRA and SAED, local master craftsmen and end-users to develop an African technical solution that is affordable, locally-constructed and acceptable to everyone in the rice-growing community, including women.

Where manual threshing yields one tonne of paddy per day, the ASI—taking its name from **A**DRAO-**S**AED-**I**SRA—produces six tonnes of paddy. With a grain-straw separation rate of 99 percent, no additional labor is required for sifting and winnowing. A high internal rate of return (IRR) and benefit cost ratio made the ASI extremely attractive for use in the Senegal River valley, with an average purchase price of 2.8 million FCFA—around US$ 5000. Even at this price, which is several times the cost of similar non-adapted Asian machines, and taking a pessimistic view on seasonal performance, the ASI had an IRR of just under 50 % in the original financial analysis.

When the ASI works 90 days, the benefit cost ratio reaches 2.3, well above standard guidelines. The economic life of an ASI is assumed to be five years, with financing over three years, and a salvage value of 30% of the purchase price. In practice, the ASI's real-life performance ensures the initial cost and debt charges can be readily paid off earlier.

ASI has become a big hit in the Senegal River valley since its commercial release in 1997 (see Table 3) and its contribution was recognized when the President of Senegal presented the ASI team with his special prize for science research. More than 50% of the total paddy produced in Senegal is now threshed with the ASI thresher-cleaner, and the proportion of grain threshed by ASI is increasing in other countries where similar partnerships have developed machines to suit local needs and capacities.

Overall labor demand is lower with the ASI, eliminating one of the most back-breaking tasks for women and children, and freeing family labor for other activities. For the investor, the potential returns to the ASI are greater than with the alternatives under similar conditions. Faster working lessens post-harvest delays that can affect grain quality. Higher quality grain is a prerequisite for competitiveness against imports that cost African countries much valuable foreign exchange.

ASI can even process wet straw, and is equally effective whether the rice has been manually cut or machine harvested. Local artisans (AGRITECH, Momar Dieng) and a medium-scale agricultural machinery factory (SISMAR) built the ASI prototypes for field testing with local farmers' organizations to ensure acceptability when the new machines were finally rolled out.

Africa Rice Center, ISRA and SAED are now using this ASI partnership model in an alliance for a further development of rice harvesting technology. This time the partnership is focused on adapting a small-scale harvester from IRRI. Successful field trials of the harvester took place in Senegal in 2005 and the first production versions are expected to roll out in time for next year's rice harvest. It is possible to transfer the 12 hp ASI engine to the ISA harvester to save costs, and the engine could also be used for powering a milling machine.

Table 3: Spillover from the ASI thresher cleaner

Country	Local name	Partners	Machines in use	Use rate (%)
Senegal	ASI	WARDA, ISRA, SAED, SISMAR, GRITECH, Local artisans, Producer groups	>250	75
Mauritania	SAC	SONADER, CNRADA, EL MALLY, GIE	>50	15
Mali	AC-IER	IER, Office du Niger, local artisans	>100	10
Burkina Faso	ANADI	INERA, CGF, PAFR, producer groups, local artisans	10	10
Ghana	GHAVIWA-TC	MADR, World Bank, KAPONG Project	11	NA
Côte d'Ivoire	ASI	ANADER, Local artisans	7	NA

Africans demand biotechnology help now

Africa Rice Center plant pathologist Dr Yacouba Séré monitors RYMV-resistant crosses in an experimental field at Niono, Mali.

Biotechnology is not just about genetically-modified organisms (GMOs). And biotechnology is not just a tool for scientists to play around with; it is the hope of many African farmers for a future free from the apparently never-ending struggle against low yields and consequent poverty.

Rice grower Abdoulaye Daou made that clear when he attended the inaugural workshop for the USAID-sponsored project on marker-assisted selection (MAS).

Mr Daou, who farms in the Office du Niger in Mali, says he and his fellow growers are counting on scientific research to find solutions to the rice yellow mottle virus infection, known colloquially as 'Riz SIDA'(Rice AIDS), which can cause up to a total loss of their crops. "The solution proposed by research will allow the diminution of the incidence of this disease even if it is still present."

Four West African countries have been selected for the MAS project. Symptoms of RYMV were seen in several of the four participating countries as early as 1980, well before confirmation came through on what was causing the losses and devastation in some crops. WARDA responded in the late 1990s by sending genetic material known to have resistance for testing in badly-hit countries such as Guinea where local scientists evaluated 165 potential lines and eventually selected 10 varieties producing yields of between 2-4 t/ha despite the presence of RYMV or blast.

Mr Jorge Oliveira of USAID says that investment in new technologies is one of the key areas which USAID wants to grow sustainably. "Biotechnology is of particular interest, not just because of genetic transformation, but also because of the molecular techniques for which new legislation is not necessary," he adds.

RYMV is unique to Africa and in irrigated rice, in particular, it is responsible for 90% of all yield losses. Resistant lines have been obtained through backcrossing but marker-assisted selection is a biotechnological tool that can speed up the process of pyramiding useful genes into elite rice varieties to improve their disease resistance.

The MAS project led by WARDA's Dr Marie-Noëlle Ndjiondjop training plant breeders and NARS technicians involved in breeding programs in Burkina Faso, Guinea, Mali and The Gambia with molecular tools and helping set up new biotechnology labs in each of those countries.

Thanks to the MAS project, biotechnology laboratories will be established in four countries in West Africa.

The population structure of RYMV in each country will be characterized and two elite varieties of rice have been chosen by each country so that the resulting resistant varieties are tailored to conditions specific to each country's rice ecology. Participatory varietal selection (PVS) will be used to introduce improved and resistant varieties to farmers in each country so they can contribute to the final selection of the most appropriate varieties for their fields. The use of parent varieties already familiar to growers should assist in gaining their acceptance of similar varieties with the benefit of resistance to RYMV.

However, Dr Ndjiondjop explains that a key legacy of this three-year project will be the establishment of molecular biology laboratories and trained staff who can work across many different crop plants. As well as training NARS staff and farmers in PVS techniques, the project is supporting several PhD students from West Africa to undertake their research studies in biotechnology. Without the support available under the project, it is highly unlikely that these students would be able to complete their theses in the near future. In the words of one student, the project is allowing him to fulfill a dream of becoming a biotechnology specialist. "Completing my thesis will give me the required research skills. It will help me make a contribution to universal knowledge in general and particularly to Africa, a less developed continent, since there is no true development without research."

While key scientists in each country are working with WARDA as designated partners within the project, an open invitation has been extended to other interested scientists to collaborate with the project where there is crossover between their research and the project workplan.

WARDA pathologist Dr Yacouba Séré explains that several pathogen variants and some isolates are capable of overcoming the recessive resistance gene *rymv1,* partial multigene resistance and, depending on the concentration of the virus, even transgenic resistance.

For some African crops, it is not lack of water that is the major constraint but the presence of indigenous and sometimes unique biotic stresses such as RYMV in rice.

However, Dr Ndjiondjop points out the resistance breaking is highly dependent on the amount of virus inoculated and on the mode of transmission. Only 5% of isolates (3 of 58) induced symptoms in the resistant cultivar Gigante compared to the 30-50% of isolates that induced symptoms in the partially resistant cultivars, and some lines with natural resistance still showed only weak mottling six weeks after inoculation compared to the stunting/necrosis observed with transgenic resistance four weeks after inoculation. This suggests that the lines with natural resistance can still be used in future breeding programs.

As well as developing varieties with genetic resistance with the help of marker-assisted technology, integrated methods of control will be needed to obtain best results in the presence of virus. Varietal resistance will have to be reinforced with cultural practices such as the destruction of infected field residues, control of insect vectors, removal and destruction of infected plants.

More research is also needed into understanding virus spread in the field, alongside the characterization of the pathogen variants, before it can be safely claimed that new plant material with durable resistance is winning the struggle against RYMV.

Scientists from all four countries participating in the USAID-funded project on marker-assisted selection joined WARDA staff and USAID experts for a preliminary workshop in Bamako.

Women are active participants in PVS selection of new varieties.

Long-haul Congo on the way back

The Democratic Republic of the Congo (DRC) is the third largest country in Africa and that poses special challenges for Africa Rice Center scientists helping revive the production of rice in several widely-scattered communities. Conflict, which claimed an estimated three million lives in the DRC, only ceased in 2004, leaving a legacy of declining agricultural production, with cereals alone showing a 20% fall in pre-conflict production, and a weakened infrastructure.

Less than 10% of the land in the DRC is presently developed for agriculture and of that barely 13,500 ha are irrigated. Against this background, NERICA and other improved rice varieties have been enthusiastically tried out in NARES trials and demonstrated to farmers as a rapid means to helping the country restore some of its lost farming potential.

Both upland and lowland NERICAs show strong ability to improve yields in different parts of the DRC. "However, it takes three full weeks to visit the four research centers and stations developing NERICAs, as well as the regional offices of our supervising partners," explains soil physicist Dr Sitapha Diatta, who has become more than a little familiar with the joys of river travel in a massive country with relatively few roads.

Dr Diatta explains how the NERICA test zone in Eastern Province puts the Congo DRC into perspective. Created in 1935, the national agricultural research center at Yangambi may well be the biggest research center in sub-Saharan Africa, with a surface area of 250 000 ha. It is only 100 km from Kisangani, a provincial capital, but access today is only possible via the river Congo.

Africa Rice Center is working with the National Institute for Agronomic Study and Research (*Institut National pour l'Etude et la Recherche Agronomiques* – INERA), the DRC's Center for Integral Development *(Centre pour le Développement Intégral* – CDI*)* in Equator Province and with the Kinshasa-based National Rice Program (*Programme National Riz* – PNR) through its regional offices. INERA has selected several sites at which NERICA varieties are tested thanks to funding from IFAD (International Fund for Agricultural Development). INGER-AFRICA and WARDA's genetic resources unit has sent more than 2000 WARDA upland and lowland rice varieties to the PNR since 1994, but IFAD has supported the recent supply and testing of seven NERICAs by INERA in Eastern Province and Equator province, as well as by the PNR.

The Congo River is a major thoroughfare for produce and people, including visiting WARDA scientists who must use it to reach Yangambi Research Center.

Technical support from WARDA is vital to the project implementation, says Dr Diatta. As well as providing the seed, WARDA is training technicians from INERA, PNR and CDI in establishing PVS research (PVS-R) and PVS extension trials (PVS-E), and in seed production (CBSS). Four technicians (2 from INERA and one each from PNR and CDI) were trained in rice seed production in July 2004 in Yamoussoukro, Côte d'Ivoire. In October 2004, these technicians also visited Guinea to inspect the farms of farmers who have adopted NERICA varieties.

Echoing the revelatory success of NERICAs elsewhere in Africa, first results from testing the seven NERICAs showed that NERICA4, NERICA6 and NERICA7 all performed better than the local check variety, Lioto. In Equator Province, NERICA7 yielded 4.2 t/ha on a more fertile site in the absence of fertilizers, against 2.8 t/ha for the local check PNR1 (Table 4). NERICA3, NERICA4, NERICA6 and NERICA7 gave the best yields in Bandundu province.

In 2005, farmers have already given their preliminary judgement on the first NERICA varieties in PVS-E trials being carried out in Eastern and Equator provinces. The farmers' first choice (85%) at Yangambi was NERICA4, which gave the highest yield, averaging 2.250 t/ha with or without fertilizers. However, 33% of farmers preferred the vigorous tillering of NERICA6, which averaged 1.68 t/ha, and 26% liked NERICA7 (1.45 t/ha). NERICA4 was also the most selected by farmers on two other sites for PVS-E, mainly because of its earliness. The main local variety has a long 180-day growing cycle instead of 100 days from planting to harvest for NERICA4.

However, in Equator Province, the farmers' order of preference was reversed with NERICA7 being most often picked in mid-season as the farmers' first choice, followed by NERICAs 6 and 4. Dr Diatta points out that these farmer preferences will undoubtedly be confirmed or altered when the final yield results are available after the 2005 harvest.

The increase in production in Yangambi varied from 33%–83% in plots without fertilizers on a very degraded soil (infected with *Striga*). The tall height of these three varieties is an asset for their adoption by farmers. NERICA1, NERICA2, NERICA3 and NERICA5 also have a better yield than the local check but are short, which may be a handicap during manual harvesting.

In addition to the seven NERICAs provided by WARDA in 2004 to launch the project, 34 NERICAs for the upland ecology and 72 varieties, including 62 NERICAs for lowland ecology, were introduced in 2005 for evaluation by INERA under upland and lowland conditions at Yangambi Research Center. Despite drought conditions, these new NERICA generations looked promising at the booting and grain filling stages. The lowland NERICAs also showed signs of promise at Yangambi, with the majority showing tolerance to iron toxicity.

Evaluation of the latest generation of upland and lowland types will continue through PVS-R trials next year at INERA research centers and stations at Yangambi, Boketa, Mvuazi and Kiyaka.

Table 4: NERICA trials at INERA research center in Boketa (Equator Province)

Tested varieties	Yield t ha^{-1}
NERICA2	2.817
NERICA3	3.733
NERICA4	3.116
NERICA6	3.090
NERICA7	4.170
PNR1 (Local check)	2.850

A revised research agenda unfolds

Continual evaluation seeks new and improved rice varieties.

The WARDA strategic goal remains the same – to significantly increase the quality, usefulness and availability of knowledge and technology within the rice sector to support the poor in Africa – but the inherent complex target problems are being re-addressed directly and vigorously.

While concentrating its research efforts on the three major rice production systems – upland, lowland and irrigated – WARDA is maximizing the partnership model established with its traditional West African NARES partners and seeking to transfer this model to its other new engagements in sub-Saharan Africa. At the same time, reorganization of the Research Division in the second half of 2004 into just two programs with eight main projects provides fresh focus for a reinvigorated team of scientists.

The main research challenges were first outlined in the 2003–2012 Strategic Plan and are now being tackled through an unfolding new research agenda. For biophysical research, the production-system-based approach specifically aims at stabilization of the fragile natural-resource base of rainfed upland systems; intensification and diversification of rainfed lowlands, improved water control, use of external inputs, and integration of vegetables especially in peri-urban environments; and improvement of resource use efficiency in irrigated systems through ICM and NRM techniques. In all systems, multiple-stress-resistant NERICAs and elite *sativas* play a key role, while the *O. glaberrima* gene pool continues to be exploited for new sources of resistance to biophysical constraints and for development of novel plant types.

Preventing damage by African rice gall midge remains a WARDA research priority.

The USAID-WARP marker-assisted selection project to produce varieties with resistance to RYMV was initiated (page 15), and a rice-vegetables systems research project in collaboration with AVRDC was also implemented. A new project on NERICA dissemination was initiated in Central Africa, using support from IFAD for NERICA trials and PVS in the Democratic Republic of Congo (page 19).

Dr Ousmane Youm was appointed Assistant Director of Research (ADR) to head the Integrated Production Systems Program with its four new projects, one of which is specifically designed to find improved drought-tolerant varieties to dovetail with integrated management options for mitigating drought. A search was initiated for a suitable candidate for the corresponding ADR post for the Policy and Development

Program. The late Dr Bob Carsky filled this post on a temporary basis until his untimely death, and subsequently Dr Paul Kiepe acted as interim program leader.

WARDA relocated to its headquarters near Bouaké, Côte d'Ivoire in September 2004. However, the resumption of the Ivorian crisis in November 2004 forced WARDA to relocate to Cotonou. This movement caused only slight disruption to Research and Development activities. The scientists evacuated from Bouaké could not be readily accommodated in Bamako for November and December but a core team, including those still based in Bamako, continued ongoing activities, while those that had left Côte d'Ivoire continued activities in other countries with the support of national partners. As a result of the sudden move from Côte d'Ivoire some trials planted at M'bé could not be harvested. The WARDA policy of dispersing trials in several countries in partnership with NARS proved a worthwhile safeguard.

Despite the ongoing difficulties, among the achieved highlights within the *Integrated Rice Production Systems* (Program 1) were:

- Development of habitat management strategy to control the African rice gall midge (AfRGM) in Nigeria by using plants of *Paspalum scrobiculatum* around rice fields as a reservoir of AfRGM parasitoids.
- Identification of a new gall midge species from a new wild grass host in Nigeria.
- Regeneration of about 3,000 rice germplasm accessions at IITA-Ibadan.
- Production of 400 *glaberrima* accessions at M'bé (Côte d'Ivoire).
- Nutrient deficiency (N, P and K) confirmed in upland and lowland ecologies.
- Research findings showed that NERICAs gave highest yield in the upper part (plateau) rather than on the lowest point (the hydromorphic zone) due to excess water.
- Development of a seed system designed to enhance the delivery of promising NERICA lines to many countries in West and Central Africa.
- Successful use of molecular markers in genotyping a segregating backcross population (BC_2F_1 single plant) and in phenotyping of the BC_2F_2 families.
- Development of near-isogenic lines (NILs) using NERICAs as donor of the character. At the end of the process, the NILs will be distributed to collaborators to evaluate in different environments.
- Development of a database and guide for the WARDA Farm Management Household Survey (FMHS) completed in October 2004.

As specified in the 2005–2007 MTP – and within the framework of the Strategic Plan – the Center was also actively involved in promoting the development of complementary technologies to enhance sustainable production in rice-based farming systems throughout West and Central Africa. To this effect:

- Improved integrated crop management technologies developed to enhance input use efficiency, productivity and profitability of Sahelian irrigated rice systems were evaluated and adapted to farmers'production environments.
- Post-harvest technologies that improve grain quality and address the drudgery of labor were adapted and tested with a wide range of stakeholders in the rice sector.
- Improved inter- and intraspecific varieties, developed for irrigated rice systems, tested and adapted to a wide range of irrigated rice environments within the context of ICM.

- Emphasis was given to the development of weed-competitive cultivars for direct seeded systems.
- In the Savanna and humid forest ecologies, ICM options developed for the Sahel were adapted and evaluated with farmers' participation at key sites.

The *Rice Policy and Development Program* initiated a major study in Burkina Faso, Mali, Niger, Nigeria and Senegal on Policy Effects on Institutions and Structural Arrangements for Rice Production and Marketing in West Africa. This study focuses on irrigated rice schemes, while the second part will focus on lowland and upland rice production systems. Through a rapid appraisal approach, background information was collected for each country. In addition, key informants in the rice production to market chain were interviewed.

Major highlights from the program were:

Rice policy and technology impact

- Timely responses made to several information and data requests from national programs and governments on rice production and trade statistics.
- Various statistical indexes, graphs and tables were generated as supporting materials for presentations and technical documents.
- Further improvements to the West Africa Rice Statistics database through information updates and start up of the development of an Access version of the database to allow easy data manipulation and to quickly respond to information and data requests.
- Developed a network of policy researchers in West Africa.
- Development of a database archiving system that will be based on an activity programmed in 2005.

Updates on the New Rice for Africa (NERICA)

Upland rice varieties: Upland NERICAs are planted on more than 100,000 ha across Africa, including about 60,000 ha in Guinea and more than 10,000 ha in Uganda. Dr Monty Jones, a former WARDA researcher was selected as a co-recipient of the **2004 World Food Prize** for developing the NERICA varieties by successfully crossing African with Asian rice species to produce drought- and pest-resistant, high yielding NERICA rice varieties, a feat which had not been achieved before in the history of rice breeding.

In 2004, NERICA increased in number from the seven known varieties to 18. WARDA's Variety Nomination Committee named 11 new NERICA varieties (NERICA8 – NERICA18) that have been developed by our breeders in partnership with the national programs for the upland ecology of SSA. Some of these varieties are already beginning to be released in West African countries.

This lady farmer explains her favorite rice choice from the range of potential varieties supplied by WARDA to Congo DRC.

Lowland* NERICA *varieties: Another scientific breakthrough was achieved with the development and release of lowland NERICAs. These new varieties have yield potential of 6–7 t per ha and have good resistance to major lowland stresses. The lowland NERICA varieties (see p5) have been developed for the African lowlands, one of the most complex rice ecologies in the world. Given the high potential of the lowlands in Africa, the new rice varieties, which have already received a stamp of approval from farmers, are expected to make an even bigger impact than the upland NERICA varieties. Four lowland NERICA varieties were released in Burkina Faso and two in Mali in early 2005.

About 60 of the new varieties for the lowlands have already been grown and evaluated by farmers in several African countries through the participatory varietal selection (PVS) process – an approach that was used successfully in accelerating the dissemination of the upland NERICAs.

Impact assessment

- An update of the results of NERICA diffusion and adoption in Côte d'Ivoire show a high (80%) long-run potential adoption rate.
- A clear impact of NERICA adoption on farmer income in Côte d'Ivoire is not yet established. Conflicting results of NERICA impact on income were observed across the adopting population.
- In Guinea, the preliminary results from the first phase of the study show that NERICA varieties are known by 27% of sample farmers.
- ASI thresher/cleaner manufacture and use continues to spread in Senegal, Mali, Mauritania, Burkina Faso and Côte d'Ivoire. Nearly 500 machines were operating by harvest 2005.

Following the completion of phase I of the project 'Participatory Adaptation and Diffusion of Technologies for Rice-Based Systems (PADS) in West Africa', a Phase II proposal has been approved and will be implemented using the Participatory Learning and Action Research (PLAR) methodology developed by WARDA.

On capacity building, several training activities involving farmers, students and other organizations were undertaken (See Annexes). A marker-assisted selection system was set up at the University of Mali, Bamako.

WAIVIS (West African Inland Valley Information System)

Land use information stored in WAIVIS is now being used across institutions and is leading to identification of new research areas. Apart from scientists in national programs, staff members of international organizations like IWMI and FAO are using WAIVIS. This has led to joint project proposal developments.

A second outcome is the development of national databases in Benin, Togo and Guinea. National scientists were trained by WARDA GIS staff in the structure and creation of their own national databases based on the same format as WAIVIS. The national program of Nigeria is discussing a similar proposal, while NARI in The Gambia has already adopted the WAIVIS format for storage of its data for characterization of the country's inland valleys.

Internal and external reviews

As part of the Board of Trustees' oversight for programs, and in anticipation of the Fifth External Program and Management Review of WARDA, the Research Division set in motion two CCERs in 2004. These were on

IVC and on Partnership, both approved by the Board. In 2005, further CCERs, one on rainfed rice and natural resources management and another on the socio-economic impact of rice, are being prepared. It should be possible to conduct one or two other CCERs in 2006. In 2004, two donor-supported projects were evaluated. These included project 1.4, entitled creating low management plant types for resource-poor farmers in rainfed ecosystems, supported by the EU. The other one was the review of Networks, including ROCARIZ, carried out by USAID WARP. WARDA prepared comments on the two review reports and has interacted with the individual donors on the future of each of the projects. Recommendations from all the review reports and lessons learnt are useful in streamlining the management of research projects and the review system in the CGIAR.

Seed dissemination

The year 2004 brought an increase in request for seed compared with 2003, with 3,170 seed samples being supplied to countries in West Africa and 14,850 to East, Central and Southern Africa (ECSA). Despite the relocation of WARDA to Cotonou in January 2005, INGER-Africa was able to restart delivery of seed samples to its partners in West Africa and ECSA. By mid-2005, 17 sub-Saharan countries had received seed samples, including Benin, Sierra Leone, Niger, Nigeria, Mali, Ghana, Guinea and Guinea-Bissau in West Africa, and Central African Republic, Democratic Republic of the Congo, Congo-Brazzaville, Malawi, Ethiopia, Kenya, Tanzania, Uganda and Sudan in ECSA.

Establishment of ECARRN

With support from the Canada Fund for Africa and from the European Union, the East and central Africa Rice Research Network (ECARRN) was established in Dar es Salaam, Tanzania. A Coordinator was appointed in January 2004 and the steering committee inaugurated. A high level meeting to boost rice production in East Africa was organized and hosted by ECARRN.

Conference and Workshop participation

Cotonou has become a convenient venue for several meetings and workshops organized by WARDA. ROCARIZ, ARI and IVC all held steering committee meetings in Cotonou, and a major policy study

Traditional crossing for varietal improvement may follow initial assessment in the biotechnology lab to determine which parental lines hold genes conferring desirable traits of quality or resistance.

methodology and planning workshop brought in NARES economists from throughout West Africa. Four countries are participating in the USAID-funded project on marker-assisted selection that got underway with a workshop in Bamako, Mali attended by all the participating scientists, farmer and donor representatives. The steering committees of ARI, ROCARIZ and IVC met in 2004 or in early 2005.

Scientists from WARDA attended more than 40 workshops, conferences, regional and international meetings, including key events such as the 4th International Crop Science Conference in Brisbane, Australia, the World Rice Research Conference 2004 at Tokyo and Tsukuba, Japan, the launch of the implementation of the Comprehensive African Agriculture Development Program (CAADP) hosted by COMESA-ASARECA in Dar es Salaam, Tanzania, and the later G8/NEPAD Summit in Accra on the CAADP implementation. ROCARIZ organized the Third Biennial Regional Rice Research Review (4Rs 2004) in Accra, Ghana, attended by more than 70 NARS and WARDA scientists, NGOs and donor representatives. WARDA helped organize the Pan-African Celebration of the International Year of Rice in Côte d'Ivoire and Ghana and participated in IYR-related events in Guinea, Nigeria and Mali.

Staff Publications

During the period under review, program staff prepared and submitted or published several papers in peer-reviewed journals, conference proceedings/book chapters and poster presentations at regional or international fora. Compared to 2003-2004, the overall publication record of WARDA staff showed some improvement, exceeding the CGIAR average of 2.5 papers per scientist. WARDA is one of eight Centers above the average.

New drought-resistant lines with high-yield potential are under development in Cotonou, Benin.

The Period under review
May 2004 to April 2005

Africa Rice Center truly began to come of age as a pan-African center of research excellence during the period under review. This greatly increased involvement in all regions of sub-Saharan Africa was undertaken at the request of both the WARDA Council of Ministers and national agricultural research systems (NARS) in many non-member countries, and because of the continuing evolution of the CGIAR and its activities in SSA.

During 2004, Director General Dr Kanayo F. Nwanze was the Chair of the CGIAR Center Directors Committee (CDC), and SSA in its totality benefited from the oversight brought to bear on the region as a result.

At the same time, the NERICAs continued to consolidate their impacts on West African farming systems and heralded the potential for expansion into similar ecologies in other parts of the continent. Four new Lowland NERICAs were released and farmers selected many others in PVS for further evaluation.

Drying rice in a village cooperative near Kumasi, Ghana.

2004

May

Program reform and the 2005–2007 MTP

Development of the new research program structure dominated the early part of this 12-month period, together with that of the new MTP for 2005–2007 based on the revised programs designed to tackle two major challenges – Integrated Rice Production Systems and Rice Policy and Development – as highlighted in the 2003–2012 Strategic Plan.

Prime elements of the previous programmatic structure are covered by the new Programs 1 and 2 which synthesize the most important concerns of SSA under eight project headings that reflect a fresh approach in line with the developments surrounding the CGIAR and its external environment. A new approach to challenging familiar problems for African agriculture and development was embodied by the inclusion of a project devoted and rice-based technologies to drought – previously identified at systemwide level as a major challenge – and another aimed at using rice to overcome the disruption that can be caused to agricultural production and infrastructure by civil conflict or environmental disaster.

June

National Experts Committee meeting, Yamoussoukro, Côte d'Ivoire

The Fourth Biennial Regional Consultative meeting of the National Experts Committee was held in Côte d'Ivoire from **24–26 June** under the chairmanship of Prof. Hamidou Boly of INERA, Burkina Faso. Member countries present were Benin, Burkina Faso, Côte d'Ivoire, Ghana, Liberia, Mali, Nigeria and Senegal, with observers from Ethiopia, Congo DRC, Guinea, Uganda and Sasakawa-Global 2000.

Displaced women rice farmers celebrate IYR in Yamoussoukro, Côte d'Ivoire.

International Year of Rice Celebrations

WARDA helped organize the successful IYR celebrations held during the NEC meeting at Yamoussoukro and those in Ghana and Nigeria. The Center also took part in the IYR celebration in Guinea where farmers have enthusiastically taken up the NERICAs.

July

MTP 2005–2007

The new program structure provided the basis for preparation of the 2005–2007 MTP. This process involved a wide range of stakeholders beginning with all WARDA scientists, WARDA senior management and the

Board of Trustees. The MTP draft was shared with the WARDA National Experts Committee, comprising representatives from more than 20 countries in Africa. During a two-day priority setting exercise, donors and selected NARS participated in the discussion and evaluation of the draft priorities. The priority setting process was guided firstly by the broad priority drawn from the Strategic Plan that 65% and 35% of the resources shall be assigned to Programs 1 and 2, respectively. The CGIAR global and regional priorities completed by the SC in 2004, NEPAD's Comprehensive African Agricultural Development Program (CAADP), WECARD/CORAF and FARA strategies and priorities were considered, all of which have given high priority to rice in development of the challenge programs, and other initiatives were taken into account in determining current and future priority themes.

Partnership is a major strength of WARDA, particularly when the Center is able to ensure that research investments are consistent with and supportive of national objectives in Africa. In this way, the priorities of NARES partners can be aligned with WARDA's own broad vision of future rice research in Africa over the next 10 years as detailed in the Center's Strategic Plan 2003–2012.

Because of the Center's new programmatic alignment, WARDA commissioned an internal task force on research priority setting. Its main objective was to develop a priority setting methodology and approach for prioritizing research outputs and activities within the new MTP. So that the possible contribution or impact of each MTP project to the mission and strategic goal of WARDA could be critically examined, a participatory priority setting exercise with a broad stakeholder consultation was carried out and concluded with a open-door workshop held in Bamako.

The task force developed a set of six impact criteria based on WARDA's mission statement and the Strategic Plan 2003–2012:

- Contribution to poverty alleviation
- Food and nutrition security and good health
- Partnership/capacity building
- Increasing productivity and profitability
- Sustainability of farming environment
- International public goods

During the project workshop, stakeholders assigned weights to the impact criteria based on their judged importance to WARDA's mission, its strategic objectives and elements of the Millennium Development Goals.

Traditional chiefs inspect rice samples during IYR in Côte d'Ivoire.

The activities and outputs of each WARDA project were examined in turn and assigned weights by the stakeholders. Together with the feedback from WARDA's close partnerships with NARS, with the National Experts Committee, whose members are heads of their respective NARS, and periodic priority-setting exercises during country-to-country visits, the underpinnings of the new MTP were developed.

The MTP itself reflects a fresh approach in line with the developments surrounding the CGIAR and its external environment, and the major role WARDA can play at the heart of the Challenge Programs as well as with continuing involvement in several Systemwide Programs.

As part of its new research agenda, the Center is reaching out beyond its traditional partners to ensure that its knowledge and technologies are relevant and accessible to a broader range of actors interested in rice development in Africa; ranging from international development banks and bilateral agencies, through government and research institutions to local NGOs and the private sector. WARDA continues to strengthen its links with WECARD/CORAF, as the sub-regional organization that takes the leadership in the consolidation and integration of research activities of both international and national centers within the sub-region.

September

ROCARIZ 4Rs Biennial Meeting, Accra, Ghana

ROCARIZ held its third biennial regional rice research review network (4Rs) meeting in Accra, Ghana from **27 September – 1 October**. Attended by more than 70 scientists from West and Central Africa, as well as visitors from other CGIAR Centers and donors, the meeting coincided with the International Year of Rice celebrations in Accra, involving Government Ministers from several West African countries.

CCER on Partnerships

Not only was this the first CCER on Partnerships by WARDA, it was also the first such evaluation of partnerships to be carried out in the CGIAR System. The evaluation team reported as "very positive and commendable" the very strong support of all those contacted to WARDA and its partnership model as a common tool for the development of rice production in West and Central Africa. The final report concentrated on four main issues: mechanisms for linkage/partnerships, information documentation and exchange, capacity building, and technologies and their impacts.

October

World Food Prize Award Ceremony, Iowa, USA

Dr Monty Jones, former WARDA researcher was selected a co-recipient of the **2004 World Food Prize** for developing the NERICA varieties by successfully crossing African with Asian rice species to produce drought- and pest-resistant, high yielding NERICA rice varieties, a feat which had not been achieved before in the history of rice breeding. Dr Jones, from Sierra Leone, shared the $250,000 World Food Prize with another rice scientist Professor Yuan Longping of China's National Hybrid Rice Research and Development Center.

World Food Prize President Ambassador Kenneth Quinn lauded both scientists for their "breakthrough scientific achievements which have significantly increased food security for millions of people from Asia to Africa."

Dr Monty Jones

CCER on the Inland Valley Consortium

A three-person team carried out an evaluation of Phase II of the IVC, visiting WARDA in Abidjan and Bamako, and the National Coordination Units (NCUs) in Ghana, Côte d'Ivoire and Mali. The continued relevance of IVC was confirmed by all six NCUs with which the team had contact. The CCER report made a number of recommendations relating to operational, financial and research aspects of the IVC.

Return to Bouaké, Côte d'Ivoire

Based on assurances from all those involved in security issues in Côte d'Ivoire and on the approvals given by the Council of Ministers and the Board of Trustees for the return of all Africa Rice Center's headquarters units to the purpose-built headquarters at M'bé near Bouaké, Côte d'Ivoire, a carefully-planned move back to Bouaké started at the beginning of October. Site preparations and the return of the M'bé headquarters to operational condition had started some time before but actual staff return did not get fully underway until October. Administration units from Abidjan and the first groups of scientists from Bamako arrived in early and mid-October.

The Executive and Finance Committee of the Board of Trustees held its 32nd ordinary meeting at M'bé headquarters from **4–6 October**.

WARDA staff prepare to leave Bouaké in convoy following the resumption of the Ivorian crisis.

November

World Rice Research Conference, Japan

The Director General and several WARDA scientists took part in the World Rice Research Conference and Symposium in Tokyo and Tsukuba, Japan from **4–7 November**. Dr Howard Gridley presented a paper entitled 'Perspectives for improving rice productivity in Africa', concentrating on the yield performance of NERICAs, especially under conditions of low fertility, and on the distribution and diffusion of NERICAs via PVS. Dr Koichi Futakuchi also presented on 'Submergence damage in rice and challenges in expanding its adaptability to submerged conditions in West and Central Africa'.

Resumption of hostilities

Scarcely, had the returnees got their respective units functioning and making ready for the full return of the Research Division in December than hostilities again resumed in the country's civil strife which had been relatively settled since 2002. Unfortunately, this led to the death of Dr Robert Carsky during aerial bombardment on **November 6** and the evacuation of Africa Rice Center staff from Bouaké to Abidjan and on to Ghana for non-Ivorian nationals.

Most staff were placed on a special leave until January 2005 and returned to their home bases. Management, together with a small group of support staff, stayed in Bamako to plan the next steps in returning the Center to full research capacity. Scientists already in Bamako carried on working as normal to complete 2004 trials and research.

Extraordinary Board Meeting, Nairobi, Kenya

The full board of Trustees met on **30 November – 2 December** to discuss the crisis in Côte d'Ivoire and the implications for WARDA's continued occupation of its headquarters there. The Board received reports on the current security situation following the ceasefire between Government and rebel forces and from WARDA teams sent to explore alternative temporary headquarters sites in Senegal, Mali and Benin. After careful consideration, it was decided to proceed with the temporary relocation of Africa Rice Center to the vacant accommodation offered by IITA at its Benin research station at Togoudo, north of Cotonou, Benin.

December

EU Monitoring Review on Project 1.4, Bamako, Mali

A monitoring team from the European Union visited WARDA's temporary offices in Bamako, Mali and met with NARS in Mali and Burkina Faso to evaluate the EU-funded research on creating low management plant types for resource-poor farmers in rainfed ecosystems, known as Project 1.4. The team made a number of recommendations and findings that are useful in streamlining the management of this research project.

Move to Cotonou, Benin

Thanks to the extraordinary cooperation of the Government of Benin and the assistance of our partners in IITA and INRAB Benin, the necessary approvals and arrangements for relocation of the entire WARDA headquarters administration and research units to Benin were completed within a matter of weeks.

2005

January

The first relocated staff, including those who had been on special leave since November, reported for work on **4 January**.

ECARRN operational

With support from the Canada Fund for Africa and from the European Union, the East and Central Africa Rice Research Network (ECARRN) was established in Dar es Salaam, Tanzania. The Coordinator was appointed in January 2005 and the steering committee inaugurated.

February

JICA Technical Seminar, Nairobi, Kenya

The WARDA Focal Point for eastern and central Africa, Dr Sylvester Oikeh, represented the DG and delivered the opening speech, keynote address and closing remarks at the JICA Technical Seminar on Rice Cooperation in East and Southern Africa held in Nairobi, 16–19 February. The meeting allowed information on NERICA to be shared with many existing and potential partners in the sub-region.

March

Research Days

Research Days postponed from 2004 because of the move from Bamako to Bouaké and then on to Cotonou were held at Togoudo Station in the presence of invited guests from NARS, including INRAB, NGOs, JICA, Sasakawa Global 2000 and other CGIAR Centers, including IRRI and IITA.

Board of Trustees Meeting, Cotonou, Benin

The full Board held its 24th ordinary meeting of the Board and all committees also met in Cotonou from **14–18 March**. It was agreed that WARDA should remain in Cotonou for a minimum of five years.

April

IVC Annual Workshop

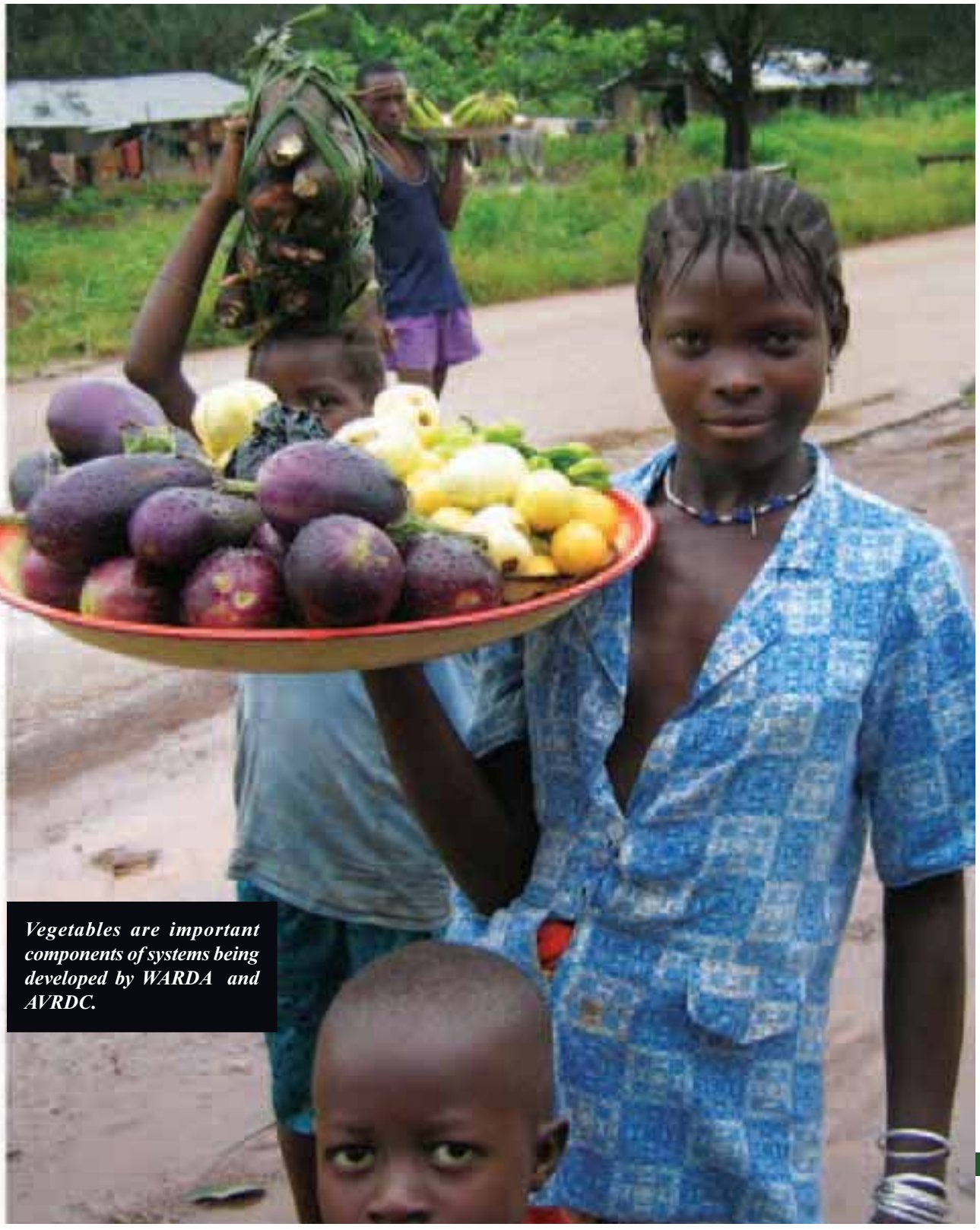
The Inland Valley Consortium staged its five-day annual workshop in Cotonou, **4–8 April**, followed by a two-day meeting of the IVC Consortium Management Committee.

Lake Kivu Pilot Learning Site launch

ECARRN Coordinator Dr Ashura Luzi-Kihupi represented ECARRN and WARDA on **26–29 April** at the launch workshop for the implementation of the Lake Kivu Pilot Learning Site for East and Central Africa as part of the Sub-Saharan African Challenge Program.

Lowland NERICA varieties

Another scientific breakthrough, with yield potential of 6–7 t per ha and good resistance to major lowland stresses. Four lowland NERICA varieties were released in Burkina Faso and two in Mali.



Vegetables are important components of systems being developed by WARDA and AVRDC.

Board of Trustees

Chairman	Gaston Grenier (Canada)
Vice-Chairman	Mary Uzo B. Mokwunye (Nigeria)
Members	Clementine L. Dabire (Burkina Faso) Bamba Gué (Côte d'Ivoire) Takeshi Horie (Japan) Remi Pochat (France) Edwin C. Price (USA) Papa Abdoulaye Seck (Senegal) Emmanuel Owusu-Bennoah (Ghana) Richard Musangi (Kenya)
Ex-officio	Kanayo F. Nwanze (Nigeria) Director General, Africa Rice Center (WARDA)

Senior Staff and Associates

1 May 2004 to 30 April 2005

Office of the Director General

Kanayo F. Nwanze	Director General
P.-Justin Kouka	Assistant Director, Board and Donor Relations
Samuel Bruce-Oliver	Executive Officer
Mohamed Mouhidiny Abdou	Internal Auditor
Savitri Mohapatra	Communication Officer

Training, Information and Library Services

Aline Lisette-Vidal	Head of Training, Information and Library Services
Thomas Adigun	Librarian
Gnah Assetou	Training Assistant
Kossi Augustt*	Translator
Bianca Beks*	Science Editor (APO)
Aboubacar Madougou†	Translator
David Millar*	Science Writer
Fassouma Sanogo	Translator
Aïssata Sylla†	Desktop-publishing Assistant

Corporate Services Division

Nguyen T. Long*	Assistant Director General, Corporate Services
George Maina	Head of Finance
Jean-Baptiste Adjovi†	Senior Accountant
Josselyne Anani**	Personnel Officer
Ignace Koui†	Senior Accountant
Mark Etsibah††	Senior Accountant
Korotoumou Ouattara*	Principal Accountant
Gnanvi Pierre Sossou	Senior Accountant
Lassina Silué	Information Systems Administrator (Finance)
Péféry Coulibaly	Information and Communications Technology Manager
Rama S. Venkatraman	Webmaster
Gabriel Dao††	Head of Human Resources and Administrative Services
Stanislas Hachemé†	Administrative Officer for Logistic Services
Lassina Soro†	Personnel Officer
Nurdin S. Katuli	Head of Operations
Klana Dagnogo	Mechanical Maintenance Manager
Gaston Sangaré	Farm Manager
Chaka Barakissa Fofana†	Purchasing and Supplies Manager

Programs Division

Shellemiah Keya	Assistant Director General, Research and Development
Frank Abamu†	Germplasm Specialist
Cyrille Adda**	Program Assistant
Inoussa Akintayo	Coordinator, African Rice Initiative (ARI)
Koffi Akator	Research Assistant
Touré Amadou	Research Assistant
Boubié V. Bado**	Sahel Agronomist
Kone Brahima	Research Assistant
Anne Bouma†	Research Support Officer
Robert Carsky‡	Cropping Systems Agronomist
Boubakary Cissé	Research Assistant
Mamadou Cissoko	Research Assistant
Aliou Diagne	Impact Assessment Economist
Sitapha Diatta	Soil Physicist
Daniel Tia Dro*	Genetic Resources Specialist (APO)
Attiogbev-Somado Eklou*	Post Doctoral Fellow – Genetic Resources
Olaf Erenstein†	Production Economist
Koichi Futakuchi	Crop Ecophysiologist
Moustapha Gaye††	Research Assistant
Howard Gridley	Upland Rice Breeder
R.Gouantoueu Guei††	Head of Genetic Resources Unit
Mohamed Kebbeh	Production Economist (Sahel)
Annmarie Kormawa	HIV/Aids Focal Point
Patrick Kormawa	Policy Economist

Kouadio Kouamé ††	Research Assistant
Paul Kiepe	Scientific Coordinator, Inland Valley Consortium
Ashura Luzi-Kihupi**	ECARRN Coordinator
Moussa Mahaman	Research Assistant
Fofana Mamadou	Research Assistant
Kouamé Miézan	Irrigated Rice Program Leader (Sahel)
Sika Mobio††	Research Assistant
Marcel Meijs*	Water Management/GIS (APO)
Philippe Morant	Regional Coordinator, Inland Valley Consortium
Augustin Munyemana**	Participatory Technology Development Scientist
Lawrence Narteh**	ROCARIZ Coordinator
Akahoua N'cho	Research Assistant
Marie-Noëlle Ndjiondjop	Molecular Biologist/Biotechnologist
Francis Nwilene	Entomologist
Sylvester Oikeh	Soil Fertility Agronomist
Amos Onasanya	Research Assistant
Olumuyiwa Osiname	WARDA Coordinator in Nigeria (Nigeria)
Jonne Rodenburg*	Inland Valley Agronomist (APO)
Sidi Sanyang††	ROCARIZ Coordinator
Kayodé Sanni	Research Assistant
Mandé Semon	Post Doctoral Fellow – Rice Breeding
Yacouba Séré	Pathologist
Moussa Sié	Lowland Rice Breeder
Abou Togola	Research Assistant
Ali Touré	Research Assistant
Paul Van Mele**	Technology Transfer Agronomist
Michel de Vries*	Irrigated Rice Agronomist (APO)
Ousmane Youm	Assistant Director of Research/Program Leader

Collaborating Scientists

Ryoichi Ikeda*	Plant Breeder (JICA)
Takeshi Sakurai†	Agricultural Economist (JIRCAS)
Horoaki Samejima**	Post Doctoral Fellow (JIRCAS)
Yoshimi Sokei*	Agronomist (JICA)
Hiroshi Tsunematsu*	Associate Upland Rice Breeder (JIRCAS)

Visiting Scientists

Rita Afiavi Agboh-Noameshi**	Sociologist

* Joined in 2004
** Joined in 2005
† Left in 2004
†† Left in 2005
‡ Deceased 6 November 2004

Financial Statement

1. Position for the years ended 2004-2003 (in US$)

ASSETS	2004	2003
Currents Assets		
Cash and Cash Equivalent	4,369,928	4,062,302
Accounts Receivable		
Donors	2,738,337	1,570,407
Employees	259,830	243,125
Others	148,376	568,756
Inventories	353,853	361,519
Prepaid Expenses	110,630	152,134
Total Current Assets	7,980,954	**6,958,243**
Property and Equipment		
Property and Equipment	8,809,715	8,589,367
Less: Accumulated Depreciation	(7,426,536)	(6,695,027)
Total Property and Equipment–Net	1,383,180	1,894,340
TOTAL ASSETS	**9,364,135**	**8,852,583**
LIABILITIES AND NET ASSETS		
Current Liabilities		
Bank Balances (Overdraft)		61,515
Accounts Payable:		
Donors	3,617,437	3,186,213
Employees	274,613	176,118
Others	1,131,915	1,341,149
Funds in Trust–Employment	308,000	296,000
Provisions and Accruals	1,128,704	1,312,906
Total Current Liabilities	**6,460,670**	**6,373,900**
TOTAL LIABILITIES	**6,460,670**	**6,373,900**

Net Assets

Unrestricted Net Assets	2,903,465	2,478,682
TOTAL NET ASSETS	**2,903,465**	**2,478,682**
TOTAL LIABILITIES & NET ASSETS	**9,364,135**	**8,852,583**

	Unrestricted	Restricted	Total 2004	Total 2003
REVENUE GAINS AND OTHER SUPPORT				
Grants	5,804,697	4,220,726	10,025,423	9,167,940
Member States–Operating Income	313,378		313,378	55,484
Member States–Capital Dev. Income				17,292
Transfer of Restricted Assets–Income				161,003
World Bank Special Grant–Income	430,000		430,000	1,221,243
Other Income	70,385		70,385	117,759
Total Revenue, Gains and Other Support	**6,618,460**	**4,220,726**	**10,839,186**	**10,740,721**
EXPENSES AND LOSSES				
Program Related Expenses	2,398,965	4,220,726	6,619,691	5,949,988
Management and General Expenses	3,264,187		3,264,187	3,476,326
Special Transition Program Expenses	592,906		592,906	1,482,935
Total Expenses Program Expenses	**6,256,058**	**4,220,726**	**10,476,784**	**10,909,249**
Indirect Cost Recovery	(461,590)		(461,590)	(1,022,974)
Total Expenses and Losses	**5,794,469**	**4,220,726**	**10,015,195**	**9,886,275**
Change in Net Assets Allocated to Capital Fund in Prior Year	**823,992**	–	**832,992**	**854,446**
Net Assets at Beginning of Year	**2,478,682**		**2,478,682**	**1,624,236**
Change in Net Assets before Prior Year Adjustments	823,992	–	823,992	854,446
Exraordinary Item:-				
General Support Staff – Temination Dues	(160,930)		(160,930)	
Prior Year Adjustment:-				
Depreciation Adjustment–Motor Vehicles	(238,279)		(238,279)	
Change in Net Assets	**424,783**		**424,783**	**854,446**
Net Assets at End of Year	**2,903,465**		**2,903,465**	**2,478,682**

MEMO ITEM ***Total Expenses by Natural Classification***	*Management & General*	*Program related*	*2004*	*Total 2003*
Personnel Costs	*1,801,844*	*3,264,725*	*5,066,569*	*4,997,036*
Supplies & Services	*1,152,797*	*2,552,402*	*3,705,199*	*4,120,939*
Collaborators and Partnerships Costs		*405,751*	*405,751*	*540,833*
Operational Travel	*330,600*	*359,735*	*690,335*	*548,844*
Depreciation	*571,853*	*37,078*	*608,931*	*405,593*
Capital Expenditure				*296,004*
Gross Operating Expenses	***3,857,094***	***6,619,691***	***10,476,785***	***10,909,249***

GRANTS

	For the year ended 31 December 2004	
UNRESTRICTED	**Total 2004**	**Total 2003**
Belgium	166,065	182,301
Canada	701,067	574,248
France	95,640	75,562
Germany	185,295	175,065
Japan	1,120,039	1,029,012
Netherlands	892,771	792,036
Norway	588,365	526,774
Sweden	514,018	416,536
United Kingdom	616,438	
USAID	225,000	225,000
World Bank**	700,000	760,000
Côte d'Ivoire		
Total Unrestricted Grants	**5,804,697**	**4,756,535**
TEMPORARILY RESTRICTED		
CANADA-Fund for Africa (CFA)*	146,150	227,824
COAT-Taiwan/AVRDC Collaborative Project	90,779	4,523
COAT-Taiwan/AVRDC COA14 -Collaboration Project	12,704	
CFC/FAO-Spirivwa Project	1,032	87,604
Denmark (Phytosanitary & Seed Health)		90,859
ENI-CONGO	80,435	13,668
European Union/CORAF Project	985,463	366,775
European Union (Policy Environment & Rice Market Dev.)*	91,819	555,632
European Union (Creating Low Management Plant Types)*	536,137	151,008
France (Collaboration IRD)		10,829
Gatsby Foundation (Containment Facility)	461	450
Gatsby Foundation (Dissemination)	3,572	46,423
GTZ (Projet Riz Nord)		131
GTZ (Hohenheim Project)	90,112	218,213
GTZ (Periurban Project)	90,956	39,856
IBRD Genebank Upgrade Project	320,804	226,955
IFAD (PADS Project)	273,864	281,247
IFAD (Congo-NERICA Dissemination Project)	10,554	
UNDP/TCDC-IHP PHASE 2	115,408	34,645
UK (DFID-Collabor.-NTR/HRI Blast Project)		67,700
Japan (Ecophysiology Project)		44,838
Japan (Grain Quality-Post Harvest Technology)*		(38)

GRANTS

TEMPORARILY RESTRICTED (*continued*)	For the year ended 31 December 2004 Total 2004	Total 2003
Japan (Interspecific Hybrid Project)	517,762	286,667
Japan/MAFF/ WARDA Project		2,142
Japan (RYMV Project)*	258,854	209,260
Japan (Blast Project)*		26,036
Japan (Genebank Project)*		6,498
Japan (Increasing Quality Compet.Loc. Project)*	48,687	132,896
Japan (Dev. Interspec. OG & OS Progenies)*		102,157
Netherlands (APO/JPO Project)	143,415	
Norway (SWIHA HIV/AIDS Project)		52,216
Rockefeller (Capacity Building)	2,269	190,306
Rockefeller (FPATDD-Mali/Nigeria)	13,398	32,873
Rockefeller (African Rice Initiative)	167,098	109,358
Rockefeller (Drought Tolerance Project)		48,629
United Kingdom (Weeds Project)		123
United Kingdom (RYMV Attributed Project)*		53
United Kingdom (Wild Rice Project)		727
United Kingdom (Blast Attributed Project)*		16,160
United Kingdom (Rice Functional Diversity)		1,285
United Kingdom (Attributed Project 2.1)*		359,652
United Kingdom (Attributed Project 2.2)*		115,816
USAID (African Networks Project)	153,797	221,516
USAID (Nigeria Rice Economy Project-FPATD)		65,696
UNDP (Guinea IAEC Project)		2,637
Miscellaneous Small Projects	13,931	10,827
Total Restricted Grants	**4,220,726**	**4,411,405**
Total Grants	**10,025,423**	**9,167,940**

* The use of these grants has been restricted towards selected projects in the 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 of the crisis being experienced in Côte d'Ivoire. This amount (US$ 430,000) has been disclosed separately in the Statement of Activities.

Training

Training Courses given between 1 January 2004 and 12 December 2004

Title	Place and Dates	Beneficiaries	Beneficiaries' Countries	No. of Participants	Partners
Training on NERICA for Bouaké and Korhogo Universities	Abidjan (Côte d'Ivoire) 27–29 January 2004	Students, Professors	Côte d'Ivoire	97 21	
Participatory Learning and Action Research for Integrated Rice Management	Banjul (Gambia) 28 June–6 July 2004	Scientists, Extension workers, NGOs, Development projects	Gambia and other English-speaking countries	25	
Participatory Learning and Action Research for Integrated Rice Management	Conakry (Guinea) 28 June–6 July 2004	Scientists, Extension workers, NGOs, Development projects	Guinea and other French-speaking countries	25	
Foundation seeds production techniques	Yamoussoukro (Côte d'Ivoire) 26–31 July 2004	Scientists in charge of seed production	Benin, Gambia, Ghana, Mali, Nigeria, DR Congo, Sierra Leone, Togo, Côte d'Ivoire	15	
Total				**183**	

Women farmers play a vital role in rice farming and are ready recipients of advice and information on new varieties, agronomy, and post-harvest technologies.

Postgraduate Trainees in 2004–2005

Name and Topic/Subject	Institution	Country of Origin	Sponsor	Degree
Davis, Beau, The management aspects of the PLAR/IRM: the political components of running the program and the activity implementation at regional, national and site farmers level.	Texas A&M University, USA	USA	WARDA	MSc
****Clark, Dustin A.G.***	Texas A&M University, USA	USA	WARDA	MSc
****Soko, Dago Faustin,*** 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.	Université d'Abidjan, Côte d'Ivoire	Côte d'Ivoire	AFDB	PhD
****Cherif, Mamadou,*** Effet de la toxicité ferreuse sur l'activité photosynthétique du riz: etude de la variabilité génétique.	Université d'Abidjan, Côte d'Ivoire	Côte d'Ivoire	AFDB	PhD
****Kotchi, Valère,*** Dynamique du phosphore dans les sols acides des regions tropicales: cas de la Côte d'Ivoire.	Université d'Abidjan, Côte d'Ivoire	Côte d'Ivoire	AFDB	PhD
****Kouakou, Koffi Patrice***	Ecole supérieure d'Agronomie de Yamoussoukro, Côte d'Ivoire	Côte d'Ivoire	WARDA	DAA
****Kouassi, Konan Marcel***	Ecole supérieure d'Agronomie de Yamoussokro, Côte d'Ivoire	Côte d'Ivoire	WARDA	DAA
****Sanon, Issa,*** Valorisation du riz *glaberrima* dans le programme de sélection.	Université Polytechnique de Bobo-Dioulasso, Burkina Faso	Burkina Faso	Private	DAA
****Nathalie, Baboka,*** Analyse de fonctionnement et procédures de qualités.	INSTEC	DR Congo	Private	MSc

Name and Topic/Subject	Institution	Country of Origin	Sponsor	Degree
Adekambi, Souleimane, Impact socio économique de l'adoption des variétés améliorées du riz, sur la scolarisation et la santé des enfants.	Université d'Abomey Calavi du Benin	Benin	WARDA	DAA
Adzato, Kossivi Mawuli, Evaluation des varietés du riz cultivé tolérant, à la sécheresse.	Université de Lome, Togo	Togo	USAID	DAA
****Yao, Kouadio Nasser,*** Androgène *in vitro* chez le riz *Oryza glaberrima* et d'hybrides interspécifiques *sativa-glaberrima*.	Université d'Abidjan, Côte d'Ivoire	Côte d'Ivoire	WARDA	PhD
Atchade, Nicolas, Caractérisation des sols de IITA, Niaouli et Bohicon.	Université d'Abomey Calavi du Benin	Benin	WARDA	DEA
****Sorho, Fatogoma,*** Pylogéographie, pathogénie et durabilité des resistances naturelles au virus de la panachure jaune du riz.	Université d'Abidjan, Côte d'Ivoire	Côte d'Ivoire	Agropolis	PhD
Efisue, Andrew, Developing durable resistant upland rice for the tropics of Africa.	University of KwaZulu, Natal, South Africa	Nigeria	Rockefeller Foundation	PhD
Dobo, Macaire, Enhance uniformity and stability of rice grain quality through genetic transformation and marker-assisted breeding.	Texas A&M University, USA	Côte d'Ivoire	Rockefeller Foundation	PhD
****Traoré, Karim,*** Marker-assisted selection for improving drought resistance in rice roots traits and osmotic adjustment.	Texas A&M University, USA	Mali	Rockefeller Foundation	PhD

* Completed in 2004–2005.
** Discontinued thesis because of the Ivorian crisis.

The outlook is sunny for higher yields from NERICAs.

Publications

Articles in Peer-reviewed Journals

2004

van Asten PJA, van 't Zelfde A, van der Zee SEATM and Hammecker C. 2004. The effect of irrigated rice cropping on the alkalinity of alkaline soils in West Africa. *Geoderma* 119: 233–247.

Abo EM, Alegbejo DM, Sy AA and **Séré Y**. 2004. Retention and transmission of rice yellow mottle virus (RYMV) by beetle vectors in Côte d'Ivoire. *Agronomie Africaine* XVI (1) 71–76.

Becker L and N'guessan Y. 2004. Le riz dans l'ancienne "Boucle du Cacao" de Côte d'Ivoire. *Autrepart* 31: 133–150.

Carsky RJ and Toukourou MA. 2004. Cassava leaf litter estimation in on-farm trials. *Experimental Agriculture* 40: 315–326.

Chianu J, Tsujii H and **Kormawa P**. 2004. Agriculture in the savannas of northern Nigeria: Pressures, transformations, damage and coping strategies. *Outlook on Agriculture* Vol. 33, No.4, pp 247–253.

Coyne DL, **Sahrawat KL** and Plowright RA. 2004. The influence of mineral fertilizer application and plant nutrition on plant-parasitic nematodes in upland and lowland rice in Côte d'Ivoire and its implications in long term agricultural research trials. *Experimental Agriculture* 40: 245–256.

Tao D, Xu P, Li J, Hu F, Yang Y, Zhou J, Tan X and **Jones MP**. 2004. Inheritance and mapping of male sterility restoration gene in upland *japonica* restorer lines. *Euphytica* 138: 247–254.

Fofana B, Breman H, **Carsky RJ**, Van Reuler H, Tamelokpo AF and Gnakpenou KD. 2004. Using mucuna and P fertilizer to increase maize grain yield and N fertilizer use efficiency in the coastal savanna of Togo. *Nutrient Cycling in Agroecosystems* 68: 213–222.

Green S, **Youm O**, Hall DR, Yacouba M and Farman D. 2004. Methods for rearing *Heliocheilus albipunctella* in the laboratory and eliminating the pupal diapause. *International Sorghum and Millets Newsletter* 45: 69–72.

Haefele SM, Wopereis MCS, Schloebohm AM and Wiechmann H. 2004. Long-term fertility experiments for irrigated rice in the West African Sahel: effect on soil characteristics. *Field Crops Research* 85 (1) 61–77.

Haefele SM, Johnson DE, Mbodj D, **Wopereis MCS** and **Miézan KM**. 2004. Field screening of diverse rice genotypes for weed competitiveness in irrigated lowland ecosystems. *Field Crops Research* 88: 29–46.

Idinoba ME, Idinoba PA, Gbadegesin AS and Jagtap SS. 2004. Water use and seasonal differences in maize performance in the transitional humid zone of Nigeria. *Journal of Sustainable Agriculture* Vol. 24, No 3.

Ikeda R. 2004. Prospects for Rice Production in the World. *Shokucho* 38 (12) 210–216.

Johnson DE, **Wopereis MCS**, Mbodj D, Diallo S, Powers S and **Haefele SM**. Timing of weed management and yield losses due to weeds in irrigated rice in the Sahel. *Field Crops Research* 85 (1) 31–42.

Kebbeh M, **Wopereis MCS**, **Miézan K,** Diack BS and Fermont AM. 2004. Assessing productivity and profitability gaps in irrigated rice production in the Sahel. *Sahelian Studies and Research* 10. Institute du Sahel.

Kormawa P, Ezedinma C and Singh B. 2004. Factors influencing farmer-to-farmer transfer of an improved cowpea variety in Kano State, Nigeria. *In: Journal of Agriculture and Rural Development in the Tropics and Subtropics* 105 (1) 1–14.

Lançon F, Erenstein O, Touré AA and Akpokodje G. 2004. Qualité et compétitivité des riz locaux et importé sur les marché urbains ouest-africains. *Cahiers d'études et de recherches francophones / Agricultures* 13 (1): 110–5.

Levasseur V, Djimdé M and Olivier A. 2004. Live fences in Ségou, Mali: an evaluation by their early users. *Agroforestry Systems* 60. pp 131–136.

Ogoke IJ, Togun AO, **Carsky RJ** and Dashiell KE. 2004. Effect of phosphorus fertilizer on soyabean residue turnover in the tropical moist savanna. *Journal of Agronomy and Crop Science* 190 (6) 367–373.

Ogoke IJ, Togun AO, **Carsky RJ** and Dashiell KE. 2004. Phosphorus uptake and balance in a soyabean-maize rotation in the moist savanna of West Africa. *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 105 (1) 15–27.

Oikeh SO, Menkir A, Maziya-Dixon B, Welch RM, Glahn RP and Gauch Jr HG. 2004. Environmental stability of iron and zinc concentrations in grain of elite early-maturing tropical maize genotypes grown under field conditions. *Journal of Agricultural Science* (Cambridge) 142: 1–9.

Oikeh SO, Menkir A, Maziya-Dixon B, Welch RM and Glahn RP. 2004. Assessment of bioavailable iron from 20 elite tropical maize varieties using an *in vitro* digestion/Caco-2 cell model. *Journal of the Science of Food and Agriculture* 84: 1202–1206.

Onasanya A, Séré Y, Nwilene F, **Abo ME** and **Akator K**. 2004. Reactions and Resistance Status of Differential Rice Genotypes to Rice Yellow Mottle Virus, Genus *Sobemovirus* in Côte d'Ivoire. *Asian Journal of Plant Sciences* (6): 718–723.

Oswald A and Ransom JK. 2004. The response of maize varieties to *Striga* infestation. *Crop Protection* 23: 89–94.

Owusu EO, **Youm O**, Yacouba M, Hall DR and Green S. 2004. Observations on factors affecting attraction and oviposition preferences of the millet head miner *Heliocheilus albipunctella* to pearl millet panicles. *International Sorghum and Millets Newsletter* 45: 72–74.

Reece D, **Sumberg J** and Pommier L. 2004. Matching technologies with potential end users: a knowledge engineering approach for agricultural research management. *Journal of Agricultural Economics* (1) 25–40.

Segda Z, **Haefele SM, Wopereis MCS**, Sedogo MP and Guinko S. 2004. Agro-economic characterization of rice production in a typical irrigation scheme in Burkina Faso. *Agronomy Journal* 96 (5) 1314–1322.

Sumberg J. 2004. The logic of fodder legumes in Africa: a response to Lenne and Wood. *Food Policy* 29: (5) 587–591.

Sumberg J and Reece D. 2004. Agricultural research through a 'new product development' lens. *Experimental Agriculture* 40: (3) 295–314.

Traore O, Sorho F, Pinel-Gazi A, Abubakar Z, Banwo O, Maley J, Hebrard E, Winter S, **Séré Y**, Konate G and Fargette D. 2004. Mechanism of emergence of Rice Yellow Mottle Virus inferred from large-scale and high-resolution phylogeographic studies. *Molecular Ecology* 14 (7).

Van Mele P and Chien HV. 2004. Farmers, biodiversity and plant protection: developing a learning environment for sustainable tree cropping systems. *International Journal of Agricultural Sustainability* 2 (1), 67–76.

Watanabe H, **Futakuchi K**, **Jones MP** and Sobambo BA. 2004. Grain protein content of African rice (*Oryza glaberrima* Steud.) lines and Asian rice (*O. sativa* L.) varieties in West Africa. *Oryza* 41 (1 & 2): 35–38.

2005

Carsky RJ and Toukourou MA. 2005. Identification of nutrients limiting cassava yield maintenance on a sedimentary soil in southern Benin, West Africa. *Nutrient Cycling in Agroecosystems* 71 (2) 151–162.

Fofana B, Tamélokpo A, **Wopereis MCS**, Breman H, Dzotsi K and **Carsky RJ**. 2005. Nitrogen use efficiency by maize as affected by a mucuna short fallow and P application in the coastal savanna of West Africa. Nutrient Cycling in Agroecosystems. 71/3: 227–237.

Rodenburg J, Bastiaans L, Weltzien E and Hess DE. 2005. How can field selection for Striga resistance and tolerance in sorghum be improved. Field Crops Research 93: 34–50

Semon M, Nielsen R, **Jones MP** and McCouch SR. 2005. The Population Structure of African Cultivated Rice *Oryza glaberrima* (Steud.): Evidence for Elevated Levels of Linkage Disequilibrium Caused by Admixture with *O. sativa* and Ecological Adaptation.*Genetics* 169: 1639–1647

Séré Y, Onasanya A, Afolabi AS and **Abo EM.** 2005. Evaluation and potential of double immunodifusion gel essay for serological characterization of Rice Yellow Mottle Virus isolates in West Africa. African Journal of Biotechnology: 4 (2) 197–205.

Sorho F, Pinel A , Traoré O , Bersoult A , Ghesquière A , Hébrard E , Konaté G , **Séré Y** and Fargette D. 2005. Durability of natural and transgenic resistances in rice to rice yellow mottle virus. European Journal of Plant Pathology. 112: 349–359.

Sumberg J. 2005. Constraints to the adoption of agricultural innovations - Is it time for a re-think? Outlook-on-Agriculture 34: (1) 7–10.

Traore O, Sorho F, Pinel A, Abubakar Z, Banwo O, Maley J, Hebrard E, Winter S, **Séré Y**, Konate G and Fargette D. 2005. Processes of Diversification and Dispersion of Rice Yellow Mottle Virus inferred from Large-Scale and High-Resolution Phylogeographical Studies. Molecular Ecology 14: 2097–2110.

Online Articles

Albar L, **Ndjiondjop M-N**, Esshak Z, Berger A, Pinel A, **Jones MP**, Fargette D and Ghesquière A. 2004. Towards positional cloning of a gene required for cell to cell movement of rice yellow mottle virus. Published online <http://www.medrice.unito.it/Riceuconf/Session>

van Asten PJA, Barro SE, **Wopereis MCS** and **Defoer T**. 2004. Using Farmer Knowledge to Combat Low Productive Spots in Rice Fields of a Sahelian Irrigation Scheme. Land Degradation & Development, 15:383–396. Published online June 15, 2004, in Wiley InterScience <www.interscience.wiley.com>

Futakuchi K, **Jones MP** and **Osiname O**. 2004. Development of lowland rice from the interspecific cross of *Oryza sativa* and *O. glaberrima*. Proceedings for the 4th International Crop Science Congress, Brisbane, Australia, 26 September–1 October 2004. Published online at <http://www.cropscience.org.au/> and also on a CD.

Hahne G, Jones MP and **Ndjiondjop M-N**. 2004. Using anther culture and microsatellite markers to generate weed competitive rices from *Oryza sativa* L. and *O. glaberrima* Steud. Published online at <http://www.medrice.unito.it/Riceuconf/Session>

Kormawa P, Keya SO and **Toure AA**. 2004. Rice Research and Production in Africa. *Agra Informa* July 2004. <www.Agra-net.com>

McCouch SR, Garris A, **Semon M**, Lu H, Coburn J, Redus M., Rutger N, Edwards J, Kresovich S, Nielsen R, **Jones MP** and Tai T. 2004. Genetic diversity and population structure in rice. <www.intl-pag.org/12/abstracts/W02_PAG12_6.html-6k>

Books or Book Chapters

2004

Diagne A, Koné M, Sylla K, **Touré AA**, Kouame A, Dibakala M and Sobia A. 2004. Environmental Impact Analysis of the World Trade Organization's Agreement on Agriculture on the Rice Sector of Côte d'Ivoire. *In: Integrated Assessment of the WTO Agreement on Agriculture in the Rice Sector*, Hussein Abaza ed. United Nations Environment Program, Economics and Trade Branch, Division of Technology, Industry and Economics, Geneva, Switzerland. pp 51–63.

Haefele SM and **MCS Wopereis**. 2004. Combining field and simulation studies to improve fertilizer recommendations for irrigated rice in the Senegal River Valley. Increasing productivity of intensive Rice systems through site specific nutrient. pp: 265–286. A Dobermann, C Witt and D Dawe (eds). Increasing productivity of intensive rice systems through site specific nutrient management. Philippines: IRRI. 420 p.

Nwilene FE, Nwanze KF and **Okhidievbie O**. 2004. African Rice Gall Midge: Biology, Ecology and Control - Field Guide and Technical Manual. West Africa Rice Development Association, Bouaké, Côte d'Ivoire. 17 pp.

Van Mele P and Cuc NTT. 2004. Semut Sahabat Petani. Meningkatkan hasil buah-buahan dan menjaga kelestarian lingkungan bersama semut rangrang. World Agroforestry Centre, Bogor, Indonesia. (Ants as Friends translated in Bahasa Indonesia).

2005

Badrul A, Magor NP and **Van Mele P**. 2005. Pump it up: developing a pro-poor mobile pump market. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Bashar MK, Salahuddin A and **Van Mele P**. 2005. Building a rice seed network. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Bentley J and **Van Mele P**. 2005. Creative learning methods. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

FAO-**WARDA**. 2005. Report of the FAO-WARDA workshop on Integrated Irrigation and Aquaculture. Bamako, Mali 4–7 November 2003. Rome: FAO. 44 pp.

Latifun Nessa H. and **Van Mele P**. 2005. Breaking down barriers: women-led group extension. *In:* Van Mele, P Salahuddin, A. and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Nash P and **Van Mele P**. 2005. Going Public: a quick way to share ideas with communities. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK. pp 103–114.

Saleque MA, Harun-Ar-Rashid M, **Van Mele P** and Bentley J. 2005. Village soil fertility maps. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Samsuzzaman S and **Van Mele P**. 2005. Innovating with federations: community institutions take the lead in seed marketing. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Van Mele P, Salahuddin A and Magor N (Eds). 2005. Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK. 330 pp.

Van Mele P, Zakaria AKM, Nasrin R, Chakroborty B and Rodgers J.2005. Bringing science to life: video development for women-to women extension. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Van Mele P, Zakaria AKM and Bentley J. 2005. Watch and learn: video communication for appropriate technologies. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Van Mele P, Salahuddin A and Jabbar MA. 2005. Grameen Seed: Grameen experiments with a pro-poor seed innovation system. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Van Mele P. 2005. Farmseed: putting farmers at the heart of the seed production and distribution system. *In*: Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Van Mele P. 2005. New Road Map. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Van Mele P, Salahuddin A and Magor N. 2005. People and pro-poor innovation systems. *In:* Van Mele P, Salahuddin A and Magor N (Eds). Innovations in Rural Extension: Case Studies from Bangladesh. CABI Publishing, Wallingford, UK.

Edited Proceedings, Abstracts in Proceedings and Project Reports

2004

Bationo A, Nandwa SM, Kimetu JM, **Bado BV,** Lompo F, Kimani S, Kihanda F and Koala S. 2004. Sustainable intensification of crop-livestock systems through manure management in Eastern and Western Africa. pp 173–199: Lessons learned and emerging research opportunities. Proceedings of an international conference held at the International Institute of Tropical Agriculture, Ibadan, Nigeria, 19–22 November 2001. ILRI, Nairobi, Kenya and CTA Wageningen, The Netherlands.

Diagne A. 2004**.** Impact assessment of agricultural technology: Concept, methodology and application to rice pests and diseases. *In:* Sanyang S, Ajayi O and Sy AA (Eds). 2004. Actes de la second revue régionale de la recherche rizicole (4Rs 2002). ROCARIZ Proceedings in French.

Erenstein O, Lançon F, Kebbeh M, Akpokodje G, Akande SO and **Osiname O**. 2004. The Nigerian rice economy in a competitive world: Constraints, opportunities and strategic choices. pp 95–108. *In:* Nigeria Rice Memorabilia. ME Abo and AS Abdullahi (Eds). Abuja, Nigeria: Project Synergy Limited.

Erenstein O, Moussa M, Oswald A and Keijzer P. 2004. Characterization of peri-urban lowland use along an ecological and market access gradient in West Africa. Project report – Factors influencing the development trajectories of lowlands in West Africa. Abidjan, Côte d'Ivoire. Africa Rice Center (WARDA) iii–68 pp.

Erenstein O, Lançon F, Osiname O, and **Kebbeh M**. 2004. Operationalising the strategic framework for rice sector revitalisation in Nigeria. Project report –The Nigerian Rice Economy in a Competitive World: Constraints, Opportunities and Strategic Choices. Abidjan, Côte d'Ivoire: Africa Rice Center (WARDA). ii–35 pp.

Ghesquière A, Lorieux M, Albar L, Heuer S, **Miézan K**, Reversat G, **Ndjiondjop M-N** and **Jones MP**. 2004. Characterization, mapping and cloning of useful genes of the cultivated rice *O. glaberrima*. Rice Science: Innovation and impact for livelihood. TW Mew (Ed). pp 275–287.

Kaboré KB and **Sié M**. 2004. Rice blast management in Burkina Faso from 1999 to 2002: use of varietal resistance and training of agents and producers. pp.23–37. *In:* Proceedings of a Stakeholder workshop. 3–7 May 2003. Accra, Ghana. Séré Y, Sreenivasaprasad S and Nutsugah SK (Eds).

Ndjiondjop M-N, Coburn J, **Jones MP** and McCouch SR. 2004. Evaluation of *O. sativa* x *O. glaberrima* derived lines using microsatellite markers. pp 147–148. *In*: Proceedings *Advances in rice Genetics: Genetic diversity, evolution and alien introgression.* Khush GS, Brar DS and Hardy B (Eds).

Ndjiondjop M-N, Albar L, Fargette D, Brugidou C, **Jones MP** and Ghesquière A. 2004. Mapping of a recessive gene conferring high resistance to Rice Yellow Mottle Virus. *In:* Proceedings *Advances in Rice Genetics: Genetic diversity, evolution and alien introgression.* Khush GS, Brar DS and Hardy B (Eds). pp 257–259.

Nutsugah SK, Dogbe JK, Twumasi JK, Dartey K, Chipilli J, Sreenivasaprasad S and **Séré Y**. 2004. Survey of Rice Blast and varietal screening in Ghana. pp 47–62. *In:* Rice blast in West Africa: Characterization of pathogen diversity, key screening sites and host resistance. Proceedings of a stakeholder workshop, Project R7552, UK Department for International, Development - Crop Protection Programme. 5 March 2003. Accra Ghana. Séré, Sreenivasaprasad and Nutsugah (Eds).

Semon M, **Jones MP,** Nielsen R and McCouch SR. Population structure of *O. glaberrima* and its implications for breeding drought tolerance in cultivated rice. pp130-131 *In:* Proceedings of a workshop on Resilient Crops for Water Limited Environment. Cuernavaca, Mexico. 24–28 May 2004. Poland D, Sawkins M, Ribaut JM and Hoisington D (Eds).

Séré Y, Sy AA, **Akator SK**, **Onasanya A** and Zai K. 2004. Screening Strategy for Durable Resistance to Rice Blast Disease at WARDA. pp 38–42. *In:* Rice blast in West Africa: Characterization of pathogen diversity, key screening sites and host resistance. Proceedings of a stakeholder workshop, Project R7552, UK Department for International, Development - Crop Protection Programme. 5 March 2003. Accra, Ghana. Séré, Sreenivasaprasad and Nutsugah (Eds).

Séré Y, Sy AA, **Akator SK**, **Onasanya A**, Zai K, Sreenivasaprasad S., Nutsugah SK, Twumasi JK. 2004 Analysis of *Magnaporthe grisea* Population Structure in Côte d'Ivoire as a Prerequisite for the Deployment of Varieties with Durable Blast Resistance. pp 72–102. *In:* Rice blast in West Africa: Characterization of pathogen diversity, key screening sites and host resistance. Proceedings of a stakeholder workshop, Project R7552, UK Department for International, Development - Crop Protection Programme. 5 March 2003. Accra, Ghana. Séré, Sreenivasaprasad and Nutsugah (Eds).

Sié M, Kaboré B, Sérémé D and Moukoumbi YD. 2004. Selection of intra-specific and inter-specific lines for their tolerance to blast in Burkina Faso. pp.23–37. *In:* Y. Séré, S Sreenivasaprasad and SK Nutsugah (Eds). Proceeding of a stakeholder workshop. 3–7 May 03.

Sreenivasaprasad S, Chipili J, Muthumeenakshi S**, Séré Y**, Zai K, **Akator SK**, Nutsugah SK, Dogbe W, Twumasi J, Dartey K, Talbot NJ and Brown AE. 2004. Diversity of blast pathogen populations in four West African countries and strategies for resistance management. pp 63–70. *In:* Rice blast in West Africa: Characterization of pathogen diversity, key screening sites and host resistance. Proceedings of a stakeholder workshop, Project R7552, UK Department for International, Development - Crop Protection Programme. 5 March 2003. Accra, Ghana. Séré, Sreenivasaprasad and Nutsugah (Eds).

Williams TO, Ehui S, and **Kormawa P**. 2004. Implications of changing domestic policies and globalisation for crop-livestock systems development. pp 45-86 *In:* Williams TO, Tarawali SA, Hiernaux P and Fernandez-Rivera S (Eds). *Sustainable crop-livestock production for improved livelihoods and natural resource management in West Africa*. Proceedings of an international conference held at the International Institute of Tropical Agriculture, Ibadan, Nigeria, 19–22 November 2001. ILRI, Nairobi, Kenya and CTA Wageningen, The Netherlands.

2005

Futakuchi K. 2005. Submergence damages in rice and challenges in expanding its adaptability to submerged conditions in West and Central Africa. Toriyama K, Heong KL and Hardy B (Eds). Rice is life: scientific perspectives for the 21st century. Proceedings of the World Rice Research Conference held in Tokyo and Tsukuba, Japan 4–7 November 2004. Los Baños, Philippines: International Rice Research Institute. Tsukuba, Japan: Japan International Research Center for Agricultural Sciences. pp 445–448.

Nwanze KF, Oikeh SO, Nwilene FE and **Kormawa P**. 2005. Beyond NERICA - Seed multiplication and dissemination in East and Southern Africa. *In:* Proceedings JICA Technical Seminar on Rice Cooperation in East and Southern Africa, AICAD, Nairobi, Kenya, 16–19, February 2005.

Oikeh SO, Menkir A, Maziya-Dixon B, Welch RM, Glahn RP, and **Onasanya A**. 2005. Relationship among nutritional grain quality and agro-physiological traits in late-maturing tropical maize grown in West Africa. pp 132–133. *In:* Li C et al. (Eds). *Plant Nutrition for Food Security, Human Health and Environmental Protection.* Tsinghua University Press, Beijing, China.

Youm O, Sithanantham S, Vaissayre M, Nibouche S, Martin T, Ochu GO and Momanyi G. 2005. Bio-ecology and Management of *Helicoverpa* for Sustainable Crop Production in Africa. pp.63–90. *In:* HC Sharma ed. *Heliothis/ Helicoverpa* Management: Emerging Trends and Strategies for Future Research. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi / Science Publishers Inc. NH, USA.

Africa Rice Center (WARDA) Publications

ADRAO. 2005. *Actes de la seconde revue régionale de la recherché rizicole* (4Rs 2002). Bouaké, Côte d'Ivoire, 284 pp**.** ISBN 92 9113 267 5.

Defoer T, Wopereis MCS, Idinoba P, Kadisha TKL**, Diack S** and **Gaye M.** 2005. *Curriculum d'apprentissage participatif et recherché action (APRA) pour la gestion intégrée de la culture de riz de bas-fonds (GIR) en Afrique sub-saharienne: Manuel du facilitateur*. ADRAO, Bouaké, Côte d'Ivoire, et IFDC, Muscle Shoals, États-Unis. 168 pp. ISBN 92 9113 263 2.

WARDA. 2005. Rice Blast in West Africa: Characterisation of pathogen diversity, key screening sites and host resistance. **Séré Y**, Sreenivasaprad S and Nutsugah SK. (Eds). Bouaké, Côte d'Ivoire, vi + 152 pp. ISBN 92 9113 266 7.

Acronyms and Abbreviations

ADC	Agribusiness Development Centre
ADG-RD	Assistant Director General, Research and Development
ADG-CS	Assistant Director General, Corporate Services
ADRAO	Centre du riz pour l'Afrique (formerly: Association pour le développement de la riziculture en Afrique de l'Ouest)
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AVRDC	World Vegetable Center (formerly: Asian Vegetable Research and Development Center)
AfDB	African Development Bank
AfRGM	African rice gall midge
AGM	Annual General Meeting
ARI	African Rice Initiative
ASI	ADRAO/SAED/ISRA thresher–cleaner
AVRDC	World Vegetable Center (Asian Vegetable Research and Development Center)
BoT	Board of Trustees
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit
CAADP	Comprehensive Africa Agriculture Development Programme (of NEPAD)
CDC	CGIAR Center Directors Committee
CGIAR	Consultative Group on International Agricultural Research
CoM	Council of Ministers
CMC	Inland Valley Consortium Management Committee
CORAF	Conseil ouest et centre africain pour la recherche et le développement agricole (French of WECARD)
CP	Challenge Program
DFID	Department for International Development
DRAHRH	Departments of Agriculture, Water and Wind Resources
ECARRN	Eastern and Central Africa Rice Research Network
EFC	Board Executive and Finance Committee
ESSD	Environmentally and Socially Sustainable Development
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
GFAR	Global Forum on Agricultural Research
GTZ	Gesellschaft für Technische Zusammenarbeit
ha	hectare
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome

ICM	integrated crop management
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDEA	Investment in Developing Export Agriculture
IER	Institut d'économie rurale
IFPRI	International Food Policy Research Institute
IIA	integrated irrigation and aquaculture
IITA	International Institute of Tropical Agriculture
INERA	Institut de l'environnement et des recherches agricoles
INGER	International Network for the Genetic Evaluation of Rice
INRAB	Institut national de recherche agronomique du Bénin
ISC	Interim Science Council
ISRA	Institut sénégalais de recherches agricoles
IVC	Inland Valley Consortium
IYR	International Year of Rice
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Sciences
MDG	Millennium Development Goals
MoU	Memorandum of Understanding
MTP	Medium Term Plan
NARES	national agricultural research and extension systems
NARO	National Agricultural Research Organisation
NARS	national agricultural research systems
NEC	National Experts Committee
NEPAD	New Partnership for Africa's Development
NGO	non-governmental organization
NISER	Nigeria Institute for Social and Economic Research
PVS	participatory varietal selection
R&D	Research and Development
ROCARIZ	Réseau ouest et centre africain du riz
RYMV	rice yellow mottle virus
SAED	Société d'aménagement et d'exploitation des terres du delta du fleuve Sénégal etdes vallées du fleuve Sénégal et de la Falémé
S-G 2000	Sasakawa Global 2000
SSA	Sub-Saharan Africa
t	tonne
TAC CGIAR	Technical Advisory Committee
TICAD	Tokyo International Conference on Africa's Development
TCDC	Technical Cooperation among Developing Countries
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WARDA	Africa Rice Center (formerly: West Africa Rice Development Association)
WCA	West and Central Africa
WECARD	West and Central African Council for Research and Development (English for CORAF)
WSSD	World Summit on Sustainable Development

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 21st century through its network of 15 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.

Membership of the CGIAR is open to international organizations, governments, and private foundations that support the mission of the CGIAR, participate in policy making, and provide support for the conduct of research at the 15 international Centers.

The CGIAR partnership includes 25 developing and 22 industrialized countries, 4 private foundations, and 13 regional and international organizations that provide financing, technical support, and strategic direction. The Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), the United Nations Development Programme (UNDP), and the World Bank serve as co-sponsors. CGIAR members contributed approximately US $437 million in 2004. Individual members make voluntary contributions to the Centers and programs of their choice, allowing funds to be targeted to areas of research and regions that align with development priorities. Independent studies consistently demonstrate that CGIAR research earns handsome returns.

CGIAR Centers

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)
CIP	Centro Internacional de la Papa (Lima, Peru)
ICARDA	International Center for Agricultural Research in the Dry Areas (Aleppo, Syria)
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)
IWMI	International Water Management Institute (Colombo, Sri Lanka)
WARDA	Africa Rice Center (Cotonou, Benin)
WORLDFISH	International Center for Living Aquatic Resources Management (Penang, Malaysia)
WORLD AGROFORESTRY CENTRE	International Centre for Research in Agroforestry (Nairobi, Kenya)

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