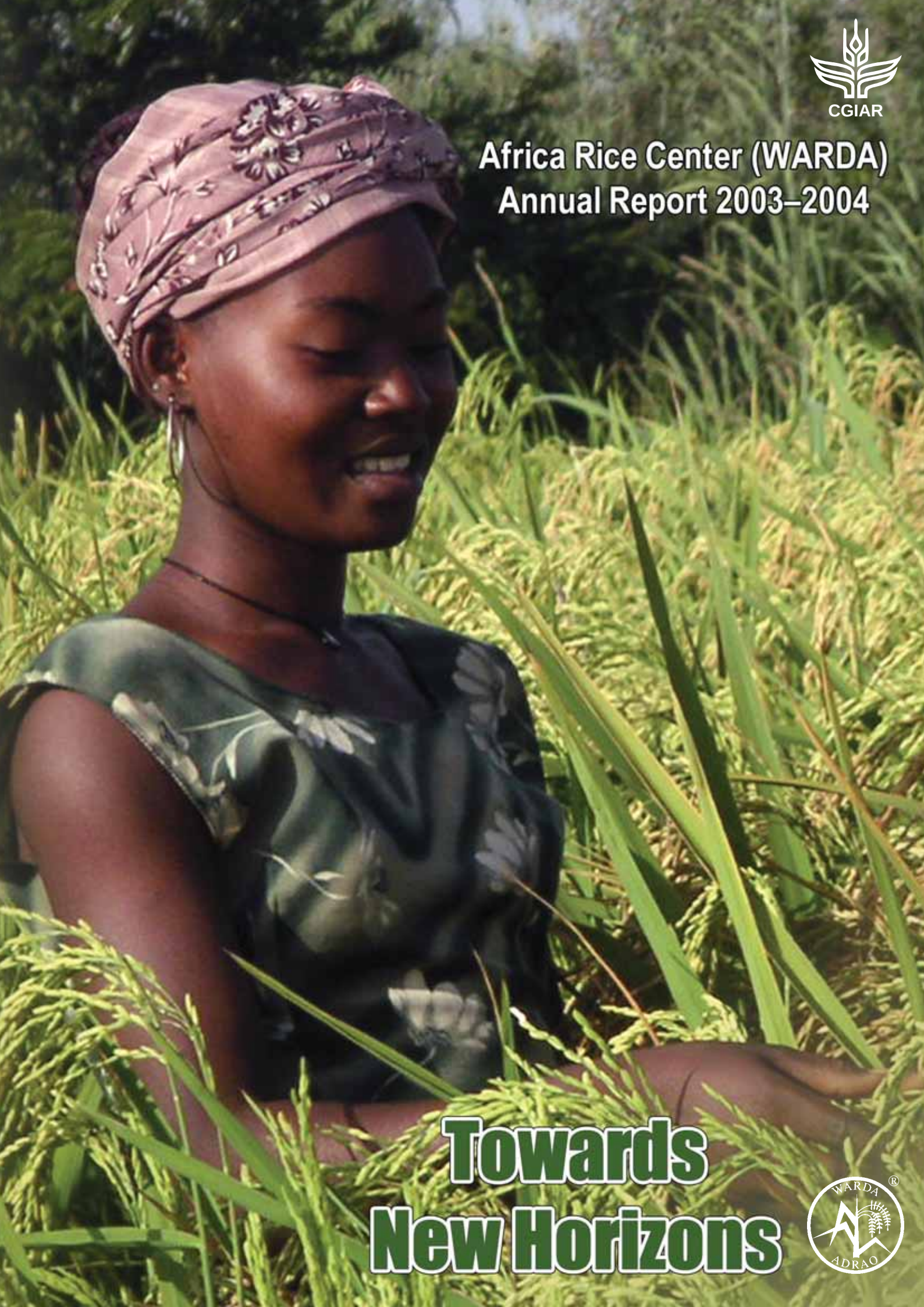

CGIAR

Africa Rice Center (WARDA)
Annual Report 2003–2004

Towards New Horizons

WARDA ADRAO

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 Ivoirian crisis. WARDA has regional research stations near St Louis, Senegal and at IITA in Ibadan, Nigeria.

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Towards New Horizons

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Annual Report 2003–2004

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Towards New Horizons

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

Foreword

After NERICA, what? This was a constant refrain that the Africa Rice Center (WARDA) heard after it won the CGIAR King Baudouin Award for the NERICA breakthrough at the beginning of this millennium.

Our next challenge was to come up with something equally good for the lowland rice ecology, which offers greater possibility for rice intensification. We can proudly announce today that our scientists and their partners in the national programs have achieved another scientific breakthrough, building on the NERICA technology. Another new rice for Africa has been developed.

Another exciting breakthrough: a new rice for African lowlands developed

In contrast to NERICA, which was designed for the upland (rainfed) rice ecology in sub-Saharan Africa (SSA), the new rice has been developed for the African lowlands, one of the most complex rice ecologies in the world. Given the high potential of the lowlands, the new rice varieties are expected to make an even bigger impact than the upland NERICA in SSA.

This exciting breakthrough was achieved, thanks to the catalytic role of the ROCARIZ rice network and the Center's highly successful partnership-based research model. You can read this breaking news story in the feature *Going beyond the upland NERICA: another new rice for Africa is born*.

For this Annual Report, which covers the period from May 2003 to April 2004, we chose the theme *Towards new horizons*, because it captures best the essence of the futuristic spirit of the Africa Rice Center. As you will observe from the stories featured in this report, the Center has been slowly but steadily moving beyond its traditional focus towards new frontiers of research, development, scope and recognition.

The theme of expanding horizons is reflected in the Center's new *Strategic Plan (2003-2012)*, the highlights of which are presented in this report. The theme also fits in well with its expansion in East and Central Africa, following NERICA's growing popularity in those regions. The feature on *The growing NERICA boom in Uganda* recounts an amazing history in the making. If this is a sign of things to come, the Center is indeed charting the future of rice in SSA.

The new horizons do not represent only the geographic expansion of the Center's reach, but also the scope of the Center's research, which is no longer focusing on just rice, but is also exploring the possibilities of diversification of rice-based livelihoods. The article *Enabling successful livelihood diversification for the rural and urban poor in sub-Saharan Africa* describes WARDA's new initiatives with partners in the areas of rice-fish and rice-vegetable farming.

With a new brand name and identity, reflecting its leadership role in rice R&D in SSA, a new research and corporate structure and a new project-based mode of activities

in line with its new strategic plan, the Africa Rice Center is now strategically positioned to confront the challenges of the future. This bold vision is bolstered by the worldwide recognition of its achievements.

It is one of the biggest ironies of Africa, that when the Center was going through immense difficulties, having been uprooted from its headquarters because of the civil strife in Côte d'Ivoire in September 2002, it was also winning the highest accolades that any research institute can ever aspire for:

- High praises for NERICA from world leaders at the Tokyo International Conference on Africa's Development (TICAD) III, where NERICA emerged as a byword for successful Asia-Africa cooperation
- The Senegalese President's Science and Technology Award for the development and promotion of the ASI rice thresher
- Appreciation for the Center's courage during the Ivoirian crisis from the Council of Ministers at its 24th Session
- Recognition from the Côte d'Ivoire Government for the Center's efforts to alleviate hunger in the country
- The Côte d'Ivoire Government's honor to Dr Kouamé Miezan, a senior scientist, for his long service to rice research at WARDA
- CGIAR-wide praise for WARDA's spirit of resilience at the 2003 Annual General Meeting
- The selection of Dr Monty Jones as the 2004 World Food Prize co-winner for NERICA development, a breakthrough that he achieved at WARDA

Rice is grown and consumed in about 40 countries in Africa

The 2004 World Food Prize for NERICA is especially rewarding—a recognition to all those who have been involved in this work, especially the donors who have championed its cause from the beginning. In the article relating to this Prize, we hail Dr Jones' achievement and give an update on NERICA's spread in SSA.

Rice is an integral part of Africa, where it has been grown for more than 3000 years and has now become a commodity of strategic significance. The article *Celebrating the International Year of Rice in Africa* describes how important rice-growing countries in SSA geared up to pay homage to this important crop as part of the global celebration.

NERICA's growing popularity in East and Central Africa has increased the demand for collaboration from governments, regional organizations and even the private sector in these two regions.

Several important agreements were signed during the reporting period and the information on these is included in the chapter *Period in Review (May 2003 to April 2004)*.

A significant milestone for the CGIAR was the signing of a Memorandum of Understanding between the New Partnership for Africa's Development (NEPAD) and the CGIAR-supported Centers represented by WARDA Director General as 2004 Chair of the Center Directors Committee. This omnibus document provides political recognition for all CGIAR Centers with which NEPAD can work towards achieving the Millennium Development Goals.

Despite the high staff turnover at the Center because of the Ivoirian crisis, we are happy that a new crop of dynamic professionals has joined the WARDA family to carry forward the Center's exciting research work within the NEPAD framework.

Foremost among these was the arrival of Dr Shellemiah Keya, Assistant Director General, Research and Development, in January 2004. Dr Keya brought a wealth of experience to the job, with an impressive track record spanning over three decades of top-level research management and administration, university teaching, scientific publishing, and research consultancies. No stranger to the CGIAR, Dr Keya was the Executive Secretary to the CGIAR Technical Advisory Committee (TAC), from 1996 to 2000, and to the Interim Science Council (iSc) from 2001 to 2003. Before joining the CGIAR, he was the Vice-Chancellor of Moi University, Kenya, from 1988 to 1994.

The reporting period also saw the appointment of: Ousmane Youm (Assistant Director of Research, Program 1), Inoussa Akintayo (African Rice Initiative Coordinator), Moussa Sié (Lowland Rice Breeder), Samuel Bruce-Oliver (Executive Officer), Philippe Morant (Regional Coordinator for the Inland Valley Consortium), Mohamed Kebbeh (Sahel Production Economist), Sylvester Oikeh (Soil Fertility Agronomist), Patrick Kormawa (Policy Economist), Robert Carsky (Cropping Systems Agronomist) and Ed Sayegh (Interim Director of Corporate Services).

As we go to press, the tragic events of November 2004 in Bouaké, Côte d'Ivoire, have become branded in the individual and collective memories of the Center's staff and their families. One of our senior scientists, Dr Robert Carsky, was killed when a bomb struck the French barracks where he had sought shelter from air strikes. It is a tragic loss for the Center and for Africa where he had spent most of his professional life dedicated to agricultural research.

Prof. Richard S. Musangi, Chair, WARDA
Board of Trustees and
Dr Kanayo F. Nwanze, Director General

The Board, Management and staff expressed their deep sympathy to the Carsky family. The Board Vice Chair, Dr Ed Price, and the Assistant Director General for Corporate Services Mr Long T. Nguyen, represented WARDA at the memorial service in November 2004 in Washington DC, where Dr Price gave the eulogy for Bob.

The resurgence of the civil strife required the evacuation of internationally recruited and senior non-Ivoirian support staff from Côte d'Ivoire. The Board decided during an extraordinary meeting in December 2004 to relocate the Center's headquarters to Cotonou, Benin, in the facilities made available by the International Institute of Tropical Agriculture (IITA) and the Institut national de recherche agronomique du Bénin (INRAB). The Cotonou facilities fulfilled the Board's criterion that the management and staff from research, administration and finance departments should be in the same location for increased efficiency.

To give the stability needed for scientists to carry out their important research agenda, the Board in its last meeting has decided that the Center will operate from Cotonou with an initial planning horizon of 5 years during which the decision will be regularly reviewed.

The Center is not abandoning its Bouaké headquarters in Côte d'Ivoire. The offices, laboratories, field facilities and genebank at the headquarters remain intact. Activities in Côte d'Ivoire have been restricted to the maintenance of the genebank and the security at the Campus.

In spite of their traumatic experience in November 2004, our staff have settled down quickly in Cotonou, which has proven to be a safe haven for research. They are vigorously engaged in brainstorming, planning and doing research, thanks to the hospitality shown by the Government of Benin, IITA and INRAB.

We are very grateful to them and to our many friends, supporters and donors around the world who have continued to champion our cause and stood by us in our darkest moments. The spirit of the Center remains invincible, despite all the odds stacked against it.

As our new scientific breakthrough testifies, the Africa Rice Center with its partners will continue to mobilize advanced science to develop global public goods that benefit not only poor people but also the economy of the African countries.

Kanayo F. Nwanze
Director General

Richard S. Musangi
Chair, Board of Trustees

Positioning the Africa Rice Center to Address the Emerging Challenges in Sub-Saharan Africa

What kind of a future do we envision for the Africa Rice Center 10 years from now? What is its comparative advantage vis-a-vis its diverse partners in the new African agricultural R&D scenario? What strategic directions should the Center take to efficiently address the emerging challenges in sub-Saharan Africa (SSA) in order to build a better tomorrow for the millions of poor African farmers and consumers for whom rice means food?

Dr Shellemiah Keya, Assistant Director General, Research and Development

These were some of the key questions that WARDA, in consultation with its broad range of partners, had begun to address as part of the development process of its new strategic plan when the Ivoirian crisis broke out in 2002. Despite the perturbation of the relocation from the WARDA headquarters, the development of the strategic plan remained high on the Center's agenda.

To give a final shape to the Plan, an Institute-wide task force was formed, which brainstormed on the issues during a retreat in July 2003 in Bamako, Mali, and the new Strategic Plan (2003-2012) finally emerged. The Plan came into force after its endorsement by the Center's Board of Trustees in September 2003.

The dynamics of SSA's new agricultural research paradigm following the emergence of the Forum for Agricultural Research in Africa (FARA), the unanimous acceptance of the Millennium Development Goals (MDGs) as a reference point, the establishment of the New Partnership for Africa's Development (NEPAD) and the outcome of the World Summit on Sustainable Development (WSSD)—all contributed to the final shaping of the Plan.

The task force also took into consideration the Center's greatly increased involvement in all regions of SSA at the request of both the WARDA Council of Ministers and national agricultural research systems (NARS) across the sub-continent, and the evolution of CGIAR in SSA.

As you will see from the section on *Highlights of the New Strategic Plan (2003-2012)* in this report, the Center aims to accomplish synergistic efforts and outcomes, leveraging creatively its comparative advantage in close association with its partners. Partnership-based research for development, which continues to be at the heart of its mode of operation, ensures that the priorities of its NARS partners are aligned within WARDA's broad vision for the evolution of rice research systems in Africa over the next 10 years.

With the appointment of a new Assistant Director General for Research and Development (ADG-RD) and the development of the new Strategic Plan, the opportunity

was taken to revamp and streamline the Center's program structure to focus on two major challenges—(1) Integrated Rice Production Systems and (2) Rice Policy and Development.

The two programs are now headed each by an Assistant Director under the supervision of the ADG-RD. These two programs will function through eight projects with specific outputs and milestones within the Medium-Term Plan (MTP).

Program 1 comprises four projects that will focus on the development of stress-tolerant cultivars and agronomic practices that help to stabilize yields and improve sustainable productivity in the major rice ecologies in SSA and address the challenge posed by drought.

The projects under Program 2 investigate socioeconomic impact, policy and market dynamics; technologies and policies to mitigate the effects of pandemics (HIV/AIDS, malaria) and disasters (natural and manmade) on agriculture and rural communities in SSA; the sustainable development of the inland valley agro-ecosystems; and a better integration of networks for greater resource use efficiency.


Today food means rice for many Africans

As part of its new research agenda, the Center will reach out beyond its traditional partners to a broader range of actors involved 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.

In addition to the launching of the new Strategic Plan, the period 2003–2004 marked a significant strengthening of WARDA's research for development agenda, carried out at Bamako and at its regional stations in Nigeria and Senegal. Our scientists have been taking active part in all the Challenge Programs; the Center has been especially involved right from the beginning in the SSA Challenge Program.

As reported in the last Annual Report, the Center was able to ensure a safe storage of duplicates of its valuable genebank collection in risk-free zones. Its genebank operations have continued unabated despite the Ivoirian crisis.

The networks and consortia, such as the Réseau ouest et centre africain du riz (ROCARIZ), the Inland Valley Consortium (IVC), and the African Rice Initiative (ARI), convened by the Center have served as powerful allies during the crisis, maintaining the Center's momentum of continent-wide activities. Considered as the hub for capacity building in rice research and development for SSA, the Center is finalizing its new training strategy and procedures manual that will enable it to become even more efficient in this domain.

Manual rice threshing in Benin

The Center's *Research Days* to review and plan activities took place from 8 to 12 December 2003 in Bamako, Mali and was attended by two members of the Board of Trustees, in addition to WARDA Management and senior staff. Scientists from the Institut d'économie rurale (IER), Bamako-based ICRAF and ICRISAT teams also participated in the meeting.

The deliberations during the Research Days facilitated the development of the *MTP 2005–2007: Charting the Future of Rice in Africa* in line with the new Strategic Plan. Heralding a new project-based approach, the MTP was finalized in part through a priority setting exercise, which fully involved the Board, heads of NARS throughout SSA, regional and international NGOs, and a wide range of experts.

WARDA commissioned an internal task force to develop the priority setting methodology and approach and apply the method to prioritize research outputs and activities for the eight projects within the new MTP. As part of this exercise, a workshop was held involving representatives of donors and NARS in addition to WARDA staff.

The participants critically reviewed each project, project outputs and activities against a set of impact criteria developed based on WARDA's mission statement and the new strategic plan. Log-frame matrices were used in the new MTP to ensure the quality of project design.

Underpinning the MTP period and beyond are four key elements:

- Pursuit of coherence and excellence in core research areas
- Adaptation of the network-based model for research collaboration
- Enhancing the institutional capacity of national agricultural research and extension systems (NARES)
- Direct engagement with the rice development sector

Together, these build towards the Center's strategic goal to "significantly increase the quality, usefulness and availability of knowledge and technology within the rice sector to support and improve the well-being of the poor in Africa."

The exciting research stories featured in this Annual Report show clearly how the Center is making progress in attaining its strategic goal. The development of lowland NERICAs, a remarkable breakthrough; the growing demand for upland NERICAs in Eastern and Central Africa, exemplified by the NERICA boom in Uganda; and the exploration of new research areas with partners on the diversification of rice-based livelihoods, such as rice-fish and rice-vegetable farming—all these stories testify that the Center is truly expanding its traditional R&D horizon.

The celebration of the International Year of Rice in 2004, the selection of Dr Monty Jones as the 2004 World Food Prize co-laureate for NERICA, and high-level recognitions—such as the Senegal President's Award for the development and dissemination of the ASI rice thresher—conferred on the Center and its scientists during the reporting period, have given high visibility to rice and the Africa Rice Center.

ASI rice thresher adapted to African conditions by WARDA and its partners: a boon for farmers

The announcement by the African Development Bank to launch a NERICA dissemination project of more than $30 million in selected pilot countries of West Africa and the selection of NERICA as a priority technology for Africa-wide dissemination by NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) are further signs of the Center's capacity to develop relevant technologies for SSA.

These developments show that despite the crisis, the Center has reached higher levels of achievement in almost every aspect of its R&D activity, thanks to the power of partnership with NARS and the tremendous support of our many donors.

Armed with a new Strategic Plan and a new R&D structure that will enhance the relevance and impact of its research products and services, the Africa Rice Center is well positioned to address the emerging challenges in SSA relating to rice-based livelihoods.

Highlights of the New Strategic Plan (2003-2012)

Introduction

In line with its new pan-African vision, the Center launched in 2003 a new Strategic Plan that charts its course for the next 10 years. It helps position the Center to address the emerging challenges in SSA in association with its partners.

The Strategy will guide present and future efforts of the Center, within the Plan period, in providing technologies for improving the livelihoods of the millions of poor African farmers and consumers for whom rice means food.

Drawing on lessons learned through the implementation of the 1990-2000 Strategic Plan, the new Strategy re-examines the Center's priorities and relevance within the framework of the New Partnership for Africa's Development (NEPAD) and the CGIAR's vision and strategy for SSA.

It capitalizes on the Center's comparative advantages and seeks to integrate the Center's activities with those of the rice stakeholders in SSA to maximize output and efficiency and minimize transaction costs.

The Center embarked on the strategic planning exercise at the beginning of the millennium and went through an extensive consultation process with its partners. It took into consideration the inputs from the series of consultations between the West and Central African Council for Research and Development (WECARD/CORAF) and the CGIAR in the late 90s and early 2000.

It also took into account the dynamics of SSA's new agricultural research scenario following the emergence of the Forum for Agricultural Research in Africa (FARA) and the creation of the CGIAR Challenge Programs.

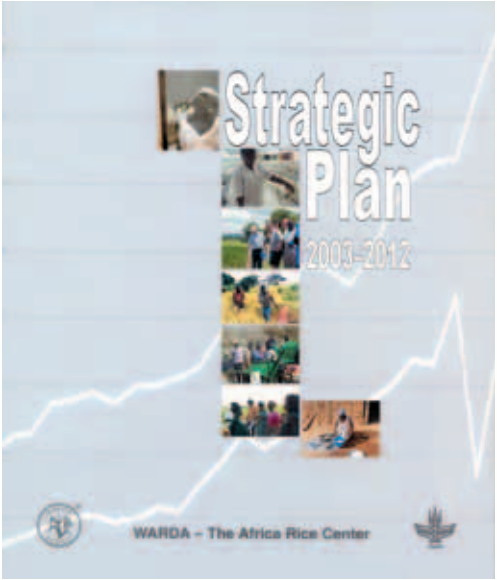
Mission and Vision for 2003–2012

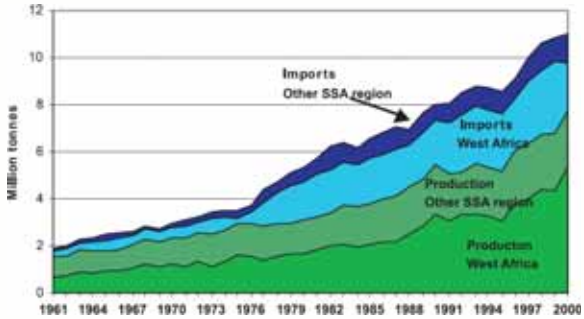
After going through a long gestation period that saw several versions, the new Strategy took final shape in 2003. It defined the Center's mission, vision and the strategic goal for 2003–2012:

Mission: 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.

Vision: Become a Center of Excellence, a leader in rice research and development as well as a hub in a region-wide network for collaborative research.

Strategic Goal: Significantly increase the quality, usefulness and availability of knowledge and technology within the rice sector to support and improve the well-being of the poor in Africa.





Rice production and imports in SSA and West Africa
Source: FAO

Context and Challenge

Since the mid-1970s, the consumption of rice in West and Central Africa (WCA), and to a lesser extent in SSA as a whole, has increased dramatically. Regional rice production has also increased but to a lesser extent. As a result, WCA—one of the most impoverished region in the world—has become increasingly dependent on the world market for one of its staple foods.

The challenge for the Center is to overcome the major constraints to rice production in SSA:

- Low productivity and sustainability of rice
- Poor quality of the marketed product
- Unfavorable market and policy environment

The research challenge is aggravated by the high level of diversity that characterizes both the natural environment and agricultural production systems in the region. The need for emphasis on the postharvest and policy aspects also adds a complex dimension.

Main Elements of the New Strategy

To address the research challenge and achieve the new strategic goal, the Center will:

1. Pursue coherence and excellence in core research areas
2. Adapt the network-based model for research collaboration
3. Enhance the institutional capacities of NARS
4. Engage directly with the 'rice development sector'

Core Research Areas

The Strategy for 2003–2012 refocuses and streamlines the Center's research programs into two major areas: (1) development of components for integrated rice production systems, and (2) rice policy and development.

1. Integrated Rice Production Systems

The major rice-growing ecologies in SSA comprise rainfed uplands, rainfed lowlands and irrigated systems. The Strategy emphasizes the development of components for integrated rice production systems for greater resource use efficiency.

Activities under this program will seek to:

- Improve resource use efficiency for more productive, profitable, and socio-economically viable rice production systems in SSA
- Develop stress-tolerant rice varieties and agronomic practices that best fit or better optimize existing production systems in SSA and are acceptable to both producers and consumers

2. Rice Policy and Development

Based on the Center's successful experience, the Strategy highlights the importance of participatory R&D approaches, appropriate policy and market environment for the rapid uptake of improved technologies. It also focuses on the need for impact assessment in the rice sector on productivity, profitability and poverty.

The thrust of this program is to:

- Build strategies for competitive rice sector development in SSA through a better understanding of rice policy and market dynamics
- Assess the impact of technical, policy and institutional change within the rice sector

Implementing through Projects

These two programs will function through a limited number of well-focused projects with specific outputs and milestones within the 3-year rolling Medium-Term Plans (MTP).

The production system-based approach will seek to:

- Stabilize the fragile natural-resource base of upland systems
- Intensify and diversify rainfed lowlands
- Improve resource use efficiency in irrigated systems through integrated crop management approaches

Constraints such as unstable policy environment, poor R&D linkages and limited market integration cut across production systems and will be addressed through an integrated approach.

Research Collaboration and Capacity Building

Owing largely to the Center's unique origin as an association of African member states, partnership is at the heart of the Center's *modus operandi*. The Center aims to enhance the institutional capacity of NARES by extending its highly successful R&D network model to other rice-producing areas of Africa.

Engagement with the Rice Development Sector

As part of its new research agenda, the Center will reach 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 NGOs and the private sector.

It will explore the creation of a self-sustaining subsidiary through public–private dialog that would provide support to farmers and small businesses within farming communities.

Capitalizing on Achievements and Technological Advances

The Center will build on its R&D successes, such as the NERICA breakthroughs for both upland and lowland ecologies; high-yielding varieties for the Sahel; the ASI rice thresher; integrated crop management strategy; farmer-participatory approaches; efficient rice germplasm distribution in SSA; and policy strategy to revive the rice sector in Nigeria.

It will draw upon its valuable rice germplasm collection, accumulated databases and research results and the enhanced capacity of NARS in SSA. It will also efficiently exploit the new opportunities offered by advances in biotechnology, GIS, modeling, information and computing technologies.

Research Priority Setting

To achieve its goal over the coming decade, the Center will address those priority areas where (i) it has or could have a comparative advantage; and (ii) it can have rapid and substantial impact. It will place emphasis on those countries where substantial impact can be achieved in 5–10 years, with a plan to scale up to other countries in the region.

The Center and its NARS partners will periodically conduct priority-setting exercises by country to revisit and coordinate research strategies.

Financing the Strategic Plan

To create an efficient financial environment for achieving the Center's strategic goal, the Center will concentrate on three main areas:

- Full cost recovery of expenditures
- Targeting innovative avenues for income generation
- Significant cash surplus and reserve to ensure financial stability and sustainability

Conclusion

The new Strategic Plan represents both continuity and change. The Center will continue to:

- Focus primarily on rice with priority on WCA
- Develop new germplasm and complementary technologies
- Address key constraints in the major rice production systems
- Use the network model for regional rice research collaboration
- Work in partnership with research institutes throughout the world

At the same time, in opening new ground, the Center will:

- Focus on an integrated production systems approach
- Expand activities into eastern, Central and southern Africa
- Emphasize more postharvest, policy and institutional issues
- Engage directly in the rice development sector
- Maximize the judicious use of biotechnology

This combined strategy will enable the Center, working in partnership, to make a significant contribution to the attainment of the Millennium Development Goals (MDG) and poverty reduction targets of NEPAD in SSA.

A growing concern: sub-Saharan Africa's heavy dependence on imported rice

Breaking Story

Going Beyond the Upland NERICA: Another New Rice for Africa is Born

Power of effective networking: the ROCARIZ network played a central role in the development of the new rice for lowlands

In contrast to NERICA, which was designed for the upland (rainfed) rice ecology in SSA, the new rice has 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, which has already got farmers' stamp of approval, is expected to make an even bigger impact than the NERICA.

Let's call this product *the New Rice for African Lowlands,* until it is officially christened. It was developed in close partnership with the national programs in West Africa.

The Uniqueness of Africa for Rice

There's a special reason why Africa has become the hotspot for developing new rice plants and why the Africa Rice Center is in the vanguard of this development.

Africa is the only continent, where the two species of cultivated rice are grown—*Oryza glaberrima* (African rice) and *Oryza sativa* (Asian rice).

It is a boon for the Africa Rice Center to be located in the region where the African rice originated about 3500 years ago. This gives its scientists a unique opportunity to exploit the biodiversity that this center of origin offers.

NERICA—the Technology versus NERICA—the Product

NERICA is more than just a product; it's a technological process, which has opened up a world of opportunities for scientists to develop hundreds of rice varieties suitable for various niche ecologies.

The NERICA technology refers to the successful crossing by researchers from the Africa Rice Center of the two species of cultivated rice to produce plants (known as interspecifics) that combine the best traits of both parents: high yields from the Asian parent and the ability to thrive in harsh environments from the African parent. The NERICA name was trademarked in 2004.

Through the crossing of the two rice species, the NERICA technology gives researchers access to new genetic combinations. Indeed, a major spin-off of the NERICA technology is the incredible diversity it has generated, releasing genes previously unavailable to the rice world.

At the Africa Rice Center, rice breeders are using the NERICA technology to go beyond the present NERICA product, which has been a remarkable breakthrough for upland rice ecologies, but has had little impact in the lowland and irrigated ecologies. The NERICA technology is thus spilling over into research for developing suitable rice plants for high-impact ecologies.

In the same way as for NERICA, developing the *New Rice for African Lowlands* posed a formidable scientific challenge because it is exceedingly difficult to produce viable offspring by crossing the two rice species, since they are generally incompatible.

Constraints and Opportunities of Lowland Ecologies

The upland or dryland ecology, where rainfed rice is grown without standing water, was rightly the initial focus of the Africa Rice Center, because it represents about 40% of the total area under rice cultivation in West and Central Africa—the rice belt of Africa—and employs about 70% of the region's rice farmers. But it's potential is limited compared to that of lowland and irrigated ecologies.

The lowlands—where rice is grown in bunded fields that are flooded for at least part of the growing season—are more fertile than the uplands and have the added advantage of providing opportunities for irrigation. In West and Central Africa, lowlands account for about 30% of the area under rice cultivation. They are often suited to cropping intensification, with the possibility of growing two or more crops per year. Rice thus becomes economically a more valuable crop.


African lowlands: one of the most complex rice ecologies in the world

In West Africa alone, the lowlands represent about 20–50 million hectares, depending on the definition used, of which only about 10–20% are now under cultivation. If only 2 million hectares of this area is grown to rice, producing an average yield of 3 t per hectare, West Africa could easily stop its costly rice imports. The lowlands, therefore, offer great potential for the sustainable expansion and intensification of rice and can help to feed the growing population in the region.

However, with high potential comes high risk. The biggest of the challenges is that the lowlands in the region are not of one kind; they are very heterogenous. So it is very difficult for researchers to develop a rice variety that would be suitable for all lowlands. Lowlands are in fact a combination of both upland and irrigated rice ecologies.

The other major challenges are lack of water control, iron toxicity, weeds, and highly destructive diseases and pests, such as the rice yellow mottle virus (RYMV), the African rice gall midge (AfRGM), stemborers and nematodes, among others. Labor constraints for weeding is another important problem for poor farmers.

Rice producers and scientists have been constantly in search of rice varieties that can withstand these stresses and produce stable and high yields. Yields from traditional rice varieties in this ecology are low, usually less than 1.5 t per ha or around 40% of the world average.

Search for a Robust Rice for African Lowlands

Networks and farmers show the way

A striking feature of the research-for-development work in the Africa Rice Center is the seamless integration between the activities carried out by scientists from the Center and those from the national programs with support from the Center-coordinated networks, such as the Réseau ouest et centre africain du riz (ROCARIZ), International Network for the Genetic Evaluation of Rice (INGER-Africa) and Inland Valley Consortium (IVC). This integrated work brings out a great synergy that leads to remarkable results.

The other striking feature is that the Center scientists are ever willing to learn from farmers' practices and experience and incorporate traditional wisdom into their research. This approach has been a major factor in the success of upland NERICAs.

Assessing the needs of rice farmers, many of whom are women, is the first step in plant breeding

The research work on lowland rice carried out by Dr Moussa Sié, Lowland Breeder at the Africa Rice Center, in association with his partners, perfectly epitomizes these two approaches. As Associate Scientist (1994–97) and Visiting Scientist (1998–99) at the Center's Research Station in Senegal, Dr Sié was actively involved in the breeding process of the new plant type under Dr Kouamé Miezan, Leader of the Irrigated Rice Program.

On his return to Burkina Faso, he maintained close collaboration with the Center's Irrigated Rice Program and continued to actively pursue the work on the new plant type for lowlands as Head of the Rice Improvement Division at the Institut de l'environnement et des recherches agricoles (INERA), Burkina Faso. He was keen to improve the productivity of the lowland ecology, because 70% of the area under rice in the country is grown on lowlands, but it accounts for only 48% of rice production. The project was carried out with support from ROCARIZ from 2000 until 2003 when he joined the Africa Rice Center as a Principal Scientist.

As part of his research on lowland rice varieties, Dr Sié has been keenly studying farmers' process of selecting rice varieties. "Farmers know very well which variety to use, when and where to use it," he said. "They don't necessarily go in for just high-yielding varieties, what they prefer are robust varieties."

Traveling across Burkina Faso to evaluate rice varieties that are well adapted to African conditions, he collected over 600 traditional varieties, including about 50 varieties belonging to the African rice species. It was during this period that he developed a great fascination for the African rice, which was fast losing ground to the Asian species, because of its low yield and problems of lodging (falling over).

Like Dr Monty Jones, *Father of NERICA*, he was struck by the higher capacity of the indigenous varieties to tolerate stresses than those of the more productive but susceptible Asian species. He also took note of the fact that the African rice was appreciated by the rural Africans for its taste. "Unfortunately until the Africa Rice Center focused on improving it, scientists during the colonial period in West Africa, had deliberately neglected it," he remarked.

Charting a New Course

Most of the traditional lowland rice varieties grown in the region have a narrow genetic base, which leads to their vulnerability to diseases and pests. Some of the stresses, such as AfRGM and RYMV are spreading fast in the region because of the predominant cultivation of susceptible rice varieties. The main objective of Dr Sié and his partners was, therefore, to tap into the African rice for traits of resistance to major stresses, especially RYMV, in order to intensify lowland rice cropping.

RYMV is a major scourge of lowland rice and can sometimes lead to total crop failure, contributing to famine in areas where rice is an important food staple. It is indigenous to Africa. Interestingly, some varieties of the African rice have been found to be immune to RYMV. Therefore, the scientists focused on crossing specific varieties of the African rice that were known for their resistance to RYMV with popular—but susceptible—Asian rice varieties.

The other difference was in the selection of the Asian rice varieties for the crossing. The Asian rice *O. sativa* has two main strains, *japonica* (traditional rainfed or 'upland' rice and *indica* (traditional irrigated or 'lowland' rice). In the creation of NERICA, *japonica* varieties were used in the crosses, while for developing the new lowland rice, the *indica* varieties were used.

Evaluating the new rice for its adaptation to lowland ecology

The *New Rice for African Lowlands* is Born

As can be envisaged, the initial problem was hybrid sterility (infertile offspring of the crosses), because the two rice species have evolved separately over millennia and are so different that often attempts to cross them do not lead to reliable variety development. "This problem is greater when we cross *indica* than with *japonica*," Dr Sié explained. The sterility blockage was overcome by backcrossing (crossing the hybrid to *O. sativa* to restore fertility).

Some of the progeny combined the best features of both parents: the droopy leaves and vigorous early growth (associated with weed-competitiveness) typical of the African rice and the high number of spikelets (indicating productivity) of the Asian rice.

A major scientific milestone was achieved when the screening for resistance to RYMV under artificial infestation showed that the crosses had successfully transferred resistance to RYMV into some of the progeny.

A new plant type with high potential for lowlands was now available, endowed with resistance to local stresses, particularly the dreaded RYMV. But it still needed to be evaluated by scientists in multilocational trials on station and by its ultimate judges, the rice farmers under their conditions.

Evaluating the New Plant Type

Scientists' Verdict

In Burkina Faso, about 500 lines belonging to the new plant type were tested in the lowlands of Banfora research station for 3 years from 2000 to 2002. Their overall agronomic performance was examined to determine their adaptability to lowland conditions based on a set of criteria including their resistance to insects, diseases and fluctuations in water control. At the end of 3 years of testing in Banfora, about 20 of the most promising lines were selected.

Lines of the new plant type were also evaluated in important rice-growing countries in West Africa—Mali, Burkina Faso, Togo, and Senegal—as part of a regional evaluation process with support from ROCARIZ. A multinational team of scientists from the region accompanied by the ROCARIZ Coordinator visited these countries and jointly selected over 70 promising lines.

The three most preferred lines of the new plant type were: WAS 122-IDSA-1-WAS-B-FKR-B-1, WAS 122-IDSA-1-WAS-2-FKR-B-1, WAS 122-IDSA-1-WAS-6-1-FKR-B-1. With a yield potential of 6–7 t per ha, good tillering ability, growth duration of 120 days and acceptable plant height, all the three varieties showed good resistance to major lowland stresses. The varieties also responded well to nitrogen fertilizer application.

"The shuttle-breeding approach between the Center and the national programs, which was adopted in the development of the new plant type was very successful," explained Dr Miezan, who was involved in evaluating the new lines under irrigated systems as part of the shuttle-breeding process. "The breeding material was shuttled back and forth among scientists to evaluate it under different conditions, which not only helped accelerate the selection process and increase its efficiency, but also helped achieve wide adaptability."

The on-station evaluation confirmed the hypothesis that the progeny of *O. glaberrima* and *O. sativa* subspecies *indica* is better adapted to lowland and irrigated rice, while that of *O. glaberrima* and *O. sativa* subspecies *japonica* is more suitable for rainfed rice.

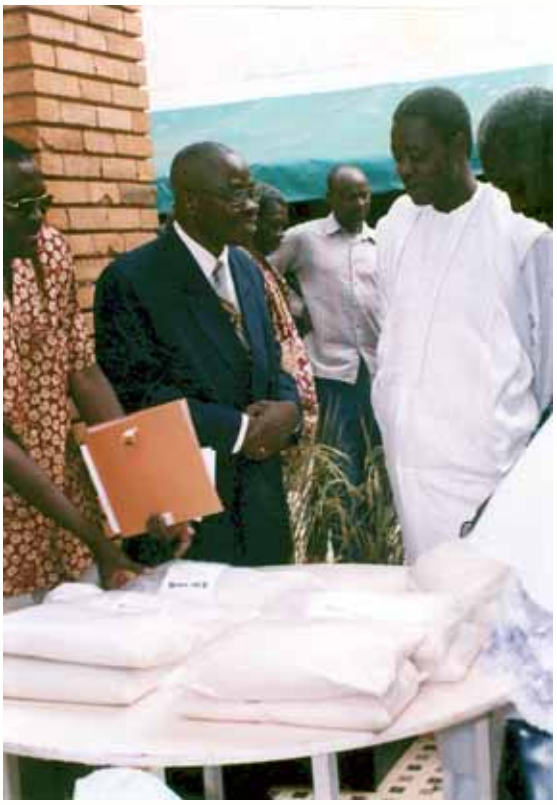
Farmers' Verdict

Following WARDA's extremely successful model of accelerating the development and dissemination of NERICA through farmer participatory methods, Dr Sié adopted a similar method for the new plant type for lowlands. This exercise was done to allow farmers to choose varieties that meet their needs and obtain feedback from them regarding their preferences for plant and grain characters, which would help speed up the fine-tuning, adoption and dissemination of the new material.

In the lowlands of Badini, Burkina Faso, over 550 farmers of which 80% were women, were invited at different phases of the plant's development to evaluate about 45 varieties including 18 belonging to the new plant type as part of participatory varietal selection (PVS), with the help of the Departments of Agriculture, Water and Wind Resources (DRAHRH).

Farmers' acceptance of the new lowland rice, evaluated through the participatory varietal selection (PVS) approach

The PVS exercise showed clearly that men and women farmers use different criteria to evaluate varieties. For instance, men gave importance to short growth duration and plant height, whereas women preferred traits such as good emergence, seedling vigor and droopy leaves that indicate weed competitiveness, since they are mostly involved in sowing and weeding operations.



Dr Moussa Sié (2nd from left), WARDA Lowland Rice Breeder, with the present Chair of WARDA Council of Ministers Prof Laya Sawadogo, Minister of Secondary and Higher Education and Scientific Research, Burkina Faso (right) at a display of lowland rice samples

This exercise was very decisive for Dr Sié's research; he experienced one of his greatest moments of fulfillment when the farmers chose six of the varieties belonging to the *New Rice for African Lowlands.* "The development of this new rice type for lowlands and farmers' positive response to them mark an important advance in R&D achievements of the Africa Rice Center," Dr Sié observed.

Future Outlook

However, a plant breeder's work is never completely over. The promising varieties chosen by researchers and farmers will be further subjected to on-station and on-farm multilocational and regional evaluations through networks and PVS trials in close collaboration with national programs—a partnership-based approach that is a hallmark of the Africa Rice Center.

The *New Rice for African Lowlands* offers a powerful new weapon for rice farmers in their management of lowland stresses. However, to be most effective, it should be used as part of the integrated crop management approach (ICM) developed by the Center's irrigated rice team under the leadership of Dr Miezan. The ICM package includes improved fertilizer, weed, and water management, efficient post-harvest technologies, and decision-making tools, in addition to improved varieties.

Meanwhile, molecular tools, such as marker-assisted selection will be used to make the development of the new plant types more efficient in time and effort. Work will continue on the development of suitable lowland varieties, both interspecific (crosses between the two cultivated species of rice) and intraspecific (crosses within the species, i.e., between *O. sativa* varieties), that is being carried out by other scientists of the Center. The Africa Rice Center will continue to collaborate with national, international and advanced research institutes, adopting an approach that will help integrate different activities in this area and avoid duplication.

"We are delighted that our prophetic vision is coming true and another amazing breakthrough has been achieved, thanks to the initiative taken by our scientists and the valuable contribution of the national programs," Director General Dr Kanayo F. Nwanze commented. "The lowlands are indeed the most promising environments for rice expansion in Africa and the *New Rice for African Lowlands*, within a sustainable and diversified land use systems approach, has a high potential for transforming the prospects for food security in the region."

As we go to press, four varieties of the new rice for lowlands, now officially known as the *Lowland NERICAs*, have been released in Burkina Faso and two in Mali.

Enabling Successful Livelihood Diversification for the Rural and Urban Poor in Sub-Saharan Africa

Women are closely involved in vegetable cultivation and sale in sub-Saharan Africa

A dynamic rice-based agriculture in Africa will depend on successful diversification into high-value commodities, such as vegetables and fish. The Africa Rice Center is exploring these new R&D paradigms with its partners, in line with its Strategic Plan's emphasis on increasing resource use efficiency for more productive, profitable and socio-economically viable rice-based production systems.

The rationale for diversification is simple. By adopting rice-vegetable and rice-fish systems, farmers can diversify their source of income, improve their nutrition, create new marketing opportunities and reduce production risks.

Diversification can also help increase resource-use efficiency and the sustainability of the system by breaking the negative soil, nutrient, water use and pest buildup trends associated with continuous rice cultivation.

Promoting Integrated Rice-vegetable System in West Africa

Vegetables are the most affordable and sustainable source of micronutrients in diets and could, therefore, play a vital role in SSA, where it is estimated that vitamin and mineral deficiencies are costing the region's economy more than $2.3 billion in lost productivity.

Vegetables are increasingly being grown in and around large cities in the region, since there is a great demand for fresh foodstuffs from the urban population. In SSA, where although some 70% of the population still live and work in rural areas, the average annual urban growth rate is 3.5% per year—the highest in the world.

Traditionally, rice farmers in the region produce, apart from rice, a range of different crops, including vegetables. "Vegetables are now an integral part of the rice-based production systems in West Africa," said Dr Virginie Levasseur, Vegetable Agronomist, who is leading the World Vegetable Center (AVRDC)-Africa Rice Center collaborative project on the *Promotion of Superior Vegetable Cultivars in West Africa*.

Citing the example of the Office du Niger in Mali—one of the largest irrigation schemes in SSA—where rice production has diversified and farmers have started supplementing their income by growing vegetables in the rice fields in the dry season, she said, "Up to one third of the rice farmers' income comes from vegetable farming."

The collaborative project, which began operating from 2003, lays emphasis on integrating vegetables into rice-based farming systems. This fits in well with the Center's new production-system based strategy for the sustainable intensification and diversification of the lowland ecology, in particular the inland valleys and peri-urban rice-based systems in the region.

The inland valley lowlands have great potential for agriculture because of their fertile soils and the relative abundance of water. The valley bottoms are generally used for rice in the wet season and for vegetable crops in the dry season with residual moisture or supplementary irrigation.

Vegetable farming is generally a women's activity, which helps them earn money and increase the food security of their families. Women cultivate traditional vegetables such as local spinach, local eggplant, okra, and exotic vegetables such as hot peppers, tomatoes and onions. However, vegetable production and availability in West Africa are amongst the lowest in the world.

According to the initial surveys conducted by the joint project to identify constraints to vegetable production and marketing in integrated rice-vegetable systems in West Africa, it was found that farmers use low-yielding vegetable varieties that are susceptible to insect pests, diseases and to extreme agroecological conditions.

Among the other important constraints are the poor quality of seeds used, low availability of inputs for vegetable production and inadequate infrastructure for conservation, processing and transport, which leads to severe post-harvest losses. Lack of qualified researchers and extension agents in the vegetable sector is another bottleneck.

The project's priorities include:

- A better understanding of the interactions between rice and vegetable production and the opportunities for improvement
- Development of improved varieties and promotion of indigenous vegetables
- Improvement of small-scale vegetable seed production systems
- Training and information dissemination

Vegetables are increasingly grown in and around cities in sub-Saharan Africa

One of the initial activities of the project was a joint workshop on *Planning for Vegetable Research and Development in West Africa* in Bamako, in March 2004, which was attended by representatives from nine West African countries.

Joint missions have been carried out in target countries to make contacts with concerned people in this area and explore possibilities of collaboration. "This has enabled us to have an interdisciplinary understanding of the integrated rice-vegetable systems," said Dr Levasseur.

Partners of the project include the national research and extension systems of target countries in West Africa, the African Network for Horticulture Development (RADHORT), vegetable producers and processors. The Africa Rice Center-convened Inland Valley Consortium (IVC) serves as an entry point for the project in the region.

Exploring the Potential of Rice-fish Farming for West Africa

Water and cultivable land are getting more and more scarce around the world, particularly in drought-prone West Africa. One way to use these resources more efficiently is to integrate agriculture and aquaculture.

For instance rice-fish farming, which has been quite successfully practiced for centuries in Asia, offers farmers more than just fish as an extra farm crop. By promoting species diversification and nutrient recycling, it increases the productivity of land and water resources. It also contributes to the sustainability of inland capture fisheries, which are globally threatened.

Integrated rice-fish farming: efficient use of land and water resources

In this system, rice and fish are grown together either on the same plot or on adjacent plots and the by-products of one are used as inputs by the other. The fish provide a high-protein *bonus* crop to the rice farmer as well as additional fertilizer to the field.

Overall rice yields increase, fish enrich family diets, farmers' incomes rise and soils become more fertile. It has been found that efficient rice-fish farming systems can result in net incomes that are 7–65% higher than for rice monoculture.

The Africa Rice Center believes that there is enormous scope for the integrated rice-fish farming system in SSA, where it could lead to improved income, nutrition and food security for poor farmers and consumers. The system could help break the downward spiral of falling food production and declining soil fertility that plagues the region.

The Africa Rice Center-convened IVC, which serves as a platform for regional cooperation to develop technologies and operational support systems for intensified but sustainable use of inland valleys in SSA, is well positioned to take up the R&D activities in this area, in close collaboration with national and international partners. IVC is a system-wide initiative of the CGIAR.

IVC started exploring the potential of rice-fish farming for West Africa when it organized, in partnership with the Food and Agriculture Organization of the United Nations (FAO), a workshop on integrated irrigation and aquaculture (IIA) for West Africa, in November 2003 in Bamako, Mali. Thirty representatives from 10 West African countries participated in the workshop, which had Resource Persons from several international and national institutes.

The workshop was timely as the Consortium is participating in the project on *Community-based Fish Culture in Irrigation Systems and Seasonal Floodplains* within the Challenge Program on Water and Food. The project aims to enhance the productivity of seasonal floodwaters of large rivers by integrating community-based fish production into existing floodplain and irrigation systems.

Apart from developing technical options for integrating fish and other living aquatic resources into seasonal floodplains and irrigation systems, the project will explore institutional arrangements so that all stakeholders can equitably share the profits of this system. A major component of the project is to improve the capacity of national research and extension systems in this field.

The target areas of the project are the floodplains and deltaic lowlands of the Indus-Ganges, Mekong and Niger rivers. During the rainy season, floods prevent the use of land in the river floodplains and deltaic lowlands for crop production for several months every year.

The WorldFish Center has found that parts of these floodwater areas can be enclosed to produce a profitable crop of specifically stocked aquatic organisms, in addition to the naturally occurring 'wild' species that are traditionally fished.

This new approach was successfully introduced in Bangladesh and Vietnam, where fenced areas were stocked with fish during the flood season, while the same land was cultivated with rice during the dry season. Fish production from the fenced floodplain areas increased at least two- to ten-fold over the natural catch. Harvests from fish were sold on the market producing cash returns that was shared among group members.

The underlying assumption of this approach is that all stakeholders can communally manage seasonal water bodies under equitable and sustainable-sharing arrangements. However, the success of this approach depends on many variables, including prevailing social and economic conditions and is, therefore, highly site-specific.

Through the Niger River basin component of the project, this approach will be introduced to SSA for the first time. If it proves successful in Mali, it can be extrapolated to deepwater rice areas in Senegal, Nigeria, Guinea, Sierra Leone and Côte d'Ivoire.

IVC is responsible for the project component relating to the floodplains of the Niger River in Mali. It will coordinate the R&D activities of this component in association with Dr Ousmane Diallo, Head of Research on Aquatic Resources, Institut d'économie rurale (IER).

Fish enrich family diets and increase rural income

"We have already decided that the research site will be around Mopti, in Mali, where the largest floating rice ecology in this area is found," said Dr Paul Kiepe, IVC Scientific Coordinator.

In addition to IVC and IER, the project partners for the Mali component include the WorldFish Center (lead center for the overall project) and the International Food Policy Research Institute (IFPRI). The launching workshop is planned to be held in early 2005.

The Growing NERICA Boom in Uganda

NERICA gets off to a flying start in Uganda thanks to successful public-private partnerships

Rice is a relatively new crop in East Africa. According to FAO, the region produces less than 0.4% of the world's total rice output. It is, therefore, all the more surprising, that within 3 years of its introduction in Uganda, NERICA has got off to a flying start in the country.

Thanks to successful public-private partnerships among the national program, NGOs, seed companies and farmers, more than 10 000 hectares are under NERICA cultivation. NERICA's success story in Uganda serves as a new model for its adoption in East Africa where rice is perceived more as a commercial product than a food crop.

In 2002, when a NERICA variety was released in Uganda by two independent sources, the National Agricultural Research Organisation (NARO) and the NASECO seed company, under two different names—NARIC 3 (NARO) and SUPARICA 2 (NASECO)—no one could have foreseen the amazing rice boom that it sparked off in the country, where rice farming was neither traditional nor popular.

NERICA has become so popular in certain areas of Uganda that some farmers are even abandoning tobacco—the country's second largest cash crop—to grow it. A team from the Africa Rice Center that visited Uganda in February 2004 reported NERICA yields of up to 4–5 t per ha in farmers' fields. One of the major attractions of NERICA for the Ugandan Government, rice farmers and traders is its short duration (90–110 days).

In January 2004, the Vice President Prof. Gilbert Bukenya initiated a NERICA-based rice initiative as part of Uganda's poverty eradication campaign. "He was impressed by its performance in the war-devastated Gulu district, where an NGO called Hunger Alert was helping the war-displaced people to grow it," stated former WARDA/IITA Research Assistant Robert Anyang, who has been closely associated with NERICA introduction and dissemination in Uganda.

President Yoweri Museveni officially launched the initiative in March 2004, in the Vice President's farm in Wakiso district. NERICA seeds were distributed to representatives of farmers' groups from 11 districts. The initiative will be eventually expanded to cover many more districts. It will include a housing mortgage scheme, which will allow farmers to buy houses using their rice harvests as mortgage.

An important factor for the Government's promotion of upland rice varieties is its concern to save the fragile wetland ecology of the country from further damage caused by paddy rice production. Cultivation of upland rice varieties, such as NERICA, offers an attractive and sustainable alternative.

"Uganda is clearly poised to become as big a success story for NERICA in East Africa as Guinea is for West Africa," stated Africa Rice Center Director General Dr Kanayo F. Nwanze. "However, the pattern of NERICA uptake in Uganda is quite different from that of Guinea, because in Uganda, rice is considered a commercial product rather than a food crop, in contrast to West Africa."

A survey covering several hundred rice farmers in five districts, conducted by the Head of the Cereals Programme, Namulonge Agricultural and Animal Research Institute, Dr George Bigirwa and his partners, to find out the potential of upland rice varieties in Uganda confirms this view. The survey revealed that rice is grown by Ugandan farmers mainly for cash. Nearly all the farmers said they were hoping to rely on it as a source of income in the coming years.

Rice is now widely grown in many parts of the country, especially in the eastern and northern regions. Domestic rice production has not been able to keep up with the demand, which is growing because of rapid urbanization and changing food habits. Uganda resorts to about $90 million-rice imports (the third largest import in the country) every year to meet the demand.

Rice in East Africa is perceived more as a commercial product than a food crop

The Government is, therefore, keen to increase local rice production and reduce imports. The release of NERICA in Uganda has thus come at an opportune moment. The Vice President is convinced that poor people in Uganda can get out of the poverty trap by growing the variety. According to him, by planting NERICA only on one hectare, a farmer can obtain up to 4 t of rice per season and sell it at sh400 (US $0.2296) per kg.

The New Vision, a leading daily of Uganda, reports a trader stating that the new variety has a good market. "A kilogramme goes for between sh800–900 wholesale and sh1000 retail." It cites a farmer who was wonderstruck when he was paid sh1.6 million (about US $900) for his first harvest of NERICA grown on less than a hectare. "They told me that I would get a lot of money but I didn't think that it would be this much. I still have a few sacks at home which my family can consume," the farmer exclaimed.

NERICA's potential as a cash crop has quickly captured the attention of Uganda's seed companies. "The NASECO Seed Company, for example, has been part of the rice success story in the country right from the beginning," commented Robert Anyang. "It continues to be closely involved in the marketing of SUPARICA 2 seed, having sold about 100 t in 2002, 158 t in 2003 and 205 t in 2004."

The two NGOs—Sasakawa-Global 2000 and the USAID-funded Investment in Developing Export Agriculture (IDEA) project of the Agribusiness Development Centre (ADC)—that have played a pivotal role in the NERICA dissemination in Uganda, purchased breeder seed from the NASECO seed company for formal seed multiplication during the initial promotion of the variety in the country. They also promoted informal seed multiplication using farmers as seed producers.

NERICA's growing popularity in Uganda is drawing rice breeders from Kenya to visit the country to familiarize themselves with the new upland varieties; Uganda's climatic conditions are similar to those of western Kenya.

NERICA's potential as a cash crop captures the attention of private seed companies in Uganda

Following the successful introduction of NERICA in the country, NARO and the other rice stakeholders were very keen to collaborate with the Africa Rice Center. A Memorandum of Understanding (MoU) was signed between the Center and NARO in October 2003 to facilitate joint activities on rice R&D, exchange of germplasm and information, and capacity building.

As a follow-up to the MoU, exchange visits by scientists have taken place in 2004. A workshop to assist NARO design a long-term proposal on rice research and development strategy for Uganda was held in February 2004 at NARO headquarters. The workshop was attended by a team from the Africa Rice Center and representatives of all the major rice stakeholders in the country, including Japan International Cooperation Agency (JICA) and Sasakawa-Global 2000.

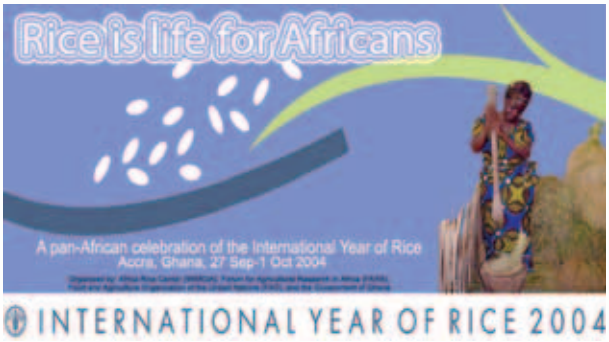
Participants discussed issues relating to rice research, seed, processing, marketing and training. The respective roles of NARO and the other stakeholders in the rice sector, i.e., farmers, seed companies, rice millers, NGOs, extension agencies and policymakers were also delineated.

To maintain the NERICA momentum in Uganda, the Africa Rice Center plans to provide a wider pool of rice germplasm for upland, lowland, and irrigated ecologies so that promising material for the country can be identified.

The workshop also found that there was a good opportunity to introduce the ASI rice thresher that has been so successfully fine-tuned and adapted to several countries in West Africa by the Africa Rice Center in association with local partners.

Speaking of the importance of the Center's future collaboration with Uganda, Dr Nwanze said, "In Eastern Africa, Uganda is our entry point by virtue of the comprehensive work-plan we have engaged in with the Ministry of Agriculture, NARO, NGOs, private seed companies and the sub-regional organization—the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), based in Entebbe."

Celebrating the International Year of Rice in Africa



Rice is a staple food and lifeline for more than half the world's population. Almost a billion households in Asia, Africa and the Americas depend on rice-based production systems for their main source of livelihood. Today, rice is the most rapidly growing food source in Africa.

The United Nations General Assembly (UNGA) designated 2004 as the International Year of Rice (IYR). The Africa Rice Center—dedicated to research and development activities on rice for Africa—led the IYR celebration in sub-Saharan Africa in collaboration with its partners.

The dedication of an International Year to a single crop is rare in the history of UNGA. But rice is worthy of this distinction, because it has a major influence on food security and human nutrition throughout the world.

However, rice is more than just a source of nutrition and livelihood. It is woven into the culture and way of life of millions of people. It has been shaping mythologies, customs, festivals and cuisine over the centuries. Therefore, the theme chosen for the IYR was *Rice is Life*.

The IYR theme recognized the special relationship that links people to this vital crop. IYR celebrations highlighted the central role that rice plays in agriculture, food security, the environment and culture.

The Food and Agriculture Organization of the United Nations (FAO) was the lead agency for the implementation of the global IYR vision in collaboration with the United Nations Development Programme (UNDP), national programs, NGOs, the private sector and CGIAR.

CGIAR Centers, such as the International Rice Research Institute (IRRI), Centro Internacional de Agricultura Tropical (CIAT) and the Africa Rice Center have developed improved rice technologies for more than a quarter century. These groundbreaking efforts have made a difference in the lives of billions of farmers and consumers in Africa, Asia, and Latin America.

One of the 2004 IYR priorities was to improve rice production through greater emphasis on rice research, development and policy. A sustainable increase in rice production will reduce hunger and poverty and contribute to environmental conservation.

As part of the IYR celebrations, public awareness campaigns on rice were organized in many countries and national committees for the IYR were formed, which served as focal points for the campaigns and linked up with the global IYR vision.

"The need for a sustainable increase in rice production affects everyone. We are all connected to the rice system, and by spreading awareness now we can ensure that the work of the International Year of Rice will reach far beyond 2004," stated Dr Jacques Diouf, FAO Director-General.

IYR Celebrations in SSA

Rice is generally associated with Asia. But it is also an integral part of Africa, where it has been grown for more than 3000 years. It was so widely grown in West Africa when the first European sailors reached there, that they called the region from Senegal to Côte d'Ivoire the 'Rice Coast'.

Rice continues to be a symbol of cultural identity for many Africans. For example, according to the *Diola* people living near the Casamance River in Senegal, in the beginning of creation their ancestors received from the Rain God the *Diola* rice, which carried a life-giving power. The rice they refer to is *Oryza glaberrima* (African rice), which is still grown by some of the *Diola* people and used in rituals to preserve the link with their ancestors.

WARDA Director General Dr Kanayo F. Nwanze (2nd from left) with representatives from the Ivoirian Government and the diplomatic corps at the International Year of Rice (IYR) celebration in Yamoussoukro, Côte d'Ivoire

Rice has now become a commodity of strategic significance in Africa. It is grown and consumed in about 40 countries in the continent. The demand for rice in West and Central Africa (WCA) is growing at the rate of about 6% per annum—faster than anywhere else in the world.

Since the Africa Rice Center is in the frontline of doing research on rice-based technologies that are adapted to SSA, it actively participated in the country-driven IYR celebrations that were organized in SSA. IYR celebrations were held in Côte d'Ivoire, Ghana, Guinea, Mali, Nigeria, Senegal, and Uganda, among others.

Under the theme of *Celebrating the International Year of Rice in Africa*, the Center organized the Fourth Meeting of the National Experts Committee (NEC)—which comprises the Directors General of its member countries—in Yamoussoukro, Côte d'Ivoire. The Meeting was preceded by a festival *La Journée du Riz*, which kicked off a series of major IYR celebrations in Côte d'Ivoire and in other African countries.

La Journée du Riz included among its programs a colorful parade by farmers, displays of rice samples and farming tools, a debate by rice experts from all parts of the continent on rice policies in Africa as part of a Round Table discussion, and a cooking competition on NERICA rice preparation.

Another major highlight of the IYR celebrations in the continent was the pan-African IYR event titled *Rice is life for Africans* that was jointly organized under the sponsorship of the Government of Ghana, the Council for Scientific and Industrial Research (CSIR), FARA, the Africa Rice Center, UNDP, FAO and NEPAD at Accra, Ghana.

Nigeria's President Olusegun Obasanjo (right) and Dr Olumuyiwa Osiname, WARDA Coordinator in Nigeria, at the WARDA pavilion during the IYR celebration in Abuja, Nigeria

The event was an opportunity to formally felicitate Dr Monty Jones, who was selected as the 2004 World Food Prize co-winner for the development of the NERICA. Recognition of specific African governments for their successful promotion of NERICA, scientific awards, prizes to rice producers and an exhibition of rice technologies featured prominently in the celebration.

An important component of the pan-African IYR was the African Rice Conference, which included the Third Biennial Regional Rice Research Review (4Rs), coordinated by ROCARIZ—the Rice Network hosted by the Center. The Conference brought together about 70 rice experts from SSA.

"Thanks to the 2004 IYR celebrations, improved rice technologies, such as NERICAs will increasingly reach villages, farms and homes of millions of poor rice farmers and consumers across SSA," said Dr Kanayo F. Nwanze.

International Year of Rice — Mission Statement

The International Year of Rice promotes improved production and access to this vital food crop, which feeds more than half the world's population while providing income for millions of rice producers, processors and traders. Development of sustainable rice-based systems will reduce hunger and poverty, and contribute to environmental conservation and a better life for present and future generations.

2004 World Food Prize to Dr Monty Jones for NERICA Development: Big Boost to the Africa Rice Center

Dr Monty Jones, co-laureate of the 2004 World Food Prize with Mrs Delphine Koudou (Bintu), a progressive woman farmer

In recognition of the immense potential of NERICA for food security and poverty alleviation in sub-Saharan Africa, Dr Monty Jones, popularly called *The Father of NERICA*, was selected as the co-laureate of the 2004 World Food Prize.

Dr Jones, the Executive Secretary of the Forum for Agricultural Research in Africa (FARA), is the first African to receive this prestigious award. He shares the prize with Professor Yuan Longping from China, whose work was instrumental in achieving the world's first high-yielding hybrid rice varieties.

The World Food Prize, known as the *Nobel Prize for Food and Agriculture*, was created in 1986 by Dr Norman Borlaug, who won the Nobel Peace Prize in 1970 for his work in developing new technologies for feeding the hungry. The World Food Prize honors outstanding individuals who have made vital contributions to improving the quality, quantity, or availability of food throughout the world.

The recognition of Dr Jones has a very special significance for Africa as a whole and for the Africa Rice Center, in particular. NERICA is a technological breakthrough for Africa by an African in an African-led institution—the Africa Rice Center—with strong support from partners across the world.

The research on NERICAs involved national agricultural research programs in many African countries, CGIAR Centers, and advanced research institutions in China, France, Japan, United Kingdom, and the United States.

"By winning this prize, Dr Jones has made us very proud," Dr Nwanze exclaimed. Thanking the Africa Rice Center, Dr Jones stated, "Indeed, this is a very prestigious award. However, it would not have come without the support and guidance of WARDA management, colleagues and friends."

It was during Dr Jones' tenure as Head of the Upland Rice Breeding Program and Deputy Director of Research at the Africa Rice Center, 1991-2002, that he achieved the NERICA breakthrough by doing pioneering research, potentially benefiting 20 million rice farmers and 250 million consumers in Africa.

NERICAs combine the toughness of the African rice species with the productivity traits of Asian rice varieties. Using participatory varietal selection (PVS) approach, Dr Jones and his colleagues tapped the knowledge of local farmers in creating NERICAs, specifically, adapting the varieties to suit the harsh growing conditions of upland (rainfed) rice ecologies of Africa, home to 70% of the region's poor rice farmers, mostly women.

The Center has generated several hundred NERICA lines, opening new gene pools and increasing the biodiversity of rice to the world of science. NERICA varieties for other more productive rice ecologies are already being evaluated in farmers' fields.

NERICAs are continuing to make headway in West, Central and eastern Africa. It is estimated that 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.

Convinced of NERICA's potential to reduce poverty and increase food security in SSA, many donors and international NGOs are collaborating with African governments to help disseminate NERICA across the region.

The NEPAD Steering Committee has identified NERICA as one of Africa's "best practices worth scaling up" and has endorsed its expansion across the continent. The African Rice Initiative (ARI), hosted by the Africa Rice Center, was launched in March 2002 to serve as a channel for coordinated NERICA dissemination efforts throughout Africa.

NERICA seed are being multiplied in several countries across the continent with assistance from Japan, United Nations Development Programme (UNDP), Food and Agriculture Organization of the United Nations (FAO), Japan International Cooperation Agency (JICA), Sasakawa-Global (S-G) 2000, and World Vision International, among others.

The African Development Bank (AfDB) announced in 2003 its plan to embark on a project of more than $30 million to support national programs in the dissemination of NERICA over a 5-year period in seven West African countries.

Receiving high tributes from world leaders at the Tokyo International Conference on Africa's Development (TICAD) III in September 2003, NERICA emerged as a byword for successful Asia-Africa cooperation. The world leaders urged that high priority should be given to NERICA's expansion "to other parts of the continent in urgent need."

"The NERICA success would not have been possible without sustained funding for rice research from members of the CGIAR and the support of African countries," Dr Nwanze said.

"We are especially grateful to the NERICA champions who have played a pivotal role in moving it to farmers' fields, namely the Japanese Government, World Bank, Rockefeller Foundation, UNDP, International Fund for Agricultural Development (IFAD), S-G 2000, Gatsby Foundation, and AfDB," he added.

The announcement of the co-winners of the 2004 World Food Prize took place during a U.S. State Department ceremony with U.S. Secretary of State Colin Powell; Secretary of Agriculture Ann Veneman; FAO Director General Jacques Diouf; Nobel Laureate and creator of the World Food Prize Dr Norman E. Borlaug; Chairman of the World Food Prize Foundation John Ruan III; and President of the World Food Prize and former U.S. Ambassador Kenneth Quinn on 29 March 2004.

Mr Ian Johnson, Chairman and Dr Francisco Reifschneider, Director of the CGIAR attended the announcement ceremony. Congratulating Dr Jones and the Africa Rice Center, they said they were very happy to see that the work of the Center was "properly recognized, which signifies a great promise for a better tomorrow."

The World Food Prize was formally presented to Professor Yuan and Dr Jones at a ceremony on 14 October 2004 in the Iowa State Capitol Building, Des Moines. The ceremony was held as part of The World Food Prize International Symposium, *From Asia to Africa: Rice, Biofortification and Enhanced Nutrition*.

The Period in Review May 2003 to April 2004

Despite the Ivoirian crisis, the period covered by this Annual Report witnessed a surge in activities and events in which the Africa Rice Center staff took active part.

The main reasons for this were the growing popularity of NERICA and other technologies developed by the Center, the launching of the International Year of Rice, the announcement of Dr Monty Jones as the co-winner of the 2004 World Food Prize for the NERICA breakthrough, and the tenure of the Director General Dr Kanayo F. Nwanze as the Chair of the CGIAR Center Directors Committee (CDC) for 2004.

Only the highlights are included in this section.

2003

FARA (18-20 May) and GFAR, 22-24 May: The FARA Executive Committee Meeting and Second Plenary Meeting and the Global Forum on Agricultural Research (GFAR) Triennial Meeting, held in Dakar, Senegal, showed strong support for the Center's products from partners and donor representatives. At the FARA Plenary, Dr Nwanze gave a presentation on *Scaling up the NERICA dissemination in sub-Saharan Africa*.

Senegal President's Award for Science, 30 June: The Center received the *Grand prix du Président de la République pour les sciences*—Senegal's highest award for science and technology—for the adaptation and dissemination of ASI, the most widely used rice thresher in Senegal. The award was presented personally by President Abdoulaye Wade to the WARDA team (led by Dr Kouamé Miezan) based in Senegal and its partners.

High-level Meeting on NERICA Dissemination, 1 July: The purpose of this meeting, which was combined with the second McNamara Seminar held by CGIAR and the World Bank in Tokyo, Japan, was to identify the most efficient way for increasing NERICA's dissemination in SSA. WARDA emphasized the role of the African Rice Initiative (ARI), which was launched in 2002 to serve as a focused channel for coordinated NERICA dissemination across SSA. The meeting was attended by several partners including representatives from the World Bank, Japan International Cooperation Agency (JICA), Japan International Research Center for Agricultural Sciences (JIRCAS), Japanese ministries, United Nations Development Programme (UNDP)/Technical Cooperation among Developing Countries (TCDC), CGIAR, and the Africa Rice Center. A second meeting to follow up on the discussion was proposed for September 2003.

Honorific Title from Ivoirian Government, 18 July: Dr Kouamé Miezan, Leader of the Irrigated Rice Program, was honored by the Côte d'Ivoire government for his long service to rice research and development through his work at the Africa Rice Center since 1983. He was conferred with the title of *Commandeur dans l'ordre du mérite Ivoirien* (Commander in the Ivorian Merit Order).

***Seeds for Life* Project, 8 August:** To revive agriculture and mitigate the food shortage in western Côte d'Ivoire, which was severely affected by the Ivoirian crisis, the Center launched a *Seeds for Life* project to donate seeds of improved rice varieties to FAO, World Food Programme (WFP), and a local NGO (ACOPCI) for distribution to farmers. The Center will monitor the use and impact of the

distributed seed on the farming communities. The *Seeds for Life* ceremony was organized under the aegis of the Ministry of Scientific Research, Côte d'Ivoire.

Rice Policy Workshop, 21-22 August: A concluding workshop of the United States Agency for International Development (USAID)-funded rice sector project *The Nigerian Rice Economy in a Competitive World: Constraints, Opportunities, and Strategic Choices*, was organized in Ibadan, Nigeria. The project was implemented by the Africa Rice Center in collaboration with the Nigeria Institute for Social and Economic Research (NISER).

The participants recommended a comprehensive approach to enhance the competitiveness of the rice sector by improving the efficiency of operators at the production, processing, and marketing levels. The recommended strategy was later presented to the Nigerian Minister of Agriculture and Natural Resources. It is also expected to feed into the *Presidential Committee on Increased Rice Production and Export in Nigeria* established by President Obasanjo in 2002.

Second High-level Meeting on NERICA Dissemination, 12 September: Building on the conclusions of the first meeting in July 2003 in Tokyo, the second meeting jointly organized by CGIAR and the World Bank, Tokyo, focused on the outcome of the JICA study mission carried out in June-July 2003 on NERICA dissemination in SSA and the ARI Management Committee Meeting held in early September.

24th Session of the WARDA Council of Ministers, 18-19 September: The Session, held in Cotonou, Benin,was chaired by Lazare Sehoueto, Minister of Agriculture, Animal Husbandry, and Fishery, Government of Benin. The Council of Ministers put on record its deep appreciation for the "courage and high sense of responsibility" of the WARDA Board, the Director General and staff during the Ivoirian crisis. Several important Resolutions were passed, including the approval of the designation *Africa Rice Center (WARDA)* and the call for recognizing WARDA as a specialized institution of the African Union within the NEPAD framework. The Council also resolved to maintain the headquarters in Côte d'Ivoire.

The National Experts Committee (NEC) comprising the Directors of the national programs of WARDA member countries met on the first day of the Session and prepared the groundwork for the Council. The Session was preceded by a *Rice Day*, organized jointly by the Institut national des recherches agricoles du Bénin (INRAB) and the Center, that included seminars and display booths by various organizations involved in rice R&D, production and processing.

African Development Bank (AfDB) Support for NERICA Dissemination, 26 September: AfDB announced a grant and loan of more than $30 million to support NERICA dissemination in seven West African countries for 5 years. The AfDB support, formalized through an agreement with the selected countries, was the culmination of a long preparatory work by the African Rice Initiative and WARDA, which hosts the Initiative.

About 80% of the targeted beneficiaries of the AfDB-funded project will be the rural poor, mostly women. The project estimates that about 33,000 farm families will be involved in participatory varietal selection (PVS) strategy to accelerate the NERICA dissemination. About 400 000 ha of additional land is expected to be under NERICA cultivation by the 5th year of the project. The import bill of the seven countries is expected to reduce by about US$100 million.

Board Executive and Finance Committee (EFC) Meeting, 22-24 September: The Ministry of Scientific Research, Government of Côte d'Ivoire hosted the EFC in Abidjan. Among the important decisions taken was the Board's approval of the Center's new Strategic Plan (2003–2012). The EFC met with the Prime Minister, Government of Côte d'Ivoire.

New Strategic Plan (2003–2012) Comes into Force, 24 September: In line with its new pan-African vision, in 2003 the Center launched a new Strategic Plan that charts its course for the next 10 years. It helps position the Center to address the emerging challenges in SSA in association with its partners. The Strategy will guide present and future efforts of the Center, within the Plan period, in providing technologies for improving the livelihoods of poor African rice farmers and consumers.

The Strategy for 2003–2012 refocuses and streamlines the Center's research programs into two major areas: (1) development of components for integrated rice production systems, and (2) rice policy and development. These two programs will function through a set of well-focused projects with specific outputs and milestones within the 3-year rolling Medium-Term Plans (MTP).

Tokyo International Conference on Africa's Development (TICAD) III, 29 September–1 October: The TICAD process initiated in 1993 has become a major global framework for Asia and Africa to collaborate in promoting Africa's development. Commemorating its 10th anniversary in Tokyo, Japan, TICAD III was one of the biggest ever conferences held on Africa with delegates from 90 countries, including 23 African Heads of State. Receiving high tributes from world leaders at TICAD III, NERICA emerged as a byword for successful Asia-Africa cooperation.

Invited to participate at TICAD III, WARDA organized a CGIAR/WARDA side event on NERICA including a display booth and a participatory Seminar, chaired by Mr Yukio Yoshimura, World Bank Vice President and Special Representative, Japan. Dr Nwanze delivered a lead-off statement on *The Challenge of Agricultural Development in Africa and the Promise of NERICA* in one of the thematically focused sessions at TICAD III.


Diplôme d'Honneur
Le Comité d'Organisation de la 23ème Journée Mondiale de l'Alimentation décerne ce diplôme spécial à
ADRAO
pour sa contribution effective dans la lutte contre la Faim en Côte d'Ivoire.

MoU between the Center and ENI, Congo-Brazzaville, 10 October: The Center signed an agreement with ENI-Congo, a private petroleum company, which is carrying out a pilot project on rice production in Congo-Brazzaville. As part of this agreement, the Center will provide technical backstopping (supply of seeds, training, data analysis, monitoring and evaluation) to the project with financial support from ENI.

Honor from the Ivoirian Government, 16 October: On the occasion of the 23rd World Food Day, WARDA received the Diplôme d'Honneur from the Ivoirian Government for its effective contribution to the fight against hunger in Côte d'Ivoire.

MoU between the Center and NARO, Uganda, 21 October: NERICA's increasing popularity has been the driving force for the Center's expansion into Eastern and Central Africa. During Dr Nwanze's trip to Uganda, which is witnessing an amazing NERICA boom, a Memorandum of Understanding (MoU) was signed between the Center and the National Agricultural Research Organisation (NARO). The MoU will facilitate joint activities on rice R&D, exchange of germplasm and information, and capacity building.

Annual General Meeting (AGM), 27–31 October: CGIAR's 2003 AGM, held in Nairobi, Kenya, introduced a new format for Centers and Members Day that included Center displays, bilateral meetings with members and holding of parallel sessions by the Centers. WARDA convened a panel discussion on the *African Rice Initiative: from Research to Development*. The panel members representing a wide array of stakeholders endorsed a coordinated NERICA dissemination effort across Africa. As the Incoming CDC Chair, Dr Nwanze made a presentation on *Looking Back into the Future: Perspectives from the Incoming CDC Chair*.

FAO-IVC Workshop, 4–7 November: FAO and IVC jointly organized a workshop on Integrated Irrigation-Aquaculture (IIA) for West Africa, in Bamako, Mali, under the aegis of the Ministry of Agriculture, Livestock and Fishery, Government of Mali. Thirty representatives from 10 West African countries participated in the workshop, which had Resource Persons from national and international organizations. The workshop was timely because IVC will be involved in the implementation of the *Water and Food* Challenge Program for rice-fish farming activities in West and Central Africa.

Research Days, 8–12 December: The Center's Research Days were organized in Bamako, Mali to review the research activities of 2003 and plan for 2004. Apart from Management and staff, two Board members, representatives from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), World Agroforestry Centre (ICRAF) and IER attended. Achievements, drawbacks and future challenges were highlighted.

2004

International Year of Rice Celebrations, 12–13 February: Researchers from the Center, together with other leading rice experts from around the world, participated in the Rice Conference convened by FAO in Rome, Italy, to present their perspectives on rice R&D activities and challenges for the future. WARDA and its partners in the national programs developed plans for celebrating the IYR in sub-Saharan Africa.

IVC Annual Meeting, 17–19 February: Since the 2003 Annual Meeting could not be held because of the Ivoirian crisis, the 2004 Annual Meeting was crucial for all the IVC stakeholders to review the Phase II activities of the Regional and National Coordination Units (RCU and NCU) conducted in 2002 and 2003. Major points reviewed by the Consortium Management Committee (CMC) at its meeting in May 2003 were presented.

The CMC decisions included the acceptance of The Gambia as a new IVC member and the nomination of the NCU of Benin as the new Chair. Strategic issues, such as the future of IVC, the possibility of launching a Phase III, scaling up of results and the need for seeking new funding mechanisms were discussed at the Annual Meeting in preparation for the external review of the IVC Phase II, scheduled for mid-2004. The WAIVIS database incorporating information on inland valley characterization collected in the 10 member countries was distributed to participants as well as posted on the IVC website.

Ugandan Parliamentary Session with CGIAR, 18–20 February: CGIAR hosted a briefing for Ugandan Members of Parliament in Jinja, Uganda. Prof. Richard Musangi, WARDA Board Chair addressed the Parliamentarians on behalf of CGIAR. Researchers from several CGIAR Centers, including WARDA, made presentations. Parliamentarians called for strengthening CGIAR's collaborative links with Uganda.

World Bank Annual Rural Week, 29 February–6 March: Environmentally and Socially Sustainable Development (ESSD) Week is hosted annually by the World Bank's ESSD Vice Presidency. Impacts of research by CGIAR Centers and contributions to the larger sustainable development agenda were showcased during the event. As CDC Chair, Dr Nwanze presented a paper on *Natural Resources Management and the Role of the CGIAR*. He also made a presentation on *Linking World Bank Operations to CGIAR: A Case Study of NERICAs in Guinea*.

MoU between CGIAR and NEPAD, 8 March: A significant milestone for the CGIAR was the signing of a Memorandum of Understanding between NEPAD and the CGIAR-supported Centers represented by Dr Nwanze, in Gauteng, South Africa. This omnibus document provides political and legal recognition for all CGIAR Centers with which NEPAD can work towards achieving the Millennium Development Goals in SSA.

International Women's Day Celebration, 8 March: ARI participated in the event, displaying posters and NERICA-based products of special interest to women's associations. WARDA Director of Research, Dr Shellemiah Keya presented a bag of NERICA to the First Lady of Mali, Mrs Touré Lobbo Traoré.

AVRDC-Africa Rice Center Workshop, 9–11 March: A workshop on *Planning Research Activities for the Improvement of Vegetable Production in West Africa* was organized in Bamako, Mali to plan the activities of the joint AVRDC-Africa Rice Center project. Participants identified priorities for research and development of the rice-based vegetable sector in the sub-region.

2004 World Food Prize Announcement, 29 March: Dr Monty Jones, former senior rice breeder at WARDA, presently the Executive Secretary of FARA, was selected as the co-winner of the 2004 World Food Prize for the NERICA breakthrough. He shares the Prize with Professor Yuan Longping from China. The announcement of the co-winners of the 2004 World Food Prize took place during a U.S. State Department ceremony in Washington DC with U.S. Secretary of State Colin Powell; Secretary of Agriculture Ann Veneman; FAO Director General Jacques Diouf; Nobel Laureate and creator of the World Food Prize Dr Norman E. Borlaug; Chairman of the World Food Prize Foundation John Ruan III; and President of the World Food Prize and former U.S. Ambassador Kenneth Quinn.

MoU with ASARECA, 3 April: A Memorandum of Understanding was signed between WARDA and the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) to support the reactivation and functioning of the ASARECA Rice Research Network (ECARRN). WARDA will provide technical backstopping for all of ASARECA's rice research and development activities and support the network coordination office that will be headed by a WARDA staff recruited from the region. It will also provide start-up funds for the network activities.

Twenty-Fourth Meeting of the Board of Trustees,19–24 April: To effectively translate the Center's new Strategic Plan (2003-2012), the Board approved a new programmatic structure that will enhance the relevance and impact of the Center's research products and services in SSA. The Center's core research areas will focus on the two major challenges highlighted in the Strategic Plan: *Integrated Rice Production Systems* and *Rice Policy and Development*. The two programs will be headed each by an Assistant Director under the overall direction of the Assistant Director General, Research and Development.

As a follow-up of the Resolution taken by the Council of Ministers in its 24th Session in September 2003 urging the Côte d'Ivoire Government to provide security to the Center to return to its headquarters in Bouaké/M'bé, the Board endorsed the Center's *Progressive Return Plan*.

1. Position for the years ended 31 December 2003 and 2002 (in US$)

	2003	2002
ASSETS		
Current Assets		
Cash and Cash Equivalent	4 062 302	3 631 562
Accounts Receivable:		
Donors	1 570 407	1 259 707
Employees	243 125	298 038
Others	568 756	632 778
Inventories	361 519	574 536
Prepaid Expenses	152 134	98 494
Total Current Assets	**6 958 243**	**6 495 115**
Property and Equipment		
Property and Equipment	8 589 367	8 029 696
Less: Accumulated Depreciation	(6 695 027)	(6 320 987)
Total Property and Equipment-Net	**1 894 340**	**1 708 710**
TOTAL ASSETS	**8 852 583**	**8 203 825**
LIABILITIES AND NET ASSETS		
Current Liabilities		
Bank Balances (Overdraft)	61 515	150 504
Accounts Payable:		
Donors	3 186 213	2 050 613
Employees	176 118	433 531
Others	1 341 149	2 646 228
Funds in Trust-Employees	296 000	
Provisions and Accruals	1 312 906	1 298 712
Total Current Liabilities	**6 373 900**	**6 579 589**
TOTAL LIABILITIES	**6 373 900**	**6 579 589**
Net Assets		
Unrestricted Net Assets	2,478,682	1 624 236
Total Net Assets	2,478,682	**1 624 236**
TOTAL LIABILITIES AND NET ASSETS	**8,852,583**	**8 203 825**

2. Statement of activities by funding for the years ended 31 December 2003 and 2002 (in US$)

	Unrestricted	Restricted	Total 2003	Total 2002
REVENUE, GAINS AND OTHER SUPPORT				
Grants	4 756 535	4 411 405	9 167 940	9 585 412
Member States—Operating Income	55 484		55 484	119 172
Member States—Capital Development Income	17 292		17 292	15 945
Transfer of Restricted Assets—Income	161 003		161 003	88 269
World Bank Special Grant—Income	1 221 243		1 221 243	180 087
Other Income	117 759		117 759	286 573
TOTAL REVENUE GAINS AND OTHER SUPPORT	**6 329 316**	**4 411 405**	**10 740 721**	**10 275 457**
EXPENSES AND LOSSES				
Program Related Expenses	1 538 583	4 411 405	5 949 988	6 981 571
Management and General Expenses	3 476 326		3 476 326	3 649 324
Special Transition Program Expenses	1 482 935		1 482 935	721 167
Total Expenses and Losses	6 497 844	4 411 405	**10 909 249**	**11 352 062**
Indirect Cost Recovery	(1 022 974)		(1 022 974)	(1 526 369)
Total Expenses and Losses	**5 474 870**	**4 411 405**	**9 886 275**	**9 825 693**
EXCESS/(DEFICIT) OF REVENUE OVER EXPENSES				
Change in Net Assets	**854 446**		**854 446**	**449 764**
Net Assets at Beginning of Year	1 624 236		**1 624 236**	**1 295 857**
Change in Net Assets before Cumulative Effect of	854 446		854 446	449 764
Refunds Due to Donors				(100 000)
Cumulative Effect of Change in Accounting Policy				(21 385)
Change in Net Assets	**854 446**		**854 446**	**328 379**
Net Assets at End of Year	**2 478 682**		**2 478 682**	**1 624 236**

MEMO ITEM	*Management and General*	*Program related*	*Total 2003*	*Total 2002*
Total Expenses by Natural Classification				
Personnel Costs	*2 265 213*	*2 731 823*	*4 997 036*	*4 354 990*
Supplies and Services	*1 905 436*	*2 756 336*	*4 661 772*	*5 609 543*
Operational Travel	*253 390*	*295 454*	*548 844*	*600 117*
Depreciation	*405 593*		*405 593*	*441 674*
Capital Expenditures	*129 629*	*166 375*	*296 004*	*345 738*
Gross Operating Expenses	***4 959 261***	***5 949 988***	***10 909 249***	***11 352 062***

3. Grants for the year ended 31 December 2003 and 2002 (in US$)

UNRESTRICTED	**2003**	**2002**
Belgium	182 301	147 565
Canada	574 248	442 655
Denmark		
France*	75 562	161 385
Germany	175 065	140 655
Japan	1 029 012	804 762
Netherlands	792 036	665 731
Norway	526 774	360 000
Sweden	416 536	357 916
USAID	225 000	225 000
World Bank**	760 000	1 080 000
Côte d'Ivoire		41 086
Total unrestricted grants	**4 756 535**	**4 426 755**
TEMPORARILY RESTRICTED		
AfDB I (Institutional Support)		9 867
CANADA-Fund for Africa (CFA)	227 824	
COAT-Taiwan/AVRDC Collaborative Project	4 523	
CFC/FAO-Spirivwa Project	87 604	51 162
Denmark (Phytosanitary & Seed Health)	90 859	33 062
ENI-CONGO	13 668	
European Union (Crop & Resources Management)		14
European Union/CORAF Project	366 775	440 676
European Union (Policy Environmt & Rice Market Dev.)	555 632	
European Union (Creating Low Management Plant Types)	151 008	
France (Collaboration IRD)	10 829	63 270
Gatsby Foundation (Containment Facility)	450	6 023
Gatsby Foundation (Dissemination)	46 423	217 580
GTZ(Projet Riz Nord)	131	
GTZ (PTDP)	218 213	387 420
GTZ (Periurban Project)	39 856	103 730
IBRD- Genebank Upgrade Project	226 955	
IFAD (PADS Project)	281 247	272 277
UNDP/TCDC-IHP Phase 2	34 645	257 078
Collaboration-NTR/HRI	67 700	20 785
Japan (Ecophysiology Project)	44 838	48 973
Japan (Grain Quality)*	(38)	12 810

*The use of these Grants has been restricted towards selected projects in CGIAR Approved Agenda for WARDA.
**Excluded from this amount is the World Bank Special Grant Income accrued against extraordinary expenditure incurred during the year as a result of the crisis being experienced in Côte d'Ivoire. This amount (US$ 180,087) has been disclosed seprarately in the Statement of Activities.

TEMPORARILY RESTRICTED (continued)

Japan (Interspecific Hybridization Project)	286 667	505 365
Japan/MAFF WARDA Project	2 142	252 648
Japan (RYMV Project)*	209 260	185 310
Japan (Blast Project)*	26 036	46 907
Japan (Project 1.3)*		534
Japan (Genebank Project)	6 498	400 000
Japan(Increasing quality Compet.Loc. Project)	132 896	
Japan(Dev.Interspec. OG&OS Progenies)	102 157	
Norway (Training Project)		290 501
Norway (SWIHA HIV/AIDS Project)	52 216	102 831
Rockfeller (Anther Culture Project)		12 796
Rockfeller (Post Doc)		60 054
Rockfeller (Capacity Building)	190 306	89 919
Rockfeller (FPATDD-Mali/Nigeria)	32 873	55 569
Rockfeller(African Rice Initiative)	109 358	
United Kingdom (Weeds Project)	123	4 828
United Kingdom (RYMV Attributed)*	53	74 260
United Kingdom (RYMV CRF Project)		5 039
United Kingdom (Soil Degradation CRF Project)		491
United Kingdom (INGER-Africa Phase 2)		291 593
United Kingdom (Wild Rice Project)	727	2 919
United Kingdom (Blast Attributed)*	16 160	29 911
United Kingdom (Rice Functional Diversity)	1 285	17 727
United Kingdom (Attributed Project 2.1)*	359 652	116 641
United Kingdom (Attributed Project 2.2)*	115 816	243 633
USAID (Network Project)	221 516	232 374
USAID (Impact Assessment Project)		40 974
USAID (Nigeria Rice Economy Project)	65 696	145 824
UNEP (Farmer Stakeholders Project)		4 686
Miscellaneous Small Projects	10 827	20 595
Total Restricted Grants	**4 411 405**	**5 158 657**
TOTAL GRANTS	**9 167 940**	**9 585 412**

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

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

Senior Staff and Associates

1 May 2003 to 30 April 2004

Office of the Director General

Kanayo F. Nwanze	Director General
Samuel Bruce-Oliver†	Executive Officer
Mohamed Mouhidiny Abdou	Internal Auditor
Péféry Coulibaly	Information and Communications Technology Manager
Ann-Marie Kormawa†	HIV/Aids Focal Point
Savitri Mohapatra*	Communication and Information Officer (Interim)
Rama S. Venkatraman	Web-master

Training, Information and Library Services

Aline Lisette-Vidal	Head of Training, Information and Library Services
Thomas Adigun	Librarian
Aboubacar Madougou	Translator
Guy Manners**	Information Officer
Fassouma Sanogo	Translator
Aïssata Sylla	Desktop-publishing Assistant

Corporate Services Division

P.-Justin Kouka	Assistant Director for Corporate Services

Administration and Finance Division

Michel P. Dubé††	Director of Administration and Finance
George Maina	Head of Finance
Jean-Baptiste Adjovi	Senior Accountant
Ignace Koui†	Senior Accountant
Mark Etsibah††	Senior Accountant
Gnanvi Pierre Sossou*	Senior Accountant
Lassina Silué	Information Systems Administrator (Finance)
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†	Director of Research
Frank Abamu†	Germplasm Specialist
Inoussa Akintayo*	Coordinator, African Rice Initiative (ARI)
Koffi Akator	Research Assistant
Touré Amadou	Research Assistant
Kone Brahima	Research Assistant
Anne Bouma	Research Support Officer
Mameri Camara††	Visiting Scientist
Robert Carsky†	Cropping Systems Agronomist
Mamadou Cissoko*	Research Assistant
Toon Defoer††	Technology Transfer Agronomist
Aliou Diagne	Impact Assessment Economist
Gnah Diarra	Research Assistant
Sitapha Diatta	Soil Physicist
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
Monica Idinoba	Agro-climatologist (Visiting Research Fellow)
Phillip Idinoba	Research Assistant
Mohamed Kebbeh†	Production Economist (Sahel)
Patrick Kormawa†	Policy Economist
Kouadio Kouamé	Research Assistant
Paul Kiepe	Scientific Coordinator, Inland Valley Consortium
Moussa Mahaman	Research Assistant
Fofana Mamadou	Research Assistant
Kouamé Miézan	Irrigated Rice Program Leader (Sahel)
Sika Mobio	Research Assistant
Philippe Morant†	Regional Coordinator, Inland Valley Consortium
Augustin Munyemana**	Participatory Technology Development Scientist
Akahoua N'cho	Research Assistant
Marie-Noëlle Ndjiondjop	Molecular Biologist/Biotechnologist
Francis Nwilene	Entomologist
Sylvester Oikeh†	Soil Fertility Agronomist
Amos Onassanya	Research Assistant
Olumuyiwa Osiname	WARDA Coordinator in Nigeria (Nigeria)
Andreas Oswald††	Cropping Systems Agronomist
Sidi Sanyang	ROCARIZ Coordinator
Kayodé Sanni	Research Assistant
Yacouba Séré	Pathologist
Moussa Sié*	Lowland Rice Breeder
James Sumberg††	Rice Policy and Development Program Leader
Abou Togola*	Research Assistant
Ali Touré	Research Assistant
Osmane Youm†	Assistant Director/Program Leader

Collaborating Scientists

Kouassi Soumaila Bredoumy**	Interim Coordinator of the African Rice Initiative (ARI)
Takeshi Sakurai††	Agricultural Economist (JIRCAS)
Hiroshi Tsunematsu	Associate Upland Rice Breeder (JIRCAS)

* Joined or changed title in 2003
** Left or changed title in 2003
† Joined or changed title in 2004
†† Left or changed title in 2004

Training

Training Courses Offered between 1 January 2003 and 30 March 2004

Title and dates	Location	Language	Participants		
			Male	Female	Total
Workshop on Iron Toxicity in Rice-based Cropping Systems in West Africa 19–21 March 2003	Cotonou (Benin)	French, English	19	0	19
Impact Assessment Methodology 5–16 May 2003	Conakry (Guinea)	French, English	12	0	12
Participatory Learning and Action Research (PLAR) for Integrated Rice Crop Management (IRM) 16–21 June 2003	Sikasso (Mali)	French	22	3	25
Participatory Learning and Action Research (PLAR) for Integrated Rice Crop Management (IRM) 23–28 Juin 2003	Kumasi (Ghana)	English	20	0	20
Proposal Writing, 27–31 October 2003	Bamako (Mali)	French	4	2	6
Proposal Writing, 3–7 November 2003	Bamako (Mali)	English	9	0	9
Total			**86**	**5**	**91**

Head of Training, Information and Library Services Mrs Aline Lisette-Vidal with students

Postgraduate Trainees in 2003–2004

Name and Thesis Topic/Subject	Institution	Sponsor	Degree
Adesanwo, O.O, Legume/phosphate rock combination for sustainable rice production in southwestern Nigeria	University of Agriculture of Abeokuta, Nigeria	WARDA/ University of Hohenheim	PhD
Aluko, Kayode Gabriel,[1] Genetic studies of soil acidity tolerance in rice	Louisiana State University, USA	Rockefeller Foundation	PhD
Amoussou, Pierre Louis, Genomics of rice yellow mottle virus	University of East Anglia, UK	Rockefeller Foundation/ DFID	PhD
Assingbé, Paulin, Intégration des légumineuses dans la rotation des cultures du riz pluvial au Bénin	Université d'Abidjan, Côte d'Ivoire	BMZ/GTZ	PhD
Awoh, Akué Sylvette, Cropping systems and their production characteristics in peri-urban agriculture	Université nationale de Côte d'Ivoire, Côte d'Ivoire	BMZ/GTZ/ WARDA	DEA
Baboka, Nathalie,[2] Analyse de fonctionnement et procédures de qualité	INSTEC Côte d'Ivoire	Private	Ingénieur (Qualité)
Bognonkpe, Jean Pierre Irénée, The influence of land use on the dynamics of native soil nitrogen at watershed scale in West Africa	University of Bonn, Germany	DAAD/ Volkswagen Foundation	DEA
Bolou, Bi Bolou Emile, Cropping systems and their production characteristics in peri-urban agriculture	Université nationale de Côte d'Ivoire, Côte d'Ivoire	BMZ/GTZ/ WARDA	DEA
Cherif, Mamadou, Effet de toxicité ferreuse sur l'activité photosynthétique du riz: étude de la variabilité génétique	Université d'Abidjan Côte d'Ivoire	AfDB	PhD
Chowen, Anthony, Evaluation of participatory research approaches in Nigeria	University of Agriculture Abeokuta, Nigeria	BMZ/GTZ	PhD
Clark, Cary, Rural finance system and related constraints for lowland rice intensification	University of Reading UK	Private/ WARDA	PhD
Coulibaly, Sotianwa Nanan,[2] Communication	Cours Pigier Abidjan, Côte d'Ivoire	Private	MA
Djadjaglo, David, Détermination des facteurs influençant la productivité des systèmes de production à base de riz au Sud du Bénin	University of Hohenheim, Germany	BMZ/GTZ	PhD
Efisue, Andrew, Developing durable resistant upland rice for the tropics of Africa	University of KwaZulu-Natal, South Africa	Rockefeller Foundation	PhD
Gnagadjomon, Koné, Socioeconomics of peri-urban agriculture	Université de Bouaké Côte d'Ivoire	BMZ/GTZ	DEA
Horna, Daniela, Brokering of knowledge and information in the rice production system in Southern Nigeria and Benin Republic	University of Hohenheim Germany	BMZ/GTZ	PhD
Koffi, Marie Chantal, Cropping systems and their production characteristics in peri-urban agriculture	Université nationale de Côte d'Ivoire, Côte d'Ivoire	BMZ/GTZ/ WARDA	DEA
Koné, Fahiraman K., Socioeconomics of peri-urban lowland agriculture	Université de Bouaké, Côte d'Ivoire	BMZ/GTZ	DEA
Macaire, Dobo, Enhance uniformity and stability of rice grain quality through genetic transformation and marker assisted breeding	Texas A&M University, USA	Rockefeller Foundation	PhD

Postgraduate Trainees in 2003–2004

Name and Thesis Topic/Subject	Institution	Sponsor	Degree
Mandé, Sémon,[1] Assessment of biodiversity in *Oryza glaberrima* using microsatellite markers	Cornell University, USA	Rockefeller Foundation	PhD
Mulder, Linda, Effect of straw application on yield and on plant availability of N and P for alkaline irrigated rice soils	Wageningen University, The Netherlands	DFID	MSc
Sanon,Alexandre Issa,[2] Valorisation du riz *glaberrima* dans le programme de sélection de l'INERA	Université polytechnique de Bobo-Dioulasso, Burkina Faso	Private	DAA
Sédia, N'Da Amenam Gisèle, Socioeconomics of peri-urban lowland agriculture	Université de Bouaké, Côte d'Ivoire	BMZ/GTZ	DEA
Soko, Faustin Dago, Epidémiologie du RYMV: Etude des conditions d'établissement et de déroulement des épidemies pour une gestion intégrée de la panachure jaune du riz en Côte d'Ivoire	Université d'Abidjan, Côte d'Ivoire	Japan	PhD
Sorho, Fatogoma, Phylogéographie, pathogénie et durabilité des résistances naturelles au virus de la panachure jaune du riz	Université d'Abidjan, Côte d'Ivoire	Agropolis	PhD
Soro, Kouendieletia, Analyse sanitaire des semences de riz	Ecole nationale supérieure d'agriculture, Côte d'Ivoire	WARDA	DAA
Thuweba, Diwani, Improving productivity of peri-urban lowland cropping systems	University of Bonn, Germany	BMZ/GTZ/ WARDA	PhD
Tiemele, Delees Edmond, Etude de la résistance des variétés à la panachure jaune	Ecole nationale supérieure d'agriculture, Côte d'Ivoire	WARDA	DAA
Traoré, Karim, Marker-assisted selection for improving drought resistance in rice root traits and osmotic adjustment	University of Texas, USA	Rockefeller Foundation	PhD
Tveteraas, Astrid, The impact of AIDS on livelihood security in rural areas of Côte d'Ivoire	Agricultural University of Norway, Norway	Agricultural University of Norway/ WARDA	MSc
van Asten, Petrus, Salt-related soil degradation in irrigated rice-based cropping systems in the Sahel	Wageningen University, The Netherlands	DGIS	PhD
Yao, Kouadio Nasser,[3] Androgène in vitro chez le riz *Oryza glaberrima* et d'hybrides interspecifiques *sativa–glaberrima*	Université d'Abidjan, Côte d'Ivoire	AfDB	PhD
Zeller, Heiko, Characterization of rainfed upland rice production systems in southern Nigeria	University of Hohenheim, Germany	BMZ/GTZ	PhD

1. *Completed in 2003*
2. *Started in 2004*
3. *Discontinued because of the Ivoirian crisis.*

Articles in Peer-reviewed Journals

2003

Albar L., M.N. Ndjiondjop, Z. Esshak, A. Berger, A. Pinel, M. Jones, D. Fargette and A. Ghesquière. 2003. Fine genetic mapping of a gene required for Rice yellow mottle virus cell-to-cell movement. *Theoretical and Applied Genetics* 107 (2): 371–378.

Audibert, M., J. Mathonnat and M.C. Henry. 2003. Malaria and property accumulation in rice production systems in the savannah zone of Côte d'Ivoire. Tropical Medicine & International Health 8(5): 471–483.

Badu-Apraku B., F.J. Abamu, A. Menkir, M.A.B. Fakorede, K. Obeng-Antwi, C. Thé. 2003. Genotype by environment interactions in the regional early maize variety trials in West and Central Africa. *Maydic* 48 (2): 93–104.

Briët O.J.T., J. Dossou-Yovo, E. Akodo, N. van de Giesen, T.M. Teuscher. 2003. The relationship between *Anopheles gambiae* density and rice cultivation in the savannah zone and forest zone of Côte d'Ivoire. Tropical Medicine & International Health 8(5): 439–448.

Dalton, T.J. and R. G. Guei. 2003. Productivity gains from rice genetic enhancements in West Africa: Countries and ecologies. *World Development* 31(2): 359–374.

De Plaen, R., R. Geneau, T. Teuscher, A. Koutoua and M-L. Seka. 2003. Living in the paddies: a social science perspective on how inland valley irrigated rice cultivation affects malaria in Northern Côte d'Ivoire. *Tropical Medicine & International Health* 8(5): 459–470.

Erenstein, O. 2003. Smallholder conservation farming in the tropics and sub-tropics: a guide to the development and dissemination of mulching with crop residues and cover crops. *Agriculture, Ecosystems and Environment* 100: 17–37.

Futakuchi, K., S. Tobita, S. Diatta and A. Audebert. 2003. WARDA's work on the New Rice for Africa (NERICA)—interspecific *Oryza sativa* L. x *O. glaberrima* Steud. progenies. *Japanese Journal of Crop Science* 72 (Extra issue 1): 324–325.

Haefele, S.M., M.C.S. Wopereis, M.K. Ndiaye, S.E. Barro and M. Ould Isselmou. 2003. Internal nutrient efficiencies, fertilizer recovery rates and indigenous nutrient supply of irrigated lowland rice in Sahelian West Africa. *Field Crops Research* 80(1): 19–32.

Haefele, S.M., M.C.S. Wopereis, M. K. Ndiaye and M.J. Kropff. 2003. A framework to improve fertilizer recommendations for irrigated rice in West Africa. *Agricultural Systems* 76: 313–335.

Henry, M-C., C. Rogier, I. Nzeyimana, S. B. Assi, J. Dossou-Yovo, M. Audibert, J. Mathonnat, A. Keundjian, E. Akodo, T. Teuscher and P. Carnevale. 2003. Inland

valley rice production systems and malaria infection and disease in the savannah of Côte d'Ivoire. *Tropical Medicine & International Health* 8(5): 449–458.

Heuer S., K.M. Miezan, M. Sié and S. Gaye. 2003: Increasing biodiversity of irrigated rice in Africa by interspecific crossing of *O. glaberrima* x *O. sativa*. *Ephytica* 132: 31–40.

Kajisa, K. and T. Sakurai. 2003. Determinants of groundwater price under bilateral bargaining with multiple modes of contracts: a case of Madhya Pradesh, India. *Japanese Journal of Rural Economics* 5: 1–19.

Kebbeh, M. and K.M. Miezan. 2003. Ex-ante evaluation of integrated crop management options for irrigated rice production in the Senegal River Valley. *Field Crops Research* 81: 87–94.

Poussin, J. C., M. C. S. Wopereis, D. Debouzie and J. L. Maeght. 2003. Determinants of irrigated rice yield in the Senegal River valley. *European Journal of Agronomy* 19: 341–356.

Reece, J.D. and J. Sumberg. 2003. More clients, less resources: toward a new conceptual framework for agricultural research in marginal areas. *Technovation* 23 (5): 409–421.

Sahrawat, K.L., M.P. Jones, S. Diatta and M. Sika. 2003. Long-term phosphorus fertilizer effects on phosphorus uptake, efficiency, and recovery by upland rice on an Ultisol. *Communications in Soil Science and Plant Analysis* 14 (7 & 8): 999–1011.

Sumberg, J., C. Okali and D. Reece. 2003. Agricultural research in the face of diversity, local knowledge and the participation imperative: theoretical considerations. *Agricultural Systems* 76: 739–753.

Sumberg, J. 2003. Toward a dis-aggregated analysis of crop-livestock integration in West Africa. *Land Use Policy* 20: 253–264.

van Asten, P. J. A., L. Barbiéro, M.C.S. Wopereis, J.L. Maeght and S.E.A.T.M. van der Zee. 2003. Actual and potential salt-related soil degradation in an irrigated rice scheme in the Sahelian zone of Mauritania. *Agricultural Water Management* 60: 13–32.

Books and Book Chapters

Aoubek, A., N'D. Cissé, M. Djitéye, J. Naino, A. Rouamba et M. Sié. 2003: Catalogue régional des variétés de semences vulgarisées dans les pays membres du CILSS. Institut du Sahel (INSAH)/ Comité permanent inter-Etats de lutte contre la sécheresse dans le Sahel (CILSS), Bamako, Mali. ISBN 2 9122693 27 6.

Defoer, T. 2003. Assessing changes in soil fertility management in Southern Mali using resource flow mapping and ResourceKIT. In: Struif-Bontkes T.E. and M.C.S. Wopereis (ed.) *A practical guide to decision-support tools for agricultural productivity and soil fertility enhancement in sub-Saharan Africa*. International Fertilizer Development Corporation (IFDC), Alabama, USA and Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. Pp. 24–39.

Papers Presented at Meetings and Contributions to Proceedings

Darboe, M. L .K., L. M., Jobe, and S. Sanyang. 2003. Identification of resistance to the African Rice Gall Midge, *Orseolia oryzivora* Harris and Gagne, in improved lowland rice cultivars in The Gambia. In: Sanyang, S., A. Ajayi and A. A. Sy (ed.) *Proceedings of the Second Biennial Regional Rice Research Review (4Rs 2002)*, 9–12 April 2002, Bouaké, Côte d'Ivoire. Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire. Pp. 83–86.

Diagne, A. 2003. The diffusion and adoption of NERICA rice varieties in Côte d'Ivoire. Paper presented at the Pre-conference International Association of Agricultural Economists (IAAE) workshop on the Green Revolution in Asia and its Transferability to Sub-Saharan Africa, 13–16 August 2003, Durban, South Africa.

Furuya, J. and T. Sakurai. 2003. Interlinkage in the rice market of Ghana: money-lending millers enhance efficiency. Paper presented at the 25th International Conference of Agricultural Economists, 16–22 August 2003, Durban, South Africa.

Futakuchi, K. 2003. The current trends of NERICAs. Paper presented at the 3rd Association for International Cooperation of Agriculture and Forestry (AICAF) Seminar on African Agriculture, 17 April 2003, Tokyo, Japan.

Gridley, H.E., A. Efisue, B. Tolou and T. Bakayako. 2003. Breeding for tolerance to iron toxicity at WARDA. Paper presented at the First workshop on iron toxicity in rice-based systems in West Africa, 19–21 March 2003, Cotonou, Benin.

Gridley, H.E. 2003. The role of participatory research in increasing rice productivity to assist in reducing poverty in West and Central Africa. Paper presented at a seminar on Agriculture, Food and Water in Africa—Policy and Practice, 11–13 February 2003, Nairobi, Kenya.

Jobe, L. M., S. Sanyang and M. L .K. Darboe. 2003. Response to some improved exotic rice varieties to the blast fungus *Pyricularia oryzae* at two sites in The Gambia. In: Sanyang, S., A. Ajayi and A. A. Sy (ed.) *Proceedings of the Second Biennial Regional Rice Research Review (4Rs 2002)*, 9–12 April 2002, Bouaké, Côte d'Ivoire. Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire. Pp. 137–142.

Ndiaye, M.K., M.C.S. Wopereis, T. Defoer and D. Guindo. 2003. Amélioration de la productivité des systèmes irrigués à base de riz en Afrique de l'Ouest et du Centre: opportunités, défis et priorités. Paper presented at the InterAcademy Council (IAC)/ Conseil ouest et centre africain pour la recherche et le développement agricole (CORAF) consultation workshop, Dakar, Senegal, 10–12 February 2003.

Nwanze, K.F., A. Youdeowei and F. Nwilene. 2003. Impact of IPM on food and horticultural crops in Africa. Keynote paper. In: Bahana, J., A. Bal, D. Dakouo and C.O. Omwega (ed.) *Book of Abstracts of the 15th African Association of Insect Scientists and the 5th Entomological Society of Kenya Joint Conference on Integrated Pest and Vector Management (IPVM) in the Tropics: Perspectives and Future Strategies*, 9–13 June 2003, International Center of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya.

Nwilene F.E., M.G. Saethre and O. Okhidievbie. 2003. Host plant resistance and biological control of African rice gall midge: Progress, problems and future needs. In: Bahana, J., A. Bal, D. Dakouo and C.O. Omwega (ed.) *Book of Abstracts of the 15th African Association of Insect Scientists and the 5th Entomological Society of Kenya Joint Conference on Integrated Pest and Vector Management (IPVM) in the Tropics: Perspectives and Future Strategies*, 9–13 June 2003, International Center of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya.

Saethre M.G., F.E. Nwilene and O. Okhidievbie. 2003. Tritrophic interactions in rice, African rice gall midge (*Orseolia oryzivora*) and its parasitoids. In: Bahana, J., A. Bal, D. Dakouo and C.O. Omwega (ed.) *Book of Abstracts of the 15th African Association of Insect Scientists and the 5th Entomological Society of Kenya Joint Conference on Integrated Pest and Vector Management (IPVM) in the Tropics: Perspectives and Future Strategies*, 9–13 June 2003, International Center of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya.

Sakurai, T. 2003. Land tenure security and investment in irrigation: evidence from lowland rice production in West Africa. Paper presented at the 25th International Conference of Agricultural Economists, 16–22 August 2003, Durban, South Africa.

Sakurai, T. 2003. Potential and constraints to intensification of rainfed lowland rice production in West Africa. Paper presented at the Pre-conference International Association of Agricultural Economists (IAAE) workshop on the Green Revolution in Asia and its Transferability to Sub-Saharan Africa, 13–16 August 2003, Durban, South Africa.

Sanyang, S. 2003. Strengthening national agricultural research systems in Africa through collaborative research networks. In: Sanyang, S., A. Ajayi and A. A. Sy (ed.) *Proceedings of the Second Biennial Regional Rice Research Review (4Rs 2002)*, 9–12 April 2002, Bouaké, Côte d'Ivoire. Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire. Pp. 3–8.

Séré, Y. et B. Koné. 2003. Biotechnologie et biosécurité en protection des plantes : enjeux et opportunités pour une agriculture durable en zone sahélienne. Paper presented at the workshop on Sustainable agriculture in the Sahel: lessons and opportunities for action. Organisé par Institut du Sahel (INSAH), Institut d'économie rurale (IER) et Syngenta Foundation, Bamako, Mali, 1–5 Décembre 2003.

Sié, M. 2003. Les NERICA ou le nouveau riz pour l'Afrique en riziculture de bas-fond. Paper presented during Journée du riz, 6 June 2003, Bobo-Dioulasso, Burkuna Faso.

Africa Rice Center (WARDA) Publications 2003

Cisadane: Gall midge tolerant variety released in Nigeria as FARO 51 in 1998. Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire, 6 p.

NERICA on the move. Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire, 6 p.

NERICA en plein essor. Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire, 6 p.

Essence of Africa Rice Center (WARDA): January–March 2003. (Quarterly newsletter). Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire, 4 p.

Esprit—le Centre du riz pour l'Afrique (ADRAO): Janvier–Mars 2003. (Quarterly newsletter). Africa Rice Center (WARDA), Bouaké, Côte d'Ivoire, 4 p.

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Esprit—le Centre du riz pour l'Afrique (ADRAO): Avril–Juin 2003. (Quarterly newsletter). Africa Rice Center (WARDA), Bouaké, Côte d' Ivoire, 4 p.

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WARDA/NARS Partnership: An African Success Story. Report of the Third Biennial WARDA/National Experts Committee Meeting, 11– 3 June 2002, Bouaké, Côte d'Ivoire. Biennial WARDA / National Experts Committee Meeting Report no. 3. Africa Rice Center (WARDA) Bouaké, Côte d' Ivoire.

Strategic Plan 2003-2012. Africa Rice Center (WARDA) Bouaké, Côte d' Ivoire, 56 p.

Proceedings of the Second Biennial Regional Rice Research Review (4Rs 2002), 9–12 April 2002, Bouaké, Côte d'Ivoire. Sanyang, S., O. Ajayi and A.A. Sy (ed.) Africa Rice Center (WARDA) Bouaké, Côte d'Ivoire, 172 p.

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	CGIAR's 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	NEPAD's Comprehensive Africa Agriculture Development Programme
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	ASARECA 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
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 et des 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

Consultative Group on International Agricultural Research (CGIAR)

The CGIAR is a strategic alliance of countries, international and regional organizations, and private foundations supporting 15 international agricultural research Centers that work with national agricultural research systems, the private sector and civil society. The alliance mobilizes agricultural science to reduce poverty, foster human well-being, promote agricultural growth and protect the environment.

The CGIAR was created in 1971. Today more than 8,500 CGIAR scientists and staff are working in over 100 countries, addressing every critical component of the agricultural sector including—agroforestry, biodiversity, food, forage and tree crops, pro-environment farming techniques, fisheries, forestry, livestock, food policies and agricultural research services. Specifically, the research targets the special needs, crops and ecologies of poor agricultural communities worldwide. In 2003, CGIAR members contributed $381 million—the single largest investment to generate public goods for the benefit of poor agricultural communities worldwide.

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 cosponsors.

For more information, please visit www.cgiar.org

Centers supported by the CGIAR

Africa Rice Center (WARDA)	www.warda.org
CIAT - Centro Internacional de Agricultura Tropical	www.ciat.cgiar.org
CIFOR - Center for International Forestry Research	www.cifor.cgiar.org
CIMMYT - Centro Internacional de Mejoramiento de Maiz y Trigo	www.cimmyt.org
CIP - Centro Internacional de la Papa	www.cipotato.org
ICARDA - International Center for Agricultural Research in the Dry Areas	www.icarda.org
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics	www.icrisat.org
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IRRI - International Rice Research Institute	www.irri.org
IWMI - International Water Management Institute	www.iwmi.org
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