Africa Rice Center (WARDA) - Annual Report 2005–2006

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Providing what's needed

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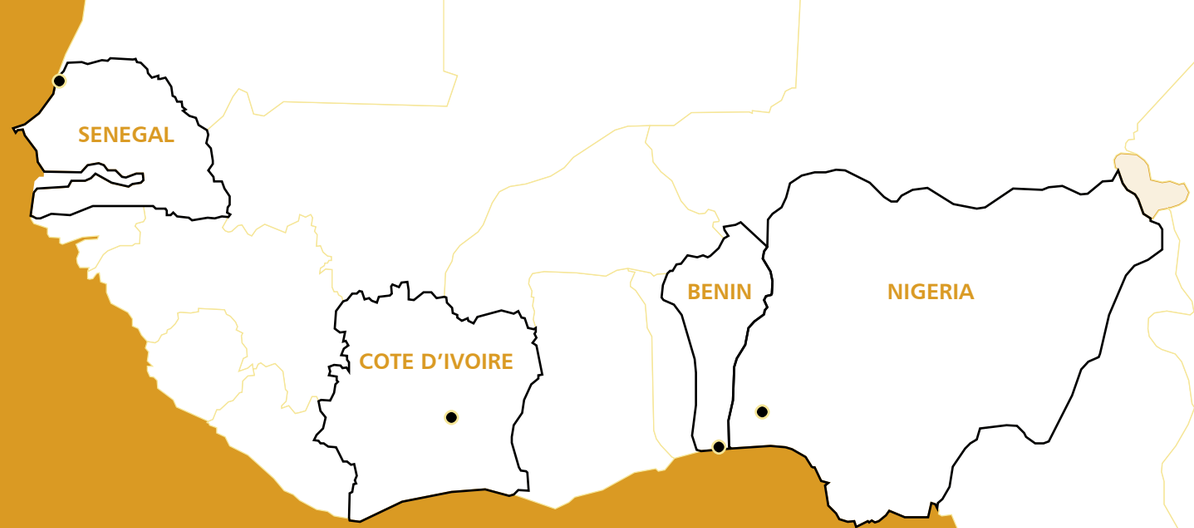

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About Africa Rice Centre

Africa Rice Center (WARDA) is an autonomous intergovernmental research association of African member states and 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 sub-Saharan Africa (SSA) 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.

WARDA hosts the African Rice Initiative (ARI), the Rice Research and Development Network for West and Central Africa (ROCARIZ), the System wide Initiative on HIV/AIDS and Agriculture (SWIHA) 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.

WARDA has its headquarters in Cotonou, Benin and regional research stations near Saint-Louis, Senegal and at the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria. WARDA's main research center is in Côte d'Ivoire but most scientists and researchers are temporarily located in Cotonou.

Contents

Message: From the Director General and the Chairman of the Board of Trustees

Synergy is not just a phenomenon found in the laboratory or in the plant breeder's screenhouse. At the Africa Rice Center in 2005–2006 synergy has touched everyone connected to the Center so that the first full year of operations in Benin are much more than just business as usual.

Indeed, business far from usual has seen the Center consolidate the success of the first upland NERICAs with lowland releases, begin a new capacity-building project to place biotechnology at the heart of the NARS, continue extension of its remit throughout sub-Saharan Africa, and present the Science Council with a highly appreciated Medium-term Plan. The goodwill towards rice research that was engendered by the 2004 International Year of Rice ensured that the Center continues to enjoy the full support of international donors and the cooperation of advanced international research centers outside SSA.

The Council of Ministers' Meeting held in Ouagadougou in 2005 confirmed the ongoing wholehearted support of WARDA's member States both for the Center's program concentrating on rice and rice-related research and for its progressive and carefully-considered expansion to meet demand from eastern and southern Africa for its international public goods. It was made clear that WARDA should remain as an independently functioning research center and the focal point for rice research in Africa, while collaborating with other CGIAR centers and other partners..

Within the CGIAR system WARDA is leading the development of the MTP for West Africa and an active participant in the Eastern Africa MTP. WARDA readily adopted the latest CGIAR System Priorities to underpin the Center's continuing engagement with poverty reduction in SSA and the creation and dissemination of the many pertinent international and regional public goods being produced by the Center. Alignment with other CGIAR centers operating in West Africa continues to be a WARDA preoccupation. Common Board members have been identified for the Center and IITA, which remains the host of WARDA's Cotonou headquarters. Common services supporting both WARDA and IITA are being examined for efficiencies that can be obtained while the head-quarters of the two centers are so geographically close.

Hot on the heels of the partnership with ASARECA that activated the ECARRN rice network with a WARDA coordinator based in Dar es Salaam, Tanzania, a revamped collaboration is being developed with IRRI and the Japanese Government in Africa. IRRI and WARDA have many decades of experience in rice R & D through working with poor farmers in unfavorable environments across Asia and Africa. Successful development of mutually beneficial IRRI-WARDA collaboration will play a critical role in supporting the rebuilding of the rice sector of resource-poor countries of SSA. Our partnership in rice-vegetable system research with the World Vegetable Center continues to strengthen in West Africa.

Through its partnership with national programs, WARDA concentrated its effort on the three major rice production systems, namely upland, lowland and irrigated. At the same time activities were undertaken in processing; dissemination of research results; policy and marketing issues; natural resource management, particularly impoverishment of soil fertility; water use efficiency; integrated pest management; and technology uptake. Issues such as the high cost of inputs, the unstable market, weak institutional policies and capacity building were addressed. A new area, which received increased attention, was the theme of drought.

Upland NERICAs were planted on more than 150,000 ha across Africa, including about 80,000 ha in Guinea and more than 20,000 ha in Uganda. Congo DRC is one of several countries outside WARDA's traditional area of operations that are turning increasingly towards the Center. A number of upland and lowland NERICAs are showing signs of good adaptation. Traditional WARDA areas are, however, far from neglected and five new irrigated rice varieties have been released in the Senegal River valley to join the three Sahel varieties already occupying more than 70% of the total irrigated rice area in the region. Three interspecific (irrigated NERICAs) and 1 intraspecific varieties were also identified for release in The Gambia.

In preparation for the 2007 EPMR, WARDA commissioned and welcomed teams carrying out Center-commissioned external reviews (CCER) on Integrated Genetic and Natural Resources Management (IGNRM) and Partnerships, and an evaluation report of the UNDP-sponsored Interspecific Hybridization Project. All of these teams produced positive and forward-looking reviews that acknowledged WARDA's output of research IPGs and made valuable recommendations for the continuation of successful and apposite research projects at WARDA. The highly diversified partnerships with all levels of the rice sector, including farmers, produced by the WARDA model was also recognized as a key factor to the Center's continuing success. The 2007–2009 MTP is already addressing realignments to focus greater efforts on irrigated and rainfed lowland rice ecosystems that have the greatest intensification potential.

The 2005 research days provided an important opportunity for WARDA team scientists from Cotonou and the satellite stations to present the results of their research activities for the previous 12 months and to present research plans and budget requirements for the year to come. We were pleased to welcome outside participants from INRAB (Benin), IRRI (Philippines), JICA (Japan), IITA (Benin) and Sasakawa Global 2000.

ECARRN organized a Stakeholders' Workshop on priority setting in Nairobi in December 2005 while SWIHA has continued to enlist new partners in its activities, developing working relationships with the national HIV/AIDS programs in Benin and other West African countries, and establishing collaborative working relationships with CABI and several NARES. A SSA Regional Workshop on HIV/AIDS and Agriculture and Nutrition in July 2005 identified negative impacts of HIV/AIDS on agriculture and food security which

need now to be addressed. A new network (ANEHA) to coordinate HIV/AIDS-related agricultural research in Africa was formed.

The reputation of the Africa Rice Center and of its research program continues to play a key part in attracting the high-caliber scientists and support staff essential to sustain an expanding and dynamic program of activities. The number of seconded experts, particularly from Japan, has been increased and there is enhanced collaboration with NARS partners. At ADG Corporate Services' level Mr Koen Geerts took up his duties in April 2006. Other arrivals in 2005–2006 were Dr Ines Sanchez, head of the GRU; Dr Margaret Kroma, sociologist; Post-doctoral fellows Dr Kassa Semagn (biotechnology – RYMV), Boubacarr Manneh (biotechnology – drought) and Dr Kazuki Saito (agronomy); Mrs Samira Hotobah-During, Head of Donor Relations; and Mr Kolade Olatifede, Budget and Planning Officer.

As well as attracting new international staff, a number of appointments resulted in the promotion of existing WARDA personnel. Dr Patrick Kormawa was appointed Leader of Program 2 within the Research Division; at the WARDA Sahel Station, Dr Vincent Bado, the Sahel Agronomist, was appointed Head of Station; Dr Mande Semon, PDF Molecular Biologist, was appointed Upland Breeder.

Scientists joining from cooperating institutions included Dr Glenn Gregorio, of IRRI, who joined the team at WARDA-Nigeria in 2006.

Among the departures were: Mr Long T. Nguyen, ADG Corporate Services; Dr Pierre-Justin Kouka, Head of Donor Relations; Dr Kouamé Miézan, Head of the Sahel Station; Dr Howard Gridley, Upland Breeder; Dr Philippe Morant, IVC coordinator; and Mr Obed Agufana, Human Resources Manager.

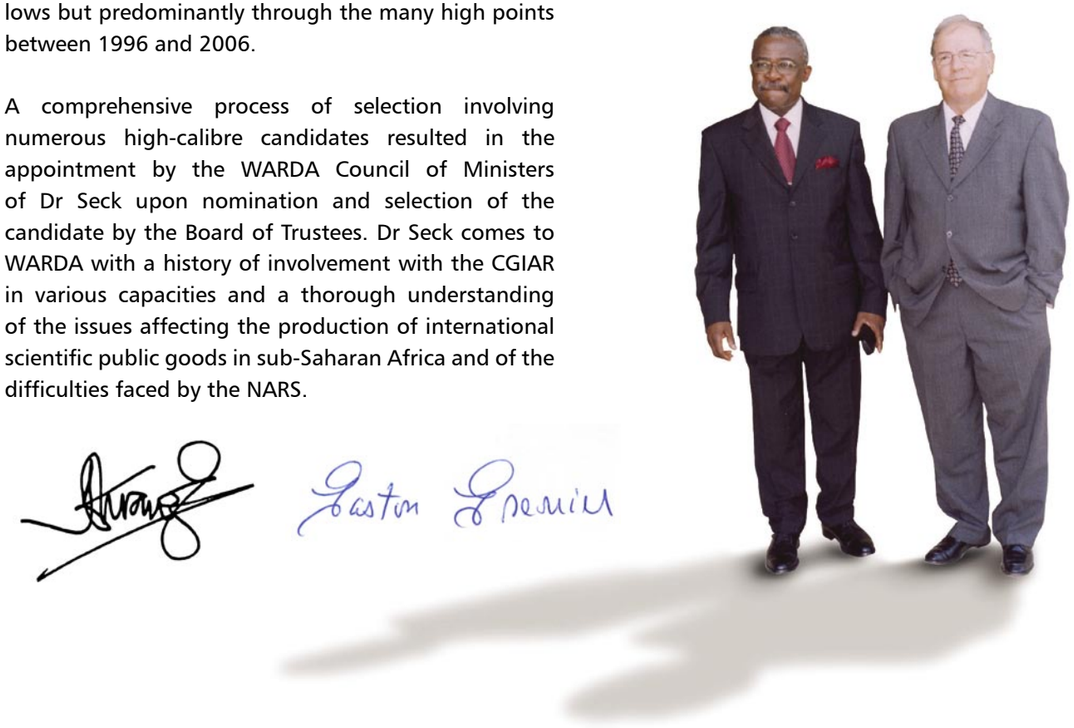
The financial health of the center continues to improve so that it meets CGIAR norms and indeed surpasses that of other larger Centers in terms of income turnover. Africa Rice Center's grant income for 2007 is projected at US$ 12.46 million, an estimated increase of US$ 0.26 million over 2006 grant income from donors. Expenditure in 2007 is estimated at US$ 12.20 million compared to actual spending of US$ 11.15 million in 2005 and estimated spending of US$ 11.89 million in 2006. The resource allocation to research for 2007–2009 is projected to be more than 66% of the total available.

The WARDA Board of Trustees and Management are implementing every possible measure to preserve the value of the investments in the M'bé headquarters and site which continues to be used for some trials and for NERICA seed multiplication.

It is not possible, *writes Gaston Grenier*, to sign off on 2005–2006 without acknowledging that this has been the last full Center year of the current Director General Dr Kanayo Nwanze who hands over the reins on 30 November, 2006 to Dr Papa Abdoulaye Seck of Senegal. In completing the full 10-year tenure allowed to DGs, Dr Nwanze is responsible for guiding WARDA through many programmed improvements and for navigating other unscheduled changes forced by circumstance. Highlights of his two terms as WARDA DG undoubtedly include the launch and dissemination of the upland and lowland NERICAs, the development of WARDA as the Africa Rice Center and its active expansion throughout sub-Saharan Africa.

Given the volatile background in which the Center has worked for many of those 10 years, he was largely responsible as its public face for the outward appearance of calm and 'business as usual'. Africa Rice Center will remain indebted to Dr Nwanze for his steadfast stewardship through a few unfortunate, unavoidable lows but predominantly through the many high points between 1996 and 2006.

A comprehensive process of selection involving numerous high-calibre candidates resulted in the appointment by the WARDA Council of Ministers of Dr Seck upon nomination and selection of the candidate by the Board of Trustees. Dr Seck comes to WARDA with a history of involvement with the CGIAR in various capacities and a thorough understanding of the issues affecting the production of international scientific public goods in sub-Saharan Africa and of the difficulties faced by the NARS.



When delighted farmers or even WARDA's own staff talk enthusiastically about NERICA it is easy to forget that NERICA stands not just for one or even 20 improved varieties of rice but an extended family of some 3000 siblings!

Of course, some of those siblings – as in any sprawling but ultimately ordered family – push their way to the fore more than others. That is why even the best-informed NERICA watchers still think of NERICA 1-18 – the first released upland varieties that took West and Central Africa by storm. Now some 60 siblings directed at lowland culture are jostling to be noticed in widespread evaluation trials throughout sub-Saharan Africa.

In addition to the upland NERICA varieties, WARDA and national programs of West African countries developed NERICA varieties suitable for rainfed and irrigated lowlands, one of the most complex rice ecologies in the world. Key to this success was the unique R&D partnership model forged between WARDA and the national programs of West African countries through the Rice Research and Development Network for West and Central Africa (ROCARIZ), which facilitated the shuttle-breeding approach to accelerate the selection process and achieve wide adaptability for the lowland NERICAs

Lowland NERICAs are being evaluated in about 20 African countries across West, Central and East Africa for different water regimes, and in different integrated crop management scenarios. Plans are under way to characterize more *glaberrima* germplasm in lowland ecosystems to allow better-targeted crosses and molecular characterization of elite and promising characteristics. Work is continuing on improving the first generation of lowland NERICAs and a second generation with improved plant height has already been developed.

The potential in the lowlands is huge. In West Africa alone there are an estimated 20 million hectares of cultivable lowlands. If just 2 million hectares of lowlands is grown to rice producing an average yield of only 3 tonnes per hectare, the region 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.

Given such high potential, the new lowland NERICAs are expected to make an even bigger impact than the upland NERICAs, which have previously unleashed the potential of the upland rice ecologies across Africa.

The lowland NERICAs were developed by a research team led by Dr Moussa Sié, WARDA's lowland rice breeder, and Dr Kouamé Miézan, then head of WARDA's Sahel Station in St-Louis, Senegal, and their national partners using the interspecific hybridization technology. The development, release and farmers' adoption of the lowland NERICAs were the direct outcome of the work done by WARDA and its NARS partners (especially INERA in Burkina Faso, ITRA in Togo and IER in Mali) during 2002-2004 through the ROCARIZ rice network.

Dr Sié highlights that the lowland varieties have a yield potential of 6-7 tonnes per ha, and are demonstrating good resistance to major lowland stresses. Use of the Participatory Varietal Selection (PVS) process is underwriting the acceptability of these new varieties to farmers, with the result that four lowland varieties were officially released in Burkina Faso and two in Mali in 2005.

In the case of Burkina Faso, rice is grown in three ecologies: upland, which accounts for 10% of the rice-cropped area and provides 5% of production, irrigated schemes (23% of cropped area and 53% of the production) and lowland rice, which covers 67% of rice-cropped area and provides 42% of the country's production.

Lowland rice is the most important traditional way of rice farming in Burkina Faso and also combines characteristics from upland and irrigated rice. However, traditional cultivars grown in most cropped lowlands are in the process of being lost because of their long cycle which is not adapted to decreasing rainfall. Farmers have been growing varieties of *Oryza glaberrima* because of their resistance to drought, their plant vigor, tolerance to weeds and good grain quality.

In order to meet the needs of both farmers and consumers, Dr Sié says it is

Table 1.
Names and origins of new lowland varieties (NERICA type) released in Burkina Faso.

Name of Varieties	Genetic origins (parents)	Geographic Origins	Released names
WAS 161-B-9-3	TOG 5681 / 4*IR 64	WARDA (ADRAO) St-Louis, Senegal	FKR 56N
WAS 191-9-3	IR 64 / TOG 5681 // 4*IR 64	WARDA (ADRAO) St-Louis, Senegal	FKR 58N
WAS 122-IDSA-1-WAS-1-1-B	TOG 5681 /.3*IR 64	WARDA (ADRAO) St-Louis, Senegal	FKR 60N
WAS 122-IDSA-1-WAS-6-1	TOG 5681 / 3*IR 64	WARDA (ADRAO) St-Louis, Senegal	FKR 62N

FKR: Farako-Bâ Riz **N:** NERICA (New Rice for Africa)

The NERICA varieties have been shown to possess better grain quality than existing local varieties (particularly whiter color and, lower susceptibility to breakage during milling). In addition, some of the NERICAs have been identified to have the same or even better cooking and eating characteristics than most types of imported rice available in West Africa.

necessary to valorize the *Oryza glaberrima* resource through genetic and agronomic improvement of its cultivars as well as to explore the yield potential of the Asian rice species, *Oryza sativa*. A research program has been carried out in Burkina Faso since 1999 on introduced breeding lines, which include hybrids from interspecific crosses between *Oryza sativa* L. and *Oryza glaberrima* St.) and intraspecific crosses (*O. sativa x O. sativa*).

The objective was to identify high yielding varieties resistant to environment constraints such as diseases and insect pests as well as climatic and edaphic factors. The research team tapped into the African rice for traits of resistance to major lowland stresses, particularly rice yellow mottle virus (RYMV). The *sativa indica* varieties (traditional irrigated or lowland rice) were used in the crosses instead of the *japonica* (traditional upland rice). 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. The crosses successfully transferred resistance to RYMV into some of the progeny.

Both farmers and scientists through PVS made selections from the introduced breeding lines. Over four years of experimentation, several advanced lines showed consistent performance resulting in the release of four named NERICAs (*Table 1*).

Selection criteria inevitably vary from one farmer to another but involvement of a large number of farmer-selectors ensures that the final choices made do indeed reflect just what is most acceptable to a wide range of rice growers. The farmers at the Sowe PVS trial site in Burkina Faso altered their selection criteria between visits. On their first visit (*Fig. 1*), they ranked tillering ability, size, color and plant recovery ability as their most important reasons for choosing particular lines. Next time they came, they selected panicle weight as the prime determinant of plant yield and vigor. Although plant growth stage was clearly a major influence on their choice, it was nevertheless possible to draw overall conclusions about the varieties when the results of the different selection times were combined.

Among the characteristics of the new released varieties, their height is shorter and cycles similar to that of the check (FKR 14). But there is an improvement in grain size and quality, particularly for FKR 60N and FKR 62N, which are larger and thinner. All four new varieties have higher 1000-grain weights compared to that of the check.

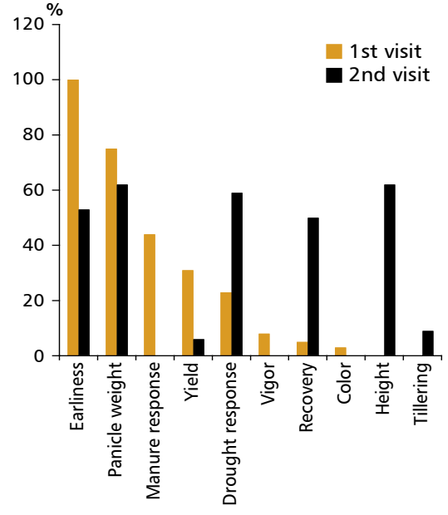


Figure 1.
Most important reasons for farmers' variety choices.

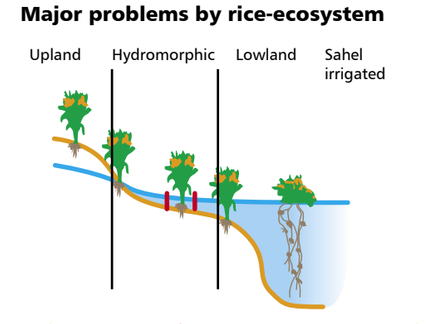


Figure 2.
How constraints to rice production pan out across ecosystems.

The yield potential of some Lowland NERICAs can reach 6-7 tonnes/ha.

Well-filled panicles are what every grower wants to see in his or her field.

An expanding number of farmers throughout sub-Saharan Africa are picking up the news about NERICA and gaining extra income by planting these improved varieties in different ecologies. But how do you make sure there is both enough seed to meet demand and that the NERICA revolution in high quality seed is sustained?

Too much like glaberrima so these offtypes are about to be removed.

As an international center, WARDA is charged with carrying out the basic and applied research that leads to the development and introduction of new rice varieties that are acceptable and beneficial to resource-poor farmers in sub-Saharan Africa. WARDA rice breeders and the Genetic Resources Unit are responsible for maintaining stocks of so-called breeders' seed – the pure and distinct result of the breeders' crossing programs – to provide a source for future crossing programs by WARDA and in the NARS as well as a check to ensure the quality of succeeding seed generations of a particular variety.

One of the biggest constraints to the successful use of NERICAs is the availability of seed. It seems clear that the success of NERICA is bigger than what the current seed supply can support. Obviously, NERICA can only have a greater impact on livelihoods of farmers in SSA if the seed supply system is enhanced. From a WARDA study published in 2005, it appears that only 29% of the farmers interviewed were cultivating improved high yielding rice varieties, according to Dr Patrick Kormawa, Associate Director and leader of WARDA Program 2.

The reason for this was a severe lack of availability of seed. An estimated 250,000 tonnes of NERICA seed would currently be needed to replace all upland rice production in Africa, he says. The study observed that in most African countries, the national agricultural extension and other systems are not sufficiently developed and have not been responsive to farmers' needs for new technologies. Another constraint was the relative high cost of complementary inputs (fertilizers, pesticides, water) compared to a low rice price.

Such concerns about the weak and sometimes non-existent seed sectors in many SSA countries prompted the creation of the African Rice Initiative (ARI), backed by the African Development Bank, in 2002. It is responsible for multiplication and dissemination of NERICA seed to requesting countries and is primarily concerned with foundation seed, says seed multiplication specialist Ryoichi Ikeda, a JICA expert seconded to ARI and WARDA.

Usually, there are three steps for seed multiplication: (1) from breeder seed to foundation seed, (2) foundation seed to registered seed and (3) registered seed to certified seed. The certified seeds are delivered to rice farmers for their cultivation. ARI takes on the production of foundation seed for delivery to national programs in SSA where it may be used by breeders in their own crossing and assessment programs or multiplied to produce registered seed.

Multiplication of rice seed under African conditions generally gives a 20-30-fold return, says Dr Ikeda, who would normally expect around 50-times multiplication with Asian varieties under Japanese growing conditions. This lower rate of return makes it particularly important to ensure only the highest quality NERICA seed is distributed to partner countries. Since moving to Cotonou, ARI has concentrated its foundation seed production on an irrigated site at Deve in central Benin, but Dr Ikeda plans to expand production to another site on the Benin-Togo border.

"*To get much more seed volume, it is better to use many different locations but that requires careful management since the risk of dissimilar seeds being mixed increases with each new site to monitor*."

Quality control starts at the breeder and GRU levels, however. Both have to monitor constantly for offtypes when renewing their retained seed stocks. The way in which breeders and the GRU cultivate varieties is different and can influence the integrity

of WARDA's seed reservoir. When the GRU cultivates NERICA varieties in the field, it always handle them as bulk populations while breeders, on the other hand, cultivate the variety in each family with several lines separately from each other. Then, they multiply the breeder seed to carry out the line selection and the individual selection simultaneously. Either method allows tracing back to the original lines to investigate the cause of suspected seed mixture, but it is important that offtypes are removed during the maintenance process for breeder seed stocks.

Dr Ikeda's quality control measures are designed to ensure that any mistakes that sometimes occur are quickly detected and corrected. He takes the breeder seeds of NERICA varieties and sows them in small plots with three seeds at first to each hill. This is reduced to one seedling per hill after emergence to make it easier to detect and remove offtypes based on factors such as variation of leaf sheath color, apiculous color, awnness, plant type, panicle type and semi-sterility. The plants are then monitored through to maturity and the resulting foundation seed harvested.

In one of his 2005 monitoring trials with breeder seed, the detection percentage of offtypes in NERICA 1-7 varied from 0.25% to 7.39% for all varieties except NERICA 4. The high incidence (86%) of offtypes in the NERICA 4 indicated that the originating stock of this variety had been replaced by other seeds and should be discarded in favor of stocks of proven integrity. The monitoring produced a sound foundation seed stock of all seven NERICA varieties for transfer to NARS. Future re-selection of breeder seed will ensure the continuing integrity of this valuable resource.

With responsibility for maintaining foundation seed and multiplying registered and certified seed lying with the NARS, Dr Ikeda is one of several WARDA scientists passing on skills in seed conservation and multiplication through training of NARS technicians in seed production.

Odd one out: a NERICA 7 offtype (center) fails to display typical basal purple coloring.

Backing up the ARI effort is that from WARDA's policy team. Despite NERICA's wide dissemination over Africa there is an urgent need for the development of a strong market for NERICA and a prominent position for it on national policy agendas. To achieve significant and sustainable increments in rice production a comprehensive rice sector development program will be required in the major rice producing countries, as part of the overall agricultural development plan, urges Dr Patrick Kormawa.

Among the most important prerequisites for capturing the full benefits of agricultural technologies like NERICA are political and social stability. This means, among others, the removal of unfair subsidies, an active involvement of the private sector, improved access by farmers to credits and affordable inputs and an overall better infrastructure, factors that are not easily met in sub-Saharan Africa.

		Year			
		2003	2004	2005	Total
Seed produced (kg)	**BS[1]**	75	151	1,474	1,700
	BS[1]	350	1,063	14,102	15,515
	Total	425	1,214	15,576	17,215
Seed distributed (kg)	**BS**	65	100	1,400	1,565
	FS	350	1,000	13,900	15,250
	Total	415	1,100	15,300	16,815
Beneficiary countries		2	4	17	17

[1]BS: Breeder Seed, FS: Foundation Seed. [2] Benin, Burkina Faso, Congo DRC, Ethiopia, Ghana, Guinea, Kenya, Mali, Mozambique, Nigeria, Sierra Leone, Tanzania, The Gambia, Togo, Uganda and India and the Philippines. *Source: ARI Coordination Unit, WARDA 2006*

Table 2. Production and distribution of NERICA seed by ARI Coordination Unit.

Country	Benin	Gambia	Ghana	Guinea	Mali	Nigeria	Sierra Leone	Total
Quantity (tonnes)	15	986	36	806	50	250	260	2 603
Seed category	FS1	CS and FS	FS	CS and FS	FS	FS	CS and FS	

[1] FS: Foundation seed, CS: Certified seed. *Source: ARI Coordination Unit, WARDA 2006*

Table 3. Production of seeds in pilot countries in 2005.

Feature: **Mixing local innovations with partnership science and South-South cooperation**

You can take a horse to water but you can't make it drink: an old adage that can apply to uptake of new technologies and knowledge unless resource-poor farmers get clear expert guidance.

Social learning is one of the underpinning principles of PLAR.

Step forward WARDA's Technology Transfer Unit which has achieved some major methodological breakthroughs over the last few years in introducing farmers to simple and cost-effective appropriate technologies as well as assisting with the spread of the flagship NERICAs.

Community-based seed production systems (CBSS) and participatory varietal selection (PVS) involving partner-farmers in selected villages were, of course, key tools used in the testing and dissemination of the first NERICA varieties. Next came participatory learning and action research (PLAR) which proved to be an excellent tool to develop and spread appropriate technologies. Recently, the Unit started focusing more on social research questions and now successful techniques from Asia are being introduced in Africa.

PVS was the first major breakthrough by WARDA's Technology Transfer Unit (Annual Report 1999, p. 11-12). Its objective is to enhance plant-breeding efforts through participative identification of important plant characteristics and by letting the farmers select their preferred cultivars. PVS improves the adoption rate of varieties; it accelerates the dissemination of new lines and is sustainable due to its participative character.

PVS was soon followed by a new seed multiplication scheme using farmers' practices and local knowledge as an alternative seed-supply mechanism for smallholder farmers – the community-based seed production system (CBSS) – allowing the rapid spread of NERICAs in Africa.

The most recent breakthrough is participatory learning and action research (PLAR). Developed in 2001 as an approach to promote technological change through improving farmers' capacity to exchange ideas, knowledge, experiences and practices in farming techniques (Annual Report 2002–2003, pp 23-32), PLAR has now been introduced in Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Madagascar, Nigeria, The Gambia and Togo. WARDA has developed a series of PLAR manuals in Engish and French.

"*PLAR is a methodology that aims to valorize scientific and local knowledge through a social learning process*", explains Dr Paul Van Mele, WARDA's Technology Transfer Agronomist. "*Local knowledge and innovations are cornerstones of PLAR, not only for the development of learning modules, but also for altering the mindset of those working with farmers. They frequently need to be trained in identifying and valuing local knowledge*".

"*We tend to forget that farmers play a significant role as local innovators capitalizing on their day-to-day experience. Their knowledge is often lost over time or remains locked up in the memories of individual families and communities because of the lack of a suitable mechanism for dissemination*".

Initially, PLAR was developed for integrated soil fertility management and integrated crop management (ICM) for rice-based cropping systems. But now farmers apply their newfound learning to a wide range of other crops including maize, sorghum, millet, cowpea, soybean and vegetables. This shows that rice can be an entry point for development, where farmers adopt technologies and adapt these to be used on other crops as well.

"*Decisions to test new ideas are made in groups, and small experiments are then conducted in each of the farmers' fields*," says Van Mele.

Technology transfer should result in quality product.

WARDA is now capitalizing on local innovations imported from Asia where they have proven successful and that are of considerable relevance to Africa. Among these are the use of tree-dwelling weaver ants (see p. 19, opposite) to benefit farmers, and the use of video tools in transfer of technologies (see p 21, overleaf). Both these examples demonstrate the importance of PLAR as a vehicle for South-South cooperation.

In 2005-2006, WARDA's Technology Transfer Unit organized four training workshops in Ghana, Guinea, Mali and The Gambia for project coordinators, extension workers, scientists and NGOs. These workshops focused on concepts, tools and techniques to better understand farmers' perceptions of innovations. They also marked the first five years of Participatory Learning and Action Research and its development from a relatively small-scale approach – focused on integrated soil fertility management and integrated crop management – into a recognized international public good, using local knowledge and innovations to improve the quality of life of millions of Africans through partnership activities and South-South cooperation.

Tree-dwelling weaver ants

The use of tree-dwelling weaver ants *(Oecophylla smaragdina* in Asia and *O. longinoda* in Africa) to protect tree crops is an example of an Asian innovation that is being adapted for use in Africa. Rather than being a harvest-time nuisance as many people think, weaver ants can control major pests on citrus, cashew, coconuts and cocoa, and thereby improve the yield and quality of the fruits and nuts. Since fewer chemicals are needed, the use of ants creates a healthier environment, saves money and gives farmers who nurture the ants the opportunity to produce fruit and nuts of better quality at lower cost and labor input.

An approach to help farmers to manage these ants and how to make best use of them, has long been a tradition in some countries in Asia. Since weaver ants can also be found in many African countries, i.e. Burundi, Cameroon, DR Congo, Côte d'Ivoire, Gabon, Ghana, Kenya, Nigeria, Rwanda, Tanzania and Zambia – it is time to

A farmer's best friend if treated well and nurtured for crop protection.

teach African farmers how these ants can play an important role in ecologically-based practices, suggests WARDA's Dr Van Mele.

WARDA uses the PLAR method for extending this knowledge to African farmers and cooperates with the International Institute for Tropical Agriculture (IITA), and the *Institut de recherche agronomique de Guinée* (IRAG) – an example of WARDA's partnership approach – in a project called 'Promoting Ant-Based Pest Control in Tree Crops in West Africa'.

The focus of the project is first on Benin and Guinea. In these countries, traditional knowledge related to ants and major mango and cashew pests will be documented, as well as its relevance for nature conservation. While placing local farmers at the center of a partnership with researchers, extension agents and conservationists, the experiences from Asia will be useful in better targeting the efforts in West Africa. Relevant publications and complementary learning tools will be translated and/or developed into French (and local languages when needed) to provide general principles from which farmers and researchers can develop their own understanding and practice.

In Guinea, a team has been trained in the collection and documentation of traditional knowledge, as well as in the use of PLAR for rice. These skills will be used to develop PLAR modules for cashew, which recently became a high priority crop for the Guinea government. The crop is increasingly planted on the fringes of lowlands, where rice is grown in the valley and training needs are high. WARDA is on top of these new developments and will actively contribute in realizing the project goals.

In Benin, WARDA's current host country, the project will focus on mango. Expertise in the area of fruit flies is available through IITA and the outputs of the project will have a significant contribution to the fruit sector in the whole of Africa.

The above mentioned activities will be beneficial in terms of biodiversity, public health, sustainability of farming practices, economics, and capacity building for farmers, conservationists and agricultural extension workers and researchers.

The use of weaver ants may not only be beneficial to mango, cashew and citrus, but also to a range of other tree crops such as cacao in West and Central Africa, and coconut in Eastern Africa. Since the geographic distribution of the weaver ant covers large parts of tropical Africa, the activities to be started in Benin and Guinea are a significant step forward in developing an Africa-wide network.

Did you know that you can get rid of termites by smoking them out with tobacco leaves;

that if rice seeds are dressed with wood ash, they can be safely stored;

or that tethering of livestock in cereal fields can help reduce Striga infestation in those fields?

If you haven't heard of these simple solutions, you are not the only one.

Quite a few agricultural researchers and extension workers are also not aware of them.

Video tools

Video is proving a particularly effective tool for spreading knowledge across borders.

African farmers are now benefiting from WARDA collaboration with CABI Bioscience and the International Rice Research Institute (IRRI), which developed four documentary films on seed health improvement. These small-scale video projects are low-cost communication solutions that enable local people to show their achievements. People in Bangladesh explain their experiences with rice seed in their local language and the videos are then transmitted to other farmers who then benefit from this knowledge. In this way, farmers learn to solve problems themselves and traditional knowledge is documented to be passed on to future generations. The training videos not only help to change the mind-shift of those working with farmers, but also to up-scale PLAR and to exchange local innovations in South-South cooperation.

WARDA is now translating the videos on seed health improvement into French and Bambara, a language widely spoken in West Africa. Since this is a cooperation between WARDA, IRRI and CABI Bioscience, the use of video tools constitutes an excellent example of partnership activities and South-South cooperation.

Five do well in Senegal

Irrigated rice farmers in the Senegal River Valley now have a wider choice of improved rice varieties thanks to collaboration between the Africa Rice Center and its NARES partners in Senegal (ISRA and SAED).

Choice is important for these farmers because more than 70 percent of the total 37,000 hectares of irrigated rice area cultivated in the region has comprised just three existing Sahel varieties making lack of genetic diversity something of a concern.

In 2005, the national rice v release committee in Senegal officially released five (5) new varieties for use by rice farmers in the Senegal River Valley where irrigation is the only option for productive agriculture but there is a potential for rice yields averaging up to 10 tonnes per hectare. These new varieties are: **Sahel 134** (IR 31851-96-2-3-2-1), **Sahel 159** (IR 32307-107-3-2-2), **Sahel 208** (ITA 344), **Sahel 209** (Tox 3241-22-3-3-1) and **Sahel 210** (ECIA 31-6066).

Following initial selection of the varieties at WARDA Sahel research station in Saint-Louis, Senegal, the Senegalese agricultural research institute (ISRA) undertook intensive multilocation tests in collaboration with the national irrigation development authority (SAED) to assess the performance of the varieties in a range of irrigated rice production environments in the Senegal River Valley. The official report of the tests was then presented to the national rice varietal release committee, which officially released the varieties to the farming population in 2005.

These varieties will further increase genetic diversity and offer varietal choices in addition to the three Sahel varieties that now occupy more than 20,000 ha. Eventually, it is planned that these five varieties will also be available for use by Mauritanian farmers who cultivate more than 23,000 hectares of irrigated rice, north of the Senegal River valley. The potential there for increasing rice yields and profits is perhaps even greater than in Senegal. The agricultural sector in Mauritania employs about 65% of the labor force and accounts for approximately 25% of GDP.

Rice is a staple food in Mauritania where the local cuisine is based on rice and lamb or goat. Paddy rice – grown almost exclusively on irrigated land in the fertile Senegal River Valley – has expanded considerably in recent years and now accounts for about 50% of cereal output. However, local rice production doesn't meet the country's demand since yields are generally far below the potential.

WARDA, in collaboration with various national partners – CNRADA, SONADER, AGETA and farmers' organizations – introduced the integrated crop management (ICM) approach with great success into irrigated rice-based systems in Mauritania with support from the World Bank, the Government of Mauritania, the UK Department for International Development (DFID) and the Japanese International Cooperation Agency (JICA).

By adapting with local farmers the ICM solutions developed elsewhere in West Africa, WARDA has introduced a basket of ICM options for improved fertilizer, weed, and water management, improved varieties and efficient post-harvest technologies as well as decision-making tools, such as optimum sowing date, seeding and fertilizer rates and timing of fertilizer application, based on crop modeling research

New varieties of rice for irrigated cultivation have the potential to yield up to 10 tonnes per hectare in the Senegal River Valley. Thanks to an Africa Rice Center collaboration with a number of overseas donors and partnership with the Government of Mauritania the underlying potential north of the Senegal River can now be exploited more fully with the new varieties and inegrated crop management methods tailor-made for the local conditions.

Integrated crop management and improved varieties are showing farmers the way to top yields

Research highlights: How research is getting to the root of Africa's food shortages

Reports of famine in various parts of Africa again focused the eyes of the world on the continent in 2005 and 2006. Irrespective of whether food shortages are attributable to climate change, conflict or underdeveloped infrastructure, WARDA's rice research program is directed to eliminating such production and supply problems. WARDA believes that food, in particular rice, can be grown sustainably to meet Africa's needs.

The development and release of new NERICAs for the lowlands are only the latest fruits of this R&D thrust, while the outward spread of the upland NERICAs continues across West, East, Central and Southern Africa. Rice represents life for many major populations throughout the world and is deeply embedded in the cultural heritage of many societies. It is a staple food for more than half of the world's population. In Africa, rice has become increasingly important, both as a food source and as an economic commodity. Rice is now the most rapidly growing food source in Africa.

NERICA is one tool for ensuring Africa's next generation has food to go around.

Potential for growth through NERICA

Rice production in Africa increased from 8.6 million tonnes of paddy in 1980 to 18.6 million tonnes in 2005. Despite such dramatic growth, demand continues to exceed supply and the region relies on imported rice. The quantity of rice imported yearly by the region increased from 2.5 million tonnes in 1980 to 7.6 million tonnes in 2004 (FAOSTAT, 2006). In the immediate future, food security in Africa will largely depend on achieving a sustainable increase in local rice production.

Land with potential for arable production in Africa is estimated at 637 million hectares, with about 68% in reserves. The area currently designated for rice production represents only about 1.6% of total potential arable land. Low labor cost and increasing availability of yield-enhancing technologies to farmers will contribute to increasing rice production.

NERICA (New Rice for Africa) is the cornerstone of the Africa Rice Center's international public goods (IPGs) in the third millennium. Such is its success with smallholder farmers that they may often overlook that NERICA is not just one variety or even one family of varieties. Today it encompasses rice varieties suitable for the very different upland and lowland ecologies and in the future the NERICA appellation will be even more embracing as varieties continue to be bred from Asian and African parents while incorporating various genes for tolerance to known constraints on smallholder rice production.

Upland NERICAs were planted on over 150,000 ha across Africa in 2005, including about 80,000 ha in Guinea and more than 20,000 ha in Uganda.

Much more rice will be gathered as NERICA adoption continues apace.

Farmers play a vital role in PVS and other selection of improved varieties.

As well as the development, testing, dissemination and uptake of these improved lines and varieties throughout Africa, germplasm is shared with researchers on other continents. Africa Rice Center research to characterize genes and develop markers associated to drought tolerance in *O. sativa* and *O. glaberrima* is expected to have widespread application in rainfed systems, together with new information on interactions between drought and other biotic and abiotic factors in rainfed rice ecosystems which will feed into the global knowledge bank on the likely impacts of climate change. Information on the physiological mechanism underlying drought tolerance in the different rice species and sub-species and databases on drought mapping will have widespread application.

Hand-in-hand with germplasm improvement goes research in complementary technologies, including integrated soil fertility management, IPM options for RYMV and AfRGM, cultivation technology options for rice-based systems in lowland, and options for integrated crop and natural resources management to enhance irrigated rice productivity and profitability. Within the framework of IGNRM, special attention was paid in 2005-2006 to addressing problems of degradation that have become particularly associated with irrigated rice-based systems in Africa.

In the joint project with AVRDC, development proceeded on rice-vegetable systems that are as relevant outside Africa as they are for many countries in Africa where the nutritional benefits of systems combining rice with other products such as vegetables or fish have still to be felt.

Through its partnership with national programs, WARDA concentrated its effort during the year on the three major rice production systems, namely upland, lowland and irrigated. At the same time activities were undertaken in processing; dissemination of research results; policy and marketing issues; natural resource management, particularly impoverishment of soil fertility; water use efficiency; integrated pest management; and technology uptake. Issues such as the high cost of inputs, the unstable market, weak institutional policies and capacity building were addressed. A new area, which received increased attention, was the theme of drought.

Severe drought in 2005 trials highlighted promising material with potential to confer drought tolerance. Although the 300 test lines had not been rigorously selected previously for drought tolerance, almost one third of the lines significantly outyielded one or more check varieties. These lines provide a valuable pool of material to assist maintenance of yield under severe drought conditions and will be disseminated widely to NARS for evaluation in SSA.

Five new irrigated rice varieties were released in the Senegal River valley. These varieties further increase the genetic diversity and offer varietal choices in addition to the three Sahel varieties that now occupy more than 70% of the total irrigated rice area in the region. Three interspecific (irrigated NERICAs) and 1 intraspecific varieties were also identified for release in The Gambia.

In Congo DRC, seven NERICAs were evaluated using participatory variety selection in two ecologies. This showed that NERICA4, NERICA6 and NERICA7 were the most adapted, but 18 upland types were also selected from 220 new NERICAs. Good results were obtained with 11 out of 72 NERICA lowland varieties evaluated.

Research in 2005–2006 for new generations of NERICAs uncovered lines with better characteristics associated with weed competitiveness than those of the first generation.

An *O. glaberrima* line showing shorter growth duration than CG 14, the *O. glaberrima* parent of all commercial upland NERICAs has also been identified. Seventy-two potential parents were characterized for drought tolerance/resistance both at vegetative and reproductive stages of plant development, and genetic and QTL assessment in NERICA was completed. The screening methodology developed at WARDA to identify durable blast resistance varieties was transferred to NARS partners.

Experiments found fewer deadhearts on rice intercropped with maize as a trap crop than on monocropped rice or maize. A habitat management strategy was developed to control the African rice gall midge (AfRGM) in Nigeria by using plants of *Paspalum scrobiculatum* around rice fields as a reservoir of AfRGM parasitoids.

On-farm trials were completed in Senegal of a prototype small-scale harvester to address the bottleneck of labor shortage for harvest and post-harvest operations. This is a follow-up to the highly successful ASI thresher now being built by local craftsmen in several West African countries. It is a further example of how partnerships at single country level can produce results for sharing across borders.

Nutrition gets a boost from rice with vegetables and fish.

Creating a dynamic policy environment

Policy-related and social sciences research has been strengthened at WARDA. Statistics summarizing rice trends for production, consumption, and trade in SSA were published on WARDA's website as well as put on CD and made available to collaborating NARES for wider dissemination. The document can be accessed from the WARDA website: http://www.WARDA.cgiar.org/publications/Rice%20Trends.pdf.

In collaboration with partners in Nigeria, Mali, Burkina Faso and Niger, a Rice Policy Research and Advocacy Network – Agricultural Policy Research and Advocacy Group (APRAG) was formed in March 2005. The main objective of the network is to bridge the gap between policy research and advocacy groups for enhancing adoption of policy recommendations.

In taking stock on rice policy and its effects in SSA countries, a regional rice policy and food security workshop was organized for 80 participants from 20 countries who identified regional research and development priority areas for promoting rice policy impact in SSA.

A study on gender-differentiated impact of collective action governance in semi-collective irrigated rice schemes in Benin was completed. The results show that women are particularly discriminated against with regards to access to land, with significant impacts on their productivities, incomes and technical efficiencies. Inequality and discrimination were also observed in the male groups, with significant negative impacts on the productivities and incomes. In fact most of the inequality in the perimeter results from the inequalities in the male groups. However, this discrimination did not have a significant impact on technical efficiency. These results show that outside intervention may be necessary to ensure that self-created collective action groups do not exacerbate intra- and inter-gender inequalities.

Research briefs

A farmer training video on an improved rice parboiling technique and equipment was developed in collaboration with local artisans and released in partnership with SG2000 and INRAB in French, Fon and English

A regional workshop on mainstreaming HIV/AIDS prevention programs in agriculture was organized and attracted over 70 participants from various backgrounds. This improved partnerships for research and development on HIV/AIDS with research and non-research organizations. The workshop participants identified priority research areas, formed and launched the Africa Network on HIV/AIDS & Agriculture (ANEHA).

More than 16 tonnes of foundation seeds were produced by the ARI coordinating unit for dissemination. Through the ARI network, more than 200 tonnes of NERICA seeds were produced in member countries and distributed during the year. More than 100 upland NERICA elite lines and other improved varieties were sent to NARS for PVS.

In 2005, GRU regenerated a total of 4,428 designated rice germplasm and multiplied 2,967 accessions at IITA Ibadan in order to obtain enough seeds for storage. In addition, 936 accessions of *O. glaberrima* from IITA Ibadan and from M'bé, Côte d'Ivoire were characterized in Benin. Designated germplasm refer to plant accessions, which were placed with the CGIAR Centers including WARDA under the auspices of the FAO and are held in-trust as international public goods (IPGs) for the benefit of mankind.

INGER-Africa distributed 2475 accessions in West Africa in 2005, 197 in East, Central and Southern Africa and 139 in other countries.

A framework of collaboration on seed health issues was established in 2005 with the Plant Protection Service of WARDA's new host country (Benin). WARDA continues to be actively involved in the process of developing biosafety regulations in the region.


Parboiling adds value to rice and does not require high investment.

May

West and Central Africa MTP

Africa Rice Center (WARDA) began detailed discussions in a meeting (**2 May**) with CGIAR partners at IITA Ibadan, Nigeria on development of a regional MTP for West Africa. WARDA is in charge of coordinating the West Africa MTP exercise being undertaken in close consultation with CORAF and all the CGIAR Centers based in and operating in West Africa.

FARA/NEPAD

WARDA participated in a meeting on the role of agricultural research for development, organized by FARA and the CGIAR in Accra, Ghana (**4 May**). A panel discussion was convened to discuss what FARA and the CGIAR can do to support NEPAD. The ADG-RD Dr Shellemiah Keya represented the WARDA DG Dr Kanayo Nwanze at the G8/NEPAD Summit (**5-6 May**) on the implementation of the CAADP, also held in Accra.

USAID MAS Project against RYMV

A planning workshop for a major USAID-funded biotechnology project on the use of marker-assisted selection in the improvement of rice resistant to RYMV was held in Bamako (**11-13 May**). The project focuses on four key countries – Burkina Faso, Guinea, Mali and The Gambia – and will greatly enhance their biotechnology capacity through supporting the establishment of functioning biotechnology laboratories in each case. Two popular varieties of rice from each country have been identified for improvement by the addition of a gene conferring resistance to rice yellow mottle virus.

June

FARA General Assembly

Four WARDA scientists participated in the 2nd FARA General Assembly in Entebbe, Uganda (**6–12 June**). WARDA hosted a side event on "Boosting Rice research in Eastern Africa". The Center participated in the CGIAR and NARS consultation at which the sub-Saharan Africa Challenge Program (SSA CP) and development of MTPs for East and West Africa were discussed.

ECOWAS

The Ministerial Conference of ECOWAS States on bio-technology was held in Bamako, Mali (**20-24 June**).

July

SWIHA Workshop

A regional workshop (**18-20 July**) on mainstreaming HIV/AIDS prevention programs in agriculture was organized by SWIHA, which is hosted by WARDA, and attracted over 70 international participants from various backgrounds. This improved partnerships for research and development on HIV/AIDS with research and non-research organizations. Participants identified priority research areas in the agricultural sector, and decided to form the Africa Network on HIV/AIDS & Agriculture (ANEHA).

PADS Steering Committee

A meeting (**26–28 July**) of the PADS Steering Committee was held at WARDA's temporary headquarters in Cotonou, Benin.

September

British Association for the Advancement of Science

SWIHA Coordinator Mrs Annemarie Kormawa was invited to present at the prestigious British Association for the Advancement of Science annual meeting held in Dublin, Republic of Ireland. Taking part in the debate on prospects for a 'Green Revolution' in Africa, she outlined the toll being taken on Africans and African agriculture by HIV/AIDS. Her presentation received widespread international press coverage. Also taking part was former WARDA plant breeder and 2004 World Food Prize winner Dr Monty P. Jones of FARA.

WARDA Council of Ministers

The 25th Session of the WARDA Council of Ministers was held in Ouagadougou, Burkina Faso (**22-23 September**) under the Chairmanship of His Excellency Laya Sawadogo, Minister for Secondary and Higher Education and Scientific Research in the Government of Burkina Faso.

The Council passed a number of resolutions relating to the future of WARDA. It emphasized that, as "the basic principles and philosophy which underpin the Center's operations conform with the expectations of member countries, WARDA should keep its identity and autonomy while increasing its relations with the Consultative Group on International Agricultural Research (CGIAR) Centers, such as the International Institute of Tropical Agriculture (IITA)". Putting its force solidly behind the Center, the Council further resolved to take necessary steps to make WARDA a Center of Excellence of the African Union because the technologies and knowledge generated by the Center were powerful tools to fight poverty and hunger in Africa.

It resolved that WARDA should retain its official headquarters in Bouaké, Côte d'Ivoire, and endorsed the process for recruitment of the next Director General while thanking the outgoing Director General Dr Kanayo F. Nwanze for his dedicated service to the cause of rice research and development in sub-Saharan Africa during his mandate.

The Council welcomed the initiative to combine the regional cereals networks in West Africa around six themes and recommended that, based on its exemplary work and mechanism, the ROCARIZ rice network hosted by WARDA, should be the coordinator of the thematic group on rice. WARDA member states were invited by the Council to make judicious use of biotechnology to increase rice productivity and it decided that WARDA should take a leading role in rice policy research for the benefit of sub-Saharan Africa, with focus on West Africa. The CoM encouraged the expansion of WARDA's geographical mandate in conformity with its deed of partnership.

Crop Science Society of Japan

WARDA scientist Dr Koichi Futakuchi attended the 220th meeting (**28-29 September**) of the Crop Society of Japan in Tokyo where he made three presentations: Yield performance of upland interspecific *Oryza sativa x O. glaberrima* progenies under different growing

ecologies; Comparison of several agronomic and grain quality traits between conventional back cross and anther culture derived interspecific *Oryza sativa x O. glaberrima* progenies; and Vegetative growth characteristics related to weed competitiveness in interspecific *Oryza sativa x O. glaberrima* progenies in lowland.

A WARDA collaborator from Nihon University also presented on studies on acidity tolerance in NERICA.

October

IHP Evaluation Review

A team appointed by the UNDP and WARDA spent four weeks in a major evaluation of the Africa-Asia joint research project on Interspecific Hybridization between African and Asian rice species. A number of recommendations were made to enable the smooth functioning of phase III of this important project aimed at impacting on farmers' livelihoods and at reducing poverty.

November

Rice policy workshop, Cotonou, Benin

In taking stock on rice policy and its effects in SSA countries, a regional rice policy and food security workshop was organized (**7-9 November**) which attracted 80 participants from 20 countries. Workshop participants identified regional research and development priority areas for promoting rice policy impact in SSA.

Research Days

WARDA Research Days form part of the Center's research planning and monitoring mechanism. Outputs and results from 2005 activities and proposals and workplans for 2006 were presented by the WARDA team from Cotonou and the satellite stations at the 2005 Research Days meeting held in Cotonou (**14–18 November**). About 80 scientists, researchers, NARS and NGO representatives, together with invited guests from other organizations with an active interest in riziculture were present at the meeting. Outside participants included INRAB (Benin), IRRI (Philippines), JICA (Japan), IITA (Benin) and Sasakawa Global 2000.

December

Fact-finding in Mozambique

ECARRN regional coordinator Dr Ashura Luzi-Kihupi carried out a fact-finding mission to Mozambique to discuss rice sector potential with a number of public and private organizations with an interest in rice. Development of the rice sector could be an important element of a strategy aiming at closing the gap between imports and exports of agricultural products. It is estimated that the total value of current rice production is $31 million and imports are estimated at about $70 million. The total value of the rice sector is therefore over $100 million. The potential area for rice production is estimated at about 900,000 ha.

Eastern and Central Africa Rice Research Network

A Stakeholders' Workshop on priority setting was organized in Nairobi by ECARRN which produced priority themes based on:

1 Human and institutional capacity development
2 Enhanced information and knowledge-sharing mechanisms,
3 Increased production and productivity of rice-based production systems in the ECA region,
4 Enabling policies and improved rice marketing systems,
5 Enhanced information and knowledge-sharing mechanisms.

March

The Africa Rice Center Board at its March meeting praised the Center for its dynamism, excellence of leadership and staff, and its unique partnership model with national programs; all achievements attained with a relatively small budget in comparison to other international research centers.

April

Science Council Meeting, Cotonou

The Togoudo Station was selected by the Science Council of the CGIAR as venue for its business meeting (**6-12 April**) with WARDA as host. By permitting WARDA and IITA staff to attend as observers, awareness of the work of the Science Council was greatly increased, and the opportunity taken to demonstrate WARDA research activities.

2006 Fukui International Koshihikari Rice Prize of Japan

Lowland rice breeder Dr Moussa Sié was chosen as one of the two laureates of the 2006 Fukui International Koshihikari Rice Prize of Japan in recognition of his significant contributions to rice production in sub-Saharan Africa. Dr Sié, a Burkinabe national, is the first African to receive this important prize at the award ceremony (**15 April**) in Fukui city, Japan. He has over 20 years experience in the selection and improvement of rice varieties, with particular emphasis on rainfed systems. The prize is shared with Dr Akihiiko Ando from Brazil, who has contributed to rice breeding by using radiation-induced mutations. The prize was instituted in 1997 to commemorate the development of Koshihikari, one of the most popular Japanese rice varieties.

Dr Moussa Sié (seated left) after receiving the prestigious Fukui International Koshihikari Rice Prize of Japan to mark his significant contribution to rice production in sub-Saharan Africa.

Position for the years ended 2005 and 2004 (in US$)

ASSETS

Current Assets	Cash and Cash Equivalent	Accounts Receivable: Donors	Accounts Receivable: Employees	Accounts Receivable: Others	Inventories	Prepaid Expenses	Total Current Assets
2005	3 850 254	3 368 566	202 190	315 934	421 407	362 751	**8 521 102**
2004	4 369 928	2 738 337	259 830	148 376	353 853	110 630	**7 980 955**

Property & Equipment	Property and Equipment	Less: Accumulated Depreciation	Total Property & Equipment – Net	TOTAL ASSETS
	8 583 442	(7 257 385)	1 326 057	**9 847 159**
	8 809 715	(7 426 536)	1 383 180	**9 364 135**

LIABILITIES AND NET ASSETS

Current Liabilities	Bank Balances (Overdraft)	Accounts Payable: Donors	Accounts Payable: Employees	Accounts Payable: Others	Funds in Trust – Employees	Provisions and Accruals	Total Current Liabilities	TOTAL LIABILITIES
2005	16 326	3 426 654	173 623	1 066 376	214 000	1 267 637	**6 164 616**	**6 164 616**
2004	--	3 617 437	274 613	1 131 915	308 000	1 128 704	**6 460 670**	**6 460 670**

Net Assets	Unrestricted Net Assets	TOTAL NET ASSETS	TOTAL LIABILITIES AND NET ASSETS
	3 682 543	3 682 543	**9 847 159**
	2 903 465	2 903 465	**9 364 135**

REVENUE GAINS AND OTHER SUPPORTS

	Unrestricted	Restricted	2005	2004
Grants	5 831 025	5 191 938	11 022 963	10 025 423
Member States – Operating Income	54 849	--	54 849	313 378
Member States – Capital Dev. Income	--	--	--	--
Special Transition Grant-Income	183 400	--	183 400	430 000
Other income	160 048	--	160 048	70 385
Total Revenue, Gains and Other Support	6 229 323	5 191 938	11 421 260	10 839 186

EXPENSES AND LOSSES

	Unrestricted	Restricted	2005	2004
Program Related Expenses	2 231 566	4 916 784	7 148 349	6 619 691
Management and General Expenses	3 126 660	275 154	3 401 814	3 264 187
Special Transition Program Expenses	681 721	--	681 721	592 906
Total Program Expenses and Losses	**6 039 947**	**5 191 938**	**11 231 884**	**10 476 784**
Indirect Cost Recovery	(589 702)	--	(589 702)	(461 590)
Total expenses and losses	**5 450 245**	**5 191 938**	**10 642 182**	**10 015 195**
Change in Net Assets Allocated to Capital Fund in Prior Year	**779 078**	--	**779 078**	**823 992**
Net Assets at Beginning of Year	**2 903 465**	--	**2 903 465**	**2 478 682**
Change in Net Assets before Prior Year Adjustments	779 078	--	779 078	823 992
Extraordinary Items				
General Support Staff – Termination Dues	--	--	--	(160 930)
Depreciation Adjustment – Prior Years	--	--	--	(238 279)
Change in Net Assets	**779 078**	--	**779 078**	**424 783**
Net Assets at End of Year	**3 682 543**	--	**3 682 543**	**2 903 465**

MEMO ITEM

Total Expenses by Natural Classification	Management & General	Program Related	2005	2004
Personnel Costs	1 540 470	3 314 696	4 855 166	5 066 569
Supplies & Services	1 667 588	2 538 333	4 205 922	3 705 199
Supplies & Services- Collaborators and Partnerships Costs	--	624 977	624 977	405 751
Operational Travel	283 207	490 705	773 912	690 335
Depreciation	592 270	179 638	771 908	608 931
Gross Operating Expenses	**4 083 535**	**7 148 349**	**11 231 884**	**10 476 784**

GRANTS - Unrestricted

UNRESTRICTED	Total 2005	Total 2004
Belgium	229 890	166 065
Canada	692 446	701 067
France	89 026	95 640
Germany	194 285	185 295
Japan**	897 249	1 120 039
Netherlands	918 612	892 771
Norway	768 255	588 365
Sweden	454 400	514 018
United Kingdom**	639 363	616 438
USAID	200 000	225 000
World Bank**	747 500	700 000
Total Unrestricted Grants	5 831 025	5 804697

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

**Excluded from this amount are the World Bank (2004), DFID (2005), and Japan (2005) Special Grant Incomes accrued against extraordinary expenditures and costs related to the relocation to Cotonou, Benin incurred during the years 2004 and 2005 as a result of the crisis being experienced in Côte d'Ivoire. These amounts (US$ 430,000), (US$ 143,400) and (US$ 40,000), respectively, have been disclosed separately in the Statement of Activities.

Biotechnology activities are strongly supported by a number of donors.

GRANTS - Restricted

TEMPORARILY RESTRICTED	Total 2005	Total 2004
AfDB I (NERICA Dissemination Project)	269 927	--
CANADA Fund for Africa (CFA)	602 457	146 150
COAT – Taiwan/AVRDC Collaborative Project	47 410	90 779
COAT – Taiwan/AVRDC COA14 - Collaboration Project	--	12 704
CFC/FAO Spirivwa Project	181	1 032
Denmark (Phytosanitary & Seed Health)	--	0
ENI-CONGO	(2 768)	80 435
European Union/CORAF Project	299 449	985 463
European Union (Rice Policy & Techn. Impact on Food Security)*	513 942	91 819
European Union (Creating Low Management Plant Types)*	--	536 137
European Union (E. and C. Africa Rice Res. Networks)	110 206	--
Gatsby Foundation (Containment Facility)	--	461
Gatsby Foundation (Dissemination)	(9 833)	3 572
GTZ (Hohenheim Project)	30 763	90 112
GTZ (Peri-urban Project)	226 166	90 956
IBRD – Genebank Upgrade Project	117 846	320 804
IBRD – WCA-Regional MTP Project	83 879	--
IFAD (PADS Project)	262 127	273 864
IFAD (Congo-NERICA Dissemination Project)	86 873	10 554

TEMPORARILY RESTRICTED	Total 2005	Total 2004
UNDP/TCDC-IHP PHASE 2	181 266	115 408
Japan (Japanese Expert – Futakuchi Project)	--	0
Japan (Interspecific Hyb. Project)	343 468	517 762
Japan (RYMV Project)*	102 626	258 854
Japan (Increasing Quality Compet. Loc. Project)*	140 484	48 687
Japan (Dev. Interspec. OG & OS Progenies)*	193 446	--
Japan (High Yield Varieties – Humid Zones)*	5 393	--
Netherlands (APO/JPO Project)	352 238	143 415
Rockefeller (Capacity Building)	70 863	2 269
Rockefeller (FPATDD – Mali/ Nigeria)	160 865	13 398
Rockefeller (African Rice Initiative)	123 543	167 098
Rockefeller (Drought Tolerance Project)	280 395	48 629
USAID (African Networks Project)	306 884	153 797
USAID – RYMV Project	146 316	--
USAID – AVRDC Project	40 989	--
UNDP (Guinea IAEC Project)	8 166	2 637
Miscellaneous Small Projects	96 370	13 931
Total Restricted Grants	**5 191 938**	**4 220 726**
Total Grants	**11 022 963**	**10 025423**

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Cyrille Adda	Program Assistant
Inoussa Akintayo	Coordinator, African Rice Initiative (ARI)
Koffi Akator	Research Assistant
Fatimata Bachabi*	Research Assistant
Boubié V. Bado	Sahel Agronomist
Kone Brahima	Research Assistant
Boubacary Cissé	Research Assistant
Mamadou Cissoko	Research Assistant
Aliou Diagne	Impact Assessment Economist
Sitapha Diatta	Soil Physicist
Daniel Tia Dro	Genetic Resources Specialist (APO)
Attiogbev-Somado Eklou	Post Doctoral Fellow – Genetic Resources
Koichi Futakuchi	Crop Ecophysiologist
Howard Gridley††	Upland Rice Breeder
Mohamed Kebbeh	Production Economist (Sahel)
Patrick Kormawa	Policy Economist
Paul Kiepe	Scientific Coordinator, Inland Valley Consortium
Ashura Luzi-Kihupi	ECARRN Coordinator
Moussa Mahaman	Research Assistant
Fofana Mamadou	Research Assistant
Baboucar Manneh*	Post Doctoral Fellow – Biotechnologist
Kouamé Miézan†	Irrigated Rice Program Leader (Sahel)
Marcel Meijs	Water Management/GIS (APO)
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Augustin Munyemana	Participatory Technology Development Scientist
Lawrence Narteh	ROCARIZ Coordinator
Akahoua N'cho	Research Assistant
Marie-Noëlle Ndjiondjop	Molecular Biologist/Biotechnologist
Abibou Niang*	Research Assistant
Francis Nwilene	Entomologist
Ayoni Ogunbayo*	Research Assistant
Sylvester Oikeh	Soil Fertility Agronomist
Amos Onasanya	Research Assistant
Olumuyiwa Osiname	WARDA Coordinator in Nigeria (Nigeria)
Jonne Rodenburg	Inland Valley Agronomist (APO)
Ines Sanchez*	Head of Genetic Resources Unit
Kazuki Saito**	Post Doctoral Fellow – Agronomy
Kayodé Sanni	Research Assistant
Kassa Semagn*	Post Doctoral Fellow – Biotechnologist
Mandé Semon	Post Doctoral Fellow – Rice Breeding
Yacouba Séré	Pathologist
Moussa Sié	Lowland Rice Breeder
Abou Togola	Research Assistant
Ali Touré	Research Assistant
Amadou Touré	Research Assistant
Paul Van Mele	Technology Transfer Agronomist
Michel de Vries	Irrigated Rice Agronomist
Ousmane Youm	Assistant Director of Research/Program Leader

Collaborating Scientists

Glenn Gregorio**	Rice Breeder (IRRI)
Ryoichi Ikeda	Plant Breeder (JICA)
Virginie Levasseur	Vegetable Specialist (AVRDC)
Horoaki Samejima	Post Doctoral Fellow – Agronomy (JIRCAS)
Yoshimi Sokei	Agronomist (JICA)
Hiroshi Tsunematsu	Associate Upland Rice Breeder (JIRCAS)

Visiting Scientists

Rita Afiavi Agboh-Noameshi††	Sociologist

* Joined in 2005 / ** Joined in 2006 / † Left in 2005 / †† Left in 2006

Postgraduate Trainees in 2005-2006

Name and Thesis Topic/Subject	INSTITUTION/ UNIVERSITY	Country of origin	Sponsor	Degree
Adzato, Kossivi Mawuli *Sélection des varieties de riz cultivés pour la tolerance à la secheresse pendant les phases végétatives et reproductives au champ*	University of Lomé, Togo	Togo	USAID	DAA
Sy, Ibrahima *Gestion des entreprises agricoles*	University Gaston Berger, Saint-Louis, Senegal	Senegal	WARDA	DEA
Boye, El Hadji Iba	University Gaston Berger, Saint-Louis, Senegal	Senegal	WARDA	DEA
Ndao, El Hadji Omar	University Gaston Berger, Saint-Louis, Senegal	Senegal	WARDA	DEA
Tussing, Michael *Observation-comptage en phytopathologie*	Ecole Nationale d'Ingénieur des Travaux Agricoles, France	France	Self-sponsored	DAA
Martinet, Anne *Evaluer l'impact du CBF dans les politiques Nationales en matières d'aménagement de bas-fonds*	Ecole Nationale Supérieure d'Agronomique de Montpellier/France	France	IVC/CBF	DAA
Atchade, Nicolas *Caractérisation des stations pour la riziculture pluviale au sud Bénin: cas de IITA (Godomey), Niaouli, Bohicon*	University of Abomey Calavi, Benin	Benin	WARDA	DEA
Assogba, Mireille *Criblage des NERICA et des sativa pour leur résistance au borer de tige Sesamia et Calamistis*	University of Abomey Calavi, Benin	Benin	WARDA	DAA
Idinoba, Philip *Sociocultural and institutional aspects of rice-based technologies*	Wageningen University, Netherlands	Nigeria	WARDA / Wageningen University	PhD
Floris, Komen *Adoption and innovation of integrated crop management options by farmers of the inland-valley production systems. Benin and Togo*	Larenstein International Agricultural College, Netherlands	Netherlands	Self-sponsored	MSc
Both, Judith *Local community perception on the conservation and use of wild plant biodiversity in inland valleys. Benin and Togo*	Wageningen University, Netherlands	Netherlands	Self-sponsored	MSc
Houngbedji, Seton Gilles *Caractérisation du système racinaire de certains cultivars de riz par rapport à la tolérance à la sécheresse*	University of Abomey Calavi, Benin	Benin	WARDA	DAA
Hadonou, Yovo Armelle *Structure de la population du virus de la panachure jaune du riz au Bénin: diversité sérologique*	University of Abomey Calavi, Benin	Benin	WARDA	DAA
Bancole, Bernice *Structure de la population du virus de la panachure jaune du riz au Bénin: Variabilité pathologique*	University of Abomey Calavi, Benin	Benin	WARDA	DAA
Anato, Florence *Enquête agronomique sur l'importance des populations et dégâts des borers de tige de riz dans différentes zones écologiques du Benin*	University of Abomey Calavi, Benin	Benin	WARDA	DAA
*Efisue, Andrew *Developing durable resistant upland rice for the tropics of Africa*	University of KwaZulu Natal, South Africa	Nigeria	Rockefeller Foundation	PhD
*Dobo, Macaire *Enhance uniformity and stability of rice grain quality through genetic transformation and marker-assisted breeding*	Texas A & M University, USA	Côte d'Ivoire	Rockefeller Foundation	PhD
Djabga, F. Justin *Experiences with inland valley development – a case study from the Ouémé Valley in south east Benin*	University of Abomey Calavi, Benin	Benin	WARDA	Maitrise
*Yao, Kouadio Nasser *Androgène in vitro chez le riz Oryza glaberrima et d'hybrides interspecifiques sativa-glaberrima*	University of Abidjan, Côte d'Ivoire	Côte d'Ivoire	USAID	PhD
Kam Honoré *Molecular marker-assisted selection for improvement of rice yellow mottle virus (RYMV) in West Africa*	University of Ouagadougou, Burkina Faso	Burkina Faso	USAID	PhD
Djedatin L. Gustave *Hérédité et cartographie de la résistance du riz à BLB et introgression du gène de résistance au RYMV dans des variétés élites d'Afrique*	University of Abomey Calavi, Benin	Benin	USAID	PhD

* Students finishing their thesis/research during the course of this year.

Courses given in 2005

Title	Date	Place	No. of partici-pants	Benefiting countries	No. of men and women
Planning workshop on marker-assisted selection (MAS) for rice improvement against rice yellow mottle virus (RYMV)	11-13 May	Bamako, Mali	9	Burkina Faso, Guinea, Mali, The Gambia	9 men
Training on impact evaluation methodology	9-14 May	Cotonou, Benin	15	Benin, Burkina Faso, Mali, Niger, Nigeria, Senegal, Sierra Leone, The Gambia	15 men
AVDRC joint training	14-16 June	Cotonou, Benin	13	Benin, Ivory Coast, Togo	2 women 11 men
AVDRC joint training	5-7 July	Bamako, Mali	25	Burkina Faso, Chad, Mali, Niger, Senegal, The Gambia	
HIV/AIDS and agriculture: Implications for food security in West and Central Africa	18-20 July	Cotonou, Benin	77	Burkina Faso, Benin, Cameroon, Côte d'Ivoire, Ghana, Mali, Mozambique, Nigeria, Senegal, Sierra Leone, Togo	20 women 57 men
PADS II Steering Committee	26-28 July	Cotonou, Benin	11	Ghana, Guinea, Mali, The Gambia	11 men
Training in computer techniques and statistical analysis for agricultural research	26 October-7 November	Cotonou, Benin	21	Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Ghana, Guinea, Madagascar, Mali, Niger, Sierra Leone, Senegal, Tanzania, Togo, The Gambia, Uganda	18 men 3 women
Regional workshop on agricultural policy and food security in sub-Saharan Africa	7-9 November	Cotonou, Benin	62	Benin, Burkina Faso, Central African Republic, Cameroon Côte d'Ivoire, Ethiopia, Ghana, Guinea, Italy, Niger, Mali, Nigeria, Philippines, Senegal, Sierra Leone, The Gambia, Togo, UK	8 women 54 men
Training in molecular techniques	18 -30 April	Cotonou, Benin	8	Burkina Faso, Guinea, Mali, The Gambia	1 woman 7 men

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Asch F, Becker M and DS Kpongor.
2005. A quick and efficient screen for resistance to iron toxicity in lowland rice.
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Asch F, Dingkuhn M, **Sow A** and **A Audebert**.
2005. Drought-induced changes in rooting patterns and assimilate partitioning between root and shoot in upland rice.
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van Asten P, Bodegom P, Mulder L and M Kropff.
2005. Effect of straw application on rice yields and nutrient availability on an alkaline and a pH-neutral soil in a Sahelian irrigation scheme.
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Carsky RJ and MA Toukourou.
2005. Identification of nutrients limiting cassava yield maintenance on a sedimentary soil in southern Benin, West Africa.
Nutrient Cycling in Agroecosystems 71(2): 151-162.

Dembelé Y, Kambiré H and **M Sié**.
2005. Gestion de l'eau et de l'azote en riziculture irriguée dans la vallée du Kou (Burkina Faso).
Cahiers Agricultures 14 (6) novembre-décembre 2005.

Ebron LA, Fukuta Y, Imbe T, Kato H, Yanoria MJT, **Tsunematsu H**, Khush GS, Kobayashi N and M Yokoo.
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Fofana B, Tamélokpo A, **Wopereis MCS**, Breman H, Dzotsi K and **RJ Carsky**.
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Oswald A.
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Poussin JC, Diallo Y, Legoupil JC and **A Sow**.
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Séré Y, **Onasanya A**, Verdier V, **Akator K**, Ouédraogo LS, Segda Z, Mbare MM, Sido AY and A Basso.
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Séré Y, **Onasanya A**, Afolabi AS and **EM Abo**.
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Sylla K, Sobia A, **Diagne A**, Droubly M, Outtara Y, Diallo S, Koné M, Binateé N and **A Touré**.
2005. *Impact des politiques d'ajustement structurel sur la filière rizicole en Côte d'Ivoire.*
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Traore O, **Sorho F**, Pinel A, Abubakar Z, Banwo O, Maley J, Hebrard E, Winter S, **Séré Y**, Konate G and D Fargette.
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Ogunbayo SA, Ojo DK, **Guei RG**, Oyelakin OO and **KA Sanni**.
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Saleque MA, Harun-Ar-Rashid M, **Van Mele P** and J Bentley.
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Acronyms and abbreviations

ACMAD	African Centre of Meteorological Applications for Development
AfDB	African Development Bank
AfRGM	African rice gall midge
AGETA	Association générale d'études techniques agricoles
ANADER	*Agence nationale d'appui au développement rural*
APO	Associate Professional Officer
ARI	African Rice Initiative
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASI	ADRAO/SAED/ISRA thresher-cleaner
AU	African Union
AVRDC	The World Vegetable Center
BLB	bacterial leaf blight
CAADP	Comprehensive Africa Agriculture Development Programme (of NEPAD)
CBSS	Community-based Seed Systems
CCER	Center-Commissioned External Report
CGIAR	Consultative Group on International Agricultural Research
CIAT	*Centro Internacional de Agricultura Tropical*
CIMMYT	*Centro Internacional de Mejoramiento de Maiz y Trigo*
CIRAD	*Centre de coopération internationale en recherche agronomique pour le développement*
CMC	Consortium Management Committee
CNRADA	*Centre national de recherche agronomique et de développement agricole* (Mauritania)
CSC	Consortium Steering Committee
DFID	Department for International Development
DRC	domestic resource cost
ECOWAS	Economic Community of West African States
ECSA	Eastern, Central & Southern Africa
ECA	East and Central Africa
ECARRN	East and Central Africa Rice Research Network
EU	European Union
FAO	Food and Agriculture Organization
FARA	Forum for Agricultural Research in Africa
GIS	geographical information systems
GSS	General Support Service Staff
HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
ICARDA	International Center for Agricultural Development in the Dry Areas
ICLARM	International Center for Living Aquatic Resources
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICM	integrated crop management
ICT-KM	Information and Communications Technology-Knowledge Management
IER	Institut d'économie rurale (Mali)
IFAD	International Fund for Agricultural Development
IHP	Interspecific Hybridization Project
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
INERA	Institut de l'environnement et des recherches agricoles
INGER	International Network for Genetic Evaluation of Rice
IINRAB	Institut national de la recherche agronomique du Bénin
INRM	Integrated Natural Resources Management
IPM	Integrated Pest Management
IRAD	Institut de recherche pour le développement
IRAG	Institut de recherche agronomique de Guinée
IRD	Integrated Resources Development
IRRI	International Rice Research Institute
ISRA	Institut sénégalais de recherches agricoles
ISFM	integrated soil fertility management
IVC	Inland Valley Consortium
IWMI	International Water Management Institute
M&E	monitoring and evaluation
MTP	Medium Term Plan
NARES	National Agricultural Research and Extension Systems
NARI	National Agricultural Research Institute
NARS	National Agricultural Research Systems
NEPAD	New Partnership for Africa's Development
NERICA	New Rice for Africa
NGOs	non-Governmental organizations
NILO	near-isogenic line
NRM	Natural Resources Management
PADS	Participatory Adaptive Research and Dissemination of Rice Technologies in West Africa
PLAR	participatory learning and action research
PAM	policy analysis matrix
PATD	participatory approaches to technology development
PRIGA	participatory rice improvement and gender/user analysis
PVS	participatory varietal selection
PVS-E	Extension-led participatory variety selection
QTL	quantitative trait locus (loci)
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 (Senegal)
SC	Science Council of the CGIAR
SONADER	Société nationale de développement rural
SPIRIVWA	Sustainable Productivity Improvement for Rice in Inland Valleys of West Africa
TILS	Training, Information and Library Services
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WARDA	West Africa Rice Development Association
WCA	West and Central Africa
WECARD/CORAF	West and Central African Council for Agricultural Research and Development/*Conseil ouest et centre africain pour la recherche et le développement*
WAIVIS	West African Inland Valley Information System
WUR	Wageningen University and Research Centre

About the Consultative Group on International Agricultural Research (CGIAR)

The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance of countries, international and regional organizations and private foundations supporting 15 international agricultural Centers that work with national agricultural research systems and civil society organizations including the private sector. The alliance mobilizes agricultural science to reduce poverty, foster human well-being, promote agricultural growth and protect the environment. The CGIAR generates global public goods that are available to all.

In a world where 75 percent of poor people depend on agriculture to survive, poverty cannot be reduced without investment in agriculture. Many of the countries with the strongest agricultural sectors have a record of sustained investment in agricultural science and technology. The evidence is clear; research for development generates agricultural growth and reduces poverty.

Agricultural research for development has a record of delivering results. The science that made possible the Green Revolution of the 1960s and 1970s was largely the work of CGIAR Centers and their national agricultural research partners. The scientists' work not only increased incomes for small farmers, it enabled the preservation of millions of hectares of forest and grasslands, conserving biodiversity and reducing carbon releases into the atmosphere. CGIAR's research agenda is dynamic, flexible and responsive to emerging development challenges. The research portfolio has evolved from the original focus on increasing productivity in individual critical food crops. Today's approach recognizes that biodiversity and environment research are also key components in the drive to enhance sustainable agricultural productivity. Our belief in the fundamentals remains as strong as ever: agricultural growth and increased farm productivity in developing countries creates wealth, reduces poverty and hunger and protects the environment.

CGIAR Centers

CIAT	*Centro Internaçional de Agricultura Tropical* (Cali, Colombia)
CIFOR	Center for International Forestry Research (Bogor, Indonesia)
CIMMYT	*Centro Internaçional de Mejoramiento de Maiz y Trigo* (Mexico, DF, Mexico)
CIP	*Centro Internaçional de la Papa* (Lima, Peru)
ICARDA	International Center for Agricultural Research in the Dry Areas (Aleppo, Syria)
ICLARM	WorldFish Center (Penang, Malaysia)
ICRAF	World Agroforestry Centre (Nairobi, Kenya)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (Patencheru, India)
IFPRI	International Food Policy Research Institute (Washington, D.C., USA)
IITA	International Institute of Tropical Agriculture (Ibadan, Nigeria)
ILRI	International Livestock Research Institute (Nairobi, Kenya)
IPGRI	International Plant Genetic Resources Institute (Rome, Italy)
IRRI	International Rice Research Institute (Los Baños, Philippines)
IWMI	International Water Management Institute (Colombo, Sri Lanka)
WARDA	Africa Rice Center (Cotonou, Benin)