REPORT OF THE SECOND BIENNIAL

WARDA/NATIONAL EXPERTS COMMITTEE MEETING
20–21 March 2000, M'bé, Bouaké, Côte d'Ivoire

Potential for a Green Revolution in Rice in West and Central Africa

WARDA/NARS Collaboration

Biennial WARDA/National Experts
Committee Meeting Report No. 2

About the West Africa Rice Development Association

The West Africa Rice Development Association (WARDA) was formed as an autonomous intergovernmental research association in 1971 by 11 countries, with the assistance of the United Nations Development Programme (UNDP), the Food and Agriculture Organization of the United Nations (FAO), and the Economic Commission for Africa (ECA). Today, the Association comprises 17 member states: Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, the Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo. Since 1987, WARDA has also been a member of the Consultative Group on International Agricultural Research (CGIAR), a network of 16 international research centers supported by more than 50 public- and private-sector donors.

WARDA's mission is: to contribute to food security and poverty eradication in poor rural and urban populations, particularly in West and Central Africa, through research, partnerships, capacity strengthening and policy support on rice-based systems, and in ways that promote sustainable agricultural development based on environmentally sound management of natural resources.

WARDA's research and development activities are carried out in collaboration with the national agricultural research systems of members states, academic institutions, international donors and other organizations, to the ultimate benefit of West and Central African farmers—mostly small-scale producers—who cultivate rice, as well as the millions of African families who eat rice as a staple food.

WARDA Headquarters are at M'bé, 25 km north of Bouaké, a major commercial center in Côte d'Ivoire. WARDA also operates research stations at N'Diaye, near Saint Louis, Senegal, and at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

Donors to WARDA in 2000 were: the African Development Bank, Belgium, Canada, CGIAR (Finance Committee), Common Fund for Commodities (CFC), Côte d'Ivoire, Denmark, the Food and Agriculture Organization of the United Nations (FAO), France, the Gatsby Foundation (UK), Germany, the International Development Research Centre (Canada), the International Fund for Agricultural Development, Japan, the Netherlands, Norway, the Rockefeller Foundation (USA), Sweden, the United Kingdom, UNDP, the United States of America, the World Bank and WARDA member states.

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2001

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1. Introduction

1.1 Background

By organizing the second Biennial WARDA/National Experts Committee Meeting from 20 to 21 March 2000 at its Headquarters at M'bé, Côte d'Ivoire, WARDA Management is implementing Resolution 4 adopted by the Council of Ministers during its Twenty-First Ordinary Session, held from 18 to 19 September 1997 in Accra, Ghana, as follows:

"Resolution on Forging Closer Interactions between WARDA and the National Experts Committee:

The Council of Ministers,

- Recognizing the role the Rice Task Forces mechanism is playing in regional agricultural integration;

- Considering the need and wish of the National Experts Committee to forge closer collaboration and strengthen linkages between WARDA and the Heads of the NARS of WARDA Member Countries;

- Considering the necessity of providing opportunities for NARS' Directors to see and discuss WARDA's ongoing collaborative activities;

Endorses the suggestion of the Director General of WARDA for Directors of NARS to meet at WARDA Headquarters during alternate years when meetings of the WARDA Council of Ministers are not being held.

Accra, Ghana, 19 September 1997
WARDA Council of Ministers"

The purpose of this statutory meeting is to provide a regular forum for interaction between WARDA and the NARS' Directors of its Member countries.

1.2 Major developments since January 1998

Partnership is the *modus operandi* of WARDA in all its activities aimed at reducing poverty and malnutrition through enhanced rice production and market development.

WARDA continues to actively involve the NARS in the process of research priority setting, program definition and project evaluation, and to ensure integration of regional priorities as defined by WECARD/CORAF in its various activities related to rice-based systems.

WARDA's program structure has evolved to accommodate the research required for evaluation and further development of promising technologies in the different agro-ecologies of the region. The new program structure discussed at the First WARDA/NEC Meeting was in full operation in 1998.

In December 1999, WARDA hosted an International Workshop on 'Effective and Sustainable Partnerships in a Global Research System: Focus on Sub-Saharan Africa. The Workshop significantly strengthened the mutual understanding of successes and failures in IARC–NARS partnerships in Sub-Saharan Africa, and noted transparency, trust, fair attribution of achievements and financial opportunities as important factors for success.

WARDA's Task Forces and the Rice Network of the West and Central African Council for Research and Development (WECARD/CORAF) were merged in 1999 to form the West and Central Africa Rice Research and Development Network (*Réseau Ouest et Centre Africain du Riz*, ROCARIZ). The role of ROCARIZ is to link rice stakeholders in the region to generate improved and relevant rice technologies and ensure their successful and widespread adoption.

Phase I of the Inland Valley Consortium (IVC) came to an end in 1998/99. After various meetings with IVC partners and stakeholders, it was decided that in Phase II, IVC activities should be included within the WARDA project portfolio

The Human Health Consortium, another highly collaborative project hosted at WARDA was also successfully completed in 2000.

The Director General chaired the joint Task Force of the Forum for Agricultural Research in Africa (FARA) and the World Bank's Special Program for African Agricultural Research (SPAAR) to develop a vision document on Agricultural Research in Sub-Saharan Africa.

Through the AfricaLink project, agricultural research institutes and scientists of WARDA Member States were linked to the information highway improving their abilities to access and distribute information, and to communicate with the international agricultural research and development community.

One of the most important events was the Fourth External Program and Management Review (EPMR) of WARDA that started in 1999 and concluded in 2000.

The Review Report itself attests to WARDA's progress in research and management over the past six years (since the Third EPMR), and much praise is given to the interspecific hybridization work that has led to the development of the interspecific rices, or NERICAs. Two quotations from the Report are worthy of note.

> "*WARDA is at the cross road where scientific breakthrough will yield large production increase in many developing countries where poor rice farmers now lag behind the technology curve. A fundamental difference is that WARDA is now developing technologies that are adapted to the African environment, without modifying the environment to fit the technology*."

> "*WARDA is best positioned to push hard for a rice-based green revolution in WCA [West and Central Africa]. The Panel urges WARDA to maintain focus on the impact of its work on people's lives—by putting more rice on the tables of poor and hungry people, and by putting more money into their pockets*."

The community-based seed production system (CBSS), a major component of the Interspecific Hybridization Project (IHP) was introduced by WARDA in 1998, because the formal system for producing certified seed of cultivated varieties is poorly developed in most countries of the region. CBSS enables farmers themselves to produce 'seeds of acceptable quality' to be grown by themselves and their neighbors, with a view to providing enough seed to meet the rapidly expanding demand for the NERICAs.

However, a major constraint that was identified in the overall impact of the products of our research and potential for a green revolution in rice in the region was the lack of a favorable socio-economic environment for wide and massive adoption. This is particularly crucial in West and Central Africa, where demand for rice is growing at an annual rate of 6%, resulting in total annual imports of over 3.2 million tonnes at an alarming price of US$ 1 billion. Thus, WARDA is faced with a major challenge and a pivotal role in enhancing national capacities, both individual and institutional, in policy analysis and formulation for meeting the food security challenges of the 21st century.

1.3 Member States contributions

To face this challenge, WARDA needs to lean on strong and deep-rooted financial pillars. During this time of general decreases in unrestricted core contributions to CG Centers, Member States' contribution is therefore particularly welcome, as it reinforces our financial base and helps to leverage additional support from the international community. All Member States should endeavor to meet their annual financial contributions fully, and defaulting Member States are urged to take appropriate measures to fulfill their financial commitments to the Association.

1.4 WARDA Director General's vision

We see WARDA as fulfilling a triple role as a dynamic center of excellence, as a model regional institution, and as the hub or pivot of an efficient technology and knowledge delivery system. In the short term, our priority as a Center of Excellence will be in fostering and sustaining an enabling environment that supports all staff in contributing to excellent, effective and efficient research—research is our *raison d'être*. A central and leadership role for WARDA in the third millennium is one of a model and pivotal regional institution for science and technology-based systems. An institutional *system* will encompass broad partnerships (WARDA's *modus operandi*) among all players and stakeholders, in contrast to an isolated *center*. The final element of our tripartite role is as the hub of an efficient technology and knowledge delivery system. This will build on our successful Task Force, Open Center and participatory research approaches in the empowerment of farmers. It will constitute a sustainable framework to respond to current and future challenges, with the aim of providing a constant flow of new rice-based technologies to farmers.

To help make our vision become a reality, we call upon our NEC partners to impress upon their governments the significance of the work of the Association for their populations, so that their governments own up to their responsibilities and demonstrate their ownership of the Association.

2. Summary Report and Main Conclusions and Recommendations

The Second Biennial WARDA/National Experts Committee Meeting was held 20 to 21 March 2000 at WARDA's Headquarters at M'bé, Côte d'Ivoire.

This meeting was attended by the Heads of national agricultural research institutions of 15 WARDA Member States: Benin (INRAB), Chad (ITRAD), Burkina Faso (INERA), Côte d'Ivoire (MESRS and CNRA), The Gambia (NARI), Ghana (CSIR), Guinea (IRAG), Guinea-Bissau (INPA), Liberia (CARI), Mali (IER), Mauritania (CNRADA), Niger (INRAN), Nigeria (NCRI), Senegal (ISRA), and Sierra Leone (NARCC). Cameroon and Togo were not represented.

The WARDA Board of Trustees was represented by Dr Diomandé Mamadou, Chairman of the Board Program Committee.

WARDA was represented by its Director General, the Deputy Director General for Programs, the Deputy Director General for Administration and Finance, Program Leaders, Program Support Unit Heads, and scientists.

The list of participants is attached as Appendix 13.

2.1 Objectives

The objectives of the meeting were to:

1. Review the activities, achievements and future prospects of the Association since the first meeting in January 1998, with emphasis on the potential for a Green Revolution in rice in the WARDA region.
2. Discuss and comment on the WARDA 2001–2010 Draft Strategic Plan.
3. Address the issue on nomination of regional Board of Trustees members.
4. Assess the efficiency and efficacy of WARDA/NARS collaborative projects.
5. Decide on the appointments of ROCARIZ Coordinator, Chairman of the IVC Management Committee, and IVC Coordinator.
6. Present the conclusions and recommendations of the Fourth External Program and Management Review (EPMR) of WARDA.

7. Brief the NEC on the CGIAR vision and strategy document and its impact on WARDA.
8. Discuss Member States' financial contributions to the Association.

2.2 Adoption of the Agenda

The agenda and program of work was adopted by the participants (Appendix 9).

Monday, 20 March 2000—Morning Session

The session was chaired by Dr P. Sérémé, Director of INERA, Burkina Faso, with Prof. Yadji Guéro, Director General of INRAN, Niger, and Dr M.C.S. Wopereis, Agronomist, WARDA Irrigated Rice Program, as rapporteurs.

Dr Kanayo F. Nwanze, Director General of WARDA, welcomed the participants to the Second Biennial WARDA/National Experts Committee (NEC) Meeting. In the opening address (Appendix 1), Prof. N'Guessan Yao Thomas, Director of Research (Representative of the Minister of Higher Education and Scientific Research of Côte d'Ivoire, Prof. Séry Bailly, who was unable to attend the meeting) stressed the importance of the meeting and of collaboration between the region's NARS and WARDA.

Four presentations were made.

2.3 WARDA's Fourth External Program and Management Review (EPMR): Main conclusions and recommendations: Dr Kanayo F. Nwanze

The Fourth External Program and Management Review (EPMR) was conducted in November 1999 (Initial Phase) and January–February 2000 (Main Phase), and resulted in 12 recommendations and various other findings and suggestions. WARDA views the review as very positive and critical. It identified areas where WARDA and its partners have made progress and where more work needs to be done.

WARDA's responses to the 12 recommendations were presented and discussed. The EPMR recommendation to conduct regular staff surveys (every 18 months) is in connection with staff turnover and new policies and procedures since 1997. The staff survey during the review was a beneficial instrument in understanding staff issues.

On the issue of outstanding vacancies at WARDA, it was explained that vacancies are filled as soon as suitable candidates are identified. However, vacancy management is also a means of resource management. Temporary delay in filling or shelving of positions helps in alleviating cash-flow problems. WARDA had not received a total of US$ 2.7 million in promised funding as of the end of 1999.

2.4 Nomination of regional members to WARDA Board of Trustees: Dr Kanayo F. Nwanze (Appendix 2)

WARDA's Board of Trustees is concerned over the difficulty in identifying suitable regional candidates with appropriate qualifications and experience in order to maintain a balance between non-regional and regional members. The same concern was expressed by the Panel of the 4th EPMR of WARDA in its report: "*clearly more is required to ensure that the very best candidates continue to be put forward for election. The Panel encourages the Board to explore with the Council of Ministers, ways to improve the identification and recruitment of quality candidates*."

In light of the above, the Board (at its November 1999 meeting) mandated the WARDA Director General to approach the Council of Ministers with the following proposal: "*That Member States nominations follow a similar rule as adopted for non-regional members. That is, three members be nominated by member states and the rest be identified directly by the Board with final approval of their serving the Board to be endorsed by the concerned member state.*"

After due discussion, it was agreed that it is important to diversify the areas of expertise on the Board, and to look beyond the traditional institutions (such as the NGO and private sector) given the fast changing environment. Membership from Member States should be broad and not limited to the traditional definition of NARS. Requests for applications should also be widely advertized, and membership should not be co-opted, but nominated on the basis of expertise and competence.

Recommendation

1. *The Committee adopted the proposal that: Member States nominations to the WARDA Board of Trustees should follow a similar rule as adopted for non-regional members. That is, three members be nominated by member states and the rest be identified directly by the Board with final approval of their serving the Board to be endorsed by the concerned member state.*

2.5 Overview of WARDA's Research Programs and progress since the last meeting: Dr A. Kassam (Appendix 3) and The potential for a Green Revolution in rice in West and Central Africa (Appendix 4)

The first presentation by Dr A. Kassam, WARDA Deputy Director General for Programs (DDG-P), covered the following: (1) evolving Program structure; (2) Medium Term Plan 2000–2002; (3) Annual Program Review and Planning Process; (4) formulation of Program and Project priorities and strategies; (5) Center-Commissioned External Review (CCER) of Program Strategy and Management; (6) External Program and Management Review (EPMR); (7) Intellectual Property (IP) Audit; and (8) research activities.

The following presentations were also made:

i. Rainfed Systems (Dr Monty P. Jones, Rainfed Rice Program Leader)

ii. Irrigated Systems (Dr Kouamé M. Miézan, Irrigated Rice Program Leader)

iii. Policy Environment (Dr Frédéric Lançon, Policy Support Program)

iv. Technology Transfer Strategy (Dr Brent Simpson, Systems Development and Technology Transfer Program Leader)

Discussions that ensued, focused on the following issues:

Intellectual Property Rights (IPR). This is an area where national programs are lagging behind, and where WARDA needs to provide guidelines regarding these issues to NARS. The question of patenting WARDA's technologies like the thresher-cleaner ASI and NERICA was raised. The NEC was also reminded that WARDA does not release varieties. The NEC was informed that a strategy is being put in place within the CGIAR to address the problem of IPRs.

Technology transfer. Regarding dissemination of NERICAs and PVS, there is a need to involve social scientists alongside breeders, and to introduce a standard information-gathering system, as this will allow comparisons between countries. The standardization of data collection has been initiated through PVS and INGER.

Transgenic rice. Concern was raised about human health risks. WARDA is not producing transgenic rice, but is mapping genes and conducting marker-assisted breeding.

The **Green Revolution** in Asia was based on modifying the environment through the introduction of irrigation, fertilizer and machinery. The NERICAs—with their high potential yield gains, higher protein content, improved eating and cooking qualities, and digestibility—have the potential to catalyze a Green Revolution without modification of the environment. This has not been an easy process, as WARDA scientists have been working on this breakthrough over the last 10 years.

Profitability of irrigation in the Sahel versus that in the savanna and humid zones, as well as the importance of competitiveness in irrigated rice systems and diversification in irrigated systems were discussed.

Iron toxicity. Use of tolerant varieties, N-P-K-Zn fertilization and some measure of water control was indicated as the best strategy for managing iron toxicity.

Salinity tolerance. Questions were asked about strategic research on marker-assisted breeding for salinity tolerance at WARDA.

Conclusions/Recommendations

2. *Before any genetically-modified material is released, risks should be scientifically assessed.*

3. *WARDA should convene a special meeting on transgenic rice.*

4. *WARDA should organize a workshop on Intellectual Property Rights (IPR) for NARS.*

5. *Naming of released varieties within each country is that country's responsibility, but WARDA must be informed about the names given to its varieties.*

6. *Community-based seed production systems should be linked to national seed multiplication programs.*

7. *WARDA should be more involved with NARS in the area of technology transfer, especially in spreading new promising technologies such as the thresher cleaner ASI.*

Monday, 20 March 2000—Afternoon Session

The session was chaired by Dr S. Bruce-Oliver, Director General of NARI, The Gambia, with Dr R. Guei, INGER-Africa Coordinator and Dr Y. Séré, Plant Pathologist, both from WARDA, as rapporteurs.

Three presentations were made.

2.6 Status of the West and Central African Rice Network (ROCARIZ): Dr Abdoulaye Adam (Appendix 5)

Dr Abdoulaye Adam highlighted several issues, including the merger of the WECARD/CORAF Rice Network and WARDA Task Forces, and the new modes of operation and governance. Several meetings have been held in the past between WARDA and WECARD/CORAF, which led to the creation of a single network; a five-year strategic plan has been developed.

Recommendations

8. *For the recruitment of the ROCARIZ Coordinator, the position should be at the WARDA Associate Principal Staff level, subject to the availability of funds. Otherwise recruitment should be as a WARDA Visiting Scientist. The Network Coordinator will be a national scientist and his/her conditions of service, criteria of recruitment and terms of reference are indicated in Appendix 7.*

9. *WARDA and WECARD/CORAF are mandated to seek funding for the Coordinator position.*

10. *Membership of the Steering Committee of ROCARIZ should be extended to include at least one non-research person (e.g. someone from the development sector).*

2.7 Appointments of the Chairperson of the IVC Management Committee, IVC Regional Coordinator and Natural Resource Management Scientist: Dr Sitapha Diatta (Appendix 7)

Dr S. Diatta, Interim Coordinator of the Inland Valley Consortium presented the new situation of IVC, including the composition of the Management Committee and the steps taken so far in appointing a Chairperson of the Management Committee, the Regional Coordinator and the Natural Resource Management (NRM) Scientist. The meeting was informed that IVC is now fully integrated into the WARDA program structure.

Conclusions/recommendations:

11. *The chairperson of the Management Committee will be elected for a term of two years from one of the following four member countries, Guinea, Nigeria, Côte d'Ivoire and Ghana, during the April 2000 meeting of IVC at M'bé.*

12. *Dr Marco Wopereis has been appointed as the NRM Scientist, a position funded by the Netherlands. Two candidates for the position of Coordinator (funded by France) have been proposed by Coopération française. The NEC rejected the male candidate and endorsed that the female candidate be invited for interview by WARDA.*

2.8 WARDA/NARS collaborative projects: assessment of efficiency and efficacy: Dr Amir Kassam (Appendix 8)

Dr Kassam highlighted the different mechanisms of collaboration between WARDA and NARS, the importance of such diversity, and the achievements and future directions of the various mechanisms. These mechanisms include Task Forces, consortia, INGER, participatory varietal selection, and community-based seed production.

Conclusions/recommendations

13. *It was noted that the training and capacity building components were not emphasized during the presentation and it was recommended that WARDA should explore more opportunities for group and postgraduate-degree training (MSc, PhD).*

14. *WARDA seems to have too many formal networks or projects that may not be financially sustainable. The networks should be few and more informal, including non-traditional partners such as NGOs.*

15. *For efficiency, and less duplication of effort and resources, WARDA and NARS should share information on their research activities for complementarity. WARDA should continue work on areas where it has comparative advantage, such as interspecific hybridization, germplasm collection, conservation and exchange, and modeling.*

16. *NARS should exchange their annual program activities and work plans for rice research with and through WARDA, and their overall agricultural research annual programs and work plans under the umbrella of WECARD/CORAF, for better rationalization of resources.*

17. *WARDA has in the past 2 years sent a number of students to advanced institutions for degree training, and the Visiting Scientist and visiting fellow programs are fully operational. WARDA is encouraged to intensify these important training activities.*

2.9 Member States' contributions to WARDA's budget

Dr Kanayo F. Nwanze urged the Committee to ensure that member countries meet their annual financial commitments to WARDA. This is an important leverage mechanism for the DG to attract funds from other donors. Representatives were requested not to relent in their individual efforts to match political support to the Association with their financial contribution.

Conclusions/recommendations:

18. *WARDA and NARS should put together a document showing clearly the impact of rice research over rice imports.*

19. *Member states should be encouraged to pay their annual commitments in installments if necessary.*

20. *National programs should urge and encourage their governments to include their contribution in their national budgets.*

21. *The DG of WARDA is urged to continue his program of visits to member countries as much as possible, to maintain awareness of the issue of contributions to the Association, especially among policy-makers, and request the payment of their contributions.*

22. *The Committee recognized that Member States' contributions to WARDA's budget are essential as a leverage for other donor funding.*

23. *The issue of outstanding contributions will be put on the agenda of the next Council of Ministers in Dakar in 2001.*

Tuesday, 21 March 2000—Morning Session

The session was chaired by Dr S. Bruce-Oliver, Director General of NARI, The Gambia, with B. Simpson, Systems Development and Technology Transfer Program Leader, and A.M. Bèye, Technology Transfer Agronomist, of WARDA, as rapporteurs.

Two presentations were made.

2.10 A briefing note on the CGIAR 2010 Vision and Strategy: Dr Kanayo F. Nwanze

The CGIAR has embarked on an exercise to develop a Vision Strategy for 2010 in order to revisit its structure and operations to ensure that the expected impact of its programs is achieved. To contribute to this exercise and respond to Recommendation 10 (Focus on Africa) of the 3rd CGIAR System Review, the CGIAR Center Directors Committee convened (in 1999) three meetings with African partners to jointly develop a CGIAR Strategy for Sub-Saharan Africa (SSA).

At the 1999 International Centers Week (ICW99), the CGIAR adopted a number of propositions, which needed further study during the next few months. Two of the propositions (Propositions 1 and 2)—addressing what the CGIAR should be doing and how it should do it in the next decade, and dealing with future resources deployment of the CGIAR—were to be looked at critically by CGIAR members and all stakeholders as they may affect the direction and scope of future institutional changes of the system.

The WARDA Director General drew attention to the dual context of WARDA as an Association of Member States and as of one of the 16 international agricultural research centers (IARCs) supported by the CGIAR. While any possible reconfiguration of the 16 centers could imply that WARDA may lose its stand-alone status as an international center, its existence as a regional Association is assured by its constitutional legitimacy and political integrity. The National Experts Committee may wish to draw the attention of the CGIAR and TAC Chairs and Executive Secretaries to this fact.

It was agreed that the position of WARDA in the future CGIAR must be supported through the different linkages of its Member States' NARS with fora such as SPAAR, FARA and WECARD/CORAF. NARS are already part of the decision-making in the CGIAR. Côte d'Ivoire and Nigeria are members of the CGIAR ,and several experts from the region belong to various committees of the CGIAR System (e.g. TAC, Finance)—these channels must be activated to convey the importance of WARDA's work to its national partners. The NEC will be kept informed of the development of the discussions on the future of the CGIAR.

Recommendation

24. In the reconfiguration of the CGIAR Centers with respect to the ongoing dialog on the CGIAR 2010 Vision and Strategy, WARDA's unique status as a regional Association by constitution must be maintained.

2.11 WARDA Strategic Plan 2001–2010: Provisional Contents: Dr Frédéric Lançon

A crucial issue for discussion was the ongoing development of WARDA's Strategy for the next 10 years. Progress to date, resulting from brainstorming and careful analysis, was presented in the form of an outline of the proposed contents, with annotations indicating the direction of thinking to date. A major factor in the Strategy, however, is priority-setting, and this forum provided WARDA with the opportunity to solicit feedback from the heads of national research institutes of its mandate region, who constitute WARDA's primary partners. WARDA is developing a questionnaire to reassess the major constraints to improved rice production in the subregion. Participants were asked to solicit detailed responses from their colleagues and other contacts. WARDA's Strategy will reflect elements of the SPAAR/FARA Vision on African Agricultural Research, the WECARD/CORAF Strategic Plan, and the CGIAR Strategy for Sub-Saharan Africa.

The issue on sustainable support for mangrove rice research was discussed. It was suggested that the development of joint proposals initiated by NARS and channelled by WARDA to donors could be explored to sustain the resources needed to operate the Mangrove Task Force and expand its activities. The NEC recommended that an assessment of the current status of mangrove rice research be conducted to define new strategies to ensure that the benefit of the research is widely and equally shared.

The NEC also noted that the Strategy is focussing on production aspects and that more attention must be devoted to post-harvest issues.

Recommendations

25. *The National Exerts Committee decided to mandate their ROCARIZ Task Force members to deliver feedback to WARDA at the forthcoming First Regional Rice Research Review (10–13 April 2000).*

26. *WARDA is requested to submit the first full draft of the 2001–2010 Strategic Plan to the NEC members, after it has been reviewed by the WARDA Board of Trustees in June 2000.*

Tuesday, 21 March 2000—Afternoon Session

2.12 Report and Closing of Meeting

The session was chaired by Dr Alpha Seydou Maïga, Director of the *Institut d'Economie rurale* (IER) of Mali, with Dr Frédéric Lançon, WARDA Policy Economist, and Dr Abdoulaye Adam, WARDA Biometrician, as rapporteurs.

It was agreed that the meeting be reported by session and that WARDA should finalize the provisional draft report and circulate it to NEC members for review and comments.

The NEC recognized that some improvements have been made in terms of circulating the meeting documents ahead of the meeting, but more effort is needed in this respect. Modern information and communication technology (e-mail) should be used to facilitate this process.

The NEC was again reminded that the majority of the member countries have not paid their dues, and of the suggestions and recommendations made to deal with the problem.

In his closing remarks, Dr Kanayo F. Nwanze, WARDA Director General, expressed his appreciation for the openness of the discussions. He noted with satisfaction the level and quality of participation, and that 15 out of 17 member countries were represented at the meeting. He highly appreciated this clear indication of ownership of WARDA by NEC members. This adds value to the Association's operation and significantly contributes to the strength of the Association. Finally, he expressed great satisfaction and gratitude to member countries for providing the funds for the construction of the Information and Documentation Center (IDC) building, within which the meeting was held, and for the Research extension.

Prof. N'Guessan Yao Thomas, Director of Research (Representative of the Minister of Higher Education and Scientific Research of Côte d'Ivoire), congratulated all participants for the quality of discussions. He thanked the WARDA Director General and staff for making this meeting possible.

Appendix 1

Opening address by Prof. N'Guessan Yao Thomas

Chairman of the National Experts Committee,
Director General of WARDA,
Directors General of the National Agricultural Research Systems,
Honorable Guests,
Ladies and gentlemen, dear participants,

The Minister of Higher Education and Scientific Research had decided personally to chair the opening ceremony of this Second Biennial WARDA/National Experts Committee Meeting.

He had informed the organizers of this decision in the reply to his letter of invitation. Unfortunately, at the last minute, an extremely busy calendar prevents him from fulfilling his commitment. So he has asked me, as Director of Research, to represent him and to extend his apologies to the Director General of WARDA as well as to you all.

Moreover, he has asked me to extend, in the name of the Government of Côte d'Ivoire, his welcome to all of you, especially those of you who came from sister nations.

It is with a particular pleasure that I am present today at this beautiful station of M'bé, excellent center of rice research which, from the center of Côte d'Ivoire, shines across the whole sub-region and beyond.

The Minister of Higher Education and Scientific Research and the Department of Research have always had a particular interest in WARDA's activities. I would like to take this opportunity to thank the Director General of WARDA for the quality of the relationships he has established with the institutions of his host country.

To strengthen the mechanisms of collaboration with its national partners, WARDA took the initiative in organizing here, in January 1998, a meeting with the Directors of national agricultural research systems from the member countries of the Association. This meeting is of paramount importance for WARDA and for agricultural activities in the region.

It is of paramount importance for WARDA because it is an additional step toward consolidating its collaboration with national agricultural research systems and in its integrating efforts for rice research in the region.

The importance of this meeting for the regional agriculture lies in the fact that it will examine the process of improving rice production, an essential cereal in the West African diet in general and that of Côte d'Ivoire in particular.

Consequently, this meeting appears as a basic contribution to the search for food security and self-sufficiency.

WARDA's contribution to the search for food self-sufficiency started long ago. In fact, every one of us knows that the *raison d'être* of this institution is the development of rice farming in West Africa.

The many rice varieties we saw at Hôtel Ivoire in Abidjan during the WARDA Day in February 1999 confirm the mission of this international institution. The Director General of WARDA restated this mission during the 22nd Ordinary Session of WARDA Council of Ministers in September 1999 in Monrovia. He pointed out that the mission of WARDA is "to contribute to food security and poverty eradication in poor rural and urban populations, particularly in West and Central Africa, through research, partnerships, capacity strengthening and policy support on rice-based systems, and in ways that promote sustainable agricultural development based on environmentally sound management of natural resources."

This occasion provides a good opportunity to thank the Director General of WARDA and all his team for their highly humanitarian action.

By congratulating WARDA in the name of the Government of Côte d'Ivoire for all its activities, I feel a twinge of sorrow because of the delay with which Côte d'Ivoire pays her financial contribution to this institution and to the CGIAR.

The Minister of Higher Education and Scientific Research, while extending the apologies of Côte d'Ivoire for not being able to fulfil her commitments on time, requested me to tell you that he will invest all his power so that the country pays off her arrears. I am quite sure that WARDA and all the other member countries have been lenient toward Côte d'Ivoire because they know that, for some years, our country has encountered unprecedented financial problems, and not long ago, an exceptionally delicate political situation.

Ladies and Gentlemen, while wishing you every success in your endeavors, I declare the Second Biennial WARDA/National Experts Committee Meeting open.

Thank you.

Appendix 2

Nomination of regional members to WARDA Board of Trustees

WARDA's Constitution requires that the Board of Trustees consist of between 8 and 14 members, half of whom are to be nationals of Member States (regional members) nominated by their respective countries, and the others being nominated at large, by the CGIAR or other entities (non-regional members). Three of the non-regional members are nominated by the CGIAR and the rest by the Board as 'members at large.'

In an attempt to identify the most dynamic and qualified prospective regional Board members, the Board of Trustees, through its Secretary writes to each of the members of the Council of Ministers to ask for names and *curriculum vitae* of people they would recommend to serve as Trustees. As vacancies on the Board of Trustees arise, the Nominating Committee of the Board draws on the pool of candidates nominated, verifies the availability and willingness of nominated individuals to serve, and attempts to fill vacancies according to various criteria.

In recent years, however, the mandated approach in respect of the Member States nominations for consideration to the Board has failed to produce candidates with the requisite skills, experience, gender mix and seniority for the position of Trustee in an internationally recognized and funded research institution. This is a great concern to the Board as steps are now needed to keep a balance between non-regional and regional members in terms of leadership.

In view of the above, the Board has taken the following initiatives:

1. urging the member states, through current regional Trustees, to be more proactive in identifying suitable candidates;

2. more clearly defining the requirements for membership to the Board in terms of experience and personal qualities; and

3. diversifying the areas of expertise by looking to the private sector within the region for high-potential candidates.

While these steps may help in the short term by widening the chances of identifying potential candidates for the next round of nominations, a long-term solution needs to be found.

In the report of the recently completed Fourth External Program and Management Review (EPMR) of WARDA, the Panel expressed concerns over the inability of the Board to successfully identify excellent candidates with appropriate qualifications. The Panel wrote "clearly more is required to ensure that the very best candidates continue to be put forward for election. The Panel encourages the Board to explore with the Council of Ministers, ways to improve the identification and recruitment of quality candidates."

In light of this and because Trustees serve on the Board in their own personal capacities, not as representatives speaking for other institutions, governments, or organized constituencies, the Board would like to approach the Council of Ministers with the following proposal:

> *That Member States nominations follow a similar rule as adopted for non-regional members. That is, three members be nominated by Member States and the rest be identified directly by the Board with final approval of their serving the Board being endorsed by the concerned member state.*

Action required: endorsement by the National Experts Committee.

Appendix 3

Overview of WARDA's Research Programs and Progress since the Last Meeting

This report covers the following topics:

1. Evolving Program Structure
2. Medium-Term Plan 2000–2002
3. Annual Program Review and Planning Process
4. Formulation of Program and Project Priorities and Strategies
5. Center-Commissioned External Review (CCER) of Program Strategy and Management
6. External Program and Management Review (EPMR)
7. Intellectual Property (IP) Audit
8. Research Activities

1. Evolving Program Structure

The new Program structure described at the First WARDA/NEC Meeting became effective in late 1997; thus, 1998 was the first full year of operation of research activities under the new structure. Given the newness of the program structure, its implementation was closely monitored during 1998 from an internal viewpoint as well as from an external collaboration angle. The most important internal aspect was the balance in terms of project activities among the four Programs. An internal assessment of scope and size against the need for a dynamic research process along the research-to-development continuum, showed that the technology generation Programs 1 and 2 should not be expected, as perhaps originally thought, to accommodate the research required for evaluation and further development of promising technologies within the broader context of targeted production systems in the different agro-ecologies. At the same time, the scope of Program 4, as originally defined, proved to be narrow and needed to be widened to accommodate the future technology evaluation research for systems development to complement technology transfer activities. These issues were discussed by Management and Board in June and November 1998, and during the initial phase of WARDA's Annual Review and Planning Meeting in December 1998. As a result, it was proposed that for the MTP 2000–2002, the title of Program 4 should be changed to *Systems Development and Technology Transfer* and the project portfolio redefined to accommodate technology evaluation research and technology transfer for

irrigated, upland and inland valley systems. Further rationalization of the overall Project portfolio was implemented this year (2000) and is reflected in the new MTP for 2001–2003. The new Program–Project portfolio is given in Annex 1.

Because some of the changes were significant, 1999 became a transition year between the old and new MTP. Nowhere was this more evident than in the Inland Valley Consortium (IVC) convened by WARDA. Phase I of the IVC came to an end in 1998/1999. WARDA therefore took the opportunity to integrate the IVC activities more fully into its research agenda. After various meetings with IVC partners and stakeholders, it was decided that IVC activities should be included within the WARDA project portfolio. During the transition year (1999), IVC reported directly to the DDG-P. With the new MTP starting in 2000, IVC activities form the basis of a new Project within Program 4. The Heads of Instiutions' meeting of the IVC was held in April 1999, where a draft strategic plan document for Phase II was discussed. Furthermore, a new collaboration agreement was signed by heads of participating institutions for the IVC Phase II, which is a new and different project and requires a new commitment for another five years from the participating institutions. WECARD/CORAF and IWMI were accepted as new Consortium members.

In addition to the programs *per se*, the last two years have seen our thinking concerning the research support functions develop. In particular, the following have been institutionalized: Genetic Resources Unit; Key Sites Coordination Unit; Research-Farm Unit; Systems Analysis and GIS Unit. The support unit portfolio is also illustrated in Annex 1.

2. Medium-Term Plans 2000–2002 and 2001–2003

Program Division participated actively in the preparation of the new MTP for WARDA. The new MTPs consolidate the project-based research planning used for the previous MTP (1998–2000), with inbuilt objective-based milestones for assessment of progress. The program structure changes introduced with these MTPs have already been mentioned above.

3. Annual Review and Planning Process

An Annual Review and Planning process was reactivated for 1999 and began with a Pre-Planning Meeting in December 1998. The Pre-Planning Meeting reviewed the progress in 1998, and established guidelines for the full Program Review and Planning Meeting in February 1999. The same process was followed again this year, with Pre-Planning in December 1999, and full Review and Planning in February 2000.

The Program Review and Planning Meetings: (a) established detailed Program Division workplans and budgetary requirements for the year by project activities, including staff and capital plans for 1999 and 2000; (b) provided the basis for updating the rolling MTP for the 2000–2002 and 2001–2003, including the project logframes; (c) facilitated a review of project outputs (leading to the compilation of the material for 1998 and 1999 Program Reports); and (d) established the basis for experimental and survey protocols for 1999 and beyond.

4. Formulation of Program and Project Priorities and Strategies

In line with discussions at the Board meeting of June 1998, the Program Division embarked in November 1998 on an exercise to further elaborate WARDA's program priorities and strategies to serve as: (a) a basis for a six-year rolling program plan; (b) an input into the formulation of the rolling MTP 2000–2002 and beyond; (c) a basis for any modifications needed in WARDA's program organization and management; (d) an input into the revision of WARDA's Strategic Plan; and (e) a background document for the CCER and EPMR.

A preliminary draft of priorities and strategies of individual programs and key support units for the period 1999–2005 was produced in 1999. The priorities and strategies described in the document are consistent with those summarized in the MTP 2000–2002, and form an input into WARDA's Strategic Plan 2001–2010. During 2000, the draft will be finalized, taking into account the priorities and strategies of WARDA's Projects and Support Units.

5. Center-Commissioned External Review (CCER) on Program Strategy and Management

The CCER panel, composed of Drs Bernard Tinker (UK, Chair), Alphonsus Emechebe (Nigeria) and Vir Chopra (India), spent the period 14–20 June 1999 at WARDA Headquarters. Prior to this, Dr Emechebe visited Saint Louis and Dr Chopra visited two key sites, Gagnoa and Korhogo. The Report concludes as follows.

> "WARDA is now a highly active and respected member of the West African rice research community. Its applied research is producing new technologies, which are being applied at an increasing rate. Some of these are adaptations of well known principles, as in the saline and alkaline soils in Senegal and Mali. Others are the continuation of its plant breeding for yield and against the pests, diseases and soil constraints of West Africa. The most important is the production of interspecific

hybrids (the 'new rice for Africa'), that are showing great promise in some ecosystems. There seems little doubt that it is now generating impact at an increasing pace. We commented earlier that WARDA has been treated relatively generously in proportion to the amount of rice produced in its region. The increase in rice demand, and this promise of truly important research developments, shows that this is both deserved and well applied. There is a doubt about the more strategic research, which is less easily identified and seems to produce rather few papers in refereed international journals. In the future this is dangerous, and WARDA needs to consider this situation with care."

6. External Program and Management Review (EPMR)

The Fourth EPMR of WARDA was held over the period November 1999 to February 2000, chaired by Mandi Rukuni of Zimbabwe. The Initial Phase was conducted 20–30 November 1999 and the Main Phase from 24 January to 12 February 2000. The Panel undertook field visits to interact with national-program partners during the Initial Phase. A separate report on the EPMR has already been presented by the Director General. The report and WARDA's response will be considered by the CGIAR at its Mid-Term Meeting in May 2000.

7. Intellectual Property (IP)

7.1 IP Audit

As a result of the Third System Review, all CGIAR Centers have been asked to undergo an IP Audit. WARDA will be audited by Venable Associates, who will also audit ICARDA, ICRISAT, IITA and IPGRI. The Terms of Reference and Work Plan have been prepared, and interactions with Venable have begun. After a joint scoping study by Venable, Centers are being visited. The visit to WARDA by Michael Gollin from Venable took place on 22–24 July 1999. The WARDA Audit is now being handled by Dodds & Associates, and is expected to be completed for consideration by the CGIAR at its Mid-Term Meeting in May 2000.

7.2 Emerging Issues in IP Rights

- WARDA preliminary draft IPR Policy

- Germplasm

    - Background: Convention on Biological Diversity (CBD); FAO designated in-trust material; CGIAR Principles; OAU Model Legislation.
    - Mechanism: Material Transfer Agreements (MTA).
    - National, community, farmers' and breeders' rights considerations.
    - Reciprocal safety arrangements with users of biotechnology products.
    - Maintenance of 'public goods' status of WARDA material—no exclusive rights.

- Equipment and information
    - IP protection of material to ensure availability to stakeholders.
    - Equipment designs made available to developing-country manufacturers, without them being able to seek patents, etc., so as to make machinery 'freely' available to farmers.

8. Research Activities

WARDA's complex of research activities has several important characteristics.

- First is the span of research, from strategic to adaptive, covering the whole research-to-development continuum; for example, from strategic laboratory-based molecular biological methods, such as identifying valuable genes in rice, to machinery development in collaboration with the private sector, other development agencies, extension services and farmers themselves.
- Second, our research is multidisciplinary: we look at many problems from many angles; for example, our integrated approach to disease and pest management.
- Third, we conduct cross-sectoral research, such as that of the Human Health Consortium, where links between lowland-rice cultivation and water-borne disease have been examined through the integration of epidemiological data with agricultural and socio-economic data.
- Fourth, our pursuit of productivity gains is integrated with conservation of natural resources; for example, the weed-competitiveness of the New Rices for Africa reduces farmers' need to shift cultivation so often, thus conserving natural biodiversity.

- Fifth, the rehabilitation of our technology transfer mandate—in line with the priorities of many of our donors—seeks to improve the returns to our investment in research, it is designed to ensure that new technologies are not ignored by the farming community.
- Sixth, there are spillover benefits from our research, both among our own research activities—such as the use of the participatory varietal selection methods developed for the New Rice for Africa to our work with legume fallows—and outflow of technologies beyond our mandate region—such as the recent adoption of several WARDA-developed lowland rice varieties in Uganda, East Africa.
- Seventh and lastly, our research is people-centered. We are here to improve the lot of farming families in the region and beyond, these are people. Our partners are people too, and we never forget that.

Research highlights are given below.

8.1 New Rice for Africa

Our work with the interspecific hybrid progenies of crosses between Asian rice *Oryza sativa* and African rice *O. glaberrima* continues to be the flagship of the 'new WARDA.' Just about every researcher now at WARDA has some activity involving the 'New Rice for Africa' (recently dubbed 'NERICA'), including agronomists, breeders, economists, grain-quality technologists, human-health experts, pest-management specialists, physiologists and soil scientists.

The NERICAs have various advantages over the traditional 'Asian' varieties grown over the past few hundred years. Most importantly, they have the profuse early growth and droopy leaves of the African parent, which smothers out weeds, thus reducing weeding labor (a *gender* issue, since most rice-weeding is carried out by women family members); but then they mature like the Asian parent, with upright stems and large seed-heads (panicles). The interspecific cross has also greatly improved the availability of resistance to rice yellow mottle virus (RYMV) in breeding material, including three lines with combined RYMV and blast resistance. Overall, many NERICAs have larger panicles and therefore greater yield than traditional varieties; high and stable yields, even with minimal inputs (fertilizer, etc.), while still responding to fertilizer application. Increased yields of 50–100% (depending on crop management) contribute to poverty alleviation and food security, and adaptation to low-input cultivation protects the environment. Additional yields enable women farmers in particular to increase their marketable surplus, generating cash used to diversify diets through the purchase of food types that they do not produce (e.g. animal protein). The

savings in weeding labor free (human) resources to be allocated to other income-generating activities, and the possibility of time for education and training for both children and adults, thus enhancing the long-term possibilities for remunerative activities. The NERICAs have been dubbed 'new biodiversity'—at the gene-level, they conserve the resistance and tolerance genes of the African rice, which otherwise might have been lost through expansion of cultivation of the Asian rices; at the level of individual plants, they constitute something never previously seen.

8.2 Participatory Varietal Selection

NERICAs have done well in Participatory Varietal Selection (PVS) in Côte d'Ivoire, Ghana, Guinea, Nigeria and Togo. For example, in Guinea, some 130 ha of NERICAs were grown by 700 farmers in 1998. The PVS is a three-year program to promote adoption of new varieties (not restricted to NERICAs): in the first year, researchers manage a 'rice garden' and invite participating farmers to visit and make selections; in the second year, farmers are given seed of varieties they chose from the rice garden to grow on their own farms; in the third year, farmers are asked to 'put their money where their mouth is' and buy seed of their favorite varieties from the previous year. This leads to genuine adoption of varieties much quicker than through conventional extension channels, and relatively rapid dissemination of the new material through the local farming community.

The last two years saw the launch of WARDA's regional training program for NARS on participatory breeding and selection. In May 1998, WARDA organized a 10-day Participatory Rice Improvement and Gender/User Analysis (PRIGA) training seminar for its member countries at WARDA Headquarters. A breeder and a social scientist from the national agricultural research institutes attended the training from each of 10 member countries. The purpose of the seminar was to introduce the scientists to participatory and gender/user analysis methods and tools, as well as to share the knowledge gained from WARDA's PRIGA work. As a follow-up to the 1998 seminar, WARDA scientists have visited most of the participants and provided backstopping for their PRIGA activities. In April 1999, we conducted two PRIGA meetings back-to-back: the first was a re-run of the 1998 training course for the benefit of the partners from the 7 remaining member countries who were unable to attend last year; the second was a Reporting and Planning Workshop, designed to enable participant-practitioners to compare experiences and to plan for the upcoming PVS campaigns throughout the region in 1999.

8.3 Community-Based Seed Multiplication System

In the process of getting new varieties to the farmers, seed multiplication is a major bottleneck in much of West and Central Africa. Borrowing from the Senegalese national research institution (ISRA), WARDA started to promote a community-based seed multiplication system (CBSS) by farmers in 1998. Special effort was made to target Côte d'Ivoire and Guinea. It was clear that farmers (especially the women) have good knowledge and skill in conserving seeds from one harvest to the next growing season. Farmers were keen on the idea of growing their own seed, and needed only a little training in order to be able to handle the process. The system has advantages over the conventional public-sector-based one: no special treatment is required, and farmers merely select the best panicles at harvest time to be saved as seed; extension agents monitor the seed multiplication to ensure the quality (germination ability and purity) of seed over 3–5 years; seed is in the hands of (at least some) farmers soon after varietal release, rather than 4–7 years later (as is typical in the conventional scheme). The Ivorian extension agency made a firm commitment in 1998 to adopt CBSS as a complement to the convention seed-supply channels.

Two manuals have been produced to enable this methodology to spread throughout the region: one is for extension agents, and one for farmers. They explain the principles and practices involved.

8.4 Genetic resources

A Genetic Resources Unit (GRU) has been established at WARDA. The GRU comprises the genebank operations, INGER-Africa, and complementary research and training in genetic-resources conservation and management. The genebank operations at WARDA involve long-term storage of rice germplasm under a 'black box' arrangement with IITA. WARDA's genebank facilities for medium- and long-term storage will be operational in 1999. The genebank operations promote germplasm collection, conservation, evaluation and utilization at WARDA and in WARDA member countries. A large number of landraces and *Oryza* species will be available, and pre-breeding activities will make new donor lines available to breeders. During the 2000–2002 period, WARDA aims to collect information on the indigenous knowledge of farmers on *in-situ* conservation and management of rice biodiversity, and to enhance genetic-resources awareness in national programs.

The establishment of International Network for the Genetic Evaluation of Rice in Africa (INGER-Africa) at WARDA facilitates dissemination of the products of WARDA's breakthroughs in plant breeding to African NARS. The complementary research activities

during the 2000–2002 period target interventions at key points in the uptake pathway to promote efficient delivery of improved germplasm to farmers, and introduce a method of measuring impact on poverty reduction.

Part of the work of the INGER-Africa is to characterize the stored material to identify useful traits for the breeding programs. In this way, 10 lines with promising levels of resistance to RYMV were identified in 1998. Work also covered continued characterization of the major morphophysiological differences and similarities among the main types of germplasm—two subspecies of Asian rice, African rice, 'NERICA' and exotic introductions.

8.5 Biosafety

With the increasing awareness of genetically modified food plants and the prospects of WARDA moving into this area and that of transgenics, WARDA assisted the Ivorian National Biosafety Committee to finalize biosafety regulations in 1998. We are also working across the region to help establish both region and national regulations for biosafety.

8.5.1 Emerging Issues in Biosafety

- In order to develop regulations, NARS and national policy-makers require unbiased information on GMOs and transgenics.
- Africa lags way behind the rest of the world in field testing of transgenics, both in terms of area and percentage area.
- Up to 1997, no rice traits had been commercialized through this route, but 6 are known to have been tested, some of which will be proposed for commercialization in the future.
- RYMV resistance has been successfully transferred by a transgenic approach using fragment of the RYMV genome and susceptible cultivars widely grown in West Africa, by a UK-based organization but we cannot test the transgenic rice obtained without appropriate policy at a subregional level.

8.6 Fertilizer and weed management in the Sahel

Several years work in the Sahel has led to targeted recommendations for fertilizer management and weed control for irrigated rice in the Sahel. These recommendations replace blanket national recommendations in effect until very recently. Overall, the most important nutrient for Sahelian irrigated rice is nitrogen, but for highest yields phosphorus

is also required; however, it seems that the old recommendation for potassium fertilization is totally inappropriate in much of the region. These refined recommendations protect the environment from excess fertilizer (potentially toxic) and improve the overall productivity of the system in terms of rice yields (up to 2 tonnes/ha increase) and costs–benefits.

8.7 Plant nutrients

For rainfed rice, phosphorus (P) has now been clearly shown to be the most limiting plant nutrient in acid soils, and under intensified cropping in the forest zone; nitrogen (N) is more limiting under intensified cropping in the savanna. A rich natural source of P has been identified, namely rock-P from Tilemsi (Mali): experiments showed this to be a better fertilizer than commercial soluble phosphate. Intensification of cropping in many areas has resulted in a 25% rice yield decline. Some 90% of this decline has been attributed to weeds and N supply. This information can feed directly into fertilizer and weed-management (including cultivar selection) recommendations. It has also been noted that potassium and magnesium may also become limiting under intense land use.

At the other end of the spectrum, iron is present in toxic levels in many irrigated lowland sites throughout the region. Work on the flow of iron from slopes to lowlands (interflow) has shown that this route is important at some sites, but not at others. Iron toxicity has been shown to be due (at least in part) to soil reduction in the lowlands freeing more iron into solution. Although potassium and zinc are not usually limiting nutrients in 'normal' soils, their application (in combination with N and P) significantly increases rice yield on iron-toxic soils, suggesting that they are limiting under iron-toxic conditions. Physiological comparison of iron-susceptible and iron-tolerant cultivars has shown that tolerant cultivars 'hold' iron in their stems, old and dead leaves, while susceptible cultivars allowed iron translocation into young and green leaves—this may be the basis of the iron-toxicity tolerance.

8.8 Legume fallows

The use of certain legumes as cover crops instead of leaving land to natural, or 'weedy,' fallow has proved beneficial, and the legume–rice rotation system is successfully being promoted through PVS-type research–extension work. The legume fallow has a knock-on effect to the subsequent rice crop, which yields some 30% higher than a similar crop following 'weedy' fallow. Experiments on legume establishment and residue management suggest even greater benefits are attainable. Legume fallows reduce labor demands for land preparation (no heavy-duty slash and burn) and weeding (legumes suppress weed growth,

thereby reducing the weed-seed bank in the soil)—both women-dominated activities. In addition, the legumes probably leave more N in the soil for the subsequent rice crop than do the weeds.

8.9 Weeds

Weeds are the number one constraint to most rice production in West and Central Africa. We have already mentioned the weed-suppression effects of the NERICAs. In 1998, WARDA further developed a screening technology involving a competitive African rice (IG10) as a substitute (experimental) weed—natural weed growth is too erratic and unpredictable in space and time to be of much use in single-season mass screening of breeding lines. With this method, several hundred lines will be screened each year, speeding the identification of superior germplasm for use in the breeding programs.

8.10 Salinity

On-going work in the Sahel has clearly demonstrated that cultivating rice in the Senegal River delta has depleted the salinity (salt content) of the cropped soil over a period of years. In addition, tools have been developed to make the monitoring of salinization easier. Recommendations for drainage (water) and crop management are now available so that farmers and extension services can minimize the negative impact of rice cultivation on soil quality.

8.11 Small machinery

Intense cropping requires the use of machinery to reduce the labor requirement. This is most evident in the Sahel irrigated agro-ecology, where potential yields are in excess of 7 tonnes/ha. However, large-scale machinery from Asia and elsewhere has proved inappropriate. Working with the national research and extension agencies, and local private manufacturers, WARDA has adapted a small-scale thresher–cleaner (originally from the International Rice Research Institute, the Philippines) to Sahelian farm conditions. The machine has been highly successful and is now available in Senegal and Mauritania. *Ex-ante* impact assessment indicates that the thresher–cleaner is far superior to other mechanical threshers, and thus has a role in increasing farming efficiency and, therefore, labor-use efficiency. Prototypes are also now available in Burkina Faso, Côte d'Ivoire and Mali.

8.12 Rice yellow mottle virus (RYMV)

Studies using polyclonal antibodies developed to RYMV samples from 5 West African countries, identified some 8 serotypes of RYMV—a somewhat greater diversity than was expected. The polyclonal antibodies will enable national programs to identify their endemic viruses, and therefore target their resistant rice material.

8.13 African rice gall midge

African rice gall midge (AfRGM) has been a problem for West African rice growers and researchers for 20 years. There are several control methods available, but it took an international meeting in 1998 (sponsored by WARDA, and hosted at IITA, Nigeria) to obtain commitment from national (regional) and international scientists to work towards integrated management of this pest—that is, combining available management techniques in the most cost-effective and environmentally friendly way to keep the pest at tolerable levels. Part of this commitment was to produce two publications to alert farmers, extension agents and researchers in the region to this problem and what to do about it. The first of these will be published this year, and the second should follow in due course.

8.14 Inland Valley Consortium

The first phase of the Inland Valley Consortium came to an end in 1998, with the completion of the agro-ecological characterization of the region as a whole, the 10 member countries, 15 valley systems (semi-detailed level) and 10 watersheds (detailed level); most of the remaining characterizations were completed in 1999. The characterization covers many aspects of agronomy, socio-economics, climatology, geology, geomorphology, soils, hydrology, flora and fauna. The idea is that characteristics at the valley-system level will be pointers for more specific characteristics at the watershed and even farm level. This will enable the more rapid identification of existing technologies which might prove successful in the target area having already done so at a similar site. The methodology should also identify those agro-ecologies for which no improved technologies are yet available, and will therefore guide technology-generating research. Once all the characterization data is collected, the analysis between levels can begin to identify the characteristics that distinguish the watershed-level agro-ecologies at the detailed level of analysis. It should also be possible to determine specific characteristics that need to be measured in order to characterize ‘new’ valleys for which technology is to be targeted.

The strategic plan for Phase II calls for the research agenda to be organized under four main themes:

- characterization of inland-valley land-use dynamics;
- development and evaluation of technologies for improved production systems and natural-resource management;
- socio-economic and policy aspects of improvements in inland-valley land-use systems;
- technology dissemination processes and impact pathways for inland-valley development.

Phase II will see the establishment of four or five benchmark sites with a focus on long-term strategic research on integrated natural-resources management.

8.15 Human Health Consortium

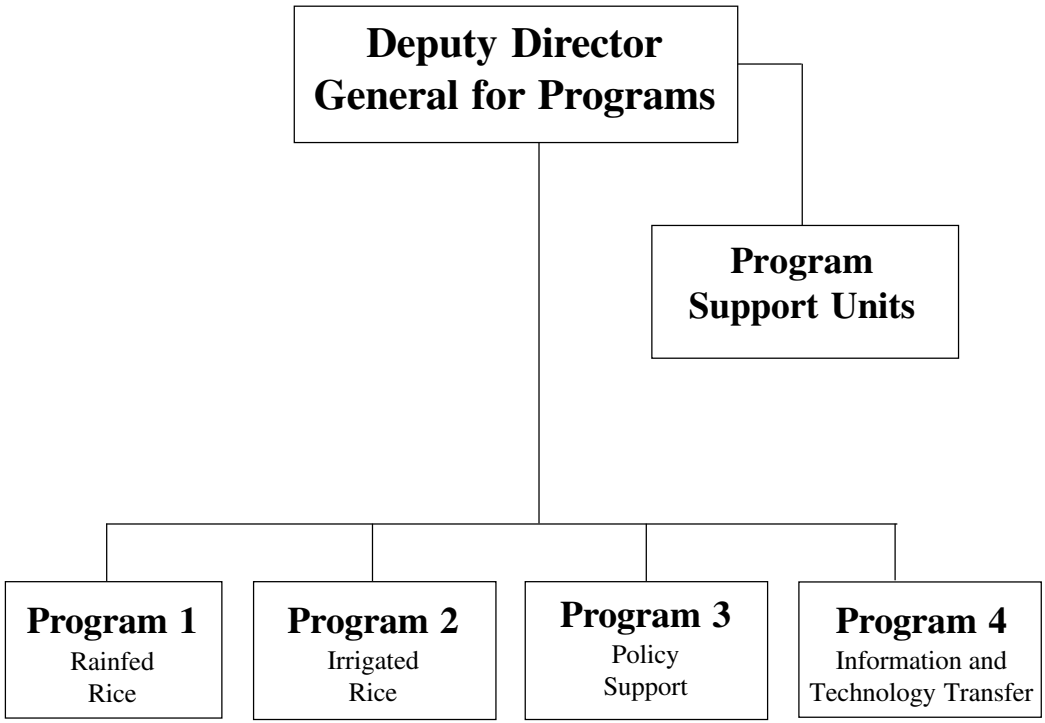
The WARDA/WHO-PEEM Health Research Consortium has also come to the end of its first phase. It has studied the impact of rice farming on vector-borne human diseases (malaria and schistosomiasis). Preliminary conclusions are that irrigation did not increase malaria transmission in the Sahel, and possibly maintained endemicity at a reduced level; reduced mosquito populations result in individual mosquitos living longer and subsequently to an increase in disease transmission—shortened flooding periods in intensified cropping in the Sahel may thus increase malaria rates; water management for rice double-cropping in the savanna did not increase malaria. On the basis of these findings, health planners are advised to improve measures to decrease human–vector contact in the Sahel (e.g. use of insecticide-treated bed-nets at night), and assist in improving women's disposable income, since they are the ones who seek treatment for infected family members.

8.16 Regional Rice Network

WARDA and WECARD/CORAF are in the process of establishing a West and Central Africa Rice Research and Development Network (ROCARIZ) through the merger of the WARDA–NARS Task Forces and the CORAF Rice Network. The merger has already been mentioned by the Director General in his report to the Council, and a report on the status of the new Network is a separate item at this meeting.

Annex 1. Program Division Structure

A1.1. Program Division Organization Chart



A1.2. Project Portfolio

Program 1. Rainfed Rice Program

Project 1.1: Sustainable Intensification of Lowland Rice-based Systems along the Gradient between Rural and Peri-Urban Areas

Project 1.2: Stabilization of Upland Rice-based Systems under Shortened Fallow

Project 1.3: Applying Watershed Management Methods to Optimize Resource Use in Inland Valleys

Project 1.4: Creating Low-Management Plant Types for Resource-Poor Farmers in Rainfed Ecosystems

Project 1.5: Development of Environment-Specific Breeding Approaches for Drought-Resistant Rice Varieties

Project 1.6: Characterization of Blast Fungus Diversity and Development of Donors for Durable Resistance

Project 1.7: Integrated Management of Iron Toxicity in Lowlands

Program 2. Irrigated Rice Program

Project 2.1: Improvement of Resource-Use Efficiency in Irrigated Rice-based Systems

Project 2.2: Development of Profitable Land and Water Use Systems Preventing Soil Degradation in Sahelian Rice Irrigation Systems

Project 2.3: Integrated Management of Rice Yellow Mottle Virus in Lowland Ecosystems

Program 3. Policy Support Program

Project 3.1: Rice Policy Formulation in the Post-Structural Adjustment Era

Project 3.2: *Ex-Ante* Impact Assessment of Rice Research

Project 3.3: *Ex-Post* Assessment of Rice Research Impact

Program 4. Systems Development and Technology Transfer Program

Project 4.1: Irrigated Systems Development and Technology Transfer

Project 4.2: Upland Systems Development and Technology Transfer

Project 4.3: Inland Valley Systems Development and Technology Transfer

A1.3 Program Support Units

- Biometrics Unit
- Genetic Resources Unit
- Information and Documentation Center
- Key Sites Coordination Unit
- Plant Quarantine/Biosafety Unit
- Research-Farm Unit
- ROCARIZ/Task Forces Coordination
- Systems Analysis and GIS
- Training and Fellowship Unit

Appendix 4

The potential for a Green Revolution in rice in West and Central Africa

The need for improved technologies to assist West and Central African farmers to increase rice production in an economically and environmentally sustainable manner has never been greater. Rice is rapidly replacing traditional foods with per-capita consumption growing faster than for any other food staple. Regional consumption is projected to increase at nearly 5% through the end of this century. Imports to fill the gap between regional production and demand, which stood at 2.2 million tonnes in 1980, will grow to 3.2 million tonnes this year (2000), costing more than US$ 1 billion in increasingly scarce foreign currency. At the same time, pressure from growing rural populations threatens to accelerate the degradation of land resources, with the risks highest in fragile upland ecosystem. The development of technical options to enable farmers to intensify production in the highly productive, more robust and generally under-utilized lowlands is a key element in strategies to ensure sustainable growth in West and Central African food production.

While the need for a more dynamic rice sector has never been greater, the preconditions for success are now in place. On the policy side, structural adjustment programs introduced in most countries of the subregion have greatly improved economic efficiency in production, processing and marketing.

On the technology side, during the 1990s WARDA launched revitalized programs of research in the humid, subhumid and Sahelian zones of the subregion. Teams of scientists, working in close collaboration with national researchers, are making rapid progress to fill the technology shelf with technologies appropriate for resource-poor farmers. An innovative wide-crossing program involving hybridization between *Oryza sativa* and *O. glaberrima* offers particularly exciting prospects for increasing and stabilizing upland and lowland rice yields in low- and high-input systems. The interspecific progenies might provide solutions at two levels, (1) the improvement of labor productivity through reduced need for weeding and other management interventions, and (2) the improved sustainability of intensified systems through durable crop resistance to pests and diseases, particularly in lowland systems that so far depend on introduced materials. Multidisciplinary and multi-institutional research on inland valleys is focusing on developing low-cost and environmentally friendly water management systems to permit the sustainable intensification of lowland ecosystems. Working in close partnership with national scientists and policy-markers, WARDA is confident that significant impact will be felt on farmers' fields before the end of this decade.

In short, the pieces are now in place for a successful take-off of rice production in West and Central Africa.

Rainfed Systems (Program 1)

Because it is a water-loving crop, rice is the preferred crop for lowland systems. WARDA places first priority on technology generation research targeting rainfed systems.

Program 1 acknowledges and confronts the challenges to regional food security and poverty alleviation by focusing on improving the productivity and sustainability of the rainfed rice systems in the uplands and inland valleys. A combination of carefully targeted gene-based and natural-resource management (NRM) technologies will be fully integrated to develop packages for improving the livelihoods of rice farming households, while conserving natural resources and biodiversity.

Rainfed Uplands: Given the growing intensity of upland use and its inherent fragility, potential production gains in upland rice-based systems are modest. WARDA's applied research aims at sustaining productivity gains while stabilizing environmental equilibria in watershed production systems undergoing intensification. Our strategy has two components: (i) the stabilization of upland systems through improved land and crop management; and (ii) relieving pressure on uplands by making the cultivation of adjacent lowlands more attractive and sustainable. Our technology development research will target various stages in the transition from extensive to intensive cropping systems. Since limited labor availability can remain an important constraint during early stages in the transition from land-using to land-saving production systems, our research focuses on developing labor-saving and environmentally compatible technical solutions.

The following approaches are being implemented in upland ecosystems:

- Improved management of upland fallow, making use of locally adapted, weed-suppressing, multi-purpose cover legumes as short-season fallows, combined with low-cost soil amendments such as rock-phosphate. The research aspect is farmer-participatory to ensure compatibility with farmers' resources and objectives. Incorporation of the legume increases rice yield through nitrogen accumulation (savanna) and phosphate accumulation (forest). Rock-P is a cost-effective alternative to soluble fertilizer P, and has a long-term effect over several seasons, rather than a single-season impact on yield.

- Development of low-management rice plant types. A breakthrough has been achieved during recent years in crossing the indigenous rice species *O. glaberrima*, which is highly weed suppressive and resistant to multiple stresses, with high-yielding *O. sativa* lines. The low-management plant types increase yield potential and yield stability at low levels of labor use. They also reduce dependency on chemical pesticides, since *O. glaberrima* contains superior resistance genes for virtually all major African rice pests. Yield stability of the 'New Rice for Africa' (NERICA) cuts across ecologies from upland to hydromorphic. In addition, many NERICAs are input-responsive, and therefore have the potential to initiate a cycle of increasing income-generation through farmers' ability to improve crop management through inputs. The first generation of NERICAs has shown higher protein contents that either of their parents—this may open the door to improved nutrition for rice-consumers.

Rainfed Lowlands: We recognize that intensification is only sustainable if it maintains the natural-resource base, including crop and ecosystem biodiversity. The technical approaches to intensification, however, must be different for rural, labor-limited production systems on the one hand, and land-limited systems, such as peri-urban lowlands, on the other. For rural areas, we are developing low-management rice varieties with multiple biotic and abiotic stress resistance derived from diverse genetic sources, as well as affordable water and soil fertility management practices, that when combined will make swamp-rice cultivation an environmentally safe and economically attractive enterprise. This will also allow resource-poor farmers to gradually shift from fragile uplands to the more robust lowlands.

Research on land-limited, high-input lowland systems, however, does not necessarily aim at further intensification. Instead, we seek greater diversification by developing economically attractive crop rotations and soil/crop management systems that protect the environment. We are developing integrated pest management methods that keep chemical pesticide use at or below current low levels in rice–vegetable and other highly vulnerable systems, and that help control human diseases transmitted by water-borne vectors. Farmer-participatory approaches are essential to ensure a good local fit and acceptance of the resulting technologies.

The strategy is, therefore, to develop lowland cultivation methods that are profitable, safe for human health, provide local food and income security, require minimal initial investment, and allow for sufficiently flexible individual calendars for labor use. These systems must build on varieties that have horizontal resistance to the major local biotic stresses. Intensification and diversification of the more robust lowlands remains a key element in the strategy for increased productivity of rice-based systems.

- WARDA's varieties obtained through traditional breeding methods have been released in several countries, having been primarily promoted through the Task Forces. Average yields on farmers' fields are estimated at 3.5 and 4.0 tonnes/ha for rainfed upland and rainfed lowland, compared to 1–3 t/ha for traditional varieties.

- Through the Task Forces and Participatory Varietal Selection (PVS) approach, over 3000 farmers in the subregion are assisting in the rapid adoption and dissemination of these new rices with unexpected results particularly in Guinea, Côte d'Ivoire, Ghana and Nigeria. To ensure that momentum is maintained**,** we are actively collaborating with NARS structures in a community-based seed production system (CBSS) for a better and easy-to-handle, cost-effective approach and good maintenance in seed production.

- WARDA now has in-house capacity in biotechnology, improving our use of anther-culture and embryo-rescue techniques, molecular-marker gene technology and marker-assisted breeding to tag and introgress genes, enhance early generation transfer and rapidly fix traits.

- We also continue to make progress in identifying resistance/tolerance to major biotic and abiotic stresses and determining the genetic mechanisms for them. The identification and tagging of a natural gene for resistance to RYMV is a major breakthrough, allowing for marker-assisted selection for RYMV resistance to commence at WARDA. Field resistance to African rice gall midge is an important feature of some NERICAs.

- Bunding of rainfed lowlands is associated with a 40% grain yield increase and 25% less weed biomass, and iron toxicity can be reduced through nutrient management and iron-tolerant varieties in lowland ecologies.

- We have improved the knowledge base on pathogen variability of the blast fungus (an essential component in the development of resistant varieties) using molecular techniques**.** A large collection of isolates from West Africa has been analyzed, in collaboration with Horticulture Research International (HRI) in the UK.

- Water control, and access to markets are key factors influencing the possibilities for cropping intensification and diversification in rainfed lowland systems. Given the extent of the lowland valleys, i.e. 20 million ha in West Africa alone, potential impact of improved crop and natural-resource management practices on food security in West Africa is tremendous. Options include dry-season cultivation of legumes,

vegetables and root crops, and double-cropping of rice. Retaining and recycling upland soil N in-situ through deep-rooting crops (e.g. pigeon-pea), capturing loss-prone N in the hydromorphic fringe or during the pre-rice cropping niche in lowlands may reduce N_2O losses to the atmosphere. Nutrient management through the use of N, P, K and Zn nutrients along with the use of iron-tolerant lowland rice varieties provides technology for increasing the productivity and production of rice in the wetlands where iron toxicity is present. Use of tolerant cultivars with proper water and nutrient management for reducing iron toxicity will help extend wetland rice cultivation in the inland valley systems.

Opportunities to Increase Irrigated Rice Production in the Sahel (Program 2)

Average yields in irrigated Sahelian systems are around 4 to 5 t/ha. WARDA studies have shown that yield gaps between actual yields and potential yields often range from 2 to 8 t/ha per season, indicating considerable scope for increased yields. In general, double cropping of rice is rare—only about 20% of the surface area under irrigation in the Sahel is double-cropped. The relatively demanding-cropping calendar leaves little room for delays in activities. Labor is often a limiting factor and mechanization is relatively widespread.

Increases in irrigated rice production can be achieved through:

- expanding area under irrigation
- increasing cropping intensity
- increasing resource use efficiency and productivity.

Maintaining or increasing the area under irrigation

The four main river systems in the Sahel (Senegal, Niger, Black Volta and the Lake Chad Basin) have the potential to irrigate far more land than is currently the case. However, expanding the area under irrigation to increase rice production in the Sahel is subject to the following constraints: (i) irrigation development costs are high, ranging from about US$ 5000 to 15,000 per ha; (ii) water over land ratios (in m^3 of renewable water per ha per year) in the Sahel and savanna environments are relatively low and water will become increasingly scarce, particularly in peri-urban areas; (iii) care should be taken to prevent loss of land under irrigation due to soil degradation.

Increasing cropping intensity

Double-cropping is difficult to realize because of severe cropping-calendar constraints that prevent farmers from harvesting the first rice crop fast enough in order to prepare the land for a second crop. Lack of access to credit and equipment to prepare the land or to harvest on

time is costly and service markets are not well developed. Post-harvest technology developed by WARDA and its partners target these types of constraint. Linkages between input supply and access to credit is a crucial point that has to be addressed to allow the diffusion of rice double-cropping.

Increasing resource use efficiency and productivity

Increasing the efficiency and productivity of existing rice-based production systems is the most promising avenue to increase rice production in Sahelian countries. It involves various components.

Dissemination of high-yielding varieties. The first step towards improved productivity in irrigated rice systems is to provide farmers with high-yielding, stable, modern varieties with good grain quality. Such cultivars should have short duration, to allow for double-cropping where possible. In some regions, salt-tolerant cultivars or cultivars resistant to RYMV can significantly improve production.

Improving natural-resource management practices. To maximize the benefit of improved varieties, farmers should have access to crop and natural-resource management techniques that improve yield and raise partial factor productivity of major inputs (land, water, fertilizer, pesticides, herbicides, labor), while safeguarding their natural-resource base. In farmers' fields in Senegal and Mauritania, improved soil fertility and improved weed management *each* resulted in a 1 t/ha yield gain, an overall 2 t/ha, or 80% increase in net benefits accruing to farmers. To maintain soil fertility over time, nutrient-balance studies are needed. Beyond the farm level, a closely related constraint that needs to be overcome in many areas is poor access to fertilizer.

Water shortages could be reduced through the introduction of less-water-demanding, short-duration varieties that allow the cultivation of two rice crops per year, or an additional non-rice crop following rice. Interventions to improve the productivity of water other than variety improvements include improving irrigation practices, and better maintenance of irrigation and drainage infrastructure. The latter aspects are particularly important with respect to resource degradation in irrigated systems.

In labor-scarce environments, such as in the Sahel, harvesting is often done too late, decreasing the quantity and quality of paddy output. Labor-saving equipment, such as small reapers and thresher–cleaners can alleviate these constraints. Guidelines for the best timing of drainage before harvest, and paddy storage conditions need to be transferred to farmers. In the Senegal River valley, a higher grain quality can double the selling price of rice, giving farmers a much better return on their efforts.

Socio-economic factors. On the output market side, there is a need to assess the potential to improve the market share of irrigated rice production. Increased investments to improve the land and to improve the management of both water and land cannot be expected without improved land-use security and further decentralization of crucial management decisions, and improved access to decision-making, knowledge and inputs. To optimize liberalization and privatization, and to create an enabling environment for farmers to invest in resource management and for the private sector to invest in input and output market development, further policy development and implementation of policy adaptations are required.

Irrigated system performance is largely influenced by institutional arrangements. Some of the causes for productivity gaps are related to the inability of farmers and institutions to collectively manage complex irrigated rice production systems in a productive manner. This situation calls for development and dissemination of improved scheme-level management recommendations and strategies that enable farmers and scheme managers to produce irrigated rice in a productive and environmentally sustainable way.

Altogether, we work on the basis that the most viable strategy to support the development of irrigated rice production is to increase cropping intensity and improve resource use efficiency through the adoption of improved technologies and practices at various levels of intervention.

Rice Policy Issues and Recent Trends in the Rice Sector in West and Central Africa (Program 3)

Transition to a liberalized environment is well advanced

In most countries of the subregion, the marketing of local production and trade of imported rice have been largely liberalized. Rice imports are mainly controlled through tariff regulations that have been significantly reduced in the past five years. Non-tariff trade barriers have been almost completely dismantled. In spite of a downward trend of rice price on the world market, the price of imported rice in local currency has not been as reduced due to the continued depreciation of the local currency against the US Dollar.

Rice trends

In this new open trade environment, the evolution of the main indicators of the rice economies indicates a stabilization of the deterioration of the rice trend balance. The self-reliance ratio (share of local supply on total consumption) has been slightly restored during recent years. This trend inversion is due to various factors.

- Per-capita consumption growth has slow down to 1.7% per year since the mid-1980s from 8% a year between 1975 and 1983. This is due to the relative increase of rice compared to other cereals or tuber crops, and to the stagnation of per-capita income that has stopped the transition to a more rice-based diet.

- Recovery of production in several countries. Rice price relative increase has been an incentive for rice producers to expand their production. Production is increasing at a higher rate than total consumption.

Rice imports are still increasing, although at a slower rate (4.8% between 1983 and 1995 against 11% during the previous eight years). With 11% of the total volume of world rice import, West and Central Africa has become an important outlet for rice exporters.

Diversified evolution by countries

These regional trends hide a large diversity across countries. Rice consumption level and self-reliance ratio are highly variable across the subregion. Rice is the main component of the diet in the southwestern countries of the region (Senegal to Liberia), while it is a component of a more diversified diet in the southeastern part (Côte d'Ivoire to Cameroon). Per-capita rice consumption levels are lower in Sahelian countries (except for Senegal). On the production side, several countries have recorded a significant increase of production, such as Mali which is becoming a net exporter of rice, and Guinea which has consistently reduced its volume of imports while the per-capita consumption increased from 60 to 90 kg.

Unequal effect of trade liberalization on rice production system competitivity

The results of several studies carried out in the region in the last five years confirm that the comparative advantage of the rice producers is affected by various factors.

- The distance to the point of import is an important determinant of the competitivity of rice systems. The high cost of transportation confers a natural protection to irrigated rice production systems in the inland Sahel.

- Low-input systems logically have benefitted more from the new macro-economic environment and remain the most competitive systems in the humid zone.

- The transformation of the post-harvest system has been an important factor affecting the competitivity of the local rice production system. Large-scale rice milling units have been gradually replaced by small-scale rice hullers, which are easier and less costly to manage. The introduction of rice hullers has also enhanced the competitivity of rice production where manual pounding was prevalent.

- The rice market remains highly segmented, local rice being valued more by consumers in certain countries, while in several cases imported rice (broken rice) is preferred by consumers—affecting the comparative advantage of rice producers.

- The evolution of rice consumers' preferences between local and imported rice varieties is a key factor for the evolution of rice competitivity.

- The recent expansion of rice production is mainly due to area expansion. The sustainable increase of rice will depend greatly on the capacity of farmers to adopt land- and labor-saving cultural practices and the establishment of an enabling policy environment is a key element for the expansion of fertilizer use.

Systems Development and Technology Transfer (Program 4)

To assist the implementation of its research program, WARDA has organized its technology generation and diffusion efforts around the conceptualization of a research-to-development continuum. Throughout its history, WARDA has worked to bring together the comparative advantages of its various institutional partners. Close collaboration with national agricultural and development organizations within the region has been an important ingredient in WARDA's approach to the development and spread of new technologies. The results, however, have not always generated the desired level of impacts. In some cases, the lack of adoption of new technologies by farmers can be attributed to the inefficiency or complete breakdown in the formal technology diffusion system. This is most clearly evident in the case of the seed sector, where blockages at a number of levels have delayed the release and spread of new high-performing varieties. In other cases, information and the accompanying technical skills necessary to put this information into practice are simply not getting into the appropriate hands. In still other instances, new technologies, although technically sound, have failed to meet the specific production objectives or local socio-economic conditions faced by farmers. Although extension programs have most often taken the blame for low levels of technology adoption, the incomplete translation of research results into usable extension themes, the inadequate on-farm evaluation and adaptation of technologies to fit local conditions, and the overall level of difficulty in generating new technologies for the region's diverse environments, are major contributors.

Technology evaluation and diffusion strengthen the on-farm impact of WARDA's technology generation activities. At the beginning of the research cycle, Program 4 contributes to characterization studies (system characterization, typology development,

constraint/opportunity analysis), studies of indigenous systems (communication and exchange networks, farmers' decision patterns, specific studies on management practices) and input into research design (problem definition and design leading to the generation of 'baskets' of alternative and complementary technologies with the widest possible range of application). As new technologies begin to emerge, the Program becomes involved in the participatory on-farm evaluation of the technologies, the organization of demonstrations with interested partner organizations, and adaptation of technologies to fit local conditions. Additional studies are carried out on the major institutional and farm-level constraints to technology diffusion and adoption.

Overall, the program ensures that research findings are translated into useable technologies and achieve the greatest possible impact within the subregion. Feedback loops are maintained with the technology generation process to provide field-level information on technology performance to help guide future research efforts. Feed-forward linkages are also established with development partners within the region to ensure that the technologies developed reach the largest number of potential user-groups.

Specifically, within each of the targeted production ecologies, the Program helps researchers to finalize transferable products from their research (including the generation of extension-ready information aids), and works with researchers in assembling 'clusters' of alternative technology options and complementary components.

Capacity-building

Program 4 is spearheading several initiatives to develop innovative new training programs that seek to build closer linkages between general capacity strengthening objectives and specific research and development activities. In particular, greater emphasis is being placed on courses and workshops that introduce new approaches to technology development, evaluation and transfer with prospects of accelerating on-farm impact. For the immediate future, however, efforts will concentrate on the following themes.

- Broadening WARDA's support of Participatory Breeding and Varietal Selection methodologies to include extension services and other development organizations within the subregion.
- Supporting regional efforts to introduce and institutionalize community-based seed production efforts with interested extension/development partners.
- Assisting the development of a regional training program on participatory approaches to technology evaluation, adaptation and diffusion.

To support the activities of both WARDA scientists and their regional partners, WARDA has greatly expanded its involvement in information exchange and dissemination activities, and continues to contribute to building national communication capacities within the region. Efforts in this area include:

- the creation of a searchable electronic database of existing (WARDA and other) rice-based technologies—ultimately this database will be accessible through the Internet, as well as on a demand basis through written requests and on-site visits;
- the new regional Technology Transfer Task Force (within ROCARIZ) brings together the major interest groups within the region (public-sector researchers and extensionists, change agents of voluntary and non-profit service organizations, and farmers' groups) in developing new methodologies and organizational capacities to improve the accessibility of new information and materials;
- the creation of e-mail networks (listservers) to strengthen the transfer of information and experiences among collaborators in WARDA's other Task Forces.

To meet the potentially vast number of organizations within the region interested in rice-based system technologies has required that a different approach be taken in establishing the Technology Transfer Task Force. Efforts will be directed at establishing national platforms of interested organizations to facilitate the exchange and development of locally adapted new technologies. These national networks will be connected on a regional basis through representatives participating in the regional regional rice research review meetings (ROCARIZ) and other functions.

The impact of the Program-4 efforts outlined above are directed towards tightening the linkage between research design/implementation and beneficial change at the farm level. Future research will not only need to respond to the most pressing problems faced by farmers in the various production environments within the region, but because of the this diversity, this research will need to be conceived and carried out in a manner that provides farmers with the widest possible range of options to choose from. Similarly, in order for WARDA's own research investments to generate their full impact, significant resources must be devoted to strengthening the individual and organizational capacities of its major partners within the region.

Conclusion

We believe that the studies reported above will contribute significantly to the expected boom in regional rice production, which is likely to draw from diverse hydrological environments and water management systems. New technologies from these studies will provide farmers with low-cost water management technologies and low-management plant types, as an incentive to increase and intensify the cultivation of lowlands. In the uplands, low-management (e.g. weed-competitive), but input-responsive rice varieties are now available and are being evaluated with farmers in participatory research. This will improve yield stability and create incentives for resource-poor farmers to replace nutrients extracted from the soil in short-fallow systems. A long-term recovery of destabilized upland systems would also require more substantial investments in resource-base quality.

In the long run, the role of high-yielding and high-management semidwarf rices is expected to increase, because farmers will find ways to improve water control as systems intensify, land will become scarce even in the rainfed lowlands, and more labor will become available due to population growth.

A recent study into the impact of rice varietal improvement across the subregion, attributes financial gains of US$ 232, $ 163, $ 69 and $ 32 *per hectare* to the adoption of improved varieties in the irrigated, rainfed lowland, mangrove-swamp and upland ecologies, respectively, to date. WARDA has made a significant contribution to the identification, development, dissemination and promotion of many of these varieties. As an indicator of future potential, some 37 new upland varieties are expected to be released in the period to 2004. If these are adopted for 10% of the upland-rice area in just three WARDA-member states—Côte d'Ivoire, Guinea and Sierra Leone—, the financial value will be near US$ 8 million *per year*; if adoption occurs across 25% of the area, the value will be near $ 25 million.

WARDA believes that a green revolution in rice production is now in the making in West and Central Africa, and to sustain the momentum will require strong continued support from its national partners.

Appendix 5

Status of ROCARIZ

1. Background

WARDA's unique character as an association of West African States gives it privileged access to national agricultural research (NARS) and a particular responsibility to serve the NARS whom WARDA has identified as its principal client group. In order to ensure that it would meet the needs of the NARS, WARDA instituted a consultative process aimed at developing its collaborative research agenda. This process led to the development of research Task Forces (TFs) in 1990. The Task Force mechanism is the principal mechanism used by WARDA in working with NARS. This is a network approach that brings together WARDA and regional scientists working on similar problems to jointly plan and execute research projects, thus building efficient and equitable partnerships.

Task Forces members are active rice scientists from WARDA's Member Countries nominated by their respective research institutions. Activities included the following.

- Master Plan: Identification of the priority constraints (see Table A5.1) to rice production within each TF's thematic area.
- Research: Small grants were allocated, on a competitive basis, to fund research activities on priority constraints defined in the master plan. From 1992 to 1998 a total of US$ 1,383,589 for 680 projects was allocated (Fig. A5.1).
- Meetings: Annual meetings were held to review the progress made in the previous year and to plan the activities for the current year. Some statistics concerning annual meetings are presented in Fig. A5.2 and A5.3.
- Training and workshops.
- Fellowships: Support for short-term training at WARDA or in another national program was provided to TF members.
- Monitoring Tours: Multidisciplinary teams evaluate the implementation of TF activities, and assess the rice production status and constraints, as well as impact and farmers' perceptions of problems and available technologies.

The mechanism was successful and gained international recognition. The Task Forces have been consolidated and their focus broadened. A new Task Force charged specifically with pursuing activities to enhance the transfer of technology has been established, Cropping Systems and Problem Soils merged into one Natural Resource Management Task Force, and all breeding Task Forces into one Breeding Task Force, giving a total of seven TFs.

Table A5.1. Profile of WARDA's original rice Task Forces

Task Force	First Year Active	No. Member Countries	Research Priorities
Mangrove Swamp Rice	1991	6	Varietal tolerance to saline and acid soils. High and stable yields. Consumer acceptability
Upland Rice Breeding	1992	14	Varietal tolerance to drought, acidity blast and weeds. High and stable yields. Consumer acceptability
Lowland Rice Breeding	1992	13	Varietal tolerance to iron toxicity, waterlogging, blast, rice yellow mottle virus and gall midge. High and stable yields. Consumer acceptability
Integrated Pest Management	1992	12	Management of blast, rice yellow mottle virus, stems borers, gall midge
Sahel Resource Management	1992	7	Soil degradation due to salinization, alkalinization and sodicity. Factor use efficiency.
Problem Soils	1993	12	Acid soils and associated phosphorus deficiency. Iron toxicity
Economics	1993	15	Cost of production, comparative advantage. Adoption and impact studies
Cropping Systems	1994	11	Upland fallow management. Residual moisture use for crop diversification
Irrigated Rice Breeding	1995	17	High and stable yields. Rice yellow mottle resistance. Consumer acceptability.

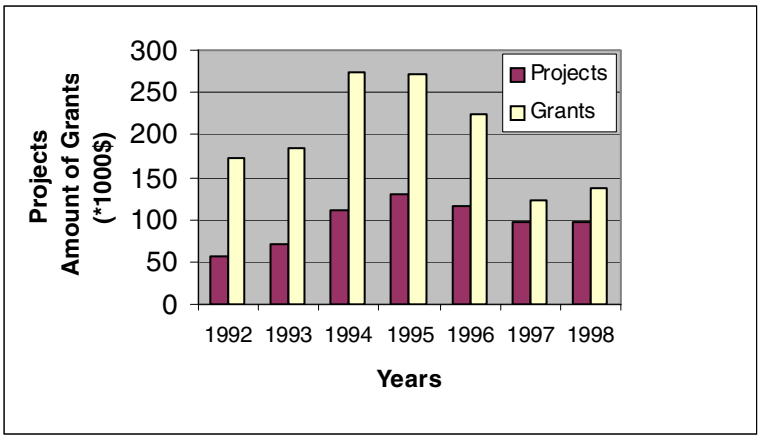


Fig. A5.1. Number of projects and amount of grants per year. Total of US$ 1,383,589 for 680 projects.

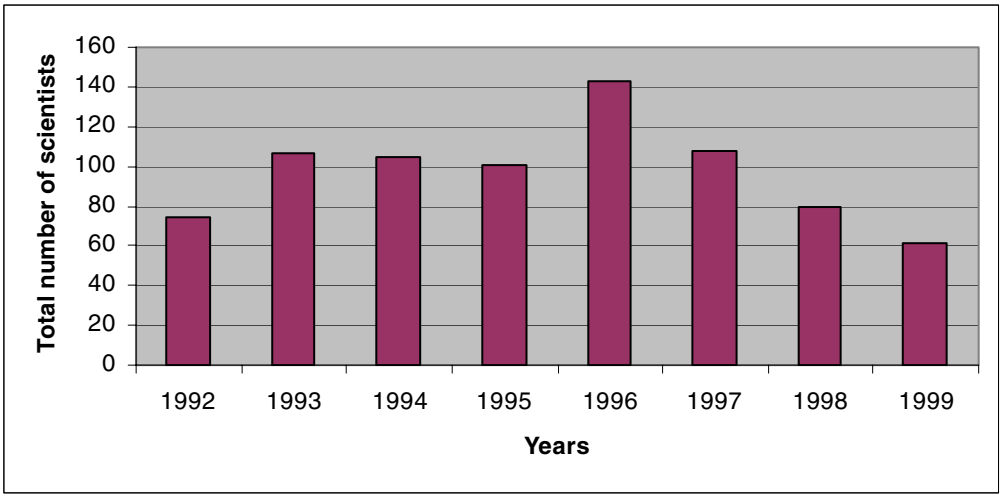


Fig. A5.2. Participation in meetings

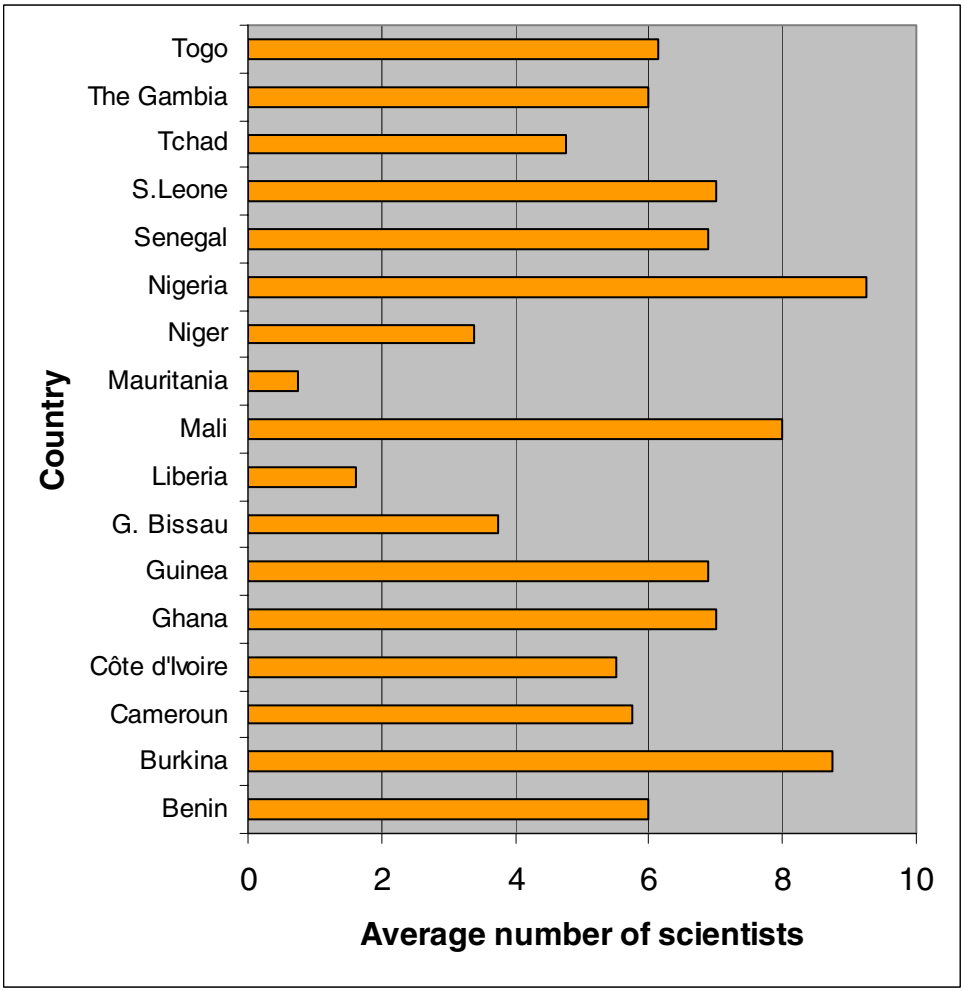


Fig. A5.3. Average number of scientists from member countries participating in Task Force meetings from 1992 to 1997

2. ROCARIZ: Merger of the WARDA Task Forces and the CORAF/WECARD Rice Network

In 1998, following a recommendation of WARDA's National Experts Committee, a consultation meeting was held between WARDA and CORAF/WECARD. The meeting resulted in the creation of a single and unique rice network by merging the WARDA Task Forces and the CORAF/WECARD Rice Network. The Network should operate under the Task Fore mode with one steering committee, **a Coordinator to be appointed based on conditions determined by NARS** and a secretariat based at WARDA.

2.1 Modalities of the merger

The Steering Committee of CORAF/WECARD Rice Network, WARDA Task Force Chairpersons and three WARDA scientists met in Cotonou on 7–8 December 1998 to work out modalities for the merger. The terms of reference of the General Assembly, the Steering Committee, the Coordinator and the Secretariat were defined. The meeting mandated WARDA and CORAF/WECARD to pursue on-going activities during the transition period and an interim Steering Committee was formed.

2.2 Five-Year Strategic Plan

A meeting of the Network's stakeholders was held on 15–17 March 1999 in Yamoussoukro to prepare a Five-Year Strategic Plan. This will be the blueprint for the Network activities for the next five years starting in 2000. The Interim Steering Committee and WARDA Task Force animators met on 10–11 September to draft the statutory instruments and the organizational arrangement of the Network to be adopted at the constituent meeting in April 2000.

2.2.1 Name of the Network

Réseau ouest et centre africain du riz (ROCARIZ)

2.2.2 Members of the Network

National agriculture research and extension services (NARES), NGOs, farmers' groups, rice private sector, development agencies of the CORAF/WECARD member countries, donors and WARDA.

2.2.3 Goal of the Network

The goal of the ROCARIZ is to link rice stakeholders in the region to generate and sustain improved, relevant rice technologies and facilitate their transfer and diffusion for rapid adoption by end-users.

2.2.4 Purpose of the Network

The purpose of the Network is to continue the strengthening of NARES' capacity and capability for participatory rice research planning, technology generation, evaluation, and transfer to end-users.

2.2.5 Objectives and Themes

Objective 1. Increasing rice genetic diversity in the region

Themes:

- Intra- and inter-specific breeding for resistance/tolerance to major stresses such as blast, RYMV, drought, weeds, acidity and salinity by WARDA and NARS.
- Hot-spot screening of segregating populations and fixed lines by NARS for resistance/tolerance to major stresses.
- Genetic enhancement through intra- and inter-specific hybridization, anther-culture and doubled-haploid, and marker-assisted breeding.
- Selection from segregating populations and evaluation of yield potential of fixed lines by NARS.

Objective 2. Increasing rice productivity and production in the region while conserving natural resources

Themes:

- Regional evaluation for yield stability and adaptability by NARS.
- Evaluation of *O. sativa* × *O. glaberrima* interspecific progeny for adaptability to lowlands, including mangrove swamp environments.
- Stabilization of over-exploited fragile upland rice-based systems.

- Sustainable diversification of underutilized rainfed lowlands.
- Development of better soil and water management techniques for direct seeding and control of stresses such as crabs, salinity, and acid sulfate soils.
- Increasing rice productivity and grain quality through better crop management practices.
- Identification an experimentation of control measures and elaboration of IPM packages against major diseases and pest of rice in West and Central Africa.
- Reducing labor needs in irrigated rice-based systems through the introduction of small-scale agricultural machinery.
- Improving soil fertility management in irrigated rice.

Objective 3. Making the tools, techniques and mechanisms available to NARES to strengthen R&D capacity and to transfer technologies

Themes:

- Breeder seed production by NARES.
- Training of NARS scientists in breeding methods related to interspecific hybridization, and participatory research methods and procedures.
- Regional evaluation by NARS for stability and adaptability of advanced lines.
- Genotype-by-environment (G×E) trials for site characterization by WARDA and NARS.
- Genotype-by-environment (G×E) interaction trials for mangrove site characterization.
- Training NARS on breeding approaches and mangrove swamp rice production technology.
- Preventing soil salinity, alkalinity and sodicity problems in irrigated rice-based systems in the Sahel.

- Comparative advantage of rice commodity systems in West and Central Africa.
- Improved technology targeting through farmer adoption studies.
- *Ex-post* impact assessment of rice research.
- Strengthening human and organizational capacities for technology diffusion.

- Investigation of the incidence and variability of rice diseases and pests in West and Central Africa.
- Development and characterization of cultivarsresistant to major diseases and pest in rice ecosystems in West and Central Africa.

Objective 4. Partnership development for an effective participatory technology transfer and market development

Themes:

- Farmer participatory rice breeding and varietal selection by WARDA and NARS.
- Improving the availability of relevant information and materials among traditional and non-traditional partners within the region.
- Developing improved approaches to technology adaptation and diffusion.

2.2.6 Steering Committee

The Network will operate under the Task Force mode with a single Steering Committee (SC) (chaired by a NARS scientist), and a Coordinator to be appointed based on conditions determined by NARS. The SC is the management body of the Network and reports to all stakeholders during the Regional Rice Research Review (4Rs) meetings and to WARDA's management, which should report to the WARDA/National Experts Committee.

2.2.6.1 Functions of the Steering Committee

- Defines the goal and objectives of the Network.
- Provides guidance on priorities and strategies of the Network and ensures that activities are implemented according to agreed plans.
- Ensures the relevance of projects and defines criteria for project evaluation and selection.
- Evaluates and selects projects submitted by the Network members for funding.
- Reviews and approves ROCARIZ workplans and annual progress reports prepared by the Network Coordinator.
- Reports to all stakeholders and to WARDA's management.

2.2.6.2 Memberships

The Steering Committee will consist of nine (9) members plus observers. Membership will be for 4 years. The 9 members are: Task Force representative (7), WARDA (2) .

Observers: CORAF/WECARD, WARDA's DDG-P, 5 (Five) WARDA TF facilitators (the 2 others are already on the SC), donors, other interest groups.

Secretary: ROCARIZ Coordinator.

2.2.6.3 Annual Meetings

The Steering Committee will meet annually to review progress reports and facilitate the implementation of the agreed program.

2.2.7 Coordinator

The Network Coordinator will be based at WARDA and operate under WARDA's policies and procedures. He/she will be responsible of the day-to-day administration of the Network.

2.2.7.1 Responsibilities of the Coordinator

- Prepare the meetings of the General Assembly and the Steering Committee, and serve as secretary to the Committee.
- Prepare annual reports to be submitted to WARDA and CORAF/WECARD.
- Prepare the 4Rs meetings, workshops and training courses.
- Coordinate the preparation of meeting reports and decisions.
- Facilitate exchange programs and other technical support in conjunction with scientific resource persons.
- Authorize expenditures of the Network and coordinate purchases of the Network in line with donor and WARDA requirements.
- Prepare the annual workplan and budget of the Network.
- Prepare projects and technical reports to be submitted to donors.
- Carry out any other tasks that may be entrusted to him/her by the Steering Committee.

2.2.7.2 Appointment of the Coordinator

The Coordinator of ROCARIZ will be appointed on the basis of conditions determined by NARS during this second WARDA National Experts Committee Meeting.

2.2.8 Regional Rice Research Review (4Rs) Meetings

A biennial Regional Rice Research Review (4Rs) will be held. Participation will be broad and not limited to Task Force members, thereby promoting expanded networking and reducing the problem of rice scientists working in isolation.

Appendix 6

ROCARIZ Coordinator

Responsibilities

The ROCARIZ Coordinator of is in charge of the daily administration of the Network. As such she/he shall be responsible for the following tasks:

- Organizing meetings of the General Assembly and the Steering Committee, and serve as secretary to the Committee.
- Preparing annual reports to be submitted to WARDA and CORAF-WECARD
- Organizing the 4Rs meetings, workshops and training courses.
- Coordinating the preparation of meeting reports and decisions.
- Facilitating the exchange programs and other technical support in conjunction with scientific resource persons.
- Preparing the annual workplan and budget of the Network, in line with WARDA's procedures, for adoption by the SC.
- Endorsing, for approval by the WARDA DDG-P, requests for expenditures of the Network, and coordinating purchases of the Network in line with donor and WARDA requirements.
- Preparing projects, progress reports and technical reports to be submitted to donors.
- Undertaking any other tasks that may be entrusted to him/her by the Steering Committee.

Recruitment and Administrative Arrangements

Option 1: The Network Coordinator is nominated by NARS and seconded to WARDA. he/she is supported by his/her own institution and receives a living allowance package from WARDA. The term of office is two years, renewable only once.

Option 2: The Network Coordinator is appointed as a visiting scientist following the WARDA Visiting Scientist scheme. He/she is supported by WARDA/CORAF/ WECARD as a visiting scientist. The term of office is two years, renewable only once.

Option 3: The Network Coordinator is recruited from among the rice scientists of the region by WARDA upon interview. The ROCARIZ Coordinator's position is a WARDA international position at the APS level. The costs of the position should be covered by the mobilized funds of the Network. WARDA and WECARD/CORAF shall be in charge of mobilizing resources needed to run the Network and to support the Coordinator position.

Reporting

The Coordinator will be based at WARDA which will provide him/her with a secretariat. The Network Coordinator serves as secretary to the Steering Committee which reports to all stakeholders including WARDA's management. Being based at WARDA and given his/her responsibilities, he/she will report to the Deputy Director for Programs of WARDA and follow the rules and regulations of WARDA.

Appendix 7

Appointment of the Chairman of the IVC Management Committee, IVC Regional Coordinator and Natural Resource Management Scientist

Inland Valley Consortium (IVC)

The Inland Valley Consortium (IVC) project for the sustainable development of inland-valley agro-ecosystems is a CGIAR-supported Systemwide activity convened by WARDA in collaboration with national and international institutions working to improve the productivity and sustainability of inland-valley use systems. The IVC project activities are integrated in WARDA's Program 4 entitled *"Systems Development and Technology Transfer."*

The IVC membership comprises national agricultural research systems (NARS) of ten (10) member countries of CORAF-WECARD and WARDA—Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Mali, Nigeria, Sierra Leone, Togo—and nine (9) international and non-regional organizations—WARDA, CIRAD, CORAF-WECARD, ICLARM, FAO, IITA, ILRI, IWMI and Wageningen University Research Center (WURC).

Appointment of the Chairperson of the IVC Management Committee (CMC)

The Consortium Management Committee (CMC) is composed of four (4) representatives of NARS and four (4) representatives from international organizations. The CMC will be chaired by one of the NARS representatives on a rotating basis (maximum 2 years but with annual renewal) and co-chaired by a CORAF-WECARD Executive Committee member. The current country members are Côte d'Ivoire, Ghana, Guinea and Nigeria; international organizations are represented by IITA, IWMI, WURC and CIRAD. WARDA and CORAF-WECARD are *ex-officio* members.

It was decided during the 1999 IVC workshop in Yamoussoukro that the Chairperson of the CMC will be designated by the member countries. Dr Otoo from Ghana was appointed Chairman for the transition period (1999). A new chairperson will be elected during the 2000 workshop by the member countries.

The CMC role is to:

- suggest policies to Consortium members regarding scientific strategy and partnerships
- monitor and evaluate the general operation of the Consortium
- amend and adopt the budget proposed by the Regional Coordinating Unit (RCU)
- review and then select projects to be funded by the Consortium.

The CMC will report to WARDA.

Appointment of the IVC Regional Coordinator

A new Regional Coordinator will be selected to replace Dr Jean-Yves Jamin whose contract ended on 17 January 2000. Two candidates (Mr Jean-Claude Legoupil and Mrs Dugué née Taguaux Marie-Joseph), whose CVs are attached, were proposed by Government of France to WARDA. The recruitment of the IVC Regional Coordinator will follow two steps:

- selection of candidate during WARDA/NEC meeting;
- interview of the selected candidate during IVC meeting (3–7 April).

Appointment of the IVC Natural Resource Management (NRM) Scientist

The contract of the former IVC Natural Resource Management (NRM) scientist (Mr Peter Windmeijer) from the Netherlands ended in September 1999. Two candidates were proposed to WARDA for selection. Those candidates were not selected by WARDA. At the same time, Dr Marco Wopereis, a WARDA NRM Agronomist from the Netherlands working at WARDA Sahel Station in Senegal, was transferred to Bouake to manage the GIS unit at M'bé. WARDA got the approval of the Government of the Netherlands to nominate Dr M. Wopereis as IVC NRM Scientist.

Appendix 8

WARDA/NARS collaborative projects: assessment of efficiency and efficacy

Background

WARDA recognizes that it cannot meet all the rice science needs in West and Central Africa on its own. The diversity of the region's rice-producing environments is great, and WARDA's resources too small relative to the challenges for it to achieve this objective working alone. Efficiency and efficacy demand that WARDA seek the contributions of scientists in other institutions, especially in national programs.

Beginning with its first Medium-Term Plan, WARDA has proactively sought a range of partners with whom it has worked to define overarching research priorities and to share research responsibilities (on the basis of institutional strengths). Collaboration has been operationalized with national agricultural research systems (NARS) through the Task Force mechanism, projects, networks (INGER-Africa) and through two Consortia, one focusing on the development of inland valleys and one targeting the human-health consequences of lowland rice production.

1. Task Forces (ROCARIZ)

In the late 1980s, NARS and WARDA began a series of consultations to lay the groundwork for a new type of regional cooperation in rice research to achieve critical mass at the regional level. At the heart of the new approach was the Task Force mechanism. The Task Forces were designed as mini-networks bringing together regional scientists who are working on very similar research problems in similar rice-growing environments. Between 1991 and 1996, the mechanism brought together more than 1000 scientists from the 17 WARDA member countries to cooperate in their research activities.

1.1 Achievements

To assess the efficiency and the efficacy of the mechanism, the regional rice research should be viewed as an integrated system with interdependent parts (Fig. A8.1).

Within the system, research activities of WARDA, national rice research programs, and between WARDA and NARS, have been harmonized, thereby reducing duplication and maximizing complementarity. This has generated a robust and dynamic collaborative research system resulting in the joint planning, implementation and evaluation of research activities. Between 1992 and 1998, some 680 NARS' projects were funded through the Task Forces for a total of US$ 1,383,589.

In addition to the highly participatory nature of planning and decision-making, the efficiency of the mechanism is also due to its light organization with only the minimum bureaucratic hierarchy in order to minimize transaction costs. The planning and evaluation of research activities as well as the decision-making is done through plenary meetings and steering committees chaired by national scientists, and animated by WARDA scientists serving as Task Force Animators responsible for providing logistical support.

The Task Force mechanism has gained international recognition and has been efficacious in the following.

- Improved interactions among rice scientists in West and Central Africa; the mechanism provides a leverage to WARDA and NARS as a whole.

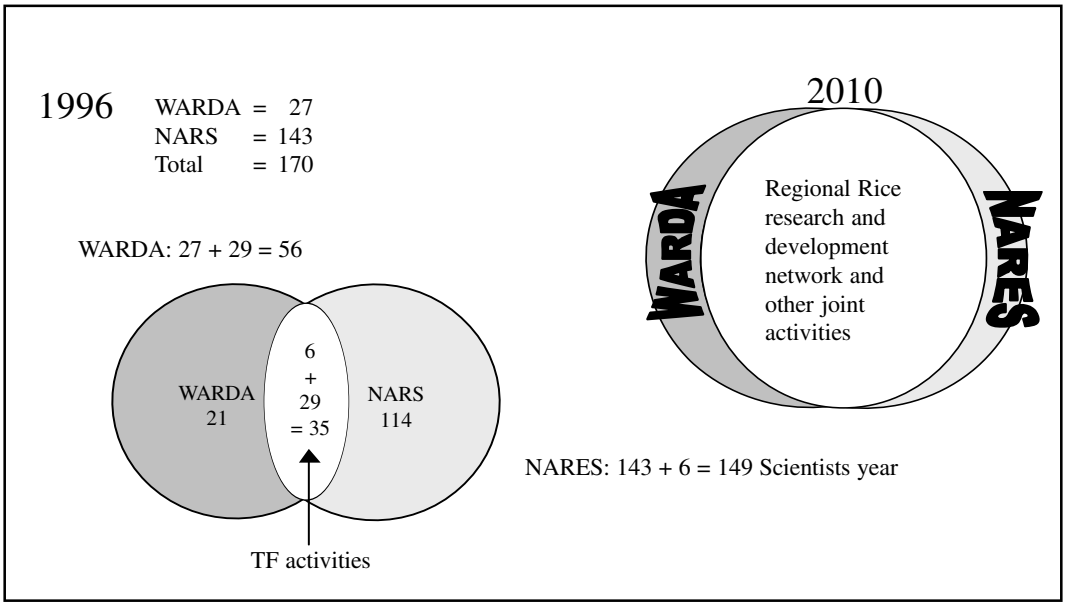


Figure 1. Leverage of the TF Mechanism on WARDA and NARES Research and Development

- Contribution to the release by national programs of new and high-yielding varieties (upland, lowland, mangrove and irrigated) with resistance/tolerance to major stresses.

- Training in methodology and professional development for NARS scientists.

- Joint projects involving scientists from different NARS in the region addressing common problems.

- Joint (WARDA and NARS scientists) publications of scientific papers on Task Forces activities.

1.2 Consolidation and Future

The Task Forces have been consolidated: Cropping Systems and Problem Soils merged into one Natural Resource Management Task Force, and all breeding Task Forces into one Breeding Task Force. The focus of Task Forces has also been broadened. A new Task Force charged specifically with pursuing activities to enhance the transfer of technology has been established, giving a total of seven Task Forces. A consolidation of rice research at the regional level led to the merger of the WARDA Task Forces and the CORAF-WECARD Rice Network in 1998. The stakeholders of the new Network have elaborated a Five-Year Strategic Plan and its activities will be launched during the first Regional Rice Research Review 10–13 April 2000.

2. Inland Valley Consortium

Inland valleys have a key role to play in providing options for sustainable intensification of production from rice-based systems. The development of profitable inland-valley technologies and an enabling policy environment are central elements in strategies to induce farmers to shift rice cultivation to the lowland ecosystems and thus reduce the pressure on the rapidly degrading uplands.

Cognizant of the need to adequately characterize the diverse inland valleys of West and Central Africa as a basis for the development of technically and economically efficient technologies, an eco-regional initiative, the Inland Valley Consortium (IVC) was formulated in 1993 among 11 research institutes active in inland-valley research in the region, to achieve a concerted research focus on these promising agroecosystems. Initially, the partners included seven national agricultural research institutes from Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Nigeria and Sierra Leone, and four international institutes (WARDA,

IITA, CIRAD and WURC). During 1994–1998, membership of the IVC expanded to include NARS from Guinea, Togo and Cameroon and, at the international level, the FAO, ILRI and IWMI in 1999.

2.1 Achievements

- Establishment of an effective collaboration for research priority-setting and planning, project implementation and monitoring.
- Establishment and characterization of 16 key sites (in 10 member countries), where applied research can be conducted with an effective support to extrapolation at the national and regional levels.
- Establishment of a network of 4–5 benchmark sites to conduct strategic research while being able to validate and adapt its results through the key sites.
- Development of a common multi-scale characterization methodology to conduct reconnaissance, semi-detailed and detailed characterization studies.
- Between 1994 and 1999, a total of 85 research projects were funded by the IVC through small research grants ($3000 to $25,000).
- Validation of DIARPA, a decision tool for water management.

2.2 Looking ahead

To achieve improved research effectiveness and efficiency in the future, IVC needs to concentrate its longer-term strategic activities in a smaller number of sites. It is therefore proposed to upgrade 4–5 key sites to 'benchmark sites,' where it is planned to implement a comprehensive, multi-year strategic research activities involving multiple stakeholder partners. These activities will include methodology development (e.g. rapid diagnosis systems, spatial transfer mechanisms) and technology evaluation and development. The latter activities will include natural-resource management and sustainability issues, and environmental protection aspects of integrated land use, including off-site effects. In non-benchmark countries, IVC-sponsored activities will concentrate on technology testing and monitoring in the existing key sites, and on outputs dissemination.

Diversified rice-based production systems for the lowlands will be developed. The improved farming systems will be tested, technically as well as socio-economically. Moreover, we should be able to estimate the impact of the improved technologies on the natural-resource base and the human environment. Decision tools for integrated land use and natural-resource management will be developed.

In 2000, IVC will be hosted in Program 4 and integrated within WARDA. This is expected to allow IVC to benefit from WARDA through cross-program and cross-project linkages and support, as well as scientific interactions; linkages to other CGIAR centers, WARDA's internal review and planning process, as well as CGIAR's evaluation processes, and the WARDA administrative and financial support.

3. Human Health Consortium

Wetland water management and irrigation schemes are thought to make vector-borne disease endemicity worse in West Africa. The development and promotion of wetland/ irrigated rice cultivation has been restrained because of such health concerns. However, with the rapidly growing consumer demand for rice (5.6% annual growth rate) and the limited options for intensification of upland areas, wetland rice development becomes a major focus for agricultural policy-makers and farmers.

The Consortium of WARDA, WHO-PEEM, IDRC, DANIDA, Government of Norway, brings together six West African research institutions of different disciplines to evaluate health and social impact of various degrees of wetland water management/ irrigation in the humid rain forest, savanna and Sahel. Results will be used to develop environmental management strategies minimizing health risks related to land use.

3.1 Some Preliminary Results

- Data from the Sahel indicate that over a 5-month period at the end of the rainy season, malaria incidence rates are similar in irrigated and non-irrigated areas even though the temporal pattern of malaria transmission intensity varies among locations.
- Density-dependent mechanisms control anopheline infectivity and thus reduces entomological inoculation rates (EIR).
- In irrigated areas, transmission is continuous but at lower levels, whereas in the non-irrigated zones, malaria transmission is of 'epidemic' nature reaching very high levels during a short period at the end of the rainy season.

- Data indicate that annualized new clinical malaria cases in children occur significantly less frequently in wetland rice single-cropping environments, whereas new malaria cases occur with similar (higher) frequency in double-cropping and no wetland rice cropping areas.

- In forest zone, there are low levels of *Schistosoma haematobium* infections in all three rice agroecosystems (0.9% in double-cropped, 4.4% in single-cropped environments and 1.6% in zones without wetland rice cropping). However, *Schistosoma mansoni* infection levels were high in double-cropped (61.4%) and in single-cropped (46.5%) environments. In zones without wetland rice cropping, 19% of the studied school children were infected.

3.2 Looking ahead

The first phase of the Consortium activities will come to an end by March 2000**.** The evaluation will lead up to a forward-looking workshop, which will outline the scope, content and partners for a second phase of the Health Consortium.

Due to the focus placed on vector-borne disease during the first phase of the Consortium activities, a complementary activity allowing the broadening of the subject has been developed as a second WARDA project entitled 'The community impact of wetland rice development on health and nutrition.'

4. International Network for the Genetic Evaluation of Rice in Africa (INGER-Africa)

In 1990, all rice research responsibilities for West Africa were transferred to WARDA, and it was agreed that INGER-Africa operations should be relocated to WARDA. During the same period, WARDA and its NARS partners initiated a successful Task Force mechanism. National rice scientists who are members of Task Forces as well as INGER-Africa recommended changes in INGER-Africa operations to make it more flexible and responsive to the diverse needs of different national programs.

Suggestions included:

1. improved targeting of nurseries to specific stresses and ecosystem requirements;

2. improved targeting of nurseries to the specific needs and capacities of particular national programs in order to increase the share of relevant materials in nurseries;

3. better characterization of trial sites;

4. greater participation of national breeders in nominating their own breeding materials for regional testing;

5. earlier preparation and distribution of results, and more rapid turn-around in utilizing results of INGER-Africa trials for the composition of subsequent INGER-Africa nurseries.

Hence, unlike the former INGER-Africa, where the same nurseries are sent to multiple recipients, in the new INGER-Africa mechanism, nurseries are tailored to meet the specific needs of each national program.

Nurseries are given based on NARS' requests and taking into account relevant plant characteristics best suited to their particular environmental conditions. It is noteworthy that every year Task Force members come together during their annual meeting to plan the activities and also report on the previous year's activities. This mechanism, which was lacking in former INGER-Africa, presents a great advantage because it has contributed tremendously to increasing the rate of return of trial results.

4.1 Achievements: Greater genetic diversity and fast varietal release

Because of the flexibility in trial request and supply, national programs have increased their share of useful material increasing genetic diversity at the national level in a short period of time. Since 1994, rice germplasm distributed have been from diverse origins/sources: WARDA (80%), NARS (15%) and other IARCs (5%). The percentage of NARS' nominations is increasing. As a result, more varieties (47 varieties all ecologies combined) have been released or are in the pipeline for release in the subregion during the past 5 years than before. Also the number of nurseries has increased tremendously, from 12 with the former INGER-Africa to around 60 with the current INGER-Africa. Every year, a minimum of 5000 varieties/lines are dispatched to collaborative NARS in West Africa and East, Central and Southern Africa (ECSA).

4.2 Future directions

As the interspecific progenies become important for upland rice and irrigated ecologies, emphasis should be on their nomination to the different nurseries and their multiplication for better utilization by NARS. We will also continue to encourage NARS breeders from West

Africa, as well as ECSA, to nominate their varieties to the network. The flow of new germplasm from other parts of the world will be maintained.

5. Participatory Research and Seed Multiplication

West and Central African farmers cultivate rice over a range of agro-climatic conditions in which a broad array of biotic constraints and adverse soil conditions combine to reduce the yield. Over 75% of the 1.7 million ha of upland rice represent difficult conditions that include: slash-and-burn rotation systems; low use of external inputs, little or no weeding; high risk of drought; diseases such as blast, glume discoloration, leaf scald, brown spot, sheath rot and sheath blight; insect pests such as stem borers, defoliators, and grain-sucking bugs, and poor soils with acidity, N and P deficiencies, and Al and Mn toxicities.

A number of physical, biotic and socio-economic factors also limit rice production in the irrigated and rainfed lowlands, which are under-developed with poor water control. This results in severe weed problems and low fertilizer efficiency. Drought can also be a problem, particularly in the valley fringes, while the bottom of the landscape may be affected by flooding, waterlogging and submergence. Iron toxicity, the most important soil nutrient disorder affecting lowland rice, can be severe in areas of poor drainage and where continuous inflow of seepage water results in high concentrations of ferrous iron. Diseases common in the rainfed and irrigated lowlands include blast, glume discoloration and the rice yellow mottle virus (RYMV). The most important insect pests are stem borers and gall midge. In the Sahel irrigated systems, varieties need to resist and/or tolerate climatic variations (particularly low temperature) and other soil problems such as salinity and alkalinity.

Due to the diversity of the upland, hydromorphic, rainfed and irrigated lowland ecosystems, there is a need to develop varieties that are stress tolerant/resistant with high and stable yields targeted to specific environmental, ecosystem, and cropping-system niches. For effective targeting of technologies to specific environmental and cropping-system niches in each country, WARDA collaborates with NARES, NGOs and farmers in the evaluation and testing of new technologies.

5.1 Participatory Varietal Selection

The conventional top-down approach to technology transfer has given way in WARDA to two novel applied and adaptive research mechanisms, which favor farmers playing active roles in the product development and spread. These approaches are (1) the Task Force (TF)

mechanism (see above), and (2) farmer participatory varietal selection (PVS) studies. These approaches are assisting in early and broad dissemination and adoption of promising lines, including interspecific progenies (NERICAs), by national agricultural research and extension systems (NARES), development agencies and farmers in West and Central Africa.

5.1.1 The Beginning of PVS Research in West Africa

WARDA brought participatory research to West Africa through a small project in Boundiali in Côte d'Ivoire in 1996. Farmers liked the concept of sharing responsibility for rice research, because they were able to select varieties that met their own needs. Encouraged by the results, WARDA scientists decided to take the participatory approach to all the WARDA member countries. In early 1998, WARDA held an eight-day training workshop to teach participatory varietal selection to cooperators who would take the concept, and varieties to six more countries: Burkina Faso, The Gambia, Guinea-Bissau, Nigeria and Sierra Leone, in addition to Côte d'Ivoire, Guinea, Ghana and Togo, where PVS was initiated earlier. Additional cooperators from Côte d'Ivoire, Guinea, Ghana and Togo were also trained.

In April 1999, WARDA held two consecutive workshops. Graduates from the 1998 training program gathered to report on how farmers had accepted the participatory research in their respective countries at the Participatory Rice Improvement and Gender/User Analysis (PRIGA) report writing and planning workshop. War and its aftermath disrupted research in Guinea-Bissau, Sierra Leone and Liberia in 1998, but nonetheless a beginning was made in Sierra Leone, sometimes with the escort of soldiers when going on field trips! It is believed that almost 2000 farmers in seven countries selected new rice varieties in 1998 through participatory research, and that includes about 1300 in Guinea alone.

5.1.2 Progress in Farmer Participatory Varietal Research in West and Central Africa

Over 3000 farmers in West and Central Africa now participate in the PVS. Also trained and helping to run the PVS in the subregion are Japanese Overseas Cooperation Volunteers (JOCVs), United Nations Volunteers (UNVs), and NGO personnel who have grassroots contacts with farmers and extension agents.

5.1.3 Preliminary Results of PVS

Data collected from seven countries so far indicates that, on average, every farmer selected three varieties rather than the maximal six allowed under the guidelines, indicating that the

restriction was not an important impediment in the expression of varietal preferences. Four groups of characteristics—height, tillering ability, yield potential and cycle—accounted for 82% of the reasons given for selection. The most striking correlation occurs between the tillering ability of traditional *Oryza sativa* and the *O. glaberrima* varieties, but closely followed by several NERICAs.

The NERICAs were the most frequently selected varieties at maturity. All farmers selected at least one NERICA, two-thirds selected at least 2, and slightly less than a quarter selected three or more. The NERICAs remained popular with farmers during the post-harvest period. During this phase, it was noted that women farmers in some locations preferred a 'bold' grain type—round and fat—inherent in many of the improved *O. sativas*, while men preferred a smaller grain type expressed in the NERICAs. Nonetheless, several NERICAs tied with few improved *O. sativa* for the most popular variety. Men were also attracted to varieties that performed well without fertilizer.

In addition to the superior yields expressed over the traditional local cultivars, farmers often cited duration as one of the advantages of the improved varieties over the local cultivars which mature in 150–155 days, while most of the improved varieties, including the NERICAs, matured 40–45 days earlier. Farmers' interest in the varieties is indicated by how much they are willing to pay for them. Top in demand were several NERICAs, e.g.WAB450-I-B-P28-HB (388 CFA/kg), WAB450-I-B-P38-HB (365 CFA/kg), followed by LAC23 (351 CFA/kg), a traditional upland cultivar of widespread use in West Africa but originating from Liberia.

5.1.4 Gender differences

Analysis indicates that male and female varietal choices differred statistically. However, men and women equally selected the NERICAs on the whole, but they selected different NERICAs. This phenomenon indicates that the hybridization program can serve the needs of men and women farmers equally well and that the technology development process does not favor one gender at the expense of the other.

5.1.5 Regional Impact

The year 1999 was watershed for over 3496 rice farmers in the humid forest region of West Africa, as approximately 150 plots were sown with the NERICAs and maintained under farmer conditions in Côte d'Ivoire alone. These farmers will be the cornerstone for assessing the regional *ex-ante* economic impact of the interspecific hybridization program and the

extent to which the welfare of small-scale producers will be affected through this technological advance. Farmer participatory varietal selection has indicated preferred varieties and preferred plant characteristics at three points in the growing season and has provided primary information to feed back into the varietal development program. Secondly, it also provides direct information into the technology transfer process by highlighting promising varieties that address the needs of agricultural populations. Two NERICAs, in particular, excelled in meeting farmer requirements in several locations of the region in the vegetative stage of development, in terms of cycle length, stature and height, and also in terms of grain quality. These are WAB 450-I-B-P-38-HB and WAB 450-11-1-P31-1-HB, with 5 additional NERICAs also excelling in particular stages. The impact in Côte d'Ivoire and Guinea has been widespread. Yield gains of up to 30% in traditional low-input systems and more than double in improved management systems has been reported. In Guinea, over 1000 farmers in 16 prefectures are participating in the process. Regionally, over 3496 farmers participated in the varietal selection program in 1999 and we project that nearly 5000 farmers will be exposed to improved upland rice varieties through the PVS approach during 2000.

5.1.6 Lessons Learned

WARDA's procedure for extending particpatory methods to national counterparts with support from the UNDP/TCDC is based upon several simplifying elements. Our focus is commodity specific and the demand for improved rice productivity is a key element in the strategic agricultural research plans of most nations in the subregion. Secondly, improved varieties are not used in most rainfed rice ecologies and farmers are very keen to experiment with scientists in order to develop more productive cultivars. Thirdly, advances in rice breeding have opened up an extremely diverse set of new plant materials with highly variable trait expression.

Participation, in this sense, largely occurs by providing farmers with a direct say in the selection of fixed lines for promotion in national research programs and in the development of new breeding lines. This is the objective of WARDA's scaling-up process. Farmers have the opportunity to influence research priorities in varietal improvement and thus, one potential impact will lie in the delivery of appropriate, productivity enhancing varieties at a faster, less-costly pace. It is our aim to develop and expand this mechanism for collaboration within all 17 member nations of WARDA.

5.2 Farmers to Produce Seed for Farmers

In many West and Central African countries, national capabilities for storage and conservation of germplasm have been very slow in developing. As a result, such NARS put tremendous pressure on WARDA for constant renewal of not only breeder seed, but also foundation seed. The lack of seed is the bootleneck in the rapid dissemination of the new cultivars to their farmers. The challenge now is to build rapidly on this demand for the new genotypes by investing in seed production, storage and distribution, particularly with extension of PVS to WARDA member countries.

The rate of use of certitifed seed in several West and Central African countries is low, and is limited to irrigated rice schemes or projects where conventional seed multiplication is in operation. The national seed system is market-oriented and based on the production of certitifed seeds to international standards, while the majority of farmers regularly use farm-saved seeds of local cultivars, probably because of: (1) lack of improved seeds; (2) weak system of variety release and registration; (3) high costs of production inputs; (4) non-functional seed quality control system; (5) limited role of the private sector in seed production; and (6) limited supply of breeder seed.

5.2.1 Conventional Seed Production Scheme

The formal or conventional seed multiplication system currently operating in Côte d'Ivoire is typical of most developing countries. Once a variety is released, the breeder provides 'breeder seeds,' from which three classes of seeds are obtained: (1) Foundation Seed (G0, G1 and G2); (2) Registered Seed (G3); and (3) Certified Seed (R1 and R2). The conventional seed multiplication requires 6 years from release of a variety to produce sufficient quantity for distribution to a large number of farmers, who do not obtain seeds of the new variety until the seventh year.

5.2.2 Community-Based Seed Production System

A new seed multiplication scheme, Community-Based Seed Production System (CBSS), using farmers' practices and indigenous knowledge, has been proposed as an alternative seed supply mechanism for small-holder farmers. In this system, the National Seed Service (NSS) certifies only the foundation seed (G2). The extension services make small quantities of these seeds available to various 'informal' seed growers, e.g. farmers' cooperatives, private seed-producers and NGOs. These will produce non-certified basic seeds for their regions, from which seeds of 'acceptable quality' will then be produced by trained farmers

for their communities by using their normal cultivation practices. In this way seed can be provided to at least to some farmers within 4 years of a variety release, i.e. 3 years earlier than under the purely 'formal' system. At the same time, NSS resources are not overstretched trying to meet the whole country's seed requirements.

The seed production and distribution is done according to farmers' practices and capabilities, with some simple guidance given to help farmers maintain the seed purity during a period of 3 to 5 years. Since rice is a self-pollinated crop, seed stocks need not be replaced every season; however, the major concerns of deterioration of seed quality over time, i.e. reduced germination ability and purity, are monitored at the farm level by extension services.

The successful implementation of this model depends on the following: (1) farmers are willing to produce their own seeds—they need to be coached in seed production, as opposed to producing grain for food; (2) they must handle seeds carefully during harvesting, threshing, winnowing and storage; (3) the seed must be properly dried, and then purified by removal of off-types, i.e. grains which do not conform to the standard of the variety—before harvest, the process is called roguing; and finally (4) farmers should test the germination of their seed before giving it to their neighbors. The model was successfully tested in 1998 in Côte d'Ivoire in collaboration with ANADER in Man, Danané, Odienné, Korhogo and Boundiali, where several field workshops were organized with farmers on seed purification, drying, germination testing, storage and conservation of landraces. Similar activities are on-going in Guinea with the new NERICAs and other promising rices including farmers' local cultivars.

The key persons in the CBSS model are: (1) basic seed producer—they meet the farmers' seed requirements at the regional level with sufficient quantities, and at affordable cost; (2) senior technicians—they train basic seed producers on how to produce seeds by following recommendations regarding maintenance of purity of previous crops of rice, and utilization of fertilizers; (3) extension agents—they supervise farmers and control seed quality; standards derived from G2 seeds are used as reference to assess the quality, i.e. 80% germination and 90% varietal purity; and (5) research personnel—initial training of trainers done by the scientists.

The advantages of the model over the conventional system are: (1) it is an open system, utilizing the farmers' cultural practices and channels for seed distribution and encourages the full promotion of traditional varieties; the conventional system is a top-down, with complete control by the seed authorities; (2) it reduces seed production costs,

which are similar to the costs of producing paddy; (3) it reduces the time required for a newly released variety to reach the farmers from 7 to 4 years; (4) it helps any farmer who is interested to produce seeds with 'acceptable quality'; (5) it encourages the availability of seeds of 'acceptable quality' at the community level and consequently improves productivity; and (6) it facilitates the rapid spread of improved varieties. This model is simple to run because it operates on simply selecting the best grains at harvest to save seed. The 'seed production' begins at the onset of harvesting, whereas the conventional model runs from before seeding when the producer has to declare an intention to produce seeds. This new scheme of seed production offers an opportunity for the rapid spread of the NERICAs derived from *O. sativa/O. glaberrima* crosses into existing low-input, subsistence crop production systems in West and Central Africa. It also helps farmers to become more self-sufficient in seeds, and to handle local diversity better. With the high level of adoption of the NERICAs in Côte d'Ivoire, Guinea and Ghana, farmers will need a better and easy-to-handle and cost-effective approach to seed production to help them ensure good maintenance of their seed from improved varieties, as well as from traditional ones.

5.2.3 Training

One of the aims of the varietal improvement project, and in line with WARDA's mandate, is to ensure the development of adequate national capacity in the region to use the emerging genetic resources and also share in the benefits arising from their use. It also aims at establishing effective collaborative arrangements and networks. Since WARDA has the only laboratory in the region with such facilities, NARS personnel are being trained at WARDA in anther-culture, molecular-marker methods and handling of interspecific progenies. Seventy-two scientists from 16 countries received training in participatory research methods and/or rice improvement methods and genetic evaluation and utilization at WARDA in recent years. WARDA continues to support visiting scientists from the region and solicit funds for training of young scientists for MSc and PhD degrees at WARDA or at advanced universities in developing countries.

6. Coordinated regional *in-situ* screening to identify varieties with durable resistance to rice yellow mottle virus

Since its discovery in Kenya in 1966, rice yellow mottle virus (RYMV) has spread over many lowland and irrigated ecosystems throughout Sub-Saharan Africa, developing into a particularly severe epidemic mainly in irrigated rice schemes in Mali and Niger. During an international symposium held at M'bé (WARDA), scientists urged WARDA to increase regional collaborative efforts to control the RYMV epidemic.

So, at the request of Institut d'économie rurale (IER, Mali), Institut national de recherches agronomiques du Niger (INRAN, Niger) and WARDA, DFID has funded a project that aims (i) to rapidly identify varieties resistant to RYMV—the yields of which are at least equal to currently released varieties; and (ii) to develop *in-situ* facilities at the 'hot-spots' in Mali and Niger in order to test the RYMV resistance of new breeding materials against local inocula.

The project is conducted jointly by IER (Mali), INRAN (Niger) and WARDA, which administratively coordinates the project and provides services (training, germplasm and information exchange, technical support to establish screening facilities and to purchase equipment).

6.1 Project achievements

6.1.1 Production of antibodies

WARDA produced high-titer antisera by injection of purified viruses from samples collected in collaboration with NARS scientists of Mali, Niger, Burkina Faso, Benin, Togo, Guinea and Nigeria.

- Ten groups of antibodies have been identified—each group recognizes a different combination West African RYMV isolates (members of the same group recognize the same isolates).
- Two of the polyclonal antibodies obtained (one from Banzon in Burkina Faso and the other from Edogizi in Nigeria) identify all the West African isolates tested.
- One representative of each group of antisera had been sent to our NARS partners in Mali and Niger to be used to diagnose RYMV and to classify the isolates at the country level.

6.1.2 Training

Three technicians from Mali and one from Niger have been trained at WARDA's plant pathology unit for 45 days on how to score RYMV symptoms, and how to identify the virus through serological tests. They are now able to conduct screening for RYMV resistance in the key sites in Mali (Niono, Sélingué and Sikasso) and Niger (Say).

6.1 3 Building screenhouses

In Mali, screenhouses have been built at Sikasso , Sélingué and Niono with the technical support of WARDA. In Niger, an unused screenhouse at Kollo had been renovated.

6.1.4 Germplasm exchange and evaluation

RYMV resistance is usually found in tropical *japonica* rices and in most of the *Oryza glaberrima* landraces. Over the last few years, WARDA has paid particular attention to the identification of resistant *indica* types that can be either adopted directly by farmers or used by breeders to develop new varieties. Some tolerant/resistant cultivars have been identified, of which 10 have been evaluated in natural conditions in Mali, Niger and Côte d'Ivoire.

- In Côte d'Ivoire even without RYMV pressure, some varieties performed well as compared to the released variety Bouaké 189.
    - At Gagnoa, 5 tolerant/resistant varieties produced more than Bouaké 189: CT 9153-11-7-1-1, PNA 647F4-56, IR 62161-22-1-2-1-1, CT 8448-1-3-4-M-2P and CT 9145-4-21-1-1.
    - At Sologo, only CT 9153-11-7-1-1 was better than Bouaké 189.
    - At Natio, two of our tolerant varieties produced well as compared to Bouaké 189: CT 9153-11-7-1-1 and CT 9145-4-21-1-1.
- In Mali at Selingué, CT 9153-11-7-1-1 seemed also to be a good candidate, together with IR 62161-22-1-2-1, CT 8665-1-16-8-1, CT 9145-4-21-1-1 and PNA 647-F4-56.
- In Niger in a nursery laid at Kollo, IR 62161-22-1-2-1 performed better than the check, IR 1529-680-3.

6.1.5 Project progress evaluation

In November 1999, INRAN hosted all the scientists involved in the Project at an annual planning meeting at Niamey. This meeting (i) reviewed the Project activities and future program; (ii) examined the progress in RYMV research in each component; and (iii) made some recommendations among which were the need to reinforce farmers' and their organizations' involvement in the trials and tests, and to broaden the Project's interaction with other African countries.

6.2 Looking at the future

WARDA Irrigated Rice Program is conducting a breeding activity aimed at transferring RYMV resistance from resistant varieties to popular released but susceptible ones. The possibility of using interspecific crosses (*Oryza glaberrima* × *O. sativa*) as well as intraspecific crosses (*japonica* types × *indica* type) provides new selection prospects for resistance to RYMV. Lines in F_3, F_4 and F_5 are available and can be made available for the various countries' breeders to carry on the selection in relation to the native inoculum from each country and identify, stable lines adapted to local conditions.

Appendix 9

Agenda and Program of Work

Monday, 20 March 2000

Plenary Session

08:00–08:30	Arrival and Registration
08:30–08:40	Welcome address by Dr Kanayo F. Nwanze, DG WARDA
08:40–08:50	Opening Address by Prof. N'Guessan Yao Thomas, Director of Research (Representative of Prof. Séry Bailly, Minister of Higher Education and Scientific Research of Côte d'Ivoire)
08:40–08:50	Adoption of the Agenda and Work Schedule, and Election of Chairs and Rapporteurs

Morning Session: Chair: Dr Paco Sereme, INERA, Burkina Faso
Rapporteurs: Prof. Yadji Guero, INRAN, Niger
Dr Marco Wopereis, WARDA

09:10–09:30	WARDA Fourth External Program and Management Review (EPMR): Main Conclusions and Recommendations (Dr Kanayo F. Nwanze, DG WARDA)
09:30–09.50	Nomination of Regional Board Members (Dr Kanayo F. Nwanze, DG WARDA)
09:50–10:30	Discussion
10:30–11:00	Coffee Break
11:00–11:30	Overview of WARDA's Research Programs and Progress Since the Last Meeting (Dr Amir Kassam, DDG-Programs)

11:30–12:30	The Potential for a Green Revolution in Rice in West and Central Africa:
11:30–11:45	Rainfed Systems (Dr Monty P. Jones, Rainfed Rice Program Leader)
11:45–12:00	Irrigated Systems (Dr Kouamé M. Miézan, Irrigated Rice Program Leader)
12:00–12:15	Policy Environment (Dr Frédéric Lançon, Policy Support Program)
12:15–12:30	Technology Transfer Strategy (Dr Brent Simpson, Systems Development and Technology Transfer Program Leader)
12:30–13:00	Discussion
13:00–14:00	Lunch

Afternoon Session: Chair: Dr Samuel Bruce-Oliver, NARI, The Gambia
Rapporteurs: Dr Sié Koffi, CNRA, Côte d'Ivoire
Dr Robert Guei, WARDA
Dr Yacouba Séré, WARDA

14:00–15:00	Status of ROCARIZ and Appointments of ROCARIZ Coordinator, Chairman of the IVC Management Committee, IVC Coordinator and NRM Scientist (Dr Abdoulaye Adam /Dr Sitapha Diatta, WARDA)
15:00–15:30	WARDA/NARS Collaborative Projects – Assessment of Efficiency and Efficacy (Dr Amir Kassam, DDG-Programs)
15:30–16:00	Discussion
16:00–16:30	Coffee Break
16:30–17:30	Events at WARDA in 2000–2001 (Dr Kanayo F. Nwanze, DG WARDA)

17:30–18:00 General Discussion

18:00 Depart for Bouaké

Tuesday, 21 March 2000

Morning Session: Chair: Dr Stephen M. Misari, NCRI, Nigeria
Rapporteurs: Dr Brent Simpson, WARDA
Dr Amadou M. Bèye, WARDA

08:30–08:50 CGIAR 2010 Vision (Dr Kanayo F. Nwanze, DG WARDA)

08:50–09:20 WARDA Strategic Plan 2001–2010 (Dr Frédéric Lançon)

09:20–10:30 Discussion on CGIAR Vision and WARDA Strategic Plan

10:30–11:00 Coffee Break

11:00–13:00 Discussion on CGIAR Vision and WARDA Strategic Plan

13:00–14:00 Lunch

Afternoon Session:

14:00–16:00 Synthesis and Report Writing
Tour of WARDA Main Research Center and Headquarters

Chair: Dr Alpha S. Maïga, IER, Mali
Rapporteurs: Dr Abdoulaye Adam, WARDA
Dr Frédéric Lançon, WARDA

16:00–16:30 Presentation of Final Report

16:30–17:00 Discussion

17:00–17:15	Closing remarks (Dr Kanayo F. Nwanze, DG WARDA and Prof. N'Guessan Yao Thomas, Director of Research, MERS, Côte d'Ivoire)
17:30	Depart to Bouaké
19:30	Official Cocktail/Dinner

Appendix 10

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Appendix 11

Abbreviations and Acronyms

4Rs	Regional Rice Research Review Meetings
AfRGM	African Rice Gall Midge
ANADER	Agence nationale d'appui au développement rural
APS	Associate Professional Staff
ASI	ADRAO/SAED/SISMAR/ISRA Thresher/Cleaner
CARI	Central Agricultural Research Institute (Liberia)
CBD	Convention on Biological Diversity
CBSS	Ccommunity-Based Seed Production System
CCER	Center-Commissioned External Review
CGIAR	Consultative Group on International Agricultural Research
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CMC	Consortium Management Committee
CNRA	Centre national de recherche agronomique (Côte d'Ivoire)
CNRADA	Centre national de recherche agronomique et de développement agricole (Mauritania)
CORAF	Conseil Ouest et Centre africain pour la recherche et le développement agricoles
CSIR	Council for Scientific and Industrial Research (Ghana)
CV	curriculum vitae
DANIDA	Danish International Development Agency
DDG	Deputy Director General
DDG-P	Deputy Director General for Programs
DFID	Department for International Development (United Kingdom)
DG	Director General
DIARPA	Diagnostique rapide de pré-aménagement (diagnostic tool)
ECSA	East, Central and Southern Africa
EIR	Entomological Inoculation Rates
EPMR	External Program and Management Review
FAO	Food and Agricultural Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
GIS	Geographical Information System(s)
GMO	Genetically Modified Organism
GRU	Genetic Resources Unit

G×E	Genotype by Environment
IARC	International Agricultural Research Center
ICARDA	International Center for Agricultural Research in the Dry Areas
ICLARM	International Center for Living Aquatic Resources Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICW99	CGIAR 1999 International Centers Week
IDC	Information and Documentation Center
IDRC	International Development Research Center (Canada)
IER	Institut d'économie rurale (Mali)
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
INERA	Institut de l'environnement et de recherches agricoles (Burkina Faso)
INGER	International Network for the Genetic Evaluation of Rice
INPA	Instituto Nacional de Pesquisa Agraria (Guinea-Bissau)
INRAB	Institut de national des recherches agricoles du Bénin
INRAN	Institut national de recherches agronomiques du Niger
IP	Intellectual Property
IPGRI	International Plant Genetic Resources Institute
IPR	Intellectual Property Rights
IRAG	Institut de recherche agricole de Guinée
ISRA	Institut sénégalais de recherches agricoles
ITRAD	Institut tchadien de recherche agronomique pour le développement
IVC	Inland Valley Consortium
IWMI	International Water Management Institute
JOCV	Japanese Overseas Cooperation Volunteer
K	Potassium
MESRS	Ministère de l'Enseignement supérieur et de la Recherche scientifique (Côte d'Ivoire)
MSc	Master of Science (degree)
MTA	Material Transfer Agreements
MTP	Medium Term Plan
N	Nitrogen
N2O	Nitrous oxide
NARCC	National Agricultural Research Co-ordinationg Council (Sierra Leone)
NARES	National Agriculture Research and Extension Services
NARI	National Agricultural Research Institute (The Gambia)
NARS	National Agricultural Research System
NCRI	National Cereals Research Institute (Nigeria)

NEC	National Experts Committee
NERICA	New Rice for Africa
NGO	Non-Governmental Organization
NRM	Natural Resource Management
NSS	National Seed Service
OAU	Organization of African Unity
P	Phosphorus
PEEM	Panel of Experts on Environmental Management for Vector Control (WHO)
PhD	Doctor of Philosophy (degree)
PRIGA	Participatory Rice Improvement and Gender/User Analysis
PVS	Participatory Varietal Selection
RCU	Regional Coordinating Unit (IVC)
ROCARIZ	West and Central African Rice Research Network (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	Steering Committee (IVC)
SISMAR	Société industrielle sahélienne de machinisme agricole, de mécanique et de représentation (Senegal)
SPAAR	Special Program for African Agricultural Research (World Bank)
SSA	Sub-Saharan Africa
TAC	Technical Advisory Committee (CGIAR)
TF	Task Force
UK	United Kingdom
UNDP/TCDC	United Nations Development Programme/Technical Cooperation between Developing Countries
UNV	United Nations Volunteer
US	United States of America
WARDA	West Africa Rice Development Association
WURC	Wageningen University Research Center
WECARD	West and Central African Council for Agricultural Research and Development
WHO	World Health Organization of the United Nations
Zn	Zinc

About the Consultative Group on International Agricultural Research (CGIAR)

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

The CGIAR works in partnership with national governmental and non-governmental organizations, universities and private industry. The United Nations Development Programme, the United Nations Environment Programme, the World Bank, and the Food and Agriculture Organization of the United Nations sponsor the CGIAR. The CGlAR's 57 members include developing and developed countries, private foundations, and international and regional organizations. Developing world participation has doubled in recent years. All members of the OECD (Organisation for Economic Co-operation and Development) Development Assistance Committee belong to the CGIAR.

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

CGIAR Centers

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

West Africa Rice Development Association

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