Proceedings of the final workshop of the Groundnut Germplasm Project

Edited by:
Bonny R Ntare, Alain H Mayeux and Farid Waliyar

Citation: Ntare, BR, Mayeux, AH and Waliyar, F (eds). 2003. Conservation, Evaluation and Dissemination of Groundnut Germplasm and Foundation Seed Production and Distribution for the West African Region: Proceedings of the Final Workshop of the Groundnut Germplasm Project, 22-24 April 2002, Bamako, Mali. (Eng). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 158 pp. ISBN 92-9066-454-1. Order code CPE 144.

Abstract

The Groundnut Germplasm Project (GGP) was initiated in 1996 with the principal aim of restoring the genetic diversity of groundnut in West Africa and supplying seed of improved varieties to National Agricultural Research Systems (NARS) and other beneficiaries. ICRISAT, as Project Executing Agency and, in collaboration with its partners ISRA and CIRAD, organized an end-of-project workshop from 22 to 25 April 2002 at Bamako, Mali. The objective of this workshop was to present the remarkable achievements of the project to a wide range of stakeholders and identify follow-up action for a sustainable seed production and delivery scheme in West Africa.

Participants at the workshop were from various spheres, including research and development (R&D), nongovernmental organizations (NGOs), the private sector, and groundnut producers. Project results were presented during the different sessions, one of which focused on presentations by NARS about groundnut seed supply systems in selected countries.

Parallel group discussions focused on conservation of genetic resources and their optimal utilization, strengthening of seed multiplication and distribution, and the role of the public and private sector in the groundnut sector. These produced important conclusions that will help guide the future development of sustainable seed systems in West Africa.

Conservation, Evaluation and Dissemination of Groundnut Germplasm and Foundation Seed Production and Distribution for the West African Region

Proceedings of the final workshop

22-25 April 2002

Bamako, Mali

Edited by

Bonny R Ntare, Alain H Mayeux and Farid Waliyar

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

Patancheru 502 324, Andhra Pradesh, India

2003

Contents

Session IV. Groundnut Seed Systems

Session V. Working Groups

Session **VI.** Strategies **For Improvement Of the Groundnut** Seed Sector

Session **VII.** Glosing Session

Foreword

The Groundnut Germplasm Project (GGP) was initiated in 1996 with the principal objective of restoring the genetic diversity of groundnut in West Africa and supplying seed of the best lines to National Agricultural Research Systems (NARS) and other beneficiaries. The activities end on 30 June 2002. Through strong partnership, a regional network of sustainable conservation and distribution of germplasm has been established. In particular, a broad range of germplasm has been assembled in the region to support future development, the capacity of national research systems to handle and improve germplasm has been enhanced, and a significant number of groundnut varieties has been tested and is now available in the region.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), as Project Executing Agency (PEA), organized an end-of-project final workshop from 22 to 25 April 2002 at the International Conference Center at Bamako, Mali. The objective of this workshop was to present the remarkable achievements of the project to a wide range of stakeholders and identify follow-up action for a sustainable seed production and delivery scheme in West Africa.

Participants at the workshop were from various spheres, including Research and Development (R&D), regional organizations, the private sector and groundnut production. Project results were presented during the different sessions, one of which focused on presentations by NARS about groundnut seed supply systems in selected countries.

Parallel group discussions focused on genetic resources conservation and utilization, strengthening of seed multiplication and distribution, and the role of the public and private sector in the groundnut sector. These produced important conclusions that will guide the development of sustainable seed systems in West Africa.

I would like to express my appreciation of the Common Fund for Commodities (CFC) without whose funding this important workshop would not have been possible.

Let me emphasize that the success of any workshop is the result of the effort and dedication of many people working behind the scenes. I am referring particularly to the project staff and local links that were instrumental in organizing the workshop.

William D Dar
Director General, ICRISAT

Session 1
Opening Session

Opening speech of the ICRISAT country representative

Ousmane Youm[1]

Her Excellency, the Minister of Rural Development, the CFC representative, the FAO representative, the Presidents of CNRA and of WECARD, the representatives of the AGC, the representatives of Institut Sénégalais de Recherches Agricoles (ISRA) and Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), the Director General of IER, the Coordinator of the GGP, honorable guests, dear participants, ladies and gentlemen

On behalf of the Director General of ICRISAT and myself, I would like to welcome you to the closing workshop of the Groundnut Germplasm Project, better known as the GGP.

The GGP began in 1996, under ICRISAT's management, with ISRA and CIRAD as its main partners, as well as Institut National de l'Environnement et des Recherches Agricoles (INERA) from Burkina Faso, IAR from Nigeria, the Institut National de Recherches Agronomiques du Niger (INRAN) from Niger and Institut d'Economie Rurale (IER) from Mali. These institutions have played a deciding role in the implementation of project activities, of which the principal results and lessons learned will be the subject of your discussions.

Please allow me to thank the Government of Mali for its constant support of ICRISAT and its partners in Mali, and for allowing this workshop to take place in Bamako. I would also like to thank IER on behalf of the Director General, who is here today, for the support and organization of this workshop, and for a fruitful and exemplary collaboration with ICRISAT in Mali.

The conception and implementation of the GGP would not have been possible without the financial support of the CFC and the support of FAO in the area of research activities carried out within the framework of this project. We would like to express well-deserved appreciation to the West

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Country Representative, Station de Samanko, BP 320 Bamako, Mali.

and Central African Council for Agricultural Research and Development (WECARD/CORAF) and the AGC for their support.

This project is of great importance to ICRISAT, as it has served as a cornerstone for sustainable development of groundnut seed production systems in West Africa. The lessons learned and know-how gleaned from the project will be the subject of thematic presentations and discussions, which will give a preview of a new program that focuses on the best possible use of research results and the dissemination of new technology to groundnut producers and other beneficiaries. I would like to congratulate the representatives of producer associations and nongovernmental organizations (NGOs) for their participation as key partners in the dissemination of new technology.

Despite a busy program, I am sure that you will profit from the sessions over the next three days. Once again, welcome, and I wish you the greatest success in your work.

Thank you.

Opening speech of the CFC representative

Mohamed Ramouch[1]

Your Excellency, the Minister for Rural Development, the representative of ICRISAT, the Director General of IER, ladies and gentlemen

Allow me on behalf of the Common Fund for Commodities and of its Director General Mr. Rolf W Boehnke to thank the Government of Mali for the warm welcome to the participants of this end-of-project workshop of the Groundnut Germplasm Project for West and Central Africa, financed by the Common Fund.

I wish to thank the many participants in this workshop, for showing the interest they have in this project. I wish also to congratulate the organizers who have enabled us to meet under excellent conditions.

The CFC, as you know, is an intergovernmental organization, established by the United Nations, with a mandate to develop the basic commodities in developing countries. The financing of this project is in line with this mandate, and recognizes the great importance of groundnuts in the economies of a large number of countries of West and Central Africa and its role in the livelihood of small farmers.

During the project supervisory mission, a meeting was held in Dakar in January of this year with the coordinator of the project and National Institutions of the participating countries. During this meeting, we noted that the project had been progressing satisfactorily.

We are thus here today to discuss the results and accomplishments of the project and efficient means of disseminating these accomplishments. I wish you success in your deliberations.

Thank you for your attention.

1. Common Fund for Commodities (CFC). P.O. Box 74656, 1070 BT Amsterdam, The Netherlands.

Opening speech of the representative of the project executing agency

Farid Waliyar[1]

Your Excellency the Minister of Rural Development, the President of CNRA and CORAF, the representative of CFC, the representative of FAO, the Director General of IER, representatives of GGP partners, ladies and gentlemen

It is a great pleasure for me today to speak to you about the objectives of this workshop. For those who have hot had the opportunity to know this project, I wish to present in a few words what the GGP is all about.

This project is entitled Conservation, Evaluation and Dissemination of Groundnut Germplasm and Foundation Seed Production and Distribution in the West African Region.

This project, supervised by FAO and financed by CFC, has been executed by three principal partners - ICRISAT (the PEA), ISRA, and CIRAD under the auspices of CORAF - and supported by the AGC. Representatives of these organizations constitute the Steering Committee. The project has six components:

1.1 Assembly, maintenance and conservation of germplasm
2.1 Characterization and multilocation evaluation of germplasm
2.2 Identification of genetic traits of economic importance
3.1 Distribution and exchange of assembled germplasm
3.2 Foundation seed multiplication
4.1 Training
5.1 Dissemination of information
6.1 Project management, coordination and monitoring

Based on the components and regional expertise, the project was conducted in Burkina Faso, Niger, Nigeria, Mali and Senegal. Other countries participated in the project through regional variety trials. In the following sessions, you will be given the detailed objectives and results.

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Patancheru, Andhra Pradesh 502 324, India.

We have come to the end of the sixth year of the project, which ends on 30 June 2002 with a closing period (writing of reports, audit and evaluation) until 31 December 2002.

This workshop that marks the end of the project has the following objectives:

- To present project achievements
- To discuss and propose strategies to facilitate the development of sustainable seed production and commercialization
- Several working groups will be organized to formulate recommendations.

This workshop is not only aimed at presenting project results to the various stakeholders (donors, NARS, farmers, NGOs and the private sector) but also seeks their support for genuine collaboration and partnership in the development of sustainable groundnut seed systems in the subregion.

I thank you for your attention and the interest you have accorded to the project and workshop.

Welcome address of the Director General of IER

Bino Témé[1]

The representative of the Minister of Rural Development, researchers, honorable guests, ladies and gentlemen

It is with great pride that the Institute of Rural Economy (IER) welcomes the participants of the Closing Workshop of the Groundnut Germplasm Project.

There is no need to emphasize the importance of this project in light of the place that groundnuts occupy in our food system. In addition, my Institute has followed the implementation of this project with special attention.

As you know, groundnut is a crop that suffers from undermanagement in our countries. This makes it difficult for producers to have access to quality seed from varieties that are adapted to local cropping systems and agroecological areas. Herein lies the importance of this project.

I must express my sincere appreciation for all the activities undertaken as part of this project, such as germplasm collection, maintenance, characterization and evaluation. The project has also helped set up a network of trials involving several NARS in the West African subregion.

Training has also been provided in important areas such as aflatoxin management and seed production technologies. These activities have made a significant contribution and must be continued in the future in order to return groundnut to its former glory.

Ladies and gentlemen, dear participants, the objective of this workshop is to take stock of the achievements of the project, make these available to farmers, and search for the most appropriate means for disseminating them on a large scale. Towards this end, existing mechanisms for technology transfer at the level of the different NARS in the subregion must be taken into account.

Ladies and gentlemen, I would also like to take this opportunity to thank the donors who are present here today, and say how much we appreciate the efforts of all those who are striving to promote groundnut development in Africa and the world over.

Thank you.

1. Institut d'Economie Rurale (IER) Directeur Général, BP 258, Bamako, Mali.

Opening speech of the Minister of Rural Development

Her Excellency Mrs Sidibé Mariam Kaidama Cissé

Minister of Rural Development, Government of Mali

The representative of the Director General of ICRISAT, the representative of the CFC, the representative of the FAO, the President of WECARD/ CORAF, the representative of the AGC, the representative of CIRAD, the representative of ISRA, the ICRISAT representative in Mali, the Director General of the IER, the Coordinator of the GGP, honorable guests, ladies and gentlemen

On the occasion of the GGP workshop for the presentation of results I am pleased to welcome you to the African land of Mali. First, I would like to thank you for choosing Mali to host such an important gathering.

Groundnut plays an important economic role in the households of most of our African countries. In most sub-Saharan countries, it is both a food and a cash crop. When Mali became independent in 1960, groundnut represented up to 38% of the country's total export.

The unprecedented crash of the world groundnut market due to competition from other oils, particularly soybean oil, and the problem of aflatoxin contamination greatly affected groundnut production in Mali. By 1966, this had decreased to less than 16% of the total export. The government immediately undertook a huge campaign to revitalize its production. By 1975, these measures led to an annual production of 160,000 tons (unshelled groundnut).

In addition to the unfavorable international climate, groundnut production is faced with several other constraints, of which the most important are a lack of varieties that are adapted to cultural conditions, a low level of intensification, and lack of organization of the groundnut production chain.

In order to find solutions to these problems IER and ICRISAT have undertaken several research activities in collaboration with various partners.

The GGP was also conceived in this dynamic partnership and brings together the main groundnut-producing countries in West and Central Africa. It is comforting to know that since its inception in 1999, GGP has

assembled an important collection of 6000 accessions that are being safely conserved. Several high-performance varieties have been identified from within this great source of genetic diversity and these are now being disseminated in different production zones. The project has also been a forum for exchange and evaluation of groundnut seed systems in West Africa, in order to overcome the difficulties involved in the distribution of groundnut seed.

Ladies and gentlemen, participants, this workshop has a dual objective - to highlight the results and lessons learned during the project and to define the methods of transferring the technology generated.

We are counting on you to analyze the different documents that will be presented with a view towards consolidating the lessons learned during GGP on the one hand, and on the other hand, defining the activities that will support seed production in the sub-region.

I am sure that pertinent recommendations for the development of a regional strategy for sustainable multiplication and distribution of groundnut seed will emerge from your deliberations over the next three days.

This is a good occasion, dear participants, to thank ICRISAT, CIRAD, FAO, CFC and the NARS of the groundnut-producing countries for their open collaboration, which has allowed the project to obtain such appreciable results.

I would also like to thank the AGC and WECARD/CORAF for having given a regional slant to the project.

I assure you that the Government of Mali, which I have the honor of representing here today, will pay special attention to the results of your work, and fully support their implementation.

It is with hope and confidence that I declare the Closing Workshop of the Groundnut Germplasm Project open.

Thank you.

Session II
Project History and Outputs

Background and objectives of the Groundnut Germplasm Project

Farid Waliyar[1]

Background

The GGP was conceived several years ago. In January 1993, the FAO-IGG/OOF submitted to the Fund a project proposal for collection, preservation and distribution of wild *Arachis* and groundnut germplasm and production of foundation seed in West Africa and Latin America.

Later, the Eighth Meeting for the Consultative Committee (CC/8) meeting recommended that there should be two separate projects:

- Groundnut germplasm for West Africa
- Wild *Arachis* for Latin America

The West African germplasm project proposal was subsequently formulated and resubmitted in November 1993. After two different versions were submitted, the CFC and IGG/OOF recommended the submission of a proposal that covered groundnut germplasm as well as foundation seed multiplication. In July 1994, a meeting was held at FAO, which was attended by representatives of FAO, CFC, ICRISAT and CIRAD. The main objective of the meeting was to merge the two proposals and to work out a modality between ICRISAT and CIRAD to collaborate closely in the execution of the project. A proposal was then submitted to the CFC, through the IGG/OOF, which was received positively. ICRISAT was asked to play the role of the Project Executing Agency (PEA). In October 1994, a meeting was held at CIRAD, Paris, which was attended by representatives of CFC, ICRISAT, ISRA and CIRAD. At that meeting the project proposal was amended to include the comments of the CFC and IGG/OOF, and the management structure was clarified.

The final document was submitted to CFC through FAO in January 1995 and was approved at the CC/12 meeting. The project partners are:

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). PEA Representative. Patancheru, Andhra Pradesh 502 324, India.

- Scientific partners: ICRISAT, ISRA and CIRAD.
- Participating countries: Nigeria, Niger, Burkina Faso and Mali. Other countries of West and Central Africa (WCA) were also involved.
- Supervisory body: FAO-IGG/OOF.
- Regional bodies: CORAF/WECARD and AGC.

The project was organized in several components:

1.1 Germplasm assembly, maintenance and conservation

Objective: To assemble, maintain and conserve groundnut germplasm in West Africa.

Output:

- Over 12,000 accessions assembled and recorded.
- Improved medium term conservation facility at ICRISAT Sahelian Center (ISC).
- Short-term storage facility at ISC fully renovated.
- *Arachis* accessions maintained by periodic rejuvenation.
- Conservation of accessions under safe storage and continued rejuvenation, supplemented by direct collection wherever a deficiency exists.

2.1. Characterization and multilocation evaluation of germplasm

Objective: To produce a comprehensive, readily available description of assembled germplasm.

Output:

- Botanical and agronomic description of conserved germplasm.
- Simplified groundnut germplasm descriptors.
- Documentation of conserved germplasm.

2.2 Identification of genetic traits of economic importance

Objective: To identify genetic sources of economic importance

Output:

- Characterization and documentation of specific genetic traits for future use in breeding activities.
- Information on genetic traits of economic importance made available to breeding programs and scientists.
- Promising genetic material selected and made available to NARS for further testing.

3.1 Enhancement of germplasm availability for utilization in crop improvement

Objective: To increase the availability of the world germplasm collection for the region's NARS, and of West African germplasm for users outside the region. This component is divided into two sub-components: 1) Distribution and exchange of germplasm, 2) Foundation seed multiplication.

Distribution and exchange of germplasm

Output:

- Genetic material, passport information and evaluation data dispatched to NARS.

Foundation seed multiplication

Objective: To provide appropriate national institutions with foundation seed of superior groundnut cultivars identified through multilocation testing.

Output:

- Foundation seed of selected superior cultivars available at ISRA facilities at Bambey.
- High quality seed available at NARS, ready for supply to national seed programs and farmers.
- Report on seed production and distribution systems in West Africa.

4.1 Training

Objective: To train professional and technical staff involved in germplasm conservation, varietal identification and seed multiplication in West Africa.

Output:

- 30 technical and professional staff from NARS trained.
- 14 fellowships granted.
- Technical manuals prepared and distributed in the region.

5.1 Dissemination of technology

Objective: To disseminate widely the technical information provided by the project.

Output:

- Workshops held in which the groundnut business and academic community of the region actively participated.
- Newsletters and bulletins produced and distributed in the region.

- Databases updated and made available on CD-ROM.
- Printed and computer-based catalogs produced.

6.1 Project management, coordination and monitoring

PEA Reports

- Various project implementation reports
- Six-monthly progress reports
- Annual implementation reports
- Annual work programs
- Annual financial reports
- A project completion report (PCR)

Reports by the supervisory body

- Annual supervisory reports

Reports by the evaluation team

- One mid-term evaluation report
- One final evaluation report

Project coordination

- Project manager supported by two sub-project managers
- Annual Steering committee meetings

During the 3-day workshop, the progress made under each component will be presented and major achievements will be highlighted.

Poster presentation

Seven posters representing specific themes were produced and presented: groundnut germplasm in a nutshell, combating groundnut rosette disease, resistance to drought, combating aflatoxin contamination, seed conservation under modified atmosphere, seed production of edible groundnut, and farmer participatory selection of groundnut varieties. Scientists involved in the GGP produced these posters. Copies of the posters were distributed to participants.

- ***West Africa Groundnut Germplasm Protect***

  B Ntare, A Mayeux and H Bissala

This presented the different project components and principal results.

- ***Evaluation of New Confectionery Groundnut Varieties under Irrigation in Senegal***

  L Sagarra, M Ndiaye, K Wagué and A Mayeux

This presented results from work conducted under irrigation in the Senegal River valley. It involved testing confectionery groundnut varieties under controlled irrigation (drip irrigation) to identify those that responded to agronomic conditions, as well as for market-preffered traits such as seed size, shape and color and for aflatoxin contamination.

- ***Combating Groundnut Rosette Disease***

  P Olorunju, B Ntare and C Echekwu

This poster highlights the importance of groundnut rosette disease, its biology, field screening techniques for resistance and integrated management of the disease, and improved resistant varieties.

- ***Conservation of Groundnut Seed under Modified Atmosphere***

  A Rouzière, J Martin, S Thiebault, E Alias, A Baldé, A Ndiaye and A Mayeux

This poster presented the results of conservation of groundnuts under modified atmosphere. This method has potential as an alternative to short-term cold storage of groundnut seed.

- ***Development of Short-Duration Groundnut Varieties for the Northern Basin of Senegal***

  D Clavel, O Ndoye and I Dieng

Drought is a major constraint to groundnut production in the Sahel. Extra early-maturing varieties adapted to the short season environment are required to maintain production of the crop in this zone. The work of CERAAS (Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse) and ISRA has enabled development of such varieties. The poster shows the performance of these new varieties.

- ***Involving Farmers in Selection of Groundnut Varieties***

  B Ntare, O Kodio and H Bissala

This poster summarizes results from on-farm, farmer-participatory trials initiated in Niger and Mali. The main participants are farmers, researchers, extension agents, NGOs and the private sector.

- ***Combating Aflatoxin Contamination in Groundnut***

  F Waliyar, A Ba, B Ntare and A Traore

This poster summarizes the importance of mycotoxins with particular reference to aflatoxin contamination in groundnut and highlights recent advances in their control and methods of detection.

Management, evaluation and utilization of groundnut genetic resources: Achievements and perspectives

Bonny Ware[1], Farid Waliyar[2] and Hassane Y Bissala[3]

Abstract

The GGP was initiated in 1996 with the objective of restoring the genetic diversity of groundnut in West Africa and providing seed of the best lines to NARS and other beneficiaries. ICRISAT, ISRA and CIRAD jointly executed the project. The main activities included the assembly, maintenance and conservation of germplasm, and its characterization, evaluation, documentation and distribution. Professionals and technical staff involved in germplasm conservation, variety identification and seed multiplication were given training.

As per the project documents, it was decided to assemble 6000 accessions from the ICRISAT Center Gene Bank. Accordingly, samples from these germplasm were transferred to the gene bank at ICRISAT-Niamey. These accessions have been fully characterized and evaluated for traits of economic importance. Germplasm possessing useful characteristics such as pest and disease resistance, drought tolerance and other traits of economic importance is available. The assembled germplasm has been documented in printed catalogs and CD-ROMs and posted on the web. A gene bank management manual was also produced. New collections were made in threatened areas of Mali and Chad. Procedures for the free distribution and exchange of improved seed material have been put in place, and 6371 samples were distributed over the duration of the project. A network of variety trials was established to evaluate 109 different improved groundnut varieties, and varieties with traits preferred by farmers and the market have been identified. Farmer participatory selection of improved varieties was initiated in Mali, Niger and Nigeria.

1. Institut International de Recherche sur les Cultures des zones Tropicales Semi-Arides (ICRISAT). Station de Samanko, BP 320 Bamako, Mali.
2. Principal Scientist (Pathology), ICRJSAT-Patancheru, 502 324, Andhra Pradesh, India.
3. Scientific Officer, ICRISAT-Niamey, BP 12404, Niamey, Niger.

Background

An initiative of the IGG/OOF of FAO of the United Nations, the project on Conservation, Evaluation and Dissemination of Groundnut Germplasm, and Foundation Seed Production and Distribution for the West African Region, also known as GGP was jointly carried out by ICRISAT, CIRAD and ISRA. The Common Fund for Commodities (CFC) provided the financial support. The NARS, CORAF/WECARD and the AGC were partners.

Before the start of the GGP in 1996, exploitation of groundnut genetic resources by regional and national organizations in West Africa was constrained by their limited access to the diversity of the crop. The movement of genetic materials from one country to the other was very rare and subject to quarantine procedures to prevent the transmission of seedborne diseases. This applied to the transfer of materials available in the world groundnut germplasm held by ICRISAT in India, as well as materials available with NARS in the region.

One of the primary objectives of GGP was therefore to enable researchers in West Africa to access the world groundnut germplasm. The first task was to restore the genetic diversity of groundnuts in West Africa and get seed of the best lines to research and development partners to contribute to the improvement of groundnut productivity and the sustainability of groundnut production systems in the subregion. Other activities included characterization, evaluation, documentation and distribution of the germplasm. Technical skills were imparted to professional and technical staff involved in germplasm conservation, varietal identification and seed multiplication.

Accomplishments

Germplasm assembly, maintenance and conservation

Assembly

The initial plan was to duplicate all accessions (about 16,000) of the global germplasm collection at ICRISAT-Patancheru to West Africa. After a review of the facilities at Sadoré, Niger, and considering the low multiplication rate of groundnut and the time frame of the project, it was deemed impossible to duplicate these numbers. To ensure that sufficient variability is maintained a smaller working collection of 6000 accessions from 73 countries all over the world has been assembled. This collection is conserved in a regional gene bank at ICRISAT-Niamey, Sadoré. The number of

accessions assembled from West African countries is shown in Table 1 and Table 2 lists those from other countries.

Table 1. Number of accessions collected/assembled from West African countries conserved at ICRISAT-Niamey.

Country	No. Collected	No. Assembled	Total
Benin	0	11	11
Burkina Faso	0	26	26
Cameroon	25	0	25
Chad	41	44	85
Cote d' Ivoire	0	59	59
Gambia	0	14	14
Ghana	29	9	38
Guinea	146	10	156
Guinea Bissau	0	59	59
Liberia	0	8	8
Mali	168	13	181
Niger	0	42	42
Nigeria	80	161	241
Senegal	0	185	185
Sierra Leone	2	15	17
Togo	11	20	31
Total	502	676	1178

Maintenance and conservation

The seed store at ICRISAT-Niamey was modified into a short- and medium-term store according to International Gene Bank Standards laid down by FAO and the International Plant Genetic Resources Institute (IPGRI).

The short-term storage room is (9.1 m x 5.1 m) x 2.45 m in size and maintained at a temperature of 15 ± 2^0C and relative humidity (RH) of 15 ± 2 %. These conditions are optimal for maintenance of maximum seed viability and longevity in storage, especially for orthodox seeds maintained at 5 ± 2% seed moisture content. The room is also used for drying and processing of seeds before transfer to the medium-term store. In addition, it is used for short-term storage of working collections and seed of popular varieties. The working collections are stored in 2-kg capacity plastic containers.

The medium-term storage room is (5.4 m x 5.1 m) x 2.45 m, maintained at 4 ± 2°C and RH of 30 ± 5%. It holds the base collections of groundnut.

Under these conditions, orthodox seeds can easily be conserved up to 15-25 years with minimal loss in seed-viability and vigor. The base collections are sealed in laminated aluminum foil containers. About 40 seeds are stored per accession. Other crop species including pearl millet (1520), sorghum (305), cowpea (220), and duplicate samples of forage and tree species (1856) are also conserved.

Static shelves have been installed in both rooms. The storage environment is monitored through electronic loggers. A localized electronic alarm alerts staff in case of any rise in temperature due to equipment failure. The power supply is from the national grid, with an independent generator to cope with longer periods of power failure.

A seed laboratory of (6.0 m x 5.0 m) x 3 m is available, with adequate infrastructure to monitor seed-viability through germination tests in an incubator maintained at 25 ± 5°C. Seed moisture content is determined by the oven method (100-250°C). There is also simple equipment for seed health monitoring. An air-cooled glasshouse is available to grow and rescue germplasm accessions with very few seeds.

Gene bank standards

The gene bank is operated according to international standards as defined by the FAO/IPGRI Expert Consultation Group on Gene Bank Standards (Rome, 1994). Germplasm maintenance requires frequent monitoring of seed viability and quantity in storage. When seed quantities fall below 50 g and a viability of less than 85%, the accessions must be rejuvenated in the field. This requires strict adherence to standards to reduce the loss of genetic integrity and to the dangers in the environment due to stresses. Thus, procedures to maximize the production of high quality seed and minimize the need for frequent rejuvenation are followed.

For regular monitoring, a gene bank management system has been developed that allows continuous access to the status of the collection and ensures security. A series of computer databases have been developed, that include passport, characterization, evaluation, inventory, regeneration, processing and distribution of accessions.

Germplasm documentation

From the moment an accession is collected or acquired, it is documented in great detail for precise origin and evolution, botanical classification, characteristics, past evaluation and value, rejuvenation history, seed viability, placement in various types of storage, and past distribution. The collection

Table 2. Number of designated accessions from other countries in the regional gene bank.

Origin	No of accessions	Country	No of accessions
		Africa	
Angola	5	Rwanda	1
Central Africa	2	Swaziland	7
Egypt	5	Tanzania	329
Kenya	43	Uganda	133
Morocco	10	South Africa	26
Madagascar	38	RDC	98
Mozambique	120	Zambia	118
Mauritius	3	Zimbabwe	612
		Asia	
China	37	Japan	15
India	715	Russia	5
Israel	9	Thailand	1
Korea	37	Taiwan	12
Myanmar	3	Vietnam	2
Malaysia	26	Indonesia	39
Philippines	13	Sri Lanka	5
		Americas	
Argentina	159	Paraguay	42
Bolivia	73	Suriname	1
Brazil	232	Uruguay	17
Barbados	4	United States	318
Costa Rica	1	Venezuela	4
Honduras	3	Ecuador	4
Jamaica	1	Cuba	7
Mexico	5		5
Peru	149		
		Other	
Australia	9	Martinique	1
Cyprus	1	Unknown	153
Spain	2		
Total	1705		1955
Grand total		**3660**	

and maintenance of this information is a key component of the conservation of ex situ collections. The availability of all or part of this information is a key to the use of the accessions. The assembled germplasm has been documented in various forms such as printed catalogs, computer-based catalog, CD-ROMs and posted on the Web (www.icrisat.org). The management of information on the accessions requires a linkage between the five basic types of data mentioned above, constituting a gene bank management system, which is critical to the wider use of the germplasm.

Documentation of operations and procedures

The maintenance of an ex situ collection requires the use of open, transparent procedures that can be reviewed at any time to ensure safety of the collections for the future. The GGP has compiled these procedures and processes in a manual, which outlines the aspects of gene bank management and conservation. This manual has been widely distributed in the region.

New collections

Since the founding of the GGP, the assembly of germplasm from world collections has been its key activity. However, there is a need to assemble germplasm from endangered areas. A survey on groundnut production in West and Central Africa revealed that farmers grow a limited number of groundnut varieties, many of which are introductions and breeding lines. Some of the varieties are grown across the region. The frequent drought and the shortened growing season in these areas are leading to serious genetic erosion of the existing varieties. These need to be rescued before they disappear. In October 2000, ICRISAT and IER-Mali organized an expedition to collect local varieties threatened by desert encroachment in the region of Mopti. Although limited diversity was found, three unique varieties were collected. Most recently, the Institut Tchadien de Recherche Agricole (ITRAD) requested ICRISAT to help in the rescue of local landraces of groundnut, sorghum and millet to reconstitute the national working collection, which was lost due to lack of proper conservation facilities. A set of duplicate samples will be kept at the regional gene bank.

Extent of diversity

Under the GGP, 6000 accessions from 73 countries have been assembled, mainly from the global collection at ICRISAT-Patancheru gene bank, as follows: India (14%), Zimbabwe (12%), United States of America (6%), Tanzania (6%) and Brazil (5%). In West Africa, the proportions are: Nigeria (5%), Senegal (4%) Mali (4%), Guinea (3%) and Chad (2%).

Botanical types fall into five major groups: *hypogaea* bunch (30%), *hypogaea* runner (16%), *vulgaris* (36%), *fastigiata* (15%) and Peruvian (4%). Only 8 accessions represent *hirsuta* and only 1 represents *aequatoriana.* Forty-five percent of the accessions exhibit an erect plant growth habit. The spreading, spreading/bunch, and bunch contain less than 25% of the accessions. The majority (53%) is breeding lines and the remaining 47% are landraces.

There are four major maturity groups, namely extra-early (80-90 days), early (90-115 days), medium- (115-120) and late- (> 120 days) maturity. There is also wide variability in oil content, edible groundnut traits and fodder production.

Characterization and evaluation of germplasm

Characterization for botanical characteristics

The value of germplasm collections held in the regional gene bank depends on the thorough botanical and agronomic characterization and evaluation of individual accessions for the traits of interest. Although the initial characterization of the assembled germplasm was done in India, each accession was further verified in West Africa during the rejuvenation and multiplication processes. User-friendly descriptors, mainly preharvest and postharvest characteristics, were used for the characterization. The descriptors were compiled in a handbook and distributed to NARS in the region. These will help in the characterization of national working collections. The project assisted the national programs of Mali, Niger, Nigeria, Burkina Faso and Senegal to characterize their national collections, and catalogs of these have been produced.

Identification of traits of economic importance

Groundnut productivity in West and Central Africa is limited by a number of biotic and abiotic constraints. The most important are foliar diseases, groundnut rosette virus (GRV), peanut clump virus (PCV), *Aspergillus flavus*/aflatoxin contamination and drought. The germplasm was therefore screened for sources of resistance to these biological stresses. It was also screened for edible groundnut characteristics such as pod and kernel size and threshing percentage.

Foliar disease

Among the foliar diseases, early and late leaf spots and rust are the most destructive diseases of groundnut, leading to yield losses ranging from 10-70% depending on the location and season. Screening of germplasm for resistance to foliar diseases was carried out in partnership with the Institut National de l'Environnement et des Recherches Agricoles (INERA), Burkina Faso, at hot spots such Niangoloko, Bengou (Niger) and Samanko (Mali). Other screening work was conducted by ICRISAT in India and Malawi. One hundred and sixty-six lines resistant to rust, 80 lines resistant to late leaf spots, and 30 lines resistant to early leaf spot were identified.

Groundnut rosette virus (GRV)

Rosette is the most destructive groundnut disease in sub-Saharan Africa. Epidemics are sporadic, but can cause substantial yield losses. Losses across Africa are estimated at US$ 156 million per year. Rosette can be managed by the use of insecticides to control the aphid vector. Cultural practices such as early sowing and optimal plant density can reduce incidence of the disease. Unfortunately, smallholder farmers have been unable to adopt these options. The most cost-effective solution is to use resistant varieties. The GGP thus focused on search for resistance to the GRV. This work was carried out by ICRISAT in partnership with the Institute for Agricultural Research (IAR) at Samaru, Nigeria, with additional screening by ICRISAT scientists in Malawi. Over 12000 germplasm lines have been screened to date and resistance identified in 130 long-duration Virginia types and 20 short-duration Spanish types. In addition to germplasm lines, over 1000 breeding lines were also screened and 110 early-to-medium maturing lines were found resistant. These sources of resistance provide an opportunity to eliminate 30-100% yield losses caused by the rosette disease.

Peanut clump virus (PCV)

Peanut clump disease is soil- as well as seedborne. It is widespread in West Africa, particularly in the dry savannas. The disease has implications in germplasm movement and exchange in the region. ICRISAT studied the variability of PCV using the double antibody sandwich form of enzyme-linked immunosorbent assay (DAS-ELISA). No resistance was found in the germplasm. To ensure production of virus-free seeds, seed multiplication plots are monitored for the occurrence of any seed-transmitted viruses.

Aflatoxin contamination

Aflatoxin contamination is a serious threat to both human and animal health. Caused by *A. flavus,* aflatoxin has been a major hindrance to international trade in groundnuts. Under the GGP, ICRISAT has screened 500 germplasm lines for resistance/tolerance to *A. flavus*/aflatoxin contamination. Varieties were also evaluated in partnership with IER, Mali and ISRA, Senegal. Seventy-four lines tolerant to *A. flavus* invasion and aflatoxin contamination were found.

Drought

Promising drought-tolerant varieties developed by ICRISAT and CIRAD in collaboration with ISRA/CERRAS were used in regional testing nurseries. New lines that produce acceptable yields under drought stress have been identified.

Edible groundnuts

The germplasm contains a wide range of lines with edible groundnut characteristics such as large kernels and low oil content. New high-yielding varieties from ICRISAT with confectionery or edible groundnut traits have been identified. Many others are in the regional germplasm. Among those selected as promising were ICGV 97041, ICGV 97047, ICGV 97049, ICGV 97052, ICGV 97065 and H75-0. These varieties are at pre-release stage in Senegal. They have also performed well in regional trials in Nigeria, Ghana, Burkina Faso and Mali.

Improving availability of genetic material for use in breeding

International undertaking on distribution and exchange of germplasm

Designated germplasm

In the past, groundnut germplasm exchange in West Africa was rare, fortuitous and not usually monitored. The development and distribution of improved groundnut varieties also faced serious constraints. There are four classes of germplasm maintained and distributed at ICRISAT. These are gene bank accessions, breeding lines developed by ICRISAT, breeding lines developed in cooperative programs, and a special class of breeding material that is nationally developed germplasm given to ICRISAT to use in crosses or tests in the national and international trials.

The Convention on Biological Diversity (CBD) recognizes the sovereign rights of nations over their genetic resources. After the CBD came into effect,

the germplasm collections held by International Agricultural Research Centers (IARCs) were placed under the auspices of FAO through an agreement to ensure their unrestricted flow for the benefit of the world community. The material covered by the agreement is referred to as 'designated germplasm'.

Material transfer agreement

The designated germplasm and ICRISAT's own breeding lines are freely available for distribution. In order to protect it as international public goods, in compliance with the FAO/CGIAR agreement on CBD, ICRISAT supplies these two classes of germplasm under a Material Transfer Agreement (MTA).

ICRISAT has traditionally adhered to a policy of unrestricted availability of germplasm held in its gene bank. In the interest of making this material available for future research and utilization, ICRISAT has undertaken not to claim Intellectual Property Rights (IPRs) over the germplasm or related information. To ensure the continued availability of designated germplasm, ICRISAT has also agreed to pass the same obligation on to all recipients of designated germplasm. Accordingly, the recipient must agree

- Not to claim ownership of the designated germplasm received, or seek IPRs over the germplasm or related information.
- To ensure that any subsequent person or institution, to which he or she makes samples of the germplasm available, is also bound by the same provision.

Germplasm acquisition agreement

The status of the germplasm acquired in the gene bank or in the breeding programs needs to be clear. This material is covered by the CBD and its conservation, distribution, and use should be clearly defined by the national programs or the donor of the germplasm. The regional gene bank will accept germplasm for medium term conservation that can freely be transferred with MTA as described above. The gene bank will hold for others under 'black box' arrangements, for safety duplication, germplasm on which the donor has placed restriction. In such cases, the material will be conserved, but usually will not be opened, examined, tested or used for research. Such material cannot be designated. There are a number of other options such as a) freely available and available for acquisition in the gene bank; b) available only for research purposes and not to be distributed; c) available for distribution only on a regional basis; or d) seed to be stored in the gene bank but not distributed.

Quarantine procedures for germplasm export

The success of international and regional germplasm exchange and utilization largely depends on its timely transfer and ease of mobility. A safe and rapid transfer of germplasm is vital for a sound crop improvement program. However, introduced useful germplasm must not endanger the new habitat with the pests and diseases. Import of small quantities of seed for experimental purposes with appropriate safeguards based on sound biological principles can often be to the way to safely improve the genetic base of crops.

Although there have been regulatory requirements for safe exchange of germplasm between different countries of West Africa region since 1967, implementing these has been difficult, due to a number of various technical and resource constraints and lack of awareness among groundnut researchers. To fill this gap, technical aspects of quarantine procedures were documented in consultation with NARS partners. This information was compiled into a handbook to provide technical information on the need for and simple procedures that can be followed for safe exchange of groundnut germplasm, not only between West African countries, but also with other parts of the world.

Distribution of germplasm and improved groundnut varieties

Distribution of germplasm remains of paramount importance and could be said to be the reason for the conservation of the collections. International attitudes toward germplasm have changed in the last decade, and there is a need to maintain distribution procedures in concurrence with these changes.

The project ensured that useful germplasm and improved breeding lines were available to NARS and other beneficiaries in a timely manner (Table 3). A network of regional variety trials for evaluation of 92 improved breeding and germplasm lines was initiated to enable NARS to have access to a diverse range of improved varieties. These varieties have desirable characteristics such as resistance to foliar diseases, groundnut rosette disease, tolerance to aflatoxin contamination, drought tolerance and confectionery traits. This has also given NARS an opportunity to select promising lines under local conditions and to facilitate technology transfer to farmers. In Nigeria, four early-maturing rosette resistant varieties (ICGV-IS 96894, ICGV-IS 96891, ICGV-IS 96808 and ICGV-IS 96855) and three medium maturing varieties (UGA 2, UGA 5 and M572.80I) were proposed to the National Variety Release Committee for registration and release. In May 2001, ICGV-IS

96894, UGA2 and M572.80I were approved for wide-scale production in Nigeria. These varieties possess traits preferred by farmers and the market. In Senegal, six high-yielding varieties with confectionery traits were identified and are likely to be released soon. Other varieties are in advanced stages of on-farm testing in national variety trials. In Mali and Niger, farmer participatory variety selection is leading to improved uptake of new varieties.

Table 3. Number of samples distributed from the regional gene bank in West Africa and other countries.

	Year						
Country	1996	1997	1998	1999	2000	2001	Total
Niger	22	1	9	7	12	202	253
Nigeria	2319	437	3	11	121		2891
Benin	5			5			10
Senegal		15		5			20
Burkina Faso			91	17			108
Sierra Leone			14			14	28
Cote d'Ivoire			2			7	9
Congo			30	30			
Mali				233		71	304
Kenya						6	6
CAR		25					25
Gambia		9					9
Britain		2					2
Algeria					4		4
Belgium		6					6
ICRISAT in W Africa	2000			200	300		2500
India	1					165	166
Total	4347	495	119	478	437	495	6371

Conclusion

Through the GGP, a broad range of germplasm has been assembled to support future development. This is essential for increasing food production, alleviation of poverty, and for promotion of economic growth. The regional working collection provides plant breeders with ready access to a greater range of groundnut diversity. It also provides desirable characteristics such as pest and disease resistance, drought tolerance, and

other traits of economic importance, important to farmers for use in developing modern varieties. In addition to the germplasm, a wide range of improved groundnut varieties is also available in the region. The genetic capital is rich and varied and provides insurance against unknown future needs/conditions. Thus the maintenance, conservation and utilization of this resource on a sustainable basis is crucial.

References

Ntare, BR and Olorunju, PE 2001. Variation in yield and resistance to groundnut rosette disease in early-and medium maturing groundnut genotypes in Nigeria. African Crop Science Journal 9(2): 1-8.

Olorunju, PE, Ntare, BR, Pande, S and Reddy, SV 2001. Additional sources of resistance to groundnut rosette disease in groundnut germplasm and breeding lines. Annals of Applied Biology 139:259-268.

Ntare, BR 2001. Germplasm exchange, transfer and Material Transfer Agreements. Paper presented at Groundnut Seed Production Workshop, 19-30 Mar, Bambey, Senegal.

Ntare, BR, Subrahmanyam, P and Waliyar, F 2001. Progress in combating groundnut rosette diseases in Sub-Saharan Africa. Paper presented at The First International Conference on Plant Virology in Sub-Saharan Africa, 4-8 Jun, IITA, Ibadan, Nigeria.

Seed production and distribution

Alain Mayeux[1] and Kisma Wagué[2]

Introduction

Groundnut is a major crop in the agricultural systems of West and Central Africa, with constantly increasing production, which went from 3 to 4.7 million t (unshelled pods) between 1979 and 1996. This represents an annual growth of 3.7% compared to 3.2% for the whole world. However, yields remain low with an average of 0.8 t ha^{-1} versus the world average of 1.3 t ha^{-1}. Production has increased in response to increased demand linked to high population growth. The extensive cropping system poses problems in the areas of occupation and soil degradation, decreasing soil fertility, and a problem of seed availability since at least 600,000 t of groundnut seed is required every year (120 kg ha^{-1}) to sow five million ha.

Successful farmers have shown that their success has been due to, among other things, their access to high quality seed and as a consequence, genetic improvements and technical innovations, which has allowed them to improve productivity and quality and conform to market requirements.

Improvement in productivity is one of the major objectives of the IGG/OOF of FAO, which has placed the GGP among its top priorities. ICRISAT, CIRAD and ISRA carried out this project with financial support from the CFC and the participation of the NARS from the groundnut-producing countries in West and Central Africa. The entire project was placed under the auspices of CORAF/WECARD and supported by the AGC.

Groundnut germplasm project activities

The lack of availability of adequate quantities of seed is a constraint to groundnut production, taking into consideration the crop's particularly low multiplication rate (= 10). Poor seed quality and the lack of choice of varieties adapted to specific agroclimatic conditions amplify this constraint. Before the GGP, fewer than twenty varieties were multiplied in the region; certain varieties were no longer adapted to environmental conditions (drought, pest

1. Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD). Chef du Projet GGP, BP 6478 Dakar Etoile, Sénégal.
2. Institut Sénégalais de Recherches Agricoles (ISRA). Spécialiste Semences GGP BP 53 Bambey, Sénégal.

pressure and viral *diseases)* or did not meet the quality standards of the market (aflatoxin contamination, standards for edible groundnut, etc.).

Creation of new varieties is a long-term activity that requires time and adequate funds. The introduction of new varieties can, in the much shorter term, lead to the identification of varieties that are adapted to specific production conditions. Component 3 of GGP, *Seed production and distribution,* is based on such a principle.

Positioned downstream of the groundnut seed production and processing chain, the GGP was conceptualized to screen a large number of varieties and distribute to the NARS those that performed the best. Each NARS must then carry out its own varietal selection on-station and then conduct on-farm tests of the best varieties under traditional farming conditions in the different agroecological zones (multi-location trials). The varieties that are finally retained could then be multiplied for the initiation of seed operations.

The ultimate goal of the GGP is to make adequate quantities of the best varieties available to farmers through downstream operations. National seed multiplication and distribution systems must be evaluated in order to make pertinent short-term recommendations that will make these systems more efficient and sustainable.

With this outlook for future development of seed operations, the Project must equally contribute to the training of researchers and technicians in techniques for seed production, storage and distribution.

Seed multiplication

The initial responsibility of seed multiplication from breeder seed nuclei was given entirely to ISRA. This production was progressively decentralized to ICRISAT and the NARS to enable easy distribution in close proximity to users. The production, distribution and seed stocks at each level are presented below.

ICRISAT (Sadoré Station, Niger and Samanko Station, Mali)

ICRISAT has mainly been involved in the multiplication of breeder seed of varieties that are currently used in Niger, Mali and Nigeria as well as the multiplication of new varieties in on-farm participatory trials under traditional farming conditions. In Niger, multiplication was concentrated on at the INRAN station at Bengou, the most appropriate site for seed production under rainfed conditions. Small quantities were also produced under irrigation at Sadoré. In Mali, varieties were mainly multiplied under rainfed conditions on the Samanko station.

Seed production

Table 1. Annual groundnut production.

Year	No of varieties	Quantity (kg pods)
1999	24	1026
2000	104	3084
2001	*66*	3707

Seed distribution

Table 2. Annual seed distribution.

Year	No of varieties	Quantity (kg kernels)
1999	17	118
2000	8	444
2001	29	376

Seed stock

Table 3. Seed stock in 2002.

Types	No of varieties	Quantity (kg kernels)
Rosette-resistant	36	636
Resistant to others (*Cercospora,* aflatoxin)	12	303
Varieties popularized	12	540
Total		1479

ISRA (Bambey Station, Senegal)

The GGP has contributed to the rehabilitation of a 3 ha irrigated area at the ISRA field station in Bambey. The pumping system (generator, well and pond relay pumps) and irrigation equipment (hoses and sprinklers) have been completely replaced. The field, which had been left fallow for several years, was entirely reconditioned (cleared, plowed and 5 t ha^{-1} of organic manure applied) in order to multiply seed in a groundnut/cereal rotation. Seed was multiplied in accordance with production standards for groundnut: proper soil preparation, fertilizer application, proper planting density, regular maintenance, weeding throughout the crop cycle, irrigation when necessary, monitoring of crop maturity, timely harvesting, rapid

curin'g, stripping, and shelling by hand. Shelled seeds were sorted, analyzed for viability, and then packaged under vacuum.

All the varieties that were chosen for the program of regional trials or those with interesting characteristics were multiplied for distribution to NARS to constitute a stock of quality seed. The multiplication program brings together an average of 125 varieties per cropping cycle.

Seed production

The production was initiated in 1997 with the multiplication of small quantities from regional collections. This production was progressively increased from 274 kg to 2370 kg (unshelled groundnut) as shown in Table 4.

Table 4. Seed production.

Year	Quantity (kg pods)
1997	274
1998	737
1999	971
2000	1900
2001	2370

Seed distribution

A total of 1150 kg of kernels from Senegal was distributed as seed to 16 countries (2 outside of the area) as shown in Table 5.

Table 5. Seed distribution.

Country	No. of varieties	Quantity (kg kernels)	Country	No. of varieties	Quantity (kg kernels)
Angola	5	30	Morocco	1	15
Burkina Faso	10	25	Niger	22	20
Benin	5	10	Nigeria	5	26
Cameroon	4	40	R D Congo	9	25
Côte d'Ivoire	5	25	Senegal	25	750
The Gambia	6	25	Chad	5	25
Guinea	8	33	Togo	8	40
Guinea Bissau	15	37	Vietnam	3	24

Seed stock

A large seed reserve is stored at ISRA (Table 6). ISRA has taken the responsibility for maintaining the vacuum-packed seeds in a cold room in order to increase their shelf life and have access to this germplasm in the future.

Table 6. Seed stock - ISRA Senegal.

Type	No. of varieties	Quantity (kg kernels)
Rosette resistant	33	315
Drought resistant	14	360
Leaf spot resistant	18	258
Aflatoxin resistant	6	131
Edible groundnut	60	837
Others	6	149
Total	**137**	**2050**

Seed conservation

Compared to farmers' stocks, which consist of large quantities of groundnut seed stored as pods, and may be able to tolerate minimal losses due to fungi, insects and other seed pests, the first level (breeder seed, foundation seed) is a precious seed capital that must be given maximum protection. Storage in a cold room is the most well known method but the equipment is costly, and difficult to install and maintain. A dependable supply of electricity is not always available. In light of these constraints, seed conservation under modified atmosphere was tested as an alternative. This technique consists of maintaining the seeds under anoxic conditions, either under a complete vacuum or under modified atmosphere (vacuum replaced by a neutral gas). These conditions were maintained in the medium-term (24-36 months) by using multilayered airtight packets that had a high level of mechanical resistance.

Insects, especially the Groundnut Seed Beetle (*Qaryedon serratus*), cannot survive under anoxic conditions. Experiments carried out in Senegal showed that all forms (eggs, larvae, adults) of C. *serratus* were killed within 21 days. Seed viability was maintained at 90% after being stored for 36 months versus 54.6% for the control treatment (initial viability of 98%). However, seeds must be properly cured (< 4% water content) and sorted before packaging in order for this technique to be effective.

National agricultural research systems

Seed multiplication by NARS was preceded by varietal trials. After preliminary trials, 91 high-performance varieties were selected. These were divided into eight groups representing strains that showed tolerance or resistance to the main abiotic and biotic constraints present in the region.

Varietal testing by NARS

The evaluation of varieties through this regional network was initiated in 1998. All the NARS that wanted to test certain varieties were given seed and a protocol for setting up the trial. The aim was to harmonize the experimental methods and trials and facilitate analysis and exploitation of the results at the national and regional levels.

Partial results based on pod yields have shown that several varieties performed better than local controls. Over the three-year period, these results were reproducible at the national and even regional levels for certain varieties (Table 7). Data on the weight of 100 pods and kernels, shelling percentage, yield of unsorted kernels, and hand-picked selected (HPS) kernels, and the oil content of the kernels will also be collected to complement the determination and analysis of pod yield data.

Seed multiplication by NARS and other partners

Certain varieties have been multiplied for 1-2 years in several countries, either for on-farm evaluation (participatory selection in traditional farming systems) or to meet the predicted needs of seed operations. Relatively large quantities of seed have been produced with GGP support (Table 8).

In Nigeria, 3 varieties resistant to GRV were registered and proposed for popularization: ICGV-IS, UGA 2 and M572.801. In Senegal, several varieties of edible groundnuts are going to be registered in the national catalog and may soon be proposed for irrigated cultivation. These varieties are being multiplied for more widespread distribution.

A regional variety map has been developed, based on agroclimatic criteria and the results from the analysis of the performance of these new varieties, with the aim of making the choice of varieties easier and to facilitate regional exchange. The best varieties that are currently popularized will also be included on the map.

A regional seed catalog, which brings together the best varieties currently available, will be published at the end of the project. A bilingual descriptive sheet will be presented for each variety. This catalog will not replace national catalogs, which must be conceptualized around a wider

range of national varieties, suited to the diversity of the country's agroecological zones.

Table 7. Best varieties in each group.

Varietal group	Variety	Varietal group	Variety
Resistance to early leaf spot	ICGV 91225 ICGV 92099 ICGV 92087 #3-94 ICGMS 42	Drought resistance	ICGV 86024 ICGV 86124 ICGV-SM 86024 GC 8-35 11908-13 55-21
Resistance to late leaf spot	ICG 7756 ICG 8298 ICGV 88274 ICGV 92082 ICG(FDRS)4	Resistance to aflatoxin	ICGV 88274 ICGV 89063 ICGV 89112
Resistance to GRV (short-cycle varieties)	ICGV-SM 93525 ICGV-IS 96802 ICGV-IS 96808 ICGV-IS 96855 ICGV-IS 96891 ICGV-IS 96894 ICIAR 19BT	Resistance to rust	ICG 10933 ICG 10963 ICG 10014 ICG 10918
Resistance to GRV (long-cycle varieties)	ICGV-IS 96812 ICGV-IS 96814 ICGV-SM 88761 M343-81A MDR 8-15 M516.791 M572.801 UGA 2	Edible groundnut	ICGV 88434 ICGV 93057 ICGV 93104 ICGV 94222 ICGV 97041 ICGV 97052 ICGV 97065 H 75-0

Table 8. Seed production by the NARS (breeder seed and foundation seed).

Country	No of varieties (2001)	Seed production 2001 (kg pods)
Burkina Faso	20	300
Benin	5	300
Cameroon	7	2550
Ghana	5	3950
Guinea	1	1780
Mali[1]	18	2800
Niger[2]	6	2570
Nigeria	20[3]	1790
Senegal	6	1950
Togo	3	500
Total		18490

1. Mali began to produce seed under GGP in 1999 and produced 1140 kg in that year and 3160 kg in 2000.
2. Niger began in 2000 with a small production of 130 kg.
3. Three recently popularized varieties make up more than 60% of the production.

Regional study of groundnut seed systems

A regional study of groundnut seed systems was conducted in 1999 for the 12 countries in West and Central Africa. The study was funded by FAO (TCP/RAF/7823-A) and supported by CORAF/WECARD. The aim was to take stock of existing systems and to orient certain decisions for their improvement in order to make them more efficient, and thereby facilitate the transfer of new varieties to farmers.

This study has made it possible to confirm farmers' interest in this crop, whose production has been steadily increasing over the last 15 years. While it is still an important cash crop, groundnut is increasingly becoming a food crop. In addition, by-products such as haulms generate relatively large earnings because of a steadily growing demand from small ruminant rearing in peri-urban areas (e.g., in Senegal).

Official report

- There is great disparity between the seed sectors of the different countries, ranging from a specialized groundnut seed production and processing chain to structures that integrate several species. The quantities treated by these different systems are also very different (several hundred to several thousand tons).

- Despite substantial investment in seed projects, very few have survived a lack of funding and government structural readjustment programs, which have progressively withdrawn and adopted market policies. The abrupt rupture with the state is often accompanied by the growing isolation of farmers and redistribution of seed production activities, which are often risky and not very favorable to the production and dissemination of quality seed. This situation has served to reinforce the activities of the informal sector, which currently supplies 90% of seed requirements. This sector was able to adapt very quickly to the situation because of its flexibility by not only ensuring collection and resale of seed in the vicinity, but also applying pricing policies that were adapted to the incomes of small farmers. Although it must be recognized that this practice has allowed certain seed shortages to be avoided, it has not, however, led to any yield increases. There has been no improvement in quality and yields continue to hover at about 700-800 kg ha^{-1}. For example, in Senegal, the oil factories complain of a significant fall in shelling percentage (small pods and unfilled pods), which has led to losses in terms of time and money, as well as premature wearing down of the machinery (lots of soil adhering to badly formed pods).
- Part of the groundnut produce is generally kept as seed but farmers do not apply the basic seed production principles (appropriate application of manure, good planting density, removal of off-type plants and selection of plants). Under these conditions the produce kept as seed (mixed seed, poor quality) cannot reproduce the characteristics of specific varieties and ensure a good production.
- Seed is often stored under inappropriate and poor conditions and exposed to pest attack (insects, fungi), which exacerbates the poor results. If the farmers sell all their produce, the middlemen in the informal seed sector store and recycle part of their seed stock, and sell these at the beginning of the next crop cycle.
- The farmer is often insufficiently informed about potential markets where he can make the most of his production by supplying a quality product that meets market specifications. This leads to a lack of interest in quality seed or varieties adapted to meet this demand. There is a great disparity between the potential and the actual demand for quality seed. There are very few private seed structures in the region. Senegal is an exception, with a professional organization that supplies 20% of the country's seed requirements (20-25,000 t yr^{-1}).

Recommendations

A regional study has led to a certain number of recommendations that may provide solutions to the problems shared by all the countries in the region. These are based on the experience of certain countries and recognized principles of groundnut seed production, while taking into account the diversity of climatic and agroeconomic conditions in each country. These recommendations have led to the development of seed production activities downstream of the GGP, which have been presented in Session II of this workshop.

Training

Bearing in mind that the strategy of the GGP and the implementation of sustainable and effective seed production and processing activities is based on efficient technical supervision, training represents an important component of the project. Training was provided in standards for seed production, storage and distribution, either in the form of visits to field stations (individuals, farmer groups and professionals), or as a workshop.

A training workshop, which brought together 44 participants representing 13 countries in the region, was organized at the ISRA center in Bambey, Senegal. This training program was conducted in the spirit of enriching and sharing the know-how and experiences of participants. It focused on improving participants' expertise and professionalism so that they could take these experiences back to their home countries and apply the lessons learned to setting up seed producing and processing operations that will allow farmers to have access to quality seed.

The training program was organized around 7 themes:

- The variety; the starting point for seed production
- Seed strategies adapted to production in traditional farming systems
- Seed regulations
- Technical basis for groundnut seed production
- Postharvest technology
- Commercialization of seeds
- Seed policy and legislation

Practical work in the laboratory (seed analysis) and field visits to production and storage sites and to an oil factory were also organized. A technical manual was developed and widely distributed in the region.

Conclusions

The regional GGP, executed in collaboration with NARS in national structures, has met its target objectives through the development of a regional system for managing groundnut genetic resources and the popularization of varieties. It has also acted as a catalyst to collaboration in the region, and this must be reinforced and expanded.

Results more specifically related to seed production are:

- Selection of more than 40 varieties that can be used to significantly increase groundnut yields in West and Central Africa.
- These varieties made available to interested NARS.
- Initiation of multiplication of these varieties by NARS.
- Development of the technology for conservation under modified atmosphere.
- Training provided to many researchers and technicians in production techniques for groundnut seed.
- Development and distribution of a technical manual on standards for production, distribution and storage of groundnut seed.
- A regional study of national seed systems proposal of downstream seed activities was conducted, which can make full use of GGP expertise and develop the production of quality seed in West and Central Africa.

Farmers' access to quality seed is fundamental to agricultural development. Because of its low coefficient of multiplication, groundnut must be multiplied several times in order to obtain the necessary quantities of seed. This method is the only one that can actually be carried out under existing conditions on traditional farms. These require numerous interventions to ensure strict reproduction of the characteristics for which the varieties were selected. They also ensure that only seeds that meet farmers' expectations are delivered to them.

The quality of seed offered to users must be guaranteed. Users must have access to a wide range of seed and this seed must be available in sufficient quantities, at the required time.

A climate of trust must be created to arouse the interest of small farmers and encourage them to use high-quality seed. The initiation of local production schemes for quality seed of appropriate varieties, with the initiative of farmers, could be a way of attaining this objective. Certain farmers can progressively become professional seed dealers through links

with professional structures. The government's responsibility (to guarantee the quality of supplied seed) must be fully assured by the inspection service, which must place emphasis on its role of adviser and trainer.

Bibliography

Mayeux, A, Da Sylva, A and Schilling, R 1997. La production de semence en Afrique de l'Ouest. Agriculture et Développement 14:22-30.

Mayeux, A (ed.). Guidelines for groundnut seed production, storage and distribution for traditional farming systems. (Technical manual in French & English). Proceedings of GGP training workshop, 19-30 Mar 2001, Bambey, Senegal.

Training and exchange of knowledge

Arthur Da Sylva[1] and Alain Mayeux[2]

The GGP activities and accomplishments have been largely disseminated in the region through progress reports, newsletters, technical bulletins, catalogs, posters and scientific journal articles, and conference proceedings.

Reports

In the project appraisal report the following publications were envisaged:

- Steering Committee (SC) report.
  The SC consisted of seven representatives of the following organizations and institutions: CFC, FAO, ICRISAT, CIRAD, ISRA, CORAF/ WECARD and AGC. Project resource persons and representatives from the NARS participated in SC meetings. The SC met once every year to review project progress, approve annual work plans and budget, and provide technical guidance.
- Six-monthly progress reports and annual reports.
  The GGP produced six half-yearly progress reports and six annual reports including project achievements and financial statements.
- Evaluation mission reports.
  Five evaluation reports were produced. These included three annual supervision reports by the FAO as the Supervisory Body (SB), one mid-term evaluation report, and one special audit report. External independent evaluation teams conducted the latter two.

Newsletter

An annual newsletter was published (450 copies) and distributed to a wide audience. The objective was to disseminate highlights of the project accomplishments. It was divided into four sections: project news, research highlights, workshops and seminars, and special articles on priority topics such as aflatoxin, edible groundnuts, drought, variety improvement and seed systems.

1. Institut Sénégalais de Recherches Agricoles (ISRA). UPSE, BP 53 Bambey, Sénégal.
2. Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) . Chef du Projet GGP, BP 6478 Dakar Etoile, Sénégal.

Technical documents

Certain technical documents were produced about specific activities. For example, a booklet listing simple groundnut descriptors was produced to assist in the characterization of groundnut germplasm. This was distributed to national programs. A manual on technical aspects of quarantine requirements for safe groundnut germplasm exchange was produced to assist NARS in proper exchange of germplasm. A manual on genetic resources and gene bank management was published (250 copies), to help scientists and technicians involved in conservation and maintenance of groundnut germplasm. To help those involved in production and distribution of groundnut seed, a technical manual on guidelines for groundnut seed production, storage, and distribution for traditional farming systems was produced (250 copies). A manual of methodologies for detection of aflatoxin and groundnut viruses was produced to assist in seed health matters. All these have been widely distributed.

Catalogs

Three groundnut germplasm catalogs were produced and distributed widely These consisted of: Vol I (Part 1) describing the taxonomy and origin of 5540 accessions, Vol I (Part 2) listing botanical and agronomic characteristics, and Vol II listing 429 unique germplasm accessions with traits of economic importance such as sources of resistance to foliar diseases *(Cercospora* leaf spots and rust), groundnut rosette disease and aflatoxin. This information can also be accessed on the Web (www.icrisat.org) and is also available on CD-ROM.

Volume III of the catalog, listing the best groundnut varieties, is under preparation. This will also include a variety map to assist in the determination of appropriate adaptation zones of new varieties.

Training

Three major 10-day training workshops each were organized:

Gene bank management

Seventeen participants from 11 countries attended this training workshop organized by ICRISAT for researchers and technicians involved in genetic resources management. The workshop covered both theoretical and practical aspects of groundnut genetic resources management, including

collection, conservation, seed physiology, gene bank standards, material exchange, documentation and distribution. Scientists from ICRISAT and IPGRI constituted the faculty.

Methods for diagnosis and detection of viral diseases of groundnut and evaluation of aflatoxin contamination

The objective of this training workshop was to harmonize methodologies for the aflatoxin and virus detection techniques in the region. Fifteen scientists from 12 countries attended the workshop. The participants used simple immunological techniques for the detection of aflatoxin and groundnut viruses to facilitate transfer in the region. ICRISAT organized the training, with resource persons from INERA (Burkina Faso), IER (Mali) and ISRA.

Production, handling, storage and distribution of groundnut seeds

This workshop was held at ISRA (Bambey) to reinforce the skills of participants in practical techniques of seed production, handling, conservation and commercialization of improved groundnut seeds. Twenty-seven participants from 23 countries attended the workshop. The training was provided by specialists from ISRA, ICRISAT, CIRAD, DISEM and the Union Nationale Interprofessionnelle des Semences (National Interprofessional Seed Union, UNIS). This training will have an important impact on national seed services in assuring distribution of good quality seed.

Informal training

A number of informal training was also given to individuals and groups. For example, ICRISAT offered individual training in seed management to Ministry of Agriculture staff in Niger, and technicians were trained in groundnut disease management in Mali. The IAR (Nigeria) trained scientists in screening techniques for resistance to groundnut rosette. In Senegal, scientists and technicians were trained in seed analyses. Farmer groups in Mali, Niger and Senegal also received training in participatory variety selection, on-farm seed production and conservation.

Posters

Scientists involved in the GGP produced seven posters representing specific themes, which were presented at the stakeholders' meeting in April 2002.

These included: groundnut germplasm in a nutshell, combating groundnut rosette disease, resistance to drought, combating aflatoxin contamination, seed conservation under modified atmosphere, seed production of edible groundnut, and farmer participatory selection of groundnut varieties.

Workshops and seminars

GGP contributed to and participated in various regional and national workshops and seminars. Three regional workshops were held in Ghana (1996), Mali (1998), and Benin (2000). At each meeting, GGP activities and achievement were presented to a wide range of participants (scientists, extension agencies, policy makers, private sector, farmers and NGOs).

The GGP also contributed to the regional study of groundnut seed systems in West and Central Africa. This study was supported by FAO under the auspices of CORAF /WECARD. CORAF and the GGP jointly organized a workshop to synthesize the results of the study.

GGP participated in the initiation of the African Seed Network meeting held in Abidjan (Côte d'Ivoire) and also the harmonization of seed laws in West and Central Africa meeting held at Dakar (Senegal). Both meetings were supported by FAO.

The GGP was also represented at the American Peanut Research and Education Society (APRES) meetings in the United States of America and the Congress of Oilseeds organized in Mozambique.

Publications

A number of scientific articles written by project scientists in collaboration with NARS scientists were published in several international refereed journals. These articles covered variety aspects, genetic resources, material exchange, seed systems, conservation and distribution.

Conclusions

Project activities conducted in the last six years will have a significant impact on the productivity of groundnut in the subregion. Improved groundnut varieties are available, efficient screening techniques to enhance use of national collections are available, and appropriate and cost-effective conservation techniques have been developed. These results have been widely disseminated.

Session III
Groundnut Sector Characteristics

Global and regional perspectives of the groundnut market: Competitiveness of African producers

Jupiter Ndjeunga[1], Bonny Ntare[2] and Robert Schilling[3]

Abstract

During the last 4 decades, West Africa has lost its position in world groundnut production and export shares. Groundnut production shares declined from 23% to 15% whereas export shares decreased from 55% to 20%. China, the leading producer, has significantly increased its shares from 11% to 41%. Argentina, the leading groundnut oil exporter, has more than doubled its world share from 12% to 29%. In addition, imports from other sources such as soybean and palm oil significantly increased in West Africa. However, since 1984, groundnut production in West Africa has been increasing by about 6% annually, mainly due to expansion in groundnut production area. Senegal and Nigeria remain among the world's largest groundnut producers. Groundnut remains a major source of employment, income and foreign exchange in many West African countries. There is, therefore, a need to reassess market prospects and highlight opportunities for West Africa to regain its share of the market.

The low productivity, aflatoxin regulations, and stricter grades and standards have limited the competitiveness of West African groundnut in the domestic, regional and international markets. Relative prices of groundnut oils are higjner in the international markets, making these products less competitive compared to palm oil, cotton oil and others. There are market niches for confectionery groundnut. Access to this market would require knowledge of market requirements. To regain its competitiveness, groundnut productivity and production has to increase significantly, technologies to reduce aflatoxin contamination have to be promoted, and grades and standards met.

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Agricultural economist, Samanko station, BP 320, Bamako, Mali.
2. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Groundnut breeder, Samanko station, BP 320, Bamako, Mali.
3. Centre de Coopération Internationale en Recherche Agronomique pour le DeVeloppement (CIRAD), Avenue Agropolis 34398 Montpellier Cedex 5, France.

Introduction

Groundnut production, marketing and trade are major sources of employment, income and foreign exchange in many West African countries. Until the mid-1970s, groundnut production, processing and trade contributed between 15% (Senegal) and 40% (Gambia) of gross domestic production in West African countries. With the exception of Nigeria and Sudan, groundnut exports provided between 40% to 90% of export revenues of West African countries during the 1960s and the early 1970s (Kinteh and Badiane 1990).

Groundnut production has evolved through 2 phases: a period of decline from 1961 to 1983 followed by an increasing trend from 1984. Since 1984, West African groundnut production growth is estimated to about 5.7% annually, mainly due to expansion in production area, accounting for more than 90% of production. However, the share of groundnut production in West Africa has decreased from 23% to 15% from 1961-65 to 1999-2001. Similarly, export shares have decreased from 55% to 20%. Most of this share has been acquired by Argentina and China. In effect, these countries have more than doubled their export shares. During the same period growth in production of other oilseeds has also been increasing.

A range of factors explains the limited competitiveness of groundnut in the domestic, regional and international markets. These include low production and stricter rules on grades and standards, which most West African producers often find difficult to meet. Domestic policies have also limited trade.

The present paper characterizes the trends in groundnut production in West Africa; highlights some of the constraints to groundnut production, processing and commercialization; presents some markets prospects for groundnut and groundnut products; and explores ways to increase groundnut competitiveness in the domestic, regional and international markets.

Production, area and yields of groundnut and other oilseeds

Groundnut production in West Africa averaged 4.83 million t (unshelled pods), about 60% of Africa's production and about 15% of world production in 1997-2001 (Table 1). Since 1961, production has been stagnant, with an annual growth rate of 0.38%. However, during the same period groundnut production followed two distinct patterns: a decline from 1960 to 1983 and

Table 1. Evolution of African groundnut production in selected countries from 1961-2001: area harvested, production and yields.

	Production					Area		Yield	
Aggregation	Average 1997-2001 ('000 t)	Average share of Africa 1997-2001 (%)	Average share of world 1997-2001 (%)	Annual growth rate 1984-2001 (%)	Annual growth rate 1961-2001 (%)	Average 1997-2001 ('000 ha)	Annual growth rate 1961-2001 (%)	Average 1997-2001 ('000 kg ha^{-1})	Annual growth rate 1961-2001 (%)
World	32,945	n.a.	100	3.30	2.01	23,772	0.56	1386	1.45
China	12,698	n.a.	38.54	6.2	5.86	4,927	2.72	2922	3.14
India	6.855	n.a.	0.02	0.46	1.18	7,287	0.20	943	0.98
Africa	8,018	100	24.34	4.87	0.53	9,154	0.33	875	0.20
Western Africa	4832	60.2	14.67	5.69	0.38	4,920	0.16	981	0.55
Gambia	113	1.4	0.34	0.23	-1.08	98	-0.40	1146	-0.68
Mali	141	1.8	0.43	2.91	0.22	146	-0.57	962	0.79
Niger	105	1.3	0.32	9.50	-3.66	254	-2.03	416	-1.63
Nigeria	2730	34.1	8.29	9.93	0.55	2571	-0.35	1063	0.90
Senegal	852	10.5	2.59	1.45	-0.65	871	-0.86	981	0.21
Benin	94	1.2	0.29	3.10	2.85	109	0.99	862	1.86
Ghana	193	2.4	0.59	1.17	3.72	188	3.53	1023	0.18
Liberia	4.2	0.0	0.01	1.87	1.94	7.0	2.10	600	-0.15
Mauritania	2.0	0.0	0.01	1.05	2.52	2.5	0.96	808	1.56
Guinea	180	2.3	0.55	7.65	2.26	180	1.04	1002	1.22
Guinea-Bissau	19	0.2	0.06	-1.73	-5.34	16	-5.95	1170	2.71
Burkina Faso	198	2.5	0.60	4.00	3.30	239	1.84	824	1.46
Cote d'Ivoire	145	1.8	0.44	1.99	5.19	151	3.59	962	1.60
Sierra Leone	26	0.3	0.08	2.42	0.70	30	1.68	868	-0.99
Togo	30	0.4	0.09	1.01	2.18	57	2.20	523	0.01

n.a. means not applicable

a subsequent increase from 1984 to 2002. Since 1984, groundnut production has been increasing at the annual rate of 6%, mainly due to expansion of 5% in production area. This increasing trend is true for all countries in West Africa except Guinea Bissau. Groundnut yield in West Africa is low (981 kg ha^{-1}) and below the world average of 1386 kg ha^{-1}, and represents less than half the yield in China (estimated to be 2922 kg ha^{-1} in 1997-2001).

Nigeria and Senegal are the largest groundnut producers in the semi-arid tropics of West Africa, together accounting for about 45% of total African production. Mali, Niger and Burkina Faso are also major groundnut producers in the region.

West Africa has lost its world production share from 23% in 1961-65 to 15% in 1999-2001. Meanwhile, China has quadrupled its production to become the world leader, accounting for over 40% of total groundnut production in 1999-2001 (Table 2). Since the 1960s, India and Senegal have lost half their shares, whereas Indonesia and Sudan are relatively stagnant.

Table 2. Production shares of the world largest groundnut producers (%).

Country	1961-65	1971-75	1981-85	1991-95	1999-01
China	11.43	12.55	26.27	31.23	41.42
India	31.55	31.03	29.35	29.12	17.76
Nigeria	11.87	6.01	3.13	5.66	8.51
USA	6.05	8.87	8.43	6.63	4.93
Senegal	6.13	5.52	3.67	2.47	3.11
Sudan	2.17	3.86	1.92	1.98	2.97

Despite the loss in production shares, groundnut remains the most important source of vegetable oils and fats in West Africa[4] (Table 3). However, the development of other competing sources of oils is becoming significant. Soybean (*Glycine max*) production grew by an annual rate of 11.6% during 1984-2001 to reach an average of 440,600 t annually in 1997-2001. Similarly, sesame (*Sesamum indicum*) production has grown by 5.2% annually since 1984. The potential of sesame to serve as the second crop in a sequential cropping system (as in some mono-modal rainfall regions), as well as its versatility in the local diet, render it a promising oilseed crop. Cottonseed (*Gossypiwn* spp) production is increasing faster than that of

4. Western Africa includes Gambia, Mali, Niger, Nigeria, Senegal, Benin, Ghana, Liberia, Mauritania, Guinea, Guinea-Bissau, Burkina Faso, Cote d'Ivoire, Sierra Leone, Togo.

Table 3. Trends in the evolution of West African production of major oilseeds from 1961-2001: area harvested, production and yields.

	Production			Area			Yield		
Commodity	Average 1997-2001 ('000 t)	Annual growth rate 1984-2001 (%)	Annual growth rate 1961-2001 (%)	Average 1997-2001 ('000 ha)	Annual growth rate 1984-2001 (%)	Annual growth rate 1961-2001 (%)	Average 1997-2001 (kg)	Annual growth rate 1984-2001 (%)	Annual growth rate 1961-2001 (%)
Soybeans	440.6	11.6	4.9	583.5	5.3	3.8	695.6	6.3	1.3
Groundnuts	4832.0	5.7	0.4	4919.0	5.2	-0.2	980.7	0.5	0.6
Sesame seed	105.8	5.2	1.3	231.9	3.0	-0.3	457.3	2.1	1.5
Palm kernels	773.5	3.0	0.7						
Palm oil	12000.0	2.3	0.9	3630.0	2.0	0.6	3272.4	-0.1	0.3
Cottonseed	2071.0	6.9	6.5	2114.0	5.9	3.6	980.8	0.9	3.0

groundnut. Groundnut and cotton must also compete for land and farm labor. Given the prospects in the fiber market, the relatively well-developed product markets for cotton, and drought-tolerant character of the crop have established cotton as a strong competitor of groundnut.

Both palm oil and palm kernel production have been increasing. Given overall slow income growth rates in Africa, and the competitive price of palm oil coupled with the prospects of rapid adoption of existing technologies in oil palm production, the competitive market pressures from both palm and kernel oils are likely to intensify, at least in the medium term.

The evolution of other oilseeds and production of oleaginous fruits in Africa and some individual West African countries is summarized in Table 4. Cottonseed production is growing rapidly in Mali and Nigeria, with an average output of 462000 t and 336840 t, respectively, with corresponding annual growth rates of 6.45% and 10.29%. Sesame production has also increased in Niger and Nigeria with growth rates of 19.3% and 5.25%, respectively. This increased output is invariably the result of area expansion. Palm oil production ranked second to cottonseed in production growth during the period 1984-2001, with an annual growth rate of 2.44%. In terms of total African production of major oilseeds and oleaginous fruit products, palm oil, cotton and soybean are the most important crops. Palm oil accounts for 86%, cotton for 48% and soybean for 42% of African production.

Groundnut utilization

Worldwide, more than 50% of groundnut produced is crushed into oil for human consumption or industrial use. The major forms of groundnut utilization in different regions are presented in Table 5. Utilization of oil, meal and confectionery groundnut is increasing, along with a gradual shift from oil and meal to confectionery use, especially in Latin America and the Caribbean. Globally, the shares of oil, meal and confectionery have not changed during the past two decades.

Between 1979-81 and 1994-96, the global demand for groundnut oil increased from 2.8 to 4.3 million t, due to a range of factors such as the relative prices of competing vegetable oils, income levels, demographic trends and cultural preferences. The share of developing countries in this consumption increased from 83 to 93% due to rising demand in Africa and Asia. This increase in demand was mainly due to population growth, growth in per caput income, and urbanization. In West Africa, in some countries like Nigeria, Gambia and Senegal, oil extraction has been an important cottage industry for years. Groundnut meal is mainly used for livestock feed.

Table 4. Evolution of production of other major oilseeds in some selected countries: area harvested, production and yields from 1984-2001.

Country	Commodity	Production			Area		Yield	
		Average 1997-2001 ('000 t)	Average share of Africa 1997-2001 (%)	Annual growth rate 1984-2001 (%)	Average 1997-2001 ('000 ha)	Annual growth rate 1984-2001 (%)	Average 1997- 2001 (kg ha^{-1})	Annual growth rate 1984-2001 (%)
World	Soybeans	160000	n.a	3.83	72000	2.25	2157	1.58
	Sesame seed	2772	n.a	1.89	6640	0.42	403.7	1.22
	Cottonseed	54000	n.a.	0.56	33000	0.14	1632	0.42
	Palm oil	110000	n.a.	6.62	9286	4.61	7589	2.01
Africa	Soybeans	899.10	100	5.56	929.20	4.96	966.5	0.59
	Sesame seed	723	100	4.23	2642	4.41	272.4	-0.14
	Cottonseed	4317	100	1.27	4520	1.64	956	-0.37
	Palm oil	14000	100	2.01	3957	2.04	3628	-0.01
West Africa	Soybeans	406.60	45.22	11.61	583.40	5.31	965.6	6.30
	Sesame seed	106	14.66	5.20	227	3.02	457.3	2.07
	Cottonseed	2071	47.97	6.87	2114	5.94	981	0.92
	Palm oil	12000	85.71	2.26	3630	2.04	3192	-0.05
Niger	Sesame seed	8.67	1.20	19.28	26.68	18.11	324.7	0.19
	Cottonseed	8.49	0.20	5.38	5.63	-1.84	1573.5	7.22
Nigeria	Soybeans	429	43.93	11.91	567.8	5.39	695.2	6.55
	Sesame seed	67.80	9.38	5.25	145.74	2.9	465.4	2.39
	Oil palm fruits	8000	57.14	2.44	2980	2.32	2564	0.01
	Cottonseed	336.84	7.80	10.25	498.4	3.11	683.2	7.14
Senegal	Sesame seed	1.92	0.27	-	4.12	-	447.6	-
	Oil palm fruits	64	0.46	-0.24	6.32	-0.24	10000	-
	Cottonseed	26.32	0.61	-3.06	35.62	-0.34	750.0	-2.72
Mali	Sesame seed	0.35	0.05	-	-	-	-	-
	Cottonseed	462.00	10.70	6.45	442.5	8.31	1573.5	-1.86

Source: FAOSTAT database, 2002.

The demand for confectionery groundnut for direct food consumption increased by nearly 80% between 1979-81 to 1994-96. Developing countries accounted for much of this increase. Utilization of confectionery in Asia more than doubled during the same period. Consumption grew rapidly in China and other fast growing Asian economies. Demand has shifted in Europe from processing to confectionery (Table 5).

Table 5. Evolution of groundnut uses (in '000 metric tonnes of unshelled groundnut).

	Total availability	Confectionery	Processing	Other uses
1979-81 average				
Africa	16005	1382	1699	855
Asia	3937	2918	6649	1288
Latin America and the Caribbean	10855	196	735	77
USA	1204	889	233	82
Europe	577	247	327	2
World	18472	6085	9995	2392
1994-96 average				
Africa	6011	1999	2670	1342
Asia	20062	6629	11360	2073
Latin America and the Caribbean	606	251	316	57
Europe	589	390	196	3
USA	1477	950	401	126
World	29703	10850	15211	3663

Source: Adapted from Freeman et al. 1999, p. 14.

Trade in groundnut and other oilseeds

Groundnut oil

Argentina is the leading exporter of groundnut oil, accounting for 29% of world oil exports, followed by Senegal (14%), Sudan (12%) and China (9%). The European Union remains, in general, the largest market for groundnut oil. In 1999-2000, France imported about 27% of groundnut oil, followed by Italy (16.2%) and China (14%). The figures in Table 6 show that African exporters still hold a strong position in international markets for groundnut oil. During 1999-2000, more than 30% of world groundnut oil originated in Africa.

West African export shares of groundnut oil have decreased from 54.46% in 1961-65 to 20.13% in 1999-01 (Table 7). Groundnut oil imports have also declined during the same period; this is largely due to the rather sharp decrease in Nigeria and Senegal. In other, smaller countries, oil supply is increasing. For example, in Mali, the share of groundnut oil export has increased from 0.22% in 1961-65 to 3.88% in 1999-2001.

The export shares in other oils have drastically declined whereas import shares have more than doubled or tripled in most cases. While West African palm oil exports averaged 25% in 1961-65, it only accounted for 1.27% of the world supply in 1999-2001 (Table 7). Trends for soybean oil have been relatively stagnant. During the same period, palm oil imports have doubled and soybean more than quadrupled from 0.52% to 2.09%. In monetary values, and in nominal terms, the cost of groundnut oil imports to the economy of West African countries is US$ 130 million, and that of soybean imports, US$ 97 million (Table 8).

Groundnut cake

India is the leading exporter of groundnut cake, accounting for 23% of world exports, followed by Argentina (22%), Sudan (22%) and Senegal (15%). The European Union remains, in general, the largest market for groundnut cake. In 1999-2000, France imported about 36% of globally exported groundnut cake, followed by Thailand (19%). The figures in Table 9 show the still strong position of African exporters on international markets for groundnut cakes. During the 1999-2000 period, about 40% of world groundnut cakes exports originated from Africa, with Senegal being the largest exporter.

Confectionery groundnut

International trade in confectionery groundnut grew steadily from the late 1970s to the mid-1990s. Global exports increased by 78% from 679,000 tons in 1961-65 to 1,209,000 tons in 1994-96 (Table 10). During the period, there has been an increasing shift in export from developed to developing countries. In the 1970s, developing countries accounted for 55% of export shares of global exports, which increased to 70% in the mid-1990s. This increase has mostly been concentrated in Asia.

Table 6. Leading world importers and exporters of groundnut oils – world share of oil exports (%).

	1961-65		1971-75		1981-85		1991-95		1999-2000	
Country	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
Argentina	-	12.00	-	10.52	-	10.71	-	19.31	-	28.97
Brazil	-	0.58	-	11.38	-	16.83	-	3.94	-	1.37
China	3.32	3.71	3.31	5.51	8.12	13.52	12.66	12.09	13.58	8.81
Malaysia	1.00	-	0.71	-	0.54	-	0.8	-	1.16	-
France	35.42	-	36.34	-	43.60	-	29.66	-	26.70	-
Germany	9.88	-	12.49	-	6.54	-	6.66	-	6.74	-
Belgium	7.86	-	6.07	-	10.25	-	10.96	-	7.19	-
Italy	0.16	-	4.78	-	7.97	-	14.00	-	16.20	-
Holland	2.13	1.88	2.90	1.94	5.66	5.27	6.76	4.31	4.42	2.91
Switzerland	1.10	-	1.82	-	3.15	-	4.07	-	5.21	-
United Kingdom	12.90	-	11.91	-	3.28	-	2.30	-	1.54	-
Senegal	-	33.05	-	30.98	-	23.11	-	22.99	-	13.69
Nigeria	-	18.32	-	6.49	-	0.00	-	0.25	-	3.35
Mali	-	0.22	-	0.67	-	1.14	-	1.90	-	3.32
Sudan	-	0.11	-	0.70	-	3.55	-	4.80	-	12.21
USA	0.14	3.52	0.04	6.74	0.13	3.34	0.82	12.62	5.88	2.36
World ('000 t)	375748	381533	451362	436468	409847	400940	323528	294896	278484	268886

Source: FAOSTAT database, 2002.

Table 7. Trends in shares of oilseed exports and imports in Africa and selected countries (%).

	Groundnut oil				Palm oil				Soybean			
	1961-65		1999-2001		1961-65		1999-2001		1961-65		1999-2001	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Africa	59.77	4.63	28.95	0.99	50.23	1.99	1.27	9.26	0.00	11.1	0.09	13.42
West Africa	54.46	0.93	20.13	0.71	25.04	0.77	0.99	1.36	0.00	0.52	0.01	2.09
Nigeria	18.32	0.01	2.69	-	23.03	-	0.02	0.64	-	-	-	0.05
Senegal	35.05	-	12.27	-	-	0.02	0.10	0.07	-	-	0.01	1.29
Mali	0.22	0.006	3.88	-	-	0.03	0.04	0.07	-	-	-	-
Niger	1.11	0.101	-	0.09	23.03	0.00	0.02	0.09	-	-	-	-

Source: FAOSTAT database 2002.

Table 8. Oilseed import values (US$ '000) in Africa.

	Groundnut oil		Palm oil		Soybean	
	1961-65	1999-2001	1961-65	1999-2001	1961-65	1999-2001
Africa	6351	1906	2381	669981	19428	602283
West Africa	1279	984	886	129573	1081	97045
Nigeria	4	0	0	66000	0	1810
Senegal	0	6	26	4321	0	42258
Mali	0	0	43	5600	0	0
Niger	106	110	2	13500	0	375
World	129843	227869	136044	6020743	173693	3549913

Source: FAOSTAT database, 2002.

Table 9. Leading world importers and exporters of groundnut cakes – world share of groundnut cakes.

	1961-65		1971-75		1981-85		1991-95		1999-2000	
Country	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
Argentina		8.67		4.08		6.46		9.55		21.92
Brazil		-		-		-		-		-
Chili	0.00		0.00		0.00		0.07		2.19	
Mexico	-		-		-		0.77		1.48	
China		0.00		0.08		0.80		11.28		1.13
Malaysia	0.00	-	0.97	-	2.73	-	5.47	-	1.35	-
Thailand	0.00		0.25		0.40		19.01		18.69	
India	-	46.68		52.31		43.56		45.14		23.03
France	10.12	-	17.64	-	13.05	-	25.88	-	35.56	-
Germany	11.49	-	11.94	-	20.08	-	0.76	-	1.18	-
Belgium	2.44	-	3.12	-	5.23	-	3.05	-	5.98	-
Italy	0.20	-	1.14	-	3.42	-	2.30	-	1.79	-
Holland	2.19	0.44	1.73	0.01	6.19	1.77	2.21	2.66	6.52	3.98
Senegal	-	11.83	-	15.09	-	16.72	-	12.97	-	14.98
Gambia	-	0.50	-	1.36	-	1.46	-	0.99	-	2.19
Sudan		1.82	-	2.19	-	12.05	-	7.77	-	21.60
USA	36.18	0	16.60	0	2.22	3.45	1.50	4.40	6.04	2.46
World ('000 t)	1550229	1465242	1509812	1461178	714442	693821	679127	668319	319112	319112

Table 10. Annual exports and imports of confectionery groundnut (shelled equivalent, '000 t).

	1979-81		1994-96	
	Exports	Imports	Exports	Imports
Developing countries	371.0	90.6	842.4	485.4
Africa	114.7	17.4	62.1	84.4
West Africa	44.2	5.1	42.0	37.6
Gambia	30.0	0.0	23.0	0.0
Nigeria	0.0	0.0	0.00	12.5
Senegal	4.9	0.1	11.0	18.2
Asia	189.4	64.7	603.4	338.5
India	28.4	0.0	102.7	0.0
Indonesia	0.0	7.0	0.0	153.0
Vietnam	11.4	0.0	112.3	0.0
China	116.5	0.0	355.3	2.0
Latin America and Caribbean	67.6	8.3	179.1	62.0
Argentina	50.8	0.0	155.8	0.0
Mexico	0.0	2.7	0.0	43.5
Developed countries	307.6	593.9	366.8	769.7
Canada	0.0	59.2	0.0	82.4
USA	242.4	0.4	189.3	25.1
Europe	17.6	423.4	141.0	581.6
United Kingdom	0.0	81.1	0.0	102.5
France	0.3	104.9	13.3	56.3
Netherlands	11.2	66.5	112.4	219.5
Germany	0.0	49.5	0.0	69.9
World	678.6	684.5	1209.2	1255.1

Source: Adapted from Freeman et al. 1999, p. 24.

Exports rose by three-fold from about 190,000 tons in 1979-81 to 603,000 tons in 1994-96, almost 50% of world export. Export shares also increased in Latin America and the Caribbean, primarily due to shipments from Argentina, accounting for 13% of the world exports. In West Africa, export volume was relatively stagnant. Among the developed countries, USA remains the major exporter of confectionery groundnut. However, its export shares fell, to the benefit of Asian exporters.

During the same period, world imports of confectionery increased twofold from 1961-65 to 1994-96. This is explained by the increased share of developing countries (from 135% in 1979-81 to 39% in 1994-96), with

Asia recording the largest share. The main importers in Asia are Indonesia, Singapore, Philippines and Malaysia.

Fulfilment of the demand for confectionery groundnut has been limited by the stringent quality requirements on the levels of aflatoxin contamination. According to EEC requirements, raw peanuts are required to have levels of total aflatoxin maintained at a maximum of 15 ppb for total aflatoxin, with less than 1 ppb for Aflatoxin B1. The presence of aflatoxin will significantly reduce groundnut exports to the European Union, the main importer of groundnuts. According to Wilson and Otsuki (2001) and Otsuki et al. (2001), if the EC were to reduce Aflatoxin B1levels by one more percentage point, groundnut exports would drop by 1.3%. A similar 10-percentage point drop would reduce groundnut exports by 13%, causing total losses in export revenues for African groundnut producers of about US $ 400 million, and a drop of 64% in total export volumes in cereals, groundnuts, nuts, vegetables and fruits. These new standards also require 8 EU members (Belgium, Greece, Ireland, Italy, Luxembourg, the Netherlands, Spain and Sweden), to reduce aflatoxin contents in their groundnut imports by more than 50%. While the EC's standards are considered too severe, the SPS Agreement still applies, as it "recognizes the rights of member countries to determine the 'appropriate levels of protection' of human health". In fact, the CODEX's standards for aflatoxin contents are set at 9 ppb; based on the fact that only 50-70 % (7.5-10.5 ppb) of total aflatoxin level of 15 ppb is caused by B1.

World prices for major oilseed products

Groundnut is thinly traded in international markets with exports accounting for only 1-2% of world production of groundnut oil and meal in 1994-96. The groundnut market was driven by domestic policies such as quantity restrictions on imports in India and China or price support and quota policies in the USA. Exports from China and the USA fluctuated from year to year and each historically accounted for 5% of world exports. However, the share of the USA has increased by 13% in recent years. Thus, domestic policies contributed to keeping domestic prices high but did not affect the international market (Freeman et al. 1999).

Groundnut oil prices have fluctuated widely over the years, with peaks in 1981 and 1987. This variability is partially due to the thinness of the market, and to climatic conditions and policy changes. Another factor is

substitutability - the price of groundnut oil is more than double that of substitutes such as soybean or palm oil.

Table 11. World prices of major oilseeds.

	Annual average prices in US$ per metric t					
Product	1996	1997	1998	1999	2000	2001
Groundnut meal	212.8	221.0	118.40	-	_	-
Groundnut oil	897.3	1010.4	909.42	787.67	713.7	680.3
Palm oil	530.9	545.8	671.08	436.00	310.3	285.7
Palm oil kernel	-	-	686.70	694.10	443.5	308.1
Soybean meal	267.5	275.8	170.30	152.20	189.2	181.0
Soybean oil	551.5	564.8	625.92	427.33	338.1	354.0
Soybeans	304.8	295.4	245.00	201.65	211.8	195.8

Source: Commodity Price Data Pinksheet - World Bank Prospects. 1996-2001.

Similarly, groundnut meal prices have fluctuated significantly for almost the same reasons as those given above. However, the relative prices of meal are lower than those of substitutes, making it more competitive than soybean meal, for example.

The role of external demand and domestic policies

West African countries lost their share of the world market for groundnut exports in the 1960s, due to pervasive domestic policies such as an overvalued exchange rate, inflated price controls, heavy taxation and poor government marketing. Tax rates ranging from 10 to 30% applied to groundnut exports in Senegal resulted in estimated revenue losses of 20-70%. The Gambia, Mali, Niger, Nigeria, Senegal and Sudan exported 23% of the world's supply of groundnuts in 1961-1965 and captured 62% of the world market for groundnut oil. Senegal alone provided 23% of world groundnut export in the same period. From 1961 to 1967, aggregate exports of unshelled groundnuts dropped by 10%, shelled groundnuts by 15% and groundnut oil by 4% annually for all AGC producers (Badiane and Kinteh, 1994).

Medium-term outlook

Groundnut production in developing countries is projected to grow by 3% per annum from 16 million t in 1990 to 30 million tons in 2010. This rapid growth, which is faster than that of the population, will lead to higher per

caput consumption. The projected growth will differ across regions due to differences in the growth of production, population and income. Population growth, urbanization and income growth will continue to have profound influences on groundnut supply and demand. Groundnut products, as with most oilseeds, have a high-income elasticity of demand, particularly in developing countries. Thus, there is considerable scope for growth in consumption in developing countries where economic growth is expected to be faster (Freeman et al. 1999).

Global trade in groundnut is projected to slow down from the sharp expansion of the 1980s, due to a fall in the demand from traditional importers of groundnut oil and meal in the developed countries. Export growth of developing countries will be concentrated in Asia and Latin America and growth in Africa will be small. Oil imports in Africa will increase slightly as production fails to keep up with population growth. However, groundnut oil will continue to be thinly traded in international markets because the major consumers will rely on their domestic production. In developing countries, policy reforms such as the gradual move from monopoly marketing parastatals and policies that directly or indirectly affect taxed tradable commodities such as groundnut will have a positive effect. Liberalization is expected to continue, leading to a more favorable environment for trade and an expanded role of the private sector.

Projections for 2015 show that there will be greater demand for groundnut products in East and Southeast Asia; the demand for confectionery will increase. There is likely to be a large demand for groundnut in West Africa, especially in Nigeria, with its potentially large regional market.

Regaining production and export market shares

There is potential in West Africa to expand demand through the domestic, regional and international markets. To regain the lost shares, there is a need to assess these markets by a better understanding of market dynamics (including trends and prospects, population growth, tastes and preferences) and requirements (grades and standards, quality). When these are known, seed has to be supplied at low transaction costs through sustainable institutions likely to deliver high quality seed to farmers. To be more competitive, groundnut yield must increase substantially using yield-enhancing technologies including improved varieties and good agronomic practices. There is a continuing need to maintain the pool of germplasm,

and to quickly ensure a consistent supply of varieties with preferred market traits. Interlinks between critical stages of the groundnut sector are presented in Figure 1.

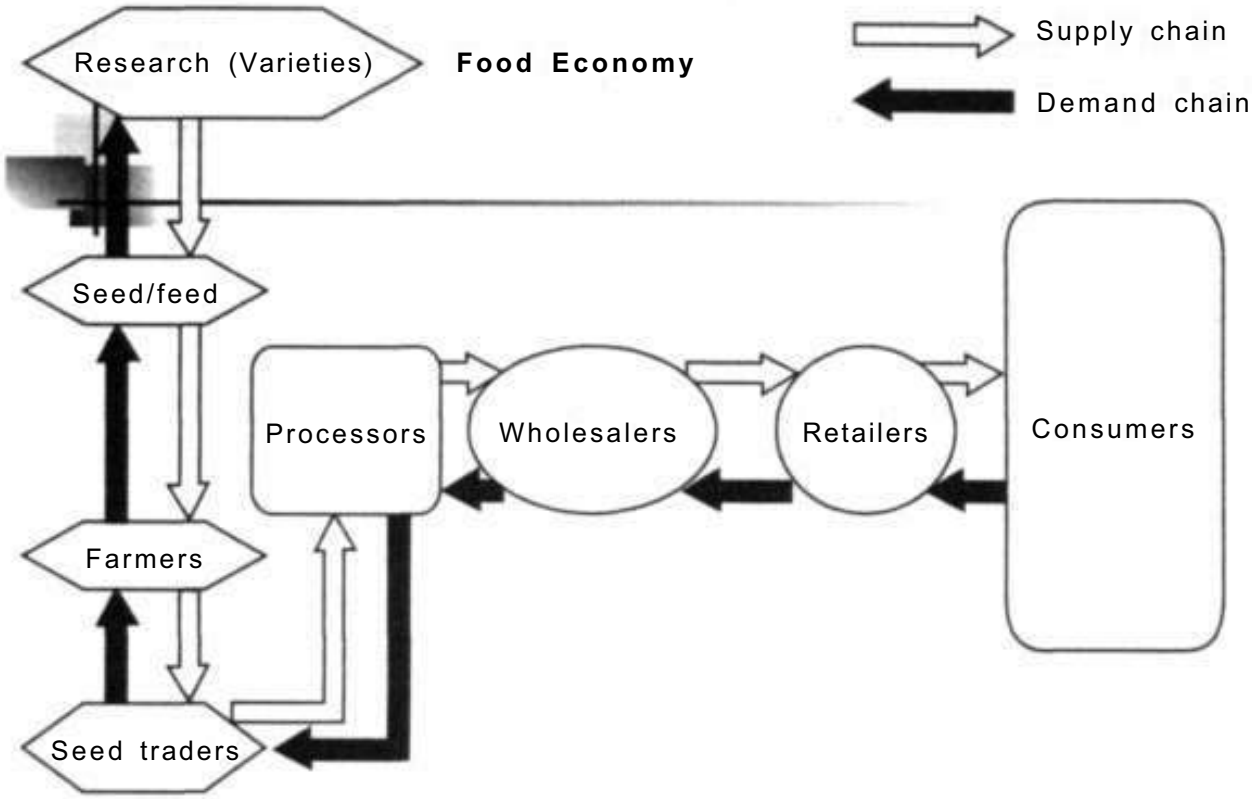

Figure 1. The supply and demand chains in the food economy.

Grades and standards

The groundnut trade is becoming more differentiated. Grades and standards are increasingly important to distinguish the relative values of competing goods. Knowledge of the market requirements is essential for matching groundnut varieties to end uses. For example, the largest red skinned Virginia kernels are used for cocktail- and salted nuts. The medium sized runner and the small Spanish varieties are best for peanut butter, oil and candy. Valencia varieties with long shells containing 3 to 4 kernels each are in demand for roasting in shell.

In addition to these grades, the seed has to meet the minimum safety standards, such as those for aflatoxin contamination. Therefore there is a need to promote technologies that help maintain these standards..

Market arrangements

The groundnut trade in West Africa is often carried out at transaction costs, making the costs of groundnut supply in the domestic, regional and

international market very high. Under such conditions, groundnut becomes uncompetitive. Therefore, there is a need to search for alternative market arrangements likely to reduce transaction costs, such as the development of collection points handled by community-based organizations (CBOs) within the production areas to increase market efficiency. In addition, appropriate market signals (price, supply and demand sources) must be disseminated to farmers and CBOs in order to better target markets and sell the products at the right price. Therefore market information systems are critical.

Building sustainable seed supply institutions

Lack of seed is a major constraint to uptake of modern groundnut varieties. Groundnut has a low seed multiplication rate and the seed is bulky. This results in high transaction costs in handling and transport to serve farmers who are widely dispersed. Therefore, sustainable community-based seed supply schemes to provide good quality seed in proximity to users are essential. Due to its low genetic deterioration, groundnut seed markets may be limited. But there are market niches, which can be accessed through test marketing of small packs of seeds. This is likely to encourage commercial farmers to multiply and package improved seed, which can be sold through rural retail outlets and collection points.

Conclusions

The contribution of the groundnut sector to the economy of West African countries has diminished consistently since the 1960s. West Africa has lost its world production and export shares. The share of West African countries in world groundnut exports fell by more than 50%, while exporters from South American and Asian countries more than quadrupled their combined share over the last three decades. The loss in market share was also accompanied by a continuous decrease in yield and acreage in West African countries, contrasted with strong yield increases in competing Asian and South American countries. It would seem, therefore, that West African exports have suffered more from domestic than external demand factors. The competitive position of West African groundnut exports is declining as a result of limited improvements in production productivity and the inability to meet stricter grades and standards. Producers and traders will need better market information about crop export opportunities, including knowledge of market demand, competitive sources of supply, price trends and quality standards.

Technology and market institutions must improve their responsiveness to changing trade prospects. Varieties suited to the market must be identified, multiplied and disseminated. Market signals must be adequate to encourage farmers to grow the right varieties, and adopt management practices capable of improving productivity, while meeting stricter quality standards. In sum, systems of production and marketing need to be built targeting the needs and competitive circumstances of identified markets.

References

Badiane, O and Kinteh, S 1994. Trade Pessimism and regionalism in African countries: the case of groundnut exporters. Research Report 97. IFPRI.

Delgado, C and Sidi Jammeh. (eds.) 1991. The Political Economy of Senegal under Structural Adjustment. New York: Praeger Publishers.

FAO, Agricultural exports and imports database, (www.fao.org). 04/15/02.

Freeman, HA, Nigam, SN, Kelley, TG, Ntare, BR, Subramanyam, P and Bougthon, D 1999. The world groundnut economy: facts, trends, and outlook. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 52 pp. ISBN. 92-9066-404-5.

IFPRI "Can Regional Trade Revitalize the African Groundnut Market?", Vol 6, No 1, February 1994. (www.ifpri.org/title.asp, 09/06/01).

Kinteh, S and Badiane, O 1990. The market potential for groundnut products facing West African countries and the role of regional markets. Washington, D.C., USA: International Food Policy Research Institute.

Otsuki, T, Wilson, J and Sewadeh, M 2001. DECRG. Saving Two in a billion: A Case Study to quantify the trade effect of European food safety on African exports. Washington DC: The World Bank, 2001.

Schilling, R 2002. L'Arachide de bouche. Unpublished paper. CIRAD.

Wilson, J and Otsuki, T 2001. Global Trade and Food Safety: Winners and Losers in a Fragmented System. Washington DC: The World Bank, 2001.

Groundnut seed supply in West Africa: Evaluation and perspectives for improvement

Robert Schilling[1], Alain Mayeux[2], Richard Jones[3] and Jupiter Ndjeunga[4]

Introduction

Groundnut occupies a special place in African farming systems, especially in the savanna areas, in rotation or in association with the basic food crop. The seed supply within this framework, which is characterized by production in traditional farming systems, is of strategic importance and is a necessary prerequisite to any activity geared towards improving the production and processing chain. Groundnut seed systems in the subregion are rarely efficient, because of lack of suitable alternatives to monopolistic or state-controlled systems, which were costly and inefficient. These were set up after independence, then done away with between 1980 and 1990. The climate of economic liberalization that prevails today has led to recommendations for government withdrawal and the active participation of private seed operators. However, none of the organizations that were founded on these principles have proven themselves. As a result, there is a structural vacuum in the field, which has aggravated chronic seed shortages. This study, based on the experience of GGP operators, is trying to take stock of what has been done as well as outline general guidelines that could lead to improving the groundnut seed production and processing chain.

The systems and techniques for multiplication, storage and distribution of groundnut seed, as they have been defined and set up in West Africa (mainly in Senegal), have been analyzed during a regional workshop held in March 2001. This was followed by a study carried out by FAO and CORAF/WECARD (West and Central African Council for Agricultural Research and Development) in 14 countries in the subregion. The study was undertaken together with the GGP with a view to pursuing GGP activities, placing special emphasis on supporting seed production.

1. Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), Avenue Agropolis 34398 Montpellier Cedex 5 - France.
2. Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), GGP Project Manager, BP 6478 Dakar Etoile, Senegal.
3. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), P.O. Box 39063 Nairobi, Kenya.
4. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Samanko Station, BP 320 Bamako, Mali.

Overview of basic agronomic data and their impact on seed production

Groundnut seeds are expensive, heavy, large and fragile. They can become rancid and are sensitive to heat, humidity and various storage pests. Their hull does not provide adequate protection against these threats.

Under the prevailing conditions in West and Central Africa where yields rarely exceed 1 t (pods) ha^{-1}, seed viability is a function of climate (negative impact of drought), soil fertility (the importance of calcium nutrition), phytosanitary protection and postharvest technology (proper curing, stripping, sorting, storage and packaging). The optimal use of selected seeds that have been evaluated by agronomic research services in Senegal cause average yield to be increased by 35% when compared to the mixed kernels most often used by farmers as seed. However, the semi-strict autogamy of groundnut simplifies the multiplication process.

The spontaneous dissemination of improved varieties and the uncontrolled reconstitution of seed stocks in traditional rural systems can eventually function for basic cereals (especially pearl millet and sorghum) whose seeds are small, robust and drought tolerant. The reconstitution of seed capital therefore does not pose a problem except in case of major natural disasters. Four kg of pearl millet are required to sow a hectare. Seeds can be sown dry, and in case of failure, farmers can easily obtain more seed. The case of groundnut is very different: it has a high market value and 100-150 kg of seed is needed to sow one hectare. This explains the findings of an ICRISAT study where the annual average for seed commercialized from 1990-1998 in Senegal was 15,217 t of groundnut seed compared to 55 t of millet seed for essentially the same acreage. For groundnut, this causes problems in terms of storage, financial insolvency, poor sprouting after planting, and crop destruction by drought or epidemics. It is very difficult for farmers to begin again, in the same year, if they depend only on their own means. The availability of good quality seed in the quantities required by its exceptionally low multiplication rate (less than 10 in traditional farming systems) is therefore the main constraint to groundnut production, especially in dry areas. As a consequence, a smaller area will be sown with lower quality seeds in the year that follows a mediocre harvest. In light of this observation, from a technical point of view, groundnut seed production must be based on three main points:

- Regular periodic renewal of farmers' seed capital.
- Centralized management of a security stock to face climatic or other disasters, to which groundnut is particularly sensitive.
- Assistance with storage and protection of seeds in traditional rural systems.

Any sustainable action in favor of the African traditional farmers who produce groundnuts must focus on the farmers themselves, the main stakeholders in the seed sector. This has been brought about because of the frequent failure of seed projects that were too directive, and whose impact rarely survived the external funding that initiated them.

The situation in the subregion

Quantitative data

Annual seed requirements, and therefore the amplitude of farmers' efforts, can be estimated from groundnut production data from countries in the area covered by WECARD and GGP (excluding D R of Congo). Estimates are based on an average of 120 kg ha^{-1} of seed (Table 1); therefore a seed capital of 600,000 t is sown annually. If a renewal rate of one-third is applied, this is generally considered as the minimum required, maintaining varietal quality and the physical characteristics of the product in traditional farming systems. In order to meet consecutive local deficits, natural disasters, and losses due to pest attack, the quality of up to 200,000 t must be improved annually to regulate production. These estimations highlight the importance of the stakes at hand, even if only operations that provide incentives, information and support are considered, excluding any direct management of seed capital.

The annual rate of growth for production between 1979 and 1986 was 3.7% for West Africa compared to 3.2% for world production; however the relationship is reversed when growth in the acreage under cultivation is compared (2.4% versus 1.3%, Figure 1). This phenomenon underscores the intensification of the crop in the subregion, resulting in the impoverishment of the soil linked to inadequate management of soil fertility with organic material and chemical fertilizers.

Table 1. Groundnut production in the area covered by WECARD/GGP.

	Acreage harvested ('000 ha)[1]	Yield (tha^{-1})[1]	Annual rate of expansion of area under cultivation[2]	Production ('000 t)[1]
Benin	111	0.8	2.6	88
Burkina Faso	261	0.8	2.7	215
Cameroon	363	0.3	1.9	124
CA Republic	91	1.0	0.1	87
Chad	305	0.8	11.5	233
RCI	140	1.2	S.7	144
The Gambia	73	0.9	-2.2	67
Ghana	177	0.9	2.5	159
Guinea	145	0.9	6.3	132
Guinea Bissau	16	1.1	-3.7	18
Mali	204	0.9	3.0	180
Niger	230	0.4	10.0	93
Nigeria	1868	0.9	10.4	1770
Senegal	863	0.8	0.2	686
Togo	87	0.5	-6.0	40
Total	4934	0.8 (average)		4036

1. Mean data 1994-96

2. Mean data 1987-96

Source: FAO and ICRISAT

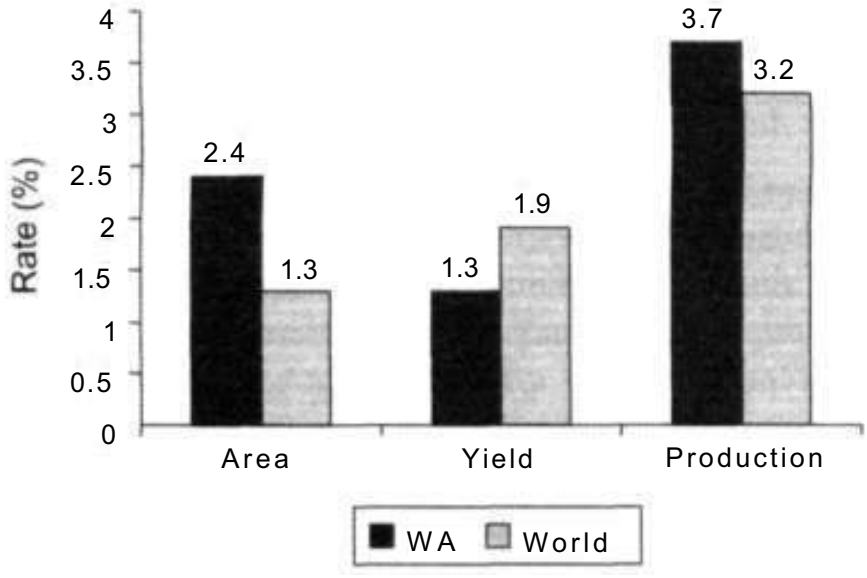

Figure 1. Annual growth rate of groundnut production 1979/1996 (Source: FAO).

Components of an official production scheme

A theoretical system for the production/dissemination of improved seed, declared or implemented in the countries participating in the 1999 study, comprises 6 main functions:

- Selection of adapted varieties
- Production of initial material initial called *pre-foundation seed*
- Controlled step-by-step multiplication until certified seeds are obtained
- Inspection at all levels (varietal purity, viability)
- Supplying users with required quantities of last generation seed
- Coordination of the various interventions

This series of interactive operations involves a great diversity of operators (including financial operators) and so the program must be properly vertically integrated. Public operators carry out the first two functions to varying degrees. The last two functions are not satisfactorily filled in any country. Existing systems are generally incapable of reducing the lag between seed demand and supply as well as ensuring a good transmission of seed value from one generation to the next. Kernels kept back on the farm, bought from local markets, or transferred from one farmer to another are the most widespread forms of dissemination of germplasm used as. seed. In terms of quantities, the shortage of seed is the main factor, which limits the expansion of acreage as a means of increasing productivity. The cause and effect of this situation must be analyzed before suggestions for an eventual reorganization can be made.

Evaluation and diagnosis

The shortcomings in coordination and the lack of means compared to stated policy has led to deficiencies and malfunctions at several levels:

- Agronomic research systems only partially meet the needs of the seed sector: the range of varieties available correspond well to certain major biotic and abiotic constraints (drought, viral diseases, ecological adaptation) as well as main market demands (oil factory, edible groundnut). However, little effort is made to improve postharvest seed technology in traditional farming systems (shelling, sorting, treatment, packaging, individual or collective storage, and means of collection and inspection). Multidisciplinary coordination of these programs by research is lacking.

- The legislative and organizational aspects are not well adapted: seed regulations and policy enacted in the countries in the subregion, patterned after the laws in practice in countries where intensive production is practiced, are rarely implemented because they are not precise or well adapted to local conditions. In addition, the dispersion and the discontinuity of efforts aimed at improving seed systems, linked to the intermittent and badly coordinated nature of the projects that were assigned to them at the will of the donors, partially explains the weakness of the results obtained. Credit and financial systems, which facilitate access to inputs, are often out of the reach of small farmers.
- Most of the seed capital in the subregion is supplied by the informal sector in the form of unsorted mixed kernels. The production capacity of the official sector rarely exceeds 5% of national capital, in spite of considerable financial efforts devoted to it. Senegal is a noteworthy exception where the level at which its requirements for improved seed were met actually decreased from 1985 to 2000. The professional level of private operators involved in the sector is generally insufficient, because of low profit margins.
- The production capacity for foundation seed assigned to agronomic research is too low, and the quality is sometimes mediocre. This limits the production of the genealogical levels that follow, and the generations must be multiplied, which increases the risk of varietal mixing. The top to down coordination of the successive actors has not been successfully ensured. Other factors such as inadequate forecasting of needs and means, ruptures in the genealogical line, lack of respect for the optimal geographic distribution of varieties, and genetic dilution of varietal characteristics and technological research, have aggravated a chronic deficit.
- The great majority of farmers in West and Central Africa produce their own seed or buy mixed kernels from the informal market. Far from being insignificant, this sector supplies more than 90% of the seed capital; it must also be taken into account that the "official" sector often supplies only recycled mixed kernels. Any activity for rehabilitation must focus on improving the production capacity and seed self-sufficiency by proposing high-performance varieties and helping the farmers to multiply these under good conditions. At present, this is not the case. Uncontrolled transfer (cession) very often leads to rapid degradation of varietal purity and the technical quality of the initial germplasm, which is multiplied without the necessary precautions being taken and under conditions of chronic shortages.

The entire subregion has been through at least a decade of state-run systems, where seed production was placed under the formal authority of specialized Services and Organizations (these were rarely given the necessary means). This is now giving way to a liberalized system where private operators must succeed the withdrawal of the government. In fact, the universally expressed need to open the groundnut seed sector to private enterprise, and deduct the finances needed to run the upstream operations of research and inspection from professionals, has not yet led to a satisfactory solution. The profit margins likely to promote investment from international seed professionals would lead to prices that are too high to interested users. Under these conditions the seed trade, as it exists in certain countries, does not reveal a real professionalism. Users do not feel that the certified seed offered to them, including those offered by research stations or multiplier organizations, are of better quality than the mixed kernels they buy on the local markets. They can supply themselves in their immediate vicinity, at lower cost. Selected seed of good initial quality, introduced without control into such a system, lose their characteristics and become diluted in less than three years.

The development of the seed sector in Senegal

The Senegalese experience in the groundnut seed sector can serve as an example of development of the seed sector. Until 1985, almost all of the national requirements (an average of 120,000 t per annum) were covered by a seed system, which was set up in 1972. This system was integrated technically and financially into a groundnut production and processing chain under government control. This system ensured controlled genealogical multiplication of foundation seed supplied by research, and was carried out in association with a network of farmers. Storage, inspection and annual distribution were then undertaken. The multiplication was scheduled based on precise estimations of needs, in accordance with a variety map, which was periodically updated with regard to new varieties from research and the strategy designed by decision-makers. Security stocks stored in refrigerated warehouses, which could be used to restart operations in case of natural disasters, completed the system. This actually took place on several occasions. Agronomic research played a deciding role in the conception, followed by the implementation of this structure. Many countries (Niger, Mali, The Gambia, Chad, Mozambique, Guinea-Bissau and Botswana) were inspired by it with various modalities and degrees of success. These

activities were not sustainable because of a lack of financial continuity on one hand, and political commitment on the other.

The private operators involved in the seed sector in Senegal include UNIS. UNIS is divided into four areas, each governed by an elected Board (Bureau), which is under the authority of an Administrative Council and a National Board of Directors. UNIS manages 300 warehouses, each serving a multiplication area. Each warehouse has a technical support team and has signed agreements with financial institutions. UNIS works in close association with research organizations, where it places firm annual orders for foundation seed. It also works closely with the official seed inspection services. Members of UNIS, called Seed Operators (SO), can either be individuals or groups of several producers, and operate privately in the seed sector or for other agricultural inputs. Each SO is in the vicinity of one (or several) seed warehouse(s), which s/he uses as a marketing outlet. S/he defines seed requirements of the area, related to the number of contract farmers, while respecting the variety map. S/he takes on the responsibility for his/her own functioning and contributes to UNIS' autonomous budget, which additionally benefits from temporary assistance from the European Union within the framework of a program to revitalize the groundnut industry, which is financed under the funds for aid to export commodities (Stabex).

Conclusion

The distribution of improved seed, onerous for both the state and the user, must bring an improvement that is farmer-friendly. It can only be implicated in the production of a small proportion of the seed capital, where the farmers ensure their own seed multiplication while respecting a coherent genealogical program. The variety catalog must offer a wide range of varieties from which the producer has the option to choose. Adequate quantities of seed of recognized quality must be available at the right time, in proximity to the place where they are to be used. The buyer must be well informed and sensitized as to multiplication programs, new varieties, marketing outlets, and means of credit and prices. S/he must be able to provide the agronomic requirements of the seed in order to fully realize its genetic potential: sowing on the right date, right depth, proper density, fertilizer application, harvest at complete maturity, and postharvest operations properly carried out.

The seed sector, which occupies over 10% of the area cultivated with groundnut, is an excellent tool for the transfer of technology for improved

production techniques, especially since seed farmers under contract will be widespread within the farmer population. Seed-producing fields must be optimally set up in order for them to be convincing. This is currently not the case, including in Senegal, where most seed fields are not fertilized and do not receive the application of calcium recommended for seed production.

General directions for groundnut seed production in African traditional farming systems

The experience gained has enabled several technical orientations to be identified. These can inspire an organized action plan for production of groundnut seed in West and Central Africa. Such a plan will aim to give farmers a sense of responsibility within a sustainable system, while distinguishing measures to be implemented at the subregional level from those that will revive national structures and policies:

- The lessons learned, expertise, and operational mechanism of GGP (collection, network for multi-location trials, distribution of first generation seed, and aids for the dissemination of information) make up the scientific capital and lay the foundation for support activities for seed production. These activities must be consolidated into a permanent regional body with reception facilities.
- The systems that have been sustainable in the subregion were based on the following principles:
  - Defining and setting up a management scheme for genealogical multiplication, specifying production standards that correspond to each generation and the predicted quantities evaluated as a function of expected seed capital.
  - Centralized management of the first generations to be multiplied and inspection services, management of seed policy through the development of a variety map, and management of a security stock to meet uncertainties and ensure renewal of seed capital.
  - Controlled private sector intervention for multiplication in one or several generations of seeds supplied by research by different mechanisms involving NGOs, cooperatives, and multiplier networks, and eventually irrigated areas (about 10% of annual capital, Table 2).
  - On-farm production of the last generation of the genealogical sequence, with technical backstopping for farmers for this production, which represents 90% of seed requirement.

- Any sustainable seed production system must be based on a coherent genealogical approach going from breeder seed to seeds used by the farmer. The basic theoretical scheme for a program of 10,000 t to be produced in traditional African farming systems and under the simplified hypothesis of a 10-fold multiplication factor is given in Table 2. The means of application are evidently variable according to the diversity of the situations.

Table 2. Theoretical genealogical scheme for seed multiplication.

Main operators	Research			NGOs, private operators, farmer groups and associations						Farmers
Level of multiplication	Breeder seed	Pre-foundation	Foundation	M1	N1	M1	N2	M2	N1	N2
N-6	10 kg									
N-5	10	100 kg								
N-4	10	100	1 t							
N-3	10	100	1	10 t						
N-2	10	100	1	10		100 t				
N-1	10	100	1	10		100		1000 t		
Year N following	10 kg	100 kg	1 t	10	t	100	t	1000	t	10 000 t

In this situation, six generations are therefore necessary to go from 10 kg of breeder seeds to the 10,000 t that will be sown in the fields. Appropriate production methods and different quality standards were applied at each successive level. These have been tested and described, and justify the choice of specialized operators and the application of differential pricing which takes into account the demands and constraints encountered at each level. The whole system will be carefully managed, variety by variety, in order to adjust the supply to the demand at each multiplication level and to ensure that farmers have access to varieties that are adapted to local conditions and cultural choices.

- Special attention will be given to the intermediate stage of multiplication: the one that leads to the production of 10% of the end of program target of 10,000 t in 3 generations (on average), i.e. 1000 t per year. This production will be given to specialized operators, NGOs, qualified private professionals and farmer groups. The last generation

leads to 10,000 t, representing 90% of the total (level 2). This will be directly carried out either by farmers from "mini-doses" multiplied twice in individual seed fields or by various local groups (seed production units, village warehouses, authorized salesmen and agro-industrial operators associated with the production).

- In all cases, public sector intervention will be limited to key areas of breeder seed, coordination and inspection. Quality standards will be set depending on the technical level and the investment capacity of users. They must not have a perfectionist goal of equaling international standards and reject entire batches when climatic conditions are difficult, or impose selling prices that put certified seeds out of the reach of small producers.

Progress is linked to involving farmer organizations supported by selected partners (NGOs), within the framework of an interprofessional, which insures vertical coordination of the various participants through a simple structure. Private sector involvement, which is very limited today, is still not very motivated by the long-term production stakes and can only develop progressively in the subregion.

Bibliography

Mayeux, A, Dasylva, A and Schilling, R 1997. La production de semences d'arachide en Afrique de l'Ouest. Agriculture et Développement, Juin 1997 n° 14: 22-30.

Mayeux, A (ed). Technical guidelines for the production, storage and distribution of groundnut seed in traditional African farming systems (GGP workshop March 2001): GGP, BP 6478, Dakar-Etoile, Senegal.

Ndjeunga, J, Kumar Anand, K and Ntare, BR 2000. Comparative Analysis of Seed Systems in Niger and Senegal, ICRISAT Working Paper Series no 3, 31 pp.

Gaye, M "Les producteurs d'arachide face au problème d'approvisionnement en semences", Arachide infos n° 4 pp. 15-17 December 1992.

Freeman, HA, Nigam, SN, Kelly, TG, Ntare, BR, Subrahmanyam,P and Boughton, D 1999. The World Groundnut Economy. Patancheru, AP, India: International Crops Research Institute for the Semi-Arid Tropics. 48 pp.

Schilling, R 1997 " L'arachide ", Maisonneuve et Larose, Paris, collection Le technicien d'agriculture tropicale, 171 p.

Session IV
Groundnut Seed Systems

The groundnut seed system in Mali

Ondié Kodio[1]

Historical background

The Government of Mali places special emphasis on selected seed since quality seed production on specific stations began in 1964, even before the creation of the Selected Seed Production Project in 1997, which was set up as part of rural development activities initiated after many years of drought.

After a decade of activity, producing under direct management, this structure has demonstrated its limitations and is faced with constraints at several different levels (organizational, technical, institutional, financial and economic).

Discussions/reflections on the inadequacies of the Operation of Selected Seed Production (OPSS) led to the development of a management scheme for seed activities called the Plan Semencier National (National Seed Plan, NSP). The NSP defined an overall policy for the country in terms of seed production and distribution, the proper implementation of which requires the full participation of agronomic research extension, seed services and users. In 1991, the scheme for production of selected seed was converted into the National Seed Service (NSS). The first efforts at seed production focused on food crops (pearl millet, sorghum, maize and rice), groundnut and cowpea. In spite of all the changes in seed policy, the government was not able to reach its expected objectives due to the following factors:

- Poor planning of the production of selected seed because of incorrect estimation of requirements.
- Centralization of orders at the headquarters of the NSS, which did not allow timely redistribution due to logistical problems.
- Inadequate seed production.
- A time lag between agronomic research and the NSS for proper renewal of selected seed.

The NSP is of top priority today because of the critical role of seed in future prospects for increasing agricultural production. The improvement of

2. Institut d'Economie Rurale (IER). Groundnut agronomist BP 281 Kayes, Mali.

the seed policy, in all its forms, is of utmost importance for Mali to make the most of its production potential.

Objectives of the National Seed Plan

The objectives of the NSP are to:

- Define and implement a seed policy and coordinate all initiatives in this area as well as the role of different partners in terms of seed production, collection, storage and distribution
- Organize foundation seed production with the involvement of village organizations and private enterprises that meet the demands of seed production, with the withdrawal of the government at the R1 stage
- Ensure implementation of the main thrusts of the seed policy in the following areas:
  - The choice of varieties
  - Organization and training of managers and farmers and seed distribution
  - Intensification of seed requirements in the field and the adaptation of supply to meet demand through appropriate scheduling
  - Creation of security stocks at all levels to alleviate difficulties related to natural disasters
  - Development of structures for conceptualization, direction and management of the seed production and processing chain
  - Implementation of seed legislation and regulation
  - Definition of a pricing policy at all levels of production and constitution of funds for the circulation of capital as well as a seed fund that will ensure sustainability of the system

Components of the NSP and their involvement in the system

The scheme for the conceptualization, the coordination and the management of the production and processing chain is structured in the following way:

National Seed Council

The National Seed Council (NSC) is an organization in charge of advising the Minister of Agriculture on the definition of seed policy.

National Variety Committee

This structure arises from the first and has a more restricted role which includes the following:

- Definition of seed production targets in terms of species and varieties.
- Determination of the quantities and acreage under production with regard to requirements assessed in the field by the revenant authorities.
- Updating the National Catalog of Varieties ratified by the National Committee for Agronomic Research.
- Development of a distribution plan for the seed produced.
- Defining and agreeing upon the specifications for certification of selected seed.

Agronomic research

Agronomic research is responsible for the selection of high-performance varieties that are adapted to the relevant ecological conditions, evaluation of their adaptation to different locations, and conservative selection until the prefoundation or foundation level, depending on the species. The ordinary production chain then continues with production of the other levels.

National seed service

Current seed policy is in keeping with a general scheme that the NSS develops in collaboration with other organizations, notably the IER, rural development organizations, farmer organizations and NGOs.

The role of the NSS is to coordinate and manage all the seed programs. It acts as the technical secretariat to the NSC and it follows up decisions taken at this level. It is therefore responsible for the implementation of these decisions. It is also in charge of providing appropriate technical backstopping to the different seed production units (foundation seed, RI and R2). The NSS is part of the Direction Nationale de l'Agriculture (National Agricultural Management Board). It directly supervises seed production centers at all stages of multiplication.

Structures for development

These must assist the NSS with the successful implementation of the country's seed policy since the main stakeholders are the farmers who benefit directly from technical backstopping from the NSS. For this reason, these structures are asked to:

- Give seed the place it merits in the process of development.
- Master and communicate the real needs in their areas of intervention for rational production and distribution of selected seed.
- Ensure the promotion of selected seed using all adequate means of popularization.
- Assist with the production and distribution of quality seed through farmer organizations, individual farmers and NGO volunteers.

Seed regulation and control (LABOSEM)

The seed laboratory is in charge of field inspection, laboratory testing and certification in keeping with regulations and defined technical standards.

Distribution and promotion of seed

Seed is currently distributed and promoted under the auspices of the Opérations de Developpement Rurale (Rural Development Operations) without real coordination. The organizational effort must be defined.

Seed multiplication scheme

Production of prefoundation seed (stock seed)

Groundnut is almost completely autogamous, which leads to limited genetic erosion. In Mali, two main approaches are used:

- The characterization and valorization of local and introduced germplasm.
- The creation of genetic variability through interbreeding.

Existing genetic variability is exploited or improved by mass selection (the seeds from the best plants of the plant population are kept for improvement) or genealogic selection (following the development of the offspring to identify the most favorable combination of characters).

This selection phase is followed by comparative tests in order to eliminate germplasm with poor performance and check the homogeneity of the lines. This is done through micro-trials, which allows choices to be made between similar germplasm, and then in multi-annual field trials. Multi-location trials are then set up with the best lines and controls (checks) for productivity or resistance, according to the objective of the selection, for a certain number of years (a minimum of 3 years). It is not until the end of the long process that research will transfer the best varieties to extension services to be multiplied by the Seed Services. This constitutes the starting point for seed production. These seeds are multiplied for one or several

generations, either directly produced or inspected by the breeder. They serve as the stock for foundation seed. Generation 0 (G0) is therefore made up of the seeds from all the initial plants.

Foundation seed

These come from a certain level of seed multiplication, which first originates from the harvest of stock seed or those from the initial plants or G0, retained and conserved by researchers (breeders). The production of foundation seed based on genealogical affiliations is normally carried out over a four-year period from G0.

The first generation (G1) is the offspring of G0.
The second generation (G2) is the offspring of G1.
The third generation (G3) is the offspring of G2.
The fourth generation (G4), the offspring of G3, usually constitutes the foundation seed.
When necessary, G1, G2 and G3 pre-foundation seed can also be certified as foundation seed.

Within the framework of Mali's National Seed Plan, the stock seeds GO to G4 are uniquely from agronomic research. It is up to the Seed Services to ensure production of foundation seed as well as R1 production on special seed farms or related farms, and R2 by seed-producing farmers.

Commercial seed

These are seeds that are marketed for crop production, but which have not been produced in the framework of a certification system.

Means of purification and genetic control

A priori testing

Tests are conducted by the official seed inspection service with the aim of controlling the description given by the breeder of his/her strain (cultivar) especially with regard to the identification, homogeneity, stability and crop value.

Post priori testing

Tests are conducted by the official seed inspection service by planting samples collected from batches of certified seed, with the aim of controlling seed origin, varietal identity, etc.

Field inspection

Seed-producing fields are regularly inspected, to check that recommended standards are applied in terms of:

- Seed origin
- Preceding crops
- Isolation - minimum separation distance required to avoid undesirable crosses
- Elimination of off-type plants, dangerous vegetative organs, other species of cultivated plant species, and diseased plants
- Proper harvesting
- Phytosanitary conditions

Laboratory testing

The control of seed quality in the laboratory aims to determine the definitive value of the seed with regard to:

- Varietal purity
- Specific purity
- Seed viability
- The level of weeds
- Water content
- Phytosanitary conditions

Seed certification

This focuses on assuring the legal and official maintenance and propagation of quality germplasm. It is based on the result of field inspections and laboratory testing which culminates with affixing a label or certificate specifically stating certain characteristics determined by the analysis of samples. This provides all the information and allows identification of the product, delivered for commercialization in an inviolable sealed package.

Evaluation of seed requirements

A determination of seed requirements was conducted for all levels of production (foundation, R1, R2) with the collaboration of all the stakeholders and these needs were translated into seed multiplication programs. The annual implementation of these programs took place, either at the level of the NSS satellite farms (foundation and RI) or by farmers at the village level (R2), with support from the NSS.

The scheme seems to be working; however, each level still requires support and reorganization. An independently managed production unit for foundation seed must be created under the responsibility of the seed services, and the satellite farms must be reorganized. Individual seed farmers and cooperatives located in isolated areas must be followed more closely by the Organizations of Rural Development (ODR) in direct collaboration with the NSS.

The development of a network of demonstration fields will facilitate basic farmer training, and extension programs will be better appreciated. The NSC sets the production targets for annual programs. This production, at the different levels, will be bought at a predetermined guaranteed price.

Strategy of the national seed plan

Constraints

Many difficulties are encountered at different levels of the groundnut production and processing chain, related to both production and sale. These are:

- Organizational: lack of adequately trained personnel to meet the needs of the different stakeholders involved in the industry.
- Financial: the total absence of funding for necessary infrastructure and equipment. There are financial difficulties that hamper the production of foundation seed. Management and cash flow problems also impede the ease of seed circulation.
- Promotional and sometimes climatic: the popularization network of the ORD lacks the means and is not experienced enough to sufficiently promote improved seed to farmers. The lack of farmer training must also be taken into consideration. It must also be highlighted that seed production under rainfed conditions can sometimes be very risky.

Problems with the interdependence of stakeholders

The choice of elements for a seed selection strategy not only directly interests and influences the fundamental decisions and actions of the Ministry of Rural Development, which represents the government, but also affects a number of Malian institutions and projects involved in seed production, dissemination and use of selected seed. More specifically, several structures are involved in the system for the production of selected

groundnut seed, as outlined above. The propositions put forward must be the subject of an in-depth consultation between all interested parties in the NSC.

Future prospects

In order for the scheme to be more sustainable, realistic seed production strategies must be devised. We think that involving farmers (farmer organizations, NGOs etc.) in the system appears to be the best adapted solution since production in close proximity greatly reduces the cost of production and assures better dissemination of seed.

A holistic training and teaching program in seed technology must be provided.

The extension service must concern itself with the dissemination of selected seed. This is the main production factor and the easiest to carry out when selected seeds of high-performance varieties are available for distribution, without forgetting the accompanying technical package. This dissemination will be facilitated by the right policies and prices, as well as by the general philosophy for the transfer of seed technology.

Moreover, the availability and circulation of funds is indispensable within the framework of the general scheme for the production of R2 seed by seed farmers grouped into well-managed cooperatives or village associations.

The groundnut seed production system in Niger: Moving towards a viable and sustainable production and processing chain

Issoufou Kapran[1]

Introduction

Food shortages are common in the Sahel, of which Niger provides the best illustration. In fact, food crises have become an almost permanent fact of life here, especially because of reduced production of Niger's four principal food crops: pearl millet, sorghum, cowpea and groundnut. The agricultural system here is essentially rainfed and small farmers cannot invest in inputs that would sustain production greatly handicapped by hazards (low and erratic rainfall, poor soils). In short, food crises are both the consequence of and the precursor to seed crises.

In addition, resolution of food shortage problems must take into account the distribution of adapted, improved varieties. It is therefore critical to make the distinction between seeds and kernels and take the necessary steps to ensure that good quality seeds are readily available to those who need them, based on an organization that will encourage the development of a viable and sustainable seed production and processing chain. The convergent conditions toward such a system are contained in the recent developments in the Niger's seed systems, with particular impact on the training of certain organizational initiatives taken by key stakeholders in the agricultural and seed industries.

Overview of the seed industry in Niger

The unavailability of improved seeds is chronic in Niger. Table 1 indicates the minimum seed requirements of the country. The quantity of seed required to cover only 10% of the acreage under pearl millet (at 3 kg ha^{-1}), sorghum (6 kg ha^{-1}), groundnut (30 kg ha^{-1}) and cowpea (15 kg ha^{-1}) may seem negligible, but the fact remains that at no time are they available anywhere in the country.

1. Institut National de Recherches Agronomiques du Niger (INRAN), BP 429 Niamey, Niger.

Table 1. Estimated minimum seed requirements in Niger (10% of acreage planted).

Species	Seed requirement (metric t)	Estimated yield (kg ha^{-1})	Surface area required to produce seeds (ha)
Pearl millet	1315	2000	658
Sorghum	1240	1500	827
Groundnut	3200	1200	2666
Cowpea	3225	1000	3225

In practice, most farmers use kernels from their own fields, from their neighbors, or those obtained on the local market, as seed. During times of chronic shortages the government buys kernels from local markets or from abroad and distributes them to farmers as emergency seed. As a measure of the scope of this activity 2800 t of sorghum and pearl millet 'seed' was ordered in 2001. In 2002 the government has ordered 1661 t of sorghum and pearl millet 'seed' and has distributed it to 1,667,800 inhabitants for emergency use. Plants grown from seed, which is often of very poor quality, are generally ill adapted and consequently give low yields, which discourages traditional farmers from even the idea of improved seed. In such a system, seed quality and varietal suitability takes second place. Moreover, this system gets in the way of the distribution of highly productive varieties and hybrids developed by researchers, and so hinders significant improvement of national production. Having said that, at least the following benefits can be obtained from the use of improved seed:

- Improved farm management, since improved varieties respond better to inputs
- Increased income for farmers
- Considerable increases in yields, leading to better food security
- Increased grain production, which will probably lead to the development of food processing industries, including animal feed, composite meals, confectionery and breweries
- Reduction, or even elimination, of food imports

Modern seed production in Niger was especially visible with the National Cereal Project (PCN - Projet Céréalier National), which targeted the supply of a small percentage of seed requirements after the drought in the 1970s. These efforts established seed centers throughout the country; however, the government has since then decided to withdraw from the seed sector.

The National Institute of Agronomic Research of Niger (INRAN), responsible for varietal improvement and production of foundation seed, for a long time multiplied small quantities of too many varieties, with the expectation that the national seed service would assure or supervise the other levels of multiplication. This has not been done because of a lack of means, and the absence of any coherent seed-producing activities in the country. The varieties multiplied were not accessible to farmers or did not really reflect their needs.

Initiatives for a viable and sustainable seed scheme in Niger

The target objective is a stable seed production mechanism that can equally satisfy current needs as well as provide for emergencies. Table 2 gives an indication of various efforts made recently or that are currently in progress in Niger, which can lead to a rapid improvement of the national seed system.

The following necessary stages must be mastered well enough in order to set up an operational seed system.

Seed production

Routine economic seed yields must be established. In Niger, a substantial effort in crop management will be the deciding factor.

Sorting and conservation

These contribute to obtaining high quality seed. Experience has shown that traditional farmers are very much aware of the importance of quality.

Quality control (seed legislation and certification)

This is an independent means of ensuring that good quality seeds are produced.

Marketing

Marketing tools and strategies must be used to ensure that improved seeds are widely distributed. Table 3 gives an indication of the roles that the Government and the private sector can play in order to achieve the following objectives, which focus on the development of a seed industry.

Table 2. Some stakeholders and approaches to seed production in Niger.

Stakeholder	Advantage (s)	Limit (s)
Farmers using traditional practices	Proximity to seed, low costs	Lack of access to improved varieties, overly sensitive to natural disasters
Farmer seed cooperatives (G Iddar, Saé, Saboua, Maizabi, Tera)	Well-managed production of large quantities of quality seed	Low capacity for commercialization
Sadia rice farm	Well trained farmers; steps in the production and processing chain followed well	Limited to rice
APPSN (Association of private Seed Producers of Niger)	Expression of real market needs for seed	Very new
AGRIMEX (private agricultural inputs company)	Excellent marketing network, especially for vegetable seed and phytosanitary products	Not very active in production
National Cereal Project (1976-1983)	Infrastructure for seed treatment and warehousing	Not sustainable, cannot function as a company
ONAHA Seed Project (wheat and sorghum, 1998-2000)	• Promotion of seed self-management • Follow-up of farmers	• Limited to needs for irrigation equipment • Lacks commercial ambitions
Project Inputs	Promotion of inventory credit (warranty) and self-management	Activities focus on fertilizer rather than seed
NGO Afrique Verte (cereal seed loans)	Favors direct marketing among producers	Quality control is not demanded
SIM (System of Information on the Markets)	Good knowledge of cereal offers throughout the country	Not directly concerned with seed
INRAN/US	Production and promotion of good quality foundation seed and farmer training/self-management	Insufficient infrastructure/ equipment
INRAN/INTSORMIL/ WINROCK-On-farm Project	Improvement of multiplier farmers' technical skills and income	• Low investment capacity of farmers • Short life span
FTDA/INRAN/ ICRISAT Project	Good knowledge of varietal choice and good management of multiplier farmers	• Low capacity of multipliers for commercialization • Short life span
CCFAN	• Partnerships between farmer organizations, private seed operators, NGOs, extension service and agricultural research • Model for a national consultative structure	Very new

Table 3. Areas of public and private sector intervention in the seed industry in Niger.

Activity	Sector responsible		
	Private	Joint	Public
Research		√	√
Breeder seed			√
Foundation seed		√	√
Commercial seed	√ hybrids	√ hybrids and PL	√ PL varieties
Demonstrations	√	√	√
Good knowledge of the seed demand	√	√	
Certification/seed regulation and laws:			
- preparation		√	√
- implementation	√	√	√
Handling and packaging of seed	√	√	√
Seed storage	√	√	√
Commercialization	√	√	
Advertising	√	√	
Credit and finance	√	√	√
Technical support		√	√
Training		√	√

The problems that must be dealt with are mostly organizational. In order to make the seed industry functional, a framework that allows the different stakeholders to work together must be set up. The Nigerien context is actually very favorable, based on the following capabilities:

- More and more seed multiplication is being carried out by private enterprise and farmer organizations. The vacuum left by the PCN has never really been filled; this is coupled with a growing need for increased food production.
- The local capacity for and experience in seed production have increased over the last few years with the emergence of many cooperatives and seed groups in various locations. For example, onion seed producers are well known for their competence in crop and land management. In addition, farmers from Saé Saboua (Maradi) produce good quality pearl millet seed. Other well-known groups from Maizabi (Madaoua), Guidan Iddar (Konni), Tchiaguiriré (Kollo) and Tamou (Say) produce pearl millet, sorghum, groundnut and cowpea seed. In Guidan Iddar,

Tchiaguiriré and the irrigated areas around Djirataoua, Galmi, Mouléla, Konni and Diffa, production of hybrid sorghum NAD-1 seed by farmer cooperatives has clearly shown the technical feasibility of modern seed multiplication by local producers. The ONAHA Seed Project (1997-1999) gave average yields of hybrid seed between 1.26 t ha"[1] and 1.76 t ha^{-1} obtained by the cooperatives from Konni and Djirataoua, when there was no infestation by ceciomids. These yields are excellent and highlight the farmers' absolute mastery of production conditions.

- There is on-site expertise in seed commercialization in Niger. A local company, AGRIMEX, has been successfully producing and marketing vegetable seeds and pesticides for almost 10 years. AGRIMEX has set up a network of retail outlets throughout the country and it advertises and promotes its products. This company is ready to commercialize any other kinds of seed once the demand exists. There is also a less well-organized seed-marketing network in many rural areas, especially for onion seed in the Maggia valley. Sorghum, pearl millet, groundnut and cowpea seed are all produced and commercialized to a certain extent by village communities, although seed quality and purity cannot be evaluated.
- Niger has good infrastructure, which can be effectively utilized for seed activities. Six seed multiplication centers have been set up in different regions including Lossa, Hamdallaye, Guéchémé, Doukou Doukou, Kouroungoussaou and Angoual Gamji. Each center has appropriate land and some of them also have irrigation facilities for seed production. They are also equipped with facilities for cleaning and storing seed. These centers are open to private producers on a contract basis.
- The popularization of the sorghum hybrid NAD-1 was the first in West Africa as far as national research programs are concerned. This success has been supported by collaborative research between INRAN and the International Sorghum and Millet Program (INTSORMIL). Important lessons were learned for the setting up of a seed production, processing and distribution network. The hybrid was recommended for promotion, following convincing data obtained in field station and on-farm trials, notably an average grain yield of 3 t ha^{-1}, 10 times the national average. The technical feasibility of seed production has been widely tested since 1989 and has shown a grain yield of 1500 kg ha^{-1}.
- Hybrid seed production by farmers was initiated in 1995 and there was a critical need for training, so a training manual for production of hybrid seed was developed and translated into eight national languages.

Hundreds of farmers, research technicians and extension workers have participated in training programs over the last five years. The market price of the hybrid seed ranges from 500 to 1000 CFA francs kg^{-1}, whereas grain for consumption costs between 100-200 CFA francs kg^{-1} and ordinary seed costs 350 CFA francs kg^{-1}. Every year INRAN records a high demand for farmer-produced improved seed. This process indicates that with an improved variety, recognized and demanded by users, a functional seed production system can be developed working with small traditional farmers in Niger.

- INRAN's Seed Unit (US - l'Unité Semencière) was created in 1998 and focuses on supporting the setting up and development of seed commercialization in the private sector. The mission of the US is to manage seed multiplication at INRAN, support private seed multipliers and farmer organizations by supplying them with certified seed, training and dissemination of information on the seed, and representing INRAN in all seed-related issues. All the US activities are carried out at real costs and these funds are reinvested to support the Unit. For example, during the 2001 wet season the Unit invested its own funds to set up ca. 90 ha of millet, sorghum, groundnut, cowpea and corn destined for seed production. This seed will be sold to multipliers, many of whom have already placed their orders. The Unit also makes inspection services available to multipliers in the absence of a certification mechanism, and organizes training sessions. The Unit's approach aims to introduce a viable and sustainable economic base for seed production in Niger.
- The Private Seed Producers' Association of Niger (APPSN - l'Association de Producteurs Privés de Semence du Niger), a national association of private seed producers, was set up in 1999 on the initiative of producers interested in modern seed techniques and a professionalization of its activities. Most of its members own land and/or have an appreciable financial capacity but greatly benefit from the close technical follow-up. The APPSN has gradually increased its membership in the country, and it has fast developed a special relationship with national authorities as far as seed distribution is concerned.
- The Groundnut Industry Consultative Committee in Niger (CCFAN): as the newest local initiative, this structure is the result of numerous discussions between stakeholders interested in the production, processing and distribution network. These discussions were catalyzed by INRAN's Seed Unit and the GGP in Niger (ICRISAT's sub-Saharan Center).

CCFAN, integrating stakeholders for improved groundnut production in Niger

In Niger, groundnut production knew a period of success in the 1960s, declined between 1972 and 1989, and has since seen significant growth. Production plummeted from 260,000 t in 1972 to 29,000 t in 1989, but increased to 196,000 t in 1996; however, yields are still low at 340 kg ha^{-1}. Apart from its contribution to the local food supply, groundnut, together with cowpea, is one of rural Nigerien farmers' major sources of income, especially in the main producing areas such as Zinder, Maradi and Dosso.

The first phase of the GGP has served to trigger renewed interest in an organized groundnut production and processing chain, which has taken form in the creation of CCFAN. Producer organizations (Plateform Paysanne, Coopérative Huilière de Kalley), seed producer associations (APPSN), the national seed service (SICCLA), the technical services of the Ministry of agriculture (DPV, DA, DEP), NGOs (Kokari), development projects (PADEL) and research institutions (INRAN/Seed Unit, DFPV/ AGRHYMET, ICRISAT/GGP) are all represented on the committee. The most important role of CCFAN is the sensitization of a large number of stakeholders. Official recognition is in sight with support from the different heads of the technical services of the Ministry of Agriculture. The participation of CCFAN in different meetings on the agricultural sector and the dissemination of information on improved varieties will help introduce selected varieties to the agricultural sector. The following factors will help to make CCFAN's mission a reality:

- There is a great demand for groundnut kernels. The requirements of the oil factories, in particular, are very high. Groups such as the Kalley cooperative or the Gaya farmer organizations (managed by the PADEL project) have started producing improved varieties and/or carrying out oil extraction. Moreover, the recently privatized SICONIGER oil works now needs tens of thousands of tons of groundnut.
- There are private seed producers as well as many producer groups who need new groundnut seed. Some of these groups are managed by NGOs, others by projects or state technical services.
- Private producers in APPSN are strategically placed to know the demand for seed and they have the capacity to supply a large part of this. However their foundation seed requirements have not yet been entirely met.

- The INRAN Seed Unit guarantees the multiplication of foundation seed of the most sought-after varieties and manages seed producers.
- The GGP Gene Bank at ISC guarantees the availability of genetic nuclei of all its groundnut lines and varieties. Following a joint program between GGP and the Seed Unit during the 2001 wet season, the national collection of groundnut was renewed and conserved in the gene bank. At present CCFAN has access to more than 2 t of foundation seed of the best known varieties (such as 55-437) and those which show very good potential on traditional farms. This can be used to reconstitute the national stock through the combined activities of the US, its private sector partners and producer groups.
- Official support for the sector has been shown through government supply of several hundred tons of seed to farmer cooperatives. Moreover, INRAN/GGP initiatives for the creation of CCFAN have been strongly backed by the Ministry of Agriculture. The Ministry has clearly expressed the wish that the gene bank should support the US in order to guarantee the quality of seed distributed to producers.

There is a real hope that CCFAN can contribute to the development of a seed strategy adapted to groundnut production by traditional farmers in Niger. The experiment, which was initiated in 2001, has obtained the consent of all partners and is built around the following points:

- The most well-known variety in Niger, 55-437, now extremely degenerated in traditional farming systems, has been obtained by CCFAN from the GGP gene bank and foundation seed has been multiplied in collaboration with the US. From 2002 a multiplication program for the subsequent levels has been developed and will be carried out in collaboration with the SICCLA, APPSN, farmer cooperatives managed by PADEL, and CARE and KOKARI. The main objective is to stockpile substantial quantity of good quality seed before distributing it to farmers, who are strongly solicited by the oil factories, notably the now privatized.
- At the same time, a seed stock will be constituted, new varieties will be introduced, and a farmer-training program will be carried out under the supervision of the US, SICCLA and ICRISAT INRAN's groundnut improvement program, together with GGP and many farmer groups, has identified a certain number of varieties adapted to various agricultural zones. Eventually a new variety map will be established for Niger and the selected varieties will be multiplied on a large scale.

- The CCFAN can eventually be used as a model for setting up a national consultative framework involving more stakeholders and covering all species of agricultural importance in Niger. Such a structure will be key to the development of all the seed stocks required in order to significantly increase agricultural production and consequently, farmer earnings. The indicative scheme (Figure 1) shows the multifaceted role that CCFAN and the US must play in order to stabilize the groundnut production and processing chain and catalyze the evolution of agricultural production.

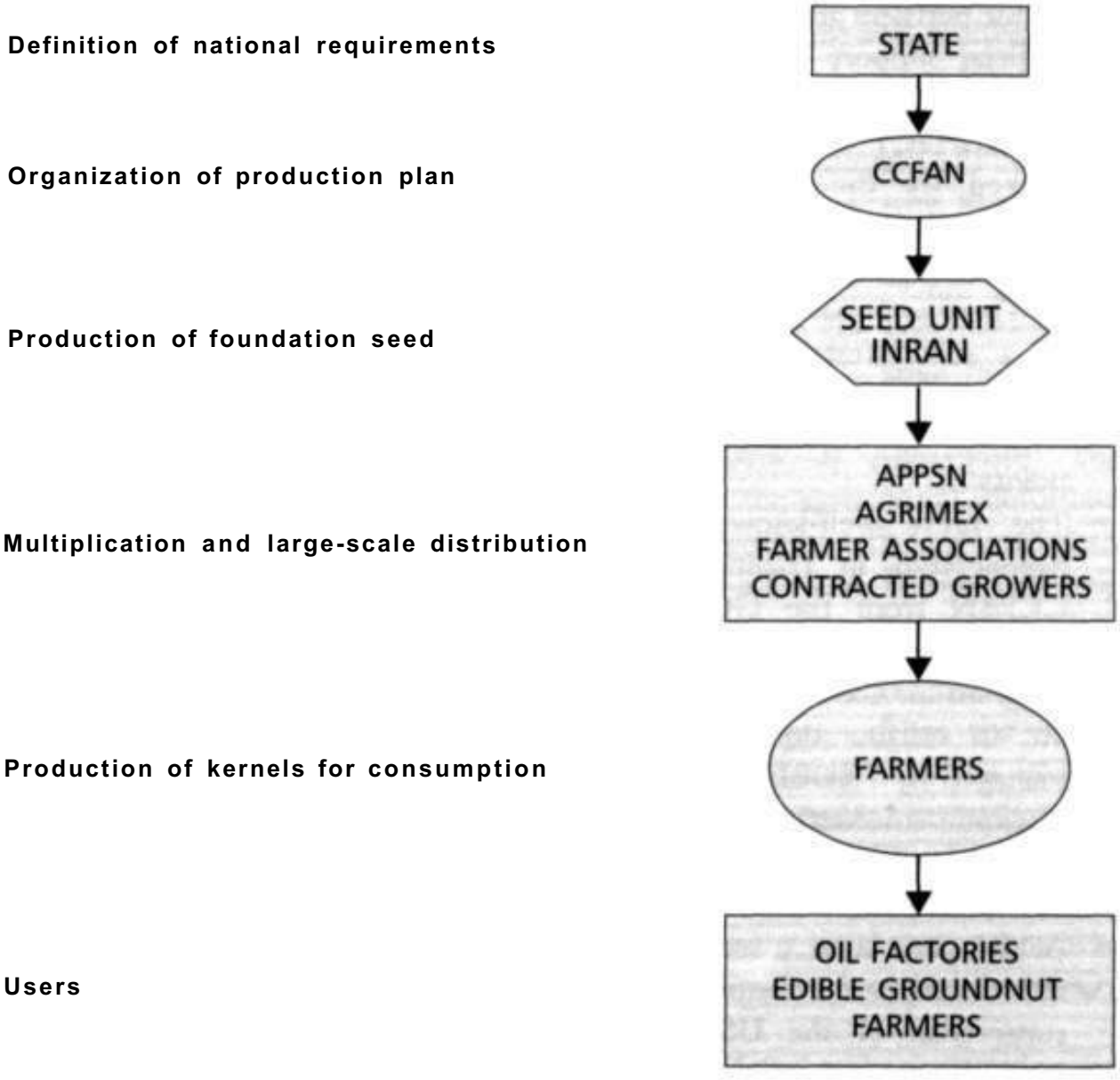

Figure 1. Steps for a multiplication scheme for groundnut seed in Niger.

Future prospects

The many stakeholders in the seed industry in Niger have shown the will to combine their efforts in order to increase agricultural production, notably that of groundnut. Stakeholders have been identified, and in many instances, the activities correspond to their needs. There is a real need for groundnut seed. The multitude of farmer organizations capable of undertaking seed multiplication activities is the seed industry's greatest asset in Niger. The availability of high quality seed from the US and the GGP gene bank are the best guarantee of success. The US and CCFAN are the axis around which the national framework required for working together to build Niger's seed industry can evolve. These two structures must be able to work independently. There are enormous management and training requirements that the availability of qualified technical personnel can help to resolve.

The groundnut seed production system in Senegal

Arthur Da Sylva[1] and Abba Diémé[2]

Introduction

Until 1972, the seed policy of Senegal consisted of covering the annual seed needs of producers and involved in-kind recovery of part of farmers' production at the time of selling the seed capital that had been distributed on credit before sowing. This policy of reconstituting the seed stock from uncontrolled production by farmers resulted in variety mixture, thus impacting the level of production. This led to the creation of the Institut pour la Recherche sur les Huiles et Oleagineux (IRHO) Seed Project, with financial support from the European Union Fund for Development from 1972. The objective of this project was to redefine the groundnut variety map and to reconstitute the seed capital from pure varieties provided by agronomic research. This was followed by the creation of a national system of seed production, with the interaction of several institutions. Except for the management, this scheme has remained the same over the years. Until today, there have been four changes in management.

1972-1979

During this period, breeder seed was produced by ISRA, foundation seed by the national seed services, and certified seed by ONCAD. Control and certification was the responsibility of the Seed Service. With this scheme, seed capital was reconstituted 100%.

The advantages of this scheme were:

- A close follow-up by different actors: extension organizations (SRDR), ONCAD, Seed Service, ISRA, Department of Agriculture, different inspections of agriculture and the Department of Crop Protection. These met annually to analyze the situation of the past year (quantities available by/at each level) and estimate the needs for the new crop season. This enhanced production planning by prior knowledge of the seed needs of each region.

1. Institut Sénégalais de Recherches Agricoles (ISRA). UPSE, BP 53 Bambey, Sénégal.
2. Division Nationale des Semences (DISEM) Ministere de l'Agriculture BP 84 Dakar Harm, Sénégal.

- Training of farmers was assured by ONCAD, which had agents in the field to conduct the training.
- Precise national seed needs by region were published in a document presented at annual seed meetings.

The drawbacks of this scheme were:

- The sector was completely controlled by the state.
- Low rate of credit recovery.

1980-1990

In 1981, criticism of the prevailing system led to the creation of the Seed Production and Certification Unit (DPCS) to replace the Seed Service, and SONAGRAINES, to be responsible for groundnut seed commercialization. The production scheme underwent slight changes whereby the DPCS produced foundation seed and SONAGRAINES produced certified seed. The state also decided to renew a third of the seed, knowing that the same seed could be sown for a period of three years without significant loss in value. The control was still the responsibility of the DPCS. The results of this scheme were in the region of 45-50,000 tonnes of N2 seed, which were annually collected and renewed to a third of the seed capital.

The advantages of this scheme were:

- Annual seed meetings continued.
- SONAGRAINES agents assured training of farmers.
- The national seed needs were always precise.

The disadvantages were:

- Reinforcement of the government control of the sector (DPCS and SONAGRAINES being state institutions).
- The credit recovered was less and less, resulting in accumulated deficits.

1990-1994

Changes took place in the state structure: the DPCS was broken into two institutions, the Autonomous Seed Project (PAS) and the Seed Division (DISEM). The PAS had the task of contracting production of foundation seed and putting in place private, professional seed associations. The DISEM was restricted to seed control and certification. The renewal of a third of the seed capital was reconducted.

The advantages of the system were:

- Private operators were trained to become professional seed producers.
- Production of foundation seed was on a contractual basis, with private seed producers' controlling stations designated by PAS.
- Progressive liberalization of the sector and emergence of the private sector; hence the creation of UNIS in 1994.

The biggest drawback of this system:

- Producers were not financially prepared to take the place of PAS.

1994-2000

Private operators were involved in seed production, associated to SONAGRAINES, and took over all production of foundation and certified seed.

The advantages of the system are:

- The private sector and SONAGRAINES are the major actors in the chain.
- Two types of seed distribution occur: buying across the counter by the private operators who are members of UNIS, and follow-up sale on credit by the state through SONAGRAINES.
- Following the drought in 1996-1997, only 6000 tonnes of certified seed was collected.
- The government decided to block the seed, even part of the grain previously destined for oil extraction, to reconstitute the seed multiplication program. These seeds were called "semences écrémées".

The disadvantages of the system are:

- This procedure started in 1995 with the state-owned company SONAGRAINES, and was a carryover by the same company at the detriment of good quality seed retained by the private operators of UNIS.
- Degradation of the seed capital in terms of quantity and quality.

Finally, the state disengaged from the sector, leading to the creation of the National Interprofessional Groundnut Committee (CNIA) in 1997. A protocol was signed between the state, SONACOS and CNIA for the rehabilitation of the groundnut crop on the Stabex fund with CNIA being the body responsible for it. The first program estimates were signed in October 1998 and financing started in March 1999. CNIA had the task of managing the sector (improvement and programming), financing state

structures involved in the seed sector, and putting in place a guarantee fund at the bank to facilitate access to credit by private operators, members of UNIS. The objective was to produce 65,000 t of high-quality certified seed by 2003.

The advantages of the system are:

- Effective programming (In 1998/1999, 16,000 t of N2 were collected, in 1999/2000 - 25,000 t, and in 2000/2001- 30,00 t).
- There is a better distribution of tasks among partners.
- An important increase in means of production by certain partners (UNIS, DISEM, UNCAS).
- An effort to apply legislation and regulations relating to the seed sector.
- An important increase in groundnut production (1.2 million metric t of unshelled groundnut were produced in 2001)

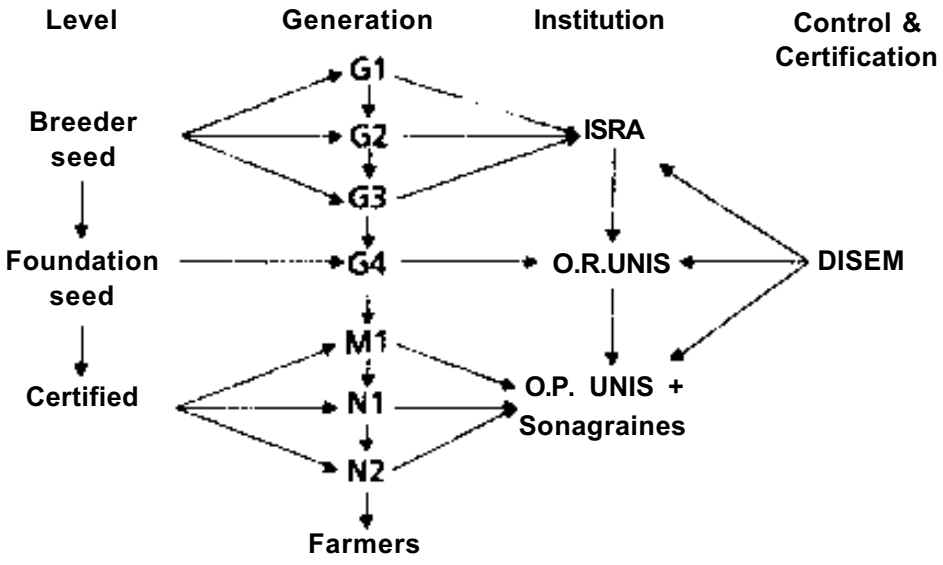

Figure 1. Actual organization of the sector, 1994-2001

In 2002

- Only 35,000 metric t of N2 seeds of good quality were available with seed producers.
- There was a deficit at the first level (MI).
- UNIS had difficulties getting credit.
- ISRA and DISEM are still underequipped, leading to difficulties in operations.

- There is a need to reorganize the edible groundnut sector with a wide range of varieties.
- There is a need to liberalize edible groundnut seed production (remove the NOVASEN monopoly).
- There is a temporary blockage of Stabex funds to rehabilitate the groundnut sector.
- The sudden dissolution of SONAGRAINES at the end of 2001 without a replacement has created a problem.

We are still waiting on part of CNIA, the disappearance of so called seeds **écrémées,** easy access to credit by private operators of UNIS and the improvement of the production scheme involving users at the level of foundation seed and MI.

Recommendations

For the system to assure production of the best quality seed and allow efficient professionalistion of the participants, the following recommendations are made:

- Reduce the deficit at the first level (basic and MI) by integrating seed production at the community level within the system, i.e., train farmers in the communities to produce and sell good quality seed.
- Conduct a study on the real cost of seed production and need for subsidy.
- Equip the state structures with quality production and postharvest materials and support with an operational budget.
- Put in place as soon as possible bank funds easily accessible to private operators to assure production and collection of seed.
- Decentralize agricultural credit to other financial structures and ensure that interest rates are compatible with the financial means of the producers
- Facilitate creation of private seed enterprises.
- Improve regional exchange of plant material and harmonize seed laws and regulations.

The groundnut seed production system in Nigeria

Adeyemi Joshua[1] and Candidus A Echeckwu[2]

Introduction

The Federal Republic of Nigeria is the largest country in West Africa, with 20% of the population of sub-Saharan Africa. Crude oil contributes 25% of the GDP of Nigeria and is the source of 70% of Government budget. Despite being an economy heavily dependent on oil, two-thirds of the country's labor force is employed in agriculture.

Groundnut is an important crop in Nigeria, where it is grown largely under the smallholder system in rainfed conditions. It constitutes a major source of protein and dietary oil as well as cash income for both subsistence farmers and urban dwellers.

Groundnut production in Nigeria in the 1960s and even up to the early 1970s was a rewarding and satisfying experience for farmers. These farmers, with adequate technical support and incentives, had demonstrated their ability to produce as evidenced by the famous groundnut pyramids, which were once a symbol of the country's abundance in groundnut production. There was a rapid decline in production from 1975 up to the mid-1980's, due to several factors including biotic and abiotic stresses, a general neglect of agriculture due to over dependence on oil, and a lack of technical support and price incentives. At this point, the government of Nigeria had to intervene to stop the total collapse of the groundnut subsector. These efforts, started in 1987, culminated in the initiation of the National Accelerated Industrial Crops Production Program (NAICPP), aimed at promoting the production of eight prominent industrial crops including groundnut. These efforts have led to a gradual increase in the production of groundnut through increased land area put under cultivation and improved yield per hectare.

The success of these rehabilitation efforts will depend very heavily on the recognition of the crucial role of improved seed in groundnut production. Good quality seed of an improved variety remains a basic input requirement in groundnut production for the simple reason that chemical fertilizers,

1 President Seed Association of Nigeria. Premier Seed Nigeria Ltd, Chikaji Industrial Estate, P.O. Box 1673 Zaria - Nigeria.

2. Institute of Agricultural Research (IAR). Ahmadu Bello University, P.M.B. 1044, Samaru, Zaria, Nigeria.

pesticides and other inputs are able to give relatively high returns only when farmers plant seeds of varieties with high genetic potential. The existing seed production system in Nigeria is briefly described in this paper, and a few suggestions for improvement of seed availability for the crop are highlighted.

Seed supply to farmers

The primary objective of any seed industry is to provide high quality seed to farmers in a way that gives an appropriate return on investment. Providing seed to farmers is the culmination of a lengthy process with many participants. This process can be divided into three broad phases:

- Research and development
- Production and processing
- Marketing and distribution

These phases are highly interdependent and the effectiveness of the activities performed in one phase depends on that of the activities performed in others. Private or public sector organizations can be active in any phase of this process, from research to seed distribution.

Seed supply systems

Three seed supply systems are usually recognized as follows:

Local seed supply system

This covers the methods of local seed selection, production and diffusion. Cromwell (1992) describes this system as traditional, informal, operating at community level through exchange mechanisms, and involving limited quantities per transaction. This corresponds to the traditional seed sector described by Camargo et al (1989).

Formal seed supply system

This covers the seed production and supply mechanisms that are ruled by defined methodologies and are backed by national legislation and international standardization of methodologies (or in the absence of de facto legislation, organized as if such laws did apply). Such systems involve cash transactions and large uniform quantities and are otherwise known as the *conventional* seed sector.

Integrated seed supply system

This covers the methodologies for improvement of the local seed supply systems by borrowing technologies from the formal sector, using informal channels. This is

similar to that described by Louwaars (1994) and corresponds to the *nonconventional* seed supply systems introduced by Camargo et al. (1989)

The groundnut seed system in Nigeria

The seed production system in Nigeria is a combination of both the formal and informal systems.

The informal seed system participants here include farmers who rely on either their saved seeds, or seed obtained from their neighbors. This system is actually aimed at producing cheap groundnut seed for easy access by farmers in remote areas. Participants in the formal groundnut seed system are composed of both public and private sector agencies. The public sector agencies comprise the following:

Institute for Agricultural Research, Samaru

Groundnut variety development, maintenance and breeder seed production are the primary responsibilities of the IAR, Samaru. In carrying out this responsibility, the institute has in the recent past collaborated with IARCs like the International Livestock Research Institute (ILRI) and ICRISAT.

National Seed Service

This is a specialized unit of the Federal Department of Agriculture responsible for the overall coordination of the seed production program. The NSS also undertakes the production of foundation seed from the groundnut breeder seed supplied to it from IAR. In addition, seed certification and quality control are statutory responsibilities of the NSS.

Agricultural development projects

These are the extension arms of the States' Ministries of Agriculture, whose seed units also undertake the production of certified seed of groundnut from the foundation seed collected from the NSS.

Participants from the private sector include small, medium and large national/multinational companies and NGOs involved in seed production and marketing. Private seed companies also have the responsibility of producing certified seed from the foundation seed collected from the NSS. The largest of these is Premier Seeds.

Performance of the present seed system

The groundnut seed production system as it exists at the moment has not succeeded in providing enough seed to meet the demands of farmers. A

large proportion of farmers still depend on the informal seed system, using farm-saved seed or seed obtained from their neighbors. There is little coordination in this system, making it very inefficient. The formal system, on the other hand, is completely dominated by the public sector agencies, both in terms of production and supply, with over 70% of the groundnut seed trade still involving these agencies. The agencies, due to under-funding, under-staffing, lack of commitment of available staff, and other logistic problems do perform below expectation. The result of the shortcomings mentioned above is that the demand for high quality seed of improved groundnut cultivars in Nigeria is by and large not satisfied.

Suggestions for improving the seed supply situation

Improving the efficiency of the existing systems can increase seed supply to farmers in Nigeria. This can be done through conscious efforts to address the shortcomings of the formal and informal seed systems as they currently operate. With the global trend toward privatization in all sectors of the Nigerian economy, however, there may be a need for a gradual withdrawal of public sector agencies in favor of the private sector in the overall seed industry in any of the phases where the private sector has comparative advantage. Activities that need to be undertaken to improve and sustain productivity of the existing seed systems in Nigeria include:

- Strengthening the research capacity of the IAR for continuous variety development and maintenance.
- Shortening the time between variety development, registration and release.
- Improving, strengthening and coordinating both the formal and informal seed systems.
- Putting in place appropriate policies and enabling an environment for private sector participation.
- Widening seed markets for community seed producers.

Privatization of the African seed industry: the Nigerian seed experience

Highlights of the Nigerian seed industry development: 1976-2002

- Nigeria is in transition from a totally public seed sector to ongoing privatization.
- Both public and private seed sector currently coexist in Nigeria.

- Seed policies/rules/regulations guiding seed trade exist.
- Seed markets in Nigeria consist of both the formal and informal seed systems.

Importance of the seed sector

- Incremental production of food and other commodities.
- Economic empowerment of farmers and the growing population.
- Increased production of agricultural materials for agroindustries, exports and foreign exchange earnings.
- Seed security is a prerequisite for national food security.

The current seed situation in Nigerian agriculture is shown in Fig 1.

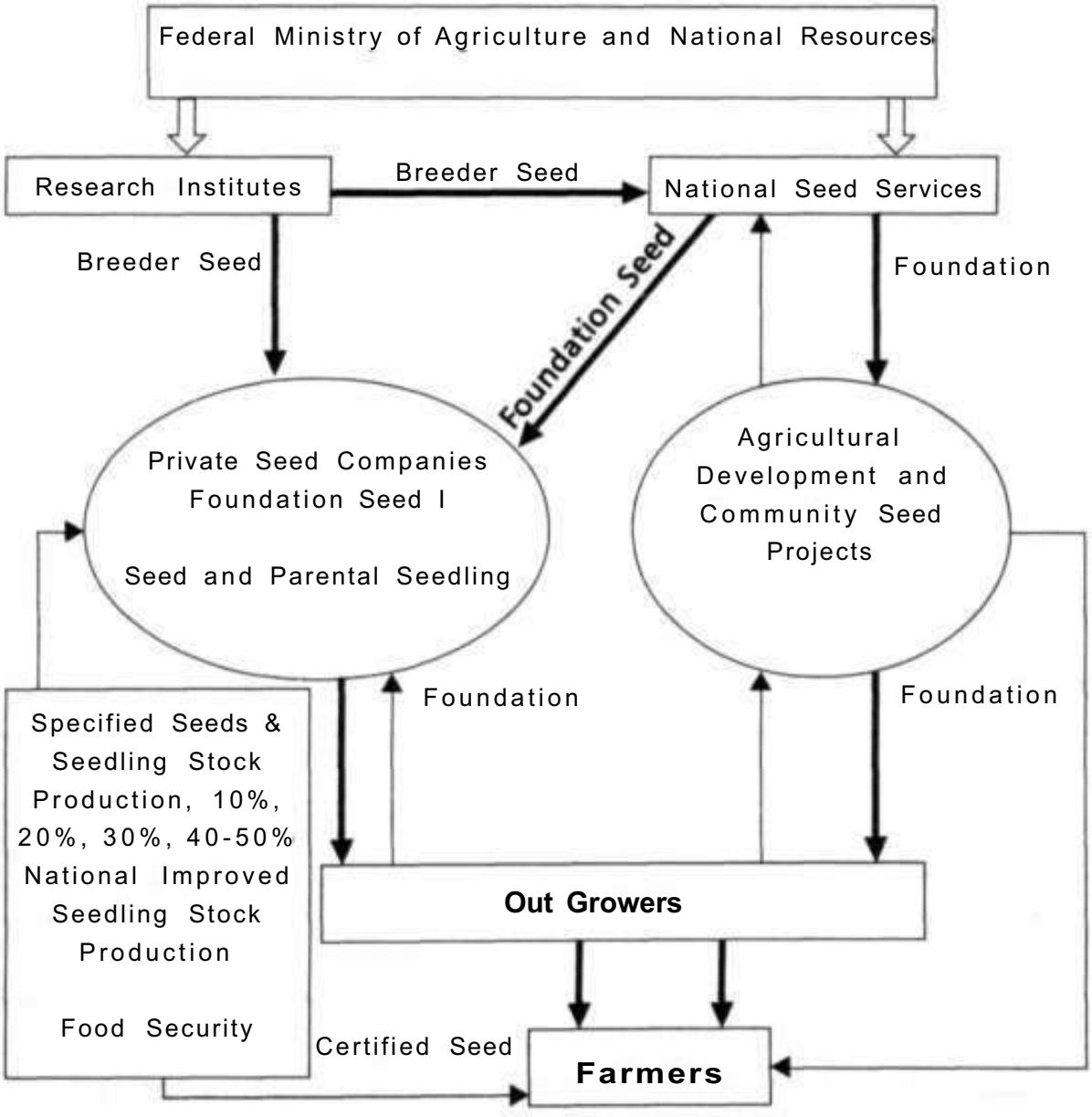

Figure 1. Production and distribution of improved seeds in Nigeria.

Challenges in developing national seed systems

- Improving both informal and formal national seed production and distribution systems.
- Developing regionally competitive seed enterprises with four key characteristics:
  - Competition
  - Linkages
  - Harmonization of Seed Rules
  - Seed Information Network
- Reforming government seed sector support policies.

Constraints

- Farmer's access to seeds is difficult.
- High price of seeds.
- Unawareness of the economic benefits of high quality seeds.
- High rural seed marketing transactions costs.
- Under-funded, logistic, under-staffed public seed sector system without proper logistical planning.
- Insufficient funding for variety testing and variety maintenance.
- Undue delays on variety registration and release.
- Inadequate availability of breeder/foundation and certified seeds of new high yielding varieties.
- Inadequate enabling environment and incentives for private sector intervention.

Production of the best-tested, best-quality, best-priced seeds

Seed production

- Carry out field trials of different varieties and hybrids for the various state agroecologies.
- Partners in progress with State ADP/IITA/ICRISAT/WARDA/NARI/ ADP to determine the best varieties for each state.
- Variety testing, maintenance, breeder seed multiplication and foundation seed production for certified seeds.
- Large quantities of high quality certified seeds produced, using growers supervised by trained seed field supervisors.
- Village seed production, compact area approach improved seed production, and effective quality seed purchase.

Company internal quality control activities

- Internal quality control decisions in addition to NSS National seed certification agencies.
- Seeds marketed under company programs, field inspected, tested and certified by NSS.

Making improved seeds available to farmers

- Farmers' involvement in variety selection (PVS).
- Coordinated multiprong approach for improved seed production and marketing.
- Involving farmers in producing more seeds for farmers.
- Improving/strengthening and coordinating both the formal and informal seed systems.
- Research/private sector partnerships.
- Integration of the formal and informal systems

Strategic approach - SSPC

- Make the new high-yielding improved seed readily available to farmers.
- Major stakeholders should come together to work for facilitating these objectives.
- Improved seeds to be used for significantly increasing farmers' yield/ha.
- Farmers' participation in identifying the best cultivars for other areas should be encouraged and enabled.
- The informal sector should be made more formal and the linkages between formal and informal sectors improved.
- More seed produced, capacity-utilization/cheaper seed and profitable seed enterprises should be enabled.

Regional level activities

- Harmonizing seed policies.
- Regional variety network.
- Regional seed information network.
- Regional seed standards.
- Harmonization to promote regional seed trade.

Sustainable seed systems

These will require:

- Competitive seed industries with a network of small, medium and large national and international companies competing in markets.

- Harmonization of seed laws and regulations to promote regionally integrated seed markets, and encouragement of seed enterprise investments.

Disaster preparedness and response

- Linkages with seed security/seed promotion group.
- Production and procurement of good quality locally adapted varieties.
- Multiplication and effective seed delivery systems - existing by private seed companies.
- Encouragement of local seed enterprises, optimum capacity utilization and joint ventures.

Table 1. Institutional roles and responsibilities in the national seed system.

Activity	Institution	Role	Action
Variety development	CGIAR/NARS	• Development and introduction of new crop varieties	• Select against biotic and abiotic stresses • Facilitate introduction and testing of new varieties
Nationally coordinated variety testing	NARIs/NCRP Coordinators &Collaborators	• Preparation of multilocation trials for 2 years • Preparation of on-farm trials for 2 years • Recommendation for registration	• Conduct multilocational trials in all agroecological zones • Collate data and make recommendations
On-farm testing	NARIs/ADPs &NGOs Private Seed Companies	• Preparation of seeds for on-farm testing • Delivering seeds for ADP • Monitoring on-farm trials • Conducting tests	• Organize planning & review meetings with ADPs, FACU • Decide on appropriate packages and protocols for the on-farm trials • Monitor, evaluate and collect data on trials • Recommend next action
Information dissemination	NAERLS, NARIs & Extension Services	• Issue of variety trials report • Diffusion of variety performance for farmers' information	• Diffuse variety test reports

...Continued

Table 1. ***Continued.***

Activity	Institution	Role	Action
Variety release	NVRM	• Release of recommended varieties for the appropriate zones	• Prepare release documents for presentation to the appropriate board
Variety registration	Variety Registration and Release Committee. GRC/NVRM	• Provisional registration • Final registration	• Technical subcommittee meets to consider registration. The concept of provisional & final registration has been developed.
Seed production	NARIs	• Production of breeder seed	• Production of breeder seed • Varietal maintenance
	NSS*	• Coordination of breeder seed production • Production of foundation seed through contract growers and NARIs • Liaison with private seed companies	• Facilitate FS production • Field inspection • Seed certification, collection, & distribution
	ADPs* * Private Seed Companies * Seed Producers/ Sellers * Seed Enterprises	• Certified seed production through contract growers and private seed companies *Liaison with private seed companies • Proprietary rights of *breeders seed • *Foundation seed production of public and private seed companies • *Certified seed production	• Identify contract growers • Facilitate CS production • Conduct field inspection and seed certification together with NSS • Provide market for contract growers • Facilitate seed distribution through FASCOM

...Continued

Table 1. ***Continued.***

Activity	Institution	Role	Action
Seed processing & storage	NSS, ADPs & FASCOM *Private Seed Companies	• Processing of foundation Seed • Processing of certified seed • Processing of FS & CS	• Facilities for seed processing & storage made available. • FASCOM & ADPs share processing facilities
Seed certification	NSS	• Inspection of BS, FS & CS	• Follow 1982 Decree on seed rules and regulations
Seed marketing	FASCOM/ ADP& NSS Seed Dealers *Private Seed Companies	• Marketing of seed through Farm Centers of FASCOM/ADPs • Seed dealers marketing seed to ADPs and public • *Private seed companies	• Fix prices to recover cost, (Govt/Private Seed Companies) • Seed dealers negotiate price with ADPs • Sell to private farmers and public establishments
Seed import/ export	Plant Quarantine Services (PQS), NSS, IAR/ICRISAT Private Seed Companies	• Issue phytosanitary certificate • Issue licenses jointly with PQS. • Import and export genetic and parental materials.	• Inspect seed and issue certificates, • Follow necessary guidelines for issuance of licenses and importation of germplasm
Seed quality control	NSS	• Law enforcement on all classes of seed	• Regional law enforcement officers in position to follow guidelines.
Seed policy formulation	NSC	• Advice on seed subsector policy • Monitoring activities of the seed subsector	• NSC organized under seed decree 72
Workshop & training	NSS * Private Seed Companies	• Training workshops organized and conducted by NSS and private seed companies	• The Seed Science and Technology Center created recently in Makurdi to be involved in the training

...Continued

Table 1. ***Continued.***

Activity	Institution	Role	Action
Monitoring of seed program activities	FDA/APMEU/ NSS	• Monitoring & evaluation of seed projects • Assessment & recommendation	• Monitor seed production in all states. Evaluate seed projects and recommend to Govt
Private sector representation	National Seed Growers & Industry Association	• 4 Representatives of private seed industry now included in NSC • Seed association of Nigeria now registered	• Attend NSC Meetings Participate in seed policy formulation- Take care of seed industry Have linkages with State ADP and NSS

The above table is based on the National Seed Policy approved for the NSPQ Project Implementation.

NB: Strategies: The government seed policy is as described above and the seed strategy is designed in accordance to the Institutional Roles.

How to enhance successful and sustainable privatization of the African seed industry

- Avoid delays on national variety registration and release procedures.
- Promotion of (i) how to produce more seeds and (ii) marketing the produced seed.
- Cost-recovery seed pricing policy/subsidiary where it exists for both public and private sectors.
- Widening seed markets and alleviating rural seed marketing transaction costs.
- Appropriate seed policies: proper implementation of seed industry policy reforms.
- Improve, strengthen and coordinate both the formal and informal seed systems.
- Increase field days, demonstration plots to farmers and improve seed information network.
- Recognize the important role played by seed associations.

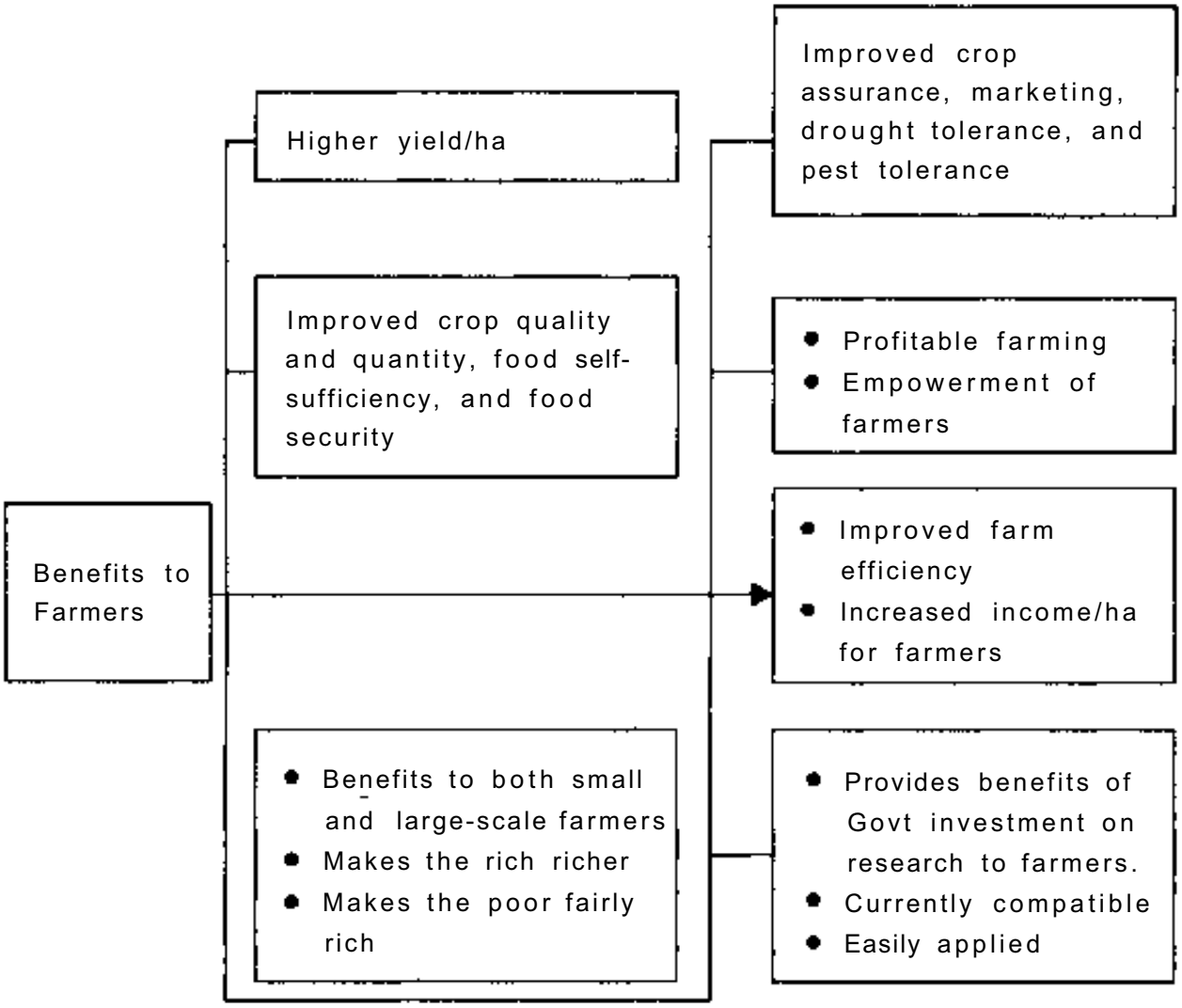

Figure 2. Benefits to farmers

References

Camargo, CP, Bragantini, C and Monares, P 1989. Seed production systems for small farmers; a non-commercial perspective. Cali, Colombia: CIAT.

Cromwell, E, Friss, E and Turner, M 1992. The seed sector in developing countries. Washington DC, USA: Agency for International Development. 117 pp.

Louwaars, NP 1994. Integrated seed supply - a feasible approach. *In:* J Hanson (ed.) Seed production by smallholder farmers. Proceedings of the ILCA/ICARDA research planning workshop, June 13-15, 1994. Addis Ababa, Ethiopia: ILCA.

Regional strategy for groundnut seed production and distribution

Richard Jones[1]

Outline

- Overview of groundnut products
- Globalization
- Changing context for research and development (R&D)
- Example of the groundnut sector in Malawi
- Alternative strategies for R&D
- Seed systems associated with R&D strategies
- Misperceptions about seed
- Constraints to seed sector development
- Interventions to improve seed sector performance

Overview of groundnut products

Products

- Groundnut oil
- Groundnut cake
- Confectionery nuts
- Fodder

Utilization

- Household consumption (food security and nutrition)
- Local markets (increasing due to population growth and urbanization)
- Regional markets (trade liberalization, ECOWAS)
- International markets (World Trade Organization)

Globalization

- Development of global markets
  - Integrated international supply chains
  - Converging consumption preferences

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). PO Box 39063 Nairobi, Kenya.

- Fewer market options
  - Trend towards differentiated improved products
- Declining prices for commodities
- Decommodification of traditional commodities
  - Crop improvement for identified niches
  - Groundnut bred for higher oil content

Changing context for research and development

- Globalization and urbanization
  - Strong transactions infrastructure
  - Transport and communications
  - Supportive policy environment
- Retailer-dominated supply chains
  - Strict quality criteria
  - Production responsive to short-term demand
  - Product innovations (new varieties, packaging, postharvest innovations)
- Need for continual cost-reduction (competition)

Groundnut sector in Malawi

- State control of marketing (1960s-1980s)
  - Grown by smallholder farmers (1-5 ha)
  - Three course rotation with maize and tobacco
  - Major export crop until mid-1980s (up to 50,000 t yr^{-1})
  - High-value confectionery nuts to UK (Chalimbana)
  - Government monopoly on input and output marketing
  - Pricing according to established grades
  - Seed supplied by marketing board
  - Higher profitability of maize relative to groundnut
  - Smallholder production decreased
  - Exports ceased
- Introduction of liberalized markets (early 1990s)
  - Increased production and local marketing
  - Pricing by weight not according to standards
  - Significant role of NGOs in input supply
  - New institutional models emerging

- Constraints
  - Limited market intelligence
  - Higher quality standards in European markets
  - Weak system of implementing grades and standards
  - Inadequate supply of seed of market-preferred varieties
  - Inadequate attention to development of the subsector

Improving linkages of smallholders to markets

- Understand market niches
  - Large confectionery nuts for Europe
  - Small nuts for South Africa
  - Analyze competitive position for oil
- Strategies
  - Develop and target varieties for market niches
  - Link seed supply to market demand
  - Implement known grades and standards (incentives). Grade according to size, color and oil content (variety)
  - Systematic testing to detect aflatoxin
  - Improve information flows to all stakeholders (MIS)
  - Organize smallholder farmers (NASFAM)

Alternative strategies for research and development

- Green Revolution
  - High productivity growth
  - High use of purchased inputs
  - Reductionism approach
    - ♦ Low agrobiodiversity
  - Limited to more favorable agroecologies
  - Sustainability concerns (e.g. water use, pest resistance)
- Pre-Green Revolution
  - Low but stable production
  - Limited use of purchased inputs
  - Complex farming system
    - ♦ High agrobiodiversity
  - Found in more marginal environments
  - Sustainability concerns (e.g. declining natural resources)

Seed systems associated with research and development strategies

- Green Revolution strategy
  - Formal (commercial) seed systems
    - ♦ In response to needs of commercial agriculture (in some cases State-supported)
    - ♦ Focus on hybrids
    - ♦ New varieties through research and development
- Pre-Green Revolution strategy
  - Informal (farmer) seed systems
    - ♦ In response to multiple needs of smallholders
    - ♦ Highly flexible and resilient
    - ♦ Can manage broad agrobiodiversity
- Relief seed systems
  - In response to disasters and chronic poverty
  - Ad-hoc and often poorly conceived
- Systems are not discrete

Comparison of seed systems

- Farmer seed system
  - Seed production integral to crop production
  - Quality control regulated internally (by farmers) and *good neighborliness*
  - Range of seed acquisition methods
    - ♦ Social networks
    - ♦ Local selection
    - ♦ Formal and informal commercial transactions
  - Meets needs of subsistence and semi-subsistence agriculture
- Commercial seed system
  - Seed multiplication separate from crop production
  - Quality control regulated externally (through seed legislation)
  - Seed acquired for cash (commercial channels)
  - New varieties through research and development
  - Dependent on a commercial agricultural system

Common misperceptions about farmer seed systems

- Farmers do not have seed
  - Rare although poor farmers may face difficulties accessing seed
  - Farmer-saved seed is of poor quality

    - Germination percentage is usually adequate
    - Physical purity very high due to hand sorting
    - Genetic purity variable compared to "certified" seed
- Varietal integrity deteriorates over time
    - Can be a problem for farmers to make selections
- Farmers do not have well developed seed storage systems
    - Certain crops are problematic due to their susceptibility to storage pests, e.g. cowpea
- Farmers are conservative and unwilling to try new seeds
    - Farmers are keen to experiment and do!

Constraints to commercial seed sector development

- Farmers' socioeconomic constraints
    - Preference for using own saved seed
    - Farmers lack purchasing power
    - Limited knowledge of end-user preferences
- Institutional constraints
    - Limited production of foundation seed
    - Difficulties discovering farmer preferences
    - Variety release, seed inspection and quality control
    - Free seed distribution by humanitarian agencies
- Demand constraints
    - Small and fragmented market
    - Few price incentives (no grades and standards)
- Policy constraints
    - Barriers to seed trade (phytosanitary)
    - Cost of complying with seed regulations
    - Deficient regulation
    - Lack of IPR legislation
- Crop and varietal constraints
    - Low seed multiplication rate
    - Bulky and perishable

Constraints to farmer seed sector development

- Limited understanding by researchers
- Limited availability and access to new varieties
- Few strategies to reach marginalized communities
- Weak investment in production of foundation seed

- Circumstances necessary to recognize benefits from germplasm (disease resistance e.g. to rosette)
- Lack of knowledge of management of seedborne diseases and pests

Common constraints (commercial and farmer systems)

- Inadequate information to stakeholders
  - New varieties
  - Production information
  - Market opportunities and constraints
- Limited production of foundation seed
- Failure to systematically collect and act on feedback from stakeholders
- Over-emphasis on seed supply rather than a focus on the commodity chain

The way forward

- Identification of four locations for pilot interventions
- Market appraisal to identify market niches
- Establishing strategic partnerships
  - Traders and processors
  - Nongovernmental organizations
  - Farmer associations and individual entrepreneurs
- Matching available germplasm to identified niches
- Designing and implementing varietal testing and demonstration together with farmers
- Identification and training of entrepreneurs for foundation seed production
- Identification of distribution channels including rural stockists
- Development and dissemination of production information
- Institutional code of conduct on seed supply strategies
- Improving linkages of producers to markets
  - Group marketing
  - Contracting
  - Collection points

Interventions to stimulate the commercial seed sector

- Improve market intelligence
- Improve system for developing and disseminating market and production information
- Seed trade liberalization

    - Regionally adapted varieties
    - Regional release
- Strengthen public-private partnerships (e.g. in priority setting)

Scaling out

- Synthesize experiences from pilot locations
- Catalyze new strategic partnerships
- Transfer experiences to new locations
- Broad-based implementation at multiple locations
- Document and disseminate experiences

Conclusions

- Smallholder agriculture remains an effective route to broad-based growth and poverty reduction
- Technologies are necessary but not sufficient
- Seed interventions must be responsive to demand
- Need for a new paradigm shift from technology-driven to demand-driven R&D
- Need for strategic partnerships

Session V
Working Groups

Terms of reference for working groups

Each group was expected to identify key (no more than 5) constraints in a particular area and suggest solutions or approaches to strengthen national and regional seed systems. Recommendations for improving seed multiplication and distribution were presented in the plenary.

Group I

- Define how the regional gene bank and genetic resources assembled will contribute to the seed sector in West Africa.
- How can the assembled germplasm be efficiently distributed and used by researchers, development agencies, communities and individual farmers?
- What are the training and research needs in genetic resources?
- Constraints in operating an effective plant genetic resources at the national level and possible solutions.

Group II

- Formal vs informal seed systems: What can bring these two systems to work closely on improve seed quality and delivery?
- How to organize seed schemes at community-based or/and individual farmer level.
- Roles of commercial seed companies.
- Emergency/seed security stocks.
- Seed information systems.

Group III

- Roles of private and public sector.
- Seed regulation and policy.
- Roles of national and international institutions.
- Roles of NGOs and farmer groups.

Session VI
Strategies for Improvement of the Groundnut Seed Sector

Working Group 1: Maintenance and utilization of genetic resources

Conclusions

An appropriate system should be developed and maintained to facilitate access to and distribution of the regional working collection to all stakeholders. There is an urgent need to increase awareness among all stakeholders and others involved in the groundnut subsector about this important resource in the region through a regional information system.

A regional harmonization on the use of plant genetic resources in general would ensure that distribution procedures are in concurrence with international changes in attitudes towards germplasm. These changes need to be understood by all stakeholders.

The method of seed storage under modified atmosphere, tested under GGP, has shown great promise. The economic feasibility of this method needs to be established and diffused widely in the region. Cold storage requires high investment and operational costs.

Attempts should be made to assist communities to conserve their groundnut genetic resources in situ. Most national programs in the region still lack basic germplasm conservation facilities and thus assistance with basic facilities is still vital.

Sharing knowledge and information on genetic resources is essential to using diversity and needs to be strengthened. Heightened awareness of genetic resources and associated IPRs is essential to facilitate the efficient use of germplasm. This will necessitate training in all aspects of genetic resources.

In order to maintain the regional collection on a sustainable basis, it is essential to sensitize all those involved in the groundnut seed sector in the region to contribute to its maintenance.

Working Group II: Alternative seed multiplication and distribution systems

Improvement of the formal and informal seed systems

To improve seed systems so that good quality seed is supplied, there is a need to :

- Integrate seed production in a scheme able to maintain quality throughout generations and ensure a balance between demand and supply for seed.
- Strengthen the capacity of institutions to produce breeder or basic seed in a sustainable way.
- Separate regulatory and quality control from seed multiplication and distribution institutions.
- Develop flexible quality norms especially for commercial seed.
- Strengthen training and information dissemination for different participants/operators.

Mechanisms for effective community-based and/or individual farmer seed schemes

- Link communities to markets of preferred varieties.
- Develop contractual arrangements between communities/farmers and processors.
- Place more emphasis on community seed systems, to help solve the problem of high transaction costs involved (bulkiness and low multiplication rate).

How to encourage commercial seed companies to invest in the provision of high-quality seed

- Assess the cost and benefits from investment in seed production and distribution.

Emergency/seed security stocks

- Seed security stocks need to be maintained for use in case of drought. This could be done at different levels:
  - For breeder seed: more responsibilities to others including public institutions.
  - At the farmer/community level: seed banks or irrigated seed production or storage under vacuum.

Working Group III: Roles of public and private sectors in groundnut seed production and supply

Constraints	Roles of various actors: Public sector (National Services, Org. Reg. & Int.)	Roles of various actors: Private sector (Farmer associations, NGOs)
Varieties		
• Limited range of old varieties	• To develop and accelerate creation of varieties by national, regional and international organizations	• Promotion of new varieties (field demonstrations and variety catalogs)
• Participatory research not well developed	• Involvement of producers and other beneficiaries in the choice of varieties.	
• Insufficient quantities of improved seed	• To put in place measures to encourage creation of seed enterprises (proper taxes, credits etc.)	• Creation of seed enterprises involving several crops to maximize profits (e.g. hybrids)
• Lack of seed security stocks	• To define a national seed policy and a national seed security plan	• To contribute to the constitution and/or maintenance of security stocks (e.g. community based)
Institutional and policy		
• Inadequate and often uncoordinated seed	• To define a favorable and realistic seed production policy in consultation with the private sector. • To enhance logistical means at the research level to produce breeder seed	• Planning seed production in liaison with research and users • Assuring on-farm evaluation of new varieties
• Delays in diffusion of new varieties	• To facilitate release of new varieties.	• Supplying high quality seed corresponding to the market requirements

...Continued

Continued

Constraints	Roles of various actors: Public sector (National Services, Org. Reg. & Int.)	Roles of various actors: Private sector (Farmer associations, NGOs)
• Lack of involvement of private seed producers in the production and distribution of improved seed	• To control seed regulations and guarantee quality of seed to producers	• Strictly following and respecting seed regulations
• Strict seed legislation	• Recognition of the profession of seed production (national register and granting of licenses) • To simplify national seed regulations. • To participate in the harmonization of regional seed legislation and regulations to facilitate exchange.	• Contributing to the elaboration of national/ regional seed regulations.
Financial		
• High cost of breeder seed • Weakness in marketing improved seed	• State subsidy on production of breeder seed • Public awareness campaigns • Encourage linkages between formal and informal sectors	• Giving favorable prices to producers • Putting in place a system of taxes on products sold • Putting in place a network of on-farm demonstrations • Respecting quality norms • Intensifying collection points for selling
Training and information dissemination		
• Lack of trained producers	• Organization of training workshops in production and commercialization.	• Supporting organization of farmer organizations • Training of seed entrepreneurs

... *Continued*

Continued

Constraints	Roles of various actors: Public sector (National Services, Org. Reg. & Int.)	Roles of various actors: Private sector (Farmer associations, NGOs)
• Poor/lack of information flow	• Putting in pace a national information network; produce information bulletins and seed catalogs.	• Diffusion of information to entrepreneurs on varieties, results from participatory trials, market trends, technical bulletins and field visits
Organizational		
• Weakness in farmer structures • Weak interaction between actors in the sector	• Institutional support to farmer organizations and associations • Contribution to organization of national interprofessionals.	• Facilitating access to credit and inputs • Encouraging dialogue among the various actors Definition of clear roles and responsibilities of each actor

Session VII
Closing Session

Closing speech of the CFC representative

Mohamed Ramouch[1]

Ladies and gentlemen

We have come to the close of the workshop and I wish to thank again the Malian authorities for their hospitality. I also thank the presenters for the high quality of their presentations and the participants for the high level discussions.

The CFC has followed the progress of this project with particular interest since its initiation and today we feel satisfied that the objectives have been attained and the results will no doubt have a significant impact on the groundnut sector in this region. I take this opportunity to congratulate all partners for the remarkable work done.

Considering the importance of the groundnut sector in the national economies and the livelihoods of smallholder farmers, the CFC is, in principle, in favor of examining the financial support of a second phase that will build on the accomplishments of the GGP. This second project proposal is in preparation by our partners and will be submitted to the Fund in the coming weeks through the relevant International Commodity Body (ICB).

Ladies and gentlemen, I would like once again to thank you for your active participation. I thank partners for the excellent organization of the workshop.

Last, but not least, I would like to thank the interpreters for their availability and patience.

Thank you for your attention.

1. Common Fund for Commodities (CFC). P.O. Box 74656, 1070 BT Amsterdam, The Netherlands.

Closing speech of the FAO representative

Peter Thoenes[1]

Mr Chairman, distinguished representatives, dear participants

I was meant to address the meeting on the first day but unfortunately could not be here in time due to conflicting work commitments. I would like first to briefly introduce myself and the role of FAO in this project and then share with you my impressions of this week's workshop.

I work with FAO's Commodities and Trade Division as economist/market analyst responsible for oil crops and also serve as Secretary to the Intergovernmental Group on Oilseeds, Oils and Fats. In fact, this group has been designated as the ICB responsible for identifying, formulating and, eventually, endorsing and supervising all CFC projects related to oil crops - a task which is performed together with the respective technical units within FAO, in this case the Seed and Plant Genetic Resources Service.

I would like to start by thanking CFC and the PEA for having made this end-of-project workshop possible. I was particularly pleased to note the wide participation at this meeting, which indeed was one of the primary goals of this workshop.

This week, we have listened to some very interesting presentations and there have been some very good and lively debates on technical issues. In this regard I wish to thank all the presenters, chairpersons, rapporteurs and discussants.

The two main outcomes of the workshop have been as follows:

1. A review of the ongoing project's main achievements. I am glad to note the general consensus that the project has achieved its main goals and objectives. The PEA (ICRISAT) and its two main partners, CIRAD and ISRA, have established a regional network for groundnut germplasm through a collaborative effort and participatory approach at the NARS level - with valuable assistance in overall coordination and management.

1. FAO, Commodities and Trade Division. Viale delle Terme di Caracalla, 00100 Rome, Italy.

2. An in-depth discussion on options for future downstream activities in the area of groundnut seed production. This forward-looking approach is in line with the FAO's and CFC's original long-term development strategy for the sector. In fact, upon endorsement by FAO, CFC has agreed to consider a project proposal for the improvement of downstream production of groundnut seed in the region (building on the improved material generated under the current project).

With regard to the development of a strategy for downstream seed production I wish to underline the following points:

Although follow-on activities will need to build on the results of the ongoing project, the programme under consideration is of an entirely different nature and dimension in that a different part of the sector (filiere) is concerned and in that different and more diverse groups of stakeholders will be involved. As a result, a completely new strategy will need to be developed. In fact, there are no ready-made strategies or blueprints for the problems to be addressed this time (as opposed, at least to a certain extent, to the stage when the GGP was designed). A number of key features seem to emerge as main strategic elements of a seed production program for the region.

(i) A purely demand- or market-driven approach as opposed to the research-driven agenda of the first project. This key difference needs to be kept in mind throughout project formulation. It implies new partners and new types of partnership. This time, operations are to be guided and determined by the perspectives of private operators, farmer organizations and NGOs as well as policy makers and legislators.

(ii) The development of integrated seed production systems. Attention would focus on the full integration or complementarity of formal and informal seed production activities. The formal sector comprises public entities as well as private operators with commercial interests, while the informal one includes organized farmers (partly in partnership with NGOs and private entrepreneurs). The envisaged integration between these two subsectors will require new forms of cooperation; partial departure from classical, traditional structures; and innovative approaches and solutions (e.g. with regard to subcontracting foundation seed production or seed quality control and certification).

(iii) Demand-driven activities imply a strong market orientation. Market forces operating at local, regional and international level need to be fully understood and taken into account. Dr Ndjeunga has elaborated on these aspects in his presentation yesterday and these will have to be

researched further. Particularly, in-depth analyses of the potential of the different segments of the markets at local and country/regional level are needed, so as to shed light on the economic parameters involved (see also further down) and to allow the formulation of concrete, location-specific marketing strategies.

The strategy elements listed above would appear to have a number of implications - at the purely operational level - within a future regional seed production program.

First, such a program would have an experimental character in that, initially, pilot activities would be conducted in a limited number of locations or countries, which ought to represent as much as possible the region's diverse seed production patterns.

Second, the program would focus on evaluating the experience gained in each module and introducing adjustments accordingly. To do this efficiently, a central coordination unit will be needed, which would also be responsible for sharing the acquired knowledge throughout the region and for building a network among concerned partners/stakeholders. Finally, work would focus on the replication of those seed production schemes that proved to be successful in other countries in the region. Hence, a phased approach would need to be adopted, moving from experimentation to testing and evaluation and finally, to replication on a larger scale. Consequently, the entire mode of operation of the program must be sufficiently flexible and adaptable.

Third, to be successful, project management and coordination must build on maximum collaboration with all stakeholders involved or potentially interested in groundnut seed production in the region. True partnerships have to be developed between all specialized research institutions (at national, regional and international level); farmer organizations and NGOs; and individual and organized entrepreneurs (at the seed production, processing and trading level).

Before concluding, I would like to discuss one aspect, which - although mentioned here and there - has not been addressed explicitly: the key issue of the economic viability of groundnut seed production in the region. While there is a general consensus about the need to involve the private sector in seed production, the multiple constraints currently faced by private operators in the region have to be investigated carefully. The reasons for the private sector's limited involvement to date are manifold, ranging from the farmers' limited demand for improved seed to the high costs involved in

producing groundnut seed as opposed to the seed of other crops (due to the groundnut's self-pollinating character, its low multiplication rate and the larger quantities required). It is clear that the sustainability of any new seed production scheme proposed will ultimately depend on its economic viability. Therefore, again, a reminder about the importance of properly identifying and analyzing all those economic and market parameters that will affect seed production and the sector as a whole. Perhaps, initially, special forms of support to stimulate private sector participation may be worth considering (and testing under a new project) - such as the establishment of revolving funds and the provision of tailormade credit packages.

Ladies and gentlemen, I am confident that the findings and recommendations of this workshop (especially with regard to downstream activities) will be taken into account by those involved in the formulation of a program to promote the production and distribution of improved groundnut material in the region.

I conclude by thanking again the PEA and its partners as well as our hosts, the Ministry of Agriculture and IER of Mali, for all their input and efforts, and for their hospitality.

Thank you.

Closing speech of the ICRISAT representative

Farid Waliyar[1]

The representative of IER, the CFC representative, the FAO representative, the members of the Steering Committee, participants, ladies and gentlemen

We have just spent three days together taking stock of the results of the Groundnut Germplasm Project. We have listened to and appreciated all the lessons learned and new discoveries, which have been the subject of interesting discussions.

First of all, I would like to thank CFC for its financial support, which has enabled us to undertake our activities. In addition to this financial support, we have always received any other assistance needed for the successful execution of the project. We have had (especially because of ICRISAT's role as PEA) a special relationship, and the CFC representatives have been exceedingly supportive in terms of project implementation. Their latest representative, Mr Ramouch, has established an excellent relationship with the group and we are all extremely grateful for his help.

I take the liberty of directly addressing a member of the GGP who has greatly contributed to the success of this project, Mr Robert Schilling. He is leaving research because he will be retiring soon. On behalf of my colleagues, I would like to thank Mr Schilling for what he has done for the entire region through various initiatives, including the GGP. The SB (Supervisory Body) has played an extremely important role; its advice and comments have made our task so much easier. Mr P Thoenes has been a friend and supervisor of this project and I extend to him our deepest appreciation.

This project was carried out in collaboration with CIRAD and ISRA and I would like to take advantage of this opportunity to express our heartfelt thanks to our two partners. Without their involvement, we would not have obtained the results that we have just presented. The project has come to an end but I hope that our collaboration will continue into the future.

I would also like to express my gratitude to the members of the Steering Committee for their guidance in our directions and implementation of the

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). PEA Representative. Patancheru, Andhra Pradesh 502 324, India.

work. I also thank WECARD and CAA for the support they have given to this project.

I would equally like to express my deepest appreciation to all the NARS for their contribution to project activities. Finally, I would like to congratulate the regional coordinator and all the national coordinators. I therefore hope that other opportunities will reunite us to successfully work together to help poor farmers in the region.

Thank you.

Closing speech of the Director General of IER

Bino Témé[1]

The representative of the Director General of ICRISAT, the representative of the CFC, the representative of WECARD/CORAF, the representative of the AGC, the CIRAD representative, the ISRA representative, the Director General of IER, the Head of the GGP, honorable guests, ladies and gentlemen

Over the last three days, you have carefully examined many aspects of the research conducted within the framework of the GGP in West and Central Africa. These range from management of genetic resources to seed production and distribution, from training and exchange of lessons learned, to characterization of the groundnut sector and global and regional perspectives of the groundnut market, and competitiveness of African producers. You have also analyzed the different West African groundnut seed systems and the regional strategy for seed multiplication and distribution.

Your working groups have discussed the problems of conservation and use of genetic resources, alternative seed production and distribution systems, and the role of the private sector, and pertinent recommendations have been made. It is comforting to note that since its inception GGP has enabled a great collection of 6000 accessions to be constituted and made available to the different West and Central African Countries. This project has also been a forum for exchange and evaluation of groundnut seed systems in West Africa in order to meet the fundamental needs of production and distribution of quality seed. Encouraging results have been obtained in the areas of training. The development of a regional network of trials has allowed the different countries involved in GGP to obtain varieties that are adapted to their different cropping conditions.

Within the framework of the new project, which will focus on transfer of GGP generated technology and knowhow, you have clearly outlined the role of the government and the private sector in the groundnut seed production and processing chain.

Ladies and gentlemen, I shall not take the risk of replying to all your recommendations; however, I can assure you that they will be taken into

1. Institut d'Economie Rurale (IER), Directeur Général, BP 258, Bamako, Mali.

account in defining the actions to be taken at the level of our national systems for agronomic research.

Last, but not least, I would like to thank ICRISAT, CFC, FAO, ISRA and the NARS of the groundnut-producing countries for their open collaboration, which has enabled the project to achieve such appreciable results. I would also like to thank the African Groundnut Council (CAA) and CORAF/WECARD for giving a regional scope to the project. Wishing you all a safe return journey to your home countries, on behalf of the Ministry of Rural Development, I declare the Final Workshop of the GGP closed.

Thank you.

List of participants

Scientific partners

Moustapha Adomou
Chercheur, Agronome Arachide
Direction Scientifique, INRAB
BP 884Cotonou, BENIN
Tél: (+229) 30 02 64
Fax: (+229) 30 07 06
Email: inrabdgl@bow.intnet.com

Amadou Ba
Chercheur
Coordinateur Réseau Arachide / CORAF
BP 53 Bambey, SENEGAL
Tél: (+221)9 73 60 50/51/54
Fax: (+221) 9 73 60 52

Alhousséyni Bretaudeau
Professeur, IPR/IFRA
Koulikoro, MALI
Tél: (+223)26 20 15/12
Fax: (+223) 26 31 93
Email: bretaudeau@afribone. net. ml

Arthur DaSylva
Chef Adjoint GGP
ISRA-CNRA
BP 53 Bambey, SENEGAL
Tél: (+221)9 73 63 36
Fax: (+221) 9 73 63 37
Email: upse@telecomplus.sn

Siaka Dembélé
Direction Scientifique, IER
BP 258, Bamako, MALI
Tél: (+223) 22 26 06
Fax: (+223) 22 37 75
Email: siaka.dembele@ier.ml

Candidus A. Echekwu
Associate Professor
Department of Plant Science, IAR, ABU
PMB 1044 Zaria, NIGERIA
Tél: (+234) 069 550 681
Fax: (+234) 069 550 563
Email: iar.abu@kaduna.rcl.ng.com

Scientific partners

Adam Frimpong
Legumes Breeder, SARI
P. O. Box 52, Tamale, GHANA
Tél: (+233)071 22411
Fax: (+233) 071 23483

Issoufou Kapran
Responsable, Unité Semencière
BP 429, Niamey, NIGER
Tél: (+227) 72 22 52
Fax: (+227) 72 21 44/72 22 52
Email: ikapran@yahoo.com

Ondié Kodio
Chef Programme Arachide
IER-CRRA Kayes, MALI
Tél: (+223)52 16 62
Fax: (+223)52 16 62
Email: crra.kayes@ier.ml

Ibrahim Mahamadou
Chercheur, INRAN
Tél: (+227) 41 06 85
Email: sareli@intnet.ne

Amos Miningou
Chercheur, INERA
Niangoloko, BURKINA FASO
Tél: (+226) 88 02 46
Fax: (+226) 88 02 46

Bino Témé
Directeur Général, IER
BP 258 Bamako, MALI
Tél: (+223)22 26 06
Fax: (+223)
Email: bino.teme@ier.ml

Kemoring Trawalley
National Agricultural Research Institute
PMB 526 - Serakunda, THE GAMBIA
Tél: (+220) 48 31 65
Email: nari@commit.gm

Scientific partners

Kisma Wagué
ISRA/GGP
BP 53 Bambey, SENEGAL
Tél: (+221) 973 63 36
Fax: (+221) 973 63 36
Email: upse@telecomplus.sn

Adama Traoré
Président CNRA, CORAF / WECARD
BP E 1911 Bamako, MALI
Tél/Fax: (+223) 22 71 65
Email: cnra@spider.toolnet.org

Scientific partners

Marcel Nwalozie
Scientific Coordinator (CORAF / WECARD)
7, Avenue Bourguiba,
BP 8237 Dakar-Yoff, SENEGAL
Tél: (+221)825 96 18
Fax: (+221) 825 55 69
Email: marcel.nwalozie@coraf.org

Ousmane Ndoye
ISRA / CNRA Bambey
BP 53 Bambey, SENEGAL
Tél: (+221)973 63 48
Fax: (+221) 832 24 27
Email: ousndoye@refas.sn

International institutions

Mohamed Ramouch
Chargé de la coopération
Common Fund for Commodities
Post box 746556
1070 BR Amsterdam,
THE NETHERLANDS
Tél: (+31)20 575 49 75
Fax: (+31) 20 676 0231
Email: Mohamed.ramouch@common-fund.org

Elhadji Mour Mamadou Samb
Secr. Exéc., Conseil africain de l'arachide (CAA)
P. O. Box 3025-Marina, Lagos, NIGERIA
Tél: (+234) 1 88 78 11

Robert Shilling
CIRAD-CA
Programme Cultures Alimentaires
BP 5035, 34032 Montpellier Cedex, FRANCE
Tél: (+33) 04 67 61 58 78
Fax: (+33) 04 67 61 71 60
Email: robert.schilling@cirad.fr

ICRISAT

Farid Waliyar
PEA, GGP
ICRISAT, Patancheru
Andhra Pradesh 502 324, INDIA
Tél: (+91)40 329 6161
Email: f.waliyar@cgiar.org

Richard B. Jones
Technology Exchange Specialist
ICRISAT-Nairobi c/o ICRAF
United Nations Avenue, Gigiri
P. O. Box 39063, Nairobi, KENYA
Tél: (+254) 2 524 556 (Office)
Tél: (+254) 2 522 280 (Residence)
Email: r.jones@cgiar.org

Alain Mayeux
GGP Project Manager, CIRAD/1CRISAT
BP 6478 Dakar-Etoile, SENEGAL
Tél: (+221)823 92 65
Fax: (+221) 823 92 65
Email: mayeux@sentoo.sn

International institutions

Peter Thoenes
Secr., Intergovernmental Group on Oilseeds, Oils and Fats
FAO, Commodities and Trade Division
ViaTeme Caracalla-00 100 Rome, ITALY
Tél: (+39) 06 57 05 34 98
Fax: (+39) 06 57 05 44 95
Email: peter.thoenes@fao.org

Pierre Fabre
Chef Programme CALIM, CIRAD -CA
Avenue Agropolis - TA 73/09
34 398 Montpellier Cedex, FRANCE
Tél: (+33) 04 67 61 71 09
Fax: (+33) 04 67 61 59 88
Email: pierre.fabre@cirad.fr

ICRISAT

Bonny R Ntaré
Germplasm Specialist
ICRISAT-Mali
BP 320 Bamako, MALI
Tél: (+223) 222 33 75
Fax: (+223) 222 86 83
Email: b.ntare@icrisatml.org

Jupiter Ndjeunga
Agro-Economist
ICRISAT-Mali
BP 320 Bamako, MALI
Tél: (+223) 222 33 75
Fax: (+223) 222 86 83
Email: j.ndjeunga@icrisatml.org

Hassan Y Bissala
Assistant de Recherche
ICRISAT Sahelian Center , Sadoré
BP 12404 Niamey, NIGER
Tél: (+227) 72 25 29
Fax: (+227) 73 83 29
Email: h.yahaya@cgiar.org

Farmer organizations

Moussa Kéita
Syndicat des Producteurs de Kita, MALI
Responsable des femmes, CMDT, Kita, MALI

Mamadou Camara
Président CRU, Kayes, MALI
Tél: (+223)52 16 73

Mme Naré Traoré
Présidente de l'Association des femmes de GonsoloBancoumana, MALI

Mme Diallo
Présidente des femmes de Samé
Kayes, MALI

Private sector

Amadou Djigo
Président UNIS-Sénégal
BP 30057 Dakar, SENEGAL
Tél: (+221) 825 75 51
Fax: (+221) 825 75 88

Adeyemi Joshua
President, Seed Association of Nigeria Ltd
Premier Seed Nigeria Ltd,
Chikati Industries Estate
P. O. Box 1673 Zaria, NIGERIA
Tél: (+234)69 334 804/33 16 30
Email: joshua@skannet.com

Development partners

Boubacar S Camara
Agronome, SG2000
BP 3541 Bamako, MALI
Fax: (+223)221 90 28
Tél: (+223) 221 90 28
Email: SG2000@afribone.net.ml

Marcel Galiba
Coordinateur régional, SG2000
BP 3541 Bamako, MALI
Tél: (+223)221 90 28
Fax: (+223) 221 90 28
Email: SG2000@afribone.net.ml

Niels Hanssens
Winrock International
Bamako, MALI
Tél: (+223) 229 38 80
Email: winrock@cefib.com

Assétou Kanouté
\ADAF-GALLE
Tél / Fax: (+223) 221 00 33
Email: adafgalle@datatech.toolnet.org
Moussa Sogoba
CREDO, Bamako, MALI
s/c ADAF-GALLE

Saydou Togola
Stop Sahel
Bamako, MALI
Tél: (+223) 223 33 80
Email: stopsahel@datatech.toolnet.org

Soriba Diakité
Point Sud
Bamako, MALI
Tél/Fax: (+223) 228 52 29
Email: pointsud@afribone.net.ml

Dassé Bouaré
Service Semencier National
BP 167 Ségou, MALI
Tél/Fax: (+223) 320 330

Resource persons

Boubakary Cissé
Logistique et Informations Générales
ICIRISAT-MALI
Tél: (+223) 222 33 75
Fax: (+223) 222 86 83
Email: b.cisse@icrisatml.org

Aoua Traoré
Logistique et Informations Générales
ICIRISAT-MALI
Tél: (+223) 222 33 75Fax : (+223) 222 86 83
Email: a.traore@icrisatml.org

Bintou Kéita
Secrétariat
ICIRISAT-MALI
Tél: (+223)222 33 75
Fax: (+223) 222 86 83
Email: b.keita@icrisatml.org

Ibrahim Ba
Hotels, Billets et Visas
ICIRISAT-MALI
Tél: (+223) 22 33 75
Fax: (+223) 22 86 83
Email: i.ba@icrisatml.org

Boubou Sankaré
Transport
Tél: (+223) 222 33 75
ICIRISAT-MALI
Fax: (+223) 222 86 83
Email: b.sankare@icrisatml.org

Bassala Touré
Comptabilité (Perdiem et autres)
ICIRISAT-MALI
Tél: (+223) 222 33 75
Fax: (+223) 222 86 83
Email: b.toure@Dicrisatml.org

Development partners

Abba Diémé
DISEM / Direction Agriculture
Dakar, SENEGAL
Tél: (+221)832 01 58
Fax: (+221) 832 21 09

Hamidou **Dramé**
DNAMR
Bamako, MALI
Tél: (+223)22 34 20/22 40 36
Fax: (+223) 22 85 49

Aibon Tembely
Chambres d'Agriculture du Mali
BP 3299 Bamako, MALI
Tél: (+223) 21 87 25

Resource persons

Diallo Daouda
Reprographie
ICIRISAT-MALI
Tél: (+223) 222 33 75
Fax: (+223) 222 86 83
Email: d.diallo@icrisatml.org

Momar K Diagne
Interprète, OPUS LINGUA
BP 5138 Dakar,
SENEGAL
Tél/Fax: (+221) 825 70 14

Abbreviations and acronyms

AGC	African Groundnut Council
CBD	Convention on Biological Diversity
CBO	Community-Based Organisations
CFC	Common Fund for Commodities
CERAAS	Centre d'étude Régional pour l'Amélioration de l'Adaptation a la Sécheresse
CIRAD-CA	Centre de Coopération Internationale en Recherche Agronomique pour le Développement, Département des Cultures Annuelles
CORAF/WECARD	West and Central African Research Council for Agricultural Research and Development
DISEM	Seed Inspection Division
FAO	Food and Agriculture Organization
GGP	Groundnut Germplasm Project
IAR	Institute for Agricultural Research (Nigeria)
ICB	International Commodity Body
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IER	Institut d' Economic Rurale (Mali)
IGG/OOF	Inter-Governmental Group on Oilseeds, Oils and Fats
INRAB	Institut National de Recherches Agricoles du Benin,
INRAN	Institut National de Recherches Agronomiques du Niger
IPG	international property goods
IPR	intellectual property rights
ISC	ICRISAT Sahelian Center
ISRA	Institut Sénégalais de Recherches Agricoles (Senegal)
IRAD	Institut de Recherche Agronomique pour le Développement (Cameroon)
IRAG	Institut de Recherche Agronomique de Guinée
ITRA	Institut Togolais de Recherches Agricoles (Togo)
ITRAD	Institut Tchadien de Recherches Agronomiques pour le Développement
MTA	Material Transfer Agreement
NARS	National Agricultural Research Systems
NGOs	nongovernmental organizations
PEA	Project Executing Agency
PM	project manager
PY	project year
SARI	Savannah Agricultural Research Institute (Ghana)
SC	Steering Committee
SB	Supervisory Body
UNIS	National Interprofessional Seed Union

Participants

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

Patancheru 502 324, Andhra Pradesh, India

www.icrisat.org

ISBN 92-9066-454-1 CPE 144 891-2002