Revitalization of Groundnut Production in West and Central Africa: Partnership between ICRISAT, the CFC, FAO, NARS and CIRAD

BR Ntare[1], F Waliyar[2] and **HY Bissala[3]** (1. ICRISAT, Bamako, BP 320, Bamako, Mali; 2. ICRISAT, Patancheru 502 324, Andhra Pradesh, India; 3. ICRISAT, BP 12404, Niamey, Niger)

The West African Groundnut Germplasm Project, commonly known as GGP, was initiated in 1996 to revitalize groundnut (*Arachis hypogaea*) production in West Africa. The main objectives of the project were to enhance the productivity and sustainability of groundnut production systems in West Africa, and to produce and distribute necessary foundation seeds that can be multiplied by the national research centers for introduction into the seed production and distribution system.

The project comprised six components: (1) germplasm assembly, maintenance and conservation; (2) germplasm characterization, evaluation and screening for genetic traits; (3) enhanced availability of germplasm for utilization in crop improvement; (4) training; (5) technology dissemination; and (6) project management, coordination and monitoring.

The Common Fund for Commodities (CFC) funded the project. ICRISAT was the project-executing agency (PEA) responsible for the overall implementation of the project, including coordination of activities, financial control (including audits), procurement and reporting of progress. Two sub-centers were selected to play a key role in project implementation: ICRISAT Sahelian Center (ISC) and L'Institut Senegalais de Recherches Agricoles (ISRA). The Centre de Cooperation Internationale

en Recherche Agronomique pour le Developement (CIRAD) based at Montpellier, France provided the project manager to assist the PEA in coordinating project activities. The Inter-Governmental Group on Oilseeds, Oils and Fats (IGG/OOF) of the Food and Agriculture Organization of the United Nations (FAO) acted as the Supervisory Body.

Key national agricultural research systems (NARS) played a leading role in some of the project activities where they had comparative advantage. For example, ISRA in Senegal was responsible for the identification of agronomically suitable varieties and foundation seed multiplication and distribution. ISRA also conducted research on drought, integrated management of aflatoxin contamination and confectionery groundnuts.

L'Institut National de l'Environement et de Recherches Agricoles (INERA), Burkina Faso was responsible for screening and evaluation of germplasm for resistance to foliar diseases: rust and early and late leaf spots. The Institute for Agricultural Research (IAR), Nigeria, with backstopping from ICRISAT, was responsible for screening germplasm and breeding lines for resistance to groundnut rosette. L'Institut d'Economie Rurale (IER), Mali carried out research in integrated management of aflatoxin contamination and variety evaluation. L'Institut National de Recherches Agronomiques du Niger (INRAN) provided the project with facilities for screening, rejuvenation, and multiplication of germplasm at its research station at Bengou in Niger. The project empowered these NARS to take a lead on specific regional constraints and has encouraged horizontal exchange of technology.

Other NARS such as Institut National de Recherche Agricole du Benin (INRAB), Benin, Savannah Agricultural Research Institute (SARI), Ghana, Institut Togolais de Recherche Agricole (ITRA), Togo, Institut de Recherche Agronomique pour le Développement (IRAD), Cameroon, Institut de Recherches Agronomiques du Guinee (IRAG), Guinée, and Institut Tchadien de Recherche Agronomique pour le Développement (ITRAD), Tchad conducted regional variety trials and have greatly benefited from research spillovers.

Germplasm Assembly, Maintenance and Conservation

The project addressed biodiversity in a broad sense and focused on upstream activities. The germplasm was characterized for botanic and agronomic characteristics, screened, and evaluated for genetic traits of economic importance. Other activities included germplasm documentation and distribution, variety identification, production and distribution of foundation seed of released varieties and training of professionals and technical staff involved in germplasm conservation and seed production.

Germpalsm assembly and conservation. Six thousand diverse groundnut germplasm accessions from the global genebank at ICRISAT, Patancheru were duplicated in a regional genebank at ICRISAT, Niamey, Niger. The regional genebank is maintained to international standards. Additional collections of unique groundnut germplasm were collected in Mali (23 samples) and Tchad (14 samples).

Germplasm documentation. The assembled germplasm has been documented in various forms such as printed catalogs, a computer-based catalog and CD-ROMs, and has been posted on the Web (www.icrisat.org). The printed catalogs and CD-ROMs have been widely distributed in the sub-region.

Germplasm distribution and exchange. The project ensured that useful germplasm and improved varieties were available to NARS and other beneficiaries in a timely manner. A total of 6370 samples were distributed during the project period. To ease germplasm exchange, technical aspects of quarantine procedures were documented in consultation with NARS partners. Most of the accessions held in the genebank are designated to the FAO. To protect this material as International Public Goods (IPGs), a Material Transfer Agreement (MTA) setting out general principles and procedures in germplasm transfer and exchange was established. This is routinely used.

Evaluation and Diffusion of Selected Germplasm and Improved Groundnut Varieties

Variety evaluation. A network of regional variety trials was established in 1998 in 11 countries of West Africa. A total of 92 improved breeding and germplasm lines were evaluated in these trials. The varieties were grouped according to various economic traits such as resistance to foliar diseases, resistance to groundnut rosette, tolerance to aflatoxin contamination, tolerance to drought, confectionery types and high yield potential. They were compared with standard controls of appropriate maturity. The best varieties across the region yield 15–40% more than the standard varieties and are listed in Table 1.

Variety releases. Four short-duration rosette resistant varieties (ICGV-IS 96894, ICGV-IS 96891, ICGV-IS 96808 and ICGV-IS 96855) and three medium-duration varieties (UGA 2, UGA 5 and M572.801) were proposed to the National Variety Release Committee of Nigeria for registration and release. In May 2001, ICGV-IS 96894, UGA 2 and M572.801 were approved for wide-scale production. These varieties offer prospects for eliminating 30–100% yield losses due to rosette, thus improving productivity of the crop in Nigeria. This will also restore farmers' confidence that they can grow the crop without losing their harvest to a devastating disease.

In Senegal, six high-yielding confectionery varieties (ICGV 97041, ICGV 97047, ICGV 97049, ICGV 97052, ICGV 9765 and H75-0) were identified and are candidates for release. These varieties will be available to farmers for cultivation under irrigation to provide protection from aflatoxin contamination and promote the groundnut trade. Other varieties are in advanced stages of on-farm testing in national variety trials in other countries.

A regional variety catalog, which brings together the best varieties currently available, has been published.

Foundation Seed Multiplication

Before the project, less than 20 varieties were multiplied in the region. Some of these are no longer adapted to environmental conditions such as drought, pest pressure and viral diseases or do not meet the quality standards of the market (free from aflatoxin contamination, and grades and standards for edible groundnut). The project assisted NARS to produce limited quantities of breeder and foundation seed of new verities at the national level. A total of 37 new high-yielding varieties is available. About 30,000 t of high quality breeder and foundation seed was produced during the project period.

Table 1. The best varieties from the regional testing program.

Variety group	Variety	Variety group	Variety
Resistant to early leaf spot	ICGV 91225 ICGV 92099 ICGV 92087 # 3-94 ICGMS 42 (CG 7)	Tolerant to drought	ICGV 86024 ICGV 86124 ICGV-SM 86024 GC 8-35 11908-13 55-21
Resistant to late leaf spot	ICG 7756 ICG 8298 ICGV 88274 ICGV 92082 ICG (FDRS) 4	Tolerant to aflatoxin contamination	ICGV 88274 ICGV 89063 ICGV 89112
Resistant to groundnut rosette (short-duration)	ICGV-SM 93525 ICGV-IS 96802 ICGV-IS 96808 ICGV-IS 96855 ICGV-IS 96891 ICGV-IS 96894 ICIAR 19BT	Resistant to rust	ICG 10933 ICG 10963 ICG 10014 ICG 10918
Resistant to groundnut rosette (medium-duration)	ICGV-IS 96812 ICGV-IS 96814 ICGV-SM 88761 M343-81A MDR 8-15 M516.791 M572.801 UGA 2	Confectionery groundnut	ICGV 88434 ICGV 93057 ICGV 93104 ICGV 94222 ICGV 97041 ICGV 97052 ICGV 97065 H 75-0

Strengthening National R&D Capacity

Training was an integral part of all research and development (R&D) activities to upgrade the skills of professional and technical staff in priority areas. Research capability in collaborating NARS was enhanced through the provision of funds for labor, supplies and equipment. Three major training workshops were organized. Sixteen national scientists from 11 countries in West Africa received training in genetic resources and genebank management, 15 scientists from 12 countries were trained in methods for diagnosis and detection of virus diseases and aflatoxin contamination; and 27 participants from 13 countries attended a training workshop on groundnut seed production, handling, storage, distribution and marketing. Two hundred farmers (100 each in Mali and Niger) received training in participatory variety selection, on-farm seed production, and conservation. Fellowships were also offered to visiting scientist and research scholars.

Technology Dissemination

Paramount among the project's goals was the imparting of information of value to beneficiaries. The project promoted the sharing of information, research databases, methodologies and outputs among all its participants and stakeholders. This was achieved by conventional means such as hosting workshops and conferences, annual planning sessions, publishing reports and newsletters, and on-farm pilot programs. Other means of information dissemination was through e-mail and web-based approaches. Seven scientific articles written by project scientists in collaboration with NARS scientists were published in refereed international journals and 16 conference papers were also published in workshop proceedings. These articles covered a variety of aspects including genetic resources, material exchange, seed systems, conservation and distribution. The publications provide both a permanent record of project achievements and an enhanced understanding of technology. Other important publications included five project newsletters, 3 training manuals and 4 technical manuals.

Lessons Learned

Development lessons

- A broad range of germplasm has been assembled in the region to support future development. Breeders and other users now have a ready access to a diverse gene pool for development of new varieties to meet farmers' and market requirements. It is imperative that this resource be maintained at a sustainable level.
- To increase the returns on research investment the promotion of technologies (improved varieties) arising from the project has to be extended to the ultimate beneficiaries (eg, farmers, small-, medium- and large-scale processors).
- There are inherent transaction costs of centralized seed production because of the bulkiness and fragility of groundnut seed. The development of sustainable systems to produce high quality seed in close proximity to those in dire need is essential.
- National programs in West Africa are highly heterogeneous, with different capacities and needs, and many face extremely difficult resource allocation choices. Those NARS that lack the required financial, scientific and infrastructure resources may use resources more efficiently by improving their capacity to be efficient spillover recipients.

Operational lessons

- Partnership and networking are essential in tackling regionally important constraints. Individual NARS possess considerable expertise in particular research areas. Tapping this potential and assuring collaboration and coordination between NARS should contribute to sustainable groundnut production in the sub-region.
- Accessibility to information is crucial. Databases developed on groundnut germplasm make ready access to this resource a practical reality. Knowing what is available in the collections, and the traits and characteristics of the material, saves users' precious time and energy.
- Farmers are eager to experiment with new varieties. This is increasing the adoption of new varieties selected by farmers themselves.

Perspectives

In the past, germplasm exchange in West and Central Africa was rare, fortuitous and not usually monitored, and the development and distribution of improved groundnut varieties faced serious constraints. Under the project, a regional network for sustainable conservation of germplasm and for the development and free distribution and exchange of improved seed material has

been established. In particular, a broad range of germplasm has been assembled in the region to support future development, the capacity of NARS to handle and improve germplasm has been enhanced and an important number of improved groundnut varieties has been tested and is now available in the region. This represents the first, essential step towards increased productivity and sustainable production of groundnut in West Africa. In an environment where public agencies have progressively withdrawn from germplasm research and seed production and distribution activities, the project has raised the awareness of stakeholders at the public, private, non-governmental organization and farmer groups of the need for long-term, coordinated efforts in the production of improved seed. To build on this solid foundation CFC approved a four-year (2003–06) follow-up project to focus on the development of sustainable seed production and delivery systems:

The main objectives of the follow-up project are:

- Promote utilization and uptake of improved groundnut varieties responding to market requirements, through the development of sustainable community-based seed systems
- Promote measures to minimize *Aspergillus flavus* and aflatoxin contamination
- Improve skills of farmers and other entrepreneurs in seed production, delivery, processing marketing and small seed enterprise management
- Improve the flow of information between various stakeholders
- Project management and monitoring

Outputs

- Groundnut varieties meeting domestic, regional and international markets available
- Sustainable breeder and foundation seed supply developed to cover at least 20% of the cultivated areas in the target areas
- Alternative seed supply strategies implemented
- Linkages between producers, processors and other stakeholders enhanced
- Impact of improved varieties and seed delivery systems documented
- Agronomic practices to reduce aflatoxin contamination demonstrated
- Diagnostic tool kits extended and safety standards system ready for implementation
- Better harvesting and storage technologies extended
- Relevant stakeholders trained
- Relevant information widely disseminated
- Project management, coordination and monitoring