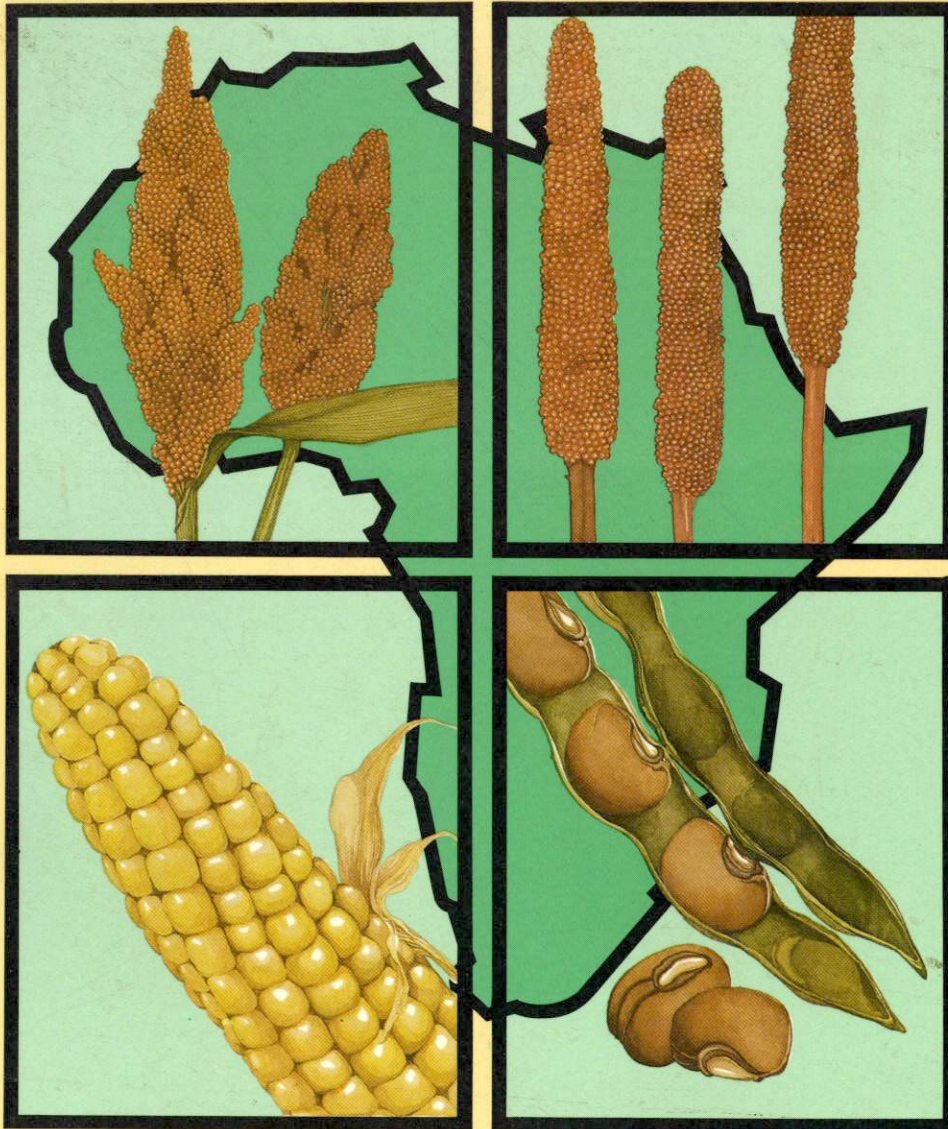


The SAFGRAD Networks

Serving National Agricultural
Research Systems and
Food Grain Farmers
in Sub-Saharan Africa



Organization of African Unity
Scientific, Technical and Research Commission



Semi-Arid Food Grain Research and Development

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and Food Grain Farmers in Sub-Saharan Africa



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ISBN 978 2453 23 4

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Introduction

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The estimated 250 million people who live in the semi-arid regions of sub-Saharan Africa depend heavily on agriculture for their survival and well being. The most important foods for these people — accounting for at least 70 per cent of their staple diet — are maize, sorghum, millet and cowpea.

In East Africa, maize and sorghum are the main crops, while millet constitutes only about 15 per cent of the grains produced. The main food item in both East Africa and southern Africa is maize meal. In West and Central Africa, maize, sorghum and millet are grown extensively, especially in the Sahel and Sudan savanna areas. Cowpea is a principal ingredient in the diet of over 80 per cent of the people in Africa's semi-arid regions, providing more than 50 per cent of their daily protein requirements. About 8 million tons of cowpea, representing approximately two thirds of the entire world production, is derived from West and Central Africa, with Nigeria and Niger being the major producers.

Throughout Africa's semi-arid areas, however, per capita food and agricultural



The environment of semi-arid Africa is harsh and hostile. Soils are fragile and are low in fertility, and the resource base is subject to rapid desertification and frequent droughts.

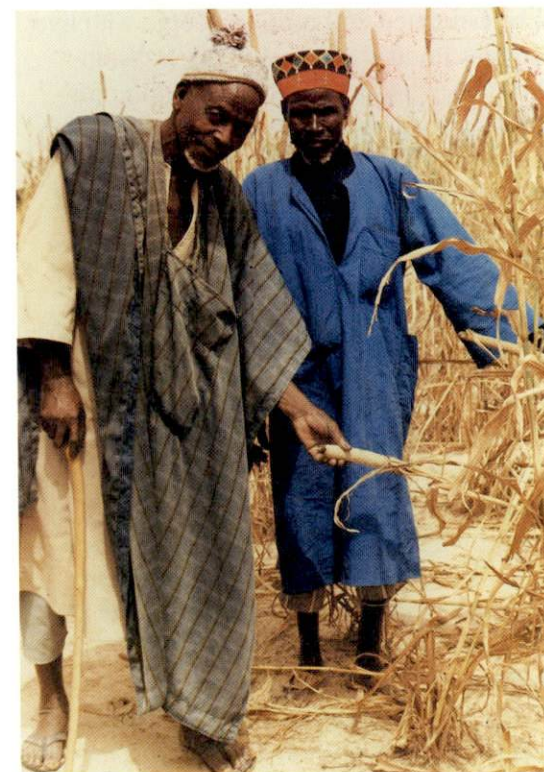
production has progressively declined but the human population has continued to increase. A major constraint is the unfavorable environment. The semi-arid zones are characterized by substantial variations in stress factors, by low and irregular rainfall, and by fragile and generally poor soils, especially in terms of nitrogen and phosphorous content. The resource base is subject to widespread degradation and deterioration, which has forced larger livestock species out of the farming system and led to a decline in the supply of animal power and manure. As a result of the human population pressures, there has been heavy cultivation and the virtual disappearance of the natural fallow system which helped maintain soil fertility. Degradation of the resource base is further exacerbated by frequent droughts and the rapid desertification process.

Food grain farmers in semi-arid Africa wrestle daily with this harsh and hostile environment to produce their staple foods. Crop yields tend to be well below potential. For example, whereas the potential yield for cowpea is 500-2000kg/ha, the average yield produced by small farmers is less than

300kg/ha. For these farmers, life is a continuous struggle to increase grain production in an attempt to meet their basic daily requirements.

Region-specific research is essential to help these farmers. Neither the national agricultural research systems (NARS), nor the international agricultural research centres (IARCs) operating in these areas, can be expected, alone, to provide effective solutions to the numerous agricultural problems faced by farmers. Weaknesses in the NARS have been frequently identified as one of the major constraints to agricultural development and to sustainable food production in sub-Saharan Africa.

To address these weaknesses, the Semi-Arid Food Grain Research and Development (SAFGRAD) organization was established. It is based on the sound rationale that investment in supporting NARS, and especially national food grain research scientists, would yield positive returns in terms not only of sustainable increases in food grain production but also of major improvements in the lifestyles of food grain farmers and their families.



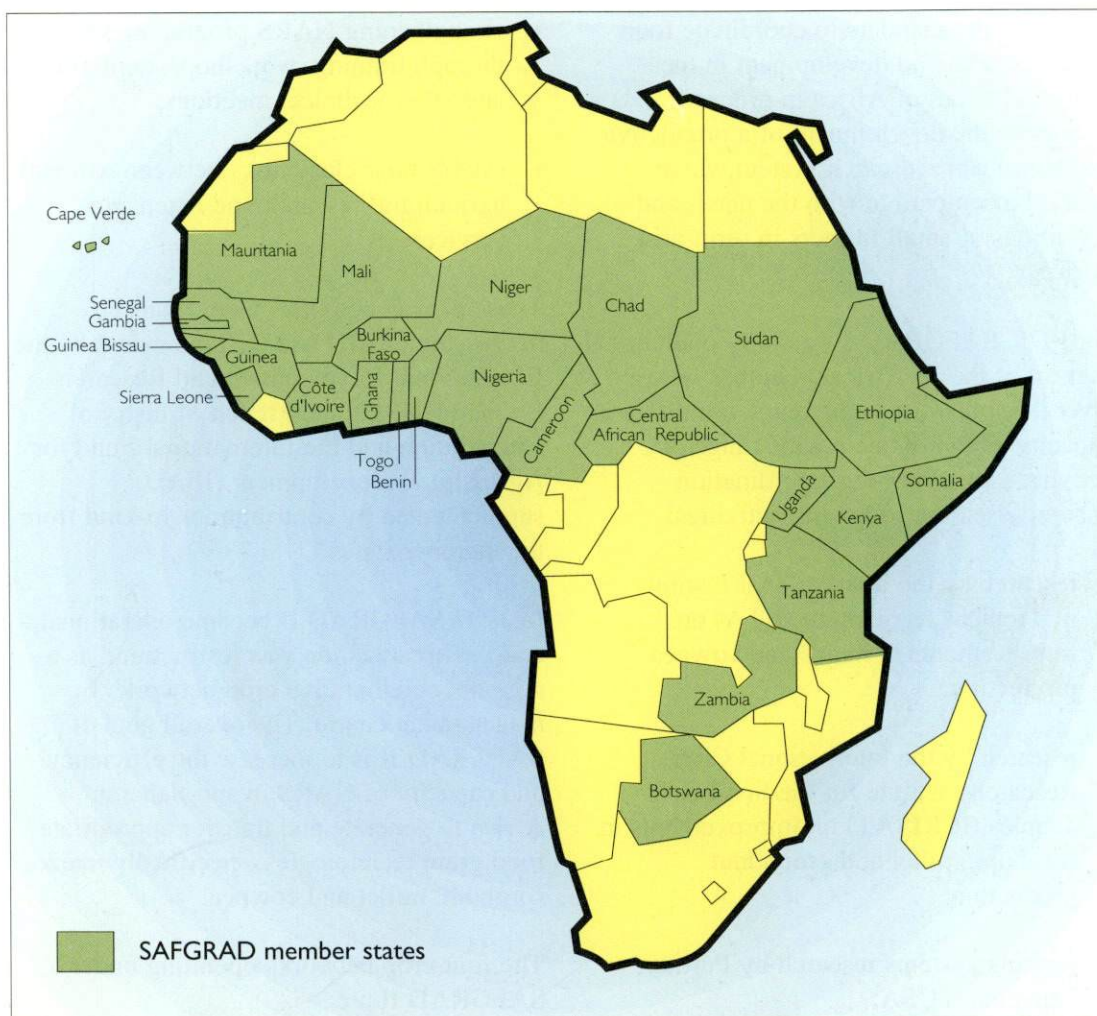
SAFGRAD work has helped farmers in the semi-arid areas of sub-Saharan Africa to increase their production of food grains and improve their standard of living.

What is SAFGRAD?

SAFGRAD was established as a result of a determined multi-donor effort to promote and utilize scientific research for increased and sustained production of the staple food grains — maize, cowpea, sorghum, millet and groundnuts — in the semi-arid zones of Africa.

The forerunner of SAFGRAD was a United States Agency for International Development (USAID) project, JP 26, which had been initiated in 1969 and was based at the Institute for Agricultural Research (IAR) in Nigeria. This project was implemented in collaboration with the Organization of African Unity's Scientific, Technical and Research Commission (OAU/STRC). Its objective was to assist regional research efforts in maize, sorghum and millet, and by 1976 it was clear that this project had been successful.

As the drought situation in Africa worsened during the 1970s, African Heads of State created SAFGRAD in 1977, following a Resolution adopted by the 1976 OAU Council of Ministers in Mauritius. A Pan-African Project, JP 31, was thus established



and given the mandate to coordinate food grain research and development in the semi-arid zones of Africa in order to accelerate the development of a productive and sustainable research system which would be compatible with the needs and conditions of small farmers in semi-arid Africa.

By 1978, SAFGRAD I was fully operational in most of the 26 African member states. Over the following eight years, it built up its capacity to coordinate a wide range of activities. By 1986, this coordination encompassed the following activities:

- research by the International Institute of Tropical Agriculture (IITA) on improvements in maize and cowpea production;
- research by the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) on improvements in sorghum, millet and groundnut production;
- farming systems research by Purdue University, USA;

- strengthening NARS programmes through training, workshops, conferences and other technical meetings;
- establishing close links between national agricultural research and extension services.

These project activities were financed mainly by USAID and to some extent by the International Development and Research Council (IDRC), the French Ministry of Cooperation and the International Fund for Agricultural Development (IFAD), supplemented by contributions in-kind from the member states.

In 1987 SAFGRAD II became operational, and the organization was restructured as a regional collaborative crop network management centre. The overall goal of SAFGRAD II is to increase the efficiency and capacity of NARS in sub-Saharan Africa to generate and transfer appropriate food grain technologies, specifically maize, sorghum, millet and cowpea.

The four crop networks operating under SAFGRAD II are:

- the West and Central Africa Maize Network (WECAMAN);
- the West and Central Africa Cowpea Research Network (RENACO);
- the West and Central Africa Sorghum Research Network (WCASRN);
- the East Africa Regional Sorghum and Millet Network (EARSAM).

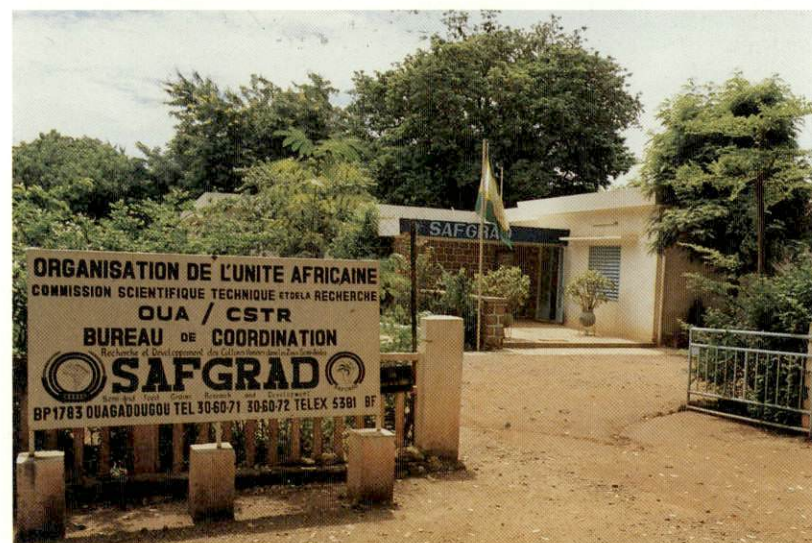
In addition to coordinating the activities of these USAID-funded regional networks through the provision of organizational and logistical support, between 1984 and 1989 SAFGRAD also managed a farming systems research project which was being conducted in Burkina Faso, Benin and Cameroon. Funding for this project was provided by IFAD.

SAFGRAD is a component unit of the OAU/STRC, and its coordination office is based in Ouagadougou, Burkina Faso. This office is headed by an International Coordinator, who is supported by a Director of Research and by financial and administrative staff.

SAFGRAD receives the highest level of political support from OAU headquarters, as illustrated by the visit of the former Secretary-General of the OAU, His Excellency Ide Oumarou.



The SAFGRAD coordination office in Ouagadougou, Burkina Faso exists to help national agricultural research systems strengthen their food grain research capacity.



SAFGRAD I 1977-1986

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Generating technologies to meet food grain farmers' needs

Research coordination

Technology transfer

Training and information exchange

SAFGRAD-coordinated research has resulted in the development of an implement for tied-ridging. Adoption of this technology is agronomically and economically feasible for increasing food grain production. Tied-ridging also helps to conserve moisture in the soil.

Generating technologies to meet food grain farmers' needs

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SAFGRAD I focused on characterizing the semi-arid zone ecologies, on identifying the critical factors which constrain food grain production in these ecologies and on regional research to develop crop varieties and technologies relevant to farmers' needs.

For the semi-arid regions of West and Central Africa, these activities were divided according to the main agroecological zones.

The Northern Guinea savanna zone, where the main crops are sorghum and maize, receives 900-1200mm rainfall per annum,

mainly between late May or early June and mid-October. Soils are mainly alfisols.

The Sudan savanna zone, in which the main crops are sorghum, millet and maize, receives 600-900mm per annum, between early June and late September. The pattern of rainfall, although more reliable than in the Sahelian zone, is too irregular to sustain grain production. Drought stress is common.

Very limited surface water resources are typical of the Sahelian zone. Rainfall is low, (200-600mm per annum) and falls between

mid-June and mid-September. Over 65 per cent of all millet grown in semi-arid Africa is grown in this zone. Cowpea is also important.

East Africa is characterized by the highland zone (over 1800m above sea level), the intermediate zone (1500-1800m) and the dry lowlands (below 1500m). The annual rainfall ranges from 500 to 1100mm. The main SAFGRAD activities in this region focus on the improvement of sorghum and millet (finger and pearl millets) production, particularly in the semi-arid region.



Maize, sorghum, millet and cowpea are very important staple foods for the people who live in the semi-arid regions of Africa.

The results of SAFGRAD's research coordination efforts can be divided into two main categories:

- SAFGRAD established effective regional research coordination and collaboration between IITA, ICRISAT and the NARS in the semi-arid areas of Africa;
- research coordinated by SAFGRAD improved farmers' grain production by developing improved varieties of maize, sorghum, millet and cowpea adapted to the different agroecological conditions.

The improved crop varieties are drought tolerant, early maturing, resistant to the major pests and diseases, and high yielding. SAFGRAD undertook the distribution of these varieties for extensive regional evaluation trials so that NARS could identify and select varieties suitable for use in their country programmes.

SAFGRAD also coordinated research into the development of more efficient water conservation technologies in order to support sustained crop production. Soil fertility in fragile soils has been enhanced



SAFGRAD-coordinated research has produced high-yielding maize varieties adapted to the environments of semi-arid Africa.

through the use of crop residues, animal manures and readily available and cheap fertilizers, especially locally sourced rock phosphates.

To increase farmers' productive capacity, it was necessary to look into ways of reducing their dependence on time-consuming,

labour-intensive farming operations. SAFGRAD research collaborators developed several labour-saving devices which have proved successful. Among these are animal traction devices such as the mechanical ridge-tier. Tied-ridging is an agronomically and economically feasible technology which has been shown to increase cereal production in semi-arid soils. In a location in Burkina Faso, maize yield increases of up to 100 per cent were achieved by the adoption of this technology. Other benefits of tied-ridging include reduced soil erosion from run-off during rains, risk aversion for the farmer in the use of fertilizers, increased soil moisture which allows the breakdown of local phosphate fertilizers, and reduced losses of organic residues.

SAFGRAD also turned its attention to cropping systems. By using traditional systems, food grain farmers in semi-arid Africa produce low crop yields. Research coordinated by SAFGRAD has resulted in the development of more efficient crop combination techniques, which have helped farmers to increase grain yields and diversify crop production.

Technology transfer

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The effective transfer of new technologies from research stations to farmers in the field was a major constraint to increased food grain production. SAFGRAD responded to this weakness by establishing

the Accelerated Crop Production Officers Programme. This programme served as a link between national agricultural research institutions, extension services and farmers. Extension agents transferred improved

crop varieties and crop production technologies to farmers, and at the same time they provided researchers with information from farmers concerning production constraints.

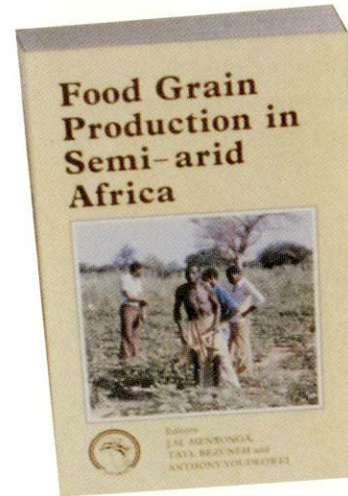


Through SAFGRAD field programmes, effective links are established between national agricultural research scientists, extension agents and farmers.

Training and information exchange

The training of research scientists and technicians was a major activity during this period. The primary aim of the SAFGRAD training programme was to strengthen NARS by helping to build up the number of appropriately trained researchers and technicians in food grain research. Training activities involving short-term in-service training in the IARCs provided extensive opportunities for trainees to acquire knowledge and improve their competence and skills in food grain research.

Between 1980 and 1985, SAFGRAD organized training for over 30 national scientists at higher degree levels in various



aspects of food grain research. In addition, over 80 scientists and technicians participated in SAFGRAD-sponsored short-term training courses on food grain production techniques.

Information exchange between researchers was facilitated through workshops, seminars, technical meetings and conferences. The publication of technical newsletters, reports, conference proceedings and books such as *Food Grain Production in Semi-Arid Africa* helped disseminate vital research information to all food grain research scientists working in Africa's semi-arid regions.

SAFGRAD II 1986-1991

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Networking

Coordinating research through the networks

Training and information exchange

Joint meetings of the Steering Committees of the SAFGRAD networks strengthen the coordination of network activities.

While maintaining its original objectives and goals, SAFGRAD II is optimizing the utilization of resources, technologies and scientific expertise which is available within national programmes to substantially improve the research capabilities of NARS through a strategy of core collaborative crop networks. SAFGRAD has now developed efficient and functional links within and between NARS to promote the generation and dissemination of proven technologies for high and sustained food grain production in the semi-arid regions of sub-Saharan Africa.

The SAFGRAD network model is based on strong collaboration between three principal partners, namely:

- NARS in SAFGRAD member states, which are the networks' target group;
- the IARCs, which provide technical research to backstop the networks;
- the SAFGRAD coordination office, which coordinates the networks and provides organizational and managerial support.



The Council of Agricultural Research Directors meets regularly to formulate policies for the efficient management of the SAFGRAD networks.

Sound management of the networks is achieved through the Council of Agricultural Research Directors from member countries of SAFGRAD. This council meets to define broad policies and elects an Oversight Committee to provide technical guidance in policy and management matters. With political support from the OAU, the committee strives to pool the infrastructural, human, material and financial resources of SAFGRAD member countries to resolve common food production problems.

Each network is technically supervised by a Network Coordinator and a Steering Committee which sets out objectives and priorities for work programmes and implements and monitors network activities. Joint meetings between the Steering Committees strengthen the coordination of network activities, especially by helping to establish collaborative research projects on specific major constraints to increased food grain production in different agroecological zones. Visits by Network Coordinators and members of the Steering Committees help national programmes to strengthen their research capabilities and foster information exchange.



The Oversight Committee provides technical guidance on the management of each SAFGRAD network.

SAFGRAD has successfully coordinated the systematic identification of the major researchable constraints to food grain production in the semi-arid zones. This critical activity has provided a sound operational framework for networking activities.

An efficient system for strengthening the research capability of NARS makes maximum use of the available human and material resources. To achieve this goal, SAFGRAD categorized NARS into three groups — Lead, Associate and Technology Adapting centres — according to their research capabilities and resources. Collaborative research projects on production constraints were then established between categories of research centres, with technical backstopping and material support from the networks coordinated by SAFGRAD.

Because many countries have recognized the benefits of participation in the SAFGRAD networks, the numbers of NARS-developed entries and technologies in regional trials have increased dramatically.



Collaborative agreements to facilitate working relationships between international agricultural research centres, national agricultural research systems and SAFGRAD are arranged and coordinated by the SAFGRAD coordination office.

West and Central Africa Maize Research Network (WECAMAN)

Through a series of collaborative research projects there has been extensive exchange of germplasm and related improved technologies among NARS, and between IARCs and NARS. For example, Togo adopted the maize-streak screening technology developed at IITA for mass rearing of viruliferous vectors. Streak-resistant maize varieties have been successfully selected. Early and extra-early maturing maize varieties suitable for cultivation in semi-arid zones have been developed and distributed to NARS and farmers.

West and Central Africa Cowpea Research Network (RENACO)

New cowpea varieties which perform satisfactorily across all the semi-arid regions in West and Central Africa and produce high-quality seeds have been developed and distributed by RENACO and are already widely cultivated by growers in many countries. Suvita-2, a cowpea variety developed in Burkina Faso, is now widely

accepted in Mali because of its high yields, good grain quality and resistance to *Striga*.

West and Central Africa Sorghum Research Network (WCASRN)

The activities of WCASRN cover some 17 countries. Research coordinated by this network has identified sorghum varieties Framida and ICSV 1007 BF as high-yielding, with satisfactory *Striga* resistance. Other improved sorghum varieties have been widely distributed to grain farmers. Between 1987 and 1988, for example, WCASRN supplied over 300kg of improved seeds to NARS in West and Central Africa.

East Africa Regional Sorghum and Millet Network (EARSAM)

EARSAM has established strong collaborative research and technology transfer programmes in East Africa. In cooperation with ICRISAT, the grain production environments of the region have been studied and characterized. Regional trials have shown the sorghum variety ICSV 112

and the finger millet variety P 244 to be high-yielding and well adapted to East African conditions. Sorghum varieties with good or satisfactory resistance to *Striga*, long smut disease (IS 8595) and ergot have also been identified. Seeds of these sorghum and millet varieties have been widely distributed to NARS for further evaluation, and work on the other crop production constraints has been intensified.

West Africa Farming Systems Research Network (WAFSRN)

This multi-donor network, now managed by SAFGRAD, aims to promote and facilitate cooperation between national and international researchers, institutions and programmes involved in farming systems research. It supports national research and strengthens NARS programmes through training and the exchange of information between researchers and technicians. It has established a scientific and technical information database on West African farming systems research which facilitates the dissemination of farming systems research information.



SAFGRAD manages the West Africa Farming Systems Research Network (WAFSRN), which supports technical workshops on farming systems research in the sub-region. Workshops facilitate the exchange of information and experiences.

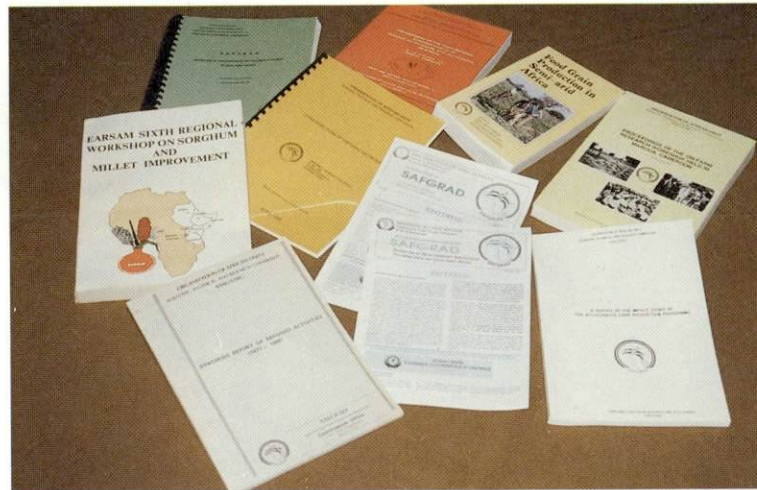
Training and information exchange

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The training of research scientists and technicians continues to be one of SAFGRAD's primary activities. By 1989, SAFGRAD had provided short-term intensive technical group training for over 220 specialists in various aspects of food grain production technology, including trial management, seed production, plant protection and research data analysis.

Workshops, seminars, conferences, symposia and other technical meetings organized through the SAFGRAD networks provide an excellent opportunity for research scientists to exchange information and share experiences.

SAFGRAD organizes frequent technical meetings to create a conducive atmosphere for increased interaction between research scientists. This has been an important contributory factor to the adoption and widespread distribution of improved food grain technologies throughout SAFGRAD member states.



Information dissemination is fostered through the publication of technical reports, books, newsletters, and conference and workshop proceedings.



A workshop was held with Cornell University (USA) on climatological changes. SAFGRAD works closely with other organizations and programmes operating in Africa's semi-arid zones.

About 80 per cent of the farmers in the SAFGRAD member countries are small-scale producers of the staple foods of the region, and thus efforts aimed at strengthening the food grain research capacity in NARS will continue to be central to SAFGRAD activities. Food self-sufficiency at the household level is attainable if technological changes take place at farm level. SAFGRAD will therefore give priority to enhancing food grain production and improving farming systems in the Sahel, Sudan and the Northern Guinea savanna zones in West and Central Africa and in the high-altitude, intermediate and dry lowland areas of East Africa. Efforts will be made to facilitate the generation and transfer of relevant, low- to medium-input technologies suited to the needs of resource-poor farmers.

The specific issues which SAFGRAD will focus on are summarized here.

Researchable issues

To address the constraints which seriously inhibit food grain production in the semi-

arid zones, the most important areas of research are:

- identification and development of cultivars that are responsive to low and medium levels of input and are compatible with existing cropping systems and farmers' resources;
- adaptation to drought and soil fertility stresses by making better use of available soil moisture and farm resources, such as crop residue and compost, in order to maximize yields of both traditional and improved varieties;
- further evaluation of lines of cowpea and sorghum which have been identified by NARS and IARCs as being resistant to *Striga*, which is now the major parasitic weed in the region, particularly in low-fertility soils in semi-arid zones;
- identification of crop lines which are resistant to diseases and insect pests (insects constitute a major constraint in food grain production and storage); relatively resistant cultivars that have already been identified for various crops

will be tested under different agronomic systems;

- intensifying cropping systems research in order to maximize the efficiency of land management and water utilization and improve soil fertility.

Collaborative research among national agricultural research systems

Many of the biotic and abiotic constraints to food grain production are common to most of the semi-arid zones, and this increases the scope for collaboration among NARS in terms of pooling their scientific capabilities and resources in an attempt to alleviate production problems. The focus of collaborative research efforts will be on priority issues in specific ecological zones.

Strengthening the research capacity of small or weak national agricultural research systems

The relevant SAFGRAD networks will help small or weak NARS, particularly those

engaged mainly in technology adaptation, in three main areas: varietal development and evaluation; evaluation of elite germplasm; and technology verification trials

Regional trials

The SAFGRAD networks will continue to play a role in facilitating the implementation of regional trials, to complement individual national efforts in the transfer and adoption of improved technologies within and between SAFGRAD member countries. Information on technologies developed by IARCs or by particular SAFGRAD countries will be disseminated through the networks, and SAFGRAD will help to facilitate the process of verifying these technologies under various environmental and socio-economic conditions.

Verification of improved technologies

Regional trial data indicate that a number of improved varieties are capable of producing high yields, but only a few of these varieties are being cultivated by farmers. This is largely because not enough work has been

done on seed production and evaluating these technologies using different agronomic practices. More support needs to be given to NARS to investigate the effects of various agronomic practices on improved varieties, specifically in relation to efficient water and soil conservation strategies and soil fertility maintenance.

Exchange of technical information

SAFGRAD will continue to facilitate the exchange of technical information through:

- short-term training on farming systems research and on problems of food production, storage and utilization;
- long-term training in research skills, to help alleviate the acute shortage of qualified researchers in most NARS; long-term training has been inadequate during the past decade, and this needs to be remedied, with the active involvement of NARS, universities and IARCs;
- workshops, seminars and monitoring tours;

- various types of publications; among the publications SAFGRAD intends producing are newsletters, technical bulletins, technology leaflets, a *Journal of Semi-Arid Agriculture*, technical reports and some technical books.

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