AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

TO BE COMPLETED BY ORIGINATING OFFICE

1. TRANSACTION CODE (*"X" appropriate box*)

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7. PROJECT TITLE - SHORT (*stay within brackets*): SAFGRAD

8. ESTIMATED FY OF AUTHORIZATION/OBLIGATION: a. INITIAL (mo. 3, yr. 77) b. FINAL FY 81

9. ESTIMATED TOTAL COST ($000 or equivalent, $1 = 22,874)

a. FUNDING SOURCE	FIRST YEAR FY 77			ALL YEARS		
	b. FX	c. L/C	d. Total	e. FX	f. L/C	g. Total
AID APPROPRIATED TOTAL			1,955			13,803
(Grant)	( )	( )	(1,955)	( )	( )	(13,803)
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. 1.						
Other U.S. 2.						
HOST GOVERNMENT			477			2,385
OTHER DONOR(S)			1,847			6,686
TOTALS			4,279			22,874

10. ESTIMATED COSTS/AID APPROPRIATED FUNDS ($000)

a. Appropriation (Alpha Code)	b. Primary Purpose Code	c. Primary Tech. Code	FY 77 d. Grant	FY 77 e. Loan	FY 78 f. Grant	FY 78 g. Loan	FY 79 h. Grant	FY 79 i. Loan	ALL YEARS j. Grant	ALL YEARS k. Loan
			1,955		2,705		2,893		13,803	
		TOTALS	1,955		2,705		2,893		13,803	
11. ESTIMATED EXPENDITURES										

12. PROJECT PURPOSE(S) (*stay within brackets*) [ ] Check if different from PID/PRP

Develop improved cereals (millet, sorghum, maize) and grain legumes (cowpea, groundnut) and cultural practices which are compatible with small farm semi-arid farming systems, and promote their adaptation and use in farmers' fields.

13. WERE CHANGES MADE IN BLOCKS 12, 13, 14, or 15 OF THE PID FACESHEET? IF YES, ATTACH CHANGED PID FACESHEET.

[ ] Yes [ ] No

14. ORIGINATING OFFICE CLEARANCE

Signature

Title: Dennis Conroy, Director, AFR/RA

Date Signed: mo. day yr.

15. Date Received in AID/W, or For AID/W Documents, Date of Distribution: mo. day yr.

AID 1330-4 (7-75)

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*being held separate by AFR/RA

C. SUMMARY DESCRIPTION

The Semi-Arid Food Grains Research and Development Project (SAFGRAD) represents a major initiative for addressing fundamental constraints to increased food production in the vast semi-arid zones south of the Sahara.

The project purpose is to develop improved cereals (millet, sorghum, maize) and grain legumes (cowpea, groundnut) and cultural practices, which are compatible with small farm semi-arid farming systems; and to promote their adaptation and use in farmers fields. The development of improved technologies is crucial to the success of agricultural development programs throughout the region which are based on the strategy of increasing small farm productivity.

Project activities fall into two broad areas: first, regionally coordinated research on staple cereals and grain legumes at three selected African research centers; second, support to national research, field trials and outreach programs to further develop, test and extend improved technologies to farmers.

The project will augment the total amount of research concentrated on cereals and food grain legumes by supplying crop researchers (including geneticists, pathologists, entomologists, physiologists, crops and soils management agronomists, and social scientists) to the Institute of Agricultural Research (IAR) at Samaru, northern Nigeria; the Centre National de Recherches Agronomiques (CNRA) at Bambey, Senegal; and the Kamboinse research station at Ouagadougou, Upper Volta.

IAR and CNRA are the major national research centers in Africa for semi-arid cereals and grain legumes. Research conducted there has direct relevance throughout the region. A few SAFGRAD scientists will be posted

at each of these two centers to fill important manpower gaps and to pursue a regional research focus, drawing on the expertise and facilities available there. Kamboinse, a small research station located near Ouagadougou in Upper Volta, will be a major recipient of crop research technical assistance. The station is geographically and ecologically well situated to test and adapt research results for the huge central Sahelian-Sudanian zone between Bambey and Samaru, including the drier areas within the zone.

Research objectives relate to: (1) Varietal improvement with an emphasis on breeding desirable characters and resistances into promising varieties with broad applicability in the region (2) Farming systems research to identify approaches and improved technologies which are best suited to small farmers and (3) Soils management research aimed at maintaining/increasing soil fertility.

Since research has no practical benefit until it is applied, SAFGRAD emphasizes the improvement of links between research and the farmer, including links between regional research and national research and between national research and extension agencies and ultimately, the farmer. The project supports regional scientific conferences, publications and information, uniform variety trials, farmers field trials, training for African scientists and technicians, and other forms of regional cooperation. Better regional and international cooperation among crop researchers and production specialists is intended to increase the overall efficiency of research in the region and to promote the adaptation and application of improved varieties and practices to local ecological and social/economic conditions. Research-farmer links are designed not only to facilitate the extension of results to farmers, but also to guide researchers in formulating research approaches with applicability to small farm systems.

Accelerated Crop Production Officers (ACPOs) will be assigned to national research agencies to perform a catalytic role in field testing and demonstrating research results and in advising researchers on small farm constraints and research needs. In most cases, ACPOs will be provided through bilateral arrangements between participating countries and individual donors. Some participating countries may provide their own ACPO.

A regional Farming Systems Unit (FSU) is established to study crucial issues related to developing and extending small farm technologies. The work of this unit is fundamental to project success.

Policy and program direction is to be provided by a Consultative Committee comprised of national crop research and development authorities, and donors. The Scientific and Technical Research Commission of the Organization of African Unity (OAU/STRC) is to perform a vital role of regional coordination and administrative support for the project. The grant agreement will be signed between AID and the OAU/STRC as Joint Project 31.

Scientific technical assistance will be supplied largely by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Institute for Tropical Agriculture (IITA) and U.S. Universities. These institutions have vital specialized expertise in the SAFGRAD crops, collections of genetic material, and an institutional interest and capability in working with national research agencies. An envisioned role for U.S. Universities involves participation in the Farming Systems Unit. Farming systems work will be conducted in close cooperation with national research centers and international research institutions (IRAT[1/], IITA and ICRISAT).

[1/] Institut de Recherches Agronomiques Tropical et des Cultures Vivrières

Total project costs are estimated at about $23 million over a five year period of which AID would finance $13.8 million, other donors including UNL and FAC $6.7 million, and host governments $2.4 million. AID's five year contribution would finance (1) eight senior crops and soils researchers doing varietal improvement and related work at the Institute of Agricultural Research (IAR) in Northern Nigeria ($1,410,000 over 5 years) and at the Kamboinse research station in Upper Volta ($2,512,500 over 5 years), (2) a three man Farming Systems Unit located at Kamboinse ($1,507,500), (3) Five Accelerated Crop Production Officers, each assigned to a participating country to augment national testing and extension of research results ($2,537,500 over five years), (4) Participant training for African scientists, research assistants and crop production specialists ($2,000,000 over 5 years), (5) OAU/STRC administration ($236,500), (6) Regional scientific conferences, approximately three annually ($303,750), (7) Office and laboratory construction and equipment ($245,000), (8) Consultants ($234,000), (9) AID project officer and operations ($570,000) (10) Contingencies and inflation ($2,246,000).

D. SUMMARY FINDINGS

The populations in the semi-arid regions[1/] of sub-Sahara Africa are among the poorest in the world. In recent years, this region has not been able to feed itself and "food self-sufficiency in the context of accelerated economic and social development"[2/] has become the first priority development objective in the region.

Of an estimated 161 million population in 18 SAFGRAD countries,[3/] 70 to 80 percent are estimated to be engaged in small farm agriculture. In the six-country Sahel region alone,[4/] an estimated 24 million persons depend almost entirely on cereal production for their livelihood. Many millions more in the other SAFGRAD countries also cultivate cereals and grain legumes as their principal staples.

Millet, sorghum and maize production accounted for 77% of all cereals produced in the SAFGRAD region in 1974. The figure is close to 100% for countries in the northern zone. The net value of this production

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1/ Defined for purposes of this project as areas where evaporation is greater than precipitation during five to ten months of the year or where annual rainfall does not exceed 1200 mm.

2/ p. 8, Report to the U.S. Congress, Proposal for a Long Term Comprehensive Development Program for the Sahel, A.I.D., Apr. 1976.

3/ Sub-Saharan African countries which will participate in the SAFGRAD Program by conducting national field trials and experimental work with SAFGRAD plant materials and guidance are referred to as "participating" countries. Participating countries are: Benin, Cameroon, Cape Verde, Central African Republic, Chad, Ethiopia, Gambia, Ghana, Guinea, Ivory Coast, Mauritania, Mali, Niger, Nigeria, Senegal, Sudan, Togo and Upper Volta.

A number of other African countries have expressed interest in receiving SAFGRAD plant materials and information. As individual arrangements are made with the OAU/STRC, these countries will be designated "cooperating" countries.

4/ Senegal, Mali, Mauritania, Upper Volta, Niger and Chad in areas of 900 mm to 1000 mm annual rainfall or less.

in 1974 is roughly estimated at nearly two billion dollars (13,700,000 MT of millet and sorghum; 3,623,000 MT of maize).

Per capita food consumption in the region has been declining during the past decade, even before the recent drought, as population has increased faster than food production. Increases in total food production have been achieved by decreasing fallow periods and increasing the total cultivated area. Yields have remained stagnant or declined as soil fertility has been reduced and as marginal lands have come under cultivation. The drought added a devastating dimension to the problem.

Until the past five years or so, research efforts on semi-arid food crops have been conducted with limited resources. In the past few years, as efforts at a few national and international research centers have accelerated, good technical progress has been achieved in incorporating desirable characters into cereal and groundnut varieties, and "improved" varieties and practices have been recommended.

But scientists and officials have been frustrated by an almost total lack of acceptance of the "improved" technologies by small farmers in Africa. "Improved" technologies developed to date have involved monoculture farming systems under "high infrastructure" conditions (with farm services and inputs available, e.g. extension marketing, fertilizer, chemicals, labor). Neither monoculture farming nor high infrastructure conditions appear possible for the vast majority of small farmers, now or in the near future.

Improved food crop technologies are necessary to feed the increasing population and to permit rural development. All development strategies for rainfed agriculture are based on the assumption that new technologies exist or can be developed. At present, with extensive national and international support, numerous seed multiplication and food crop production

programs are proceeding throughout the region on the basis of limited technology. New technologies, to be effective, must be compatible with small farmer farming systems. A "low infrastructure," low risk technology is needed (refer to Issue No. 5).

While the obstacles are very significant, experience indicates that the potential does exist to develop suitable technologies if research is conducted with adequate resources and integrated interdisciplinary research teams. Under the Joint Project 26 (J.P. 26)[1/], excellent progress was achieved with maize breeding, good progress with sorghum and less with millet. High yielding maize varieties have been successful enough in Africa to begin replacing sorghum in the more reliable rainfall areas of the Sudanian zone. While few improved sorghum or millet varieties have been produced, desirable traits and resistances have been identified and potential exists for varietal improvement.

Very little research has been conducted to date on cowpeas, a major food crop in West Africa, but the potential is exciting. Cowpea is normally intercropped with millet or sorghum but has very low yields compared to its potential, mainly because of insect and disease damage. Otherwise, cowpea has highly desirable characteristics including ecological adaptability and high nutrition. It also has important intercrop potential as a means of soil management and fertility maintenance.

The Institut de Recherches Agronomiques Tropical et des Cultures Vivrières (IRAT), a French research organization, has conducted considerable research on groundnuts, primarily as a cash crop, at Bambey, Senegal. This will be a valuable base for improvement of groundnut as a food

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1/ J.P. 26 is the designation of an AID supported OAU/STRC cereal research project which commenced in 1964 (refer to "Project Background.").

crop within small farm farming systems.

Soil fertility becomes an immediate and fundamental constraint as land is more intensively farmed. Soil management agronomists will be affiliated with the SAFGRAD varietal improvement and farming systems units to address this subject.

Economically, research has high cost-benefits potential. An increase in farm productivity of only one percent in the region (net of costs of using new technology) would generate economic benefits of roughly $20,000,000 per annum. Refer to "Economic Analysis."

While the number of researchers to be supplied under SAFGRAD are few compared to the number already in the region, they are expected to make an important contribution to crop research by: 1) Filling manpower gaps in breeding teams at existing national research centers; 2) Encouraging international and regional communication and exchange of results and materials among researchers; 3) Emphasizing research approaches appropriate to small farm conditions; 4) Adding a regional research dimension, and 5) Increasing the total amount of scientific talent in the region concentrated on cereals and grain legumes.

Project activities have been designed to reflect considerable experience with crop research in Africa. The design incorporates the suggestions and views of participating governments, national and international research institutes, principal donors, special studies such as the comprehensive "African Agricultural Research Capabilities" by the National Academy of Sciences, Wash., D.C., 1974, as well as experience with J.P. 26. Project concepts and specifics have been discussed thoroughly with the principal participants.

A regional role is considered vital in Africa in relation to the following activities. The SAFGRAD program contains elements directly relevant to each.

1. Intensify plant breeding for major cereals and grain legumes.

2. Test varieties and practices in practical farming systems at practical levels of fertility.

3. Facilitate the flow of information and plant materials among scientists.

4. Train African scientists and technicians.

5. Develop linkages between research and extension programs.

6. Focus effort on the drier areas where the most vulnerable populations live.

E. ISSUES

The following issues have been raised during the project development and addressed as part of the project design. Annex B presents the issues discussion.

1. Project management.

2. Role of Accelerated Crop Production Officers (ACPOs).

3. Research potential in the drier parts of the semi-arid zone.

4. Adequacy of inputs; recurrent costs.

5. Developing technologies relevant to small farmers.

F. Project Design Team

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Charles Sanders, Agricultural Officer, AFR/RA

Raymond V. Olson, Agronomist, Kansas State University

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II. PROJECT BACKGROUND ON DETAILED DESCRIPTION

A. Background

There has been considerable effort in support of agricultural research in Africa. Prior to the 1960's, the principal colonial powers organized and conducted research within their groups of colonies. Much of the research was concentrated toward commercial or cash crops. Inadequate effort was put forth to improve the production of food crops which was of primary importance to the small farmer.

Donors and newly independent African nations began, in the early 1960s, to address the problem of increasing production of food crops.

AID's first food crop research assistance began in 1964, in West and East Africa. This research was primarily concentrated on maize, sorghum, and millet. Research and limited field trials were conducted to determine local adaptability of existing varieties, to develop new varieties and agronomic practices to best utilize the genetic capabilities of the adapted or developed varieties, and to realize the potentials offered by current scientific progress in breeding techniques for high yielding and higher protein content varieties. In 1969, AID's food crop research assistance to Africa was separated into two operational projects. The East African portion of the program was supportive of the East African Community (EAC) and the West African portion was supportive to research at the Institute for Agriculture Research (IAR) at Ahmadu Bello University, Northern Nigeria. The West Africa project was coordinated by the Scientific and Technical Research Commission of the Organization of African Unity (OAU/STRC). It concentrated on establishing

and developing a coordinated research, testing and multiplication program for 16 countries in staple food crops (maize, sorghum and millet). Additionally, it addressed the training of a small core cadre of agricultural researchers. This program primarily involved a team of AID-financed USDA researchers posted in Nigeria at IAR/ABU, plus a researcher posted at Ibadan on maize and four Field Trials Officers (FTOs) supplied by the United Kingdom and France posted in Ghana, Nigeria, Senegal and Cameroon. This project (known as J.P. 26) became multidonor supported in the early 1970's. J.P. 26 is phasing out during 1976. The project attained very satisfactory results and recognition by host country officials and donor nations.

The United Kingdom has also been providing agricultural researchers in various posts in the Anglophone countries with emphasis perhaps at IAR/ABU. Likewise, the Institut de Recherches Agronomiques Tropical et des Cultures Vivrières (IRAT) has been conducting research in many locations in Francophone countries. The two most important IRAT sites involving cereal crops were at Bambey, Senegal and Maroua, Cameroon. Some research has been directed in recent years toward mixed cropping and farming systems with emphasis on the Francophone zones of West Africa.

Examples of the accomplishments from the above programs follow:

1. Identified maize as having the highest yield potential of the cereal crops in the Guinea Savanna region of West Africa.

2. Determined that yield limiting factors for maize are soil fertility and not climate in the Guinea Savanna, a deficiency correctable with chemical fertilizer or farmyard manure.

3. Developed more rust and leaf blight resistant maize varieties for Nigeria.

4. Initiated breeding program using recurrent selection of composites to improve the quality and quantity of protein in maize.

5. Discovered lines of sorghum with increased resistance to striga, head mold, shoot fly and sorghum midge.

6. Identified several races of downy mildew of millet, and learned that millet bred in one area for resistance is not resistant in areas with other races.

7. Conducted West African Uniform Trials of sorghum and maize.

8. Trained scientists from five West African countries.

While the above accomplishments are significant, it is generally recognized by leading Agricultural Development and Research Officers, that more research is vitally needed. Experience has indicated the need to research minimum input approaches which can be effectively disseminated thru national research/extension networks to reach small farmers.

The J.P. 26 experience, combined with the acknowledged need for continuation and expansion of research on mixed crops, farming systems, and field trials, has resulted in the preparation of the SAFGRAD proposal.

In January 1976, OAU/STRC and the West African Economic Community (CEAO) hosted a Conference on the SAFGRAD Proposal at Ouagadougou, Upper Volta. This conference was attended by fourteen (14) African countries, five (5) Donors, and five (5) International Centers/Agencies. About fifty (50) individuals were present. The group confirmed the need and urgency to

proceed with the SAFGRAD proposal. Likewise, the Conference recognized that ICRISAT had a mandate to conduct research in the area on sorghum/millet and has obtained United Nations Development Program (UNDP) funding for up to ten researchers for a three-year period. This UNDP support has already permitted initiation of research work on these two crops in the region, thus stimulating a broader multidonor approach for the SAFGRAD program.

The conferees made specific written recommendations on the research and training priorities, organization and management of the proposed SAFGRAD project, and the role of the ACPO under the respective National Research Directors. The Africa Bureau believes that continuation and expansion of the food crop research program is consistent with the combined objectives of the African countries, International Centers, and Donors, and will be supported by all interested parties.

B. Detailed Description

B.1. Project Organization and Management

General policy, planning and project management will be provided by a Consultative Committee (CC) assisted by a Technical Advisory Committee (TAC), both comprised of SAFGRAD country representatives, the OAU/STRC and key donor representatives. Representatives of the International Research Institutes will serve on the TAC. SAFGRAD country representatives on the two committess are to be key individuals concerned with national agricultural research and development, e.g., national research directors or research station directors. African representatives will be in the majority on both committees.

In planning and reviewing SAFGRAD regional research and development activities, the CC and the TAC will coordinate closely with national authorities of host countries to ensure effective integration of and mutual agreement about SAFGRAD and national programs. This coordination will be particularly important in detailing crop research objectives and annual workplans.

The OAU/STRC will provide a project coordinator, with an office at Ouagadougou, whose functions will be similar to those of an executive secretary under the CC.

Detailed description of project organization and management is presented in Part IV.A. "Administrative Arrangements".

B.2. SAFGRAD Regional Research

Technical assistance and operation support will be provided at the following regional research centers.1/

1. Institute of Agricultural Research (IAR), Nigeria.

As described more fully in the Technical Analysis, the IAR maintains a large and advanced crop research program with major centers at Samaru and Kano, Nigeria. In conjunction with the JP 26 project, considerable progress has been achieved in recent years in varietal improvement

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1/ Centers referred to as "regional research centers" in this document are actually national research stations. They are "regional centers" in the sense that national governments have agreed that regionally funded researchers are to be assigned there to conduct research that is regional in scope -- aimed at identifying and resolving crop production constraints of significance over broad ecological zones of the region. These stations are also regional in that they are major crop research stations in the region (particularly IAR, Nigeria and Bambey, Senegal), whose research findings have significance throughout the entire region.

of maize and, to a lesser extent, sorghum and millet, in the central and southern Sudanian zone. A solid base has been laid for future varietal improvement work with millet and sorghum thru the identification of major physical production constraints and the selection of breeding material with desirable characters -- photo insensitivity, high yield, and disease and pest resistances.

The IAR, which is part of Ahmadu Bello University, is predominantly staffed, operated, and funded by the Government of Nigeria (GON). The Nigerian government and IAR management have long recognized the regional value of crop research conducted at IAR and have expressed positive interest in supporting SAFGRAD to share IAR expertise and plant materials.

ICRISAT has made tentative plans with the GON to post up to eight scientists at IAR, if financing is available. Given the large amount of scientific resources already engaged in research at IAR, the ICRISAT-supplied scientists would constitute a relatively minor augmentation of the total research effort there. More importantly, however, they would be integrally involved and familiar with the IAR research programs and able to draw on IAR research results for adaptation and application to crop production problems in the SAFGRAD countries.

Of the eight positions tentatively agreed to, UNDP is to finance three and AID will finance three under SAFGRAD as indicated below. Two positions remain unfunded.

1 Plant Breeder (sorghum) - UNDP

1 Plant Breeder (millet) - UNDP

1 Seed Technologist - UNDP

1 Striga Physiologist - AID

1 Pathologist (millet/sorghum) - AID

1 Entomologist (millet/sorghum) - AID

1 Physiologist - Unfunded

1 Production Agronomist - Unfunded

As under the JP 26 project, scientists at IAR will operate as integral elements of the IAR varietal improvement program for these crops. At the same time, IAR management concurs that these scientists are responsible to focus on varietal improvement aspects that have importance in a regional context. As under JP 26, this gentlemen's agreement is expected to continue to operate satisfactorily to serve regional and national needs.

The entomologist and pathologist will assist the breeders by testing and selecting lines for desirable resistances; the striga physiologist will work to identify and test striga resistance in sorghum and millet.

The seed technologist will continue the work of the JP 26 seed technologist in the areas of seed multiplication, storage, treatment and transportation in support of national and regional trials and production programs.

AID-funded ICRISAT scientists are to be provided with $40,000 annual supplemental operating support for two research assistants, farm costs, etc. As under JP 26, the Government of Nigeria has generously agreed to provide housing, the use of offices, laboratories, experimental farms, equipment, supplies and technical cooperation. ICRISAT scientists will utilize scientific equipment, commodities and vehicles supplied under JP 26.

Varietal improvement objectives and targets are tabulated in Table 1. The explanation and rationale for these targets is presented in "Part III. A., Technical Analysis."

2. Centre National de Recherches Agronomiques (CNRA), Senegal

The CNRA at Bambey, Senegal, under the Institut Senegalese de Recherches Agronomiques Tropicals (ISRAT), is the major crop research center in Francophone West Africa for semi-arid cereals and certain other crops.

With major support from the French Institute de Recherches Agronomiques Tropicales (IRAT), extensive research has been conducted on improving millet and sorghum varieties and cultural practices (Refer to Part III. A. "Technical Analysis"). Bambey has an important role in relation to the SAFGRAD program as a regional research center in the drier part of the Sudanian zone with an annual rainfall of approximately 600-700 cm. and as a focal point for cooperation between research efforts and institutions in Francophone and Anglophone nations in semi-arid West Africa.

ICRISAT plans to post two UNDP funded researchers, a plant pathologist and an entomologist, at Bambey to supplement the work of two sorghum breeders, four millet breeders and numerous other national and international research staff already posted there. This would provide an important linkage with SAFGRAD researchers posted in Nigeria and Upper Volta. Refer to Annex F for CNRA organization chart and staffing pattern. Also, the ICRISAT coordinator for West Africa (seconded to ICRISAT by IRAT and funded by UNDP) is stationed in Senegal at Dakar.

The ICRISAT staff are provided to fill manpower gaps at Bambey, which is otherwise well staffed and equipped to continue its comprehensive millet and sorghum crop improvement research program. The provision of additional technical assistance to Bambey is severely constrained at the present time by a shortage of staff housing, research facilities and equipment, office space and experimental plots to accommodate a larger staff.

As at IAR, a principal reason for posting ICRISAT staff at Bambey is not only to augment the Bambey program, but equally important, to derive regional benefits from the research program at Bambey. ICRISAT scientists at Bambey will operate as integral elements of the CNRA program and will be in a position to use and benefit from research resources and results at Bambey and to facilitate their adoption and application to regional priorities.

The major external technical and financial support to Bambey is France, thru IRAT and FAC. While French support is of long standing and not considered part of the SAFGRAD project, continued French support is anticipated and is essential to the SAFGRAD strategy, i.e., to rely on Bambey as a major regional semi-arid research center.

3. Kamboinse, Upper Volta

The situation at Kamboinse, Upper Volta, is quite different than at IAR and Bambey. Kamboinse is not presently a major research center, but it is currently being developed with ICRISAT and UNDP support as a major national research station for semi-arid crops. ICRISAT, with UNDP funding, has provided a sorghum breeder and a plant pathologist to Kamboinse and is constructing new laboratory and office space and developing the experimental farm and multilocal trial sites.

Under the SAFGRAD project, AID technical and financial support to regional crop research will be concentrated largely at Kamboinse. The principal rationale is: (1) to develop crop research capability in an ecological zone representative of large areas of the central and northern portions of the Sudanian zone, in between the major existing research centers and ecological zones represented at Bambey and IAR; (2) to create a "demand pull" situation in this zone for the adoption and application of research. Little benefit will accrue to the vast central and northern Sudanian and Sahelian zone farmers from the work performed at Bambey and Samaru without a local research capability to test and adapt new varieties with adequate research resources in the area where they are to be applied. From Kamboinse, research will be conducted in multilocal sites in northern Upper Volta, which is representative of the drier cropping regions of semi-arid Africa, where the poorest and most vulnerable farm populations live; (3) Kamboinse is located about 15 km. from Ouagadougou which makes it possible to house and service senior scientists with minimal capital improvement expenditure at the station.

Nine senior researchers are to be provided under SAFGRAD to the regional varietal improvement and soils research effort at Kamboinse, -- four AID-funded, three UNDP-funded and two remain unfunded. Three other scientists comprising a special Farming Systems Unit will be provided by a U.S. University and AID-funded (see page).

Technical assistance is planned as follows:

3.1 Varietal Improvement/Soils Research

(1) Sorghum Breeder - ICRISAT provided -- UNDP-funded[1/]

1/ On board.

(2) Pathologist -- ICRISAT - UNDP-funded

(3) Millet Breeder -- ICRISAT[2/] -- UNDP-funded

(4) Production Agronomist - Unfunded

(5) Soil Fertility Agronomist -- IITA -- AID-funded

(6) Soil Management Agronomist -- ICRISAT[2/] -- AID-funded

(7) Entomologist (grain legumes & cereals) - Unfunded

(8) Grain Legume Breeder (cowpea) - IITA[2/] -- AID-funded

(9) Maize Breeder -- IITA[2/] -- AID-funded

The millet/sorghum research team would be comprised of ICRISAT scientists. The maize and grain legume team would be provided by IITA. The work of these researchers will be closely coordinated with that of IRAT, other donor, and national scientists doing similar work in the area. As of June 1976, there were 10 IRAT agronomic researchers posted in Upper Volta, some of whom were working on projects related to SAFGRAD crops.

Research objectives are the same as those relevant to the regional research at IAR (refer to Table 1), except that emphasis at Kamboinse would be on the lower rainfall agriculture (800 mm. rainfall p.a. and less) and ecological conditions of central and northern Sudan and southern Sahel.

Research workplans will be developed by the ICRISAT/IITA/National Researchers, in close collaboration with the Technical Committee and the host government. Work plans will be approved by the CC. Technically, the research effort should benefit greatly from the expertise and experience of the international research institutes (IITA, ICRISAT) and from their collection of plant materials and information.

2/ Probable source of technical assistance.

Each group of regional scientists is to develop (1) a general long term workplan (4 years, 1978-1981) with a strategy and approach for addressing the SAFGRAD research objectives and (2) an annual detailed workplan presenting intermediate objectives and approaches, quantifying the work to carry out the annual plan. Refer to Part IV. B. "Implementation Plan" for more detailed description of the research workplanning process.

AID-funded scientists at Kamboinse would be provided $40,000 annually for operating expenses which includes assistants' salaries, farm operations, supplies, vehicle etc. Other donors should likewise program similar funding to support their researchers.

Two-way links between researchers and farmers are to be organized, i.e., (1) a flow of information from farmers' fields to scientists so that scientists can direct their research to small farm conditions (2) mechanisms for transmitting research benefits to national research stations, to extension/trials/demonstration programs and ultimately to the farmer. The Farming Systems Unit also stationed at Kamboinse is a vital mechanism for linking research to farmers.

3.2 Farming Systems Research

The organization and functions of the Farming Systems Unit (FSU) constitutes a response to the major project issue, i.e., how to develop relevant small farm technology (Refer to Issue No. 5). To date, "improved" techniques have not produced significant benefits for small farmers, and this fact has raised questions not only about the efficiency of the technology transfer mechanism, but also about the crop research approaches.

A three man FSU will be formed to contribute to a better knowledge of small farm conditions and to the potential and means of benefitting small farmers through crop research. The team will be comprised of a production agronomist, an agricultural economist and a rural sociologist, and social anthropologist. The team will be assisted by research assistants and graduate students. It will coordinate closely with the ACPOs.

Principal functions of the FSU are to: (1) Analyze small farm conditions and the application of new technologies to those conditions; (2) Formulate strategies regarding the development and application of small farm relevant technology; (3) Develop recommendations regarding physical research priorities; and (4) Design, help organize and analyze farmer field trials as a means of performing the first three functions.

A critical question to be addressed in regard to functions nos. 1 - 3 is whether or not the development of "low infrastructure" technology is technically possible and economically and socially efficient compared to the more standard "high infrastructure" technology.

Much of the empirical observation and verification needed for this analysis would be derived from farmer field trials. The FSU would work with scientists and ACPOs to help design farmers trials and to assist ACPOs in conducting and analyzing them. Properly designed, farmers field trials under small farm conditions should reveal small farmer production constraints (physical, economic, cultural, etc.) and suggest directions, potential and priorities for additional varietal improvement or other research. Studies of the use of "improved packages" under small farm conditions should reveal what new technologies seem applicable or promising and the reasons why.

Innovative field trials methodologies are needed. New technologies need to be tested under practical farm conditions, i.e., multicrop, low infrastructure, labor constraints, etc.

Physical, agronomic, economic, and social analyses are needed. In calculating farmer benefits, it is necessary to estimate returns to the entire farming system as a result of the innovation, not just returns to a sole crop. The subject of risk and its implications regarding technology needs examining.

The FSU works closely with SAFGRAD scientists to develop research priorities which appear to have potential under small farm "low infrastructure" conditions.

Where new technologies prove beneficial, national agencies should be encouraged by regional researchers to further develop, demonstrate, and extend the results.

Arrangements will be attempted to assign graduate university students in agronomy, agriculture, economics and social anthropologists to the unit to conduct accredited research as part of their graduate program.

The work of the FSU requires coordination with ACPOs and national governments in conducting the needed field trials and studies. While ACPOs are not administratively responsible to the FSU, countries with an ACPO must recognize that FSU - ACPO cooperation is to be encouraged on an organized basis. Such recognition should be provided in the bilateral agreement which establishes the ACPO positions and responsibilities. Refer to discussion below on Accelerated Crop Production Officers and Issue No. 2.

The FSU will draw heavily on the considerable information sources available including:

a. Rural Economy Research Unit ABU, at Samaru

b. Nigerian Extension Liaison Research Service (ELRS) at Samaru

c. Nigerian "National Accelerated Food Production Project (NAFPP)" headquartered at Moor Plantation Ibadan

d. Cropping Systems research program at IITA, Ibadan, and ICRISAT Hyderabad.

e. Farming systems studies at CNRA, Bambey

4. Niger

At a research site to be selected, ICRISAT will post one breeder for millet and sorghum. This appointment will help effect an important link between SAFGRAD and important Nigerian millet research activities being funded partly by AID within the "Niger National Cereals Production Program". This program provides seven research and production scientists funded by AID and FAC. They will augment the work of several Nigerian plant improvement scientists, three FAC scientists and four CIDA plant protection scientists already provided thru other programs.

B.3. Coordinated National Research/Trials/Extension

Most nations in the SAFGRAD region maintain a food crop research program. While most of these national research programs are relatively small, they represent, in the aggregate, a significant and costly scientific resource which must be used effectively and efficiently. National research capability and crop extension capability are necessary to further develop and extend improved technologies to local ecological areas.

Coordination among researchers working on similar problems internationally is critical to the effectiveness of national research. But

at the present time, national research is characterized by the application of inadequate resources in relative isolation from research in neighboring countries. Coordination has been better in the Francophone countries because of IRAT. Even though many individual countries are increasing their national research capability, it is not economically or technically effective for individual countries to finance and implement a full program of the detailed and extensive research that cereal crops and grain legumes require. International coordination is essential.

National research and outreach capability and regional coordination will be enhanced by SAFGRAD support to:

a. Scientific conferences to develop personal and working relationships and information and plant materials exchange among technical researchers.

b. Regional varietal trials.

c. Farmer field trials.

d. Training of African research scientists and assistants and production specialists.

e. Exchange of scientific reports.

1. Scientific Conferences

Approximately three scientific conferences will be held annually to enable technical researchers working on similar crops or problems to present findings and exchange information. Technical researchers are to be invited from national research stations, regional research centers and international research institutes. OAU/STRC will organize the conferences, under the direction of the CC. The initial conferences in year one of the project will probably cover the following topics: (a) Millet/Sorghum, (b) Grain

Legumes, and (c) Maize. Subsequent conferences will address subjects to be determined by the CC.

The conferences are viewed as a major SAFGRAD activity for inducing long term regional cooperation among scientists and institutions; expanding technical knowledge; coordinating national, regional and international research; and generally dispelling the relative isolation of research programs in semi-arid Africa, thereby increasing the efficiency of crop research in the region. The NAS study on African Agricultural Research Capabilities recommended scientific conferences in the manner of the JP 26 conferences as a high priority research need.[1/]

Scientific conferences are not to be confused with meetings of the CC or the Technical Advisory Committee. The scientific conferences are intended to foster cooperation and exchange of technical information among breeders and other scientists engaged in experimental work. Meetings of the CC and the TAC relate to program planning and management. It would appear beneficial, however, for the CC and the TAC to convene simultaneously with the scientific conferences since program planning and management should be based on the problems and potentials as revealed thru technical research.

SAFGRAD funds are budgeted to augment costs (international travel, simultaneous translation, room and board, per diem, and printed materials) for approximately 30 attendees for a 3-5 day conference at a site such as IITA, Ibadan -- assuming that half of the attendees pay their own travel.

1/ "African Agricultural Research Capabilities" 1974, National Academy of Sciences, p. 52.

2. Field Trials

Field trials, including (a) uniform varietal trials and (b) farmers field trials, constitute a direct operational link between regional and national research and between research and the farmer.

As described above, the regionally-funded Farming Systems Unit will play a role vis-a-vis national field trials. Also, the OAU/STRC will facilitate the administrative and logistic arrangements related to distribution of the seed. Seed for field trials will be multiplied and distributed by the regional research centers. SAFGRAD sponsored field trials are to be integrated into the national field trials/extension programs under the direction of appropriate national research and outreach agencies.

3. Accelerated Crop Production Officer

In most countries, the Accelerated Crop Production Officer (ACPO), formerly referred to as the Field Trials Officer under JP 26, will be a key individual involved with implementing national trials. The ACPO will usually be a fully qualified agronomist. The ACPO role will vary from country to country depending on national research and outreach programs and staffing. Besides the implementation of field trials, the ACPO will also be assigned broad responsibilities related to: (a) studying the applicability of improved technologies to farmers conditions (b) informing researchers about field trial results and farmers conditions for the purpose of stimulating the development of varieties and practices applicable to small farm conditions (c) extending research results to farmers (d) encouraging national-regional research links and coordination. Annex E provides more illustrative information on the role of the ACPO.

Some participating countries are to be provided an expatriate ACPO thru bilateral arrangements with an individual donor. A few countries with the financial and technical resources will provide their own ACPO. Several donors including FAC (French), ODM (British), CIDA (Canada) and the FED (EEC) have tentatively agreed to fund ACPOs and ACPO programs within the SAFGRAD umbrella, subject to official request from individual host governments. Definitive commitments must await the conclusion of bilateral negotiations in each case. To insure coordination among participants and donors regarding the functions of the ACPO, the bilateral agreements should incorporate the understandings reached at the Ouagadougou Conference as subsequently elaborated. Annex E provides the basis for bilateral agreements establishing an ACPO position.

The five AID-funded ACPO positions will be provided in each case according to the terms of a bilateral Memorandum of Understanding to be negotiated between the host country and the local USAID office. The SAFGRAD Project Officer will assist the local USAID ADO or CDO in the negotiations as needed.

Current projections for the assignment and support of ACPOs are as follows:

Country	Direct ACPO Support	ACPO Program Support
1. Benin		
2. Cameroon	FAC	Cameroon/FAC
3. Cape Verde		
4. Central African Rep.		
5. Chad	AID	Chad/AID

Country	Direct ACPO Support	ACPO Program Support
6. Ethiopia		
7. Gambia		
8. Ghana	ODM ODM	Ghana/ODM
9. Guinea		
10. Ivory Coast	Ivory Coast	Ivory Coast
11. Mauritania	FAC or AID	Mauritania/FAC or AID
12. Mali	AID	Mali/AID
13. Niger	Fac or FED	Niger/FAC or FED
14. Nigeria	Nigeria	Nigeria
15. Senegal	FAC or Senegal	Senegal/FAC
16. Sudan	ODM	Sudan/ODM
17. Togo	AID	Togo/AID
18. Upper Volta	AID	Upper Volta/AID

To stimulate innovative field operations, ACPOs will be provided with supplemental operating support by bilateral donors. AID-funded ACPOs will be provided $50,000 annually to supplement national support for staff salaries and program operations. National governments are expected to provide a similar amount of in-kind and/or financial support in conjunction with field trials, local staff salaries, demonstration, extension, etc.

4. Training

Two million dollars is budgeted for training: (1) degree training for scientists and researchers (2) non-degree training for research assistants and crop production specialists.

The development of African research and outreach capability is a matter of great concern to participating countries. There is regional unanimity that training must be a SAFGRAD priority. First priority is to train African scientists to conduct regional and national research. Also, African ACPOs must be trained who have the knowledge and orientation to deal with the broad issues related to translating research into benefits in farmers fields. Many African countries need training to develop a minimum national research capability. Research assistants and production specialists are needed to work with research and field trials and extension programs.

Graduate level training will be provided at the agricultural research and ACPO level. Where qualified candidates are not available, however, undergraduate training in pertinent agricultural sciences may be financed. The $1.6 million AID contribution for degree training is expected to finance about 40 participants for 2 years each or 20 participants for 4 years each. In most cases, AID-funded graduate training will be at U.S. universities, but where arrangements can be made, participants will be sent to African universities such as ABU, the University of Ibadan, etc., where graduate training is offered. Many Francophone and Anglophone countries offer a B.S. in agriculture, and any AID-funded participant training at this level should be at African universities, if it can be arranged.

Training for non-degree technicians is to be provided largely by ICRISAT and IITA. Short courses at national research centers are not precluded. Special concentrated 3-6 month courses have been designed to inculcate the techniques and philosophy of small farm related technologies. From 5 to 10 research assistants and technicians are needed to backstop one

senior agricultural researcher. Practical technical training at this level is urgently needed in most participating countries. AID's $400,000 contribution is expected to finance approximately 80 individuals for an average of 6 months training each.

Other donor organizations, particularly FED and FAC, support large training programs in West Africa, including a considerable amount of degree training for agricultural scientists and technicians. This training contributes to the development of the same human resources sector addressed by the SAFGRAD training, but there has been no attempt to coordinate such a large and disparate assistance effort among so many donors. Under SAFGRAD, training support will be arranged by the AID project manager and the OAU/STRC, in consultation with host governments and the CC, following an appraisal of research manpower needs.

5. Distribution of research documents.

OAU/STRC will provide documentation services for researchers. Scientists in this region frequently mention the unavailability of reference materials and up-to-date reports on research activities and results elsewhere as important constraints to their experimental work. Priority will be on the translation, publication, printing and distribution of papers presented at the scientific conferences. Also, reports regarding regional research results at IAR, Bambey, and Kamboinse, and reports on ACPO programs will be distributed.

B.4. Logical Framework

Refer to Annex C.

Table 1. SAFGRAD Crop Research Objectives (Varietal Improvement).

The overall research objective is to genetically improve suitable broadly-adapted varieties which fit easily into the indigenous farming systems.

Within this broad objective, the following research targets are indicated. These targets are based on the design team appraisal of production constraints and research potential and results. Priorities will vary over time and by location, based on new knowledge.

A. Millet

(1) Resistance to:

(a) Downy Mildew races: The various races need to be identified, resistant lines selected, and resistance incorporated into suitable varieties.

(b) Smut.

(c) Ergot.

(d) Witchweed (striga).

(2) Response to moderate soil fertility increases caused by fertilizer application or other cultural practices.

(3) Shorter Stem, less lodging better grain/stalk balance (high yield).

(4) Range of maturity times to correspond to rainy season durations in important rainfall zones.

(5) Drought resistance.

B. Sorghum.

(1) Resistance to:

(a) Striga

(b) Head mold

(c) Stem borers

(d) Shoot fly

(e) Midge

(2) Response to moderate soil fertility.

(3) High yield.

C. Maize

(1) Selection for improved protein quantity and quality.

(2) Resistance to:

(a) Streak Virus

(b) Blight

(c) Rust

(d) Stalk borers

(e) Stalk rot

(3) Recurrent selection of broad based composites for improved yield and other characters.

Much progress has been made incorporating desirable characters into maize, e.g. improved protein quality, resistance to blight, rust, stalk rot, etc. under sole crop semi-arid conditions. Under those conditions, the limiting factor is soil fertility rather than plant characteristics. Maize varietal improvement under SAFGRAD may involve the adaptation of these desirable lines to mixed cropping conditions.

D. Cowpea.

(1) Vigor, high yield

(2) Resistance to:

(a) Pod borers and certain sucking insects (Hemiptera)

(b) Mildew

(c) Anthrocnose

(d) Rust

(e) Virus

(f) Bacterial disease and nematodes

(3) Early maturity

(4) Drought resistance

(5) Shade tolerance (for intercropping)

E. Groundnut

Within the SAFGRAD research program, groundnut research has a much lower priority than the crops mentioned above. Extensive breeding work has developed high yield varieties suitable to sole crop commercial stands in West Africa. SAFGRAD research on the groundnut would relate to the adaptation of the HYV to intercrop conditions for farm consumption.

III. PROJECT ANALYSES.

A. TECHNICAL ANALYSIS

1. Feasibility

Despite significant advances in per acre production of food grains in many parts of the world, yields in the Sudanian and Sahelian zones of West Africa have remained at low levels. Such increases in total production as have occurred have been due primarily to the cultivation of additional land areas. Traditional farmers are still growing the same varieties of crops and using the same production practices that have been the vogue for many centuries. The indigenous crop varieties that have evolved from this system, where farmers save their own seed year after year, are varieties of low production potential, long maturity, and photosensitivity but which are capable of producing some grain under the adverse conditions of low soil fertility, periods of drought, and the presence of harmful insects and plant diseases. The indigenous varieties are also adapted to the common cropping systems which involve the growing of several crops in mixtures in the same field.

Plant breeding research has proven many times that traditional local varieties can be made more productive, if sufficient effort is put forth, by the introduction of exotic germ plasm and by establishing breeding objectives to produce varieties that minimize the effects of major production constraints. Some efforts in this direction have been made in the southern part of the Sudanian zone, but little effort has taken place in the drier parts of the Sudanian zone or in the Sahelian zone. Such work as has been done has involved selection and yield trials with pure stands of the crop in question, under conditions of high soil fertility and has not involved

selection for varieties that do well under the indigenous practice of mixed cropping and low levels of soil fertility.

Given the above mentioned situation, it is evident that there is a high probability that a well-organized and well-executed regional effort for development of improved food grain varieties in the drier areas of West Africa can make a major contribution to increasing the food supplies and enhancing the nutritional and economic status of the traditional farmers of the areas.

2. Major Varietal Constraints to Food Grain Production

It is relatively easy to demonstrate that yields many times higher than those obtained by indigenous farmers may be obtained by use of highly responsive crop varieties grown under conditions of adequate moisture, in pure stands, and supplied generously with required inputs of fertilizers, insecticides, nematicides, fungicides and herbicides. However, under West African conditions these crops are rarely grown in pure stands and the required inputs are not within reach of indigenous farmers nor will they be for the forseeable future. Therefore, research efforts must concentrate on eliminating the major constraints faced by indigenous farmers under the general framework of the cropping systems to which they are accustomed.

Some inputs to improve soil fertility, such as rock phosphate and moderate amounts of synthetic nitrogen, will be required for significant yield improvements. Varietal improvements will also be required. Plant breeding efforts should concentrate on products which will yield better than indigenous varieties, respond to soil fertility when it is present, and carry resistance to drought and major insects and diseases.

a. Maize

Maize has a higher potential for grain production under favorable conditions than either millet or sorghums. However, people in the drier regions are not accustomed to eating maize as a dried grain, so adoption of improved maize varieties cannot be expected to be rapid. It has potential, in years when grain production is in excess of local needs, for use as livestock feed or for export to the south where it has been a human food for many years.

For drier areas, maize varieties of early maturity must be developed so they may complete their growth during the short rainy season. Drought resistance during short drought periods must also be incorporated. Varieties that will produce under relatively low soil nitrogen levels, but respond well when nitrogen is present, must be selected.

In addition to soil fertility, maturity period and drought hazards, major constraints with present varieties relate to damaging effects of blight, rust, strigo, stalk borers, streak virus and stalk rot. Resistance to these pests must be incorporated into agronomically and physiologically desirable materials having proper maturity patterns to fit various rainfall regimes in the semi-arid regions.

Since maize is grown both as a sole crop and in crop mixtures, selections should be made under conditions.

b. Cowpeas

Cowpeas have the potential of being the "savior" crop for semi-arid regions of West Africa. Not only do they provide a high protein food, but they offer a means of improving the nitrogen fertility status of

vast areas of impoverished soils. They possess considerable drought resistance and may be grown over most of the Sudanian and Sahelian zones. Every possible effort should be made to improve the productivity and the nitrogen-fixing capability of this crop.

Cowpeas are grown almost exclusively as a ground cover crop in mixtures with maize, sorghum, millet, and other crops. Emphasis in the breeding program should therefore be placed on varieties doing well in mixed crop situations.

The major problem with cowpeas in West Africa relates to insect pests. The pod borer and certain sucking insects of the Hemiptera family are especially damaging. Other pests attacking the crop include mildew, anthracnose, rust, viruses, bacterial diseases and nematodes. Cowpea varieties having vigor, high yield potential, drought resistance, early maturity and tolerance to shading in crop mixtures are also required.

c. Sorghums

Sorghums provide a major source of food for a large portion of the population in the semi-arid regions of Africa. However, with rare exceptions, farmers are growing the same indigenous varieties that have been used for many generations. These varieties are low-yielding, long-seasoned and unresponsive to improved soil fertility, but are able to produce grain when grown on impoverished soils and have some resistance to major pests. Only limited progress has been made to date in developing improved varieties, and these have been developed for sole cropping rather than mixed cropping as is usually practiced.

Among the characteristics that must be incorporated into adopted new sorghum varieties are: earlier maturity, responsiveness to moderate increases in soil fertility levels, shorter stalks, drought resistance, high

yield, and resistance to stem borers, striga, head mold, shoot fly and midge.

d. Millets

Millets are the earliest maturing and most drought resistant of the cereal grain crops commonly grown in Africa, and are thus the best adapted crop for the drier areas of the continent. Bulrush, or pearl millet, is the species generally grown. As with sorghums, however, the millets presently grown are tall, low-yielding varieties, with low grain production efficiency, and are generally non-responsive to improved soil fertility and cultural practices. They are often grown in association with other crops in the same field.

In addition to varieties that are shorter and more responsive to cultural improvements, millets must be developed which are resistant to common downy mildew races, smut and ergot. Varieties having a range of maturity times are needed to fit areas having different lengths of rainy seasons, thus maximizing utilization of available water.

e. Groundnuts

Extensive research has been done on developing improved groundnut varieties both from Africa and other areas of the world. However, this research has concentrated on varieties adapted to single crop culture. Emphasis on future research with groundnuts should be related to selecting those varieties which (1) grow well in mixtures of other crops and (2) provide a maximum of improvement in the nitrogen status of soils on which they are grown.

3. Past and Current Research Efforts

a. West Africa, General

British and French Colonial Governments in Africa established numerous agricultural research locations. Because of greater potentials for agricultural production, most of these were in the more humid regions, with essentially no work being done in the Sahelian zone. Colonial interest was primarily in export crops rather than local food crops. Since research staffs were small, there was little opportunity to work with food grains, and plant breeding projects for these crops were generally non-existent.

Since African nations have become independent, the former colonial research locations have become or are in the process of being nationalized. Most research stations are being continued but many have difficulties in employing appropriately trained staff for effective programs. Research emphasis is also being changed to include more work with food grains.

Because of these limitations and the complexities of plant breeding research, there has been almost no crop improvement research with food grains in the Sahelian zone of Africa, and only a minor effort in the Sudanian zone. This is a most unsatisfactory situation, particularly since many countries are now launching seed multiplication schemes with no background of research to indicate what varieties should be grown. Many of the countries in the semi-arid zones are totally without plant breeding programs for food grains, and others have only enough research personnel to test some of the varieties developed elsewhere. In the Francophone countries, much of the research done in the past has been conducted by the French research

organization, I.R.A.T. In most countries, I.R.A.T. research is now in the process of being discontinued. In Chad, for instance, there are only one breeder and one agronomist doing research on unirrigated crops. They are located in the southern, wetter part of the country and must work with rice in addition to dryland crops. In Niger, there are 2 breeders, one indigenous and one French. Both are working at Maradi, in the Sudanian zone. In Upper Volta, except for a sorghum breeder recently placed by ICRISAT, there is only one agronomist working with dryland crops and he is stationed where there are about 1200 mm. of rainfall per year.

b. Bambey, Senegal

The most significant past and present food grain research in the semi-arid regions of West Africa has been and is at two centers: Bambey in Senegal and Samaru in Nigeria. Bambey is in the drier part of the Sudanian zone (600 mm. rain/yr.), whereas Samaru is in the wetter portion of this zone (1200 mm. rain). Neither station represents the drier Sahelian zone.

At Bambey, past efforts have primarily been with sorghum, millet, groundnuts and cowpeas, with groundnut research receiving major emphasis. Sorghum and millet varietal improvement efforts have been primarily through selection of the most productive indigenous varieties for various ecological regions of Senegal, with limited crossing of indigenous materials. Until recently, little effort was made to improve indigenous varieties by introduction of exotic germ plasm.

The Bambey station presently has two sorghum breeders supported by an entomologist and plant pathologist. One breeder is responsible for development of varieties for northern Senegal for both irrigated and dryland (450-700 mm. rainfall per year) conditions. The other

sorghum breeder works in central and southern Senegal where average annual precipitation is 700 to 1200 mm.

In the millet improvement area, the Bambey station now has four millet breeders who are beginning a vigorous variety improvement program for pearl millet. Some supporting services in entomology and plant pathology are also available. In addition to drought, disease, and insect resistance, breeding objectives include high yields and improved seed germination for varieties having three maturity ranges to fit areas with different lengths of rainy seasons.

In addition to the Senegalses staff for sorghum and millet improvement, ICRISAT intends to station two researchers, a plant pathologist and an entomologist at Bambey to augment the efforts toward development of improved varieties of these crops for semi-arid areas.

Senegal has an extensive program of varietal improvement for groundnuts. This work is almost entirely with groundnuts grown as a single crop for export purposes, rather than as a mixed crop, since groundnuts are the principal export for the country. Some research is also being done with cowpeas, including efforts of a soil microbiologist and a biochemist who are testing the effects of various legume inoculants on cowpea production.

The CNRA research station has a total of 33 professional staff at Bambey plus 19 others at 3 other locations in Senegal. Research facilities are limited and staff housing is a problem since no developed city is nearby.

c. Samaru, Nigeria

The Ahmadu Bello University Institute for Agricultural Research, integrated with the Faculty of Agriculture, has developed a very significant agricultural research thrust for northern areas of Nigeria. The total professional staff of the Institute includes 283 established positions of which 168 were filled as of January 1, 1976. This staffing includes those at four outstations, three of which are in the semi-arid areas of Nigeria. Teaching staff, many of whom also conduct research, are not included in these figures. All disciplines related to agricultural research are represented in the staffing pattern and perhaps as many as 15-20% of the staff may be considered to devote all or part of their research effort toward the overall goal of improving food grain production in the Sudanian zone of Nigeria.

Ahmadu Bello University began breeding work with sorghums about 1960. Maize breeding activities began in 1964 and millet breeding a few years later. Groundnut breeding activities have been underway for many years and numerous improved varieties have been developed and are being grown by Nigerian farmers.

Although additional vacant positions are available when qualified staff can be recruited, ABU presently has three breeders for groundnuts and one each for sorghum, millet, maize and cowpeas. They also have strong support for plant breeding programs in the areas of plant pathology, entomology, nematology, soil fertility, soil management, crop production, weed control and agricultural economics and rural sociology. Facilities and staff for foundation seed maintenance increase and distribution have also been developed.

Ahmadu Bello University has well-developed facilities in the nature of land, offices, laboratories and supporting facilities. Staff housing is a problem but the Nigerian Government has set aside funds to build eight additional houses for ICRISAT staff members to be stationed at ABU. ICRISAT has placed one sorghum breeder at ABU and plans to add a millet breeder under a grant from UNDP.

Since past activities in plant breeding programs for maize, sorghum and millet have been conducted jointly by ABU staff and JP 26 project personnel, discussion of these activities is given in the following in the following section. Promising materials have been developed in the cowpea breeding program, but since the project is rather new, little is yet available in the way of improved varieties.

d. Kamboinse, Upper Volta

The Kamboinse research station is located about eight miles from the city of Ouagadougou. It is in thedrier portion of the Sudanian zone and can serve as a research center for field testing to be done in Sahelian areas. This station, which was previously a seed increase farm, is being developed by the Upper Volta Government as a National Research Center.

Research at Kamboinse in the past has been of little consequence. However, for the past year, one sorghum breeder from ICRISAT has made this station his headquarters. An ICRISAT plant pathologist has recently been designated. ICRISAT has plans to station two additional sorghum and millet researchers at this location in the near future. At present, one field trials officer is temporarily assisting the sorghum breeder. Field testing of promising lines is being done at numerous locations in the northern Sudanian zone and the Sahel.

Physical facilities at Kamboinse are now minimal although ICRISAT is constructing an office and laboratory building. Sufficient land is available for considerable expansion and irrigation is available for dry season nurseries. Good quality housing may be rented in nearby Ouagadougou.

e. JP-26 Major Cereals Project

From 1964 until the present breeding efforts with maize, sorghum and millet have been conducted at Ahmadu Bello University and Moor Plantation at Ibadan, U.S. Department of Agriculture. This group functions on a West African regional basis as project JP 26 under the Scientific and Technical Research Committee of the Organization of African Unity (STRC/OAU). The JP 26 project is phasing out during the present year.

Sorghum breeding activities have met with many difficulties. Varietal improvements by selection within indigenous materials have given yield increases of only 10-15%. Since these varieties have a low yield ceiling and are unresponsive to soil fertility, use of fertilizer gives only marginal benefits. Shortening of the plant is of some benefit, but the long growing season results in dwarf plants with as many leaves as the tall local varieties and gives little yield benefit.

Shorter-seasoned improved sorghums give significant yield increases in the shorter rainfall regions of the northern Sudanian zone. In 1974, some varieties yielded 4,000 to 5,000 kg/ha. In the southern Sudanian zone with longer rainy seasons, these varieties are subject to head mold if seed matures during the rains and to shoot fly and midge if they are planted late enough to mature after the end of the rains. Introduced, responsive sorghums also have little or no striga resistance and are more susceptible to stem borer attacks than are local varieties. Because of these problems,

the JP 26 project has devoted a great deal of effort to incorporating insect and disease resistance into adapted, high yielding short sorghum varieties with early maturity.

Reactions of over 8,000 sorghum lines from the world sorghum collection to a number of diseases havebeen determined. From the results of this screening, 74 lines have been selected which have head mold resistance. They are being incorporated into adapted, early maturing varieties. Resistance to leaf diseases has also been found and is being used in the breeding program.

Over 4,000 sorghum lines have been tested for striga resistance. From the resistant material obtained, 19 striga-suppressing or striga-resistant lines have been chosen for desirable agronomic traits and are being increased for further testing. Variability of striga infestations in different parts of West Africa has been noted, so striga virulence tests are being conducted in Nigeria, Senegal, Ghana, Upper Volta and Cameroon.

Insect resistance studies with sorghum have concentrated on sorghum midge, sorghum shoot fly and maize stem borer. Thirty-nine varieties selected as midge-resistant from the world collection and eight lines from the U.S. converted from tall photosensitive to shorter photoinsensitive lines are being included in the breeding program. Shoot fly resistance is of two types, "primary" and "recovery". "Recovery" resistance is production of new tillers by damaged plants. Material of importance to the sorghum breeding effort has been selected from Nigerian sources, East African selections, Indian materials and a West African Base Composite.

A maize stem borer colony has been maintained in a rearing room for use in testing resistance of sorghum lines. The world sorghum collection has been screened for resistance and 80 lines selected. These have been crossed with lines having other desirable characteristics and tests are being made. In 1974, 121 resistant lines were isolated from these crosses.

Some sorghum lines carry resistance to more than one insect. Crosses have been made in efforts to combine resistance to the 3 insects in varieties having desirable agronomic characteristics.

This essential, detailed development of disease and insect resistant lines by the JP 26 project has not yet culminated in many finally released varieties of benefit to the wetter portions of the Sudanian zone. Five varieties have been released for drier areas which give 2 to 3 times the yield of indigenous materials when grown under favorable conditions. As the JP 26 program phases out, the insect and disease resistant lines will be utilized by the Nigerian sorghum breeding project as well as by projects throughout Africa and the world in general. There has already been extensive distribution of promising materials throughout the sorghum growing area of West Africa.

Much less emphasis has been placed on millet than on sorghum by the JP 26 project. The Nigerian millet breeding program, with which JP 26 cooperates, is centered at Kano, an area having about 700 mm. of rain per year. One improved variety of millet has been distributed and others are in advanced stages of testing. Emphasis in disease research has been placed on downy mildew. It has been found that there are local races of downy mildew which attack millets and that present mildew-resistant varieties are suitable only in the locality in which they originate. Efforts are under-

way to determine the number and distribution of these races and to find broad-based resistance that will be effective over large areas. At present the screening of several thousand millet lines has yielded 23 lines which carry some degree of downy mildew resistance.

The JP 26 project's greatest progress has been made with maize. While maize is not traditionally a major crop in the central Sudanian zone, it has a higher yield potential than sorghum or millet and varieties have been developed which greatly outyield these crops, are responsive to improved cultural practices, and are more resistant to insects and diseases than other cereals. It has also been shown that maize will yield almost twice as much when grown in this zone as in the humid areas of Africa where it is commonly found.

Since Ahmadu Bello University had two sorghum breeders when JP 26 was started, and later provided a millet breeder, the plant breeder on the JP 26 project has devoted most of his efforts to maize breeding. This work was originally done in cooperation with a USAID-provided maize breeder in the western state and a Rockefeller Foundation pathologist at the University of Ibadan. Cooperation has continued with Federal Department of Agriculture workers at Ibadan where one of the JP 26 scientists has been posted. The materials developed under this program now form the basis for the maize breeding program at IITA.

In 1968, it was decided to set up three composites called Nigerian Composites A, B, and C, with lines from American, Columbia, Mexico, and Africa incorporated in them. These composites, plus an earlier one, Samaru 1, 2, 3, and a recent Biu Yellow, are being used at Samaru in a program of recurrent selection for improving yield and other characters. Each composite contains lines with high lysine. Selections are also being

made for improved protein quantity and quality. The JP 26 project has coordinated a regional uniform maize trial utilizing varieties developed from this program. This trial has been conducted annually at one or more locations in Nigeria, Senegal, Mauritania, Gambia, Sierra Leone, Mali, Ivory Coast, Upper Volta, Ghana, Togo, Niger, Cameroon, Chad, Central African Republic, and Kenya. In 1974, 14 additional performance trials, each with numerous varieties and hybrids, were conducted by the JP 26 project. The two top yielding varieties in the National Zonal Maize Trial at 17 Nigerian locations were from the JP 26 breeding program (C 10 x Biu Yellow and NCA).

Disease and insect work with maize has included selection and incorporation into promising lines of resistance to leaf rust, stalk rot, striga and maize streak virus. Work is underway to identify the vector of maize streak virus in Nigeria.

Much of the maize breeding activity involves increasing seed of, and selecting within full-sib families from recurrent selection trials using 4 composite populations. Many inbred lines are being developed for possible hybrid production. Protein increases of over 1% have been accomplished in selecting for high protein maize.

Numerous high yielding maize varieties of a range of maturity periods have been developed by the JP 26 program and distributed to government units and private growers in West Africa. In 1974, seed of 3 additional varieties was increased for distribution. Further seed increases may be made easily by farmers since these lines are varieties and not hybrids.

JP 26 plant breeding activities have had strong support in the areas of soil fertility and soil management research. It has been established that indigenous varieties of millet and sorghum are unresponsive to improved cultural practices. The limiting factor in growing maize, on the other hand, is soil fertility. Most soils are deficient in nitrogen and phosphorus and maize yields of 100 to 700 kg/ha are obtained without fertilizers. With fertilizers, yields as high as 10,000 kg/ha have been obtained. Preliminary results indicate as much as 40 kg n/ha can be made available to maize using cropping systems with grain legumes. A mixture of rock phosphate and sulfur was found to be nearly as effective as superphosphate. Since many countries of the semi-arid region of Africa have deposits of phosphate rock, research on use of these phosphorus sources should be pushed vigorously.

A two-year study of the feasibility of use of maize with improved technology by indigenous farmers accustomed to growing sorghum was conducted in the central Sudanian zone of Nigeria. The farmers consumed about half their production and sold the remainder. Farmer yields averaged 3,000 kh/ha and some reached 5,000. Under these conditions, all costs, including labor were met with a yield of 1022 kh/ha. The average net return to the farmers was $304 per hectare.

The JP 26 program has included help to other countries in West Africa in the form of consultations and the supplying of seeds of experimental lines for testing under other African conditions. Since 1972 a seed production specialist has been included on this team and seed increase, processing, storage and distribution systems have been developed for improved varietal materials. In 1975, over 230 tons of processed seeds

of 5 maize varieties, 4 sorghums, and one millet were distributed.

f. International Research Institutes

On the international level, the International Crops Research Institute for the Semi-Arid Tropics has been designated by the Consultative Group for International Agricultural Research to serve as a world center for genetic improvement of sorghum, pearl millet, pigeon peas and groundnuts. An agreement between ICRISAT and UNDP was signed in January, 1975, whereby ICRISAT would engage in a cooperative research program in 12 countries of West Africa for improvement of sorghum and millet in the Sahelian-Sudanian zone. To date, four ICRISAT researchers have begun their duties in West Africa, one at Samaru in Nigeria, two at Ouagadougou in Upper Volta, and one at Bambey in Senegal. Six additional positions are designated to be filled in the near future.

The International Institute for Tropical Agriculture at Ibadan, Nigeria, has also been established by the Consultative Group for research in the humid tropics. Maize and cowpeas are among the crops on which IITA is conducting plant breeding research. While IITA has not extended its work with these crops to the semi-arid regions of Africa, it is interested in doing so.

4. Proposed Research Program

It is proposed that USAID funds available for direct research activities under this project be used to provide research workers to supplement, at suitable regional centers, those researchers who are being provided by National Research Organizations and through the agreement between UNDP and ICRISAT. The researchers so provided would become a part of the research team at each location and would fill in the gaps of scientific disciplines required to provide a well-rounded research effort. It is

further proposed that USAID contract with ICRISAT to provide the staff to work on sorghum, millet, and groundnut projects, and with IITA to provide staff members for maize and cowpea work.

4.1. Research Objectives

The research effort suggested is one of genetic improvement of the indicated crops to result in crop varieties that minimize the major varietal constraints to increased production, as outlined in the above section of this report, and socioeconomic research to identify major constraints in the farming systems currently used, and provide information to physical scientists regarding improvements that would be of relevance to indigenous farmers. The varieties so developed should be of such a nature that they may easily be fit into the cropping systems presently employed by indigenous farmers. A necessary first step to accomplish this objective will be a survey, in various major ecological zones, of the predominant cropping systems generally used. Breeding efforts should also include development of varieties of cereals and legumes, which, when grown together in commonly used cropping systems, will make a maximum contribution to the nitrogen requirements of the crops present.

The research program should address itself to problems that are of major consequence to the entire semi-arid regions of West Africa. To accomplish this, it is suggested that research be concentrated at two locations, one in the southern, more humid portion of the Sudanian zone and the other in the northern, drier part of this zone. Efforts in the plant breeding program should be to develop varieties with a broad genetic base which are adapted over wide geographical areas and carry resistance to major types and races of diseases and insects.

Breeding programs should make full use of indigenous varieties, materials developed under the JP 26 project and genetic stocks available at the international research centers and from national programs and commercial sources. Varietal testing should be done under indigenous conditions of mixed cropping, where applicable. Close working relations should be maintained between plant breeding groups and soil fertility and management scientists, so that varieties developed will be responsive to improved soil fertility and will perform well under feasible systems for soil productivity improvement.

Soil fertility and soil management specialists under this program should concentrate on two aspects of food grain production: (1) Effects of various cropping systems which include legumes, and effects of legume cultivars on soil nitrogen levels, moisture conservation and erosion control. This would include development of mixed cropping systems compatible with indigenous practices which will result in constantly improving soil nitrogen levels when combined with minimal levels of natural or synthetic nitrogen fertilizers; and (2) Methods for improvement of soil phosphorus and other needed nutrient levels through use of locally available mineral resources such as phosphate rock. The soil scientists should work closely with plant breeders, assisting them in selecting varieties having lowest nutrient and water requirements and those which result in greatest soil improvement. They should give guidance to breeders concerning fertility levels and crop mixtures under which variety testing should take place.

The farming systems research staff should conduct microeconomic and sociological research leading to a better understanding of

the nature of, and reasons for, present agricultural practices as followed by indigenous farmers in various ecological zones and under predominant cultural patterns. This would involve the collection and analysis of farm level data, determination of the most researchable production problems, major constraints to adoption of improved practices, and a study of the economics of production, management systems and marketing. Results of this research should be utilized by the scientists in determining researchable problems and setting research priorities.

4.2. Research Locations

Because of the relatively high state of development of agricultural research at Ahmadu Bello University in Nigeria, it is suggested that this location be utilized as the research center for the more humid area of the Sudanian zone. A large Nigerian staff is already engaged in research, physical facilities are well developed, perhaps the best agricultural library in West Africa is present, housing is available, and ICRISAT has already begun locating staff at ABU. The posting of a few additional scientists at ABU would make possible a well rounded, efficient team for food grain research.

The second center for research, should be located at Kamboinse, Upper Volta, in the dry portion of the Sudanian zone near the Sahelian zone. While present research at this location is minimal, it is proposed to be the center for agronomic research for the national research organization of Upper Volta, and ICRISAT has selected it as a major location for their food grain research efforts. Nearby Ouagadougou is on the major air route from Paris to Abidjan and is the most northern city in sub-Saharan West Africa

to have regular rail service. It is also connected to the south by improved roads. Good housing is available for rental in Ouagadougou. Kamboinse represents well the vast area of semi-arid climate stretching across the continent of Africa and may serve as a base for research in the even drier Sahel. It is suggested that the proposed socio-economic farming systems research team be located here, in order to work closely with the physical scientists, since this type of research is already well developed in the more humid region at Ahmadu Bello University.

Bambey, in Senegal, is considered to be less desirable than Kamboinse for several reasons. The proximity of Bambey to the Atlantic Ocean causes some deviations in climate from the normal inland situation. To station additional personnel at Bambey would require the construction of staff housing. Construction of additional housing and laboratory facilities would overload present utility systems, requiring additional water, sewer and electrical facilities. Land resources at Bambey are also almost fully utilized at present.

4.3. Research Staff

a. Samaru, Nigeria

The three additional AID-funded SAFGRAD scientists at Ahmadu Bello University would supplement the work of the ABU and ICRISAT/UNDP sorghum and millet breeders, crop production specialists, and soil fertility and soil management specialists working at Samaru and Kano, Nigeria. The plant pathologist would help the sorghum and millet breeder in selection and testing of germ plasm having resistance to the important plant diseases and study other methods of control for these diseases. Emphasis would be placed on head mold, striga, and leaf diseases with sorghums and downy mildew, smut, and ergot with millets. This individual

would replace the plant pathologist formerly supplied by the JP 26 program.

The striga physiologist would study the growth requirements of this parasitic plant in order to better understand the parasite and enhance the possibility of developing varieties which restrict its attack.

The USAID-funded entomologist would replace the one formerly provided on project JP 26. He would continue the insect resistance work carried on by JP 26, concentrating on control of stem borers, shoot fly and midge on sorghums and insect pests of millet.

b. Kamboinse, Upper Volta

The major input of USAID personnel under this project is to be placed at Kamboinse, since much less research effort has been exerted in the past in the drier regions of West Africa, and since present staffing at Samaru is much greater than at any stations in the northern Sudan.

The millet breeder would cooperate with millet breeders at Samaru (Kano), Bambey, ICRISAT in India, and those in national research organizations, in developing improved millet varieties for the drier areas of Africa. The production agronomist for sorghum and millets would assist the sorghum and millet breeders in carrying out off-station variety trials, particularly in and near the Sahel.

The entomologist provided by USAID funding, as well as the ICRISAT pathologist, would be expected to assist all of the plant breeders (sorghum, millet, maize and legumes) in developing pest restraint materials.

The maize breeder would cooperate with maize breeders at Samaru, IITA, and in national research organizations, in developing adapted, short-season, drought-resistant maize varieties for the drier areas. The maize breeder would work closely with the legume breeder and soil fertility and management staff in selecting materials that perform well in crop mixtures

with legumes and that are efficient in utilizing phosphorus from phosphate rock.

Soil fertility and soil management scientists would be concerned with developing cropping systems compatible with traditional indigenous practices and soil management and amelioration practices that would lead to soil fertility improvement, erosion control and efficient use of available rainfall. They would cooperate closely with the plant breeders, helping to evaluate genetic materials for desirable mixed cropping systems, and would give guidance to breeders concerning crop characteristics of importance to maintenance and improvement of soil productivity. Close contact would be maintained with work at Samaru, IITA, Bambey, ICRISAT, and other locations.

The research team for socio-economic farming system research, consisting of an agricultural economist, sociologist and production agronomist, would conduct village level research in the drier areas, complementing that being done at Samaru and Bambey. They would consult extensively with the other scientists at this location concerning research methodology, relevant research problems, and indigenous acceptability of research results.

In addition to the research teams at the above two locations, a vital research role will be played by cooperating national research organizations and/or Accelerated Food Production Officers (ACPO) who will be a part of this project. The cooperating organizations/ACPOs not only can contribute ideas and materials to the research teams, but can accelerate the research effort greatly by carrying out field testing of promising varieties/cropping systems developed by the research scientists.

4.4. Research Linkages and Coordination

It is essential that this project provide for a maximum of cooperation and coordination of research among countries of the Sudanian and Sahelian zones, the research teams involved, and the International Research Institutes. This is important, not only from the standpoint of having an effective research effort, but also from the standpoint of dissemination of the research results and the strengthening of national research programs.

Coordination and administration of the research program will be accomplished through several mechanisms and at different levels.

(1) Overall research policy will be determined by a Consultative Committee assisted by a Technical Advisory Committee representing regional research organizations and cooperating governments.

(2) The OAU/STRC will play a secretariat role in the research program. They may be called upon to provide committee secretaries, make meeting arrangements, print and distribute reports and assist in any inter-country problems that might arise during the period of research operation.

(3) Scientific personnel and research policy as determined above will be administered by the contracting agencies involved (IITA, ICRISAT, U.S. University).

(4) Details of the cooperative, regional research program will be determined by work planning conferences of the scientists involved in various specialized areas, together with resource persons from the International Institutes or U.S. Universities.

There should be an annual work planning session for research in each disciplinary area. Initially, one conference concerning workers with each crop may suffice, but periodic meetings on plant pathology, entomology, soil fertility and management, farming systems, etc., may be desirable. It is visualized that these would be open, informal meetings with representatives invited from each participating research center and all cooperating governments. The research workers involved would be expected to elect their own chairman but could ask OAU/STRC to provide secretarial, logistic, and publication support.

5. Training Activities

Indigenous personnel trained for food crop improvement research are very few in number in the semi-arid countries of West Africa. This is particularly true in the Francophone countries. The scarcity exists at all levels -- from technical assistants to Ph.D. research scientists. The shortage is made more acute by the necessity to use all available personnel in food production efforts and in the many externally-financed development projects being started in these countries.

While regional research efforts by internationally funded expatriate research scientists can be a very effective short-time solution to food production problems, the ultimate responsibility for continued progress will rest with the national research organizations. When this project phases out, many lines of the crops being worked with will still be in the selection stages, many will need to have seed increased, and many will be merely potential for later improvement. Local selections and refinements in regionally adapted varieties may also be expected to improve

crop performance. Also, new pests constantly appear and new strains of common diseases frequently develop, making a continuing plant breeding project essential.

With the exception of Nigeria and Ghana, the countries in the semi-arid regions of West Africa do not have graduate university level training in agriculture. Senegal, Niger and Chad are reportedly developing such programs. Baccalaureate degrees in general agriculture do not provide sufficient training for plant breeding research. Advanced degrees, many of the Ph.D. level, are required. Because of the current situation, it is highly desirable that training to the B.S., M.S. and Ph.D. levels be sponsored under this project. Such training can, in some cases, be carried out in Africa. Much of it, however, will be conducted abroad.

Training at technical levels as research assistants is also required in all the countries concerned.

B. FINANCIAL ANALYSIS AND PLAN.

1. Financial Rate of Return/Viability.

Crop Research in the African context is a costly, long-term, non-revenue producing endeavor. Research activities will be government and donor financed for the foreseeable future.

In the broadest terms, international crop research has been shown by recent studies to be cost-effective. In Africa, however, food crop research cannot be said to be cost-effective to date since so few farmers have benefitted.

The project objective is to develop new technologies to increase small farm productivity. The target group is huge -- over 50 million persons in the vast semi-arid regions rely on cereals and grain legumes for more than 50 percent of their calories and protein. The crops to be researched are overwhelmingly the most important crops to this target group. A slight increase in small farm productivity would pay many times over for the cost of the research. Refer to III.B. Economic Analysis.

Whether or not the project is actually cost-benefits effective depends on several factors, the most important being the technical feasibility of producing a low risk "low infrastructure" technology acceptable to small farmers. If such a technology can be developed, the potential economic benefits are great. This feasibility issue is discussed under Issue No. 5.

Important constraints to the adoption of new technologies by small farmers have been economic and financial. Scientists have produced "improved packages" which are uneconomic or which do not generate a cash flow sufficient to cover cash costs. Under SAFGRAD, one of the principle functions of the Crop Systems team will be to study the economic/financial viability of improved

technologies at the farmer level. By inducing physical and social scientists to coordinate in the testing and development of crop research at the farmer level, SAFGRAD is taking an important step toward insuring that project activities focus on improved technologies which are technically, economically, financially and socially viable.

2. Budget Analysis of Implementing Agencies.

IAR is in a good financial position. The Government of Nigeria imposes budget economies on IAR from time to time, but is committed to the expenditure of significant financial resources for agricultural research. CNRA has a leaner budget than IAR, but the station has continued to expand and continued Government of Senegal and foreign donor support is anticipated.

The situation at Kamboinse, Upper Volta, is different. There is no specific national crop research institute in Upper Volta, partly because the nation has not, to date, been able to afford it. Research operations at the major Upper Voltan research stations, Farakoba, Saria, and Kamboinse, are managed directly by the Ministry of Agriculture, with technical assistance provided largely by IRAT. The financial and technical viability of research programs in Upper Volta depends to a great extent on a continued high level of French support.

Over the life of the SAFGRAD project, recurrent operating costs for Kamboinse will be assured largely by donor-provided project financing, with the Upper Voltan MOA contribution provided largely in kind -- land, management, equipment, facilities.

Financing recurrent project costs after the project period may represent a serious problem for the Government of Upper Volta. While the

recurrent costs of research would be considerably reduced with African scientists rather than expatriates, there is still little assurance that the GOUV would be able to financially sustain research at a very meaningful level. Refer to Issue No. 3.

3. Financial Plan/Budget Tables.

AID financed expenditures are summarized in Table 2 and detailed in Annex A, Table 1. Total project costs and financing are summarized in Table 3 and detailed in Annex A, Tables 2-7.

C. ECONOMIC ANALYSIS.

1. SAFGRAD Area.

Per capita agricultural production for Africa as a whole has been stagnant or declining for more than ten years. Most of the countries with the poorest agricultural performance in Africa are included in the SAFGRAD Project Area. The figures in Tables 5 and 6 show recent per capita agricultural and food production for Africa and for the SAFGRAD Project Area. The Index per capita food and agricultural production in the SAFGRAD area has remained below that of Africa as a whole for the last fifteen years. The Sahelian drought served to exacerbate conditions due to an already deficient agricultural performance in the area.

The SAFGRAD Project Area includes some countries that are among the poorest in the world. Two broad divisions can be made of the SAFGRAD Area: In the first zone are the coastal countries of Senegal, Ivory Coast, Ghana, Togo, Benin, Nigeria, and Cameroon, which, while having some territory in the humid tropical zones, have their northern territories in the Sahelian and Sudanian zones. More importantly, these countries have generally higher levels

TABLE 2 - Summary AID Financed Costs

	5 year totals	FY 1977	FY 1978	FY 1979	FY 1980	FY 1981
. TECHNICAL ASSISTANCE	4,621.5	542.9	1,030.4	1,042.7	1,002.7	1,002.7
A. Crop Research Scientists	3,150.0	350.0	700.0	700.0	700.0	700.0
Nigeria (IAR) (3 scientists)	810.0	90.0	180.0	180.0	180.0	180.0
Upper Volta (Kamboinse) (5)	1,462.5	162.5	325.0	325.0	325.0	325.0
Farming Systems Unit (Kamboinse) (3)	877.5	97.5	195.0	195.0	195.0	195.0
B. ACPO (5)	1,237.5	137.5	275.0	275.0	275.0	275.0
C. Short term Consultancy (5 man-years)	234.0	55.4	55.5	67.7	27.7	27.7
I. CAPITAL COSTS	375.0	375.0	-	-	-	-
A. Construction	170.0	170.0	-	-	-	-
B. Research Equipment	75.0	75.0	-	-	-	-
C. Vehicles (13)	130.0	130.0	-	-	-	-
II. OPERATING COSTS	3,990.25	801.25	797.25	797.25	797.25	797.25
A. Scientists' Program Support	2,200.0	440.0	440.0	440.0	440.0	440.0
B. ACPO Program Support	1,250.0	250.0	250.0	250.0	250.0	250.0
C. Scientific Conference	303.75	60.75	60.75	60.75	60.75	60.75
D. OAU Coordination	236.5	50.5	46.5	46.5	46.5	46.5

TABLE 2 - Summary AID Financed Costs (cont'd)

	5 year totals	FY 1977	FY 1978	FY 1979	FY 1980	FY 1981
V. PARTICIPANT TRAINING	2,000.0	80.0	480.0	480.0	480.0	480.0
A. Long term (degree)	1,600.0	-	400.0	400.0	400.0	400.0
B. Short term (non-degree)	400.0	80.0	80.0	80.0	80.0	80.0
. AID PROJECT OFFICER plus operations	570.0	70.0	125.0	125.0	125.0	125.0
BASE COST SUBTOTALS	11,556.8	1,869.15	1,432.75	2,444.95	2,404.95	2,404.95
I. INFLATION & CONTINGENCY	2,246.1	86.3	272.0	447.6	621.7	818.5
A. Contingency (flat 5%)	524.5	86.3	110.1	110.7	108.7	108.7
B. Inflation (7% compounded annually beginning FY 1978)	1,721.6	-	161.9	336.9	513.0	709.8
GRAND TOTALS	13,802.85	1,955.45	2,704.75	2,892.55	3,026.7	3,223.45

TABLE 3. Summary Project Costs + Financing

	Total	FY 77	FY 78	FY 79	FY 80	FY 81
AID-Financed	13,803	1,955	2,705	2,893	3,027	3,223
Other Donors 1/	6,686	1,847	1,839	1,000	1,000	1,000
Host Governments 2/	2,385	477	477	477	477	477
Total	22,874	4,279	5,021	4,370	4,504	4,700

1/ Includes UNDP funding only through 1978. Aditional UNDP funding FY 79-81 is feasible. Several "Other Donor" contributions are rough estimates based on AID's knowledge of other donor intent.

2/ Most host government contributions represent imputed values for in kind contributions.

TABLE 4. Population in 18 Countries and Per Cent of Active Population in Agriculture

Country	1974 Population (thousands)	Per Cent in Agriculture (1970)
Benin	2,993	52.3
CAR	1,672	87.2
Cameroon	6,332	81.8
Cape Verde	265	N.A.
Chad	4,089	91.2
Ethiopia	27,365	84.6
Gambia	396	83.8
Ghana	10,276	54.8
Guinea-Bissau	587	86.0
Ivory Coast	4,760	81.1
Mali	5,619	91.1
Mauritania	1,288	85.0
Niger	4,348	91.4
Nigeria	61,240	67.0
Senegal	4,337	75.6
Sudan	17,946	85.7
Togo	2,073	74.9
Upper Volta	5,870	88.8
TOTAL	161,456	Wt Ave 75.0

Source: UN/FAO

TABLE 5. Index of Per Capita Agricultural Production for 12 SAFGRAD Countries Africa 1960, 1965, 1970-75

Country	1960	1965	1970	1971	1972	1973	1974	1975
Benin	110	95	93	90	91	95	99	99
Cameroon	95	109	99	99	94	91	94	93
Ethiopia	97	99	99	102	100	97	99	100
Ghana	99	94	88	92	83	85	85	87
Ivory Coast	96	107	110	119	118	112	122	121
Mali	104	94	98	88	76	70	73	79
Niger	89	102	96	89	75	55	91	91
Nigeria	101	100	96	94	96	89	92	93
Senegal	93	110	67	95	66	76	86	90
Sudan	91	95	112	112	105	97	100	101
Togo	109	104	98	98	96	88	90	92
Upper Volta	97	105	74	74	71	68	70	72
Wt. Ave.	98	99	96	96	93	88	91	89
Africa (Excl. S. Af.)	101	101	99	99	99	91	94	92

TABLE 6. Index of Per Capita Food Production for 12 Countries 1960, 1965, 1970-75

Country	1960	1965	1970	1971	1972	1973	1974	1975
Benin	110	95	93	90	91	95	99	99
Cameroon	96	105	97	99	94	91	94	93
Ethiopia	97	99	99	99	97	94	91	71
Ghana	99	94	88	92	83	85	85	87
Ivory Coast	95	100	112	119	115	120	125	126
Mali	107	94	90	79	67	60	64	70
Niger	89	102	96	88	74	54	91	91
Nigeria	100	100	96	94	96	89	92	93
Senegal	93	110	66	93	63	72	82	86
Sudan	94	95	106	109	100	91	99	99
Togo	110	104	105	100	98	91	92	94
Upper Volta	97	105	79	71	68	64	67	69
Wt. Ave.	98	99	96	96	93	88	91	89
Africa (Excl. S. Af.)	102	100	98	98	97	91	93	92

TABLE 7. Economic Indicators for SAFGRAD Countries

Country	GNP Per Capita 1974 (U.S. dollars)	Ave. Per Capita GNP Growth Yearly 1960-74 (percent)
Group I		
-Benin	124	.41
-Cameroon	235	.79
-Cape Verde	N.A.	N.A.
-Gambia	175	2.42
-Ghana	303	.20
-Guinea-Bissau	N.A.	N.A.
-Ivory Coast	561	4.41
-Nigeria	248	2.67
-Senegal	270	-.12
-Togo	198	3.79
Group II		
-CAR	172	-.64
-Chad	91	-2.82
-Ethiopia	82	1.76
-Mali	71	.13
-Mauritania	198	3.62
-Niger	115	1.00
-Sudan	138	.11
-Upper Volta	85	.32
16 Countries 1960-74	195	1.55
Africa (Excl. S. Africa)	311	2.21

of income, education, and infrastructural development.

The second zone includes the northern tier of Sahelian countries comprised of Mauritania, Mali, Upper Volta, Niger, Chad, Central African Republic, Sudan, and Ethiopia. The agricultural resources of these countries are contained almost exclusively in the marginal semi-arid Sahelian and Sudanian zones. Their main agricultural resource consists of dryland agriculture, although irrigation potential, largely undeveloped, exists for some. Socio-economic characteristics of these two groups of countries are contrasted in Tables 4 and 7 where marked differences in per capita GNP, in rate of economic growth, and in education are seen.

A substantial amount of trade and commerce already exists between the two groups of SAFGRAD countries. The northern tier of countries, particularly Mali, Mauritania, and Upper Volta, supply seasonal labor to the coastal states. Trade in agricultural products consists principally of cattle exports from the Northern tier countries to the coast, and exports of sugar and certain fabricated products to the inland areas. A sound development strategy will doubtlessly be founded on reinforcing this trade. The Northern Zone countries, owing to lower population density, have a comparative advantage in raising cattle, an activity that requires extensive land resources.

In summary, the SAFGRAD area includes some of the poorest nations.

2. Economic Importance of SAFGRAD Crops in Africa.

The SAFGRAD program is designed to increase the production of food crops in the Sahelian and Sudanian zones of Africa. The primary food crops in these regions are sorghum and millet. Corn is also grown, but is much less important. Groundnuts are used to a limited extent for domestic food production,

but are primarily an export crop in most of the countries. Cowpeas and other leguminous crops, while produced in limited quantities, are important to the cropping system due to their nitrogen-fixing capabilities.

Corn is recognized as having greater photo-synthetic efficiency for food production in semi-arid Africa, but is grown in limited quantities due to the heavy risk associated with the crop. Sorghum and millet have greater drought resistance; if drought occurs during the early part of their growing cycles these crops can recover when corn crops are lost. It would seem that corn research should concentrate on a viable means of introducing the culture without appreciably increasing farmer's risk.

Scientists need to be concerned with the leguminous crops because of the low level of soil nutrients in semi-arid Africa, and the bleak prospects for greatly increasing ferilizer use. Therefore, a balanced research program for food crops must include leguminous crops.

Tables 8-10 list production of SAFGRAD crops for 18 countries. Approximately four times as much millet and sorghum as corn was produced in the area during 1974. The combined tonnage of chickpeas, cowpeas, and other pulses was less than one-third of that for corn during the same year. The relative importance of sorghum, millet, and corn is indicated in Table 7. In 1974, these crops accounted for 77 percent of all cereals produced in the 18 countries. The figure is close to 100 percent for the countries of the northern SAFGRAD zone. Wheat is a more important crop in Ethiopia, which has a large supply of moist land at higher elevations. Rice supplies a substantial part of the food supply in the SAFGRAD countries having wet coastal lands.

The economic value of millet, sorghum and maize production in Africa

Table 8

Combined Millet and Sorghum
Production in SAFGRAD Countries
Ave. 1961-65, 1972-74

Country	1961-65	1972	1973	1974
	(thousand metric tons)			
Benin	66	56	95	82
CAR	46	50	50	50
Cameroon	413	339	321	340
Cape Verde	—	—	—	—
Chad	895	366	350	528
Ethiopia	1554	1259	1250	1140
Gambia	142	35	35	45
Ghana	172	249	270	29
Guinea-Bissau	9	9	12	12
Ivory Coast	44	45	46	48
Mali	782	600	525	00
Mauritania	93	50	30	30
Niger	830	500	525	800
Nigeria	6819	6609	5118	6300
Senegal	483	323	486	500
Sudan	1559	1655	1893	2265
Togo	99	151	130	140
Upper Volta	814	778	734	620
Total	14,820	13,074	11,870	13,790

1975 est: 14,617

Source: UN/FAO

TABLE 9. Corn Production in 18 SAFGRAD Countries 1961-65, 1972-74

Country	1961-65	1972	1973	1974
Benin	219	207	238	310
CAR	32	50	55	55
Cameroon	188	319	300	340
Cape Verde	26	13	13	13
Chad	11	6	6	7
Ethiopia	743	971	1000	900
Gambia	1	2	2	2
Ghana	202	389	438	480
Guinea Bissau	2	2	3	3
Ivory Coast	79	133	116	130
Mali	80	60	80	87
Mauritania	4	4	3	3
Niger	3	2	3	3
Nigeria	1040	1182	608	1100
Senegal	32	20	31	40
Sudan	17	11	18	20
Togo	75	76	60	80
Upper Volta	100	59	58	50
Total	2854	3486	3032	3623

Source: FAO

TABLE 10. Production of Chickpeas, Cowpeas, Pulses in SAFGRAD Countries Ave. 1961-65, 1972-74

CHICKPEAS
(Thousand tons)

Country	1961-65	1972	1973	1974
Ethiopia	165	198	196	198
Sudan	2	2	2	2
	167	200	198	200

COWPEAS
(Thousand tons)

Country	1961-65	1972	1973	1974
Mauritania	10	9	8	8
Nigeria	562	1103	750	830
Senegal	14	11	13	14
Upper Volta	71	60	50	55
	657	1183	821	907

PULSES
(Thousand tons)

Country	1961-65	1972	1973	1974
Cameroon	3	8	8	8
Cape Verde	4	1	1	1
CAR	4	4	4	4
Chad	65	65	70	70
Dahomey	2	3	2	3
Ethiopia	52	61	62	63
Gambia	1	1	1	1
Ghana	6	9	9	10
Ivory Coast	9	7	7	7
Mali	22	18	18	19
Nigeria	43	49	49	50
Sudan	32	45	47	49
Togo	8	66	4	5
Upper Volta	68	60	50	40
	319	337	332	330

TABLE 11. Total Cereals Production in 18 Countries - Production of Corn, Millet and Sorghum and Percent of Cereals Production

Country	1974 Cereals Prod (Thou. Metric Tons)	1974 Corn	1974 Millet and Sorghum	Percent of Total Cereals Millet, Sorghum & Corn
Benin	400	310	82	98
CAR	119	55	50	88
Cameroon	692	340	340	98
Cape Verde	13	13	--	100
Chad	577	7	528	93
Ethiopia	5545	900	1140	38
Gambia	107	--	45	42
Ghana	877	480	290	88
Guinea-Bissau	65	3	12	23
Ivory Coast	560	130	48	32
Mali	891	87	600	77
Mauritania	34	3	30	97
Niger	847	3	800	95
Nigeria	7806	1100	6300	95
Senegal	635	40	500	85
Sudan	2527	20	2265	90
Togo	238	80	140	92
Upper Volta	699	50	620	96
	22622	3621	13790	77 Wtg. Ave.

is not easy to assess, given price control schemes in most of the countries and unrealistic exchange values for local currencies. Nonetheless, a value can be imputed from prevailing market prices for these commodities in countries with market economies. The 13,700,000 metric tons of millet and sorghum and 3,623,000 metric tons of corn produced in 1974 in the SAFGRAD countries would have a value of 1,940,984,820 U.S. dollars at U.S. average farm prices that year. ($116.14 m.t. for corn, $100.24 m.t. for sorghum and millet.) Markets for food grains in West Africa are not well developed, therefore local prices are not a good indicator of values. In general, domestic prices seem to be held at a level about one-half of world market prices. Using this valuation, a figure of about one billion dollars is generated for the value of the production of these crops in 1974.

SAFGRAD countries have been forced to import food grains in recent years, so the value of the crop, if it had to be imported, is perhaps more relevant. In this case, ocean and land freight costs need to be added to the U.S. prices. In most of the project area, this would add at least one-third to the cost of grain in the U.S., giving a value of production of around three billion dollars.

Using the middle figure, two billion dollars, for valuation, it can be seen that if the SAFGRAD project could increase the productivity of food grain production by one percent (net of costs of using new technology), then a yearly dividend of 20,000,000 dollars would be generated. The present value of twenty million dollars yearly, in perpetuity, liberally discounted at 15 percent, is 133,333,333 dollars.

Perhaps a more relevant measure of the value for millet-sorghum

production in the SAFGRAD countries is that these crops provide more than 75 percent of the cereal supply in 14 of these countries. Over 80 percent of the population in these countries is engaged in agriculture. Since agricultural practice is largely characterized by subsistence farming for food crops, with generally small amounts of commercial crops being produced, an improvement in food crop productivity would contribute directly to the welfare of most people in these countries.

3. Research Benefits - Macro Level

A number of benefits at the macro level can be identified for countries that participate in the SAFGRAD program. Among them are:

(1) Increased ability to meet the food needs of their people.

(2) Improved labor productivity through better nutrition.

(3) Greater use of scarce foreign exchange to purchase products and services for development that cannot be produced locally.

(4) Improved credit-worthiness in international financial markets.

(5) Better relations with African states as a result of useful cooperation.

(6) Ability to allocate scarce planning and management resources, from relief needs of the population to long-run development efforts.

(7) Reallocation of critical physical resources, such as transportation, from relief and similar operations to development.

The severity of the recent Sahelian drought captured the attention of the world and resulted in a massive relief operation for the area. It is important to remember, however, that human existence has always been marginal in this part of the world. Protein deficiency and precariously-balanced diets are commonplace even in good years. Higher yields for foodgrains, which is the

purpose of the SAFGRAD program, will permit greater success by governments in meeting the food reeds of their populations and thereby have an important political payoff.

Low labor productivity is often the result of weakened populations with inadequate diets. Poor diets and low productivity can operate to produce a vicious circle, in which the possibility of productivity gain is foreclosed by inadequate diets. It is generally recognized that the most innovative populations are not those living on the margin of existence, but those whose basic needs are met, and for whom visible progress is possible. Low productivity can be the result of lack of motivation, physical weakness, or lack of innovation. The SAFGRAD Program may contribute to increased labor productivity in the region through making more adequate diets possible, giving farmers new possibilities for improved practices, and permitting the population to be brought to a level where the rate of innovation, which always requires risk-taking, can be increased.

Sahelian countries pay an enormous price in using their scarce foreign exchange resources to purchase food imports. The economic infrastructure in many of these countries is among the thinnest in the world, with lack of adequate port and airport facilities, poorly developed road and transportation systems, inadequate water distribution systems, to mention only a few. Foreign exchange that is currently spent on food requires a heavy sacrifice in terms of investments that could increase the future productivity of these nations.

The SAFGRAD countries, in order to develop, need to supplement donor assistance with borrowed funds from international financial centers. Their financial credibility, and therefore their credit worthiness will be

severely impaired as long as they fail to meet the basic food needs of their people. If SAFGRAD can contribute to increased agricultural productivity, an important side effect may be to increase the pace of development generally, through improving the credit-worthiness of these countries and thereby the development funds available to them.

SAFGRAD countries can scarcely permit national differences to impair the realization of development opportunities such as river basin development, that are available only through regional cooperation. Since the best way to build a framework of international cooperation is actually to cooperate in significant and useful areas, SAFGRAD can be one element in promoting regionalism in Sahelian Africa.

The small number of locally-trained people available for development projects in many Sahelian countries operates as an important constraint on develop ent. To the extent that these people are preoccupied with the daily subsistence needs of their people, their attention cannot be given to development. Donor assistance requires input and management by key people in the recipient country. When donor assistance must consist of relief projects as opposed to development projects, the future development of these countries is compromised, both by the channeling of outside resources into projects with little or no development potential, and by the demands that these projects place on local expertise.

Physical infrastructure, transportation and communications systems, and all types of supporting services for professional personnel are scarce in most of these countries. Many have a very limited capacity to support the needs of expatriate advisors and technicians. Improved food production capability

can permit a reallocation of scarce foreign personnel from population maintenance activity to development activity as such.

The development process is typically subject to a number of binding constraints. The SAFGRAD program can help to relieve critical constraints to development that are exacerbated by deficient food production, such as foreign exchange, local professional personnel, expatriate experts, and infrastructure, and thus contribute to overall development in Sahelian Africa. Important benefits could also accrue through more regional cooperation and a more productive labor force.

4. Research Benefits -- Micro Level

Besides the benefits of improved nutrition, improved food grain varieties developed under SAFGRAD can have an important indirect effect in increasing cash income of farmers, even though food grains are typically produced for home consumption. Farmers, even the poorest ones, must allocate their land and labor between subsistence and cash crops. Even the poorest people in the Sahelian region have minimal needs that can only be met from the market economy, and these needs are reflected in their allocation decisions for land and labor. Better yields for food crops, in addition to making possible a higher level of nutrition, will also permit farmers to devote more of their time to cash crops, such as groundnuts or cotton, to cottage industry, or to off-farm employment, thereby contributing to higher levels of cash income in the region.

To the extent that food grain varieties developed under SAFGRAD are more disease, or drought-resistant, the reliability of food output in the region will be increased. This can be an important element in promoting technical

change, since high risk levels and marginal existence do not permit innovation.

5. Research: Getting Results to the Farmers.

Success in disseminating scientific information and transferring technical information to farmers in Sahelian Africa has generally been quite low, according to specialists in the field. For this reason, it is extremely important that the design of the SAFGRAD Project include features that will guarantee its ultimate productivity in farmers' fields.

Lack of success in transferring technology to farmers can be the result of a number of factors. Deficiencies in the existing extension service are often listed as being among the chief causes. It is true that the number of agents, their organization, training, and operating procedures often leave much to be desired. It should be remembered, however, that the extension services generally work with a set of improved practices, including perhaps new varieties, that are given to them by scientists. That is to say, they work with the supply of technical change as received from scientists.

Failure to transfer this technical change may be the result of inappropriate extension methodology, or insufficient extension resources. It can also be the result of the technical package being inappropriate to farmers' conditions. That is to say, scientists may also produce the wrong outputs.

The demand for improved practices is really derived from farmers and the conditions they face. There are immense difficulties in interpreting farmers' demands for technical change in Sahelian Africa. This is primarily the result of the vast differences in sociological and physical living conditions between the research scientists and the farmers. This problem is less

severe in developed countries since agricultural scientists often have rural backgrounds themselves, the economic gulf between themselves, the economic gulf themselves and farmers is not large, extension personnel are well-trained, and farmers articulate their desires well.

The supply of improved practices, nonetheless, comes from scientists, laboratories and test plots. Practices that are developed without knowledge of what farmers need run a heavy risk of being infeasible for farmer adoption.

The extension service should essentially serve as a two-way communications medium between farmers and scientists. That is, it should facilitate the expression of farmer needs to scientists as well as the transfer of technology developed by scientists to farmers.

SAFGRAD should make use of, and possibly support, existing farming system research in Sahelian Africa. Three centers of such activity in West Africa were identified during the Project Design Mission. Mr. Raymond, at Bambey, Senegal, has begun important work in identifying existing farming technology. An important aspect of his methodology is minimal use of expensive foreign technicians and maximum use of locally-trained people. Precise identification of existing farmer technology is a requirement for answering the question of where scientists' inputs can be most effective. It is clearly in the interest of the SAFGRAD program for Raymond's work to continue. His work should be linked to the SAFGRAD program and, if necessary, supported by it.

The International Institute of Tropical Agriculture (IITA) at Ibadan is conducting a cooperative program with the Nigerian Federal Ministry of Agriculture called the National Accelerated Food Production Program (NAFPP). As part of this program, production "minikits" have been developed. The minikits

program, which has just seen its first full year of operation, has had varying degrees of success to date. The program has been most successful in rice, a high-value crop, where, under irrigation, most physical conditions can be controlled. Success has been less clear for the dryland crops of sorghum and millet, where the variance of uncontrollable factors, both meteorological and biological, is greater. Nonetheless, the minikit program is one that should be examined for possible application elsewhere.

Research results often fail to be used by farmers due to the failure of the input delivery system to supply one or more critical factors. The minikit includes detailed instructions on use of new varieties as well as seed, fertilizer, and pesticides. An added dividend is that both farmers and extension workers are encouraged to participate in the research process since comparisons between existing and new varieties and practices are part of the program.

The Extension-Research Liaison service at Zaria, Nigeria, now staffed almost completely by Nigerians, is one of the largest and best university extension units in West Africa. Organized along conventional extension lines, and including a publishing unit, this unit has produced a large volume of specialized literature in the technology transfer area. The work of Dr. Norman and his associates in the Agricultural Economics Department at ABU has also contributed greatly to that center's standing in technology transfer. The SAFGRAD Program should consider training in extension methodology at Zaria.

D. SOCIAL ANALYSIS.

1. Cultivation constraints.

In some instances, social factors may constrain the adoption of

improved agricultural technologies by small farmers. What the farmer grows and how he grows it is determined by physical/biological, economic and social/cultural factors. Little is known about the relative importance of economic/social constraints at the small farm level in semi-arid tropical Africa, however.

As discussed previously, the Farming Systems Unit has been established specifically to study cultivation constraints (physical/biological, economic and social). To ensure emphasis on social factors as they relate to the farming system, a rural sociologist/social anthropologist has been placed on the three man farming systems team. Refer to II.B.1., "Farming Systems Research."

2. Benefits incidence.

The project has been designed to produce a level of technology which will result in a broad and equitable diffusion of benefits among the target group. The entire project emphasis on low-risk, "low infrastructure" technology stems from the assumption that high infrastructure technology cannot be made available or acceptable to the bulk of small farmers in the area for many years. Benefits incidence is directly dependent on the feasibility of developing low-infrastructure technologies. The development of low-infrastructure technologies which can be utilized by small farmers with a practical level of farm inputs and services will permit the accrual of benefits to the poorest majority (Refer to Issue No. 5.).

The application of new technologies developed under SAFGRAD implies transition from subsistence to commercial farming systems and the considerable social change which invariably accompanies such development.

IV. IMPLEMENTATION PLANNING

A. ADMINISTRATIVE ARRANGEMENTS.

1. Project Organization.

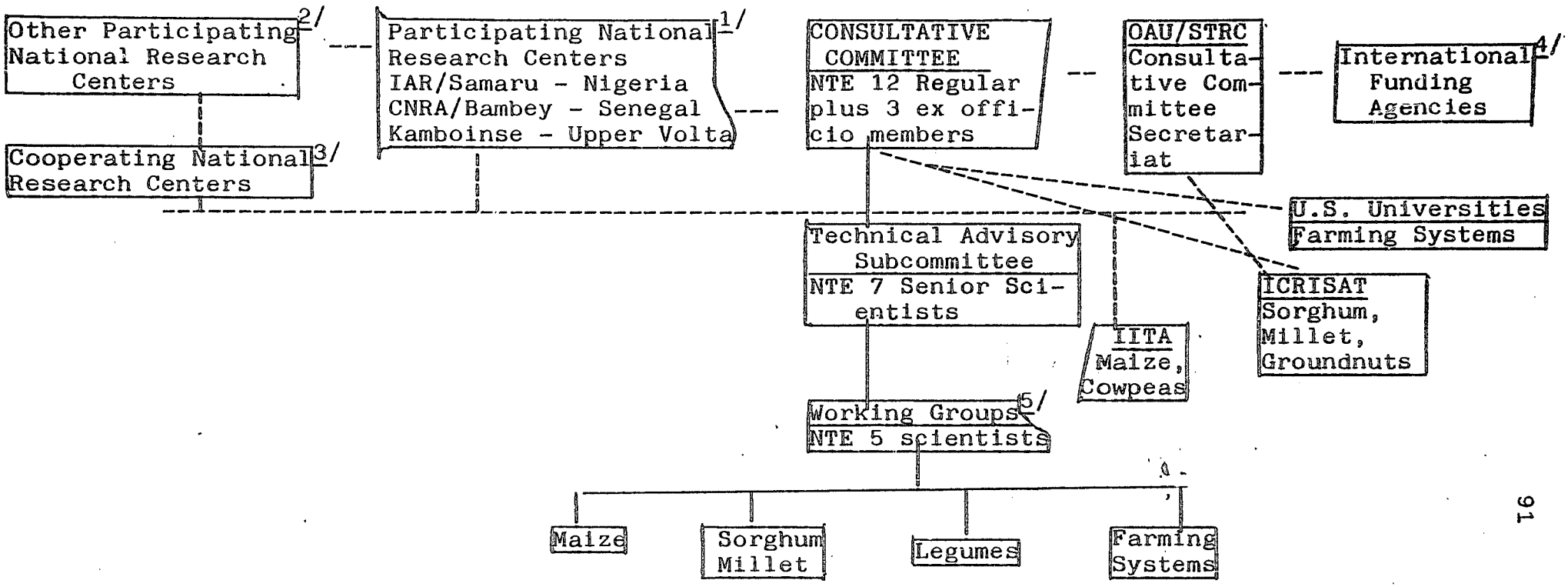
As described briefly in the project description, policy, and technical guidance will be provided by a multinational Consultative Committee (CC) and a Technical Advisory Committee (TAC). The project will be coordinated by an OAU/STRC Project Manager. In addition, an AID Direct-Hire Project Officer will assist in managing the A.I.D. project inputs. The AID Project Officer and OAU/STRC Project Manager will be headquartered in Ouagadougou, Upper Volta. This office will be the main contact point for other donors, participating and cooperating African states, and international centers or agencies interest in SAFGRAD.

The SAFGRAD project will be implemented by teams of researchers supplied by IITA, ICRISAT, and a U.S. University, supplemented by ACPO's and, possibly, other researchers supplied by participating African states or donors.

CC and TAC meetings will be scheduled at least on an annual basis, but more frequently if deemed appropriate. It will be essential to secure involvement of a maximum number of key individuals in the project. Cooperation and coordination are essential to (1) effectively channel research results from SAFGRAD-assisted sites to the various national researchers for testing and dissemination to the national extension services and, in turn, to farmers and (2) channel farmer results and/or problems back to the research centers.

SAFGRAD Project organization is shown in Chart 1. Anticipated roles of the various SAFGRAD participants are discussed below.

CHART 1. SAFGRAD Project Organization



----------Coordination line

1/ These Centers have regionally funded components. ACPOs are included.
2/ These are centers conducting national research which do not have regionally-funded researchers assigned to them. ACPOs are included.
3/ These centers are peripherally concerned about the crops addressed by the project and will participate in the project on a "cooperative" basis. Such countries would be Zaire, Buinea, Tanzania, etc.
4/ These agencies may include UNDP, AID, FAC, ODM,EEC and others.
5/ Working groups will be established, as needed, by the Consultative Committee. Working groups shown are illustrative.

2. AID's Role.

The organization and management of the AID input into the SAFGRAD Program will be a challenging task. A fulltime direct-hire Agriculture Development Officer will be assigned as project officer with an African Program Assistant and a secretary. The project officer position description is attached as Annex D. Concurrence has been received to post the officer in Upper Volta. His office will be established in conjunction with the OAU/STRC Field Office there. This officer will monitor and coordinate the AID inputs in cooperation with other donors, national governments, international research centers, U.S. University, and OAU/STRC and local USAIDs. He will provide coordination between SAFGRAD and AID-assisted bilateral food crop seed multiplication and production programs where appropriate.

The AID Project Officer will perform a role with the various participating countries in coordination of the ACPO's role and in selection and development of training programs for participants.

3. Consultative and Technical Advisory Committee.

It was recommended at the Ouagadougou Conference, in January 1976, that there should be a Consultative Committee served by a technical advisory committee to deal with policy, coordination, cooperation, implementation, and overall management of the SAFGRAD program.

Conferees felt that a maximum amount of management flexibility was essential to permit the SAFGRAD Program to function with the large number of actors involved to address the broad array of problem areas which the program is designed to address.

Participating African countries will be in majority on the two

committees. The proposed role and composition of the Consultative Committee is outlined as follows:

a. Role:

1. Identify, review and make recommendations on policy matters;

2. Review management, organization, or technical problems and make recommendations for donors, implementators and participating and cooperating countries to follow in seeking solution to problems;

3. Facilitate project implementation and assure sound administrative management and technical practices;

4. Serve as a receiving and reviewing body for questions or suggestions from any participating or cooperative party.

b. Composition:

1. The Consultative Committee will initially be comprised of twelve (12) permanent members (exclusive of ex-officio members). The OAU/STRC will serve as permanent secretary for the Committee. The membership will be no less than 50% representatives from the participating or cooperating countries.

2. Suggested membership follows:

Agency/Cooperator Members		
FAC	(1)	
AID	(1)	
ODM	(1)	
UNDP	(1)	
Other Donor	(1)	(ODM, FED, Netherlands, Germany, etc.)
OAU/STRC	(1)	(Permanent Secretary)
African Reps	(2)	
African Reps	(2)	

Agency/Cooperator Members (cont'd)

African Reps	(2)	
IRAT	(1)	Ex-Officio Members. May attend all sessions.
IITA	(1)	
ICRISAT	(1)	

The Consultative Committee would be required to meet annually or more frequently if determined necessary by the majority of the regular members.

The proposed role and composition of the Technical Advisory Committee may be outlined as follows:

a. Role:

1. Review annual research and ACPO work plans and submit recommendations to Consultative Committee.

2. Review other research work plans/documentation related to SAFGRAD in the Sudanian-Sahelian Zone, and submit recommendations to the Consultative Committee on approaches for improvement or coordination of food crop research.

b. Composition:

1. The Technical Advisory Committee will initially be composed of NTE seven (7) senior scientists including an OAU/STRC technical representative who may serve as Permanent Secretary for the committee.

2. Suggested membership follows:

Agency/Cooperating Member	
IITA	(1)
ICRISAT	(1)
IRAT	(1)
OAU/STRC	(1)
African Reps	(1)
African Reps	(1)
African Reps	(1)

4. Organization of African Unity-Scientific, Technical and Research Commission (OAU/STRC)

The OAU/STRC is based in Lagos, Nigeria, which is one of OAU's three main offices. Since their establishment, they have been active in various regional agriculture, livestock and fisheries activities. A significant OAU/STRC project activity was the coordination and management of the Major Cereals Research Project (JP 26). Functions included coordinating project operations among donors and African countries, arranging training, conducting seminars and conferences, securing multidonor support, and performing a host of other duties. Thus, OAU/STRC has considerable experience relevant to the SAFGRAD Program.

OAU/STRC has agreed to establish a field office in Ouagadougou specifically to coordinate the SAFGRAD Program. To head this office, they will assign an OAU/STRC technical officer, who may serve as the permanent secretary of the Consultative Committee and/or the Technical Advisory Committee. The AID Project Officer and possibly other donor staff would be attached to this office.

The OAU/STRC role in SAFGRAD is envisioned as providing a number of functions:

(1) Serve as regional coordinator for SAFGRAD with regard to implementation matters involving governments of participating countries.

(2) Facilitate the application of Consultative Committee recommendations regarding program operation, research priorities, etc.

(3) Convene Consultative Committee and Technical Advisory Committee meetings.

(4) Facilitate SAFGRAD training program including OJT and donor contributions.

(5) Encourage and assist participating countries to contribute to the project by developing their own infrastructure and programs.

(6) Facilitate seed/germ plasm distribution.

(7) Organize scientific conferences.

(8) Print, translate, distribute research documents. (conference reports; regional research reports)

(9) Coordinate ACPO activities, including bilateral negotiations, donor and national support, and program content.

(10) Coordinate donor support and national support to SAFGRAD.

(11) Liaison with international research institutes.

The current OAU structure, as it relates to SAFGRAD, is described in Chart 2.

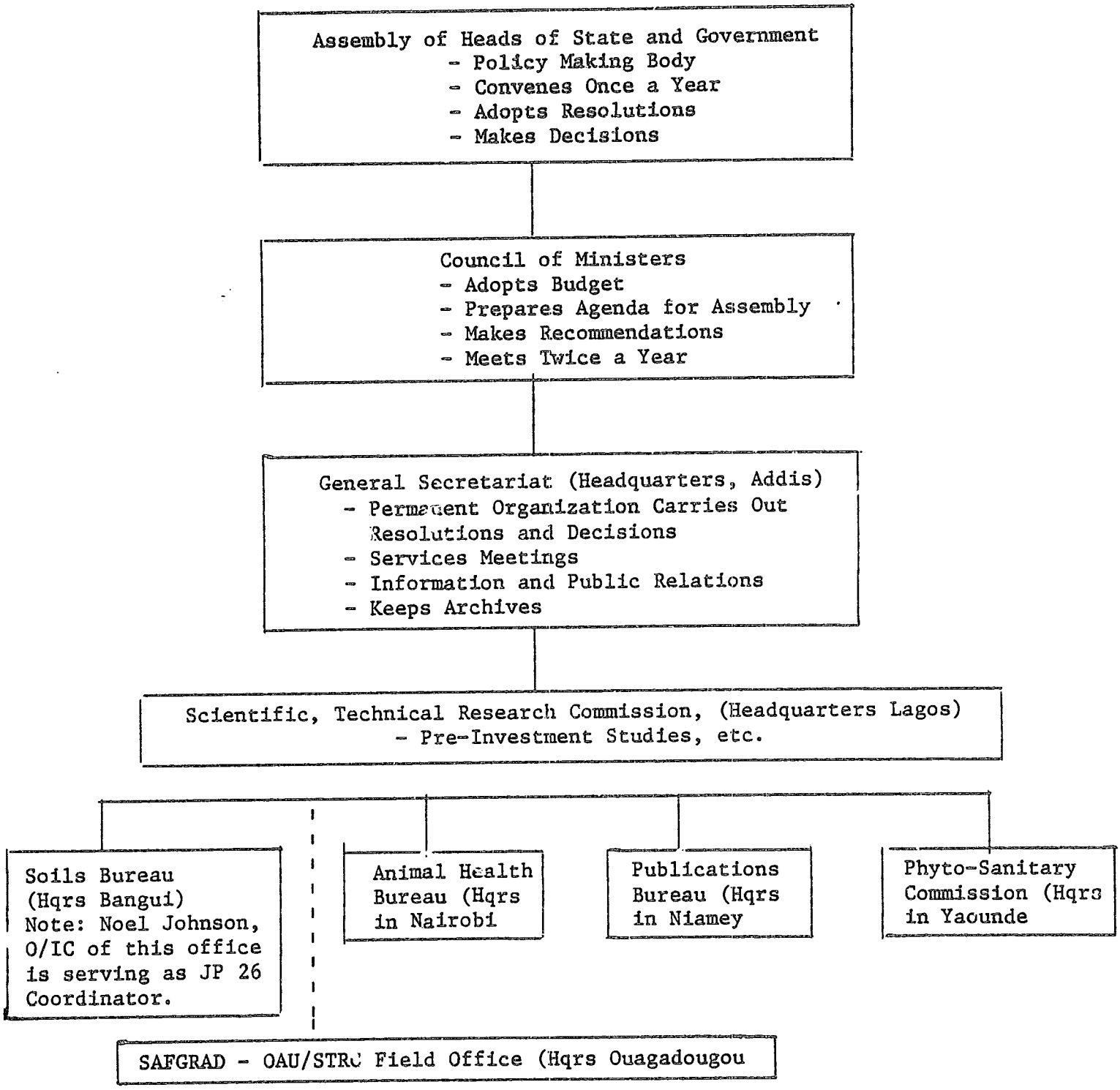
5. International Institute of Tropical Agriculture (IITA).

IITA is headquartered near Ibadan, Nigeria. Originally, its major objective was to seek solutions to problems associated with the transition from traditional shifting cultivation to more productive land-use systems in the humid tropics. This mandate has been extended to include semi-arid areas for certain crops IITA has four core research programs: farming systems; cereals (maize and rice); grain legumes (cowpeas, lima beans, pigeon peas, soybeans); and roots and tubers (yams, cassava, sweet potato).

Maize improvement has been an important IITA program for several years. Emphasis has been on the humid tropics, but considerable work has been undertaken in drier areas. IITA has worldwide responsibility for the improvement of cowpeas. The institution has ideal resources at its disposal to provide technical assistance for regional research on maize, cowpeas, and related farming systems under the SAFGRAD program.

During 1971-76, AID bilaterally funded assistance (#620-798) in Nigeria with focus on the research and extension aspects of the production of maize, rice, sorghum/millet, wheat and cassava. During 1973-80, AID is

Chart 2. OAU Organization Chart



The SAFGRAD-OAU/STRC Field Office will benefit from services of the existing OAU Soils Bureau, Publication Bureau, and Phyto-Sanitary Commission.

bilaterally funding an agriculture research project (#621-107) in Tanzania to select and develop high-yielding varieties of food crops, primarily maize and legumes, for various ecological zones. These two programs were implemented by IITA. Thus, IITA has experience in research and production programs in maize, cowpeas and farming systems under African conditions.

IITA would concentrate its SAFGRAD role in maize and cowpeas. Initially, this will be at Kamboinse and will possibly expand to other selected national sites, as research results and resources permit, and as arrangements can be made in areas with suitable climate and environmental conditions.

The officials of IITA, ICRISAT and AID have discussed the anticipated roles of the two international centers in the SAFGRAD program for over a year. Both centers have indicated positive interest in cooperating and participating in the program.

6. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

In July 1972, ICRISAT was established by the Consultative Group for International Agricultural Research (CGIAR) to serve as a world center for the genetic improvement of sorghum, pearl millet, pigeon peas, chickpeas, and groundnuts, and to develop farming systems that will help to increase and stabilize production of these crops throughout the semi-arid tropics. Through a system of cooperative programs, ICRISAT is to strengthen national and regional programs by providing technical assistance and assisting in the development of improved technologies, and by training scientists and production specialists in the semi-arid tropical countries.

ICRISAT began a cooperative program of research and training for the improvement of sorghum and millet in the Sudanian-Sahelian Zone of West African in January 1975, with the signing of an agreement with the UNDP. The focal point of this agreement is to strengthen national programs of twelve countries of the region (Senegal, Gambia, Mauritania, Mali, Togo, Benin, Ghana, Upper Volta, Niger, Nigeria, Chad and Cameroon) by posting teams of scientists located at Bambey, Senegal, and Samaru, Nigeria with selected scientists in Upper Volta and Niger. Thus, this UNDP/ICRISAT program directly relates to:

a. IRAT research conducted at Bambey and other Francophone sites;

b. The research conducted at IAR, Samaru, Nigeria, including the AID-assisted Major Cereals Research Project (JP 26), which phases out in December 1976.

The conferees at the SAFGRAD Ouagadougou Conference supported the idea of using ICRISAT for supplying key crop researchers, assisting in both short and long-term staff training and related farming systems research.

B. IMPLEMENTATION PLAN.

Implementation actions and responsibilities are presented on the attached 1) Critical Performance Indicator (CPI) Network and 2) Critical Performance Indicator (CPI) Description.

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE		APPROVED
AFR Reg	698-11-130-XXX	SAFGRAD	10/76	[X] ORIGINAL [ ] REVISION # ____	

OR FY 1977 1978 1979 1980
CY 1977 1978 1979 1980

MONTH MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB

0 12 24 36

PRIOR ACTIONS

POST ACTION

(11/76) 8 22 33 43
(12/76) 9 23 34 44
(1/77) 5 10 15 24 29 31 35 39 45
(2/77) 6 11 13 16 17 20 25 30 32 36 40 41 42 46
7 12 18 19 21 26 37 47
13 27 38 48
28

100

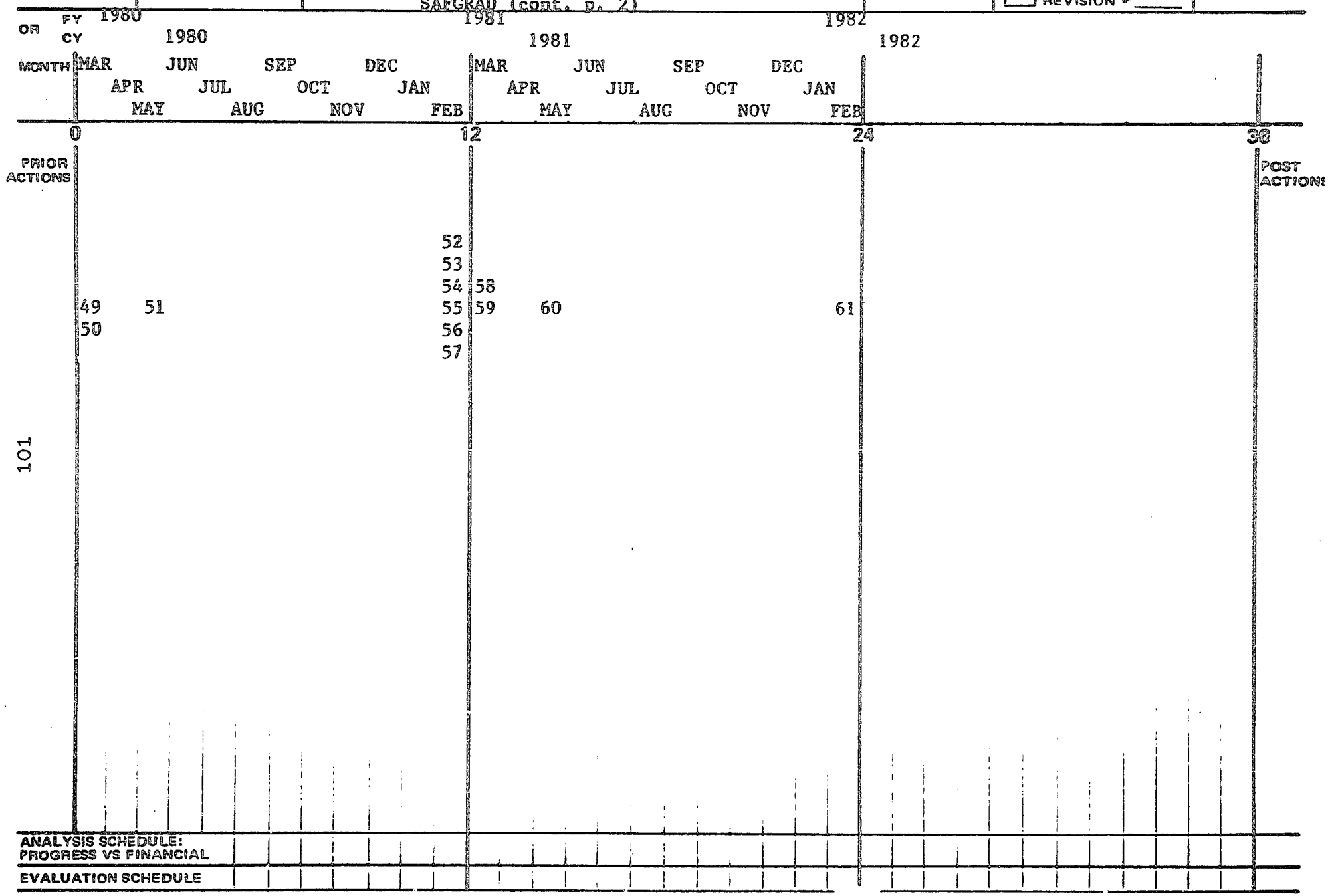
ANALYSIS SCHEDULE: PROGRESS VS FINANCIAL

EVALUATION SCHEDULE

CRITICAL PERFORMANCE INDICATOR (CPI) NETWORK

AID 1020-35 (6-76)

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE	ORIGINAL / REVISION #	APPROVED
		SAFGRAD (cont. p. 2)			



AID 1020-35 (6-76)

CRITICAL PERFORMANCE INDICATOR (CPI) NETWORK

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE	☐ ORIGINAL ☐ REVISION # ____	APPROVED

PROJECT PURPOSE (FROM PRP FACESHEET)

102

CPI DESCRIPTION

1. Project Paper Draft

SAFGRAD Project Paper (PP) sent to participating countries, donors, research institutions, OAU/STRC USAID's for comment. Critical 11/76

2. ACPO requests
Participating countries, in liaison with OAU/STRC, have planned/arranged for an Accelerated Crop Production Officer (ACPO), either national or expatriate, for the 1977 crop year. Critical 2/77

3. PP finalized in AID/W based on reviewers' comments. Target 1/77.Critical 2/77

4. Recruitment
Informal Recruitment of expatriate scientists and ACPOs begun in anticipation of SAFGRAD project. Target 2/77. Critical 2/77

5. Grant Agreement signed with OAU/STRC. Grant agreement will specify AID as implementing agent for certain elements of the agreement, i.e., (1) Technical Assistance (researchers, ACPOs, short-term consultants) to be provided by ICRISAT, IITA, or U.S. Universities. (2) Certain commodity procurement, e.g., vehicles, scientific equipment, (3) Construction at Kamboinse (4) Participant training. OUA/STRC will be principle implementing agent for (1) Administrative/coordination support (Refer to numerous OAU/STRC Functions in this regard -- IV.A. Administrative Arrangment, P __) (2) Scientific conferences.
In every case, contracts or project implementation orders (PIO) will be cleared and approved by the host governments directly involved, e.g. the Government of Nigeria must be party to any contract providing researchers to IAR, Nigeria; the Government of Upper Volta must be party to any contract providing researchers to Kamboinse, etc. Target 3/77. Critical 4/77

6. Consultative Committee Organized
OAU/STRC arranges for the organization of the SAFGRAD Consultative Committee (CC) and the Technical Advisory Committee. Target 3/77. Critical 6/77

7. Consultative Committee Convenes. First convening should occur as early as possible. Target 4/77. Critical 8/77

8. Field Trial Workplans
Prior to organization and operation of the CC and the technical committee, abbreviated first year research workplans and field trial workplans will be developed by ICRISAT and IITA, in conjunction with host government and OAU/STRC, for crop year 1977. Note: This arrangement applies to those locations where a few ICRISAT or IITA researchers will actually be on board in time for crop year 1977 farm operations. Target 4/77. Critical 4/77

9. OAU/STRC Office
Coordinating Office established in Ouagadougou. Target 4/77. Critical 4/77

10. ACPO Memos of Agreement
AID and OAU/STRC sign Memorandum of Agreement with each country where an AID Funded ACPO is to be provided. Understandings should be reached about the ACPO role, his position within the national research and extension programs, his operating support (national and donor

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE	ORIGINAL / REVISION # ____	APPROVED

PROJECT PURPOSE (FROM PRP FACESHEET)

CPI DESCRIPTION

support). Target 4/77. Critical 8/77

11. Research Memos of Agreement
AID and OAU/STRC signs Memorandum of Agreement with the Governments of Nigeria and Upper Volta regarding the nature, scope, support of SAFGRAD activities to be conducted at IAR and Kamboinse, respectively. Target 4/77. Critical 7/77

12. AID-ICRISAT Contract
Contract signed with ICRISAT, and approved by OAU and Governments of Nigeria and Upper Volta, to provide technical assistance plus operating support to SAFGRAD regional millet and sorghum research activities at IAR and at Kamboinse. Target 4/77. Critical 6/77

13. AID-IITA Contract
Contract signed with IITA, and approved by OAU and Government of Upper Volta, to provide technical assistance and operating support to SAFGRAD regional maize and grain legume research activities at Kambonise. Target 4/77. Critical 6/77

14. Field Trials
Per workplans developed (item 8), field trials commence for crop year 1977. Note: These trials are expected to be few in number, only where a few SAFGRAD provided ACPOs are on-board. Target 5/77. Critical 5/77.

15. ACPO Agreements
Where ACPOs are not AID funded, bilateral grant agreements signed between national governments and donors of their choice to provide ACPOs and operating support. Where national governments provide their own ACPO, arrangements for assignment and national support should be made. Agreement should specify understandings regarding ACPO role, position in the national government, and operating support (national and donor provided). Target 6/77. Critical 8/77

16. AID project manager arrives in Ouagadougou. Target 6/77. Critical 7/77.

17. Conference Plans
OAU/STRC plans year 1 scientific conference (3 conferences). Second convocation of the Consultative Committee and the technical committee combined with the first scientific conference. Plan also the first ACPOs conference. Target 7/77. Critical 9/77

18. Training Needs Assessment
OAU/STRC in coordination with AID project manager will assess and prioritize manpower training needs in national cereals and grain legume research needs. A short-term consultant may be necessary to develop this assessment. A SAFGRAD training plan will be developed from this assessment and approved by the CC.

19. Participant Training plan completed and approved. See 18, above.

20. Construction
Begin construction of office and lab facilities at Kamboinse. Target 12/77. Critical 2/78.

21. Millet/Sorghum Conference
First scientific conference (millet/sorghum) held jointly with second convening of CC and Technical

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE	☐ ORIGINAL ☐ REVISION # ____	APPROVED

PROJECT PURPOSE (FROM PRP FACESHEET)

CPI DESCRIPTION

Advisory Committee. Target 12/77. Critical 3/78.

22. Scientists on-board

All AID funded researchers and ACPOs on-the-job. Target 2/78. Critical 2/78.

23. Research workplans

SAFGRAD researchers (at IAR, Kamboinse, Barbey) draft two regional research workplans, (a) a general overall plan to cover the 4 year period 1978-1981, and (b) a more detailed workplan for crop year 1978. Draft plans should be developed in close coordination with host national research institution and in conformance with CC and Technical Committee guidance (per item 20). Plan should (1) State station objectives and approaches by crop or by area of study. (2) Quantify the work to be performed, to extent reasonable (3) Itemize the inputs and cost (annual budget) needed to conduct the 1978 research program (4) Discuss the administrative, organizational, logistical arrangements needed to carry out the plan.

The 4 year plan will be revised annually. Plans will be reviewed and approved by the Consultative Committee upon the advice of the Technical Committee. Target 2/78. Critical 3/78

24. Farming Systems workplans

Farming Systems Team drafts workplans (a) general overall 4 year plan and (b) detailed workplan for crop year 1978. The long term plan is particularly important and should present a strategy for addressing the two crucial issues over the life of the project, i.e., (1) How to make research relevant (technically, economically, etc.) to farmers conditions (2) How to transfer beneficial technology to farmers fields, within the 4 year strategy. The Crop Systems Team should describe the type of coordination envisioned with ACPO in planning and appraising farmer field trials. Plans should be coordinated with the regional varietal improvement workplans.

The annual farming systems plan for crop year 1978 should (1) State objectives/approaches (2) Quantify work (3) Budget for work (4) describe organizational/administrative arrangements. Target 2/78. Critical 3/78.

25. ACPO Workplans

Each ACPO develops a workplan for the year ahead. This plan should be developed in close coordination with national research and outreach officials and reflect the guidance of the Technical Advisory Committee and the SAFGRAD regional researchers. The plan should be responsive to national problems and to the effective use of regional SAFGRAD provided support (vis-a-vis the regional varietal improvement program and the regional crop improvement programs). Plan should:

(1) State objectives and approaches regarding
(a) Uniform variety trials (b) Farmer Field trials
(c) Extension/demonstration linkages (d) Coordination of activities with crop improvement researchers
(e) Studies related to these activities.
(2) Quantify work to be achieved
(3) Budget for work
(4) Describe organizational/administrative arrangements.

Plan should be completed in time to permit a serious ACPO effort in Crop year 1978. Target 2/78. Critical 3/78.

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE	☐ ORIGINAL ☐ REVISION # ____	APPROVED

PROJECT PURPOSE (FROM PRP FACESHEET)

CPI DESCRIPTION

26. Conference (maize/cowpea)
Maize/cowpea scientific conference held. Note: Date of conference is flexible. February is suggested so as (1) not to overlay too closely with the Millet/Sorghum conference in December and (2) To fall at about the same time the research workplans are being developed. Target 2/78. Critical 4/78

27. Consultative Committee
CC or Tech Committee convenes third time at second scientific conference. Intent is to review research and field trials workplans and to provide management direction and generally facilitate actions (personnel, financial, logistic, administrative, management, etc.) needed to bring about implementation of plans and a full SAFGRAD program in crop year 1978. Target 2/78. Critical 4/78.

28. Annual reports
In any annual field trials and research reports, specify problems, progress. Target 2/78. Critical 2/78. Not applicable where no SAFGRAD activities undertaken in CY 1977.

29. OAU/STRC plan
OAU/STRC, with guidance of CC, initiates plan of administrative action to help effect implementation of workplans as scheduled. OAU/STRC will review research and ACPO workplans in view of implications vis-a-vis OAU/STRC functions. (Reference IV.A. Administrative Arrangements, p. ___ for list of OAU/STRC functions regarding this project.) Target 3/78. Critical 3/78

30. ACPO Conference
Annual ACPOs conference. Review results of previous crop year work. Review plans for coming year. Target 3/78. Critical 3/78.

31. Construction complete
Complete construction and equipping of facilities of Kamboinse. Target 5/78. Critical 5/78.

32. Annual repeat of indicator No. 14.

33. Annual repeat of indicator No. 23.

34. Annual repeat of indicator No. 24.

35. " " 25.

36. " " 26.

37. " " 27.

38. " " 28.

39. " " 29.

40. " " 30.

41. " " 14.

42. Midpoint Evaluation of SAFGRAD
The project design provides $20,000 for a midpoint evaluation by an outside consultant. Evaluation is timed to follow 2 full cropping seasons so that sufficient time has elapsed to permit progress toward achievement of research progress and so that sufficient

COUNTRY	PROJECT NO.	PROJECT TITLE	DATE	☐ ORIGINAL ☐ REVISION # ____	APPROVED

PROJECT PURPOSE (FROM PRP FACESHEET)

CPI DESCRIPTION

time remains to effect meaningful design modifications if needed.

43. Annual repeat of indicator No. 23.

44. " " 24.

45. " " 25.

46. " " 26.

47. " " 27.

48. " " 28.

49. " " 29.

50. " " 30.

51. " " 14.

52. " " 23.

53. " " 24.

54. " " 25.

55. " " 26.

56. Annual repeat of indicator No. 27.

57. Annual repeat of indicator No. 28.

58. " " 29.

59. " " 30.

60. " " 14.

61. Final Evaluation.

ANNEX A.
Table 1, p. 1.

AID FINANCED PROJECT COSTS.

	Cost/Unit	No. Units 5 year Total	77	78	79	80	81	5 year Totals Total	FY 1977 Total	FY 1977 FX	FY 1977 LC	FY 1978 Total	FY 1978 FX	FY 1978 LC	FY 1979 Total	FY 1979 FX	FY 1979 LC	FY 1980 Total	FY 1980 FX	FY 1980 LC	FY 1981 Total	FY 1981 FX	FY 1981 LC
I. TECHNICAL ASSISTANCE								4,621,500	542,928			1,010,429			1,042,714			1,002,714			1,002,714		
A. Crop Research Scientists								3,150,000	350,000			700,000			700,000			700,000			700,000		
Nigeria (IAR)								810,000	90,000			180,000			180,000			180,000			180,000		
1. Physiologist (Striga) (ICRISAT)	60,000 1/	4.5m/y	.5	1	1	1	1	270,000	30,000			60,000			60,000			60,000			60,000		
2. Pathologist (sorghum/millet) (ICRISAT)	" "	4.5m/y	.5	1	1	1	1	270,000	30,000			60,000			60,000			60,000			60,000		
3. Entomologist (sorghum/millet) (ICRISAT)	" "	4.5m/y	.5	1	1	1	1	270,000	30,000			60,000			60,000			60,000			60,000		
Upper Volta (Kamboinse)								1,462,500	162,500			325,000			325,000			325,000			325,000		
Aid to fund 5 of the following 7 positions: 3 IITA positions & 2 ICRISAT positions. (1) millet breeder (ICRISAT) (2) entomologist (cereals, legumes) (IITA) (3) production agronomist (Field trials) (ICRISAT) (4) legume/cowpea breeder (IITA) (5) maize breeder (IITA) (6) soil fertility agronomist (ICRISAT) (7) soil management agronomist (ICRISAT)	65,000 2/	4.5m/y	.5	1	1	1	1	292,500	32,500			65,000			65,000			65,000			65,000		
	" "	4.5m/y	.5	1	1	1	1	292,500	32,500			65,000			65,000			65,000			65,000		
	" "	4.5m/y	.5	1	1	1	1	292,500	32,500			65,000			65,000			65,000			65,000		
	" "	4.5m/y	.5	1	1	1	1	292,500	32,500			65,000			65,000			65,000			65,000		
	" "	4.5m/y	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]			[illegible]			[illegible]			[illegible]		

AID FINANCED PROJECT COSTS.

	Cost/Unit	5 year Total	No. Units 77	78	79	80	81	5 year Totals Total	FX	LC	FY 1977 Total	FX	LC	FY 1978 Total	FX	LC	FY 1979 Total	FX	LC	FY 1980 Total	FX	LC	FY 1981 Total	FX	LC
Regional field trials Liaison/Cropping Systems team (Kamboinse, Upper Volta)								877,500			97,500			195,000			195,000			195,000			195,000		
1. Production agronomist	65,000	4.5m/y	.5	1	1	1	1	292,500			65,000			65,000			65,000			65,000			65,000		
2. Agricultural economist	65,000	4.5m/y	.5	1	1	1	1	292,500			65,000			65,000			65,000			65,000			65,000		
3. Rural sociologist	65,000	4.5m/y	.5	1	1	1	1	292,500			65,000			65,000			65,000			65,000			65,000		
B. Accelerated Crop Production Officer								1,237,500			137,500			275,000			275,000			275,000			275,000		
1. Upper Volta	55,000	4.5m/y	.5	1	1	1	1	247,500			275,000			55,000			55,000			55,000			55,000		
2. Chad	" "	"	.5	1	1	1	1	247,500			275,000			55,000			55,000			55,000			55,000		
3. Mali	" "	"	.5	1	1	1	1	247,500			275,000			55,000			55,000			55,000			55,000		
4. Togo	" "	"	.5	1	1	1	1	247,500			275,000			55,000			55,000			55,000			55,000		
5.	" "	"	.5	1	1	1	1	247,500			275,000			55,000			55,000			55,000			55,000		
C. Short Term Consultancy/Evaluation								234,000			55,429			55,429			67,714			27,714			27,714		
1. Senior Scientist consultants3/		3.5m/y	1	1	.5	.5	.5	194,000			55,429			55,429			27,714			27,714			27,714		
2. Evaluation team		5m/m	-	-	5m/m	-	-	40,000			-			-			40,000			-			-		
II. CAPITAL COSTS								375,000			375,000			-			-			-			-		
A. Construction								170,000			170,000														
Kamboinse																									
1. 7 office/4 lab complex plus furnishings 4/								170,000			170,000			-			-			-			-		
B. Research equipment (Kamboinse)	15,000 per scientist							75,000			75,000			-			-			-			-		

ANNEX A

Table 1 p. 2. AID FINANCED PROJECT COSTS.

	Cost/Unit	5 year Total	No. Units 77	78	79	80	81	5 year Totals Total	FX	LC	FY 1977 Total	FX	LC	FY 1978 Total	FX	LC	FY 1979 Total	FX	LC	FY 1980 Total	FX	LC	FY 1981 Total	FX	LC
C. Vehicles (for scientists and technicians) 5/	10,000 per vehicle	13	13	-	-	-	-	130,000			130,000			-			-			-			-		
III. OPERATING COSTS																									
A. Scientist Program Support (Ten AID funded scientists)	40,000 per scientist/yr	50	10	10	10	10	10	2,000,000			400,000			400,000			400,000			400,000			400,000		
1. Farm operations (labor, cultivation etc)	14,000 per scientist/yr							700,000			140,000														
2. Supplies for farm, laboratory, office (fertilizers, chemicals etc)	3,000							150,000			30,000														
3. Vehicle operation & maintenance	2,000							100,000			20,000														
4. Travel (domestic & inter-Africa)	4,000							200,000			40,000														
5. Research associates (2 to 4)6/	7,000							350,000			70,000														
6. Field assistants	7,000							350,000			70,000														
7. Administrative 7/	1,500							75,000			15,000														
8. Secretarial 7/	1,500							75,000			15,000														

ANNEX A
Table 1 p.4. AID FINANCED PROJECT COSTS.

	Cost/Unit	5 year Total	No. Units 77	78	79	80	81	5 year Totals Total	FX	LC	FY 1977 Total	FX	LC	FY 1978 Total	FX	LC	FY 1979 Total	FX	LC	FY 1980 Total	FX	LC	FY 1981 Total	FX	LC
D. ACPO Program Support (5 AID funded ACPOs -- same expenses as above plus 10,000 for field trials)	50,000 per ACPO m/y	25m/y	25 m/y	5 m/y	5	5	5	1,250,000			250,000			250,000			250,000			250,000			250,000		
C. Scientific Conferences 8/ (three annually)								303,750			60,750			60,750			60,750			60,750			60,750		
1. Grain legumes								101,250			20,750														
2. Maize								101,250			20,750														
3. Sorghum/Millet								101,250			20,750														
								101,250			20,750														
D. OAU Coordination 9 /								232,500			50,500			46,500			46,500			46,500			46,500		
IV. PARTICIPANT TRAINING																									
A. Long-term (degree) 10/	10,000 per student year (s/y)	160s/y	-	40	40	40	40	2,600,000			-			400,000											
B. Short term (non-degree) (Research assistants, Extension trainers, Field trials officers, etc.)	9,400 s/y 700 s/m travel	40s/y	-	10	10	10	10	400,000			80,000			800,000											
BASE COST SUBTOTALS																									

ANNEX A
Table 1 . p.5. AID FINANCED PROJECT COSTS.

	Cost/Unit	5 year Total	No. Units 77	78	79	80	81	5 year Totals Total	FX	LC	FY 1977 Total	FX	LC	FY 1978 Total	FX	LC	FY 1979 Total	FX	LC	FY 1980 Total	FX	LC	FY 1981 Total	FX	LC
V. INFLATION & CONTINGENCY																									
A. Contingency (5% flat)																									
B. Inflation (7% compounded annually beginning FY 1978)																									
GRAND TOTAL																									

1/ Salary, allowances, travel utilities. Housing furnished by IAR as Nigerian contribution.

2/ Salary, allowances, travel plus housing.

3/ One and one-half man-years (1.5 m/y) consultant time fully funded by A.I.D. plus 2 m/y short-term consultant time provided by IITA, ICRISAT, IAR, CNRA core staff (salary paid by host institution) with A.I.D. financing for related travel, and perdiem:

18 m/m x $ 8.000 m/m = $144,000

2 m/y x $25,000 m/y = $ 50,000

Total for short term consultants = $194,000

4/ $150,000 for 7 offices plus 4 adjacent laboratories for research scientists plus 3 man cropping systems team.

5/ One vehicle supplied for each A.I.D. funded researcher except the three at I.A.R. where J.P. 26 vehicles are available. 3 man crop improvement/soils management team (kamboinse) plus 3 man Crop Systems team (Kamboinse). Also, one vehicle each for the OAU/STRC coordinator and the A.I.D. Project Manager.

6/ This assumes host government funds core salary & allowances for 2 of 4 research assistants to be assigned to each researcher.

7/ Assumes that administrative officer serves 3 or more researchers and that one secretary serves 2 researchers.

8/ Refer to Annex A, Attachment 1 "Estimated costs -- Scientific Conferences".

9/ Refer to Annex A, Attachment 2, "Estimated Budget -- OAU/STRC Coordinators Unit".

10/ Training will be in African Universities where this can be arranged. In this case, per annum student costs will be reduced by 20 to 40 percent, enabling project funds to support more degree training where OAU/STRC training needs appraisal shows this to be desirable.

Annex A. Table 2 "Estimated Other Donor Contributions".

	Total	77	78	79	80	81
UNDP*	1,696	852	844	-	-	-
France	2,240	445	445	450	450	450
Britain	1,000	200	200	200	200	200
Other	1,750	350	350	350	350	350
Total	6,686	1,847	1,839	1,000	1,000	1,000

* Already obligated. See Annex A Table 4.

Annex A. Table 3 UNDP Contribution. 1/

Item	Total	FY 77	FY 78
A. General Director & Supervision	140	68	72
B. Bambey, Sengal* TA, operating operating expenses, construction	404	204	200
C. Kamboinse, Upper Volta	605	305	300
D. IAR, Nigeria	363	183	180
E. Niger (breeder)	170	85	85
Grand Total	1,696	852	844

1/ Obligated via UNDP-ICRISAT Cooperative West Africa Project signed in January 1975. Total UNDP support over life of the UNDP-ICRISAT project (1975-1978) is $2.5 m, of which the $1.7, shown here, is obligated for FY 1977 & FY 1978.

* Some of this funding may be shifted to Kamboinse.

Annex A. Table 4. Est. French Contribution (FAC & IRAT)

	Total	77	78	79	80	81
A. General Directors & Supervision						
1. Icrisat Project Director (IRAT)	240	45 1/	45 1/	50 2/	50 2/	50 2/
B. ACPO Support including operating support (FAC)	2,000 3/	400	400	400	400	400
Grand Total	2,240	445	445	450	450	450

1/ Obligated by IRAT.

2/ Estimated IRAT contribution on assumption IRAT provides the ICRISAT West Africa director over life of SAFGRAD project.

3/ Based on FAC intentions to support up to 4 ACPOs over life of project, depending on requests from African countries (Cenegal, Cameroon plus two others). AID estimates of cost of ACPO plus operations support for one year is $105,000.

Annex A. Table 5_. Est. British Contribution (ODM)

	Total	FY 77	FY 78	FY 79	FY 80	FY 81
A. ACPO and support 1/	1,000	200	200	200	200	200

1/ Based on ODM intention to fund 2 ACPOs annually upon receipt of request from African governments, probably Ghana & Sudan.

Annex A. Table 6. "Donors other than AID, UNDP, France, Britain"

	Total	FY 77	78	79	80	81
A. ACPO support 1/ (3 ACPOs)	1.500	300	300	300	300	300
B. Training 2/ (Degree & non-degree training for scientists & technicians)	250	50	50	50	50	50
Total	1,750	350	350	350	350	350

1/ Not yet committed to project. Potential donors include FED & CIDA.

2/ Uncommitted. Potential donor is Ford Foundation.

Annex A. Table 7. Est. Host Country Contributions.

A.	Nigeria	735,000 1/
B.	Senegal	200,000 2/
C.	Upper Volta	150,000 3/
D.	Other participating countries	1,300,000 4/
	Total	2,385,000

1/ Total Estimated Nigerian Contribution over the 5 year Project Period includes:

a. Scientists housing.....$125,000
(up to 8 houses are available; Assumes 5 SAFGRAD researchers assigned to IAR for 5 years at an inputed rental of $5,000 yr/house)

b. Operations Support (financial).....$360,000
($100,000 Naira already committed to support ICRISAT programs in FY 77; continued support is assummed at reduced annual rate of $50,000 dollars).

c. Operations support (in kind).....$250,000
(Assumes annual inkind contribution $50,000 for use by 5 SAFGRAD scientists of laboratories, offices, equipment, local management & staff assistance).

5 year Total $735,000

2/ In-kind contributions of (economic rent) on labs, office, land, equipment, management & staff roughly estimated equal to $40,000 annual contribution, or $200,000 over 5 years.

3/ In-kind contributions of lab, office, land, equipment, management & staff roughly estimated equal to $30,000 annual contribution or $150,000 over 5 years.

4/ Each participating country with an ACPO is expected to contribute financial support to ACPO operations plus inkind support including office, land, equipment, management & staff (research & extension). An estimate for each participating countries' inkind support is $20,000 per ACPO per year. Estimated 13 ACPOs x 5 years at $20,000 yr. = $1,300,000.

Annex A. Attachment 1. Estimated Costs -- Scientific Conferences.

Assumptions:

1. IITA Conference Facilities available free of charge.

2. Three annual conference held with about 25-30 attendees each.

3. Daily costs per participant at IITA equal to 14 Naira/day lodging + 5 Naira meals = 19 N/day = &30 day/participant.

Est. Cost per Conference.

1.	Lodging/Food 30 participants $30/day x 30 = $900/day 7 day cost = $6,000	
2.	Planning/preparations/publications =	= $ 750
3.	Translation: 2 translators for 7 days @ $100 day/each + transportation	= $2,500
4.	Travel. Assuming 15 participants provide travel out of other source official travel budgets. 15 participants at $750 each round trip	=$11,250
	One conference	=$20,750
Est. annual cost for three conferences		=$60,750
Est. 5 year cost for 15 conferences		=$303,750

Annex A. Attachment 2. Estimated Budget -- OAU/STRC SAFGRAD Coordinators Unit.

Annual Budget.

a.	Coordinators salary	$15,000
b.	Staff salary	7,000
c.	Housing	5,000
d.	Vehicle operation, maintainance, insurance*	2,000
e.	Official travel	4,000
f.	Travel (arrival at post, home leave)	1,500
g.	Office supplies, equipment **	6,000
h.	Printing, distribution	10,000

Five year costs

5 year Total	FY 1977	FY 1978	FY 1979	FY 1980	FY 1981
$236,500	$50,500	$46,500	$46,500	$46,500	$46,500

* Vehicle is AID funded.

** $6,000 provided in year 1, reduced to $2,000 thereafter.

ANNEX B. PROJECT ISSUES.

1. Project Management.

With more than eighteen participating and cooperating countries each with its own crop research and extension programs; several donors; the OAU/STRC; a specially created Consultative Committee and its Scientific and Technical Advisory Committee, and two international research institution, and a U.S. University, project administration & coordination will be complicated. (Refer to Part IV A "Administrative Arrangements").

The Consultative Committee (CC) is to be the principal policy and planning body. Comprised of national research directors and donor representatives, the Consultative Committee is to convene as necessary to review and approve regional research programs and initiatives related to regionally coordinated ACPO activities.

In practice, reconciling the views and interests of the many participating countries and organizations may be a time consuming function. Each national government has control over the direction of crop research at its national research stations and not to lose that control to a regional committee. In a situation like IAR, where national research direction and capability are very strong, SAFGRAD supported research must be closely integrated with the national program.

Regional guidance to ACPO programs will be indirect. ACPO programs are negiotiated bi-laterally between individual donors and host countries and ACPOs are supervised by the respective national research directors.

Overall, SAFGRAD program direction is likely to suffer from the normal apathy of national governments in directing regional projects.

Projects like SAFGRAD, despite their great aggregate importance to the region, do not loom large enough vis a vis individual national perceptions or budgets to command significant national management resources.

The membership of the CC and its subcommittee appear relatively unwieldy from a management point of view. The member ship is large to insure representation at the policy/planning level by each participating country and agency. Nevertheless, the project administration as designed has been agreed upon as a compromise approach to effect project management and regional coordination while enhancing national interests. For day to day program direction, it is anticipated that the CC will voluntarily boil down to an effective nucleus of one or more working subcommittees, with the confidence of all participants, which will coordinate closely with the OAU/STRC.

The Ouagadougou conferees agreed that the overhead costs of project administration must be minimized in order to concentrate project resources on essential scientific endeavor.

The roles of the IITA and ICRISAT are important not only in providing scientific talent but in contributing an organizational mechanism and interest in continued long term internatioanl & regional cooperation in food crop research & production. These institutions are acutely aware of the need to work closely with and be responsive to national agencies. IITA and ICRISAT are expected to contribute to program direction in their role as members of the technical committee. IITA and ICRISAT scientists will participate in drawing up the annual SAFGRAD research workplans which will be approved by the national research institutes and the CC.

2. Role of Accelerated Crop Production Officers (ACPO)

The appointment of ACPOs is an important SAFGRAD response to critical weaknesses in research programs -- weakness in getting research information to national research stations and getting it tested and adapted and to the farmers.

Careful attention will be required by the Consultative Committee and the OAU/STRC to achieve regionally coordinated and effective ACPO programs. ACPOs are not directly supervised by the CC or the OAU/STRC. Most will be provided and supported thru bilateral arrangements between the host country and a donor. ACPOs will work for the national crop research institutions.

ACPO programs will be somewhat different in each country because of differing national research extension organizations, capabilities and priorities. Illustrative ACPO responsibilities are provided in Annex E. These responsibilities fall into 2 or 3 main categories: (a) Provide linkages between national research program and research elsewhere in the region. (b) Conduct field trials and studies under various conditions to test the adaptability, deficiencies and potential of various recommended varieties and practices (c) Where varieties and packages appear technologically superior and otherwise suitable, to coordinate with extension agencies to encourage broader testing and demonstration.

To be effective, ACPO program must be well conceived, appropriate to the national situation and adequately supported. But in many cases, the two parties to the negotiation will be only generally familiar with SAFGRAD

project concepts and details.

As agreed at the Ouagadougou Conference, ACPOs are being integrated into national research programs so that they will be responsive to national needs and will command resources and have influence on the way research is directed, tested and applied. Precaution is needed to prevent the ACPO from becoming so enmeshed in the conduct of national programs that he is without time or resources to respond to regional initiatives.

Early OAU/STRC and CC attention to the bilateral ACPO negotiations is needed to insure that ACPO programs are well planned and supported and permit adequate flexibility to enable ACPOs to respond to the regional initiatives which have national value.

3. Recurrent Costs; Adequacy of Project Inputs.

Crop research is complex, long term and expensive. With more available funding, the project could have been benefically expanded. There is a need for more research related to varietal improvement, farming systems, soil management, field trials, social-economic study and mechanization, as well as a need for more training, regional coordination and national extension linkages.

Over the next decade at least, donor agencies should anticipate long term commitments to the development and dissemination of small farm technologies as an integral and cost-effect strategy of development. In the case of SAFGRAD, it is certain that 5 year funding will not be sufficient.

4. Returns to Research in the Drier Semi-Arid Zones.

An issue for which there is no present answer is: Where does it become uneconomic to pursue technological improvement for rainfed crops as one moves north across the Sudanian-Sahelian zone into increasingly dry and marginal agricultural land. Rainfall, the principle cultivation constraint, becomes not only less, but more erratic with longer and unpredictable dry spells between rains. Agricultural potential becomes less and the risks associated with farming magnified. At some point, it is inefficient to expend scarce and expensive resources on crop productive and less difficult for example in the wetter Sudan, where great agricultural potential exists.

In fact, this same problem in somewhat different form faces all development projects in that poorest individuals in the target group are usually inadequate land, labor and capital resources, and high risk situations can seldom make the investment (take a chance) on new technologies.

Equity considerations are important and the A.I.D. objective is to benefit the poor majority. J.P. 26 was criticized for not emphasizing enough research in the drier areas of the region were the poorest and most vulnerable populations live.

By emphasizing the importance of research in the drier areas as well as in the more favorable semi-arid areas, SAFGRAD attempts to benefit poorest groups, but the potential for economic returns to research are reduced as the zone becomes drier and poorer. More experience with millet and sorghum research in the region should indicate where efforts become inefficient.

5. ISSUE: Making Research Applicable to Small Farm Conditions

Small farmers in Africa have generally not benefitted from the results of cereal research on millet or sorghum, while research has produced "improved packages" which give increased yields under good conditions. There is a need for low risk "intermediate" technologies which can increase productivity within the severe physical and economic parameters faced by small farmers. The difficulty of developing such technologies cannot be minimized. Indigenous crops and cropping systems are well adapted to minimize risk and assume some production (thereby maximizing survival) under worse conditions. Detailed discussion follows:

The ultimate objective of semi-arid crop research in Africa must be to develop technologies that will enable the bulk of the rural population in that zone to increase their agricultural productivity and welfare. Yet, there is increasing frustration that Africa farmers families have not often been able to improved their farms thru the use of research induced technology.

Despite the fact that a number of millet and sorghum production projects are being planned or implemented in Africa on the basis of a standard improved package, the design team was unable to ascertain that these packages have been adequately or successfully applied under other than controlled conditions. To the contrary, indications were that the improved packages were not generally superior to traditional varieties and practices under farmer conditions. The improved varieties and practices appear to be particularly less suitable than traditional

varieties under high stress conditions (drought, disease, insect, etc.). This is an unsatisfactory situation in semi-arid regions where risk avoidance is a prime farmer consideration.

The improved package normally include: the use of an improved variety; closer plant spacing; seed spacing, seed treatment; more intensive weeding; mono-culture crop stands; and sometimes, compost, crop rotation; chemical fertilization, animal traction, and intermediate mechanization.

Some farmers are known to be using "improved" millet and sorghum varieties, particularly in areas severely affected by the drought where governments have distributed improved seed to replace that lost to the drought. The results have not been adequately documented.

In order to direct research and induce its application in ways that will benefit small farmers, it is necessary to understand why research results have not been more widely applied. Probable reasons for this include:

(1) Lack of technology relevant to physical/ecological farm conditions.

(2) Lack of farm service infrastructure, e.g., extension, farm inputs, credit, marketing.

(3) Lack of improved technology compatible with the farmers' mixed cropping system.

For millet and sorghum, all of these condiditons exist, and the third point appears to represent a serious constraint. Regarding the first point above, progress has been made in varietal improvement work. Desirable characters have been introduced into selected varieties and resistance to several limiting plant diseases and pests have been identified. Continued emphasis is needed to breed improved high yield varieties with resistances to the major physical constraints -- drought, insect, disease, etc. for the important ecological areas. The SAFGRAD project continues major support to this research effort (Reference "Project Description.")

Regarding the second point, it has been commonly observed that technology transfer mechanisms and other essential farm service infrastructures have not existed to enable small farmers to adopt the new technologies. Research results have not adequately "packaged" in forms relevant to extension or production programs; improved seed and physical farm inputs (e.g. fertilizers and chemicals) have not been available or affordable in needed quantities and time frames, financial capital has been unavailable, market mechanisms and economic incentives have not existed for the cereal food crops.

Most planned millet and sorghum production projects attempt to address the infrastructure constraints by providing extension, inputs, markets, etc. But, the great bulk of small farmers will probably not benefit from such projects into the foreseeable future because of limited government finances and capabilities.

Regarding the third point, physical and social scientists have begun to place increasing emphasis on research approaches which have relevance

to farmer cropping systems. In tropical Africa, including the semi-arid regions, small farm systems almost invariably follow a multi-cropping and inter-cropping pattern where several different crops are grown interspersed together in the same field. More than 4 or 5 different crops may be cultivated in a mixed farming system by a single family in semi-arid rainfall areas, as farmer options are narrowed by water, the principal physical constraint. In the driest cultivation zones in the Sahel, farms may be limited to a sole millet crop.

Intercropping appears to maximize production and returns to labor while minimizing risk. Recent studies have shown that the profitability of production over the cropping season is greater under intercropped conditions than under sole crop conditions. 1/ The yield of each individual crop in the intercropped mixture averages lower than would be the case if it were grown in a sole stand, but the total yield from all crops in the mixture is more than the total yield of the sole stand.

"There is an increasing understanding among physical and social scientists that traditional cropping systems have evolved over generations and represent some sort of sustained balance with the total farm environment which consists of both technical (biological/physical) and human (social/economic/political) elements ...."2/

1/ David W. Norman, "Developing Mixed Cropping Systems Relevant to the Farmers' Environment"; Institute for Agricultural Research, Ahmadu Bello U., Zaria, Nigeria. p.8.

2/ Ibid. p2.

The systems that have evolved appear to maximize farmer objectives (maximum returns to scarce resources, minimum risk, adequate nutrition during each period) within the parameters of the principle constraints -- water, labor, soil fertility and sometimes land. The economicsof intercropping seem to result from: (1) complementary relationships that exist between certain plants; (2) better use of land and water and (3) economies of labor steps. Illustrative description of how multicropping generates these economies is presented in Attachment 1 to this Annex.

Scientists have recognized that a closer study of these cropping systems could be important in evaluating prospects for increasing production as a result of introducing changes which take into account the underlying principles.

Several major crop research centers in Africa (notably IITA and IAR), have undertaken "cropping systems" research to identify the basic physical, agronomic and economic principles related to the cultivation of crops in mixtures or rotation. Basic cropping systems research involving multi-factorial rotation experiments are large and costly, however, and must continue for several years.

Most crop research to date has concentrated on the development of varieties and practices that optimize monoculture crop yields per acre of land under good conditions. The great crop improvement advances produced by modern agricultural science relate principally to the development of fertilizer responsive varieties which also display other desirable characteristics vis-a-vis pest and disease resistance. These scientific advances necessitate dramatically changed cultivation patterns including

the use of chemical fertilizers, pesticides, etc., with a concomitant requirement for a "high infrastructure" farm support system to provide knowlege, capital, transport, seed, chemicals and to market the produce.

In Africa, the results of this research has been excellent progress with certain cereals, particularly rice and corn in the development of varieties and practices that give high yields under high fertilizer, high infrastructure conditions. Less progress has been achieved with millet and sorghum.

The improved packages are not necessarily superior under harsh climatic conditions. A major concern in the semi-arid zones is to maximize survival by ensuring an irreducible minimum level of food production and availability every year and in every season despite vagaries of climate and other natural disaster. Where populations live close to subsistence under risky conditions it is not sufficient to use crops, crop systems and technologies that satisfy food requirements and are profitable only under good or average conditions. High cost, high risk technologies will never be acceptable for small farmers in the semi-arid zones.

Progress achieved, however, has had little applicability under the low infrastructure conditions faced by the great bulk of millet and sorghum farmers. In essence, the improved varieties and practices, even when they display certain technical/physical superiorities are unavailable, uneconomic or incompatible to farmers cropping systems.

The vast majority of small millet and sorghum farmers will probably continue to face low infrastructure, multi-cropping conditions

for the foreseeable future. The financial, organizational and economic barriers to the use of the "traditional" improved technologies are enormous.

Under these circumstances, some physical and social scientists are emphasizing the need to develop low risk "low infrastructure" technologies which require only minimum inputs and farm support services.

In terms of national economic welfare, total crop production and equity may be better served by successive marginal productivity gains by many farmers using "low infrastructure" technology as opposed to more dramatic productivity gains by fewer farmers using a "high infrastructure" technology . The development of low infrastructure technologies would seem imperative from an equity stand-point -- to permit small farmers access to improved technologies.

The difficulties of the "low infrastructure" technology approach cannot be under estimated. "Low-infrastructure" technology may be more complex than high infrastructure tehnology, since the constraints are greater, and the research methodologies not fully understood.

Traditional varieties and methods arein most cases well adapted to local conditions. Improving on their physical characteristics is difficult. Some improvement is possible in breeding plants that are more efficient in the use of nutrients, have better stalk-grain ratio, are more disease or pest resistant, but plants nevertheless quickly encounter physical limitations to growth imposed by lack of nutrients. Soil fertility is a principle constraint to increased productivity in the zone and some improvement of soil fertility thru chemical or natural fertilization, nitrogen fixation or soil conservation, is imperative.

Considering the difficulties discussed above, the potential for the development of intermediate technologies is unknown. Similarly, the methodology for developing such technologies is not clear but certain directions are suggested. Simply to continue the high technology cereals research without emphasis on economic or farming system constraints is not fruitful. An intermediate technology approach would require good feedback from farmers fields to physical scientists regarding farm conditions and the apparent applicability of improved varieties and practices under those conditions. Such knowledge would allow scientists to direct research toward specific constraints within realistic parameters. Equally important is the need for physical and social scientists to cooperate in conducting promising research. Organized cooperation of this type is not generally practiced at the present time.

The SAFGRAD project will attempt to improve the information feedback to physical scientists and to enable better coordination of physical and social scientists. A Farming Systems Unit will be established to facilitate the study of crop systems and the testing of research results region-wide. The Unit would be expected to provide assistance and guidance to ACPOs regarding the conduct of in-country studies and field trials.

A major objective of the Farming Systems Unit will be to explore the feasibility and potential of developing research that is applicable to small farm conditions. In this regard, the Unit is to appraise the issues and constraints involved in making research applicable to small farm conditions and to consider the potential and methodology of addressing those constraints thru research. The focus of the Unit should

be operational as well as theoretic -- to ascertain thru innovative farmers field trials and studies what varieties and practices and research approaches appear relevant or promising under small farm conditions. The Unit is to (1) guide and assist ACPOs in the conduct of farmers field trials and studies related to the application and benefits of technology to small farms; (2) feed information gained back in the SAFGRAD physical research program for the guidance of physical scientists.

Farmer field trials could be designed to provide opportunities for experimentation by farmers. Certainly, more innovative methods of adaptive research are needed.

Research resources are inadequate to test and adapt improved varieties and practices under controlled conditions for the innumerable existing ecological conditions and cropping systems. With a certain amount of guidance and inputs, it is likely that selected individual farmers will be willing to experiment within their own cropping systems with varieties and practices, and to relate the apparent results back to field workers. Farmers would be expected to experiment naturally with an infinite number of variations on the "package" provided to suit their own conditions. If improved varieties and practices do appear to represent improvement under farmer conditions, this knowledge would be available even if the reasons for the success and the exact conditions of the success are only partially understood.

ANNEX C. LOGICAL FRAMEWORK

A. 1. Goal

To increase the quantity and quality of staple food crops effectively available to the increasing populations in the semi-arid zone of Africa.

A. 2. Measurement of Goal Achievement

1. Increase total cereal production in the SAFGRAD region by an annual rate equal to the population increase, i.e., increase production approximately 2.5% to 3.0% annually from an estimated base of 13,074 MT in 1972 -- refer to Table 8.

2. Reverse the decline of per capita food production in this region. Per capita food production was at an index of 92 (1975) compared to a base of 100 in 1965.

3. Increase productivity on selected small farms in representative ecological zones on a sustained basis.

A. 3. Means of Verification

1. UNDP/FAO statistics compared to base figures given in Table 8.
2. UNDP/FAO per capita food index for Africa.
3. Farm surveys measuring farming systems productivity.

A. 4. Assumptions

1. Cereal prices will be managed to induce increased cereal productivity and increased production of cereals.

2. The dynamics of the ecological-population balance in the drier parts of the target area (northern Sudan and southern Sahel) are such that an increase in farm family welfare as a result of new technology will be sustainable and will not result in a perpetual cycle of increased pressure on, and ultimate degradation of, the land.

B. 1. Purpose Summary

1. Develop improved cereals (millet, sorghum, maize) and grain legumes (cowpea, groundnut) and cultural practices which are compatible with small farm semi-arid farming systems, and promote their adaption and use in farmers' fields.

2. Strengthen the coordination and capability of African research within a regional framework.

B. 2. End of Project Status Conditions (EOPS)

1. Varieties and related cultural practices of sorghum, millet and maize which when cultivated under small farm conditions:

a. Provide for increased per hectare production

b. Provide for increased total farm production

c. Provide for increased profitability

d. Are consistent enough with indigenous small farm conditions (physical, economic, social, etc.) that they can be applied broadly and successfully, without the necessity of impractical farm support infrastructure or undue risk.

2. Improved varieties of sorghum, millet and maize developed which have a range of maturity dates to fit varying lengths of the rainy season

in different ecological zones of West Africa.

3. Varieties of grain legumes developed which meet the tests of EOP no. 1 above and which provide a maximum amount of nitrogen for accompanying or succeeding cereal crops.

4. Systems of cropping patterns and improved soil conditions developed which are compatible with existing patterns, contribute to improvement of soil productivity, minimize erosion and soil moisture losses, and provide overall increases in food grain production.

5. Improved varieties and practices being successfully demonstrated by indigenous farmers in the representative ecological zones of the semi-arid regions of West Africa.

6. Progress made in incorporating genetic resistance to head mold, striga, leaf diseases, and insects and other targeted characters into high yielding, adapted sorghum varieties.2/

7. Progress made in incorporating genetic resistance to downy mildew, smut, ergot, and insects and other targeted characters into high yielding, adapted millet varieties.2/

8. Progress made in incorporating genetic resistance and other desirable characters in maize and grain legumes.2/

9. Scientists in region cooperating thru network of organizational and individual professional relationships to share research findings.

10. National crop research and extension programs reflect an awareness of research efforts throughout the region and are designed to benefit from and supplement that research conducted elsewhere.

2/ Refer to Table 1. "SAFGRAD Crop Research Objectives"

11. National research directors periodically and systematically appraising regional research needs and priorities and effecting regional collaboration in instances of mutual benefit, beyond the immediate administrative and management concerns of SAFGRAD.

B. 3. Means of Verification

1. For EOPS nos. 1 thru 4, Farmer field trials results

2. For EOPS no. 5, ACPO reports on crop demonstrations.

3. For EOPS nos. 6-8, Results of researchers experimental trials under controlled experimental conditions.

4. For EOPS no.9, Evaluation of scientific conference success in generating scientific cooperation among scientists.

5. For EOPS no. 10, National research programs and plans.

6. For EOPS no. 11, The formulations and recommendations of the Consultative Committee; visible demonstrations of international research cooperation and concentration of effort toward regional priorities.

B. 4. Purpose Assumptions

1. Crop research can result in developing improved technologies which are compatible enough to typical small farm/low infrastructure conditions to be successfully applied by the bulk of small farmers who comprise the target groups in the SAFGRAD area (Refer to Issue no. 5)

2. Low infrastructure technology is benefits/cost effective compared to the alternative high infrastructure research (Refer to Issue no. 5)

3. The concept of regional research coordination is accepted enough by national governments to provide a general coalescing momentum in this direction.

C. 1. Outputs Summary

Output 1. Regional Crop Research (Varietal Improvement Soils Management)

a. Millet & Sorghum improvement (IAR)

b. Millet & sorghum improvement (Bambey)

c. Millet and sorghum improvement (Kamboinse)

d. Maize improvement (Kamboinse)

e. Grain legume (cowpea etc) improvement (Kamboinse)

Output 2. Regional Farming Systems Research.

a. Periodic overview analysis of regional state-of-the-art and potential re: (1) development of research pertinent to small farmers (2) the actual application of research results by small farmers.

b. Information available concerning physical, economic, social, and cultural reasons for non- adoption of new crop technologies.

c. Recommendations concerning crop characteristics or practices that would be readily adopted by indigenous farmers.

d. Guidance and assistance to ACPOs on farmer field trials (organization of, methodologies, varieties, analysis of).

Output 3. National Field Trials/Demonstration Activities.

Note: Participating countries will undertake field trials/ demonstrations, with the help of an ACPO. Scope and nature of activities will vary by country depending on local needs and circumstances. Sub-outputs listed below are illustrative.

a. Uniform Varietal Trials (regionally coordinated)

b. Farmer Field Trials/experiments/demonstrations.

c. Production packages: Regional researchers, in conjunction with other researchers, will develop "production packages" for broad testing or demonstration. Improved production packages represent "end-product" sought thru the research and field trials program.

d. Seed distribution system (for trials, multiplication, breeding, etc.).

e. Field trials analyses and findings; identification of production constraints.

f. Feedback to regional crop breeders regarding production constraints and research needs.

g. Guidance/assistance to national Extension Agencies regarding available technologies and their delivery.

Output 4. Systematic exchange of crop research information among Scientists.

a. Millet conferences

b. Sorghum conferences

c. Maize conferences

d. Food legume conferences

e. Otherperiodic research conferences as scheduled.

f. Publication, translation, printing, distribution of scientific documents and research results regarding crop improvement.

Output 5. African Research scientists and technicians trained and on-the-job.

a. Reconnaissance of crop research manpower needs of participating countries.

b. Researchers trained to B.S., MS, and Ph.D. levels

c. Technicians trained (research, production).

d. English/French proficiency attained by scientists/technicians.

e. On-the-job training for returned participants.

Output 6. System for regional research planning and coordination.

a. Consultative Committee and Technical Advisory Committee established. Functions include:

(1) provide policy guidance for SAFGRAD program management and administration.

(2) establish regional research priorities; review regional research workplans for adherence to priorities.

b. OAU/STRC Coordination/Administration. Functions are listed in A."Administrative Arrangements," item 4.

C. 2. Output Objectively Verifiable Indicators (Magnitude of Outputs).

1a. Major physcial constraints identified, assigned priorities, addressed.

1b. Varietal improvement targets/objectives for each major SAFGRAD crop are summarized in Table 1. "SAFGRAD Research Objectives".

1c. A research workplan, specifying research approach and quantity, developed annually by senior SAFGRAD researchers, in coordination with the TAC and the host government at each site - IAR, Kamboinse, Bambey.

1d. Research targets and research workplans modified each year based on: (1) new research results, (2) new knowledge about constraints under farm conditions.

2a. Annual report by SAFGRAD Farming Systems Unit covers regional progress, difficulties, potential in developing production technologies and production packages adaptable to farm conditions.

2b. Annual guidelines developed and distributed to each ACPO on:

(1) Uniform variety trials (Technical Advisory committee role)

(2) Farmer field trials/studies. Possible types of trials/studies include:

(a) Testing new production packages under sole crop or intercrop conditions.

(b) Economic/social studies of traditional farming systems or improved farming systems.

(c) Uncontrolled farmer field trials for purpose of having farmers experiment with adaptability of improved varieties.

2c. Tabulations and analysis of field trials/studies.

2d. Recommendations for future research needed to develop small farm technologies.

2e. SAFGRAD Farming Systems Unit communicates regularly with breeders and varietal improvement scientists; findings presented annually at scientific conferences.

3a. Varietal trials and farmer field trials underway as projected in annual ACPO workplans.

3b. SAFGRAD-recommended packages developed and applied in demonstration areas. Results appraised.

3c. Sufficient seed distributed to support field trials and other ACPO programs.

3d. ACPOs routinely inform SAFGRAD Farming Systems Unit and national researchers of field trial results and apparent implications.

3e. Findings presented at special ACPO conferences or scientific conferences.

4a. Re outputs 4a through 4e, approximately three annual scientific conferences. Year one conferences may include:

1) Millet improvement

2) Sorghum improvement

3) Maize improvement

4) Grain legume improvement (semi-arid tropics)

5) Farming Systems - agronomic/economic/social/cultural considerations.

4b. Scientific conference proceedings and other regional research reports.

5a. Training needs and priorities established by OAU/STRC, with CC approval, within 12 months.

5b. 160 student years degree training provided (AID-funded)

5c. 40 student years non-degree training provided (AID).

5d. Language training provided where needed in conjunction with b. and c. above.

5e. Amount of OJT depends on overlap between expatriate technicians and Africans being trained. OJT plans developed for returning participants.

6a. - CC holds annual meetings; performs functions specified.

- CC composition: key national researchers, donors, OAU/STRC, international research institutions (ex-officio).

6b. - Permanent OAU/STRC administrative office established in Ouagadougou with one full-time OAU/STRC professional.

- OAU performs functions specified.

- Expanded capability of the international research institutions (IITA, ICRISAT and U.S. Universities) and the major national research centers (IAR, Bambey, etc.) to provide technical support to research in the region -- working relations and knowledge of production problems, programs, governments and research institutions in the region strengthened through frequent contact.

C.3. Means of Verification

1a. Consultative Committee reports

b. Regional research workplans.

2a. Farm System unit reports

3a. Field trial instructions

b. Tabulated regional trials results

c. "Production packages" exist and have been distributed

4a. Conferences held per OAU schedule

b. Proceedings distributed

5a. Field trials plans

b. Tabulated national field trials results

c. National research workplans and status reports

6a. Training needs tabulation

b. Participant training record

7a. CC reports

b. OAU/STRC reports

C.4. Output Assumptions

1. Regarding national field trials, national governments (a) coordinate with SAFGRAD (b) provide management and financial resources (c) use ACPOs effectively.

2. Regarding national crop research, national research directors cooperate with regional researchers in defining problems, exchanging information and materials, coordinating research.

3. Regarding national outreach, national extension agencies coordinate with national research agencies to conduct demonstrations/trials under representative farm conditions.

4. Returned participants will continue in the fields of work in which they have been trained.

D. Inputs

Detailed input description and costs are provided in Annex A, "Project Costs."

Annex D AID Project Manager

POSITION DESCRIPTION (SAFGRAD)

I. General Description

The incumbent of this position serves as an Agricultural Development Officer responsible for planning, formulating and assisting in implementing the AID-financed portion of a multi-donor regional semi-arid food grain research and development program in Africa. The officer will consult and deliberate with other donors, the international agricultural research centers, the Scientific, Technical and Research Coordination Unit of the Organization of African Unity (STRC/OAU) and national governments in Africa as well as other offices of AID and other agencies in the United States. The officer will be stationed at Ouagadougou, Upper Volta.

II. Duties and Responsibilities

Personally, and/or with the assistance of the other professional personnel, plans, formulates and implements the regional food grain research and development project:

1. Provides professional counsel, advice and guidance on program and policy strategy;

2. Consults with other donors, international agencies, African governments and other U.S. Bureaus and Agencies;

3. Arranges for appropriate groups of representatives to discuss and formulate an acceptable working format;

4. Leads a team in the preparation of a comprehensive project paper that incorporates the intent of the key parties involved in the program;

5. Provides counsel, professional advice and guidance on food crops development strategy in formulating programs and policy guidance in the Bureau for Africa.

6. Visits Missions, contractors, agencies and institutions to provide personal advice and assistance, to evaluate food production programs, and to secure information and background to promote development efforts.

7. Manages AID's inputs and monitors project operations, giving particular attention to the role of each implementing entity and promoting realistic measures to enhance coordination and project operations at all levels.

8. Prepares documentation, assists in negotiating grants, submits reports and evaluates performance.

9. Promotes coordinated performance of the several implementing agencies to keep research oriented to priority areas and to assure that the generated technology is disseminated to each country for trial and adaptation. Of key importance is the role of the Accelerated Crop Production Officer (ACPO) (formerly Field Trials Officer (FTO) under the old Major Cereals JP #26 Project) in each country. The Agricultural Development Officer will play an important role to assure that this key function is properly developed, supported and maintained.

10. Works closely with the Scientific, Technical and Research Coordinating Unit (headquartered in Lagos, Nigeria) of the Organization of African Unity (STRC/OAU) in arranging for and promoting

the training component, arranging coordinating meetings, supporting operations, and performing other related tasks.

11. Assists implementing organizations and countries establish practical working arrangements that will result in an integrated program for increasing food production in the several countries of Africa.

III. Controls Over Work:

Performs under general supervision of the Director, AFR/RA, who provides policy guidance and direction, with broad scope to perform his duties and responsibilities.

IV. Qualifications

As a minimum, must have been awarded a Bachelor's Degree of Sciences in Agriculture and have ten years of successful experience in developing agricultural production programs in less developed areas. Must have working knowledge of agricultural research and agricultural extension systems and how these systems can be successfully established and managed in less developed areas.

The incumbent must be able to negotiate with directors of international agricultural research centers, national directors of research and extension, Ministries of Agriculture, and such other officials at the various levels. Experience in agricultural programs in Africa will be helpful.

Should have management proficiency to promote the development and implementation of broad regional programs. French language proficiency at S-2 level is required,

ANNEX F

LIST OF AID-ASSISTED PROJECTS IN AFRICA WHICH LINK TO SAFGRAD

(Taken from CPs FY 1977 & 76)

1. Entente Food Production (Ivory Coast, Togo, Benin, Niger, Upper Volta) 626-203. Increase the level of efficiency and reliability of food production to small farmers.
2. Sahel Crop Protection - 625 - 916 (all food crops) Improve capability of the Sahel States to control common annual crop pests.
3. North Cameroon Seed Multiplication - 631 - 202 To establish and institutionalize a self-sustaining system for production, distribution of sorghum and peanut seed.
4. Seed Production Center (CAR) 676 - 201 To establish and institutionalize a seed production and multiplication capacity for principal food and oilseed crops (maize, peanuts). This supplements three on-going UNDP projects.
5. Mali Crop Production (Sorghum and Millet) 688 - 202 Expands "Operation Mils" in Mopti Region where agricultural extension work in sorghum/millet with improved seed, credit and etc., and increased small scale irrigation in rice and sorghum near Gao, Mali.
6. Niger Cereals Production (Sorghum/Millet) 683 - 201 Designed to develop improved varieties of millet and sorghum, recommended package of cultural practice and an Agricultural extension and cooperative-credit infrastructure.
7. Food Crop Production (Nigeria) 620-798
8. East Africa Food Crops Research 618 - 657 Assist EAC Development

and instruction and capability to conduct food crop research - maize, sorghum, millet, legumes.

9. Grain Production and Marketing 625-161 (Niger and Upper Volta) Improve production and marketing of domestic food crops - sorghum, millet, cowpeas.

10. Senegal Cereals Production 685 - 201 Supports Senegalese Agricultural Extension (SODEWA) to carry out and expand an intensive drylands agriculture production program (millet and peanuts).

11. Rural Agriculture Development (Ethiopia) 663 - 167 Minimum package program - inputs to increase production of small farmers - seeds, fertilizer, etc.

12. Pulse Diversification and Implementation (Ethiopia) 663 - 166 Increase pulse production with small farmers.

13. Managed Inputs Delivery and Agricultural Services (Ghana) 641 - 067 Coordinated national program providing inputs, services and credit to small farmers - credit, fertilizer, seed multiplication with demonstrations and field trials.

14. Agricultural Research (Sierra Leone) 636 - 102 Adapt existing low-cost technologies to the use of small farmers by establishing a capable national Research Organization. (Maize, millet, sorghum, groundnuts and legumes).

15. Seed Multiplication (Tanzania) 621 - 092 Multiplication of high quality seed for cereal and legume crops (maize and sorghum)

16. Agriculture Research (Tanzania) 621 - 107 Concentrates on agriculture research priorities, improve crops varieties, produce breeder seed, recommend suitable cultural practices

to farmers (maize, legumes, sorghum, and millet) - IITA is principal contractor.

17. Guinea Agricultural Production and Training 675 - 201 Assist increase the production of food crops through strengthening of its agricultural education, research and extension program.

ANNEX G.

Bempfy

C.N.R.A. ET SECTEURS

DIRECTION
G. BEYE

RECHERCHES

SERVICES	GROUPES
Bioclimatologie Physique des sols Chimie des sols Biochimie - Microbiologie Physiologie Laboratoires	Etude et amélioration du milieu R. NICOU
Amélioration des mils Amélioration sorghos Amélioration arachides Amélioration maïs, soja Cultures de diversification Entomologie Phytopathologie Malherbologie - Stock Introduction des plantes	Etude amélioration et protection de la plante J.C. MAUBOUSSIN
Machinisme agricole Etudes agro-pastorales Economie rurale Hydraulique Technologie, post-recolte Structures d'exploitation	Etude et amélioration des systèmes de production C. RAMOND
Exploitation domaine Semences de base Application de la recherche Expérimentation Thiès Diourbel Information documentation	Application de la recherche G. POCTHIER

SERVICES GENERAUX

SERVICES	GROUPES
Service financier Service contentieux Service d'achats Service du personnel et social Service d'entretien	Directeur S. DIOUF Directeur adjoint C. BADIANE

SECTEURS

SECTEURS	SERVICES
Centre G. POCTHIER	Agronomie Cotonnier selection Cotonnier Entomologie Arachide de bouche Technologie arachide de bouche Application recherche Sine-Saloum Application recherche Sénégal-Oriental Unités expérimentales Chef U.E. Socio-économie Régime foncier
Fleuve M. SONKO	Agro-pédologie Riz Sous-Station Ndiol Sous-Station Fanaye
Casamance M. TOURE	DJIBELOR: Agro-pédologie Riz - maïs Systèmes culturaux SEFA: Agro-pédologie Machinisme agricole

C. DANCETTE R. NICOU C. PIERI F. GANRY, J. WEY P. SIBAND, V. SENE R. OLIVER	BLANGUERNON LABONNE J.M. BEGEL J.P. CRINQUETTE J.P. CRINQUETTE M. DIALLO
SARR, MARROT, BONNOT, KANE J.C. MAUBOUSSIN, J.C. DE'S J. GAUTREAU, GARET, CAMARA J. DUROVRAY J. DUROVRAY B. VERCAMBRE J.C. GIRARD J. DEUSE G. DELAFOND	J.F. RICHARD M. BENOIT CATIN J. FAYE, M. NIANG M. SONKO J.P. AUBIN A. REYNARD P. COURTESSOLES
R. PIROT M. MBODJ C. RAMOND T.M. DUC, E. DU TILLY G. YACIUK J. MONNIER	M. TOURE, G. ARIAL C. MAGNE Y. MBODJ
G. DELAFOND G. DELAFOND G. POCTHIER L. SENE G. SAYRE PASTORE	I. DIATTA
C. BADIANE F. DIOUF B. GUEYE Y. NDIAYE B. NDIAYE	