Organization of African Unity
Scientific, Technical and Research Commission

Joint Project 31: Semi-Arid Food Grain Research and Development

SAFGRAD II

West and Central Africa Cowpea Network
"Réseau Niébé de l'Afrique Centrale et Occidentale"

RENACO

FINAL REPORT
1987 - 1993

Funded by: United States Agency for International Development (USAID)

International Institute of Tropical Agriculture
Oyo Road
PMB 5320
Ibadan, Nigeria

April, 1993

WEST AND CENTRAL AFRICA COWPEA NETWORK

"Réseau Niébé de l'Afrique Centrale et Occidentale"

R E N A C O

1987-1993

A Successful Peasant Farmers' Cowpea Production in Africa: The Case of Networking

FINAL REPORT

Cowpea Research Component of the SAFGRAD
J.P. 31; 1978-1993

Editor:

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April 1993

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"Can African Peasant Farmers Accept Innovations in Food Crop Production"?

The answer is certainly yes,!

But on condition that they are given the right and most appropriate production package, meeting their needs and requirements. This is being witnessed since the late 80's to early 90's with peasant farmers in West and Central Africa through the Cowpea Network.

Preface

This report synthesizes cowpea improvement research activities coordinated and/or conducted by the International Institute of Tropical Agriculture (IITA) in the Semi-Arid Sub-Saharan Africa. It covers the period 1977 to 1978 and 1979 to 1986, respectively, prior to and the inception of the Semi-Arid Food Grain Research and Development (SAFGRAD) phase-I project; and from 1987 to 1992 under, SAFGRAD phase-II.

The report highlights remarkable progress made in SAFGRAD phase-II through collaborative cowpea research conceived and implemented by National Agricultural Research Systems (NARS) in a networking approach. The primary objective was to stimulate the initiative and capacity of national scientists in West and Central Africa to solve cowpea production problems themselves.

Acknowledgements

The West and Central Africa Cowpea Network (RENACO), wishes to extend its gratitude to the Government and people of Burkina Faso for the support of the network activities. The Network is particularly grateful to the Ministry of Higher Education and Scientific Research and to the Ministry of Agriculture and Livestock, through which the "Institut d'Etudes et de Recherches Agricoles" (INERA) and the "Centres Régionaux de Production Agro-pastoral" (CRPA), provided the needed land at some INERA stations and two CRPA sub-stations for the implementation of the research activities.

The understanding and cooperation of the Director General of the "Centre National de Recherches Scientifiques et Technologiques" (CNRST), the Director of INERA, the Heads of the Kamboinse and Farako-Bâ stations, the Leader of the Oil and Grain Legumes Improvment Program of INERA and all cowpea scientists in Burkina Faso is deeply appreciated. The successful execution of the RENACO activities could not have been possible without their concern.

RENACO is grateful for the enthusiastic support from the Directors of Agricultural Research of national agricultural research systems (NARS) of member-countries. They permitted national scientists to fully participate in the implementation of network activities, which contributed to the positive achievements recorded by the Network.

RENACO commends the efforts and the achievements obtained by its Lead and Associate Centers: Burkina Faso, Cameroon, Ghana, Niger, Nigeria and Senegal and Benin and Mali, respectively. They were highly instrumental in the accomplishment of the network objectives during the last five years.

The coordination role and backstopping provided by IITA is gratefully acknowledged. This permitted the rapid transfer of research methodologies and advanced technologies to NARS, thereby enhancing the efficiency of research output in the RENACO Lead and Associate Centers, especially.

The Organization of African Unity, Scientific and Technical Research Commission (OAU/STRC), through the SAFGRAD Coordinating Office in Ouagadougou, Burkina Faso, provided immense logistic support and facilitated a free flow of scientific information, technologies and movement of scientists from one country to the other, without which the success of the cowpea network could not have been possible.

Finally, but not the least, these achievements would not have been possible without the financial assistance of the United States Agency for International Development (USAID), to whom we are deeply grateful.

Ouagadougou
April, 1993

Nyanguila Muleba
Cowpea Network Coordinator
(RENACO)

Declaration

Mention of a particular pesticide, any other chemical or product in this document does not imply endorsement of, or discrimination against any manufactured products by IITA/SAFGRAD.

Abbreviations

ACPO	Accelerated Crop Production Officer.
CNRST	Centre National de Recherches Scientifiques et Technologiques.
CRPA	Centre Régional de Production Agro-Pastorale.
GLIP	Grain Legume Improvement Program, IITA.
IAR	Institute of Agricultural Research, Nigeria.
IARC	International Agricultural Research Center.
ICRISAT	International Crops Research Institute for Semi-Arid Tropics.
IDRC	International Development Research Center, Canada.
IITA	International Institute of Tropical Agriculture.
INERA	Institut d'Etudes et de Recherches Agricoles, Burkina Faso.
INRAN	Institut National de Recherches Agronomiques du Niger.
NARS	National Agricultural Research Systems.
OAU	Organization of African Unity.
RENACO	Réseau Niébé d'Afrique Centrale et Occidentale. (West and Central Africa Cowpea Network).
SAFGRAD	Semi-Arid Food Grain Research and Development.
SCO	SAFGRAD Coordination Office, Ouagadougou.
STRC	Scientific, Technical and Research Commission.
USAID	United States Agency for International Development.

Executive Summary

Semi-arid West and Central Africa has been experiencing drastic climatic changes since the early 1970's, characterized by frequent and severe dry, hot spells. This resulted in loss of adaptation of local varieties in their localities of origin; hence crop failures or severe yield losses, creating problems of malnutrition, famine, starvation and death in early to mid-1970's. Confronted with this dramatic situation, African Leaders met and voted for scientific agricultural research to be conducted with the view of developing new and appropriate technologies which could minimize the gravity of yield losses during hazardous years in order to prevent undue hardships and sufferings of the people of the semi-arid zone of Africa.

Although the International Institute of Tropical Agriculture (IITA) has a world wide research mandate for humid and sub-humid tropics, it was called upon in 1977 to technically assist Burkina Faso, then Upper Volta, of the semi-arid zone, establish a cowpea improvement program under a bilateral agreement with the Government of Burkina Faso and the International Development Research Center (IDRC) of Canada. This was necessary because cowpea is an important source of cheap and good quality proteins, but, due to the climatic changes, adaptation of local varieties was lost; hence the severe yield losses. This apart, IITA has a world wide mandate for cowpea research.

A cowpea breeder was posted to Burkina Faso in 1977 to conduct cowpea improvement research activities and train national scientists and technicians in cowpea research and production at Kamboinse. With the subsequent establishment of the Semi-Arid Food Grain Research and Development (SAFGRAD) Project in 1978, IITA agreed to merge its efforts with the SAFGRAD project's mandate. A cowpea agronomist and an entomologist were therefore,

posted by IITA to Kamboinse to work together with the cowpea breeder in cowpea improvement for semi-arid Africa. The SAFGRAD project was sponsored by the United States Agency for International Development (USAID).

Since the semi-arid zone of Africa is so vast, IITA adopted the strategy of conducting resident research activities in Burkina Faso. Promising technologies so developed were tested together with those from national programs and other organizations in regional trials for validation, adoption by national programs and eventual release to farmers in the SAFGRAD member countries. From this effort, cowpea production constraints were identified; new cowpea production technologies overcoming the constraints were developed and most importantly, research methodologies for developing appropriate technologies for the semi-arid zone were devised.

The laudable scientific breakthrough of SAFGRAD Phase-I, culminated in SAFGRAD and IITA establishing the Cowpea Collaborative Research Network for West and Central Africa known by its French acronym "RENACO" in 1987. RENACO was born with a primary objective of stimulating the initiative and capacity of national programs to solve cowpea production constraints and direct network activities themselves. The network area covers 18 member countries within West and Central Africa. In order to achieve its objectives, workshops were organized biennially by RENACO to discuss all problems relating to cowpea production in inidividual member countries and for the renewal/election of a Steering Committee which presides over the decisions relative to the Network.

The Steering Committee meets bi-annually. Among other responsibilities, it assigns technology development research responsibilities to relatively strong national programs, commonly known as (Lead Centers), in areas where they have a comparative advantage and of primary interest to their home countries and which of course, they agree to share results: scientific information and technologies with other member countries. The Committee plans cowpea monitoring tours, workshops, seminars and training sessions as part of a training program for all national scientists and technicians of member countries. It reviews research workplans and research findings of RENACO Lead Centers and nominates promising technologies including those from IITA for regional trials in member countries.

Six national programs, namely: Burkina Faso, Cameroon, Ghana, Niger, Nigeria and Senegal, based on their available research personnel, infrastructure and resources and ecological representivity were given the function of Lead Centers as described above, within the network. Because of *Striga gesnerioides* strain variation in cowpea and in order to accertain *Striga* resistance stability across the West and Central African sub-region, two national programs, Benin and Mali, were assigned *Striga* validation research responsibilities. These are referred to as Associate Centers. Technology adaptation research and transfer being the responsibility of each participating NARS.

In order to enable NARS scientists properly discharge their respective assignments, RENACO organized, with backstopping from IITA, various types of training activities consisting of monitoring tours to selected key NARS programs and IITA research facilities in Nigeria and Niger as well as seminars and training sessions. Appropriate research methodologies, agricultural experimentation and technology transfer and shaping agronomic research in West and Central Africa were some of the topics discussed during the training activities. As a result, nearly all member countries have carried out their responsibilities vis-à-vis RENACO highly satisfactorily. This has culminated in a positive impact of RENACO on NARS at various levels as follows:

<u>Level 1.</u>: Changes in the performance of research institutions, human resources and policy environment for research: All RENACO Lead, Associate and Technology Adopting Centers have discharged their research responsibilties satisfactorily. This was well illustrated by NARS scientists research output nominated in regional trials for Lead Centers and on-farm testings for each NARS member countries. Also the policy environment for research has been improved remarkably as the Directors of Research facilitated and encouraged the national scientists to participate actively in networking activities. This has contributed to the breaking of the linguistic barriers that have traditionally prevented Francophone, Anglophone and Luzophone African scientists from learning from one another.

<u>Level 2:</u> Changes in the output from research and development agents: The number of new technologies developed by NARS have been increased measurably from 1987-1992 as compared to the previous period 1982-1986. The new technologies have been transferred to member countries through regional trials. They have also contributed to renewed interest in on-farm testings, seed increase and release of new cultivars to farmers. Some cultivars were released in more than one country indicating, thus, a spill-over effect promoted by the network.

<u>Level 3:</u> Changes in utilization of high yielding and sustainable agricultural technologies: Although the network does not have, at hand, tangible data showing the acrage of the new technologies used in each member country, there is sufficient evidence showing that some technologies, such as cultivars: IT82E-32, KN-1, Suvita-2, TVx 3236, KVx396-4-5-2D, IT82E-9 and many others are widely used by farmers in more than one country.

<u>Level 4:</u> Changes in production, productivity, and income: Although the 1992 USAID-SAFGRAD impact assessment team has provided evidence that the cowpea network has contributed to increased production, productivity, and incomes in sample countries, the greatest impact of the network on NARS is its contribution to guaranteed food security to farmers. This is because the poor peasant farmers constitutes 70 to 80% of the total population; and their major preoccupation may not necessarily be "total production and/or income", but rather what to live on during bad crop years.Thus, the multiple attributes, i.e., *Striga*, diseases and drought resistances, insect tolerance, good seed quality and high yield, incorporated in the new cultivars promoted and released through network efforts was a priceless achievement for resource poor farmers.

Major constraints encountered in attaining objectives were: lack of critical mass of national scientists, insufficient funding for agricultural research, and insufficient national scientific leadership development. The success achieved by the network in development and transfer of new and appropriate technologies, which initiated for the first time in modern Africa a harmonious agricultural development, suggests that once the above mentioned constraints are overcome, national scientists can be effective, principal actors of agricultural development in their home countries. However, their credibility vis-à-vis decision makers and other partners in agricultural development in bringing the needed policy changes conducive to a harmonious agricultural development is still to be built up through repeated success stories.

From the SAFGRAD project achievements, a few lessons can be drawn in relation with food crop production in semi-arid sub-Saharan Africa. They are as follows: Climatic change is a reality since 1970; it calls for new and appropriate research methodologies for the development of production technologies, ensuring food security as well as sustainable agriculture; when offered appropriate technologies, meeting their needs and requirements, African peasant farmers can be receptive to agricultural innovations; and finally, the African food crisis experienced since 1960, can be brought under control through sound agricultural research activities and transfer to and adoption by farmers of their outputs.

Finally, although significant progress has been made, a lot more is still to be done to render NARS fully operational in agricultural development. To this effect, national scientific leadership development is still to be built and its credibility vis-à-vis to all partners in agricultural development, enhanced through repeated scientific success stories. Also a sound cowpea production in the sub-region cannot be envisaged in the near future without the use of chemical poisons, which are not only inaccessible to farmers, but are also hazardous to them. Therefore, a thorough search for either new sources of resistance or biological control needs to be tackled vigorously in order to bring insect pest damage to cowpea under control. In addition, new cultivars possessing a combination of high heat, drought and excess moisture tolerances; *Striga*, diseases and insect pest resistances, good seed quality and storability and of course, high yield should be given top priority. This requires a concerted effort of national, regional and international multidisciplinary team works within the framework of the network.

I

Introduction

Introduction

A total of about 181.8 million people lived in West and Central Africa in 1989, as follows: Benin 4.0, Burkina Faso 6.9, Cameroon 9.7, Cape Verde 0.3, Central African Republic 2.7, Chad 5.2, Côte d'Ivoire 10.1, The Gambia 0.8, Ghana 14.4, Guinea Bissau 0.9, Guinea Conakry 6.1, Mali 7.7, Mauritania 1.9, Niger 6.5, Nigeria 91.2, Senegal 6.7, Sierra Leone 3.7, and Togo 3.0 million people. About 70-80% of these populations reside in rural areas and practice traditional Agriculture, the main source of employment, for production of staple food for subsistence.

Shifting and fallow cultivation system has been the basic practice in traditional agriculture for milleniums. It consisted of clearing the land and using it to grow food crops for about 3-6 years before abandoning it to fallow for about 10-20 years when it would have restored soil fertility before putting it back to use. If the soil fertility of all the farming lands of a village or the household was exhausted, the village or household simply abandoned it and resettled on new fertile lands elsewhere. Note that the primary objective of the peasant farmer is to produce enough food to live on during both good and hazardous years. The main agricultural inputs in this type of farming system is therefore: land, rainfall, seed, labour and the duration period of the land left to fallow. Peasant farmers are not necessarily interested in achieving maximum yields as may be the case of commercial farmers, but are rather much concerned in minimizing risks in order to ensure food security for their families. However, owing to the erratic nature of the rainfall in semi-arid West and Central Africa, peasant farmers have developed throughout the milleniums, a strategy for producing large quantities of food stuffs during favourable years and storing them for consumption during years of poor harvest or natural calamities. It is, therefore, not surprising to see the way visitors from the humid and sub-humid Central Africa are often amazed by the number of graneries they see in semi-arid zones.

While graneries may appear to be imperceptible in the humid and sub-humid zones, an increase of 2-3 per household is very common in the northern Guinea savanna and 6-10 in the Sudanian Sahelian zones of semi-arid West Africa.

Shifting cultivation with fallow seems to be the most reliable and efficient agricultural system that African ancestors have ever developed. This system did not only ensure the food security, but also permitted them to live in equilibrium with the ecosystem for milleniums. Thus, as recently as the mid-20th century, Africa was renowned world wide for its abudant game and wild life. This prompted european rulers, such as Kings, Queens, Lords and Presidents as well as rich industrialists from north America and other parts of the world to visit Africa's wild life. However, the shifting cultivation with fallow was not compatible with high population density, thereby keeping Africa's population density under 10 people per km^2, especially in the lowland areas.

The colonization of Africa by the europeans in the late 19th century which resulted in the creation of urban centres with exportation economy and the construction of road systems linking urban centres with sea ports, did not only facilitate exportation and importation activities, but had also increased trade transactions between rural and urban centres for local food products as well as imported products, especially modern medications. Consequently villages started becoming more or less permanent and infant mortality reduced considerably and human life was prolonged. This resulted in high increase in population growth rate of over 2.7% yearly these days. Thus, the African population which was less than 10 people per km^2 at the beginning of the 20th century had more than doubled, reaching to about 80 people per km^2, especially in certain areas of the Mossi plateau of Burkina Faso in the semi-arid zones. As village settlements became permanent during this period, the high population density resulted in a reduction of the duration of the fallow period, with the subsequent, soil fertility decline, soil erosion and reduced land productivity.

Belgian scientists visiting the French Sudan, the present Republic of Mali in 1948, observed the stability of village settlements and the subsequent suppression of land fallow system and the *de facto* adoption by farmers of a continuous cultivation system without the use of organic matter or chemical fertilizers for soil fertility restoration (Renard 1949). They predicted a tragic soil fertility decline in a not-too-distant future, unless soil conservation and fertility restoration measures were used.

Although some soil fertility measures, such as animal manure and chemical fertilizers are currently being used, they are not adequate enough for sustainable agriculture (Bationo *et al*.1985). In addition to this, the West and Central African regions are currently experiencing some drastic climatic changes since 1950 (Nicholson 1989, cited by Tucker *et al*. 1991) and this has had some bad repercussions on varietal adaptation. The study by Nicholson shows that the erratic nature of rainfall of which peasant farmers are used to prevailed since the beginning of the 20th century up to the year 1950. It was characterized by the alternance of 1, 2 or 3 years of above or below average rainfall. The farmers' strategy described above was probably able to help them survive such rainfall variations.

As from 1950 to 1970 an unprecedented period of abundant rainfall was experienced. While that period was good for human welfare: abundant food supply, it could have culminated in varietal changes towards better adaptation to abudant and well distributed rainfall under the combination of natural selection and the farmers ability to identify better genotypes under cultivation. However, with the second major climatic change in 1970 up to date, with rainfall below average (Tucker *et al*. 1991) peasant farmers were taken by surprise without either adapted varieties or appropriate crop production practices. Under these circumstances, the farmers' traditional strategy was out of place.Consequently, frequent crop failures, famine and starvation leading to death were reported world wide in 1973 and 1974. These tragic events called for agricultural research to be conducted in order to develop new and appropriate technologies, if human hardships and sufferings were to be prevented in the future.

First of all, a discussion of the contribution of IITA in strengthening national programs is presented in this report before dealing with the changes that have taken place at "levels 1, 2, 3 and 4", being the results of increased and improved research outputs of national agricultural research systems through RENACO efforts.

II

IITA Contribution to Strengthening National Cowpea Programs in Semi-Arid West and Central Africa

2.1. IITA Involvement in cowpea improvement in Burkina Faso

Although the mandate of the International Institute of Tropical Agriculture (IITA) covers only the humid and sub-humid tropical regions of the world, it was called upon to assist Burkina Faso, then Upper Volta, technically establish and develop a cowpea improvement program following a bilateral agreement between the Government of Burkina Faso and the International Development Research Center of Canada (IDRC). This, because cowpea is an important source of good quality and cheap proteins for low income people and since IITA has a world mandate for cowpea reasearch. The climatic changes experienced since the early 1970's had hampered cowpea production and consequently new technologies were required to ensure a sustainable cowpea production in the country.

A cowpea breeder was appointed and sent to Kamboinse, Burkina Faso in 1977 by IITA. His mission was to develop a cowpea improvement program, train national cowpea scientists and technicians and promote a sustainable cowpea production scheme for peasant as well as commercial farmers.

2.2. IITA involvement in the SAFGRAD Project

With the establishment of the Semi-Arid Food Grain Research and Development (SAFGRAD) project in 1978, sponsored by the USAID, IITA was one of four Agencies contracted to implement the SAFGRAD Project's mandate. IITA's role of the SAFGRAD mandate consisted of carrying out resident research activities in the semi-arid zones of Africa for maize and cowpea; train national maize and cowpea scientists and technicians through lectures, monitoring tours and workshops; and to ensure transfer of scientific information and technologies from advanced laboratories in developed countries to national programs in developing countries. The overall objective of IITA involvement in semi-arid Africa under the auspices of the SAFGRAD project was to promote a sustainable cowpea production based on scientific knowledge compatible with peasant as well as commercial farmers' aspirations and meeting their needs and requirements. In order to achieve this objective, IITA assigned a cowpea agronomist and an entomologist sponsored by USAID in addition to the cowpea breeder posted earlier in 1977 to the Kamboinse station, Burkina Faso. A 3-man team, was, thus, put together in 1979 to execute IITA's role of the SAFGRAD project's mandate in semi-arid Africa. The activities of the team were as follows:

2.2.a) Resident research

Since the African semi-arid zone is vast, stretching from the West, through Central to East Africa and extending to Southern Africa, it was not possible to conduct research activities throughout this zone. IITA, therefore set up a strategy of conducting resident research activities in the three agro-ecologies of the semi-arid zone in Burkina Faso; first of all to understand problems related to cowpea production, identify the production constraints and secondly to develop technologies overcoming them. The technologies so developed were nominated for regional trials and were distributed to national agricultural research systems (NARS) for validation tests and possible adoption and extension to farmers.

2.2 a.1) <u>Cowpea production constraints:</u>

Three agro-ecological zones, from north to south were recognized in West Africa. They are as follows:

The Sahel: 200-600 mm rainfall from mid-June to mid-September;

Sudan Savanna: 600-900 mm rainfall from June to September;

Northern Guinea savanna: 900-1250 mm rainfal from June to mid-October.

Major cowpea production constraints in the semi-arid zones identified include:

1) **Climatic constraints:** Drought (inadequate, poor distribution and erratic rainfall) and heat (high air and soil temperatures) stresses, and sandblasts due to high wind velocities. They increase gradually from south-northwards.

2) **Biological constraints:** Diseases (scab, brown blotch, *Septoria* leaf spot, viral diseases, bacterial blight, ashy-stem rot), insect pests (thrips, aphids, bruchids, pod sucking bugs and *Maruca* pod borers), parasitic weeds (*Striga* and *Alectra*).

3) **Soil constraints:** Soil compaction, soil surface sealing, high run-off and erosion, low water retention capacity, low fertility and high soil temperatures.

4) **Socio-economic and cultural constraints:** Limited number of qualified scientists; high rate of illiteracy in farmers' community, poor on-farm testings, inadequate seed production and distribution system; traditional farming system and continued cultivation without use of appropriate inputs.

5) **Financial constraints:** All national programs have limited resources to conduct appropriate research, upgrade research infrastructures, train and keep their scientists abreast with the latest scientific achievements.

Efforts deployed by the IITA team at Kamboinse, Burkina Faso to overcome the first three constraints consisted of cowpea breeding, agronomy and entomology research as below:

2.2 a.2) **Cowpea breeding**

Cowpea breeding in Burkina Faso started in 1977 on a bilateral agreement between the Government of Burkina Faso and IDRC with IITA as an executing Agency. It was incorporated in 1979 in the SAFGRAD project sponsored by USAID. Thus, the newly IITA assigned cowpea agronomist and entomologist had to work with the breeder in a cowpea improvement team for semi-arid zone of Africa based at Kamboinse.

The IITA cowpea breeding effort from the on-set in 1977 to its closure in 1987 is given in Table 2.1. Over a thousand cultivars were introduced from IITA Ibadan, Nigeria, yearly. They were tested in Burkina Faso for adaptation including cereal-cowpea intercropping and for seed quality. Local and introduced germplasm evaluation trials, preliminary yield trials, advanced yield trials, multilocation yield trials or elite variety trials conducted from 1977 to 1987 are given in Table 2.1. Promising cultivars identified from this effort as well as varieties nominated by national cowpea programs were regionally tested for the first time in 1980 as listed in Table 2.2.

In 1980, the IITA cowpea breeding project at Kamboinse, Burkina Faso, undertook to make its own crosses in order to tackle cowpea production constraints specific to semi-arid zones. The constraints delt with since 1980 were mostly climatic:drought and heat stress resistances and biological: insect pests, Aphids, Thrips, *Maruca* and bruchids resistances; and from 1982 they were biological: including *Striga* resistance and combined biological

Table 2.1. Cowpea Network: Flow of Germplasm.
Country: Burkina Faso (IDRC & IITA/SAFGRAD).

Activities	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1. Local germplasm collection											
. Number of accessions	39	-	-	50	-	109	-	-	-	-	-
2. Local germplasm evaluation											
. Number of trials	-	1	-	-	1	1	-	-	2	-	-
. Number of entries	-	39	-	-	>250	109	-	-	335	-	-
. Number of test locations	-	1	-	-	1	1	-	-	1	-	-
. Number of selected entries	-	7	-	-	95	63	-	-	44	-	-
3. Introduced germplasm evaluation											
. Number of trials	2	1	1	2	-	1	1	-	-	-	-
. Number of entries	870	1070	1210	193	-	223	10	-	-	-	-
. Number of locations	1	1		2	-	1	1	-	-	-	-
. Number of selected entries	204	228	355	27	-	28	2	-	-	-	-
4. Breeding crosses											
. Number of populations	-	-	-	24	12	8	12	16	-	15	9
. Total number of lines	-	-	-	-	>2000	-	>2000	-	-	-	465
5. Breeding nursery											
. Number of nurseries	-	-	-	-	3	6	5	6	4	4	1
. Total number of lines	-	-	-	-	>2000	>4000	>500	241	>1500	>734	>500
. Number of test locations	-	-	-	-	2	1	1	2	2	1	1
. Number of selected lines	-	-	-	-	724	776	1193	40	129	168	175
6. Preliminary yield trials											
. Number of trials	2	2	3	5	-	4	6	11	5	8	9
. Number of entries	265	318	544	520	-	525	376	200	80	157	147
. Number of test locations	1	1	1	13	-	3	4	4	3	2	1
. Number of selected entries	85	18	24	26	-	12	6	15	13	21	6
7. Advanced yield trials											
. Number of trials	3	3	5	3	4	-	5	10	12	12	5
. Number of entries	75	75	102	70	55	-	114	90	199	184	95
. Number of test locations	1	3	3	3	3	-	3	4	3	3	2
. Number of selected entries	4	8	21	4	2	-	4	12	36	30	6
8. Multiplication trials											
. Number of trials	2	2	1	-	-	-	-	-	-	-	-
. Number of entries	20	20	7	-	-	-	-	-	-	-	-
. Number of test locations	6	8	11	-	-	-	-	-	-	-	-
. Number of selected entries	2	3	2	-	-	-	-	-	-	-	-

Table 2.1. cont'd. Cowpea Network: Flow of Germplasm.
Country: Burkina Faso (IDRC & IITA/SAFGRAD).

Activities	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
9. Elite variety trials											
. Number of trials	-	-	3	-	-	1	-	-	-	-	-
. Number of entries	-	-	6	-	-	6	-	-	-	-	-
. Number of test locations	-	-	16	-	-	8	-	-	-	-	-
. Number of selected entries	-	-	1	-	-	1	-	-	-	-	-
Total flow of germplasm	1269	1522	1869	857	>4305	>4980	>3000	540	>1835	>1090	>1207
10. Constraints tackled#											
. Adaptation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-
. Drought resistance	N	N	N	Y	Y	Y	Y	Y	Y	Y	-
. Insect pests resistance											
.. Aphids	N	N	N	Y	Y	Y	Y	Y	Y	Y	-
.. Thrips	N	N	N	Y	Y	Y	Y	Y	Y	Y	-
.. *Maruca*	N	N	N	Y	Y	Y	Y	Y	Y	Y	-
.. Bruchids	N	N	N	Y	Y	Y	Y	Y	Y	Y	-
. *Striga* resistance	N	N	N	N	N	Y	Y	Y	Y	Y	-
. Combined constraints res.	N	N	N	N	N	Y	Y	Y	Y	Y	-
. Intercropping with cereals	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-
. Seed quality	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-

Y = Yes; N = No

Table 2.2. Cowpea Network: cultivars nominated for regional trials: IITA-IDRC-SAFGRAD

Name of Trial	1980		1981		1982	
	Origin	Cultivars	Origin	Cultivars	Origin	Cultivars
1). **Adaptation**	Benin	Kpodiguegue	Benin	Kpodiguegue	Benin	Kpodiguegue
	Botswana	Blackeye, Rhenostar	Botswana	Blackeye,Rhenostar	Botswana	Rhenostar
			Niger	TN88-63,TN13-78	Niger	TN88-63
	Nigeria	IAR/341,AIR/48,IAR/355	Nigeria	IAR/341,IAR/48,IAR/355	Nigeria	IAR/341,IAR/48,IAR/355
	Senegal	58-57,Mougne,Bambey-21, NDiambour	Senegal	58-57,Mougne,Bambey 21, NDiambour	Senegal	58-57,59-9, Mougne,Bambey-21, Diambour.
	IITA/SAFGRAD (Burkina)	TVx1999-01F,TVx1999-02E, TVx309-1G,TVx1948-01F, VITA-4, VITA-5, Gorom Local(SUVITA-2) VITA-7 (KN-1), Ife-Brown.	IITA/SAFGRAD (Burkina)	TVx1999-01F,TVx 1948-01F VITA-4,VITA-5,Gorom L. (SUVITA-2), VITA-7 (KN-1) TVx 3236	IITA/Ibadan (Nigeria)	TVx4262-09D
					IITA/SAFGRAD (Burkina)	TVx1999-01F, TVx1948-01F, VITA 4,VITA-5, Gorom L. (SUVITA-2) VITA-7 (KN-1), TVx3236.
2) INSAH		None		None	- Mali	15-316, Niban
					- Mauritania	Kaedi B & Gris.
					- Niger	TN88-63
					- Senegal	58-57,Mougne
					IITA/SAFGRAD (Burkina)	VITA-7 (KN-1), Gorom Local (SUVITA-2)
3) Regional early maturity trial		None		None		None
4) Regional medium maturity trial		None		None		None

Table 2.2. cont'd-1. Cowpea Network: Cultivars nominated for regional trials: IITA-IDRC-SAFGRAD.

Name of Trial	1980		1981		1982	
	Origin	Cultivars	Origin	Cultivars	Origin	Cultivars
5) Regional *Striga* resistant trial		None		None		None
6) Regional drought resistant trial		None		None		None
- <u>Total number of cultivars</u>		19 cultivars		20 cultivars		27 cultivars
- <u>New cultivars</u>		19 cultivars		2 cultivars		3 cultivars

Table 2.2. cont'd-2: Cowpea Network: Cultivars nominated for regional trials: IITA-IDRC-SAFGRAD

Name of Trial	1983		1984		1985	
	Origin	Cultivars	Origin	Cultivars	Origin	Cultivars
1) Adaptation Trial		None		None		None
2) INSAH Trials		None		None		None
3) Regional early maturity trial	IITA-Ibadan (Nigeria) Senegal IITA-SAFGRAD (Burkina)	IT82E-18, IT82E-32, IT82E-60, IT82E-70, IT82E-77. Bambey-21 KVu 69, TVx4659-13C-1K		None		None
4) Regional Medium maturity trial	Ethiopia Niger Nigeria Senegal IITA-Ibadan (Nigeria) IITA-SAFGRAD (Burkina)	White wonder Tr. TN88-63 IAR/48 Mougne TVx4262-09D, IT81D-994, IT81D-1157, IT81D-1137, IT81D-952, TVx4659-03E Gorom local (SUVITA-2) TVx3236, VITA-7 (KN-1), TVx1999-01F		None		None
5) Regional *Striga* resistance trial		None	Senegal IITA-SAFGRAD (Burkina)	Mougne(susceptible control). KVx30-166-3G, KVx30-183-3G, KVx100-1, KVx100-2, KVx68-1, KVx68-2, KVx61-1, KVx61-2, KVx61-3, Gorom Local (SUVITA-2).	Senegal IITA-Ibadan (Nigeria) IITA/SAFGRAD (Burkina)	Mougne(susceptible control). IT82D-716 KVx30-166-3G, KVx30-183-3G, KVx100-1, KVx100-2, KVx61-2, KVx61-74, KVx60-1, KVx65-80, KVx 64-54, KVx65-114, KVx65-119-2, Gorom Local (SUVITA-2)

Table 2.2 cont'd-3: Cowpea Network: Cultivars nominated for regional trials: IITA-IDRC-SAFGRAD.

Name of Trial	1983		1984		1985	
	Origin	Cultivars	Origin	Cultivars	Origin	Cultivars
6) Regional drought resistance trial		None	Niger	TN88-63	Niger	TN88-63
			IITA-Ibadan (Nigeria)	IT82D-716,IT82D-952, TVx3236	IITA-Ibadan (Nigeria)	IT82D-699,IT81D-985, IT83S-853,IT82D-716, IT82D-952,TVx3236.
			IITA-SAFGRAD (Burkina)	KVx30-309-6G, KVx30-305-3G, KVx30-470-3G, TVx5050-02C-K Gorom Local (SUVITA-2)	IITA-SAFGRAD (Burkina)	KVx30-309-6G,KVx30-305-3G,KVx30-470-3G, TVx5050-2C-K,KVx100-2, KVx61-74,Gorom Local (SUVITA-2).
- <u>Total number of cultivars</u>		21 cultivars		20 cultivars		27 cultivars
- <u>New cultivars</u>		13 cultivars		15 cultivars		10 cultivars

Table 2.2. cont'd-4: Cowpea Network: Cultivars nominated for regional trials: IITA-IDRC-SAFGRAD.

Name of Trial	1986	
	Origin	Cultivars
1) Adaptation trial		None
2) INSAH		None
3) Regional early maturity trial		None
4) Regional medium maturity trial		None
5) Regional *Striga* resistance trial	Senegal	Mougne (susceptible control).
	Niger	TN88-63
	IITA-SAFGRAD (Burkina)	KVx61-1,KVx61-2, KVx61-74,KVx61-59-1, KVx64-54,KVx65-119-2, KVx68-31-3,KVx100-2, KVx100-21-7,KVx183-1, KVx183-2,Gorom Local (SUVITA-2)
6) Regional drought resistance trial	Niger	TN88-63
	IITA-Ibadan (Nigeria)	IT82D-952,IT82D-716, TVx3236
	IITA-SAFGRAD (Burkina)	KVx30-305-3G,KVx60-P04-1, KVx61-74,KVx222-K16-9, KVx243-K10-16,KVx246-K34-2, KVx256-K17-11,KVx257-K21-13, KVx268-K03-3,Gorom Local (SUVITA-2)
- Number of cultivars		**27 cultivars**
- New cultivars		**12 cultivars**

and climatic constraint resistances. Also, from 1980-1987, there was a big shift from massive germplasm introduction from IITA-Ibadan in favour of local germplasm or locally bred cultivars (Table 2.1). This effort was translated by the nomination for regional trials of *Striga* and drought resistant cultivars by the project beginning 1984 (Table 2.2).

A cowpea workshop was organized yearly from 1980-1986 which permitted NARS and IITA breeders to interact with one another and discuss their research findings and also nominate their best varieties or cultivars for regional testings.The low number of varieties or cultivars nominated by NARS breeders during this period clearly demonstrated the weakness of NARS research capabilities in the semi-arid zones of Africa (Table 2.2).

2.2.a.3. Cowpea Agronomic Research

The SAFGRAD project's cowpea agronomic research was initiated in 1979. Research was conducted in management of pure-stand cropping as well as intercropping and relay-cropping systems with cereals. Both introduced daylength-insensitive improved cultivars and daylength-sensitive local varieties were tackled in all research projects. Research topics carried out from 1979-1987 are contained in Table 2.3.

From the agronomic research results, it was found that:

1) The climatic change has had a negative impact on the adaptation of local daylength sensitive varieties in their original localities. It was discovered that there was a southwards shift of the geographical regions of adaptation of local varieties. Thus, Sahelian varieties becoming better adapted to Sudanian zones and Sudanian varieties getting adapted to northern Guinea savanna zones. However, during very wet years, the new varieties stand the risk of exhibiting susceptibility to the

Table 2.3. Cowpea Network: Research efforts in cowpea agronomy.
Country: Burkina Faso (IITA/SAFGRAD).

Actitivties	1979	1980	1981	1982	1983	1984	1985	1986	1987
a) Managemnet of pure-stand cowpea									
a.1) Sowing dates									
- Local cultivars									
. Number of trials	-	-	1	2	1	1	1	1	1
. Number of treatments	-	-	28	52	18	18	18	18	18
. Number of locations	-	-	2	2	1	1	1	1	1
- Improved cultivars									
. Number of trials	-	3	-	-	5	5	3	2	2
. Number of treatments	-	27	-	-	114	114	54	72	48
. Number of locations	-	1	-	-	3	3	2	2	3
a.2) Plant population density									
. Number of trials	-	1	-	-	2	2	1	1	-
. Number of treatments	-	15	-	-	24	24	12	12	-
. Number of locations	-	3	-	-	2	2	1	1	-
a.3) Soil water management									
- Soil preparation									
. Number of trials	1	1	-	-	-	1	-	2	-
. Number of treatments	5	12	-	-	-	45	-	42	-
. Number of locations	1	1	-	-	-	1	-	2	-
- Tied ridges									
. Number of trials	-	-	1	3	2	2	1	-	-
. Number of treatments	-	-	20	68	28	53	24	-	-
. Number of locations	-	-	1	2	2	2	1	-	-
- Mulching									
. Number of trials	-	-	-	-	-	3	-	-	-
. Number of treatments	-	-	-	-	-	23	-	-	-
. Number of locations	-	-	-	-	-	2	-	-	-
- Integrated crop management									
. Number of trials	-	-	-	-	-	-	1	2	2
. Number of treatments	-	-	-	-	-	-	16	36	36
. Number of locations	-	-	-	-	-	-	1	1	1

Table 2.3. cont'd. Cowpea Network: Research efforts in cowpea agronomy.
Country: Burkina Faso (IITA/SAFGRAD).

Activities	1979	1980	1981	1982	1983	1984	1985	1986	1987
a.4) Soil fertility improvement									
- Phosphorus fertilizers									
. Number of trials	2	2	1	-	1	3	6	4	3
. Number of treatments	26	14	8	-	24	72	112	80	58
. Number of locations	6	6	1	-	1	2	3	2	2
- Rotation with cereals									
. Number of trials	1	-	-	-	-	2	1	1	1
. Number of treatments	6	-	-	-	-	3	8	24	32
. Number of locations	1	-	-	-	-	2	1	1	1
b) Mixed cropping									
- Maize-cowpea relay cropping									
. Number of trials	1	3	6	5	4	2	3	1	-
. Number of treatments	32	31	56	47	58	26	36	12	-
. Number of locations	1	1	2	2	2	1	1	1	-
- Sorghum-cowpea intercropping									
. Number of trials	1	1	1	-	-	4	4	4	4
. Number of treatments	16	3	4	-	-	34	34	34	34
. Number of locations	1	1	1	-	-	2	2	2	2
- Millet-cowpea intercropping									
. Number of trials	-	-	1	-	-	2	2	2	2
. Number of treatments	-	-	10	-	-	17	22	22	22
. Number of locations	-	-	1	-	-	1	2	1	1
c) On-farm verificative research									
. Number of trials	-	-	-	-	1	2	1	1	-
. Number of treatments	-	-	-	-	20	7	2	2	-
. Number of locations	-	-	-	-	1	6	1	1	-
Total number of technologies tested.	**85**	**102**	**126**	**167**	**286**	**463**	**338**	**378**	**248**

prevailing diseases in the new environment. Rust, scab, brown blotch, *Septoria* leaf spot and viral diseases being problems in the northern Guinea savanna, while brown blotch, bacterial pistule and viral diseases are problems of the Sudan savanna (IITA-SAFGRAD Annual Reports, 1981-1985; Muleba *et al.* 1991a & b).

2) It was also found that introduced, improved daylength-insensitive cultivars had to be heat and drought stress tolerant in order to be useful for cowpea production in the semi-arid zones; earliness *per se* was inadequate for better adaptation (Muleba 1988b, Muleba *et al.* 1991a & b).

3) Optimum sowing date was determined to be in mid-July for northern Guinea and Sudan savanna zones and at the on-set of the rains in the crop season for the Sahel (IITA-SAFGRAD Annual Reports, 1982-85 Muleba *et al.* 1991a).

4) A critical plant population density was estimated at 40,000 plants/ha for daylength-insensitive cultivars and 22,000 plants/ha for daylength-sensitive cultivars (IITA-SAFGRAD Annual Reports, 1983-87).

5) Ploughing soils by hand, tractor or animal traction prior to planting is conducive to high yields in all agro-ecologies, especially the Sudan savanna than planting on untilled soils in the absence of *in situ* mulch. *In situ* mulch can be a good substitute for soil tillage if the cover crop provides an adequate canopy cover during preceding years. In addition, the withdrawal of crop residues for animal feed detrimentally affects soil physical properties and its fertility and can result in subsequent yield reduction (IITA-SAFGRAD Annual Reports 1983-87).

6) In the Sudan savanna, but not the northern Guinea savanna or the Sahel, tied ridge techniques, in non sandy soils can improve soil water retention and increase seed yield even during very wet years (IITA-SAFGRAD Annual Reports 1981-85, Muleba & Brockman 1991).

7) The use of windbreak barriers and mulch can boost cowpea yield by more than 15% compared to a check without windbreak treatment in the Sahel (IITA-SAFGRAD Annual Reports 1985-87).

8) Phosphorus (P) is the most soil limiting nutrient element in semi-arid West Africa and must be supplied at a rate of about 22 kg P/ha from soluble phosphatic fertilizers or 44 kg P/ha from the natural West African phosphatic rock fertilizers. At such a rate, P stimulates the uptake of other essential elements such as nitrogen, potassium, calcium, etc; it also has positive residual effect on the subsequent cereal crop (IITA-SAFGRAD Annual Reports, 1983-87).

9) A 90-day to maturity maize, sown in early-to-late-June may be relay-cropped with a prostrate daylength-sensitive cowpea that flowers in mid-September without hampering maize seed yield significantly. Good yields of more than 3t/ha maize and 0.7-1.5t/ha cowpea have been repeatedly obtained in the northern Guinea savanna (IITA Annual Reports 1981-87, Muleba & Brockman, 1985).

10) Cereals and cowpea can be intercropped in all the three agro-ecologies, but cowpea should, however, be sown in alternating rows with cereals 2 weeks after cereals. Land equivalent ratios greater than 1 have been repeatedly observed in the three ecologies of semi-arid West Africa. However, during very dry

years, a complete failure of both crops in intercropping can be experienced while pure-stand cowpea crop could give an acceptable yield (IITA-SAFGRAD Annual Reports, 1983-87, Muleba *et al.* 1985).

11) Successional sowing can be used in assessing cowpea for drought and heat resistances in the Sudan savanna and in the Sahel (IITA Annual Reports 1983-87, Muleba *et al.* 1991a & b).

12) Wide crosses involving excess moisture tolerant and drought resistant cowpea cultivars together with successional sowing for screening lines for adaptation in Sudan savanna are conducive in developing widely adapted cultivars (tolerant to both excess and deficit moisture) that can be grown in all the three ecologies of semi-arid West Africa (IITA-SAFGRAD Annual Reports, 1985-87).

13) A 9-month old *Striga gesnerioides* debris (seed and plant materials harvested in the month of October in the Sudan savanna) mixed with wet sand (10g/m^2) can improve the uniformity of *Striga* infestation so as to enable screening of cowpea germplasm for *Striga* resistance (IITA-SAFGRAD Annual Report 1981).

2.2. a.4) <u>Cowpea entomology research</u>

Like cowpea agronomy, entomology research work was initiated in 1979 until 1987 when the IITA-SAFGRAD resident research activities came to an end. Research topics conducted are given in Table 2.4.

Table 2.4. Cowpea Network: Research efforts in entomology
Country: Burkina Faso (IITA/SAFGRAD).

Activities	1979	1980	1981	1982	1983	1984	1985	1986	1987
1) Insect survey									
. Number of trials	3	1	1	1	1	1	1	1	1
. Number of insects species studied	6	1	1	1	1	4	6	5	1
. Number of locations	3	1	1	1	1	1	3	3	3
2) Yield losses due to insects pests									
. Number of trials	2	1	-	-	-	1	3	3	3
. Number of treatments	8	8	-	-	-	2	2	2	2
. Number of locations	1	3	-	-	-	1	3	3	3
3) Integrated pest management									
. Number of trials	1	1	1	1	2	6	1	3	2
. Number of treatments	8	24	8	8	8	14	12	3	8
. Number of locations	1	1	1	1	1	3	1	3	3
4) Chemical crontrol									
. Number of trials	-	2	-	1	1	-	-	1	1
. Number of treatments	-	19	-	7	6	-	-	14	14
. Number of locations	-	1	-	1	1	-	-	1	1
5) Biological test for resistance									
. Number of trials	1	2	6	6	5	1	1	2	1
. Number of treatments	14	28	48	>230	>29	23	21	19	8
. Number of locations	1	1	1	1	1	1	1	1	3
Total number of technologies tested:	**30**	**80**	**57**	**>246**	**>44**	**43**	**41**	**43**	**33**

Results on the insect surveys indicated that *Aphids* (*Aphis craccivora*), flower thrips (*Megalurothrips sjostedti*), pod borers (*Maruca testulatis*) and pod sucking bugs (*Anoplocnemis curvipes, Riptortus dentipes, Acanthomia* spp, etc.) were the major field insect pests. Yield losses up to 100% due to insect pests, particularly with introduced cultivars have been observed. Different methods for controlling insect pest damages were studied. The most appropriate and effective method developed towards the final phase of the SAFGRAD project was: the use of better adapted cowpea cultivars sown in mid-July (northern Guinea and Sudan savannas) or at the onset of the rainy season (Sahel) along with two or three insecticide sprays at critical growth stages. It was termed as "Minimum Insecticide Treatment" as opposed to 4-7 sprays. The minimum insecticide treatment consists of Deltamethrine(R) spray at 12g a.i./ha at flower bud formation to control flower thrips and a mixture of Deltamethrine(R) and Dimethoate(R) at 400g a.i./ha sprayed at pod formation (pods well visible). A third spray with Sisthoate(R) at 400g a.i./ha was necessary anytime there was Aphids infestation on the crop. The insectides were selected on the basis of their low cost price and not very dangerous for use under farmers' conditions.

Bruchids (*Callosobruchus maculatus*) were found to be disastrous to stored cowpea. Infestations start in the field prior to harvest and go on during storage. Nearly 100% damage on cowpea grain stored for 3 months after harvest have been recorded (IITA-SAFGRAD Annual Reports, 1979, 1980, 1981). Whereas less than 50% damages were noticed for cowpea stored with pods.

Biological tests conducted both in the fields and laboratories permitted the validation of some sources of insect pest resistances identified at IITA, Ibadan and a further discovery of new sources under semi-arid conditions (IITA-SAFGRAD Annual Reports, 1980, 1981). The insect pest resistant sources validated or newly identified were as follows.

- Aphids: TVu36, TVu 2896, TVu3000.
- Bruchids: TVu 2027.
- *Maruca*: Kamboinse Local Rouge and TVu946.
- Thrips: TVu1509 and TVx3236, at a low level.

This information enabled the cowpea breeder to embark on breeding projects for insect pest resistances and a combination of other good attributes searched for, such as multiple disease, drought and *Striga* resistances as well as good quality grain, etc.

2.2.b) Workshops, regional trials, cowpea monitoring tours and training

The above-cited activities were carried out side-by-side with the resident research work. They were geared towards facilitating the disemination of scientific information and transfer of new technologies from IITA-Ibadan in Nigeria and IITA-SAFGRAD, Burkina Faso, to NARS and from one NARS to the other.

Workshops: NARS and IITA scientists of various disciplines met yearly beginning 1980-1985 to discuss their research findings and their implications on cowpea production in semi-arid Africa. Based on promising technologies exposed during the workshops, regional trials were designed and put at the disposal of NARS for request and obtention.

Regional trials:Regional trials were seen as the most appropriate vehicle for transferring new technologies from IITA-Ibadan, IITA-SAFGRAD, Burkina Faso, to NARS and from one NARS to the other. Cowpea varieties and cultivars nominated for regional trials from 1980 to 1986 by both NARS and IITA scientists are listed in Table 2.2. The number and diversity of varieties and cultivars nominated by NARS went down yearly, thus reflecting the weakness of NARS agricultural research capabilities. A summary of regional cowpea variety trials sent out from 1980 to 1986 to national programs is given in Table 2.5. Similarly, regional cowpea agronomy and entomology trials are contained in Tables 2.6 and 2.7, respectively.

Cowpea Monitoring Tours: A team of 4-8 national scientists from various disciplines toured 3 to 6 countries each year to see the performance of cowpea varieties and other technolgies in the SAFGRAD member countries' regional trials. They also got acquainted with cowpea production constraints and production technologies of the host countries. The overall objective was to inject new research ideas in the national scientists, so that once back in their home countries, they could improve their working efficiency.

Training: During SAFGRAD Phase-I, the IITA-SAFGRAD cowpea team in Burkina Faso carried out an in-service training course for junior scientists and technicians. A minimum of 3 people (one person under the supervision of each of the three IITA/SAFGRAD scientists) participated yearly at a 6-month (June-November) practical course, working in the field experimental plots and laboratories at Kamboinse, Burkina Faso. They were involved in planning, implementing, conducting and harvesting trials and recording the data. This was aimed at improving research data gathering and processing for a better interpretation of results.

Table 2.5. IITA-IDRC-SAFGRAD Phase-I Cowpea breeding regional trials dispatched and feedback returned from national programs from 198O-1986.

Country	198O		1981		1982		1983			
	Semi-arid cowpea variety trials		Semi-arid cowpea variety trials		Semi-arid cowpea variety trials		Regional medium maturing var.trial		Regional early maturing cowpea variety trials	
	Sets dispatched	Feedback received	Sets dispatched	Feedback received	Sets dispatched	Feedback received	Sets dispatched	Feedback received	Sets dispatched	Feedback received
Benin	2	1	-	O	-	O	2	O	2	O
Botswana	2	O	-	O	-	O	1	O	2	O
Burkina Faso	3	3	-	3	-	3	3	3	3	3
Cameroon	2	2	-	1	-	O	O	O	O	O
Cape Verde	O	O	-	O	-	O	O	O	O	O
Central Afr.R	O	O	-	O	-	O	O	O	O	O
Chad	1	O	-	O	-	O	O	O	O	O
Côte d'Ivoire	O	O	-	O	-	O	O	O	O	O
Ethiopia	O	O	-	O	-	O	1	1	1	1
The Gambia	1	1	-	O	-	O	O	O	2	1
Ghana	1	O	-	O	-	1	2	1	O	O
Guinea Bissau	O	O	-	O	-	O	O	O	O	O
Guinea Conakry	2	O	-	2	-	2	2	1	2	O
Kenya	O	O	-	O	-	O	1	O	1	O
Mali	2	2	-	3	-	3	2	2	2	1
Mauritania	1	O	-	1	-	O	1	O	2	1
Niger	1	1	-	O	-	1	2	1	1	1
Nigeria	3	1	-	2	-	3	3	2	O	O
Senegal	2	O	-	4	-	4	2	2	2	2
Sierra Leone	O	O	-	O	-	O	O	O	O	O
Somalia	O	O	-	1	-	O	O	O	1	O
Togo	O	O	-	1	-	1	1	1	1	1
Tanzania	O	O	-	O	-	O	1	O	1	O
Zambia	O	O	-	O	-	O	1	O	1	O
Zimbabwe	O	O	-	O	-	O	1	O	1	O
Total	**23**	**11**	**33**	**18**	**31**	**18**	**26**	**14**	**25**	**11**

Table 2.5. (cont'd-1) IITA-IDRC-SAFGRAD Phase-I Cowpea breeding regional trials dispatched and feedback returned from national programs from 1980-1986.

Country	1984				1985			
	Cowpea trial for drought		Cowpea *Striga* resistance trial		Cowpea variety trial for drought resistance		Regional cowpea *Striga* resistances trial	
	Sets dispatched	Feedback received	Sets dispatched	Feedback received	Sets disptached	Feedback received	Sets dispatched	Feedback received
Benin	-	1	O	O	3	3	2	2
Botswana	-	O	O	O	O	O	O	O
Burkina Faso	-	2	2	2	4	4	2	2
Cameroon	-	O	O	O	1	O	1	O
Cape Verde	-	1	O	O	O	O	O	O
Centr.Afr. Rep.	-	O	O	O	O	O	O	O
Chad	-	O	O	O	O	O	O	O
Côte d'Ivoire	-	O	O	O	O	O	O	O
Ethiopia	-	O	O	O	1	O	O	O
The Gambia	-	1	O	O	2	1	O	O
Ghana	-	O	O	O	O	O	O	O
Guinea Bissau	-	O	O	O	O	O	O	O
Guinea Conakry	-	1	O	O	2	O	O	O
Kenya	-	O	O	O	O	O	O	O
Mali	-	3	1	1	4	2	2	2
Mauritania	-	1	O	O	1	O	O	O
Niger	-	O	1	O	2	1	2	2
Nigeria	-	3	3	3	3	3	3	1
Senegal	-	O	O	O	O	O	O	O
Sierra Leone	-	O	O	O	O	O	O	O
Somalia	-	O	O	O	O	O	O	O
Togo	-	1	O	O	1	1	O	O
Tanzania	-	O	O	O	O	O	O	O
Zambia	-	O	O	O	O	O	O	O
Zimbabwe	-	O	O	O	O	O	O	O
Total	**29**	**14**	**7**	**6**	**24**	**15**	**12**	**9**

Table 2.5. (cont'd-2) IITA-IDRC-SAFGRAD Phase-I Cowpea breeding regional trials dispatched and feedback received from national programs from 1980-1986.

Country	1986			
	Cowpea variety trial for		Cowpea *Striga*	
	Sets dispatched	Feedback received	Sets dispatched	Feedback received
Benin	-	0	-	0
Botswana	-	0	-	0
Burkina Faso	-	4	-	2
Cameroon	-	0	-	0
Cape Verde	-	1	-	0
Centr.Afr. Rep.	-	1	-	0
Chad	-	1	-	0
Côte d'Ivoire	-	0	-	0
Ethiopia	-	0	-	0
The Gambia	-	0	-	0
Ghana	-	1	-	1
Guinea Bissau	-	0	-	0
Guinea Conakry	-	0	-	0
Kenya	-	0	-	0
Mali	-	0	-	0
Mauritania	-	0	-	0
Niger	-	1	-	1
Nigeria	-	0	-	0
Senegal	-	0	-	0
Sierra Leone	-	0	-	0
Somalia	-	0	-	0
Togo	-	1	-	0
Tanzania	-	0	-	0
Gambia	-	0	-	0
Zimbabwe	-	0	-	0
Total	**26**	**10**	**11**	**4**

Table 2.6. IITA-SAFGRAD Phase-I Cowpea agronomic trials dispatched and feedback received from national programs from 1983-1986 *.

Country	1983		1984				1985			
	Maize-cowpea-relay cropping		Management trial		Maize-cowpea relay cropping		Management trial		Maize-cowpea-relay cropping	
	Sets dispatched	Feedback received	Sets dispatched	Feedback received	Sets dispatched	Feedback received	Sets dispatched	Feedback received	Sets dispatched	Feedback received
Benin	-	-	-	-	-	-	1	1	1	1
Botswana	-	-	-	-	-	-	-	-	-	-
Burkina Faso	-	-	-	-	-	-	-	-	-	-
Cameroon	-	-	-	-	-	-	1	0	1	0
Cape Verde	-	-	-	-	-	-	-	-	-	-
Centr.Afr.Rep.	-	-	-	-	-	-	-	-	-	-
Chad	-	-	-	-	-	-	-	-	-	-
Côte d'Ivoire	-	-	-	-	-	-	-	-	-	-
Ethiopia	-	-	-	-	-	-	-	-	-	-
The Gambia	1	0	-	-	1	1	1	1	1	1
Ghana	1	1	-	-	1	0	-	-	-	-
Guinea Bissau	-	-	-	-	-	-	-	-	-	-
Guinea Conakry	-	-	-	-	-	-	-	-	-	-
Kenya	-	-	-	-	-	-	-	-	-	-
Mali	1	0	1	1	1	0	1	0	-	-
Mauritania	-	-	-	-	-	-	-	-	-	-
Niger	-	-	-	-	-	-	-	-	-	-
Nigeria	1	0	-	-	1	1	-	-	1	0
Senegal	1	1	-	-	-	-	-	-	-	-
Sierra Leone	-	-	-	-	-	-	-	-	-	-
Somalia	-	-	-	-	-	-	-	-	-	-
Tanzania	-	-	-	-	-	-	-	-	-	-
Togo	1	1	-	-	1	1	-	-	1	1
Zambia	-	-	-	-	-	-	-	-	-	-
Zimbabwe	-	-	-	-	-	-	-	-	-	-
Total	**6**	**3**	**1**	**1**	**5**	**3**	**4**	**2**	**5**	**3**

* Regional cowpea agronomic trials for soil fertility management (10 sets), sowing date management (15 sets) and maize-cowpea-relay cropping (10 sets) were dispatched to member countries in 1980. Feedback was, however, not recorded.

Table 2.7. IITA-SAFGRAD Phase-I Cowpea agronomic trials dispatched and feedback received from national programs from 1980-1986

Country	1980				1981				1982			
	Standardized sampl. methods		Minimum insecticide		Sampling methods		Minimum insectide		Sampling methods		Minimum insecticide	
	Sets sent out	Feedback received	Sets sent out	Feedback received	Sets sent out	Feedback received	Sets sent out	Feedback received	Sets sent out	Feedback received	Sets sent out	Feedback received
Benin	-	-	1	0	-	-	-	-	1	0	-	-
Botswana	-	-	-	-	-	-	-	-	-	-	-	-
Burkina Faso	1	1	1	1	3	3	-	-	1	0	-	-
Cameroon	1	0	1	0	-	-	1	1	1	0	-	-
Cape Verde	-	-	-	-	-	-	-	-	-	-	-	-
Centr.Afr. Rep.	-	-	-	-	-	-	-	-	-	-	-	-
Chad	-	-	-	-	-	-	-	-	-	-	-	-
Côte d'Ivoire	-	-	-	-	-	-	-	-	-	-	-	-
Ethiopia	-	-	-	-	-	-	-	-	-	-	-	-
The Gambia	-	-	-	-	-	-	-	-	1	0	-	-
Ghana	1	0	1	0	-	-	-	-	-	-	-	-
Guinea Bissau	-	-	-	-	-	-	-	-	-	-	-	-
Guinea Conakry	1	1	1	0	-	-	-	-	-	-	-	-
Kenya	-	-	-	-	1	1	-	-	-	-	-	-
Mali	1	0	1	0	-	-	-	-	-	-	-	-
Mauritania	1	0	1	0	-	-	-	-	-	-	-	-
Niger	-	-	1	0	-	-	-	-	-	-	-	-
Nigeria	-	-	-	-	8	1	-	-	1	0	-	-
Senegal	-	-	1	1	2	2	1	1	1	0	1	1
Sierra Leon	-	-	-	-	-	-	-	-	-	-	-	-
Somalia	-	-	-	-	-	-	-	-	-	-	-	-
Tanzania	-	-	-	-	-	-	-	-	-	-	-	-
Togo	-	-	-	0	1	1	-	-	-	-	-	-
Zambia	-	-	-	-	-	-	-	-	-	-	-	-
Zimbabwe	-	-	-	-	-	-	-	-	-	-	-	-
Total	**6**	**2**	**9**	**2**	**15**	**8**	**2**	**2**	**6**	**0**	**1**	**1**

Table 2.7. (cont'd) IITA-SAFGRAD Phase-I Cowpea entomological trials dispatched and feedback received from national programs from 1980-1986.

Country	1983		1984		1985		1986	
	Minimum insecticide		Minimum insecticide		Minimum insecticide		Minimum insecticide	
	Sets sent out	Feedback received	Sets sent out	Feedback received	Sets sent out	Feedback received	Sets sent out	Feedback received
Benin	1	0	-	-	1	0	-	-
Botswana	-	-	-	-	-	-	-	-
Burkina Faso	1	1	6	6	5	5	-	4
Cameroon	-	-	1	0	-	-	-	-
Cape Verde	-	-	-	-	-	-	-	-
Central Afr. Rep.	-	-	-	-	-	-	-	-
Chad	-	-	-	-	-	-	-	-
Côte d'Ivoire	-	-	-	-	-	-	-	-
Ethiopia	-	-	1	0	1	0	-	-
The Gambia	1	0	-	-	1	1	-	-
Ghana	-	-	1	1	1	1	-	1
Guinea Bissau	-	-	-	-	-	-	-	-
Guinea Conakry	-	-	-	-	-	-	-	1
Kenya	-	-	1	-	-	-	-	-
Mali	-	-	-	-	-	-	-	-
Mauritania	-	-	-	-	-	-	-	-
Niger	1	1	1	0	2	2	-	1
Nigeria	-	-	1	1	-	-	-	-
Senegal	1	1	1	0	-	-	-	-
Sierra Leone	-	-	-	-	-	-	-	-
Somalia	-	-	-	-	-	-	-	-
Tanzania	-	-	-	-	-	-	-	-
Togo	1	1	1	1	1	1	-	1
Zambia	-	-	-	-	-	-	-	-
Zimbabwe	-	-	-	-	-	-	-	-
Total	**6**	**4**	**14**	**9**	**12**	**10**	**16**	**8**

III

RENACO Contribution to Strengthening National Programs

3.1. Introduction

From the laudable scientific breakthroughs of the SAFGRAD Phase I research activities, it was unanimously agreed at two workshops held at Ouagadougou, Burkina Faso on 23-27 February 1987 and from 23-27 March 1987 by national directors of agricultural research, together with their national cowpea scientists of West and Central Africa as well as Regional and International Research Centres that the SAFGRAD project should be extented into a second phase. USAID again agreed funding the project under the auspices of the Organization of African Unity, Scientific, Technical and Research Commission (OAU/STRC).

Phase-II of the SAFGRAD cowpea research project had a primary objective of boosting the initiative and capacity of national scientists to solve cowpea production and direct cowpea research activities themselves in the sub-region in the not-too-distant future.

In order to prepare the foundation for the eventual take over of cowpea research activities by national scientists, a collective venture on cowpea research was established by SAFGRAD-IITA during the March 1987 workshop. It involved 18 countries: Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Côte d'Ivoire, The Gambia, Ghana, Guinea Bissau, Guinea Conakry, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo and bore the name "West and Central Africa Cowpea Collaborative Research Network (RENACO)". Cowpea production constraints, research personnel, infrastructure as well as research strengths and weaknesses of the individual national programs were examined and discussed. The needs, researchable topics and the state of art of cowpea research in West and Central Africa were also enumerated and discussed.

The national directors of research and cowpea scientists were sincere in appraising their individual country's research capabilities. They were convinced that the network exercise was the most feasible solution to tackling common cowpea production constraints by sharing scientific information and technologies developed from this effort or by other regional and international agricultural research centres. The idea of networking was therefore, acclaimed with enthusiasm.

A Steering Committee comprising of six national cowpea scientists of various disciplines was elected during the March 1987 workshop. The major responsibility of the Steering Committee stipulated in the recommendations of the February 1987 workshop of the Directors of agricultural research, was to preside over all decisions relating to the cowpea network activities. The implementation of the decisions taken is carried out by the IITA seconded Network Coordinator and member of the Committee.

Strengthening NARS through RENACO efforts was accomplished in this order:

- Bi-annual Steering Committee meetings;
- Collaborative research activities;
- Training programs for cowpea senior scientists (monitoring tours and seminar sessions), junior scientists and technicians (monitoring tours and group training sessions).
- Regional trials;
- Visits to national programs by RENACO Coordinator, IITA and/or selected NARS scientists.
- Financial assistance to NARS.

3.2. Cowpea steering committee meetings

In accordance with the recommendations of the African Directors of Agricultural Research during the workshop of February 1987, all decisions relative to the cowpea network were taken during the bi-annual meetings of the Steering Committee. Since March 1987, the Steering Committee met 11 times as shown in Table 3.1.

Important decisions taken by the Steering Committee can be enumerated as follows:

- Identification of common cowpea production constraints in the sub-region.

- Evaluation of the strengths and weaknesses of the participating member countries.

- Prioritization of researchable topics to overcome production constraints.

- Assignment of research responsibilities for technology development to relatively strong NARS known as RENACO Lead Centers. The main role of the Lead Centers is the development of technologies of interest to their respective countries with a spill over to other member countries.

- Yearly review and approval of research workplans before the commencement of the crop season and inspection of progress reports furnished by Lead Centers at the end of crop season.

- Review and approval of new technologies nominated by IITA scientists, RENACO Lead Centers, and any others for regional trials and designing such trials during the cowpea bi-ennial workshops.

Table 3.1. RENACO Steering Commitee Meetings held since 1987-1992

Date	Venue	Number of Attendance	Absent	Observers*
26-27 March, 1987	Ouagadougou (Burkina Faso)	7	0	10
9-12 Nov., 1987	Ouagadougou (Burkina Faso)	6	1	8
28-31 March, 1988	Ouagadougou (Burkina Faso)	5	2	9
7-11 Nov., 1988	Zaria (Nigeria)	7	0	6
23-24 March, 1989	Lome (Togo)	7	0	5
6-10 Nov., 1989	Ouagadougou (Burkina Faso)	7	0	6
26-30 March, 1990	Ouagadougou (Burkina Faso)	5	2	4
5-9 Nov., 1990	Cotonou (Benin)	7	0	7
13-14 March, 1991	Niamey (Niger)	7	0	2
11-14 Nov, 1991	Ouagadougou (Burkina Faso)	7	0	5
19-21 May, 1992	Ouagadougou (Burkina Faso)	5	2	5

* Observers include senior scientists and administrators from IITA Headquarters, Ibadan, Nigeria; Officials of the OAU-STRC, Lagos, Nigeria; Officials from the SAFGRAD Coordination Office and USAID, Ouagadougou; Other donors and host country officials.

- Allocation of financial support and small research equipment and material to NARS.

- Planning visits for the Coordinator and other NARS scientists to different member countries.

- Planning the bi-ennial cowpea monitoring tours and workshops.

- Planning cowpea seminars and group training sessions, etc.

3.3. Collaborative research activities

With the termination of the IITA-SAFGRAD resident research activities in Burkina Faso in 1987, coupled with the pressing needs for new technologies to overcome cowpea production constraints and boost its production in the sub-region, the RENACO Steering Committee felt that it was imperative for technology development research activities to be continued. Participating member countries were, therefore, urged to assume that responsibility directly to step up their research output both in quantity and quality. In order not to spread itself thin and to be cost effective, the RENACO Steering Committee adopted a strategy of assigning technology development research responsibilities to relatively strong NARS in research areas for which they have a comparative advantage and of primary intrest to their home countries. Scientific information and new technologies thereby generated are put at the disposal of other member countries. Technology adaptation research activities are carried out by individual member countries.

3.3.1. Research responsibilities

Technology development research responsibilities assigned to the relatively strong NARS known as Lead Centers are as below:

Burkina Faso: Breeding for drought, *Striga*, insect pest and disease resistance. Entomology and pathology (including viral diseases) for the three ecological zones of semi-arid West Africa.

Cameroon: Cowpea storage including the control of storage insect pests.

Ghana: Breeding for adaptation to humid, sub-humid and transition zones. Cowpea entomology for above zones.

Niger: Breeding for drought, *Striga* and *Microphomina spp.* diseases. Agronomic studies (millet-cowpea intercropping) and cowpea pathology (*Macrophomina spp*) for the Sahelo-Sudanian zones.

Nigeria: Breeding for drought, *Striga*, *Alectra*, insect pests and disease resistances. Cowpea agronomy, pathology (including scab, brown blotch, *Septoria* leaf spot, *Striga* and *Alectra*) as well as entomology for the three ecological zones of semi-arid West Africa. Studies include the mode of inheritance of diseases, *Striga* and *Alectra* resistances in cowpea.

Senegal: Breeding for drought, insect pests and disease resistance. Cowpea entomology for the Sahelo-Sudanian zones.

Owing to variation in *Striga* strains, two countries: **Benin** and **Mali** were assigned the responsibilities of validating research results obtained by Lead Centers and IITA for *Striga* resistance since 1990.

After a review of the performance of the RENACO Lead Centers at Niamey, Niger, in March, 1991, the responsibility for cowpea entomology initially assigned to Senegal was withdrawn by the RENACO Steering Committee. This was due to the fact that the Cowpea Entomologist, Dr. B. Bal who left the National Program was not replaced. It was therefore, felt that Senegal would not be able to discharge the assignment properly in the absence of an entomologist.

3.3.2) <u>Implementation of collaborative research activities</u>

Each RENACO Lead Center discharges its collaborative research duty by developing a number of research projects yearly since 1988 and which of course must be of interest to its national program and the results of which are reported together with other RENACO countries for common interests. Research projects carried out by Lead Centers since 1988-1991 are enumerated in Table 3.2.

In addition, some important work on biological constraints of interest to RENACO, such as *Striga*, insect pests and thrips control have been published by NARS and IITA scientists (Singh & Emechebe 1990, Bal 1991, Toure 1991). The work was carried out in accordance with the Network assigned responsibilities to NARS scientists, namely, Emechebe of Nigeria and Bal of Senegal.

3.4. Training Programs

One of the major cowpea production constraints identified during SAFGRAD Phase-I which was validated during the March 1987 Workshop of cowpea scientists was "insufficient number of skilled scientists, technicians and extension workers" in the sub-region. This, together with financial difficulties were the causes of the weaknesses of technology development activities of NARS. This handicap is evidenced by the low number of varieties or cultivars nominated by NARS for regional trials during SAFGRAD-I, which

Table 3.2. Research projects carried out by RENACO Lead and Associate Centers.

Country	1988*			1989			1990			1991		
	P	C	Report	P	C	Report	P	C	Report	P	C	Report
<u>**Benin (Assoc.C)**</u>												
Validation studies for *Striga* resistance in coastal zones				x	x	Yes	x	x	Yes	x	x	Yes
<u>**Burkina Faso**</u>												
1) Breeding for adaptation to Sahel, Sudan & Northern G. savannas	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
2) Breeding for *Striga* resistance	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
3) Breeding for Bruchids resistance	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
4) Breeding for Aphids, bruchids, *Striga* resistance and adaptation to Sahel, Sudan & N.Guinea savannas	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
5) Entomological studies including insecticide screening	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
6) Virological studies including screening cowpea for resistance	x	x	No	x	x	No	x	x	No	x	x	Yes
<u>**Cameroon**</u>												
1) Use of botanical products in cowpea storage	x	x	Yes	x	x	Yes	x	x	Yes	x	x	No
2) Use of solarisation in sterilization of cowpea weevils	x	x	Yes	x	x	Yes	x	x	Yes	x	x	No
3) Study of low input storage containers and facilities	x	x	Yes	x	x	Yes	x	x	Yes	x	x	No
4) Screening cowpea for pod and seed resistance to cowpea weevils	x	x	Yes	x	x	Yes	x	x	Yes	x	x	No

* P = planned; C = completed; X = effected; - not effected

Table 3.2. (cont'd-1): Research projects carried out by RENACO Lead and Associate Centers.

Country	1988*			1989			1990			1991		
	P	C	Report	P	C	Report	P	C	Report	P	C	Report
Ghana												
1) Breeding for adaptation to transition zones							x	x	Yes	x	x	No
2) Cowpea entomology for transition zones including storage studies							x	x	Yes	x	x	No
Mali (Assoc. Center)												
1) Validation test for *Striga* resistance in the Sahel and Sudan Savanna							x	x	Yes	x	x	Yes
Niger												
1) Breeding for adaptation to Sahel and Sudan savanna	x	x	Yes	x	x	No	x	x	Yes	x	x	No
2) Screening cowpea for *Striga* resistance	x	x	Yes	x	x	No	x	x	Yes	x	x	No
3) Screening cowpea for ashy stem resistance	x	x	Yes	x	x	No	x	x	Yes	x	x	No
4) Pathology of *Macrophominas sp.*	x	x	Yes	x	x	No	x	x	No	x	x	No
5) Cowpea Agronomy	x	x	No	x	x	No	x	x	Yes	x	x	No
Nigeria												
1) Breeding for adaptation to Sahel, Sudan savanna and N. Guinea savannas	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
2) Breeding for *Striga*, *Alectra*, insect pests and disease resistance	x	-	-	x	-	-	x	-	-	x	x	Yes
3) Screening cowpea for scab, brown blotch and *Septoria* resistance	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
4) Study of inheritance of *Striga* resistance in cowpea	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes

Table 3.2. (cont'd-2): Research projects carried out by RENACO Lead and Associate Centers.

Country	1988*			1989			1990			1991		
	P	C	Report	P	C	Report	P	C	Report	P	C	Report
NIGERIA (Cont'd)												
5) Study of inheritance of *Alectra* resistance in cowpea				x	x	Yes	x	-	-	x	x	Yes
6) Cowpea cereals inter-cropping studies	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
7) Soil fertility studies	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
8) Weed science studies	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
Senegal												
1) Breeding for adaptation to Sahel and Sudan savannas	x	x	Yes	x	x	Yes	x	x	Yes	x	x	Yes
2) Cowpea entomology including insecticide screening	x	x	Yes	x	x	Yes	x	-	-	-	-	-

gradually fell down to zero as time went on. Thus, during the March 1987, none of the participating NARS was able to nominate a single new technololgy, variety or cultivar for regional testing. Under these circumstances, RENACO had no alternative than to embark on an aggressive training program. The objective of which, in compliance with the RENACO mandate, was to boost the iniative and capacity of national scientists to solve cowpea production constraints themselves, geared towards helping NARS, especially Lead Centers discharge their duties as effectively as possible. In this regard, RENACO did not relent its efforts and available means in organizing monitoring tours, workshops and group seminars and training sessions with the view of imparting new ideas in national scientists which will go a long way to improve on their skills and research outputs.

Unlike SAFGRAD-I during which training activities were directed to junior scientists and technicians, RENACO rather addressed its training efforts to the senior scientists. Of course a well trained senior scientist can have a multiplying effect, in the sense that he would not only increase the quantity and quality of his or her research outputs, but also makes him or her a capable resource person in offering on-the-spot training to the junior scientific personnel of his or her country's research program. This is not to say that junior scientists were neglected in the RENACO vast training campaign; relevant training courses were organized for the participation of junior scientists and technicians for countries without senior research staff.

A record of training activities by RENACO towards strengthening NARS is as follows.

3.4.1) <u>Cowpea monitoring tours</u>

The practical, powerful effect of imparting new ideas and useful interactions resulting from the field and laboratory visits were tapped by RENACO to impose a change of attitude of national scientists and technicians for a better approach to their local research responsibilities. Two monitoring tours were organized in 1988 and 1990. The tour in 1988 comprised of 6 NARS scientists from Burkina Faso, Cape Verde, Guinea Bissau, Guinea Conakry, Niger and Senegal. The host countries were Burkina Faso, Niger, Northern Nigeria and IITA facilities at Niamey, Niger as well as IITA headquarters, Ibadan, Nigeria. That of 1990 comprised of 9 NARS scientists from Benin, Burkina Faso, Cameroon, the Gambia, Ghana, Niger and Nigeria. The same countries as in 1988 were visited including IITA facilities at Kano, Nigeria.

Cowpea production constraints, research methodologies to overcome the constraints and available production technologies were exposed to the touring scientists during the two tours.

3.4.2) Workshops

Three workshops were convened by RENACO in 1987, 1989 and 1991. Unlike in SAFGRAD-I, where international scientists were the principal actors of workshop activities, national scientists have now been playing an important and increasing role in RENACO organized workshops since 1987.

The RENACO organized workshops were made up of two main components, dealing with (a) scientific information exchange and (b) technology exchange. The scientific information exchange being a continuous training program by RENACO to scientists of its member countries. Thus, the workshop serves as a forum in which NARS and IITA scientists can report their original and unpublished research findings in all aspects of cowpea research and the results are discussed together during the workshop. Fifteen papers were presented and discussed in the 1989 workshop at Lome, Togo (Fajemisin *et al.* 1989); and fourteen papers presented in 1991 at Niamey, Niger (proceedings being published by SAFGRAD Coordination Office).

The technology exchange component offers the opportunity to NARS and IITA scientists to present their research activities. Also reported are the results of previous years' regional trials, cowpea production constraints or other problems related to cowpea production as well as highlighting newly identified or developed technologies.The most promising technologies are nominated for regional trials, which are designed by the RENACO Steering Committee for acquisition upon request by national programs (Workshops proceedings 1987, 1989, 1991).

Fifty percent of the RENACO Steering Committee is also renewed during the workshop in order to maintain its continuity. Table 3.3 supplies details of workshops and monitoring tours organized by RENACO since 1987.

3.4. 3) <u>Seminars and Group Training Sessions</u>

Besides the two above informal training activities, RENACO organized two formal group training courses. One was held in November 1988 at IITA, Ibadan; it involved 12 scientists from RENACO Lead Center national programs made up of breeders, agronomists, pathologists and entomologists. Research topics delt with, were mainly on appropriate technologies for semi-arid West and Central Africa and methodologies used in developing them. In September 1989, another course was organized at Kamboinse, Burkina Faso, in collaboration with the national cowpea program (INERA) of that country. Ten scientists and technicians from Benin, Côte d'Ivoire, Guinea Bissau, Guinea Conakry, Mali and Niger participated. Course topics centered mainly on appropriate technology development and transfer with cowpea as an example. While the third one was organized in conjunction with the maize-sorghum collaborative research networks for West and Central Africa in January 1991 at IITA, Ibadan, Nigeria. Twenty agronomists from all the member countries, except Cape Verde, Côte d'Ivoire, The Gambia, Guinea Bissau, Sierra Leone and Togo participated. The obejective of the seminar was to improve the understanding of the low input technology strategy through close contact and discussions with specialists from international centers: IITA and ICRISAT as well as NARS. The course topics centered on low input technology strategies and appropriate technologies for semi-arid West and Central Africa and research methodologies used for their development.

A recapitulation of training courses including number of participants and number of countries involved is presented in Table 3.4. The proceedings of each training activity was published (Muleba & Emechebe 1988; Muleba & Detongon 1991; Muleba *et al.* 1992).

3.5. Regional Trials

Regional trials designed by RENACO and distributed to NARS since 1987 are given in Table 3.5 with regards to cultivars and Table 3.6 for cowpea agronomic and entomological trials. The regional trials for 1987 and 1988 came from IITA-Ibadan an IITA-SAFGRAD research efforts; no NARS contributed a new technology during those two years. Cultivars TN88-63 and Mougne listed for Niger and Senegal were infact nominated for regional testing in the early 1980's and were maintained in the system since then as control cultivars.

The 1989-90 and 1991-92 regional trials were the tangible results of RENACO efforts, especially from the training activities (monitoring tours, workshops and group seminars and training sessions) which stimulated NARS scientists interest and ability to solve cowpea production constraints by themselves. It is gratifying to note the increasing diversity of cultivars and the number of trials carried out. Thus, Burkina Faso was able to strive hard and nominated new cultivars for regional trials as early as 1989, whereas Niger, Ghana, Nigeria and Senegal managed to nominate cultivars for the first time in 1991. Nevertheless, the Institute of Agricultural Research (IAR), Samaru of Nigeria undertook the responsibility in 1987 and 1988 of screening all IITA cultivars included for international trials

Table 3.3. Workshop and Cowpea Monitoring Tours

	1987	1988	1989	1990	1991
Activity	Workshop	Tour	Workshop	Tour	Worksop
- Number	1	1	1	1	1
- Theme	Establishment of cowpea network for Central & West Africa	Scientific information & research methodologies exchange	Joint maize-cowpea workshop with two sub-components: . Scientific up-to-date . country reports	Scientific information & research methodologies exhange	Inter-network conference with the sub-components: . New frontiers of food grain research in the 1980's . Scientific up-to-date . Country Reports
No. of participants	30	6	43	9	44
No. of countries	18	6	16	7	16

Table 3.4. Training and Seminars organized by RENACO

	1988	1989	1990	1991
- Number	1	1	0	1
Theme	- State of research in West and Central Africa	- Experimentation agricole et transfert de technologie avec le niébé comme exemple	-	Shaping agronomic research in West and Central Africa (A joint maize, cowpea & sorghum networks Seminar).
No. of participants	12	10	-	20
No. of Countries	6	7	-	12

and further identified multiple disease resistant ones which were proposed to RENACO for regional testing in 1989 for adaptation to Sudanian-Sahelian and northern Guinea savanna zones (Table 3.5).

Regional agronomic and entomological trials, issue of IITA-SAFGRAD efforts were distributed only in 1987-88 (Table 3.6). Since then, RENACO has been encouraging through its training activities for NARS to strengthen their research activities in those areas, including pathology.

The total number of regional trials distributed to NARS and feedback received since 1987-1991 are presented in Tables 3.7, 3.8, and 3.9.

3.6. Visits to NARS Programs

Periodic visits were made to national programs during the crop season or for technical consultation either by the RENACO Coordinator, Steering Committee members or IITA cowpea scientists as shown in Table 3.10. The objectives of the visits were to permit visiting scientists to get acquainted with cowpea production constraints and other problems as well as production technologies and research work being carried out in the host countries. This, to afford them the opportunity to be able to guide RENACO as to the appropriate actions to be taken to better serve NARS. The visits also offered an informal and on-the-spot training opportunity to national scientists, technicians and support staff of the visited countries through the observations and discussions held in the fields or laboratories.

Table 3.5. Cowpea cultivars nominated in RENACO regional trials

Name of Trial	1987-88		1989-90		1991-92	
	Origin	Cultivars	Origin	Cultivars	Origin	Cultivars
1) Regional *Striga* resistance	Niger Senegal IITA-Ibadan	TN88-63 Mougne Vita-5,IT82D-450-4, IT82D-479-1,IT82D-849	INERA Burkina	KVx396-11-6, Vx396-8-5, KVx396-6-1,KVx 4-4-2,KVx396-4-4-4,	INERA Burkina	KVx164-65-5, KVx291-47-222,KVx397-6-6, KVx402-5-2,KVx402-19-5,KVx305-118-31,B301
	IITA-SAFGRAD	KVx61-1,KVx61-2, KVx61-74,KVx65-114, KVx68-31-3,KVx183-1, B301, Gorom Local (Suvita-2)	IITA-SAFGRAD Burkina	B301,IT82D-849; IT82E-32 (Susceptible control) Gorom Local (Suvita-2)	IITA-Ibadan	IT81D-994,IT82D-849, IT82E-32,
			INRAN	TN93-80,TN121-90;	INRAN,Niger	TN5-78
2) Adaptation to Sahelian-Sudanian zones	Niger	TN88-63,	IITA-Ibadan through IAR Nigeria	IT85D-3517-2, IT85D-3516-2, IT85D-3577, IT83D-219;	INERA, Burkina	KVx396-4-5-2D,KVx164-41-64,KVx402-5-2, KVx402-19-5,KVx396-16-10-1, KVx396-18-10
	IITA-Ibadan	IT83S-343-5,IT81D-994,IT82D-699, IT84S-2137,IT83S-340-5;	IITA-Ibadan Niger	TVx3236 TN88-63 (control)	INRAN,Niger	KC85-7,KB85-18
					ISRA,Senegal	IS86-275N;B89-504N;
	IITA-SAFGRAD Burkina	KVx30-305-3G,KVx 60-K26-2,KVx60-P04-1,KVx61-1, KVx65-114,KVx183-1, KVx249-P37-30,KVx250-K27-18,KVx257-K21-3, KVx268-K03-3,KVx256-K17-11, Gorom Local (Suvita-2)	INERA Burkina Faso	KVx30-309-6G,KVx 396-4-4,KVx396-4-5,KVx396-18-10, KVx396-11-6;	IITA-ICRISAT IITA-Ibadan	ITN89E-4, IT89E-3, TVx3236

Table 3.5. cont'd-1 Cowpea cultivars nominated in RENACO regional trials.

Name of Trial	1987-88		1989-90		1991-92	
	Origin	Cultivars	Origin	Cultivars	Origin	Cultivars
3) Adaptation to northern Guinea savanna		None	IITA-Ibadan through IAR Nigeria	IT86D-1056, IT83D-213,	INERA, Burkina	KVx305-2-118-23-2, KVx305-118-31, KVx 402-5-2, KVx402-19-1, KVx398-7-1, KVx396-4-5-2D;
			INERA Burkina	KVx396-4-4, KVx396-18-10, KVx396-4-2, KVx 396-16, KVx396-4-5, KN-1 (Vita-7)	CR, Ghana	CR-06-07
					IAR, Nigeria	IAR7/180-4-5, IAR7/180-4-5-1;
					IITA-Ibadan	KN-1 (Vita-7) TVx3236;
4) Adaptation to transition zones		None	IITA-Ibadan	IT82E-32, IT82E-16 IT81D-1137, IT82D-885, IT84S-2246-4, TVx1999-01F;	CR, Ghana	CR-06-07
					IITA-Ibadan	IT86D-641, IT81D-1137, IT86D-444, IT85D-3577, IT82-16, IT82E-18, IT83S-818, IT82E-32
			INERA, Burkina	KVx396-4-4, KVx396-16;		
5) Observation Nursery		None		None	IITA-Ibadan	IT86D-719, IT86D-879-1, IT87D-697-2, IT86D-715, IT87D-885, IT89KD-374, IT89KD-245;
					INERA, Burkina	KVx164-41-64, KVx291-47-222, KVx295-2-124-99, KVx402-5-2, KVx295-2-124-51, KVx305-118-31
- Total number of cultivars		**33 cultivars**		**38 cultivars**		**58 cultivars**
- New cultivars		**18 cultivars**		**23 cultivars**		**35 cultivars**

Table 3.6. RENACO Research effort in regional cowpea agronomy and entomology trials.

Activity	1987	1988	1989	1990	1991
a) Agronomy					
1. Maize-cowpea relay cropping system					
. Number of treatments	20	6	-	-	-
. Number of sets	5	1	-	-	-
. Number of countries	3	1	-	-	-
2. Sorghum-cowpea intercropping system					
. Number of treatments	12	12	-	-	-
. Number of sets	6	3	-	-	-
. Number of countries	5	1	-	-	-
b) Entomology					
1. Minimum insecticide treatment					
. Number of treatments	10	-	-	-	-
. Number of sets	10	-	-	-	-
. Number of countries	8	-	-	-	-
Total number of technologies tested	32	18	-	-	-

Table 3.7. Regional Trials dispatched and feedback received from national programs in 1987-88.

Country	Drought resist.*		*Striga* resist.		Intercropping				Maize-cowpea relay		Observation nursery		Minimum insecticide		Total	
					Sorghum-cowpea		Millet-cowpea									
	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sents	Feedb. rec.	Sets sent	Feedb. rec.
Benin	2	2	0	0	2	0	0	0	0	0	2	2	2	0	8	4
Burkina Faso	3	2	3	2	2	2	0	0	2	2	2	2	3	3	15	13
Cameroon	0	0	1	0	1	1	0	0	1	0	0	0	1	1	4	2
Cape Verde	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1
Centr. Afr. Rep.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Chad	2	0	0	0	0	0	2	0	1	0	2	2	0	0	7	2
Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
The Gambia	1	0	0	0	2	0	2	0	0	0	1	0	1	1	7	1
Ghana	2	2	1	1	2	1	0	0	0	0	0	0	1	1	6	5
Guinea Bissau	1	0	0	0	1	0	0	0	0	0	1	0	0	0	3	0
Guinea Conakry	0	0	0	0	1	1	0	0	2	2	2	0	1	1	6	4
Mali	2	2	2	2	0	0	3	0	0	0	1	0	0	0	8	4
Mauritania	3	1	0	0	0	0	0	0	0	0	0	0	0	0	3	1
Niger	3	2	3	2	0	0	0	0	0	0	1	1	2	1	9	6
Nigeria	2	2	3	3	1	0	3	0	1	0	1	0	2	1	13	6
Senegal	2	0	0	0	1	0	1	0	0	0	2	0	2	2	8	2
Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Togo	0	0	0	0	2	2	0	0	1	1	2	2	0	0	5	5
Total	23	13	13	10	15	7	11	0	8	5	20	10	15	11	105	56

Table 3.8. Regional trials dispatched and feedback received from national programs in 1989-1990

Country	Northern Guinea savanna*		Sahelo-Sudan. zone		Transition zone		*Striga* resist.		Aphids resist.		Bruchids resist.		Virus resist.		Total	
	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.
Benin	1	1	0	0	0	0	2	2	0	0	0	0	0	0	3	3
Burkina Faso	1	1	1	1	0	0	0	0	1	1	1	1	1	0	5	4
Cameroon	1	1	1	1	0	0	0	0	0	0	1	0	1	0	4	2
Cape Verde	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
Centr.Afr. Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chad	0	0	1	1	0	0	1	1	1	1	1	1	1	0	5	4
Côte d'Ivoire	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
The Gambia	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Ghana	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Guinea Bissau	0	0	1	0	0	0	0	0	1	0	1	0	0	0	3	0
Guinea Conakry	0	0	0	0	3	2	0	0	3	2	4	2	3	0	13	6
Mali	0	0	0	0	0	0	3	3	0	0	1	1	0	0	4	4
Mauritania	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1
Niger	0	0	2	1	0	0	2	1	1	0	0	0	1	0	6	2
Nigeria	1	1	1	1	0	0	2	2	1	1	1	1	1	0	7	6
Senegal	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1
Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Togo	1	1	0	0	1	1	1	1	2	2	1	1	1	0	7	6
Total	**8**	**8**	**7**	**5**	**4**	**3**	**12**	**11**	**11**	**8**	**12**	**8**	**9**	**0**	**63**	**43**

Table 3.9. Regional trials dispatched and feedback received from national programs in 1991-1992

Country	Northern Guinea savanna*		Sahelo-Sudanian zone		Transition zone		*Striga* resistance		Observation nursery		Total	
	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.	Sets sent	Feedb. rec.
Benin	0	0	3	3	0	0	3	3	0	0	6	6
Burkina Faso	2	2	2	2	0	0	2	2	3	3	9	9
Cameroon	2	2	2	2	0	0	2	0	0	0	6	4
Cape Verde	0	0	0	0	0	0	0	0	2	1	2	1
Centr. Afr. Rep.	2	2	0	0	1	1	0	0	0	0	3	3
Chad	0	0	3	2	0	0	1	0	3	2	7	4
Côte d'Ivoire	1	1	0	0	1	1	0	0	0	0	2	2
The Gambia	2	2	0	0	0	0	0	0	0	0	2	2
Ghana	1	1	0	0	1	1	1	1	1	1	4	4
Guinea Bissau	2	0	0	0	2	0	0	0	1	0	5	0
Guinea Conakry	1	0	0	0	2	1	0	0	1	0	4	1
Mali	1	1	2	2	0	0	2	1	2	2	7	6
Mauritania	0	0	1	1	1	0	0	0	1	1	3	2
Niger	0	0	1	1	0	0	3	3	2	2	6	6
Nigeria	1	1	1	1	0	0	3	2	2	1	7	5
Senegal	0	0	0	0	0	0	1	0	3	0	4	0
Sierra Leone	0	0	0	0	3	2	0	0	0	0	3	2
Togo	2	2	0	0	1	1	2	1	0	0	5	4
Total	**17**	**14**	**15**	**14**	**12**	**7**	**20**	**13**	**21**	**13**	**85**	**61**

Table 3.10. Visits to NARS under RENACO efforts other than Monitoring Tours.

Year	Name of Scientist	Institution	Countries visited
1987	Muleba Nyanguila	RENACO, Coordinator	Burkina Faso, Guinea Conakry, Mali, Mauritania, Niger, Nigeria, Senegal and Togo.
1988	Muleba Nyanguila	RENACO, Coordinator	Burkina Faso, Cameroon, Cape Verde, Niger, Nigeria, Senegal, Tchad and Togo.
1989	H.W. Rossel K.F. Cardwell	IITA, Ibadan IITA, Ibadan	Burkina Faso, Niger, Nigeria, and Togo.
1989	Muleba Nyanguila	RENACO, Coordinator	Benin, Burkina Faso, Cameroon Côte d'Ivoire, Ghana, Guinea Bissau, Mali and Togo.
1989	Jean Detongnon	RENACO Steering Committee Member (Benin)	Cameroon
1990	O.O. Olufajo	RENACO Steering Committee Member (Nigeria)	The Gambia, Cape Verde.
1990	G. N'Toukam	RENACO Steering Committee Member (Nigeria)	Central African Republic, Tchad.
1990	Jean Detongnon	RENACO Steering Committee Member (Benin)	Niger
1990	Muleba Nyanguila	RENACO, Coordinator	Burkina Faso, Mali, Niger and Senegal.
1990	K.F. Cardwell	IITA, Ibadan	Benin, Burkina Faso, Niger, Nigeria and Togo.
1991	C. Dabire	RENACO Steering Comitee Member (Burkina Faso)	Ghana.
1991	O.O. Olufajo	RENACO Steering Committee Member (Nigeria)	Niger
1991	Muleba Nyanguila	RENACO, Coordinator	Burkina Faso, The Gambia, Ghana, Guinea Bissau, Mali and Niger.

3.7. Financial support to NARS

During the November 1987 meeting, the RENACO Steering Committee felt that agricultural research activities of all participating countries were the responsibilities of each country. However, RENACO was called upon to assist national programs as a supplement with either a small sum of money, material or equipment in order to ensure efficient discharge of their research activities. It is under this understanding that RENACO provided assistance to NARS as from 1987 to 1992 presented in Table 3.11.

Table 3.11. Assistance to National Cowpea Programs in cash and cash equivalent of materials/equipment ($) (1987-92)

Country	1987/88	1989	1990	1991	1992	Total
Benin	667	580	-	2,000	1,000	4,247
Burkina Faso	9,800	6,500	5,327	5,484	4,000	31,111
Cameroon	1,950	1,900	1,000	2,000	1,000	7,850
Cape Verde	700	600	-	580	604.2	1,880
Central Afr. Rep.	-	-	527	580	-	1,107
Chad	-	-	-	580	-	580
Côte d'Ivoire	-	585	527	580	604.2	2,296.2
Gambia	-	580	-	580	-	1,160
Ghana	-	580	1,928	2,000	1,000	5,508
Guinea	700	1,180	-	580	604.2	3,604.2
Guinea Bissau	700	600	-	580	-	1,880
Mali	-	-	1,909	2,000	1,079.6	4,988.6
Mauritania	-	600	-	580	-	1,180
Niger	1,950	-	1,000	2,000	-	4,950
Nigeria *	4,700	4,000	2,000	4,000	4,000	18,700
Senegal	2,923	2,923	2,862	2,000	1,000	11,708
Togo	-	600	-	-	-	600
Total	24,090	21,228	17,080	26,124	10,892.2	103,414.2

* Nigeria receives its financial assistance directly from IITA headquarters, Ibadan.

IV

Strategy for Cowpea Production

4.1. Traditional farming system

Production factors of traditional farming system include: land, labour, rainfall, propagules of farmers' cultivars, fallow and storage facilities. In order to obtain adequate food supply, ensuring food security of the farmer and his family, traditional farmers' strategy in semi-arid West and Central Africa, is to plant on a large piece of land as possible at the onset of the rains without ploughing the land. After all the planting has been done, weeds start emerging on the first planted fields, the farmer is automatically obliged to weed and scarify to eliminate weeds and to improve soil water infiltration.

Productivity in traditional farming system is a function of land availability and manpower, amount of rainfall and its distribution pattern, soil fertility which in itself depends on the quality and duration of the fallow period and the use of certain sporadic organic manure as well as yield ability of landrace varieties.

Landrace varieties are a mixture of different adapted and compatible genotypes. They do not have any maximum yield advantage, but rather a good population buffering capacity against environmental and weather hazards. Hence farmers' basic food security can be guaranteed. Propagules of landrace varieties are selected from each harvest for the next planting season. They are very often passed on from one farmer to another. Farmers produces are usually stored in three distinct parts: short, medium, and long-term uses. The short and medium storages being the daily food supply for the family from one harvest to another. The long-term or strategic storage is a provision for any eventualities, such as total crop failure due to bad weather or natural calamities. Thus, traditional farming is a recycling of farm resources for subsitence, but not at all, or little exportation or importation is done outside the farmers' residing area.

4.2. Modern farming

Production factors in modern agriculture are not significantly different from traditional farming system, except that the use of modern inputs, such as chemicals and organic fertilizers, pesticides and improved cultivars as well as farm machinery are used in production strategies. Also, though it may be used, the fallow, no longer plays a critical role in soil fertility restoration and its duration is considerably reduced in modern as compared to traditional farming systems.

Modern, including mechanized farming imposes socio-economic, cultural, and political changes in a society. For instance, a modern farmer should be able to read and write, calculate, measure risks, forsee consumer needs and requirements and take appropriate decisions as to what, how much, where and when to produce crop commodities with minimum risks of failure. The prospects of such a farmer is dependent on the quality and usefulness of the information he or she receives from agricultural research, extension services or agricultural input suppliers and marketing agencies as well as agricultural credit facilities and well defined government policies.

In summary, modern agricultural production strategy is a function of (i) quantity and quality of agricultural research outputs, (ii) the efficiency of the extension services in the transfer of new technologies, (iii) the availability of agricultural inputs as well as agricultural credit facilities assessible to farmers, (iv) marketing information and organizations, (v) government policies and finally, (vi) basic education for every farmer.

4.3. Shaping agricultural production strategy for peasant farmers in semi-arid Africa.

About 70-90% of the populations of the Semi-Arid African Regions are involved in agricultural production. The majority of these populations are illiterates. Thus, any attempt to move from the traditional to modern farming system will require a tremendous expenditure of money and energy on basic education. Why, because the farming population including other economic sectors will have to undergo a total change in their socio-economic, cultural and political practices to make room for such essential functions, like production, education/extension, supply, marketing, research and governance before a harmonious economic development in this region could be envisaged. Since this strategy cannot be achieved so soon, an alternative agricultural production strategy must be put in place. Such a strategy ought to bring an improvement in the productivity and production of traditional farming without imposing a major change in the behaviour and life style of traditional farmers.

An attempt to improve cowpea production in Semi-Arid Africa, using modern production strategy based on improved cultivars and new agricultural inputs, namely pesticides, ploughed and/or fertilized field plots, etc., from 1977-1982 did not seem to be appropriate for the resource-poor semi-arid African farmer presently. The IITA-SAFGRAD Cowpea Research Team in Burkina Faso decided, therefore, to adopt a new strategy based on genetically buffered cultivars to be introduced to farmers. Such cultivars must be drought, high heat, disease and *Striga* resistant and tolerate insect pests. Their yield must be the same or even better than traditional farmers cultivars under low input treatment, but significantly higher than the latter under high input treatment. Such cultivar will no doubt replace the traditional landrace varieties, if not for their low productivity.

The newly conceived strategy is compatible with current traditional farming system. A rapid improvement in the traditional farming system can be guaranteed if only farmers can have access to modern inputs. Quite apart a smooth transition from traditional to modern farming system can be assured.

The strategy was materialized for the first time in Burkina Faso with the development of the KVx396 line series in 1986-87 by the IITA-SAFGRAD Cowpea Research Team in Burkina Faso. The strategy is presently actively pursued by the national cowpea program of Burkina Faso since 1988. Other RENACO Lead Centers have also started applying it.

4.4. Conclusion

In SAFGRAD Phase-I, the Cowpea Research Team in Burkina Faso developed the necessary components of a strategy for modern cowpea production in Semi-Arid Africa. Its implementation was expected to increase cowpea productivity from 200 kg/ha to 1500 kg/ha. However, certain important investment in all the essential functions will have to be done in all the countries involved in the cowpea research network in order to attain a harmonious economic development, using this strategy.

It is clear that certain countries are not in a position at this point in time to undertake heavy investments in order to sustain modern cowpea production. Hence an alternative strategy was developed; it was based on injecting in traditional farming, new genetically, highly buffered cultivars. The strategy will, hopefully, emulate current traditional farming system, except for the low yield of landrace varieties. In addition, it will steadily transfer traditional to modern farming systems without imposing any radical changes in farmers life style. The strategies are currently being extended to NARS through the Cowpea Network efforts.

V

Impact of the West and Central Africa Cowpea Network (RENACO) on Cowpea Production in the Sub-Region

5.1. Introduction

Modern agriculture requires that mankind makes an effort to produce enough food stuffs, animal feed, fibre, wood and medications for its welfare without necessarily degrading the environmental resource base, the ecosystem. It is also correct to say that mankind is not only concerned about what it produces to ensure food supply in order to live, but also the sustainability of such production while safeguarding the ecosystem to which it belongs. Fortunately, the application of science offers the possibility of accomplishing this through the development of new and appropriate technologies.

Scientific investigations leading to the development of new and appropriate technologies are usually handled in this order:

i) New technologies said to be appropriate are evaluated against available local technologies (local germplasm) or obtained from neighboring countries or elesewhere (introduced technologies or germplasm). If they are not entirely satisfactory:

ii) A combination of these and any other available local or introduced technologies for agricultural practices (or a hybridization, breeding crosses, and a selection program for germplasms) to improve any deficiencies, is carried out. A reevaluation follows then. If proven satisfactory:

iii) A first test is carried out against commercially released technologies in a few selected experimental stations (preliminary trials).

iv) A further test is carried out against the best commercially released technologies in experimental stations in replicated and more precise trials. Note that commercial technologies are used in their areas of adaptation and exploitation. If the new technology purported to be appropriate is confirmed.

(v) A series of multilocational trials are then carried out in experimental stations and in farmers' fields: on-farm testings and on-farm demonstrations, all under both scientist and farmer supervisions.

(vi) The technology is then released if found acceptable and meeting farmers needs and requirements.

A breakdown of the technology development and transfer procedure is as follows:

a) Identification of potential and appropriate technologies (Steps i and ii).

b) Testing of new technologies: (Steps iii and iv).

c) Validation of the new technologies and identification of its geographical area of adaptation and/or recommendation domain (Step v multilocation trials).

d) Transfer of technologies: (step v: on-farm testings and demonstrations). And finally,

e) Release of the new techonolgy.

The identification of potential and appropirate technology phase is the most tedious part of scientific investigations.It demands a lot of hard work and extra zeal if any tangible results were to be obtained. This, among many others, includes exploration of the geographical areas for which the technology is intended, identification of production constraints, gathering information on farmers needs and requirements and selecting potential technologies that are likely to overcome the constraints and fitting farmers conditions and their acceptance.

This involves testing as many as possible, of new technologies and tunning the promising ones to the best of farmers appreciation as shown in Fig. 1.

The essence of networking is focused on mobilising NARS on the importance of technology experimentation and transfer. Therefore, the efforts of the Network, resulting in NARS increasing awareness of technology experimentation and transfer methodologies and their adherance to it, such as working in a group venture of technology development, constitute a positive impact on NARS.

The variables for measuring the impact of RENACO on participating NARS are at four levels as below:

Level 1: Changes in the performance of research institutions, human resources and policy environment for research.

Level 2: Changes in the output from research and development agents.

Level 3: Changes in the utilization of high yielding and sustainable agricultural technologies.

Level 4: Changes in the productivity, production and incomes.

The activities of RENACO in strengthening NARS synthesized in this report were extracted from the feedback received from NARS annual reports, visits of RENACO senior scientists to NARS and questionnaire information obtained from NARS scientists in 1991. An in-depth study, based on a sampling methodology conducted by a technical support team of USAID/SAFGRAD, has also reported the impact of the cowpea and other SAFGRAD networks elsewhere (Bezuneh *et al*. 1993, Sanders 1993, Schroeder 1993 and Scott 1993).

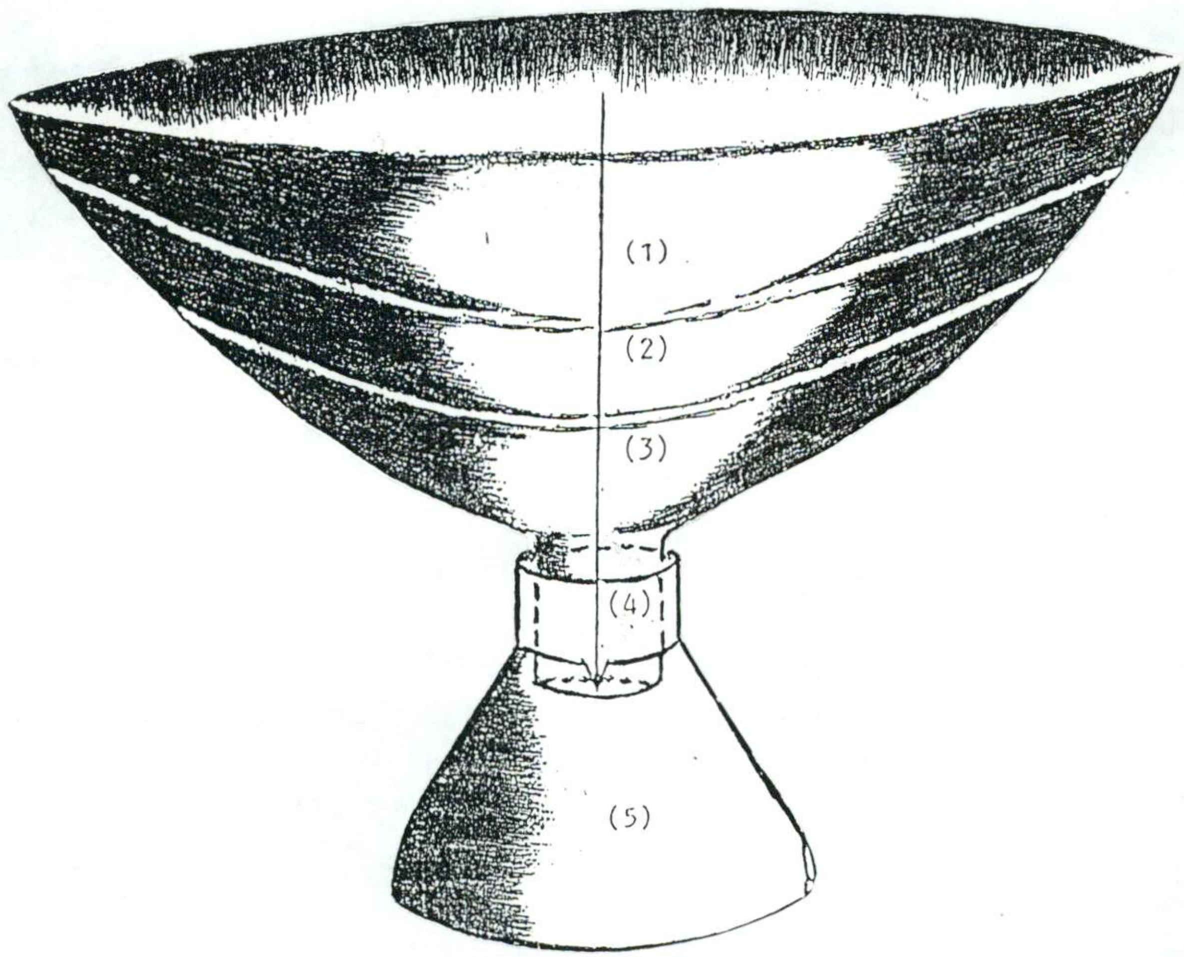

Figure 1. Flow of technologies from agricultural experimentation and their transfer to farmers' hands with germplasm as an example carried out in 5 distinct phases visualized as a funnel. With (1) identification of potential technologies (germplasm collection, introduction and evaluation; breeding crosses, breeding nurseries, line generation and evaluation); (2) Testing of new technologies (preliminary yield and advanced yield trials); (3) Validation of new technologies (multilocation trials); (4) Transfer of technologies (on-farm testings, both under scientist and farmer's supervision and on-farm demonstrations); (5) Release and commercial use of new technologies by farmers.

5.2. RENACO Impact on NARS (Level 1)

Changes in the performace of research institutions, human resources and policy environment for research are evidenced by:

5.2.1) Improvement in research output quantity and quality by RENACO Lead Centers

a) Adoption of new research methodologies and production technologies.

New research methodologies: (1) Use of sowing date in screening cowpea cultivars for adaptation to semi-arid zones; and (2) Use of a single seed descendant method for advancement of lines from F1 to F6 generations in about 3 years and for the development of new cultivars in about 7 years; and production technologies: Minimum insecticide application to protect cowpea against insect pests; were studied by the IITA-SAFGRAD cowpea research team during SAFGRAD Phase I. These and others were extended to NARS through seminars, group training sessions and regional trials. Some NARS have adopted them as given in Table 5.1.

b) RENACO Lead Centers Research Projects

All the RENACO Lead Centers have carried out their research projects satisfactorily (Table 3.2), with the view of identifying or developing new and appropriate technologies. The research projects have been reported in the SAFGRAD Maize-Cowpea Networks Annual Reports of 1988/89, 1989/90, and 1990/91. The projects followed the technology experimentation and transfer funnel model shown in Fig.1. An example is given for the Burkina research efforts on cowpea breeding since 1982-1991 (Table 5.2), cowpea agronomy from 1988-1991 (Table 5.3), cowpea entomology from 1988-1991 (Table 5.4), and cowpea pathology (Table 5.5). Similarly,

Table 5.1. Research methodologies and new technologies developed by the IITA/SAFGRAD cowpea research team in Burkina Faso prior to 1987 and extended by RENACO and accepted by NARS.

Description of research methodology and new technologies	Countries applying them	Year of first application
- Use of sowing dates in screening cowpea for adaptation to semi-arid zones.	- Burkina Faso	1988
	- Niger	1990
	- Nigeria	1991
- Use of a single seed descendant method for advancement of lines from F1 to F6 in less than 3 years and for the development of new varieties in less than 7 years.	- Burkina Faso	1988
- Minimum insecticide application to protect cowpea against insect pests	- Benin	1990
	- Burkina Faso, Cameroon,	1988
	- The Gambia, Guinea Conakry, Senegal and Togo	Prior to 1987
	- Niger, Nigeria	1989
- Maize-cowpea relay cropping and cereals-cowpea intercropping	- Benin, Cameroon, The Gambia, Ghana, Nigeria	Prior to 1987
	- Burkina Faso, Guinea Bissau, Guinea Conakry, Chad and Togo	1988
- Bio-test for screening cowpea for bruchids resistance	- Cameroon, Ghana,	Prior to 1987
	- Burkina Faso	1988
	- Guinea Conakry, Mali and Togo.	1989
- Bio-test for screening cowpea for aphids resistance	- Burkina Faso	1988
	- Ghana	Prior to 1987
- Tied ridges technique	- Cameroon and Mali	Prior to 1987
	- Burkina Faso	1988
- *Striga* resistance methodology*	- Mali, Niger and Nigeria	Prior to 1987
	- Burkina Faso	1988
	- Benin, Ghana, Senegal and Togo.	1990

*Mali, Niger and Nigeria developed independently *Striga* resistance methodologies but have also adapted those developed by the IITA-SAFGRAD research team in Burkina Faso.

Table 5.2. Cowpea Network. Flow of Germplasm in the national cowpea program of Burkina Faso: INERA

Activities	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1. Local gerplasm collection										
. Number	-	-	-	-	-	-	-	-	-	-
2. Local germplasm evaluation										
. Number of trials	2	-	-	-	-	-	2	2	1	3
. Number of entries	133	-	-	-	-	-	80	565	8	94
. Number of Locations	1	-	-	-	-	-	3	2	2	2
. Number of entries selected	47	-	-	-	-	-	19	15	1	26
3. Introduced germplasm										
3.1. IITA International Trials										
. Number of trials	1	9	4	3	5	-	4	3	1	-
. Number of entries	20	140	42	40	62	-	72	36	12	-
. Number of locations	1	2	5	6	6	-	3	1	2	-
. Number of entries selected	1	14	13	5	2	-	9	10	4	-
3.2 SAFGRAD-RENACO Reg. Trials §										
. Number of trials	2	3	1	2	2	-	-	2	-	-
. Number of entries	28	33	10	23	23	-	-	28	-	-
. Number of locations	5	6	5	6	6	-	-	3	-	-
. Number of selected entries	7	5	6	8	8	-	-	3	-	-
4. Breeding crosses										
. Number of crosses	7	11	-	-	-	-	-	-	17	32
. Number of lines generated	-	-	-	-	-	-	-	-	1750	-
5. Breeding nursery										
. Number of nurseries	4	5	2	2	2	1	3	-	3	4
. Number of entries	>2000	>6000	>1500	>1300	>1200	>500	3500	-	6990	2847
. Number of locations	2	1	1	1	1	1	2	-	3	3
. Number of selected entries	366	1816	361	260	224	100	655	-	1500	647
6. Preliminary yield trials										
. Number of trials	2	3	-	1	2	3	3	2	4	3
. Total number of entries	481	432	-	15	29	53	36	28	60	62
. Number of test locations	2	5	-	2	2	2	3	5	3	4
. Number of selected entries	6	17	-	4	8	19	12	12	19	19
7. Advanced yield trials										
. Number of trials	1	2	2	3	3	4	-	-	2	2
. Total number of entries	21	56	25	40	40	34	-	-	15	25
. Number of test locations	1	4	3	3	3	2	-	-	4	5
. Number os selected entries	3	3	7	12	12	10	-	-	5	3

Table 5.2. cont'd-1. Cowpea Network. Flow of Germplasm in the national cowpea program of Burkina Faso: INERA

Activities	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
8. Multiplication trials										
. Number of trials	-	1	2	-	-	-	-	-	-	-
. Total number of entries	-	12	22	-	-	-	-	-	-	-
. Number of test locations	-	2	3	-	-	-	-	-	-	-
. Number of selected entries	-	3	9	-	-	-	-	-	-	-
9. Elite variety trials										
. Number of trials	1	-	-	-	-	-	-	-	-	-
. Total number of entries	6	-	-	-	-	-	-	-	-	-
. Number of test locations	6	-	-	-	-	-	-	-	-	-
. Number of selected entries	3	-	-	-	-	-	-	-	-	-
Total germplasm tested	>2689	>6673	>1599	>1418	>1354	>587	>3688	657	7085	3028
10. Constraints tackled										
. Adaptation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
. Drought resistance	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
. **Insect pest resistance**										
.. Aphids	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
.. Thrips	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
.. *Maruca*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
.. Bruchids	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Viral disease & diseases of the Guinea savanna	N	N	N	N	N	N	Y	Y	Y	Y
. *Striga resistance*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
General adaptation without insecticide treatment	N	N	N	N	N	N	Y	Y	Y	Y
. Combined constraints resistance	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
. Intercropping with cereals	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
. Seed quality	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

§ The SAFGRAD Regional Trials conducted in 1989-91 by the Burkina national program were not reported by them.

Table 5.3. Cowpea Network: Research efforts deployed by the national cowpea program of Burkina Faso, INERA, in cowpea agronomy.

Activities	1988	1989	1990	1991
a) **Management of pure-stand**				
a.1) Sowing dates				
- Improved cultivars				
. Number of trials	–	1	–	–
. Number of treatments	–	6	–	–
. Number of locations	–	1	–	–
a.2) Plant population density				
. Number of trials	–	–	–	1
. Number of treatments	–	–	–	3
. Number of locations	–	–	–	4
a.3) Soil water management				
- Tied ridges				
. Number of trials	–	1	1	1
. Number of treatments		12	12	12
. Number of locations	–	1	1	1
- Integrated crop management				
. Number of trials	–	–	1	1
. Number of treatments	–	–	12	12
. Number of locations	–	–	1	1
b) **Mixed cropping**				
- Maize-cowpea relay cropping				
. Number of trials	–	1	1	1
. Number of treatments	–	10	10	10
. Number of locations	–	1	1	1
- Sorghum-cowpea intercropping				
. Number of trials	1	–	1	–
. Number of treatments	10	–	10	–
. Number of locations	2	–	1	–
- Millet-cowpea intercropping				
. Number of trials	–	1	1	–
. Number of treatments	–	5	10	–
. Number of locations	–	3	2	–
c) **On-farm verificative research**				
. Number of trials	2	–	–	–
. Number of treatments	12	–	–	–
. Number of locations	2	–	–	–
Total number of technologies tested	22	33	54	37

Table 5.4. Cowpea Network. Research efforts deployed by the national cowpea program of Burkina Faso, INERA, in the area of cowpea entomology.

Activities	1988	1989	1990	1991
1) Insect pest survey				
. Number of trials	3	1	1	1
. Number of insect studies	1	3	3	3
. Number of lcoations	3	1	1	4
2) Integrated pest management				
. Number of trials	-	1	1	1
. Number of treatments	-	9	9	9
. Number of locations	-	1	2	2
3) Chemical control				
. Number of trials	1	1	1	1
. Number of treatments	15	15	15	15
. Number of locations	1	1	1	1
4) Biological tests				
. Number of trials	3	7	2	3
. Number of treatments	91	77	30	71
. Number of locations	3	3	3	5
Total technologies tested	**107**	**104**	**57**	**98**

Table 5.5 . Cowpea Network. Research efforts deployed by the national cowpea program of Burkina Faso, INERA, in cowpea pathology.

Activities	1988	1989	1990	1991
1) **Disease survey**				
. Number of surveys	-	1	1	-
. Number of diseases	-	4	4	-
. Number of locations	-	6	6	-
2) **Yield losses due to diseases**				
. Number of trials	1	1	1	1
. Number of treatments	9	9	9	9
. Number of locations	2	2	2	2
3) **Biological tests for disease resistance**				
. Number of trials	2	-	-	-
. Number of treatments	35	-	-	-
. Number of locations	2	-	-	-
4) **Chemical control**				
. Number of trials	-	-	-	1
. Number of treatments	-	-	-	4
. Number of locations	-	-	-	1
Total technologies tested	**44**	**13**	**13**	**13**
1) **Viral disease survey**				
. Number of surveys	-	1	1	1
. Number of diseases(or treatments)	-	2	2	150
. Number of locations	-	4	4	1
2) **Yield losses due to diseases**				
. Number of trials	-	1	1	-
. Number of treatments	-	20	20	-
. Number of locations	-	1	1	-
3) **Biological tests for disease resistance**				
. Number of trials	1	2	2	-
. Number of treatments	16	36	36	-
. Number of locations	1	1	1	-
Total technologies tested	**1**	**1**	**1**	**-**

Nigeria carried out research work in the same order: Cowpea breeding (Table 5.6), agronomy (Table 5.7), entomology (Table 5.8) and pathology (Table 5.9).

c) **Technologies developed through RENACO efforts from 1987-1992**

RENACO Lead Centers have successfully identified or developed the folowing technologies, which include:

- *Striga* resistant cultivars identified by Benin, Burkina Faso and Niger (Table 5.10);

- Cultivars with good agronomic attributes developed or identified by Burkina Faso, Ghana, Niger, Nigeria and Senegal (Table 5.11).

Most of the cultivars listed (Tables 5.10 & 5.11) have been subjected to regional trials for adoption by other member countries. It should be noted that the contribution of NARS to regional trials declined nearly to zero from 1982-1987 (Tables 2.2 & 3.5). But an increase of over 80% was recorded from 1989-1991 after the inception of the Cowpea Network (Table 3.5).

The following countries contributed technologies to regional trials: Burkina Faso and Niger in 1989; Burkina Faso, Ghana, Niger, Nigeria and Senegal in 1991 (Table 3.5).

With the help of the US-Bean-CRSP project, Cameroon has developed a methodology for sterilizing cowpea for storage by the use of solarisation through white transparent and black plastic sheets. The sterilized cowpea can be stored in airtight double plastic bags or in traditional containers with 3 cm of ash on top of stored cowpea to prevent further reinfestation by bruchids (Bean/Cowpea CRSP/IRA-Cameroon Annual Report, 1990).

Table 5.6. Cowpea Network. Flow of Germplasm in the national cowpea program of Nigeria, IAR.

Activities	1987	1988	1989	1990	1991
1. Local germplasm collection					
. Number of acessions	-	-	-	-	-
2. Local germplasm evaluation					
. Number of trials	-	-	-	-	-
. Number of entries	-	-	-	1	-
. Number of locations	-	-	-	16	-
. Number of entries selected	-	-	-	1	-
3. Introduced germplasm					
3.1. IITA international trials					
. Number of trials	1	3	3	2	2
. Number of entries	5	41	37	17	18
. Number of locations	1	3	1	1	1
. Number of entries selected	2	2	10	5	8
3.2. SAFGRAD-RENACO Regional Trials					
. Number of entries	2	-	3	3	3
. Number of entries	25	-	33	33	36
. Number of locations	2	-	2	2	2
. Number of selected entries	3	-	10	12	12
4. Breeding crosses					
. Number of crosses	-	-	-	-	-
. Number of lines generated	-	-	-	-	-
6. Preliminary yield trials					
. Number of trials	1	1	1	1	1
. **Total number of entries**	**24**	**60**	**60**	**60**	**120**
. Number of test locations	2	2	2	2	2
. Number of selected entries	0	15	30	18	58
7. Advanced yield trials					
. Number of trials	1	2	3	2	4
. **Total number of entries**	**24**	**>20**	**57**	**40**	**55**
. Number of test locations	3	4	6	5	3
. Number of selected entries	2	3	20	16	1
9. Elite variety trials					
. Number of trials	2	-	-	1	1
. **Total number of entries**	**24**	-	-	**8**	**7**
. Number of test locations	3	-	-	4	4
. Number of selected entries	2	-	-	4	0
. **Total number of entries**	**102**	**121**	**187**	**158**	**236**
10. Constraints tackled					
. Adaptation	Y	Y	Y	Y	Y
. Drought resistance	Y	N	N	N	N
. Insect pest resistance					
.. Aphids	-	-	-	-	-
.. Thrips	-	-	-	-	-
.. *Maruca*	-	-	-	-	-
.. Bruchids	-	-	-	-	-
. *Striga* resistance	Y	Y	Y	Y	Y
. Combined constraints resistance	-	-	-	-	-
. Intercropping with cereals	-	-	-	-	-
. Seed quality	Y	Y	Y	Y	Y

Table 5.7. Cowpea Network. Research efforts deployed by the national cowpea program of Nigeria, IAR, in cowpea agronomy.

Activities	1987	1988	1989	1990	1991
a) Management of pure stand cowpea					
a.1) Sowing dates					
- Local cultivars					
. Number of trials	-	-	1	-	-
. Number of treatments	-	-	12	-	-
. Number of locations	-	-	1	-	-
a.2) - Plant population density					
. Number of trials	-	-	1	-	-
. Number of treatments	-	-	15	-	-
. Number of locations	-	-	1	-	-
a.3) Soil fertility improvement					
Phosphorus fertilizers					
. Number of trials	-	-	2	2	1
. Number of treatments	-	-	28	14	32
. Number of locations	-	-	1	1	1
Nitrogen fertilizers					
. Number of trials	1	-	3	3	4
. Number of treatments	18	-	88	30	73
. Number of location	1	-	1	2	4
Other nutrients					
. Number of trials	1	-	-	-	-
. Number of treatments	12	-	-	-	-
. Number of locations	1	-	-	-	-
b) Millet-cowpea intercropping					
. Number of trials	-	2	-	-	-
. Number of treatments	-	25	-	-	-
. Number of locations	-	1	-	-	-
c) Weed control					
. Number of trials	2	-	1	1	2
. Number of treatments	32	-	22	16	49
. Number of locations	1	-	1	1	1
Total technologies tested	**62**	**25**	**165**	**60**	**154**

Table 5.8. Cowpea Network. Research efforts deployed by the national cowpea program of Nigeria, IAR, in cowpea entomology.

Activities	1987	1988	1989	1990	1991
1) Insect biology					
. Number of trials	1	-	1	1	-
. Number of insects studied	1	-	1	1	-
. Number of locations	1	-	1	1	-
2) Integrated pest management					
. Number of trials	-	3	-	1	1
. Number of treatments	-	36	-	6	6
. Number of locations	-	3	-	1	1
3) Chemical control					
. Number of trials	-	-	1	1	1
. Number of treatments	-	-	6	6	14
. Number of locations	-	-	1	1	1
4) Biological tests					
. Number of trials	1	4	3	3	1
. Number of treatments	8	46	33	42	32
. Number of locations	-	1	2	2	1
5) Minimum insecticide treatments					
. Number of trials	1	-	1	1	-
. Number of treatments	6	-	6	9	-
. Number of locations	1	-	2	1	-
Total technologies tested	15	82	46	64	52

Table 5.9. Cowpea Network. Research efforts deployed by the national cowpea program of Nigeria, IAR, in cowpea pathology.

Activities	1987	1988	1989	1990	1991
1) Disease survey					
. Number of surveys	1	-	-	-	-
. Number of diseases	1	-	-	-	-
. Number of locations	1	-	-	-	-
2) Yield losses due by diseases					
. Number of trials	-	-	1	-	-
. Number of treatments	-	-	5	-	-
. Number of locations	-	-	1	-	-
3) Screening for disease reistance					
. Number of trials	7	3	6	14	12
. Number of treatments	289	200	67	137	199
. Number of locations	1	2	1	1	1
4) Chemical control					
. Number of trials	4	1	-	2	1
. Number of treatments	34	7	-	15	18
. Number of locations	1	1	-	1	1
5) Screening for *Striga* and *Alectra* resistances					
. Number of trials	-	1	2	2	12
. Number of treatments	-	66	30	30	86
. Number of locations	-	1	2	1	1
6) Inheritance studies					
. Number of trials	-	1	1	-	-
Total technologies tested	324	274	102	182	303

Table 5.10. *Striga* Resistant Cowpea Varieties in West and Central Africa

Name of variety	Origin	Country having identified or confirmed the resistance to *Striga*	Country in which the resistance to Striga hold	National programs incorporating the resistance in good agronomic background
- B301	Botswana	Burkina Faso IITA-SAFGRAD)	Burkina Faso, Mali, Senegal, Niger, Nigeria, Benin	Burkina Faso, Mali, Niger, Nigeria
- TN93-80	Niger	Niger (INRAN)	Burkina Faso, Mali, Senegal, Niger, Nigeria	Burkina Faso
- TN121-80	Niger	Niger (INRAN)	Burkina Faso, Mali, Senegal, Niger, Nigeria	Burkina Faso
- KVx61-1	Burkina Faso	Burkina Faso (IITA-SAFGRAD)	Burkina Faso, Mali	Burkina Faso
- KVx61-74	Burkina Faso	Burkina Faso (IITA-SAFGRAD)	Burkina Faso, Mali	Burkina Faso
- IT81D-994	IITA-Ibadan	Burkina Faso (INERA)	Burkina Faso, Nigeria	Burkina Faso
- KVx100-21-7	Burkina Faso	Benin	Benin	-
- KVx295-124-52	Burkina Faso	Burkina Faso (INERA)	Benin, Burkina Faso	Burkina Faso
- KVx291-47-222	Burkina Faso	Burkina Faso (INERA)	Benin, Burkina Faso, Mali	Burkina Faso
- NI86-650-3	Benin	Benin	Benin	Benin

Table 5.11. New cultivars with good attributes identified by NARS beginning 1987 upto date.

Type of attribute	Cultivars	Country in which it was identified or developed
Drought resistance		
	- Gorom Local, KVx30-305-3G, KVx396-4.	Burkina Faso (IITA-SAFGRAD)
	- KVx402-5-2, KVx402-19-5	Burkina Faso (INERA)
	- B89-504N, IS86-275N	Senegal (ISRA)
	- KB85-18	Niger (INRAN)
Cultivar adapted to coastal and transisition zones	- CR-06-07	Ghana
Cultivars adapted to drought and excess moisture conditions		
	- KVx396-18-10, KVx396-4-5-2D, KVx402-5-2,	Burkina Faso (INERA)
Multiple disease resistant cultivars		
	- IT86D-1056, IT83D-213, IT85D-3517-2, IT85D-3516-2, IT85D-3577 and IT83D-219	Nigeria (IAR)
Aphids resistant cultivars	- IT82E-25, IT83S-742-2, IT86D-3577	IITA, Ibadan (Nigeria)
	- KVx295-2-124-51	Burkina Faso (INERA)
Bruchids resistant cultivars	- IT84S-275-9, IT84S-2246-4	IITA, Ibadan (Nigeria)
	- KVx30-6467-5-10K, KVx295-2-124-51	Burkina Faso (INERA)
Dual purpose cowpea varieties: (fodder and seed yield)		
	- IAR7/180-5-1, IAR/180-4-5	Nigeria (IAR)

5.2.2) Technologies in the pipeline within the Network.

From collaborative research activities conducted by RENACO Lead Centres, several technologies were in the pipeline as of December 1992. They are listed in Table 5.12 and were developed by Benin, Burkina Faso, Nigeria and IITA, Ibadan.

5.2.3) Technology adoption

All RENACO member countries are using the technology experimentation and transfer funnel model described in Fig.1. Through this exercise, with perhaps the exception of Chad and Central African Republic, all the NARS listed in Table 5.13 have identified promising technologies since 1987. Those technologies are in various stages of nation-wide and on-farm testings before eventual release.

5.2.4) Human resources

Insufficient number of skilled national scientists was a major socio-economic handicap that impeded the development and/or indentification and transfer of new technologies in the sub-region prior to 1987. This is well examplified by the absence of new technologies from national programs nominated for regional trials in 1983-1987 (Tables 2.2 & 3.5).

As a solution to this handicap, RENACO embarked on intensive training programs for national scientists and technicians in 1988-91. These included cowpea monitoring tours to selected NARS countries and to IITA sub-station facilities at Niamey, Niger, Kano and Ibadan, Nigeria. Workshops, group training and seminars were also organized. The topics treated included: *State of Art of Cowpea Research in West and Central Africa; Agricultural Experimentation and Technology transfer: The case of cowpea; Shaping Agronomic Research in West and Central Africa*. All these activities have been documented and distributed to national programs.

Table 5.12. Cultivars in the pipeline at the Network level as of December 1992.

Attributes	Name of Cultivar	Origin
1) Wide adaptation, high yield, Aphid and *Striga* resistant	- KVx 426-1, KVx426-2, KVx426-4 and KVx 427-9	Burkina Faso
2) Wide adaptation, high yield, Burichid resistant	- KVx426-2, KVx414-22-21 KVx414-22-92, KVx414-16T, KVx4O4-22-3 & KVx4O4-52	Burkina Faso
3) *Striga* resistant cultivars	- IT90K-59, IT90K-77 & IT90K-76	IITA/Ibadan IAR/Nigeria
	- KVx397-6-6	Burkina Faso
	- NI86-5O3-2, NI86-650-3 and NI84m-1321	Benin
4) Adaptation to transition zones	- IT86D-4OO, IT86D-534, IT88DM-361, IT87D-2O75, IT87S-1393.	IITA/Ibadan

Table 5.13. Cultivars adopted by NARS since 1987 and which are in the various stage of multilocation trials and on-farm testing and demonstration before their eventual release.

Country	Name of Variety
Benin	IT84S-2246; IT84D-513; TVx 1999-01F; IT81D-1137; KVx100-21-7; KVx295-124-52; NI86-650-3
Burkina Faso	KVx 30-309-6G; KVx 61-1; KVx 396-4-4; KVx 396-4-5; KVx 396-18-10; KVx402-5-2; KVx402-19-5; KVx295-2-124-51.
Cameroon	IT81D-994, KVx396-4-5-2D;
Cape Verde	IT83D-444.
Côte d'Ivoire	GR-06-07; TVx3236; IT87D-1010; IT87D-1627; IT88DM-363; IT84S-2246; IT88DM-361; IT82E-32.
The Gambia	IT84S-2049; IT83S-728-13; TVx3236.
Ghana	IT81D-1137; IT83S-818; KVx396-4-2; KVx396-4-4; KVx396-4-5; KVx396-18; KVx30-305-3G.
Guinea B.	IT85D-3516-2; IT86D-498; IT87S-1390; IT85D-3577; IS86-275N; IS87-416N; IT86D-373; KVx30-309-6G.
Guinea C.	IT84S-2246-4; IT82E-32; IT86D-1048; IT86D-1056; IT85F-867-5.
Mali	TN93-80; TN121-80; KVx30-309-6G; KVx61-1; Dan Illa; TVx 3236.
Mauritania	IT86D-472; IT82D-544-4; IT81D-897; IT82ED-716; IT82D-927; TVx 1948-01F; TVx3236; KB85-18; KVx295-2-124-89; IVx295-2-124-51; IT81D-994.
Niger	A18-1-1; A73-1-2; KVx30-309-6G; KVx100-2; KVx30-305-3G; KVx396-4-5.
Nigeria	TVx 3236; IT81D-994.
Senegal	B89-504N; IS86-275N
Togo	TVx 1850-01E; IT81D-985; 58-146; IT83S-818; IT82E-66; KVx 396-4-4.

From the vast training campain, NARS scientific leadership development has been strengthened remarkably. This is well illustrated by the output of RENACO Lead Centers in technology development (Tables 5.10 & 5.11) and their contribution to regional trials in 1987-1992 (Tables 3.5) described above.

In 1987, some senior cowpea scientists, namely Issaka Maga (Niger), Issa Drabo (Burkina Faso) left their respective national programs to pursue higher degree courses. Due to the lack of senior scientists, they were replaced by junior scientists. But from the RENACO training activities the latters benefited, they managed to maintain the colloborative research output remarkably well in their respective countries.

Cowpea production in southern Benin, particularly in Cotonou, Lokossa, Bohicon and Save areas was handicapped by *Striga gesnerioides* infestation. In March 1989, the RENACO Coordinator received an SOS call for help from the extension services of the Bohicon district. Since no research work on *Striga* in the coastal and transition zones was ever reported by anybody, it was not possible to find an immediate solution to this constraint. The Network, therefore, had to resort to training activities in order to find an everlasting solution to the problem. A senior cowpea breeder from Benin, was awarded a two week visiting scientist fellowship at the Kamboinse station, Burkina Faso. At the station, he interacted with national scientists in Burkina Faso and got acquainted with *Striga* and other research methodologies, which he and his cowpea team applied to tackle the problem in 1989. In 1992, they did not only confirm the *Striga* resistance of introduced germplasm, such as: KVx100-21-7 and KVx295-124-52 from Burkina Faso, but had also developed their own *Striga* resistant cultivars, namely NI86-503-2, NI86-650-3 and NI84m-1321. The new technologies developed are being extended to farmers. Quite apart the new technologies have a potential spill-over effect in Togo and Ghana. This could not have been possible in such a short time without the positive contribution of the cowpea network.

The greatest impact of RENACO on NARS is the renewed interest and total commitment of national cowpea scientists to research activities. A total of 67 national scientists in West and Central Africa now know one another personally and what research responsibilities each of them has in their respective countries. Thus, the linguistic barriers that have seperated anglophones, francophones and luzophones from learning from one another have been broken.

5.2.5) **Policy environment for research**

A strong link has been established between SAFGRAD Coordination Office (SCO) and the Directors of Research of participating countries. The directors have been very active and responsive to all network activities (Steering Committee meetings, monitoring tours, workshops, training and regional trials), either by encouraging the contribution and participation of their scientists and/or hosting meetings. In many countries, steps are underway towards specializing some scientists in cowpea research work (as opposed to a scientist or group of scientists working on several crops). It should be noted that without the full copperation of the Directors of Research, the success of the network in any form could not have been possible. As to policy changes, a lot more is still to be done. Because the national scientific leadership has to build up its credibility vis-â-vis decision makers, extension workers, farmers, agricultural input suppliers, etc., through repeated success stories in agricultural scientific breakthroughs.It is only such breakthroughs that interact with decision makers powerfully in persuading them to make the necessary policy changes that are conducive to a harmonious agricultural development.

5.3 RENACO Impact on NARS (Level 2)

The following substantiate changes in the output from reseach and development agents as a result of RENACO efforts.

5.3.1) **Advanced yield trials and/or multilocation testings**

Nearly all the countries were visited by RENACO officials; they were found to have embarked on advanced yield trials and/or multilocation testings with promising cultivars obtained either from their local or introduced germplasms including those from RENACO regional trials. The cultivars are listed in Table 5.13.

The advanced yield trials and multilocation trials were conducted for the identification of geographical areas, i.e, recommendation domains, where the new and promising cultivars have a comparative advantage over local varieties so that they can be recommended for use by farmers in such areas after on-farm verification trials. The best performing cultivars obtained in the Advanced Yield Trials conducted in Burkina Faso since 1982 are presented in Table 5.14. Note, however, that the commercial varieties in farmers' hands were not used in 1982-1987. A comparaison of commercial varieties in their respective exploitation areas was carried out in 1990 and 1991 throughout the 10 recommendation domains of Burkina Faso and cultivar KVx 396-4-5-2D showed an average yield of 9 and 78% higher than commercial cultivars across the domains. The tests comprised of pure-stand and intercropping with cereal production schemes, treated with and without insecticides.

Table 5.15 shows advanced yield trials carried out in Nigeria from 1987-1991. Unfortunately, only the 10 top lines were reported for each test location, it was not possible, therefore, to calculate the percentage increase over the commercial cultivars of farmers at each location. Nevertheless, it is noted with satisfaction that both the Burkina and Nigeria's national programs are striving hard to make promising cultivars suitable for their farmers' needs and circumstances.

5.3.2) Renewed interest in on-farm testings

In addition to advanced yield trials and multilocation trials reported, cultivars listed in Table 5.13; many of the same cultivars were also subjected to on-farm testings. Through this exercise, breeders, farming system research scientists and

Table 5.14. Cowpea Network: Gerplasm flow: National Advanced Yield Trial Outputs. Country: Burkina Faso, INERA.

Year	Name of variety	% Yield Inc. (Over check)	Constraint(s)*	Source(s)**	Quality rating	Acceptability rating	Stability rating	Utilization rating
1982	KVx30-166-3G	0	adaptation & storage.	IITA-SAFGRAD	Good	Good	-	-
1982	KVx30-141-16	0	- do -	- do -	- do -	- do -	-	-
1982	KVx30-183-3G	0	- do -	- do -	- do -	- do -	-	-
1983	KVx30-309-6G	0	- do -	- do -	- do -	- do -	-	-
1983	Tvx3236-5-2	0	adaptation	IITA-Ibadan	Poor	- do -	good	-
1983	TVx3236	0	- do -	- do -	- do -	- do -	good	-
1984	IT82D-716	0	adaptation &	- do -	- do -	- do -	-	-
1984	KVx30-6172-1-6K	0	storage	- do -	- do -	- do -	-	-
1984	KVx30-6200-1-3K	0	- do -	IITA-SAFGRAD	Good	Good	-	-
1984	KVx145-27-4	0	adaptation &	- do -	- do -	- do -	-	-
1984	KVx146-13-3	0	aphids	- do -	- do -	- do -	-	-
1984	KVx-146-44-1	0	- do -	- do -	- do -	- do -	-	-
1984	KVx165-14-1	0	- do -	- do -	- do -	- do -	-	-
1986	KVx30-166-3G	0	drought resistant	- do -	- do -	- do -	-	-
1986	KVx30-309-6G	0	- do -	- do -	- do -	- do -	-	-
1986	KVx61-74	0	*Striga* resistant	- do -	- do -	- do -	-	-
1986	KVx64-54	0	- do -	- do -	- do -	- do -	-	-
1986	IT82D-952	0	adaptation	IITA-Ibadan	- do -	- do -	-	-
1986	IT82D-513-1	0	- do -	- do -	- do -	- do -	-	-
1986	IT82D-504-4	0	good storage	- do -	- do	- do -	-	-
1986	IT82D-789	0	adaptation	- do -	- do -	- do -	-	-
1986	IT81D-1228-13	100	vegetable cowpea	- do -	- do -	- do -	-	-
1986	IT81D-1228-12	100	- do -	- do -	- do -	- do -	-	-
1986	IT83S-898	100	- do -	- do -	- do -	- do -	-	-
1987	IT83S-720-2	0	adaptation	- do -	- do -	- do -	-	-
1987	IT81D-1137	0	good storage	- do -	- do -	- do -	-	-
1987	KVx60-K26-2	0	- do -	IITA-SAFGRAD	- do -	- do -	-	-
1987	KVx268-K03-9	0	- do -	- do -	- do -	- do -	-	-
1987	KVx165-14-2	0	aphids resistant	- do -	- do -	- do -	-	-
1990	KVx396-4-5-2D	9	drought,& heat	- do -	- do -	- do -	excellent	good
1990	KVx396-18-10	0	resistant	- do -	- do -	- do -	- do -	- do -
1990	IT85D-3516-2	0	- do -	IITA-Ibadan	- do -	- do -	- do -	-
1990	IT85D-3516	0	- do -	IITA-Ibadan	- do -	- do -	-	-
1991	KVx396-4-5D	78	- do -	IITA-SAFGRAD	- do -	- do -	excellent	good
1991	KVx 402-5-2	55	- do -	INERA-Burkina	fair	-	excellent	-
1991	IT85D-3516-2	36	- do -	IITA	fair	-	good	-

Table 5.15. Cowpea Network: Germplasm Flow: National Advanced Yield Trial Outputs
Country: Nigeria, IAR.

Year	Name of variety	% Yield Inc. (Over check)	Constraint(s)*	Source(s)**	Quality rating	Acceptability rating	Stability rating	Utilization rating
1987	IAR 11/48-2	17	Adaptation	IAR, Nigeria	good	good	-	-
1987	IAR 7/189-4-15-1	60	- do -	- do -	good	good	-	-
1987	IT85F-9580	15	- do -	IITA, Ibadan	-	-	-	-
1987	Ife Brown	0	- do -	Nigeria	good	good	fair	-
1988	IT82D-699	-	- do -	IITA, Ibadan	-	-	fair	-
1988	48-47	-	- do -	IAR, Nigeria	good	good	-	-
1988	48-18	-	- do -	- do -	good	good	-	-
1989	48-48	-	- do -	- do -	good	good	-	-
1989	48-18	-	- do -	- do -	good	- do -	-	-
1989	48-11	-	- do -	- do -	good	- do -	-	-
1989	48-37	-	- do -	- do -	good	- do -	-	-
1990	Dan Sokoto	-	- do -	- do -	good	- do -	-	-
1990	1696/TVx 3000-25	-	- do -	- do -	good	- do -	-	-
1990	48 W	-	- do -	- do -	good	- do -	-	-
1990	1696/TVx3000-1	-	- do -	- do -	good	- do -	-	-
1990	1696/TVx3000-7	-	- do -	- do -	good	- do -	-	-
1990	1696/K59-9	-	- do -	- do -	good	- do -	-	-
1990	1696/K59-39	-	- do -	- do -	good	- do -	-	-
1991	K-28	-	- do -	- do -	good	- do -	-	-
1991	1696/K59-9	-	- do -	- do -	good	- do -	-	-
1991	1696/TVx 3000-7	-	- do -	- do -	good	- do -	-	-
1991	11/48-3-2	-	- do -	- do -	good	- do -	-	-
1991	1696/TVx3000-1	-	- do -	- do -	good	- do -	-	-
1991	11/48-3-1	-	- do -	- do -	good	- do -	-	-
1991	IT82D-699	-	- do -	IITA, Ibadan	-	-	-	-

extension workers are working closely together to expose the new technologies to farmers and to gather the latters' reactions as to the appropriateness of the technologies for further improvement, if necessary. The best cultivars obtained from the on-farm testings in Burkina Faso from 1982-1991 are given in Table 5.16. Yields of these cultivars were 15-78% higher than the available commercial varieties in their areas of exploitation. On-farm test results from Nigeria are presented in Table 5.17.

5.3.3. Technologies released

Table 5.18 shows cultivars released; they are being widely used by farmers for commercial purposes. Improved agronomic practices, such as minimum insecticide treatments, soil tillage including tied-ridge techniques (Table 5.1) are being extended to farmers alongwith released cultivars.

5.3.4 Seed multiplication

Foundation seed is being multiplied for distribution to seed companies and potential commercial farmers in Burkina Faso, Cape Verde, Central African Republic, Ghana, Guinea Bissau, Mali, Mauritania, Senegal and Togo.

Table 5.16. Cowpea Network: Gerplasm flow: On-farm Yield Trial Outputs. Country: Burkina Faso, INERA.

Year	Name of variety	% Yield Inc. (Over check)	Constraint(s)*	Source(s)**	Quality rating	Acceptability rating	Stability rating	Utilization rating
1982	KN-1 (Vita-7)	15	adaptation	IITA-Ibadan	fair	fair	poor	fair
1982	Suvita-2	56	*Striga* & drought resistant	IITA-SAFGRAD	good	good	fair	good
1982	TVx1999-O1F	40	adaptation	IITA-Ibadan	fair	poor	good	poor
1982	TVx3236	43	- do -	- do -	fair	- do -	- do -	- do -
1982	Mougne	43	- do -	Senegal	- do -	- do -	-	poor
1984	KN-1	O	- do -	IITA-Ibadan	- do -	fair	poor	fair
1984	TVx3236	O	- do -	- do -	- do -	- do -	fair	poor
1984	Suvita-2	O	*Striga* & drought resistant	IITA-SAFGRAD-INERA, B.F.	good	good	fair	poor
1985	TVx 3236	O	- do -	IITA-Ibadan	fair	fair	fair	poor
1985	KN-1	O	- do -	- do -	fair	fair	poor	fair
1986								
1987	KVx61-74	-	*Striga* resistant	IITA-SAFGRAD	good	good	fair	good
1987	KVx64-54	-	adaptation	- do -	- do -	- do -	- do -	- do -
1987	KVx30-309-6G	-	" (drought)	- do -	- do -	- do -	- do -	- do -
1987	IT82D-789	-	- do -	IITA-Ibadan	- do -	- do -	- do -	- do -
1987	IT82D-852	-	- do -	- do -	- do -	- do -	- do -	- do -
1987	IT82D-540-4	-	- do -	- do -	- do -	- do -	- do -	- do -
1987	IT82D-513-1	-	- do -	- do -	- do -	- do -	- do -	- do -
1990	KVx61-1	O	*Striga* resistant	IITA-SAFGRAD	very good	good	fair	good
1990	KVx396-4	41	adaptation	IITA-SAFGRAD INERA, B.F.	good	good	excellent	good
1990	TVx3236	16	adaptation	IITA-Ibadan	fair	poor	good	poor
1990	KN-1	45	adaptation	- do -	fair	fair	poor	fair
1991	KVx30-309-O6G	53	" (drought)	IITA-SAFGRAD	fair	fair	fair	fair
1991	KVx61-1	68	*Striga* resistant	- do -	very good	good	fair	good
1991	KVx396-4	71	adaptation	IITA-SAFGRAD-INERA, BF.	good	good	excellent	good
1991	Suvita-2	62	*Striga* & drought resistant	IITA-SAFGRAD-INERA, B.F.	good	good	fair	good
1991	KN-1 (2 locations only)	78	adaptation	IITA-Ibadan	fair	fair	poor	poor
1991	TVx3236	65	adaptation	IITA-Ibadan	fair	fair	good	fair

Table 5.17. Cowpea Network: Germplasm Flow: National Advanced Yield Trial Outputs
Country: Nigeria, IAR.

Year	Name of variety	% Yield Inc. (Over check)	Constraint(s)*	Source(s)**	Quality rating	Acceptability rating	Stability rating	Utilization rating
1987	2/180-4-18_1	34	Adaptation	IAR, Nigeria	good	good	-	-
1987	IT82D-699	38	- do -	IITA, Ibadan	good	good	-	-
1987	19/48-18	28	- do -	IAR, Nigeria	good	good	-	-
1987	81-40	27	- do -	IAR, Nigeria	good	good	fair	-
1987	KVx 30-166-3G	62	- do -	IITA-SAFGRAD (Burkina Faso)	-	-	-	-
1987	KVx 61-2	29	- do -	- do -	-	-	-	-
1987	11/48-2	41	- do -	IAR, Nigeria	good	good	-	-
1987	19/48-18	33	- do -	- do -	good	good	-	-
1989	I19/48-18	25	- do -	- do -	good	good	-	-
1989	IAR 48 (Sampea 7)	41	- do -	- do -	good	good	-	-
1989	48 W	21	- do -	- do -	good	good	-	-
1989	11/48-2	18	- do -	- do -	good	good	-	-
1990	18 W	37	- do -	- do -	good	good	-	-
1990	11/48-2	63	- do -	- do -	good	good	-	-
1990	IAR 48 (Sampea 7)	56	- do -	- do -	good	good	-	-
1990	19/48-18	31	- do -	- do -	good	good	-	-
1990	2/180-4-1-1	51	- do -	- do -	good	good	-	-
1991	IAR 48 (sampea 7)	8	- do -	- do -	good	good	-	-
1991	48 W	13	- do -	- do -	good	good	-	-
1991	1696-1	12	- do -	- do -	good	good	-	-

Table 5.18. Cultivars released or in use by farmers since 1987.

Country	Variety	Year first used by farmers
- Benin	- TVx 1850-01F	1987
	- IT82E-32	1988
	- IT81D-1137	1990
- Burkina Faso	- TVx 3236; Suvita-2 (Gorom Local)	1987
	- KVx396-4-4; KVx396-4-2 and KVx396-4-5-2D.	1991
- Cape Verde	- Local Santiago	1987
	- KN-1	1988
- Ghana	- Vallenga (IT82E-16), Asontem (IT82E-18).	1987
	- Bengpela (IT83S-818) and Brown eye 5IT81D-1137)	1991
- Guinea Bissau	- IT82E-9	1988
	- IT83S-889.	1990
- Guinea Conakry	- IT83D-338-1	1989
	- IT85F-867-5 and IT84S-2246-4	1990
- Mali	- Suvita-2	1987
	- KVx61-1.	1990
- Mauritania	- IT83S-343-5-5, Suvita-2 and KVx 256-K17-11	1988
- Nigeria	- Sampea-7 (IAR-48).	1987
- Senegal	- IS86-275	1990
- Togo	- VITOCO (IT81D-985) and 58-146	1988

5.4. RENACO Impact on NARS (Level 3)

5.4.1) Network observations

We do not have tangible data at hand that show production and acreage of SAFGRAD-RENACO cultivars in member countries. But we do have clear evidence of them being cultivated in large areas as described below. Nevertheless, new cultivars or technologies usually take quite some time before getting deep down to every farmer's hand, especially in the case of the resource poor African farmer who has no means of purchasing seed. Also this lapse of time may vary from one farmer to another and one country to the other, depending on the economic standing of a farmer or country to purchase seed. SAFGRAD-RENACO cultivars being used popularly by member countries are as follows:

Benin: Vita-5 is widely used in the southern coastal regions because of its white seed clour preference to the local cultivar, Kpodiguegue. Vita-5 was introduced in Benin through SAFGRAD collaborative research efforts earlier than 1987. Other cultivars gaining good grounds are: IT82E-32, IT81D-1137 and TVx1850-01F.

Burkina Faso: KN1 (Vita-7), was released for the first time in 1981. But it has been widely used in most of the tests in Burkina Faso as a control cultivar. This has permitted it to fall rapidly in the hands of local farmers throughout the northern Guinea savanna zone. It is also popular in the Sudan savanna for its usefulness as a pot herb, especially during the dry season. Cultivar Suvita-2 (Gorom local) is very popular in the Sahel. TVx3236 is also used in the northern Guinea and sudan savannas. And cultivars KVx396-4-2, KVx396-4-4 and KVx396-4-5-2D, developed quite recently are grown in many parts of the country, especially the Sahel.

Cameroon: VYA, of a local origin, was promoted by the SAFGRAD accelerated Crop Production Officer (ACPO). It is used extensively in northern Cameroon. Cultivar IT81D-985, released as Br-1 because of its bruchid resistance, i.e., a storage advantage, is used in northern Cameroon by peasant farmers.

Cape Verde: KN-1 (Vita-7) and Local Santiago are used extensively throughout the country. KN-1 was introduced through SAFGRAD and RENACO Collaborative Research efforts.

Ghana: IT82E-16, released under the local name "Vallenga", is widely used throughout northern Ghana. Other cultivars gaining farmers grounds in the same region are IT81D-1137 and IT83S-818. IT82E-32, released under the local name "Asontem", is widely used in the forest and transition zones of Ghana.

Guinea Bissau: IT82E-9 is heavily used in eastern and northern regions of the country. IT83S-889 is receiving farmers appreciation too.

Guinea Conakry: IT85F-867-5, IT83D-338-1 and IT84S-2246-4 are used for commercial purposes.

Mali: KN-1, introduced through SAFGRAD-RENACO collaborative research efforts, has replaced local varieties in the northern Guinea savanna where it is extensively used. Suvita-2 (Gorom local), *Striga gesnerioides* resistant and introduced through SAFGRAD-RENACO, is widely used in the north-eastern part of the country because of its *Striga* resistance advantage and has gradually replaced the local cultivar, Niban (*Striga* susceptible). And KVx61-1, introduced through RENACO efforts is gaining grounds over Suvita-2 because of its good taste preference and is also *Striga* resistant.

Mauritania: IT83S-343-5-5, Suvita-2 and KVx256-K17-11, introduced through RENACO, are reported to be extensively used for commercial interest.

Nigeria: TVx 3236 was released before 1987 in Northern Nigeria and IAR-48 was released in the same region under the name "Sampea-7", after 1987.It is being used extensively for commercial purposes.

Senegal: IS86-275, developed quite recently, is grown in many parts of Central and Northern Senegal where it is gradually replacing cultivar 58-57.

Togo: 58-146 has gained a wide scale use in the northern region where a SAFGRAD ACPO is based and conducts adaptative research. IT81D-985, bruchids resistant (with good storage), was released under the local name "VITOCO" and is also popular. And KVx396-4-2 is gaining farmers' preference in northern Togo since 1991.

5.4.2 Findings of the SAFGRAD Impact Assessment Study

A case study was conducted by a USAID/SAFGRAD team in 1992 with 6 sample countries, namely: Burkina Faso, Cameroon, Ghana, Mali, Niger and Nigeria. The objective of the study was to determine the impact of the cowpea network and other SAFGRAD commodity networks on: (i) NARS member countries; and (ii) production, productivity and income at farmers' level. The findings of the study have been reported elsewhere Bezuneh *et al.* 1993; Sanders 1993; Schroeder 1993 & Scott 1993.

With regard to cowpea growing area, the team admitted that a remarkable expansion in area was noticed for the period 1987-91 in all the sample countries except Cameroon as compared to 1982-1986 (Scott 1993). A detailed study conducted in Ghana and Nigeria revealed the area grown to improved cowpea cultivars to have expanded at the expense of local varieties.

5.5. RENACO Impact on NARS: (Level 4)

5.5.1) Network observations

Feedback received from member countries on the performance of new cultivars subjected to on-farm testings were reported to give similar or higher yields than local varieties and most importantly, they possess good yield stability than the latter. The fact that they are early maturing, drought and heat tolerant than local varieties, makes them more valuable than the latters. The multiple attributes incorporated in the new cultivars alone are considered to be a priceless achievement for the resource poor farmers of the sub-region, not to talk of total production and income. This follows the fact that about 70-80% of the total population of the SAFGRAD member countries are the very poor peasant farmers whose major preocupation may not necessarily be "total income", but rather a guaranteed food security for them and their families under the unpredictable and critical conditions of semi-arid tropical Africa.

5.5.2) Findings of the Impact Assessment Study on: Production and Productivity.

As far as production and productivity were concerned, the Impact Assessment Team found that cowpea production and to some extent, productivity have increased measurably in all sample countries from 1987 to 1991 as compared to previous years: 1982-1986 (Sanders 1993 & Scott 1993). The increase was attributed to (i) increased productivity only for Cameroon since its area grown to cowpea had declined; (ii) both expansion in area and productivity in Burkina Faso, Ghana and Nigeria; (iii) expansion in area and a slightly increased productivity in Mali; and (iv) expansion in area and a decline in productivity in Niger (Scott 1993).

However, in Ghana and Nigeria where a detailed study was made, the team discovered the area grown to improved cultivars had expanded at the expense of the local varieties. The productivity, on the other hand, declined for improved cultivars and increased for local varieties (Scott 1993).

5.5.3) Impact Assessment Study Findings on Profitability

Only Nigeria provided data that permitted an estimation of profitability of cowpea production from 1982 to 1990 (Scot 1993). Per unit profitability for all varieties of cowpea was found to have increased between 1982 and 1988, but a decline was observed thereafter to 1990. The profitability of improved cultivars was significantly greater every year than the corresponding one for the unimproved varieties. Thus, improved cowpea cultivars contributed measurably to increasing farmers income.

VI

Implication of the Findings of the Impact Assessment Study

The impact assessment study team was satisfied that new, early and drought resistant and high yielding cultivars developed through network efforts and adopted by NARS had gone deep down to farmers in member-countries (Sanders 1993, Schroeder 1993 & Scott 1993). The cultivars had also contributed to maintaining and/or improving cowpea production at the farmers' level. Their impact on productivity, however, depended on each country and its prevailing production problems (Scott 1993).

The impact assessment team also raised three issues listed below (Bezuneh *et al.* 1993 & Scott 1993). The issues point to weaknesses in the network in discharging its mandate. It should be noted, however, that these are not weaknesses, but they reflect the necessary evolutionary steps the network had to go through from its inception to its maturity stage. This is particularly true since NARS, the major actors in the network, had to be moved from the state of poor performance they were in prior to 1987 to becoming full partners in agricultural development.

6.1. Decline in productivity of improved cultivars

The countries, i.e., Ghana (in northern parts), Mali, Niger and Nigeria; for which an expansion in area, particularly for improved cultivars was evident; are severely infested with *Striga*. Therefore, as rightly observed (Scott 1993), productivity declines are expected if the released cultivars are susceptible to *Striga*. This is because *Striga* infestation can cause severe to total yield losses, particularlyly when *Striga* was combined with drought or with any other natural calamity. Improved cultivars, i.e., IT82E-16, IT82E-32, KN-1, TN88-63, TVx3236 and SAMPEA-7, except SUVITA-2 and TN5-78; released in those countries up to 1989 were *Striga* susceptible.

With a new range of improved and *Striga* resistant cultivars such as: KVx61-1, KVx61-74, KVx30-303-3G and KVx30-309-6G, KVx295-124-52 and many others which are being adopted by farmers in those countries, productivity decline with expansion area of improved cultivars is expected to be minimized in the near future.

6.2. Lack of expansion in area in Cameroon.

Until 1989, Cameroon did not have a national cowpea breeding program or a well structured cowpea agronomic research program. Its major activities were concentrated in cowpea storage research, although cultivars introduction and testing were carried out in collobaration with IITA and SAFGRAD since early 1980's. The local cultivar: VYA, in northern Cameroon was the only best performing cultivar. None of the introduced cultivars could out yield it. But, as of 1989, line KVx396-4-5-2d, promoted by the network, started out-performing VYA. The line has been promoted by national scientists in Cameroon for on-farm testing in 1992. It is expected that it will soon be released and cowpea production in Cameroon would certainly retain farmers interest.

6.3. Weak linkage between the network and technology transfer

Prior to 1987-1989, several factors were responsible for weak linkage between NARS and Extension Services and farmers. Some of them were: poor understanding of technology experimentation and transfer process by NARS scientists and/or insufficient number of technologies to be transferred or the latters did not meet farmers adoption even if they were available.

With the increasing number of appropriate technologies, i.e., drought, disease and *Striga* resistant; insect pest tolerant and good quality grain cultivars; the need for their extension to farmers would be given top priority. This calls for a strong linkage between NARS and extension services and farmers. For instance, in Burkina Faso, national cowpea scientists found themselves compelled to establish a linkage with extension services in 1989 as they had developed sufficient number of appropriate technologies. To this effect, they organize a yearly workshop to expose to extension workers, new technologies to be transferred to farmers. Steps are being taken by the World Bank, through its structural adjustment programs, to establish formal linkage between agricultural research and extension services in Burkina Faso, Ghana, Mali, Niger and many other countries. As many more new and appropriate technologies are being developed, linkage between research and extension services gets stronger.

VII

Problems and Dificulties Encountered in Attaining Objectives

Although remarkable progress has been made by NARS during SAFGRAD phase-II, three major constraints are still impeding the performance of national programs. These include inadequate number of scientists, insufficient funding for agricultural research and insufficient national scientific leadership development.

7.1. Inadequate number of scientists

With perhaps, the exception of Ghana and Nigeria, most of NARS lack the minimum number of scientists to effectively and efficiently tackle cowpea production constraints. The discipline represented mostly in cowpea research is cowpea breeding. Other areas, such as agronomy, pathology and entomology even if available, spend only a bit of their time on cowpea research.

7.2. Insufficient funding to sustain agricultural research

In most NARS, funding for agricultural research has been increased during the last decade (Bezuneh *et al.* 1993). However, since the number of scientists and support staff have increased out of proportion with the increased funding, the overall result is a decline in funding per scientist. Many NARS are not equiped with libraries and where there may be one, they do not have enough funds to maintain yearly subscriptions to good quality, international agricultural and scientific journals. Likewise the salaries paid to scientists do not permit them to be abreast with new scientific findings by subscribing personally to any sound international scientific journals. To alleviate this deficiency, national scientists, especially the highly experienced ones leave their national positions for better paid jobs elsewhere, or involve themselves in scientific consultancy with national, regional and/or international organizations.

The overall result of insufficient funding of agricultural research is: (i) lack of incentives to attract and maitain qualified scientists; and (ii) inefficient agricultural research outputs. The network provided financial support to national scientists, however, modest and a forum for them to report their research findings and to expose their newly developed or identified technologies. This contributed greatly to boosting their moral. The result of which was the increased research outputs transferred to farmers for high production, productivity and income.

7.3. Insufficient national scientific leadership development

In spite of the early to mid-70 droughts that prompted African Governments to put more emphasis on agricultural research to solve Africa's food crisis, so as to avoid human suffering, agricultural research has not yet been considered as a top-priority for food security. This is partly due to the fact that: (i) scientific breakthroughs had been slow in getting to Africa during the last two decades for food crops, at least; (ii) many scientists, either national, regional or international, do not have a long time memory of food crop research in the continent; (iii) therefore, research methodologies or concepts capable of generating fast and reliably new and appropriate technologies were not developed until very recently.

Frustrated by the slow progress in the development or identification of new technologies and by difficulties in transferring them to farmers, many national scientists have not been able to establish "self-confidence" in their achievements.This puts them in an awkward position when it comes to persuading decision makers as to the need of appropriate policy changes for a harmonious agricultural development in their countries. Moreover, their credibility vis-à-vis policy makers, extension personnel, farmers, agricultural suppliers, etc, is still yet to be enhanced through repeated success stories and demonstrations.

One should not loose sight of the fact that most, if not all, agricultural development projects in Africa are conceived, financed and implemented by expatriates based on experiences gained overseas. Even, where national scientists and/or technicians work in development projects, they play only a minor role. As a consequence, the national scientific leadership in agricultural development matters, such as use of new technologies, agricultural inputs, etc., including policy changes, is still to be strengthened.

VIII
Lessons Learnt from the SAFGRAD Project

The following lessons were drawn from the SAFGRAD project from 1978 to 1992.

8.1. Climatic change

Climatic change in semi-arid West and Central Africa occured since early 1970. It is characterized by (i) the shortening of the crop season by 15-30 days towards the end of the season, depending on the agro-climatic zone; (ii) a reduction in total precipitation during the growing season and poor distribution, particularly at the beginning and towards the end of the season (Muleba 1988a); (iii) increased air and soil temperatures during dry spells (Muleba 1988b & Muleba *et al.* 1991a); and (iv) increased wind velocities and the consequent high frequency of sandblasts, causing severe damages to seedlings at the beginning of the crop season in the Sahelo-Sudanian zones.

Since the climatic changes took place after an unprecedent period of 20 years (1950-1970), characterized by the above average and well distributed rainfall (Nicholson 1989, cited by Tucker *et al.* 1991), cowpea landrace varieties in the region prior to 1970, have lost their adaptation. The photoperiod-sensitive local landraces which required a critical photo-period in mid to late September in Sudan savanna, and in late September to mid-October in northern Guinea savanna, to flower, set and fill pods, can no longer complete their growth cycle; rains end since 1970 in mid to late September in Sudan savanna, and late September to early-October in northern Guinea savanna.

Moreover, photoperiod-insensitive cultivars introduced from humid zones lack adaptation in semi-arid West and Central Africa due to either high air and soil temperatures (Muleba *et al.* 1991 a & b), *Striga* infestation or diseases of semi-arid zones: bacterial blight, bacterial pistules and/or brown blotch; or any combination of these yield reducing factors. Similarly, the productivity of introduced Sahelian varieties in Sudan and northern Guinea savannas, although adapted to drought and heat stresses, can be seriously hampered by moist condition diseases: cowpea aphids borne mosaic virus, scab, web blight; *Septoria* leaf spot and rust.

Also, because rainfall distribution can improve from year to year, without necessarily implicating total increased rainfall, protracted wet spells can occur in any of the agro-ecological zone of semi-arid regions. Under such circumstances severe cowpea yield losses can be experienced due to either high soil water saturation and/or any of the moist condition diseases if the variety was not resistant. Therefore, to ensure food security for peasant farmers in semi-arid zone, cultivars to be released must be drought, *Striga*, insect pest and disease resistant and tolerant to excess moisture conditions.

8.2. Classical germplasm evaluation methods in breeding programs

If classical germplasm evaluation methods, characterized by randomized and replicated blocks established at one site, have proven effective in some humid tropical and temperate environments, they have not been reliable for rapid progress in semi-arid zones. This is because the high year to year fluctuation in total rainfall and distribution pattern and the related high air and soil temperatures are conducive to highly significant genotype x year interactions. Under such conditions, only high yielding cultivars that interact the least with environmental conditions, i.e., which are widely adapted with a stable high yield, must be identified and promoted to farmers.

The identification of such cultivars in semi-arid zone requires multilocation testings in contrasting environments. To achieve this, more financial support must be made available to NARS to implement, monitor, collect data and harvest multilocation trials established at some key selected sites. The cost of cultivar evaluation may be reduced without much of a sacrifice on the precision of the trial by use of successional sowing dates at a key site or a minimum of two sowing dates at two key sites (Muleba *et al*. 1991a &b).

8.3. African peasant farmers can be receptive to food crop production innovations

By involving national scientists in technology development or identification research, the cowpea network established a strong linkage between advanced laboratories in developed countries through: IITA and NARS, and farmers in member-countries. National scientists by fine-tuning technologies developed by IITA to meet the needs and requirements of farmers in their home countries, do not only enlarge the number of ecological niches modern science can reach, but also facilitate positive interactions between farmers in developing countries and advanced science laboratories in developed countries.

Thus, with new technologies meeting their needs and requirements, peasant farmers could no longer resist adopting them. By so doing, they invalidated the wrong belief that: African peasant farmers are not receptive to food crop production innovations. This was well illustrated in the USAID/SAFGRAD 1992 impact assessment study of the SAFGRAD networks (Sanders 1993). Therefore, peasant farmers in Africa can adopt new technologies, to increase their food crop outputs, productivity and incomes.

8.4. African food crisis can be brought under control

The African food crisis experienced since mid-1960's can be attributed to several factors as follows:

1) African Agriculture evolved from a very delicate tropical ecosystem characterized by most plant nutrients being store in above-ground plant parts; the situation is even worse in non-volcanic lowland tropics of West and Central Africa which are almost devoid of soil nutrient reserves because of the acidic nature of its parental rocks;

2) A rapid destruction of organic matter due to high air and soil temperatures. The consequence is difficulty in maintaining good soil physical properties and fertility in continuous cultivation without an appropriate soil fertility restoration program;

3) High runoff and erosion favoured by soil denudation through cultivation, overgrazing by livestock, brushfire and frequent short duration tropical rainstorms.

4) High human population pressure; the result is increasing demand for food to sustain a rapidly growing population;

5) Use of traditional agricultural husbandaries, which are characterized by: lack of systematic application of chemical and organic fertilizers; lack of integration of livestock, tree plants and food crop production; and reliance only on fallows for soil fertility restoration;

6) Reduction of the duration of the fallow or its suppresion altogether due to an extensive food production system under high population presssure; the result is rapid decline in soil organic matter and fertility and degradation in soil physical properties;

7) The use of landrace varieties which provide high population buffering capacity against weather hazards but not high yield under good conditions; and

8) A long time neglect of agricultural research for food crop production; or when conducted, it did not have sufficient funding, nor adequate and experienced personnel to generate sufficient and appropriate technologies transferrable to farmers.

The success obtained by the Cowpea IITA-SAFGRAD project in phase-I, particularly in generating new agronomic practices such as: tied-ridges, use of no-tillage with *in situ* mulching and herbicides, use of phosphatic fertilzers on cowpea especially in rotation with cereals, restitution of crop residues to soil, use of windbreak; etc; these coupled with new genetically buffered cultivars, such as KVx396-4-5-2D and KVx402-5-2 and others developed through networking during SAFGRAD phase II, illustrate opportunities modern science can offer to agricultural development in Africa, even though agricultural production may be under the hold of traditional peasant farmers.

Indeed, the new genetically buffered cultivars emulate local landrace varieties except for the low yield. Because they are responsive to modern high input managements, they do not only offer an opportunity to peasant farmers to get acquainted with modern technologies, but also to progressively shift from their traditional low to modern high input management practices, such as fertilizers, pesticides, crop rotation, etc. They could also provide sufficient incentives that can cluminate in the long overdue agricultural policy changes. This because, as policy makers interact with NARS scientists, extension workers and farmers through on-farm demonstrations, they would ultimately be convinced as to the potential of modern agricultural production in national economies.

Thus, with proper funding and adequate staffing of agricultural research, priorities can be set and appropriate and transferrable technologies, developed. The use of such technologies, by farmers would result in increased production, productivity and incomes, while the ecosystem can be conserved. The ultimate result would be food self-sufficiency, or food self-reliance, at least. Therefore, the seemingly difficult African food crisis could be solved through appropriately conducted agricultural research.

IX

Future and Uncompleted Plans

Although sinificant progress has been made, a lot more is still to be done to render national programs fully operational in agricultural development in semi-arid West and Central Africa in the near future. Areas where networking emphasis are further required for the next five years are:

9.1. Scientific leadership development

During SAFGRAD phase-II, IITA provided for cowpea research in West and Central Africa a network coordinator and scientific backstopping. The network by regrouping about 67 cowpea scientists in the sub-region and coordinating collaborative research succeeded in establishing a critical mass of scientists working in a concerted manner in tackling cowpea production problems. Network coordination and scientific backstopping are major components of sciedntific leadership development, which together with the critical mass of scientists was lacking in most NARS member-countries, thereby impeding research progress by NARS scientists prior to 1987-1989.

Thus, with the critical mass of scientists and a sound scientific leadership, national scientists in the cowpea network had no alternative, than to increase their research output both in quantity and quality. Similarly, farmers had no other choice than to adopt the new and appropriate technologies so developed. As a result, their output and productivity as well as incomes increased as reported by the 1992 USAID/SAFGRAD impact assessment study team (Sanders 1993 & Scott 1993).

It should be noted, however, that: although several national cowpea scientists have built up experience and acquired new skills in scientific problem solving processes and the whole cowpea scientific community in West and Central Africa of 67 scientists grew up with five new high degrees as follows: Cameroon one M.Sc., since 1990; Senegal, one M.Sc., since 1990; Burkina Faso, one Ph.D., since mid-1992; Mali, one Ph.D., since mid-1992 and Nigeria, one Ph.D, since 1990; the need for consolidating the scientific leadership development of NARS member-countries is still a top priority. This is because the change in the behaviour of national cowpea scientists towards finding sound agricultural development solutions must become permanent and deeply rooted in self-confidence in their ability to solving production constraints. As such they ought to become credible interlocutors with national decision makers with whom they should frequently interact positively to effect policy changes that can promote increased cowpea production and productivity and so enhance farmers' incomes.

9.2. Uncompleted research plans

Although significant research breakthroughs have been attained, an efficient cowpea production in the sub-region cannot be envisaged in the future without the use of chemical poisons, apparently not compatible with the poor African economy nor within the reach of the resource poor African farmer at this point in time. Therefore, a thorough search for either new sources of resistance or biological control needs to be tackled vigorously in order to bring insect pest damages under control. In addition, new cowpea cultivars possessing a combination of high heat, drought and excess moisture tolerances; *Striga*, disease and insect pest resistances and good seed quality and storability, and of course, high yield should be given top priority. This requires a concerted effort of national, regional and international multidisciplinary team works within the framework of the Network.

Moreover, agricultural research is a continuous process. We must have learned from the experiences of north America and Europe that as old constraints are solved, new and even more virulent ones emerge. As the human population grows and agricultural and industrial development advance, human activities are bound to encroach on the ecosystem.

Thus, the latter is distroyed. The consequences are: (i) the genetic diversity disappears in favour of a more genetic uniformity, but without the natural buffering capacity of the ecosystem; (ii) the hydrology changes in both flux and quality of its contents: with underground, stream and lake water becoming prolluted with excessive plant nutrients, salinity and chemicals used for agricultural production; (iii) industrial emissions contaminate the atmosphere and cause acid rains, ozone layer depletion; this in addition to increasing greenhouse gases such as: CO_2 and other; as a result of ecosystem destruction; and (iv) human activities for survival ultimately become highly vulnerable to natural calamities such as: heat waves, episodic drought or excess moisture, different kinds of disease or insect outbreaks, etc.

There is no doubt, therefore, that networking is inevitable, if human suffering is to be eliminated and brought under control in the-not-too-distant future.

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Appendix 1. Entries tested in observation nurseries in 1987-89. Cowpea Network: RENACO

Bruchids resistance		Aphids resistance		Virus resistance	
Source	Entries	Source	Entries	Source	Entries
IITA/Ibadan	IT81D-1137, IT84D-449, IT84E-460, IT84S-275-9, IT84S-2246-4, IT85F-2205, IT86D-472, IT86D-534, IT86D-641.	IITA/Ibadan	IT83S-720,IT83S-742-2, IT84S-2246-2, IT85D-3577, IT85S6867, IT86D-901, IT86D-1033, IT86D-1038, IT86D-1057.	IITA/Ibadan	IT84S-2135, IT85F-2805, IT85F-867-5, IT85F-2687, IT85-1380, IT85F-3139, IT84D-448, IT84D-449, IT83S-872, IT81D-1137, IT83S-818, IT82E-16, Ife Brown, IT82D-889, IT83D-442.
IITA/SAFGRAD Burkina Faso	KVx30-G246-2-5K KVx30-G183-3-5K KVx30-G6467-5-10K KVx30-G172-1-6K KN-1.	IITA/SAFGRAD Burkina Faso	KVx145-27-6, KVx145-27-4, KVx146-44-1,KVx165-14-1, TVx3236,KN-1.		

Appendix 2. Entries tested in observation nurseries in 1989-90. Cowpea Network:RENACO

Bruchids resistance		Aphids resistance		Virus resistance	
Source	Entries	Source	Entries	Source	Entries
IITA/Ibadan	IT86D-364, IT86D-498, IT86D-560, IT86D-713, IT86D-1038, IT86-87S-1393, IT87S-1463, IT84S-2246, IT87D-1827.	IITA/Ibadan	IT82E-25, IT86D-373, IT86D-888, IT86D-444, IT87S-1390, IT87S-1394, IT87S-1459, IT84S-2246, IT85D-3577.	IITA/Ibadan	IT84S-2135, IT85F-2805 IT85F-867-5, IT85F-2687, IT85F-1380, IT85F-3139, IT84D-448, IT84D-449, IT83S-872, IT81D-1137, IT83S-818, IT82E-16, Ife Brown, IT82E-889, IT83D-442.

1993-04

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MULEBA, Nyanguila