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WEST AND CENTRAL AFRICA COWPEA NETWORK

"Réseau Niébé de l'Afrique Centrale et Occidentale"

(R E N A C O)

Synthesis of Activities in Strengthening National Programs

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EXECUTIVE SUMMARY

Semi-arid West 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 and promising technologies from the resident research efforts were tested together with those developed by 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 deviced.

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 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.

Nearly all member countries have carried out their responsibilities vis-à-vis RENACO highly satisfactorily. New technologies have been developed by RENACO Lead Centers; the most promising ones have been regionally tested and have either been released or in various stages of multilocation and on-farm testings; as well as on-farm demonstration/seed multilplication of member countries.

The impact of networking on national programs is discussed in terms of:

- Changes in the performance of research institutions, human resources and policy environment for research;

- Changes in the output from research and development agents;

- Changes in utilization of high yielding and sustainable agricultural technologies; and

- Changes in the production, productivity, and incomes.

Note, however, that the new technologies developed under RENACO efforts could have, or probably not, contributed substantially to increased productivity, total production and incomes, but have undoubtedly contributed immensely to minimizing risks during bad years, which is the main concern of the peasant farmer of the semi-arid zone of Africa. This is so, because of the erratic nature of the rainfall in this zone. Perhaps it will

be worthwhile pondering over the question as to what would have been the fate of farmers, if agricultural research did not come up with alternative solutions in light of the climatic changes that have resulted in the loss of adaptation of local varieties in their localities of origin since the 1970's and 1980's. The answer is simply "catastrophic", so, there is the impact!

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, 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, Tchad 5.2, 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 foods 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 liking 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.

I

IITA CONTRIBUTION TO STRENGTHENING NATIONAL COWPEA PROGRAMS IN SEMI-ARID WEST AND CENTRAL AFRICA

1. IITA INVOLVEMENT IN COWPEA IMPROVEMENT IN BURKINA FASO

Although the mandate of the International Institute for 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. 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 United States Agency for International Development (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 to national programs. 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. The 3-man team, made up of a breeder, and agronomist and an entomologist were 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:

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 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.

a.1) **Cowpea production constraints:**

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

1) The Sahel: 200-600 mm rainfall from mid-June to mid-September;
2) Sudan Savanna: 600-900 mm rainfall from June to September;
3) Northern Guinea savanna: 600-900 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 are gradually increasing 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 constraints**

Poor on-farm testings, inadequate seed production and distribution system and continued cultivation without use of appropriate inputs.

5) **Financial constraints**

All national programs have limited resources to conduct appropriate research, up-grade research infrastructures, train and keep their scientists abrest 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:

a.2) **Cowpea breeding**

Cowpea breeding in Burkina Faso started in 1977 on a bilateral agreement between the Government of Burkina Faso and the International Development Research Center (IDRC) of Canada with IITA as an executing Agency. It was incorporated in 1979 in the SAFGRAD project, sponsored by USAID with the IITA assigned agronomist and entomologist to work with the breeder in 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 1.1. 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 1.1. 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 1.2.

In 1980, the IITA/SAFGRAD 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 resistance and biological: insect pests, Aphids, Thrips, *Maruca* and bruchids resistances; and from 1982 they were biological: including *Striga* resistance and combined biological

Table 1.1. 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 1.1. 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 1.2. 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 Botswana Nigeria Senegal IITA/SAFGRAD (Burkina)	Kpodiguegue Blackeye, Rhenostar IAR/341,AIR/48,IAR/355 58-57,Mougne,Bambey-21, NDiambour TVx1999-O1F,TVx1999-O2E, TVx309-1G,TVx1948-O1F, VITA-4, VITA-5, Gorom Local(SUVITA-2) VITA-7 (KN-1), Ife-Brown.	Benin Botswana Niger Nigeria Senegal IITA/SAFGRAD (Burkina)	Kpodiguegue Blackeye,Rhenostar TN88-63,TN13-78 IAR/341,IAR/48,IAR/355 58-57,Mougne,Bambey 21, NDiambour TVx1999-O1F,TVx 1948-O1F VITA-4,VITA-5,Gorom L. (SUVITA-2), VITA-7 (KN-1) TVx 3236	Benin Botswana Niger Nigeria Senegal IITA/Ibadan (Nigeria) IITA/SAFGRAD (Burkina)	Kpodiguegue Rhenostar TN88-63 IAR/341,IAR/48,IAR/355 58-57,59-9, Mougne,Bambey-21, Diambour. TVx4262-O9D TVx1999-O1F, TVx1948-O1F, VITA 4,VITA-5, Gorom L. (SUVITA-2) VITA-7 (KN-1), TVx3236.
2) INSAH		None		None	- Mali - Mauritania - Niger - Senegal IITA/SAFGRAD (Burkina)	15-316, Niban Kaedi B & Gris. TN88-63 58-57,Mougne 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 1.2. 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
- **Total number of cultivars**		**19 cultivars**		**20 cultivars**		**27 cultivars**
- **New cultivars**		**19 cultivars**		**2 cultivars**		**3 cultivars**

Table 1.2. 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)	IT82E-18, IT82E-32, IT82E-60, IT82E-70, IT82E-77.		None		None
	Senegal	Bambey-21				
	IITA-SAFGRAD (Burkina)	KVu 69, TVx4659-13C-1K				
4) Regional Medium maturity trial	Ethiopia	White wonder Tr.		None		None
	Niger	TN88-63				
	Nigeria	IAR/48				
	Senegal	Mougne				
	IITA-Ibadan (Nigeria)	TVx4262-09D, IT81D-994, IT81D-1157, IT81D-1137, IT81D-952, TVx4659-03E				
	IITA-SAFGRAD (Burkina)	Gorom local (SUVITA-2) TVx3236, VITA-7 (KN-1), TVx1999-01F				
5) Regional *Striga* resistance trial		None	Senegal	Mougne(susceptible control).	Senegal	Mougne(susceptible control).
			IITA-SAFGRAD (Burkina)	KVx30-166-3G, KVx30-183-3G, KVx100-1, KVx100-2, KVx68-1, KVx68-2, KVx61-1, KVx61-2, KVx61-3, Gorom Local (SUVITA-2).	IITA-Ibadan (Nigeria)	IT82D-716
					IITA/SAFGRAD (Burkina)	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 1.2 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).
- Total number of cultivars		21 cultivars		20 cultivars		27 cultivars
- New cultivars		13 cultivars		15 cultivars		10 cultivars

Table 1.2. 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 constraints 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 1.1). This effort was translated by the nomination of *Striga* and drought resistant cultivars by the project beginning 1984 (Table 1.2).

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 1.2).

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 1.3.

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 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

Table 1.3. 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 1.3. 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**

blotch, bacterial pistule and viral diseases are problems of the Sudan savanna (IITA-SAFGRAD 1981, 1982, 1983, 1984, and 1985 Annual Reports; Muleba *et al.* 1991).

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 *et al.* 1991).

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).

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, 1983-1987).

5) Ploughing soils by hand, tractor or animal traction prior to planting is conducive to high yields in all ecologies, especially the Sudan savanna than planting on no-tillage 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 can improve soil water retention and increase seed yield even during very wet years (IITA-SAFGRAD Annual Reports 1981-1985, 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 1985-1987).

8) A 90-day to maturity maize, sown in early-to-late-June can 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).

9) Cereals and cowpea can be intercropped in all the three 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, 1983-1987, Muleba *et al.* 1985).

10) 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).

11) 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).

12) 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).

a.4. **Cowpea entomology research**

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 1.4.

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.

Table 1.4. 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**

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.

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.

b.1) **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.

b.2). **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 1.2. 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 1.5. Similarly, regional cowpea agronomy and entomology trials are contained in Table 1.6.

b.3) **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.

Table 1.5. Cowpea Network Recapitulation of IITA-IDRC-SAFGRAD regional cowpea variety trials.

Trial name	1980	1981	1982	1983	1984	1985	1986
1 Adaptation§	Y	Y	Y	N	N	N	N
2 INSAH	N	N	Y	N	N	N	N
3 Early maturity	N	N	N	Y	N	N	N
4 Medium maturity	N	N	N	Y	N	N	N
5 *Striga* resistance	N	N	N	N	Y	Y	Y
6 Drought resistance	N	N	N	N	Y	Y	Y
- Number of total cultivars dispatched	19	20	27	21	20	27	27
- Number of new cultivars dispatched	19	2	3	13	15	10	12

§ Y and N indicates trials dispatched or not, respectively, during these years.

Table 1.6. Cowpea Network: Regional agronomic and entomological trials dispatched to members countries by IITA/SAFGRAD.

Activities	1980	1981	1982	1983	1984	1985	1986
a) **Agronomy**							
1) **Cowpea management trials**							
. Number of treatments	8	-	-	-	18	12	-
. Number of sets	13	-	-	-	1	4	-
. Number of countries	5	-	-	-	1	2	-
2) **Maize-cowpea relay cropping system**							
. Number of treatments	-	-	-	8	8	8	-
. Number of sets	-	-	-	3	6	5	-
. Number of countries	-	-	-	3	3	3	-
3) **Sorghum-cowpea intercropping system**							
. Number of treatments	-	-	-	-	-	-	-
. Number of sets	-	-	-	-	-	-	-
. Number of countries	-	-	-	-	-	-	-
b) **Entomology**							
1) **Standardized sampling methods**							
. Number of trials	1	1	1	-	-	-	-
. Number of insects	3	3	5	-	-	-	-
. Number of countries	2	5	2	-	-	-	-
2) **Minimum insecticide treatments**							
. Number of treatments	9	9	9	9	10	4	4
. Number of sets	-	-	-	6	9	8	18
. Number of countries	2	2	1	4	4	4	6
Total number of technologies tested	**18**	**10**	**10**	**17**	**36**	**24**	**4**

b.4) **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.

II

RENACO CONTRIBUTION TO STRENGTHENING NATIONAL PROGRAMS

From the laudable scientific breakthrough 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 cowpea scientists of the 18 SAFGRAD member countries as well as Regional and International Research Centres that the SAFGRAD project should be extented into a second phase. The United States Agency for International Development (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.

1. 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 2.1.

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 2.1 RENACO Steering Commitee Meetings held since 1987-1992

Date	Venue	Number of		Observers*
		Attendance	Absent	
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	o	6
23-24 March, 1989	Lome (Togo)	7	o	5
6-10 Nov., 1989	Ouagadougou (Burkina Faso)	7	o	6
26-30 March, 1990	Ouagadougou (Burkina Faso)	5	2	4
5-9 Nov., 1990	Cotonou (Benin)	7	o	7
13-14 March, 1991	Niamey (Niger)	7	o	2
11-14 Nov, 1991	Ouagadougou (Burkina Faso)	7	o	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.

2 .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 it imperative that the technology development research activities 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.

2.1. Research responsibilities

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

1) **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.

2) **Cameroon**

- Cowpea storage including the control of storage insect pests.

3) **Ghana**

. Breeding for adaptation to humid, sub-humid and transition zones.

. Cowpea entomology for above zones.

4) **Niger**

. Breeding for drought, *Striga* and *Micropmhomina spp* diseases.

. Agronomic studies (millet-cowpea intercropping) and cowpea pathology (*Macrophomina spp*) for the Sahelo-Sudanian zones.

5) **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.

6) **Senegal**

. Breeding for drought, insect pests and disease resistance.

. Cowpea entomology for the Sahelo-Sudanian zones.

Owing to variations 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.

2.2. Implementation of collaborative research activities

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 2.2.

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, Bal of Senegal and Toure of Mali.

Table 2.2. 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
Benin (Assoc.C)												
Validation studies for *Striga* resistance in coastal zones				x	x	Yes	x	x	Yes	x	x	Yes
Burkina Faso												
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
Cameroon												
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 2.2. (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 2.2. (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	-	-	-	-	-

3. 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 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 with the view of helping NARS, especially Lead Centers discharge their duties as effectively as possible towards accomplishing its objective of boosting the iniative and capacity of national scientists to direct cowpea research activities themselves in the nearby future. 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 a capable resource person in offering on-the-spot training to the junior scientific personnel of his 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.

3.1. Cowpea monitoring tours

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 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.

3.2. 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 actitivities, 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 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).

The technology exchange component offers the opportunity to each NARS and IITA scientists to present their research activities, including 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 for nomination and designing of regional trials 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 2.3 supplies details of workshops and monitoring tours organized by RENACO since 1987.

3.3. Seminars and Group Training Sessions

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

Table 2.3. Workshops and Cowpea Monitoring Tours

	1987	1988	1989	1990	1991
Activity	Workshop	Tour	Workshop	Tour	Workshop
- 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

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 2.4. The proceedings of each training activity was published (Muleba & Emechebe 1988; Muleba & Detongon 1991; Muleba *et al*. 1992).

Table 2.4. 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

4. REGIONAL TRIALS

In addition to scientific information generated by Lead Centers and IITA scientists which are presented during a workshop, either as scientific papers or country research activity reports, regional trials constitute an important output of the network efforts. Any new technology tested in a regional trial, adoppted by NARS and transferred to farmers in a country, represents a major economic breakthrough for such a country. Technology development; be it a cultivar or an agronomic practice, demands spending huge sums of money, time, energy and hard work for planning and implementing experiments of which concrete results may not be obtained in less than 5-6 years.

Regional trials designed by RENACO and distributed to NARS since 1987 are given in Table 2.5 with regards to cultivars and Table 2.6 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, epecially 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. More over the departure of certain senior cowpea breeders for higher education, namely Issa Drabo of Burkina Faso and Issaka Maga of Niger, were replaced by junior scientists, yet remarkable research ativities were carried out by those countries. Thus, Burkina Faso with the support of the Network Coordinator, 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

Table 2.5. 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-45O-4, IT82D-479-1,IT82D-849	INERA Burkina IITA-SAFGRAD Burkina	KVx396-11-6, KVx396-8-5, KVx396-6-1,KVx 4-4-2,KVx396-4-4-4, B3O1,IT82D-849; IT82E-32 (Susceptible control) Gorom Local (Suvita-2)	INERA Burkina	KVx164-65-5, KVx291-47-222,KVx397-6-6, KVx4O2-5-2,KVx4O2-19-5,KVx3O5-118-31,B3O1
	IITA-SAFGRAD	KVx61-1,KVx61-2, KVx61-74,KVx65-114, KVx68-31-3,KVx183-1, B3O1, Gorom Local (Suvita-2)	INRAN	TN93-8O,TN121-9O;	IITA-Ibadan INRAN,Niger	IT81D-994,IT82D-849, IT82E-32, TN5-78
2) Adaptation to Sahelian-Sudanian zones	Niger IITA-Ibadan	TN88-63, IT83S-343-5,IT81D-994,IT82D-699, IT84S-2137,IT83S-34O-5;	IITA-Ibadan through IAR Nigeria IITA-Ibadan Niger	IT85D-3517-2, IT85D-3516-2, IT85D-3577, IT83D-219; TVx3236 TN88-63 (control)	INERA, Burkina INRAN,Niger ISRA,Senegal	KVx396-4-5-2D,KVx164-41-64,KVx4O2-5-2, KVx4O2-19-5,KVx396-16-1O-1, KVx396-18-10 KC85-7,KB85-18 IS86-275N;B89-5O4N;
	IITA-SAFGRAD Burkina	KVx3O-3O5-3G,KVx 6O-K26-2,KVx6O-PO4-1,KVx61-1, KVx65-114,KVx183-1, KVx249-P37-3O,KVx25O-K27-18,KVx257-K21-3, KVx268-KO3-3,KVx256-K17-11, Gorom Local (Suvita-2)	INERA Burkina Faso	KVx3O-3O9-6G,KVx 396-4-4,KVx396-4-5,KVx396-18-1O, KVx396-11-6;	IITA-ICRISAT IITA-Ibadan	ITN89E-4, IT89E-3, TVx3236

Table 2.5. 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 2.6. RENACO Research effort in regional cowpea agronomic and entomological trials.

Activities	1987	1988	1989	1990	1991
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**	**-**	**-**	**-**

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 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 2.5).

Regional agronomic and entomological trials, issue of IITA-SAFGRAD efforts were distributed only in 1987-88 (Table 2.6). 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 Table 2.7.

Table 2.7. Regional Trials dispatched to RENACO member countries and feedback received since 1987-91*.

Country	1987-88			1989-90			1991		
	Number		Report (Yes/No)	Number		Report (Yes/No)	Number		Report (Yes/No)
	Planned	Compl.		Planned	Compl.		Planned	Compl.	
Benin	4	4	Yes	2	1	Yes	6	6	Yes
Burkina Faso	10	10	Yes	6	4	Yes	9	9	Yes
Cameroon	3	2	Yes	4	2	Yes	6	4	Yes
Cape Verde	1	1	Yes	2	1	Yes	2	1	Yes
Central Afr.Rep.	1	0	No	0	0	-	3	3	Yes
Côte d'Ivoire	1	0	No	1	1	Yes	2	2	Yes
The Gambia	6	2	Yes	1	1	Yes	2	2	Yes
Ghana	4	4	Yes	1	1	Yes	4	4	Yes
Guinea Bissau	3	1	Yes	3	0	No	5	0	No
Guinea Conakry	6	4	Yes	13	6	Yes	4	2	Yes
Mali	8	4	Yes	3	3	Yes	7	6	Yes
Mauritania	1	1	Yes	2	2	Yes	3	2	Yes
Niger	9	6	Yes	4	1	Yes	6	6	Yes
Nigeria	13	6	Yes	6	5	Yes	7	5	Yes
Senegal	8	2	Yes	1	1	Yes	4	0	No
Sierra Leone	0	0	-	0	0	-	3	2	Yes
Tchad	7	2	Yes	5	5	Yes	7	2	Yes
Togo	7	7	Yes	9	9	Yes	5	4	Yes
Total	**92**	**56**		**63**	**44**		**85**	**60**	

* Upon recommendation of the Steering Committee in November 1987, RENACO dispatches regional trials every two years, i.e., the year during which a workshop is held

5. 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 2.8. 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 2.8. 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 Comittee 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.

6. FINANCIAL SUPPORT TO NARS

During the November 1987 meeting, the RENACO Steering Committee felt that agricultural research activities of all participating countries was the responsibility 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 1991 presented in Table 2.9.

Table 2.9. Assistance to National Cowpea Programs in cash and cash equivalent of materials/equipment ($) (1987-91).

Country	1987/88	1989	1990	1991*	Total
Benin	667	580	-	2,000	3,247
Burkina Faso	9,800	6,500	5,327	5,484	27,111
Cameroon	1,950	1,900	1,000	2,000	6,850
Cape Verde	700	600	-	580	1,880
Central Afr. Rep.	-	-	527	580	1,107
Chad	-	-	-	580	580
Côte d'Ivoire	-	585	527	580	1,692
Gambia	-	580	-	580	1,160
Ghana	-	580	1,928	2,000	4,508
Guinea	700	1,180	-	580	2,460
Guinea Bissau	700	600	-	580	1,880
Mali	-	-	1,909	2,000	3,909
Mauritania	-	600	-	580	1,180
Niger	1,950	-	1,000	2,000	4,950
Nigeria	4,700	4,000	2,000	4,000	14,700
Senegal	2,923	2,923	2,862	2,000	10,708
Togo	-	600	-	-	600
Total	24,090	21,228	17,080	26,124	88,522

III

IMPACT OF THE WEST AND CENTRAL AFRICA COWPEA NETWORK (RENACO) ON COWPEA PRODUCTION IN THE SUB-REGION

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 of which it belongs to. 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 adpatation 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, 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.

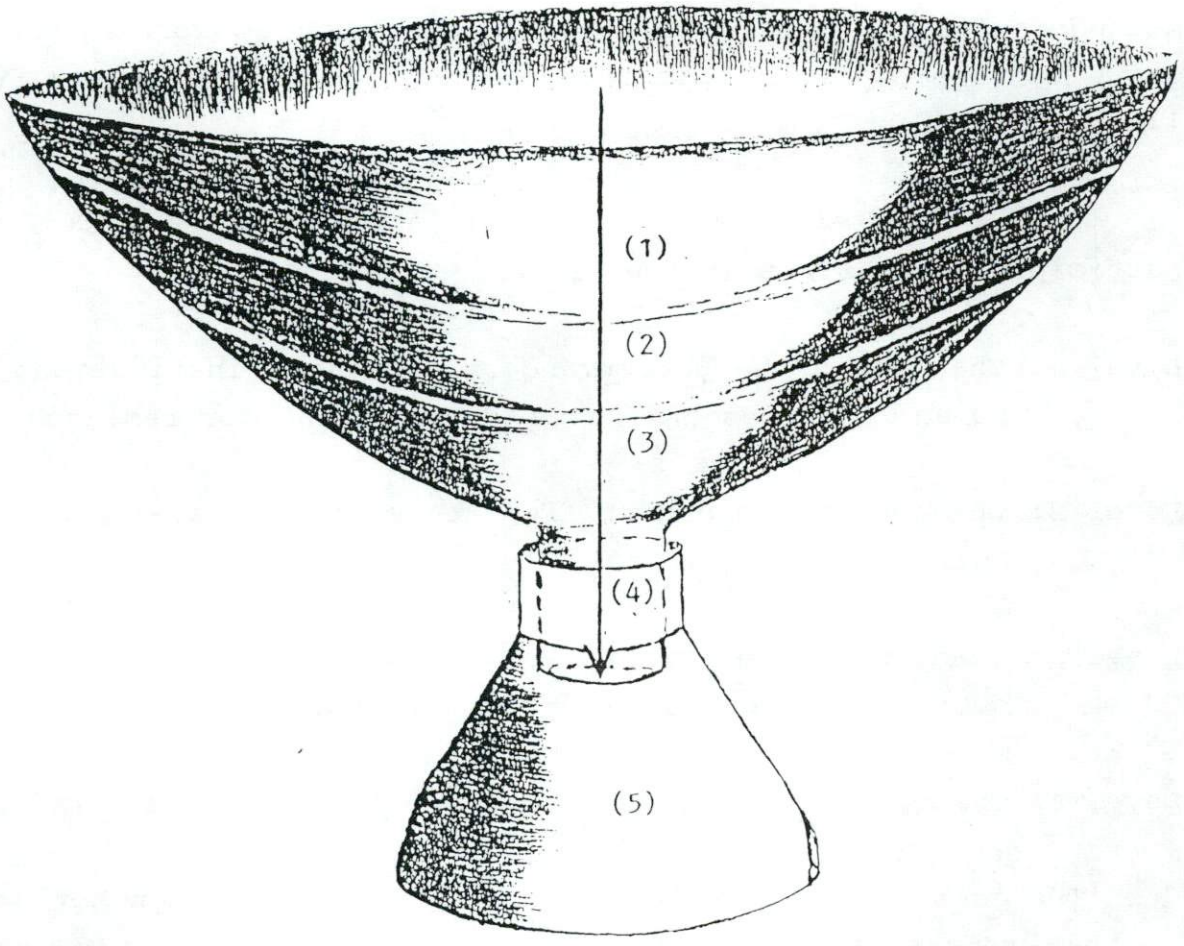

Figure 1. Flow of technologies from agricultural experimentation and their transfer to farmers hands with germplasm as an example is carried out in 5 distinct phases visualized as a funnel. With (1) identification of potential technologies (germplasm collection, introduction and evaluation; breeding 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 farmers supervision and on farm demonstration); (5) Release of and commercial use of new technologies by farmers.

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 parameters for measuring 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 synthetized in this report were extracted from the feedback received from NARS annual reports, visits of RENACO senior staff to NARS and questionaire information obtained from NARS scientists in 1991. The in-depth study based on sampling methodology proposed by the technical study support team will reveal the extent of RENACO impact on NARS.

RENACO IMPACT ON NARS (LEVEL 1)

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

1.1. Improvement in research output quantity and quality by RENACO Lead Centers

a) Adoption of new research methodologies

New research methodologies including some agronomic practices extended to NARS by RENACO to improve their research outputs as well as farmers production ability were adopted by Lead and technology adapting centers of NARS, Table 3.1.

b) RENACO Lead Centers Research Projects

All the RENACO Lead Centers have carried out their research projects satisfactorily (Table 2.2), 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 3.2), cowpea agronomy from 1988-1991 (Table 3.3), cowpea entomology from 1988-1991 (Table 3.4), and cowpea pathology (Table 3.5). Similarly, Nigeria carried out research work in the same order: Cowpea breeding (Table 3.6), agronomy (Table 3.7), entomology (Table 3.8) and pathology (Table 3.9).

c) Technologies developed through RENACO efforts from 1987-1991

RENACO Lead Centers have successfully identified or developed the folowing technologies.

Table 3.1. Research methodologies and findings extended by RENACO and accepted by NARS.

Description of research methodology and findings	Country applying it
- Use of sowing dates in screening cowpea for adaptation to semi-arid zones.	Burkina Faso, Niger and Nigeria
- 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
- Minimum insecticide to protect cowpea against insect pests	Burkina Faso, Cameroon, The Gambia, Ghana, Guinea Conakry, Niger, Nigeria, Senegal.
- Maize-cowpea relay cropping and cereals-cowpea intercropping systems	Benin, Burkina Faso, Cameroon, The Gambia, Ghana, Guinea Bissau, Guinea Conakry, Nigeria, Tchad, Togo
- Bio-test for screening cowpea for bruchids resistance	Burkina Faso, Cameroon, Ghana, Guinea Conakry, Mali, Togo.
- Bio-test for screening cowpea for aphids resistance	Burkina Faso, Ghana.
- Tied ridges technique	Burkina Faso, Cameroon, Mali.
- *Striga* resistance methodology	Benin, Burkina Faso, Ghana, Mali, Niger, Nigeria, Senegal, Togo.

Table 3.2. 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 3.2. 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 3.3. 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 3.4. 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 3.5 . 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**	**-**

Table 3.6. 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 3.7. 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 3.8. 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 3.9. 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**

- *Striga* resistant cultivars (Table 3.10)
- New cultivars with good agronomic attributes (Table 3.11).

All these cultivars and even some others not listed in Tables 3.10 & 11, such as CR-06-07 have been subjected to RENACO regional trials.

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 storage of sterilized cowpea in airtight double plastic bags or traditional containers with 3 cm of ash on top of stored cowpea to prevent further reinfection by bruchids (Bean/Cowpea CRSP/1IRA-Cameroon Annual Report 1990).

1.2. Technology adaptation

Most NARS members of RENACO are applying the technology experimentation and transfer funnel model; with Burkina and Nigeria cited as examples. From this exercise, cultivars listed in Table 3.12 have been adopted by NARS and are presently in various stages of multilocation testing and on-farm testings/ demonstrations before release, eventually.

1.3. Human resources

The greatest impact of RENACO on NARS with regards to the above aspects is the renewed interest and total commitment of national scientists to cowpea research activities. A total number of about 62 national scientists from the West and Central Africa Cowpea Network member states are not only enthusiastic in carrying out their respective responsibilities in cowpea research but also keep collaborative contacts among themselves including IITA in developing approriate technologies meeting their local farmers' needs and requirements. Note that management of RENACO is by the NARS driven Steering Committee which meets twice a year to examine the activities of the Network and decide on areas needing attention to be executed by the Network Coordinator. It is recognized that their hard work and frankness in taking

Table 3.10. *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

Table 3.11. 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)
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)

Table 3.12. 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.
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.
Cape Verde	IT83D-444.
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.
Togo	TVx 1850-01E; IT81D-985; 58-146; IT83S-818; IT82E-66; KVx 396-4-4.

decisions for implementation is the result of the positive accomplishment of RENACO objectives and goals attained. It is further recognized that without the total concern of NARS, RENACO output, either from regional trial distribution, the scientific papers and country reports presented at the biennial network workshops could not have been possible.

Thus, the linguistic barriers that have always separated luzophone, anglophone and francophone countries from learning from one another have been broken.

In addition, an unprecedented collaborative research link has been established between cowpea scientists and peasant farmers, thanks to the farming systems research and extension workers throughout the cowpea network area. This has permitted the conduct of multilocation trials and on-farm testings and the release of new cultivars (see impact level 2) and many others in the pipeline to be released in the very near future (Table 3.12).

1.4. **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.

RENACO IMPACT ON NARS (LEVEL 2)

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

2.1. 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 of RENACO regional trials. The cultivars are listed in Table 3.12.

The advanced yield trials and multilocation trials were conducted with the view of identifying the geographical areas or recommendation domains where the new and promising cultivars will have a comparative advantage over local varieties so that they can then 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 3.13. 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 3.14 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

Table 3.13. 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 3.14. 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	-	-	-	-

programs are striving hard to make promising cultivars suitable for their farmers needs and circumstances.

2.2. Renewed interest in on-farm testing

In addition to advanced yield trials and multilocation trials reported, cultivars listed in Table 3.12; many of the same cultivars were also subjected to on-farm testings, of which breeders, farm systems research scientists and extension workers are working closely together to get them to farmers and to gather their reactions as to their appropriateness for further improvement, if necessary. The best cultivars obtained from the on-farm testing in Burkina Faso from 1982-1991 are given in Table 3.15. Yields of these varieties were 15-78% higher than the available commercial varieties in their areas of exploitation. On-farm test results from Nigeria are presented in Table 3.16.

2.3. Cultivars released

Table 3.17 shows cultivars released; they are being widely used by farmers for commercial purposes.

2.4. 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 3.15. 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	TVx1999-01F	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	0	- do -	IITA-Ibadan	- do -	fair	poor	fair
1984	TVx3236	0	- do -	- do -	- do -	- do -	fair	poor
1984	Suvita-2	0	*Striga* & drought resistant	IITA-SAFGRAD-INERA, B.F.	good	good	fair	poor
1985	TVx 3236	0	- do -	IITA-Ibadan	fair	fair	fair	poor
1985	KN-1	0	- 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	0	*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	KVx30-309-06G	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 3.16. 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 3.17. Cultivars released or in use by farmers since 1987.

Country	Variety
- Benin	IT82E-32; IT81D-1137; TVx 1850-01F.
- Burkina Faso	TVx 3236; Suvita-2; KVx396-4-4; KVx396-4-2; KVx396-4-5-2D.
- Cape Verde	KN-1; Local Santiago.
- Ghana	Vallenga (IT82E-16); Asontem (IT82E-32).
- Guinea Bissau	IT82E-9; IT83S-889.
- Guinea Conakry	IT85F-867-5; IT83D-338-1; IT84S-2246-4.
- Mali	Suvita-2; KVx61-1.
- Mauritania	IT83S-343-5-5; Suvita-2; KVx 256-K17-11
- Nigeria	Sampea-7 (IAR-48).
- Senegal	IS86-275.
- Togo	58-146.

RENACO IMPACT ON NARS (LEVEL 3)

Although we have no data at hand showing production acreage of SAFGRAD-RENACO cultivars in member countries, there is clear evidence of them being cultivated in large areas as described below. Nevertheless, new varieties or technologies usually take quite some time before getting deep down to every farmer's hands, especially in the case of the resource poor African farmer who has no means of purchasing seed, although 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:

- KN-1 (Vita-7), although was released for the first time in 1981, it has been widely used in most of the tests in Burkina Faso which 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.

- Suvita-2 (Gorom local) is very popular in the Sahel.

- TVx3236 is also used in the northern Guinea and sudan savannas.

- 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.

- IT81D-985, released as Br-1 - bruchid resistant, 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 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).

- 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

- IAR-48 was released 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), is also very popular.

RENACO IMPACT ON NARS: (LEVEL 4)

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 cultivars, makes them more advantageous over local cultivars. The multiple attributes incorporated in the varieties alone are considered to be an unmeasurable 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.

The productivity, total production and income generated to farmers by agricultural research proposed by the SAFGRAD Impact Study Team shall be useful for scientific and economic planning and we shall endeavour to gather this information through our economic studies to be conducted. Nevertheless, it will be interesting to imagine what would have been the fate of farmers if agricultural research did not come out with timely solutions towards the climatic changes that have taken place, rendering local cowpea varieties unadapted since the 1970's and 1980's. The answer is simply "catastrophic", so, there is the impact!.

REFERENCES

Annual Report (1989): SAFGRAD-II: Maize and Cowpea Collaborative Research Networks' for West and Central Africa. IITA-SAFGRAD (International Institute of Tropical Agriculture, Semi-Arid Food Grain Research and Development Project), Ouagadougou, Burkina Faso. *Annual Report 1988/89,* pp. 24-37.

Annual Report (1990): SAFGRAD-II: Maize and Cowpea Collaborative Research Networks' for West and Central Africa. IITA-SAFGRAD, Ougadougou, Burkina Faso. *Annual Report 1989/90,* pp. 26-59.

Annual Report (1991): SAFGRAD-II: Maize and Cowpea Collaborative Research Networks' for West and Central Africa. IITA-SAFGRAD, Ouagadougou, Burkina Faso. *Annual Report 1990/91,* pp 37-106.

Bal, B.A. (1991). Action threshold for flower thrips on cowpea *(Vigna unguiculata (L.)* Walp.) in Senegal. *Tropical pest management,* 37,363-367.

Bationo, A., Mokwunye,U.A. & Baanate, C.A. (1985). Agronomic and economic evaluation of alternative phosphate fertilizer sources in Niger.In: *Appropriate Technologies for farmers in Semi-Arid West Africa* (Eds. H.W. Ohm and J.G. Nagy), pp. 110-122. Purdue University, U.S.A.

Bean/Cowpea CRSP Purdue University/IRA-Cameroon project (1990). A supplement of the 1990 detailed project Annual Report, October 1-December 31, 1990. Maroua, Cameroon. pp. 1.24.

Fajemisin, J.M., Muleba, N., Emechebe, A.M. & Dabire, C. (1989). Towards production technologies for maize and cowpea in Semi-Arid West and Central Africa. *Scientific papers presented at a Joint Workshop of SAFGRAD Maize and Cowpea Networks;* Lome, Togo, March 20-24, 1989. IITA-SAFGRAD, Ouagadougou, Burkina Faso.

IAR (Institute of Agricultural Research) (1978). Report on legumes eand Oilseeds Research Programme. Zaria, Nigeria. *IAR*, pp. 89-140.

IAR (1989). Report on Legumes and Oilseed Research Programme, Zaria, Nigeria. *IAR,* pp. 297-338.

IAR (1990). Report on Legumes and Oilseed Research Programme, Zaria, Nigeria. *IAR,* pp. 64-110.

IAR (1991). Report on Legumes and Oilseed Research Programme, Zaria, Nigeria. *IAR,* pp. 73-128.

IAR (1992). Report on legumes and Oilseed Research Programme, Zaria, Nigeria. *IAR,* pp 73-120.

IITA-SAFGRAD (International Institute of Tropical Agriculture, Semi-Arid Food Grain Research and Develoment Project) (1979). Annual Report. Ouagadougou, Burkina Faso. *IITA-SAFGRAD*, pp. C1-C71.

IITA-SAFGRAD (1980). Annual Report. Ouagadougou, Burkina Faso.*IITA-SAFGRAD*, pp. C1-C76

IITA-SAFGRAD (1981). Annual Report. Ouagadougou, Burkina Faso. *IITA-SAFGRAD*, pp. C1-C102.

IITA-SAFGRAD (1982). Annual Report. Ouagadougou, Burkina Faso. *IITA-SAFRAD*, pp. 74-104.

IITA-SAFGRAD 1983. Annual Report. Ouagadougou, Burkina Faso. *IITA-SAFGRAD,* pp. 104-218.

IITA-SAFGRAD 1984. Annual Report. Ouagadougou, Burkina Fa
IITA-SAFGRAD, pp. D1-D38, E1-E68 & F1-F18.

IITA-SAFGRAD 1985. Annual Report. Ouagadougou, Burkina Faso.
IITA-SAFGRAD, pp. D1-D41, E1-E69 & F1-F34.

IITA-SAFGRAD 1986. Annual Report. Ouagadougou, Burkina Faso.
IITA-SAFGRAD, pp. D1-D39, E1-E55 & F1-F28.

IITA-SAFGRAD 1987. Annual Report. Ouagadougou, Burkina Faso.
IITA-SAFGRAD, pp. D1-31, E1-E9O & F1-F31.

Muleba, N., Brockman, F. (1985). Système de relais de cultures maïs-niébé dans la savanne Soudanienne. *Liaison Sahel (Institut du Sahel, Bamako, Mali),* 3,71-79.

Muleba, N. & Brockman, F. (1991). Effect of seedbed preparation methods on cowpea yield in Alfisols and Oxisols in Semi-Arid West Africa. *Tropical Agriculture (Trinidad)*, 68, 45-5O.

Muleba, N., Brockman, F. & Kagne, D. (1985). Variety development for association cropping. In: *Appropriate technologies for farmers in semi-arid West Africa* (Eds. H.W. Ohm and J.G. Nagy), pp.269-277.

Muleba, N. & Detongnon, J., (1989). Proceedings of the Cowpea Workshop: Country Reports and other Activities, Lome, Togo, March 2O-24, 1989. 27 pp.

Muleba, N. & Detongnon, J. (1991). Experimentation Agricole et transfer de technologies avec le niébé comme exemple. *Compte rendu du stage de perfectionnement professionnel tenu à Ouagadougou, Burkina Faso, 1O-24 Septembre, 199O;* pp. 92. (Publié par IITA-SAFGRAD, Ouagadougou, Burkina Faso).

...ebe, A.M. (1988). State of cowpea research in ...ones of West and Central Africa. *Proceedings of ...eminar for Cowpea Lead Center scientists held at ...dan, Nigeria, November 14-25, 1988;* pp. 74. ...ed by IITA-SAFGRAD, Ouagadougou, Burkina Faso).

..., Mwanke, M. & Drabo, I. (1991a). Use of successional ...owing in evaluating cowpea (*Vigana unguiculata*) adaptation to drought in the Sudan savannah zone. 1. Seed yield response. *Journal of Agricultural Science, Cambridge*; 116, 73-81.

Muleba, N., Mwanke, M. & Drabo, I. (1991b). Use of successional sowing in evaluating cowpea (*Vigna unguiculata*) adapatation to drought in the Sudan savannah zone. 2. Response of reproductive traits. *Journal of Agricultural Science, Cambridge*, 116, 83-93.

Muleba, N. & Olufajo, O.O.,(1991). Proceedings of the Cowpea Workshop: Country Reports and other Activities, Niamey, Niger, March 8-14, 1991 (in preparation).

Muleba, N., Thomas, M.D. Fajemisin, J.M. & Olufajo, O.O. (1992). Shaping agronomic research in West and Central Africa. *Proceedings of a Joint SAFGRAD Maize, Cowpea and Sorghum Networks' for research agronomists in West and Central Africa, January 7-18, 1991; IITA, Ibadan, Nigeria,* pp. 47 (Published by IITA-SAFGRAD, Ouagadougou, Burkina Faso).

Proceedings of Workshop on the reorientation of SAFGRAD Cowpea Research in Central and West Africa. March 23-27, 1987, Ouagadougou, Burkina Faso. pp. 27.

Rapports de synthèse (1982 & 1983), Programme national (CRDI/Haute Volta) pour l'amélioration du niébé; Kamboinsé, Ouagadougou, Burkina Faso.

Rapports de synthèse (1984-87), Programme national (CRDI)/Burkina Faso) pour l'amélioration du niébé; Kamboinsé, Ouagadougou, Burkina Faso.

Rapport d'activités (1988). Amélioration du niébé au Burkina Faso.

Rapport Annuel (1989). Programme protéagineux: Synthèse des resultats 1989. INERA (Institut d'Etudes et de Recherches Agricoles), Ouagadougou, Burkina Faso; pp. 2-57.

Rapport Annuel (1990). Programme Protéagineux: Rapport Annuel 1990; pp. 1-118.

Renard, P. (1949). La régéneration des terres épuisés du Sudan Français. *Bulletin Agricole du Congo Belge*, 40,2173-2188

Singh, B.B. & A.M. Emechebe (1990). Inheritance of *Striga* resistance in cowpea genotype B301. *Crop science*: 30,879-881.

Toure, M. (1991). La résistance génétique du niébé (*Vigna unguiculata (L.)* Walp.) à deux biotypes de *Striga gesnerioides* (Wild.) Vatk. Thèse de *Philosophiae Doctor* (Ph.D). Ecole de Gradués, Université Laval, Canada. pp. 104.

Tucker, C.J., Dregne, H.E. & Newcomb, W.W. (1991). Expansion and contraction of the Sahara desert from 1980-1990. *Science*, 253,299-301.

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