The Pan-Africa Bean Research Alliance (PABRA): Strengthening Collaborative Bean Research in Sub-Saharan Africa

1996-1999

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THE PAN-AFRICA BEAN RESEARCH ALLIANCE (PABRA): STRENGTHENING COLLABORATIVE BEAN RESEARCH IN SUB-SAHARAN AFRICA

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CANADIAN INTERNATIONAL DEVELOPMENT AGENCY (CIDA)
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INTRODUCTION

History of Bean Research Networks in Africa

The CIAT Bean Program was established by the CGIAR in 1974 with the world mandate to make a lasting increase in food availability and incomes of the poor by improving bean productivity through technology developed in collaboration with national institutions. To effectively work on a global scale, a Bean Program pioneered a strategy for grouping countries into *regional research networks* having agroecological and socioeconomic affinities to facilitate the development and transfer of new technologies across a large area in a more efficient and economical manner. In Africa, the first regional bean network was established in the Great Lakes Region (RESAPAC) in 1984, and soon followed by the Eastern Africa Bean Research Network (EABRN) and the Southern Africa Bean Network (SADC).

Prior to the establishment of the research networks, bean production in sub-Saharan Africa was poorly understood. National programs had little success in developing technologies capable of overcoming important production constraints. When new technologies were developed many were found not to be appropriate to farmer needs. The underlying reason for the lack of progress was that individual national programs were generally understaffed, with multiple legume crop development responsibilities, very limited budgets, no direct access to new technologies being developed elsewhere, and lacked training and orientation in on-farm research. The establishment of CIAT-managed regional bean networks was critical for strengthening national programs and organizing research activities in some of the poorest countries of the world.

The networks function as voluntary associations among national agricultural research systems (NARS) and with CIAT, and have a common objective to increase bean productivity in particular agro-ecological zones and/or socio-economic regions. All decisions on technical priorities, resource allocation, and assessment of research progress are the responsibility of the regional Steering Committees. Policy decisions concerning network activities are determined by regional committees of NARS Directors. Research planning is done through participatory Project Planning by Outputs (PPO) which gives individual scientists and other groups, such as extension agents and local NGOs, a sense of ownership and identification with the network. The core set of activities within a network is collaborative research, organized as regional sub-projects, and led by selected NARS scientists from institutions offering comparative advantages for a particular line of research.

The significant accomplishments achieved to date by the regional bean networks are a direct result of the close collaboration between CIAT scientific staff in the region and national program researchers. Daily interaction provides NARS with quicker access to new technologies and to on-the-job research training. It is not, however, a one-way flow of information. CIAT depends on the regional networks as much as the NARS to develop and test new technologies. The networks also facilitate the development and exchange of technologies

within/among NARS members. Greater across-network exchange of new technologies is evolving as the networks mature and strengthen.

The situation concerning bean research in Africa is very different today than it was ten years ago. The networks and their steering committees are now seasoned in network management, and the research sub-project mechanism has become institutionalized. Increasingly, coordination of the networks is being turned over to local management. The first network to be devolved was SADC in 1994, followed by RESAPAC in 1995. EABRN will become self-managing in 1996. The natural evolution of the networks towards self management is fully supported by CIAT, the donors, and the regional directors.

Yet, previous experience has shown that for the networks to be successful after devolution, there must be in place three critical components: 1) a commitment by the donors for continued support to the networks, 2) commitment by the NARS to conduct high quality research and to exchange the results with other member countries, and 3) a continuous supply of new technologies and research inputs by CIAT scientists to the NARS in a frequent and participatory manner.

Looking Toward the Future

As the regional networks evolve, research needs and priorities also change. Greater research effort is now needed to tackle and solve some of the most difficult constraints limiting bean productivity. Many of these constraints, such as low soil fertility, drought, specific diseases and insects, seed production methods, etc. are not regional in nature, but rather, go across regional boundaries and are common throughout much of sub-Saharan Africa. Increasingly, experienced CIAT and NARS scientists from one region are being called upon to supply technologies and information to other regional networks. Efficient collaboration among networks and scientists in Africa can greatly help to define common problems, priorities, and action strategies to combat these and other important constraints.

Inter-regional collaboration has become more important as overall donor support to bean research declines and the number of CIAT staff within the regional networks is reduced. A joint donor (CIDA, SDC, USAID)/CIAT meeting was held in Nairobi in 1991 (Graf et al, 1991) to discuss the future of the three bean networks. The overall purpose of the meeting was to develop a framework of action by the donors to establish sustainable support to bean research in Africa. The donors agreed that there were two overall problems with the present situation of maintaining three separate donor-funded projects on beans. First was the duplication of administrative activities among networks: Each of the three donors requires separate project proposals and budgets, and separate monitoring and evaluation reports for each network. This increases administrative overhead and ties up resources that could be made available for bean research activities. Second, was the cut backs in CIAT outreach staff: A full complement of CIAT technical staff to each regional network could not be sustained with declining budgets,

but any further loss of CIAT staff would cause a non-acceptable reduction in research output in the medium time frame.

The overall opinion of the donors was expressed as: "*Donor support for bean research in Africa has in the past focussed on a regional network framework. Over time this scenario is changing to require support on a inter-network modality in addition to support for sub-project activity in the intra-network context of the current scenario. As the networks progressively assume the responsibility of coordination and management of funds for sub-project activities, donors will need to find venues for channeling funds. As the same time CIAT personnel will assume an inter-network mode, which will require the donors to recognize that staff supported by them will increasingly be used on an inter-network basis until such time as CIAT core funding is sufficient to cover its activities.*" (Report of Joint Donor/CIAT Meeting on Bean Research in Africa, Nairobi, 20-22 November, 1991).

The report recommended that several actions be taken by CIAT, the networks, and the donors to investigate the possible merger of the three donor projects into one pan-Africa project. Within the larger pan-Africa project framework, the regional networks would be maintained as self-managing research units or sub-networks. Technical interactions among the networks has been encouraged through the formation of Pan-African Working Groups consisting of experienced scientists whose function is to review research progress and to advise steering committees.

Since the donor meeting, other events have continued to promote inter-network collaboration and self management. The Eastern Africa Committee of Directors, now functioning as the Association for the Strengthening of Agricultural Research in Eastern and Central Africa (ASARECA) was formed to develop regional policy guidelines on agricultural research and to provide governance to the different networks operating in the region. Through ASARECA there now exists the possibility of direct donor funding to the regional networks through this association.

Underway, is the recommended merger of RESAPAC with EABRN to form the Eastern and Central Africa Bean Research Network (ECABREN/RESAPACE). An immediate advantage of this merger is that the Directors of Research from Rwanda, Burundi, and Zaire can insure that the particular needs of the Great Lakes Region receive sufficient attention as members of a larger regional initiative. Another advantage is that research efforts, disrupted in Rwanda due to the outbreak of civil war and the continuing post-war reverberations on neighboring Zaire and Burundi, can be sustained in other ECABREN member countries. Indeed, this is already the case. Both Uganda and Tanzania have been active participants in the Seeds of Hope Project to resupply Rwanda with local genetic diversity that may have been lost or threatened due to the war.

In Southern Africa, Malawi recently reorganized its research on common bean and created a new program within the Ministry of Agriculture. The reorganization and funding of this

program has been back-stopped by a bilateral project funded by British ODA. Technical support to the newly formed national program is supplied by one CIAT scientist in the project. Research capacity in southern Africa has also been strengthened through the joining of the Republic of South Africa to the SADC-Bean Regional Network. South Africa, having excellent research infrastructure and well trained staff, may be able to supply important technical back-stopping to SADC. This is especially important as the number of CIAT scientist in SADC has declined significantly after CIDA support to the network ceased in 1993. South Africa can also benefit from being a member of the network by acquiring technologies that are especially appropriate to the millions of small-scale South African bean farmers.

The future of bean research in Africa is based on two important evolutions: 1) the formation of mature, self-governing regional research networks, and 2) greater involvement of CIAT staff in pan-Africa research efforts to solve recalcitrant and complex bean production constraints. This situation now permits the donors, CIAT, and the NARS to contemplate a new strategy for bean research in Africa which is put forth in the following project proposal: ***The Pan-Africa Bean Research Alliance (PABRA): Strengthening Collaborative Bean Research in Sub-Saharan Africa, 1996-2000***.

CHAPTER 1

IMPORTANCE OF BEANS IN AFRICA

1.1 Nutritional Significance

The nutritional trend in sub-Saharan Africa, unlike other regions of the developing world, has deteriorated since 1980, according to the United Nations Second Report on the World Nutrition Situation (UN ACC/SCN, 1992). One-third of the population of sub-Saharan Africa is not consuming adequate calories to maintain the already modest recommendation level of 2,100 kcal per day. Yet, the nutrition problem is not just one of total calories. Protein and micro-nutrient deficiencies are also increasing. When cereal consumption is not combined with legumes, protein deficiencies due to incomplete amino acid balances are common. Declining legume production and consumption in favor of cereals leads to decreased intake of dietary iron and increased anemia, especially in women and young children (Pinstrup-Andersen, 1993; Calloway, 1994).

Beans are characterized as being a nearly `perfect' food by the Nutrition Action Healthletter (1993). Beans are nutritionally rich, especially in protein, iron, and folic acid, and are a good source of dietary fiber and complex carbohydrates (Carpenter, 1981; Nutritional Action Healthletter, 1993; Uebersax and Hosfield, 1984). Furthermore, the presence of beans in the diet increases the utilization of maize and rice proteins due to complementarily in amino acids. Moreover, beans are one of the best sources of iron, with a single serving providing 23-30 percent of daily recommended iron levels.

Beans play an increasingly important role in the human nutrition in sub-Saharan Africa. In Eastern and Southern Africa, beans are the *second* most important source of protein after maize, and the *third* most important source of calories, after maize and cassava (Pachico, 1993). Beans outrank such stables as plantains, sweet potatoes, sorghum and millet in the caloric contribution, and exceed fish, milk, and beef as sources of total protein. In the Great Lakes region of Central Africa, beans play an extremely important role in daily dietary regimes as they provide up to 65% of the dietary protein and 32% of caloric intake (MINIPLAN, 1988) In Rwanda and western Kenya, per capita annual consumption of beans exceeds 66 kg and is among the highest in the world.

Consumption of beans is high in large part because beans are a relatively inexpensive food (Pachico, 1993). Beans are the cheapest source of calories and protein in Uganda and Rwanda, and the cheapest source of protein in Tanzania. Nevertheless, recent production shortages in certain regions of Africa (e.g. Malawi and Rwanda), caused by the lack of high yielding varieties, environmental constraints, and civil strife, have driven bean prices up and above

what poor consumer can afford to pay. Consequently, malnutrition has sharply increased in these areas.

1.2 Production Facts and Trends

The principal bean producing countries in Africa are Kenya, Zaire, Tanzania, Uganda, Burundi, Rwanda, and Ethiopia (**Table 1**). The official statistics, however, underestimate bean production in countries where area statistics tend to reflect only monoculture beans, and exclude large areas inter-cropped with maize, sorghum, or bananas.

Bean production in Africa generally has been increasing by 2.1% per year, primarily through area expansion. But in recent years, area expansion has slowed due to population pressure, while bean yields have remained static. Present-day production practices can no longer keep up with consumption demands. CIAT economists warn that demand for beans in Africa will increase by 72% between 1985 and 2000, requiring an increase in average yield of 308 kg per hectare, including the new production areas (Pachico, 1993).

Meeting this demand through increased productivity now appears feasible as shown by on-farm research results of new technologies, and by adoption/impact studies of new bean varieties and cropping practices in Rwanda (refer to Section 2 on Impact).

Economic incentives will also continue to encourage bean production. The high annual rates of bean production increase in Kenya (5.9%) and Ethiopia (7.1%) during the past decade reflect a strong competitive position relative to alternative enterprises. A strategic study by Uganda's Ministry of Agriculture suggests that beans and bananas, the two dominant food crops, are likely to continue to be the most profitable crops (including the traditional cash crops).

Beans are grown predominantly by women farmers throughout sub-Saharan Africa, traditionally as a subsistence crop. Yet, recent economic surveys by EABRN indicate that about 50% of producers sell part of their harvest, mostly to urban populations: Tanzania and Uganda have an active informal trade to Rwanda, Kenya and Sudan; Kenyan beans are consumed in Somalia; Ethiopia's formal exports generated income of USD 20 million in 1989; Madagascar exports to Reunion and Mauritius. The income-generating aspect of bean production is becoming more important with improved market channels to urban centers, where populations are increasingly reliant on beans as an inexpensive source of protein. Fresh (non-dry) beans command a premium price due to their taste and fast cooking time. Snapbeans provide many enterprising small farmers with their first experience of cash-crop vegetable production; Kenya's rapidly expanding industry exported 19,000 tons in 1990 at a value of USD 28 million, while Ethiopia and Tanzania have smaller export markets. Tanzania also produces snapbean seed on contract to European seed producers.

Table 1. Estimated annual dry bean production statistics for African countries.

Country	Hectares	Yield (Kg/ha)	Imports (MT)	Exports (MT)
Angola	110,000	364	18,352	0
Burundi	380,000	902	0	0
Ethiopia	239,000	528	0	7,117
Egypt	20,000	2,000	24	1,487
Lesotho	7,300	343	1,000	700
Kenya	687,000	690	-	-
Madagascar	95,000	802	144	2,802
Malawi	135,000	559	-	-
Morocco	7,000	600	906	0
Mozambique	181,000	343	-	-
Rwanda	320,000	873	1,000	0
South Africa	87,000	-	16,850	6,950
Sudan	70,000	-	-	-
Swaziland	4,700	383	-	-
Tanzania	465,000	620	-	20,000
Tunisia	3,000	1,060	2,739	0
Uganda	400,000	741	-	12,000
Zambia	24,000	653	-	-
Zaire	510,000	593	-	-
Zimbabwe	24,000	691	0	1,868
Total	3,769,000			

Sources: Grisley, 1990; Grisley and Mwesigwa, 1990; Gitu, 1992; Eldin, 1983; Halila and Bouslama, 1983; Central Statistical Office, 1989; Bouazza, 1983. For Ethiopia, estimates are based partially on reports of farming systems surveys. Estimates for Zaire are based on observations of bean researchers.

CHAPTER 2

RESEARCH CAN INCREASE BEAN PRODUCTIVITY

2.1 Technical Solutions for Important Production Constraints

Low soil fertility, drought, diseases, insects, and the lack of inputs, together with the use of local varieties having low yield potential, are the principal technical constraints limiting bean productivity in sub-Saharan Africa (**Table 2**). Not all important constraints are biological in origin. Socio-economic factors related to farmer adoption of new technologies, seed distribution, and market regulations may also restrict bean production. New technology development is limited by the degree of organization, resources, and number of trained personnel within the national programs.

Over the last ten years, considerable progress has been made in applying science to understanding bean production constraints in Africa. Research results of CIAT and the NARS provided the networks a solid base upon which to build an effective research agenda for the end of the decade. Some of the new technologies being tested to solve important production constraints are as follows:

Improve soil fertility and bean adaptation to low fertility

- Low soil nitrogen and low organic matter contribute to poor yields in many African bean production environments. Green manuring by inter-cropping with *Crotalaria,* and in agroforestry associations with deep-rooted legumes such as *Sesbania,* is greatly increasing experimental yields. Participatory on-farm trials with agroforestry species have recently started in Uganda, Ethiopia, and Tanzania.

- Modern biotechnological approaches to study *Rhizobia* strain competitiveness for greater biological nitrogen fixation (BNF) are being used to evaluate the effectiveness of rhizobium inoculations under different environmental conditions. Indicator varieties that have lost the capacity to fix biological nitrogen through mutation breeding have been developed at CIAT for field use to quantify nitrogen fixation of bean varieties under a variety of environmental conditions. These materials will give African researchers a reliable and cheap tool for measuring nitrogen fixation in farmers' fields. Several promising new strains of *Rhizobia* have already been introduced to Africa from CIAT.

- Bean germplasm is being evaluated for tolerance to low soil phosphorus, low soil nitrogen, and low pH complexes. Low soil phosphorus is a problem commonly occurring in Madagascar, Rwanda, Malawi, Zambia, Mozambique, South Africa, and

in valley bottoms in Uganda and Tanzania. Lines showing greatest tolerance to soil nutritional constraints are distributed to breeders and agronomists through the Bean Improvement of Low Fertility in Africa (BILFA) trials.

Table 2. Bean production constraints of high importance in Sub-Saharan Africa, indicated by number of hectares ('000) and percent of area. [1,2,3]

Constraint	Hectares	(% area)
Diseases		
Angular Leaf Spot	2567	67
Rust	619	17
Anthracnose	1782	47
Ascochyta Blight	286	8
Charcoal Rot	260	7
Root Stem Rots	490	13
Fusarium Welt	190	7
Common Bacterial Blight	607	18
Bean Common Mosaic Virus	772	22
Insects		
Aphids	613	18
Bean Stem Maggot	1581	46
Trips	200	6
Ootheca	200	6
Bruchids	174	5
Low Soil Fertility		
Low Soil N	2015	53
Low Soil P	1667	44
Low Soil K	110	3
Low Exchangeable bases	296	8
Al/Mn Toxicity	306	8
Fe/P Fixation	257	6
Soil Moisture deficits		
Early Season	75	2
Med Season	594	15
Late Season	452	12

[1] High importance is indicated by > 300 kg/ha loss in yield potential.
[2] Estimates generally exclude bean production of West Africa (approx 100,000 ha), and occasionally other areas where information is lacking.
[3] Adapted from Wortmann and Allen (1994).

Control losses to foliar diseases, root rots, and insect pests

- Sources of resistance to the main foliar diseases (anthracnose, bacterial blight, angular leafspot, rust and BCMV) are now available from CIAT and NARS breeding programs to develop multiple disease resistant varieties. Progress is expected to be rapid in many cases, especially in the improvement of local varieties.

- Roots rots are becoming increasingly more destructive in intensively cultivated low-fertility soils of Kenya and Rwanda, and in other regions as well. Root rots present a more difficult problem to control as several different species of fungi are usually involved. A series of lines selected from CIAT breeding populations in Zaire and Rwandan have been shown to be highly tolerant to root rots. Integrated crop management practice consisting of moderately tolerant varieties with appropriate cultural practices are being tested on-farm to control these diseases.

- High levels of seed resistance to bruchids weevils has recently become available in commercial bean types. The resistance is a simply inherited dominant gene that can be rapidly backcrossed into local varieties. In the meanwhile, a simple mechanical method of controlling bruchid infestation in sacks of stored beans has been developed by a Tanzanian student at Michigan State University. This technology needs immediate verification with farmers, and if successful, it should be easily adopted.

- Sources of tolerance to bean stem maggot (bean fly) have been identified in Ethiopia and Burundi from germplasm distributed by CIAT and the Bean Stem Maggot Working Group. These new resistance sources were recently crossed into acceptable grain types at CIAT, and segregating materials returned to Africa for selection.

Intensify cropping systems that include beans

- Beans, being quick growing and shade tolerant, are commonly used by farmers in inter-cropping systems. A great potential exists in much of the African highlands to increase the overall productivity of the banana/bean cropping system through use of climbing cultivars. Other systems being tested are double cropping with rice in the dry season in Madagascar; extending sugarcane/bean inter-cropping expertise from Mauritius to other countries; and for introducing new bean cultivars into maize monocrops in Ethiopia.

- Successes already achieved through introducing improved climbing beans into areas where these types are not traditionally grown, can be extended to other regions in Africa. Selection of climbers for earlier maturity, for which variability already exists, would further extend their range of adaptation.

- Improved methods for tillage and weed control are required, particularly to raise the labor productivity in extensive systems. On-farm testing of a minimum tillage system is in progress in Kenya. An inexpensive ox-drawn seeder which would permit mechanical control of weeds in Ethiopia is also entering on-farm tests; recent research to identify varieties that compete well with weeds is helping bean breeders.

Accelerate technology transfer through improved seed systems

- Formal seed systems in all member countries are proving (now that new varieties are flowing from research) to be slow, expensive or simply unable to supply bean seed to farmers. The problems are particularly acute in the case of beans because scale and profit margins are reduced by the crop's true-breeding nature, by the subsistence nature of some of the production, by the low multiplication rates, and by farmers' preferences for a range of grain types often grown in mixtures.

- Work in Rwanda, Uganda, and more recently in Tanzania and Malawi has demonstrated that new bean varieties can be disseminated at very low cost through non-formal channels. Prior to the civil war in Rwanda, several hundred thousand farmers were growing the new variety, Umubano, and several other bean varieties were also being adopted as a result of farmer-to-farmer dissemination systems. In Uganda, 64% of collaborators in on-farm trials passed on seed of new varieties to others, half of them being inhabitants of other villages. Several NGOs and development projects have now accepted the role of multiplying and disseminating varieties proven with farmers. These seed distribution approaches need to be followed-up and demonstrated in other countries.

Improve socioeconomic relevance of research

- Considerable advances in socioeconomic studies have been made by national programs as a result of fifteen diagnostic surveys undertaken in seven network countries. There is also increased feedback to research on new technologies from the much increased participatory research with farmers. Regional planning workshops and the development of national research strategies in the larger countries help reduce research duplication and inefficiencies. A special opportunity now exists to extend farmer-participatory research methods developed by CIAT to Anglophone countries in Africa.

- Traders are important members of bean commercialization. They quickly distribute a few commercial varieties, but as they are risk adverse, they can also restrict diffusion of new varieties that could be acceptable to consumers. Greater involvement of traders in promotion of new varieties and increased competition among traders as new markets open, could help reduce this barrier to variety acceptation. Increasing cross-border trade opportunities for both grain and seed may also provide new markets for farmers to sell their produce.

Increased benefits for women farmers

- It is expected that the yield advantage of improved varieties will benefit the lives of women in their capacities as principal bean farmers and home managers. As women traditionally market beans in some African countries (Due, 1985; Robertson, 1995), there is less risk of converting a "woman's crop" to a "man's crop" as yield potential and market value of the crop increase. However, household level impact studies are needed to investigate implications of increased yield on labor intensification, gender division of labor, control over income from bean marketing, and how these aspects in turn affect household welfare and food security.

- After land, labor is a farmer's principal investment in bean production. In most areas, except northern Sudan and northern and central Ethiopia, women provide the majority of labor in bean production - for example, women consistently contribute a greater share of time to the production of beans than to maize across three very different farming systems in Tanzania, and do so in all farm operations. Aggravating the demands on women's time is the firewood requirement for cooking beans (which takes up to 3 hours in Rwanda). For this reason, short cooking time and long retention of flavor after cooking are varietal attributes commonly sought by women, who are normally responsible for selecting planting seed.

- The role of women in maintaining genetic diversity is evident from naming of varieties, recognition of new bean types, the large number of varieties maintained, interest in acquiring new varieties, and seed selection criteria which often place culinary qualities second only to yield (Ferguson and Specher, 1987). Since bean varieties grown in Africa originated from a small part of the genetic diversity occurring in the crop's Latin American home, the liberal approach to variety development advocated here offers the prospect of maintaining (in some countries, even increasing) genetic diversity on farms.

Environmental aspects of bean technology development

- As beans are typically slower to cook than other foods with which they are often mixed in the pot, this component of the diet generally determines the amount of fuel required. In the case of traditional varieties, up to 7 kg of firewood are needed per kilogram of beans. Introducing varieties with shorter cooking time, and/or flue-efficient stoves, would therefore have an immediate effect on rates of deforestation. While this project has no comparative advantage in stove development, considerable genetic variation for cooking time in beans is available and most national programs already include this characteristic in routine evaluation procedures.

- As a quick-maturing (3-month) crop, beans offer an ideal complement to maize, bananas, and other carbohydrate staples in both traditional and intensified cropping

systems. Early ground cover by beans minimizes soil exposure and consequently soil losses from erosion. In eastern Zaire, bean weeds stimulated by the flush of soil nitrogen following the onset of rains, are cut, stored, and applied later to coffee or banana crops (Fairhead, 1987); examples of indigenous knowledge of this kind are learned from farmers through participatory research and applied to the development of sustainable, but more productive systems.

- The introduction of high-yielding climbing beans is providing an incentive to farmers to use agroforestry-based systems which offer low-cost soil conservation in the medium term but are labor-intensive in the short term, The project works with several NGOs and AFRENA interested in promoting agroforestry by association with climbing beans, which can double average bean yields if staked.

- Currently, little fertilizer is applied directly to bean crops. Increasing this amount is economically desirable, but problems with excessive use and fertilizer run-off need to be avoided. Introducing varieties that are efficient at utilizing soil nutrients would assist both objectives by increasing the rate of response to relatively small fertilizer applications, as well as improving levels of subsistence production by those unable to afford any fertilizer. In particular, improved nitrogen-fixing bean varieties would enable good yields to be obtained from applications of rock phosphorus fertilizer (immobile in the soil and hence non-contaminating of water sources), while minimizing need for addition of inorganic nitrogen fertilizer.

- While pesticides are rarely used in dry bean production in Africa, and are unlikely to be increased as a result of this project, the production of snap beans currently involves an excessive number of applications (up to 12 per season in Kenya) and also inappropriate use of insecticides and fungicides. Sub-project research aims to develop integrated pest management (IPM) methods for these farmers, based on the elimination of pesticides in cases where pest-resistant varieties are available; reduced applications of chemicals that are less harmful to the environment where pesticides are still necessary; and promotion of IPM principles among extension workers.

- CIAT and this project expect to be an active partner with ICRAF, other IARCs and commodity networks, and NGOs in the Africa Highlands Initiative. This consortium of institutions is taking a more integrated approach to tackling the dual problems of declining productivity and increasing environmental degradation of the Eastern Africa Highlands. Current priorities are: maintaining soil productivity, developing IPM approaches to pest problems aggravated by crop intensification, and more detailed diagnosis of the complex problems of the densely populated highlands.

2.2 Strengthening National Research Capacity

Prior to the start-up of the regional networks, the NARS lacked continuity, focus, access to information, and were largely confined to on-station research. There was little recognition of the importance of women as primary bean farmers or involvement of farmers in participatory research. Today there still exists considerable differences among NARS for bean research capacity: relatively large programs exist in Ethiopia, Kenya, Tanzania, Uganda, and South Africa, however, many researchers in these countries have only a first degree.

Kenya, Rwanda, Uganda, and Malawi consider research on beans to be among the top two priority food crops, and Tanzania places beans among a set of food security crops that are ranked second only to research in traditional export crops. In a 1995 priority setting exercise conducted by ASARECA and its member countries, beans were ranked number two among all crops. Yet, national budget allocations for agricultural research have decreased recently in real terms in most countries in sub-Saharan Africa.

Building national capacity to plan, manage, and budget research

The CIAT network approach toward building national research capacity focusses on four principal opportunities:

- improved setting of priorities
- specialization with agreed division of responsibilities
- information sharing and scientific accountability at the regional level
- regional training activities adapted to more specialized modes of operation

Improved setting of priorities: Six bean producing countries have developed national strategies for bean research and development: Ethiopia, Kenya, Tanzania, Uganda, Malawi, and Zambia. These strategies aim to focus limited resources on the most important and promising technical opportunities and to share research responsibilities among national institutions according to the comparative advantages of each one. Regional priorities have also been established by means of participatory planning by objectives (PPO). CIAT believes that this methodology encourages wider participation by national researchers and others in the planning process and also encourages a greater sense of commitment, and ownership by the national programs for the research agenda and outputs. The participatory planning exercise also encourages a better balanced research portfolio, with increased attention given to soil fertility maintenance and socioeconomic opportunities.

Research specialization: Limited resources can be utilized more efficiently by an agreed division of responsibilities and effort among countries on the basis of regional priorities and national comparative advantages for addressing them. Planning for specialization ensures better focus on the most important research opportunities, enables each topic to be investigated more thoroughly and increases the potential impact of each innovation. This

principle has been fundamental to CIAT's strategy and operations in Africa since posting its first staff member to Rwanda in 1984.

The foundation of the regional bean networks will continue to be collaborative research subprojects, by which the more experienced national scientists specialize in complementary areas of research of high priority to a region. Specialized topics cover biotic stresses, abiotic stresses, socio-economic constraints and marketing opportunities, on-farm and farmer participatory research, varietal development, integrated pest management, and integrated crop and soil management (**Table 4**). Currently, over 90 regional subprojects are in operation.

Advances in research have led to the identification of more stable sources of resistance, which are being used in NARS and CIAT in crossing programs. For example, the Ugandan-led subproject on bacterial blight now provides a crossing service to other countries, which submit varieties for improvement of this character. Duplication of effort is also minimized as in Ethiopia's decision to rely on the Uganda subproject for its CBB resistance needs. Malawi is responsible for receiving CIAT introductions and multiplying the seed for subsequent distribution throughout southern Africa.

In most priority research areas, the development of new technology is further advanced than could have been expected if each country had worked independently. In 1988 (only two years after network start-up) Uganda released its first new variety in 20 years from a Rwandan entry introduced in a network trial; Rwanda borrowed a control treatment for bean stem maggot from Burundi and proceeded directly to on-farm testing and release, circumventing the normal period needed for on-station development. Climbing bean lines originally tested and released in Rwanda are in on-farm trials in western Kenya and Malawi.

Information sharing and scientific accountability: Prior to the establishment of the networks, bean researchers from member countries rarely met, if at all. Regular interaction among NARS researchers is now possible through problem-focussed working groups, multidisciplinary workshops, and field monitoring tours; the latter are usually organized around research subprojects. Peer group evaluation of network research takes place in all three types of meetings.

Annual interdisciplinary workshops and planning meetings have been held in the Great Lakes Region since 1985, only being disrupted by recent civil strife. In eastern Africa, regional workshops were initiated in 1987, and continues to be held every third year. A series of pan-Africa workshops focussing on discrete themes in bean improvement has been developed to review the body of knowledge and to coordinate strategies on a series of topics, such as: bean stem maggot and other insect pests; bean diseases; breeding and variety development; drought; soil fertility in bean cropping systems; biological nitrogen fixation; farmer participatory methods in varietal development, etc. Twenty four published proceedings from the workshops have been widely distributed. These activities will continue in their present format, easily accommodating evolution in technical priorities and breakthroughs.

Table 4. Regional bean subprojects in Africa (1993-1994)

Priority	Number of Subprojects		
Research Areas	ECABREN[1]	SADC[2]	Total
Biotic Stresses	22	11	33
Abiotic Stresses	15	5	20
IPM	9	1	10
ICM/Socio-Economics	28	1	29
Total	74	18	92

[1] Includes RESAPAC and EABRN. Most subprojects in Rwanda are halted at this time.
[2] Number of subprojects declined significantly after CIDA funding to SADC was withdrawn in 1993.

The networks also enable technical input from CIAT to be more efficiently delivered. A CIAT specialist in each major discipline interacts with national colleagues in several NARS, provides training and carries out difficult or pilot-scale collaborative research that can benefit a whole region or regions. The Ugandan-based regional breeder, for example, has developed adapted breeding material with resistance to an African race of BCMV to supply to national programs through out Africa; the regional agronomist conducts pilot research on sustainable approaches to soil fertility in Uganda, Kenya, Tanzania, and more recently in Malawi; the regional economist supports emergent national research on seed dissemination methods.

Transfer of skills through training: More than thirty key scientists, mostly in bean breeding and crop protection, have received specialized training of 2 to 3 months at CIAT-HQ. More than 500 national program participants are benefiting from numerous locally organized courses on agronomic research methods; experimental design, analysis and use of computer packages; on-farm research methods for extension staff; training for research technicians in field techniques; and economics methods. Several of these short courses were conducted in collaboration with other research centers, particularly CIMMYT and IITA on topics related to farming systems and grain legumes in general. Scholarships have been provided through the network for 15 bean researchers to undertake postgraduate studies – several of these scientists are now well placed to take on regional leadership in their fields of specialization.

CIAT's role in network strengthening

CIAT has been successful in its objective to institutionalize the regional research network model within Africa. By 1996, all three of the original bean networks in Africa will have appointed a local coordinator to manage network activities.

Already, the NARS collectively make all decisions regarding the allocation of network funds through their Steering Committees (SC). These decisions are then reviewed and monitored by the Directors' Committees (DC). In 1992, the DC for Eastern and Central Africa, ASARECA, agreed that at least 25% of the nominal cost of each regional sub-project should be contributed by the lead NARS within this network. This proportion would increase over time in recognition of and in conformity with the priority given to beans by member countries.

NARS also manage a large part of the expenditures approved by the SC. Funds for executing the subprojects were transferred by CIAT to the collaborating institutions. Each subproject leader then provides the network SC with an annual financial report signed by both the sub-project leader and the institution's financial manager; the signed subproject agreement provides for external audit upon request. Similarly, funds are allocated for most workshops and training courses against a written work plan and budget.

CIAT staffing in Africa: The first CIAT regional bean network in the Great Lakes Region began in 1984 with four CIAT staff based in Rwanda. EABRN and SADC were begun in 1985 and 1986, respectively, and other CIAT researchers were outposted to Uganda, Ethiopia, and Tanzania to support these networks. By 1992, fourteen CIAT researchers (including a training officer) were providing coordination and collaborative research support to three African bean networks.

In 1993, CIDA withdrew its funding from the SADC network and CIAT cut back the number of research positions working in that region and devolved coordination of the network to the region. By 1994, the coordinator of RESAPAC was also devolved to region, and the number of CIAT position in the Great Lakes Region was reduced.

By the start of PABRA in 1996, CIAT will have seven researchers in Africa. In PABRA, CIAT's responsibilities shift toward strategic research activities and network research support: less effort will be devoted to national program strengthening and coordination activities. By the end of 1997, two further CIAT positions will be phased out. *As five CIAT researchers is below the minimum critical mass needed to support Pan-Africa bean research activities, CIAT hopes to be able to attract new donors to PABRA.*

Gender analysis in CIAT's research strategy for Africa

At the policy level, an underlying concern behind CIAT's efforts to encourage NARS to adopt a multiple variety release strategy is meeting the multiple and diverse needs of farmers, specifically the disadvantaged, which includes the poorest subsistence-oriented farmers who tend to be, for the most part, women.

Gender analysis is crucial in five areas of research undertaken by CIAT's regional social scientist in collaboration with NARS, NGOs, and local extension agencies.

1. Gender sensitive diagnosis

Gender-sensitive data gathering techniques are used to ensure that the different concerns, priorities, and interests of men and women, and other categories of bean producers are represented. These include: wealth ranking and survey sampling (use of stratified sampling to include different income/wealth categories and female headed households); other participatory rural appraisal (PRA) techniques; and focus groups (e.g. for investigating the importance of fuelwood problems in relation to bean consumption).

2. Gender sensitive technology development and testing

Selection of trial farmers: The importance of considering socio-economic characteristics, such as wealth, gender of the head of household, market orientation etc., in the selection of trial farmers is stressed when the trials are designed and when regional subproject funds are assigned.

Trial design: Recent studies designed in collaboration with the Malawi National Bean Program will test both researcher-designed and farmer-designed varietal trials; the objective of the latter being the collection of acceptability data for the new technologies. In the absence of a specified trial design, it is expected that farmers will grow test varieties in the way they normally grow beans and hence will be able to provide researchers with more reliable evaluations (i.e. unbiased by the trial design). For example, in farmer designed trials, farmers are allowed to harvest fresh bean pods and leaves, which may play an important role in the food security strategy of women and poorer households. In short, farmer designed trials are expected to replicate farmers' own forms of experimentation.

3. Ensuring women's roles in seed production and germplasm conservation

Since 1994 CIAT's social scientist has worked with 4 groups (3 women's groups and one mixed group) to establish small-scale artisan bean seed enterprises. These enterprises are proposed to address two issues affecting bean productivity in Eastern and Southern Africa: the development of alternative systems for supplying seed of improved bean varieties to small-scale farmers and involving farmers in maintaining/increasing genetic diversity of beans *in situ*. Farmer involvement in the production and distribution of bean seed is likely to have several advantages over formal seed production: lower cost of production, the likelihood of timely seed delivery, the selection by farmers themselves of varieties for multiplication in accordance with local preferences, and the maintenance or improvement of genetic diversity through the dissemination of improved as well as local varieties. The less structured nature of farmer seed production may also mean that traditional means of exchanging seed (e.g. in-kind exchange, labor exchange) could be employed, with the result that the poorest farmers may benefit from introduced varieties. Small-scale farmer seed enterprises are also likely to have a spin-off effect on income generation and small enterprise building capacity by women farmers, the group most in need of diversified small-scale income generating opportunities.

4. Ensuring women's access to seed of new bean varieties

Action research on informal seed dissemination channels has included a gender components in terms of the use of women's groups and health clinics as seed delivery points and in the sex desegregation of data on seed buyers. In 1994, seed of two new bean varieties was given to 3 women's groups and one health clinic in Uganda. Because of high female participation in social groups in East Africa, and since women spend considerable periods of time attending to the health needs of their children and themselves, it was felt that both institutions constitute logical distribution outlets for seed of new bean varieties. In the clinic context, the majority of sales were made from maternity clinics and most purchases were made by women. By contrast, sale of seed through rural markets and shops in Uganda revealed that most (over 50%) purchases through those outlets are made by men due to the high participation of Uganda men in trade and their greater freedom relative to women to travel away from home.

NGOs and the extension system (ie. sale of seed by extension agents in markets) are also investigated as alternative dissemination channels.

5. Gender sensitive adoption and impact studies

Data collection approaches used in adoption and impact studies are designed to capture gender differences in adoption rates and patterns and the possible differential impact of new technology on men and women with regard to the gender division of labor, labor input, absolute income, control of income, household/individual nutritional status, organization of production etc. These approaches include: participatory impact assessment and social impact assessment.

Gender analysis in training NARS scientists: Although specific courses on gender analysis or skills have not been conducted within Africa, the CIAT Bean Program has always incorporated the expertise of the Regional Social Scientist in formal and informal training events. Specific topics covered in this regard include gender considerations in selecting trial farmers, survey sample selection, and desegregation of adoption and impact data by sex.

CIAT staff with gender skills: CIAT's socio-economist based in Uganda, Dr. Soniia David, specialized in Gender and Development during her Ph.D. studies at the University of Wisconsin-Madison. She also received special training in this area at the Institute of Development Studies, U.K. At CIAT-HQ, the Gender Committee has recently been reactivated with the appointment of Dr. Joytee Smith, Economist, as the committee chairperson, and the hiring of Dr. Jacqueline Ashby, Socioeconomist, as a specialist in Farmer Participatory Techniques . The Leader of the Bean Program, Dr. Julia Kornegay, is also a member of the Gender Committee. This committee has conducted Awareness Training Activities for CIAT staff, and developed a series of documents and training materials to help orient CIAT scientists and national program trainees in gender related issues.

Statistics on involvement of women scientists in Eastern Africa Bean Network:

Percentage of investigators trained in CIAT/Network short courses that were women: 25%

Note: This frequency is higher than that of other commodity research programs in the region. While we have no control over the numbers of women recruited by NARS, women scientists are relatively more numerous in bean research because the crop is known as one predominantly grown by women farmers.

Percentage of scientists sponsored/supervised by CIAT/Bean Networks for doctoral studies that were women: 75%

Note: This is substantially higher than the frequency of women in the bean research community, and a major contribution to the advancement of women in local research and leadership positions. Also, every one of the women scientists returned to their country and job after study (unlike some of their male colleagues).

Percentage of regional sub-projects leaders in EABRN who are women: 35%

Note: This is a substantial higher frequency compared to the total number of women scientists in the region and indicates that women are disproportionately active/successful in research, and so recognized by their peers.

Percentage of research and network managers who are women: 50%

Note: This figure indicates the high degree of confidence shown by the NARS directors for women leaders. As these women also represent their countries on Network steering committees, this represents a very unusual degree of women involvement in management. Furthermore, the Chairperson of the EABRN Steering Committee is a women.

2.3 Impact of Bean Research in Africa

Technological dissemination

Varietal releases: Over 40 new bean varieties have been released by the national programs in 14 countries throughout Africa since 1984 when CIAT began work in Africa. Nineteen of the varieties were direct releases of CIAT breeding lines developed at HQ, another 23 varieties were selected from CIAT introductions (e.g. germplasm and breeding lines from other countries in Latin America).

In Rwanda, Zaire, Burundi, Uganda, and Kenya, the introduction of improved climbing beans and climbing bean production technology is being rapidly adopted by farmers. These new materials represent a unique set of genetic diversity that was not available in Africa prior to 1984. The lines are liked by farmers because of their greater yield potential and disease resistance, and their highly favorable culinary qualities. The introduction of Latin American climbing beans made a significant impact on bean production before civil war erupted. An adoption survey conducted in 1992 showed that 43% of Rwandan bean farmers (480,000-500,000 households) were growing the improved climbing beans on 17% (approximately 15,600 ha) of the total nationwide bean production area. This new technology produced an additional 50 thousand tons of beans, depending on the region, equivalent to an extra $12 million dollars income for Rwandan farmers (Sperling, 1993, CIAT Bean Program Annual Report, 1993).

A recent survey after the war conducted by the Seeds of Hope Initiative for Rwanda indicates that planting seed of the new climbing beans is scarce and that a concerted effort is needed to multiply seed of these materials for redistribution. Fortunately, seed of the improved climbers is available in southwest Uganda and western Kenya where these new technologies are also rapidly being adopted.

In addition to the improved climbing beans, other bean varieties with bush (or dwarf) architecture have also been released in various countries throughout sub-Saharan Africa. In Zambia, the variety Carioca is gown over a large area in the northern region. New bush varieties in Uganda, MCM 5001 (the first variety released for resistance to the necrotic strains of BCMV) and CAL 96 (a large-seeded highly commercial grain type) will soon be surveyed for their adoption by farmers. In Ethiopia, several CIAT lines have been released as "pea bean types" for canning and exporting. These, and other new varieties, will be evaluated for their adoption and impact in different countries by the project.

Scientific knowledge: CIAT's research collaboration with national program scientists has been highly successful in the increasing scientific knowledge about bean production and constraints in Africa. Prior to 1984, very little scientific or technical information was available. Since 1989, over 25 scientific papers have been published in international refereed journals (Appendix 3). In addition, more than 200 proceedings from workshops and conferences, book

chapters, and reports have also been published by CIAT and the national programs. These papers represent a significant and very important step forward in understanding bean production constraints in Africa and for orienting research to solve these problems. The papers also represent progress achieved by the national programs in developing their scientific capacity to do quality research.

Ten years of collaborative bean research in Africa have shown that research can make a difference. Yet, to meet future bean demands in Africa even greater research effort is needed. Basic research to achieve scientific breakthroughs must be carried out to solve some of the more recalcitrant, but important production constraints; other bean production problems are already well researched and now need more applied application of science with significant participation of farmers in technology testing.

New technologies developed by CIAT and NARS: A variety of new technologies in different stages of diffusion and adoption are now available to farmers in ECABREN and SADC networks (**TABLE 5**).

TABLE 5. Bean production and storage technologies developed in ECABRAN and SADC member countries in collaboration with CIAT[1].

Country	Technologies widely recommended and used by farmers	Technologies available to farmers on restricted scale [2]	Very promising, new technologies [3]
ECABREN			
Ethiopia	Introduced CIAT varieties: *Awash-1, Roba-1.* Broadcast seeding at high rate for weed suppression.	Introduced CIAT varieties: *A 262, A 410.* Intensification by broadcast intercropping in maize [Rift, Western]. Seed dressing against bruchid. Alley cropping with *Sesbania.*	Bruchid control by botanical products, and by resistant varieties. Varieties tolerant to stem maggot. Varieties tolerant to drought [Rift & E. Ethiopia].
Kenya		Intensified cropping with climbing beans (*Umubano*) from Rwanda [W. Kenya]. Tolerance to root rots and poor soil by Rwanda varieties (*Rwandarugali*) [W. Kenya]. Reduced tillage for beans [Central Kenya].	Introduced & locally bred rust-resistant snap beans. Several bred bean lines from University of Nairobi. Integrated pest management for snap beans. Bean samozas and other foods.
Madagascar		Introduced varieties: *CLP X92, G 13671, XAN 78, BTZ 3, G 2005.*	Other introduced lines.

Country	Technologies widely recommended and used by farmers	Technologies available to farmers on restricted scale [2]	Very promising, new technologies [3]
Mauritius	Intensified food production by sugarcane/bean intercropping Pest, disease & weed control. Introduced varieties: *Long Tom, Teebus, Caronel*	Bred varieties: *ASR 127, ASR 159.*	Introduced lines: *MCD 252, PAN 22, Ex-Rico 23, V 5003.*
Sudan			Introduced lines.
Tanzania	Introduced varieties: *Lyamungu 85 & 90* [mid-alt], *Uyole 84 & 90* [high-alt]. Local variety: *Ilomba* [high-alt] Herbicidal weed control.	Introduced varieties: *EP4-4, SUA 90* [low-alt], *PVAD 1156* [mid-alt], *Red Kasukunyele, EAI 2525* [high-alt]. Bruchid management by tumbling/sun drying/ash.	Introduced varieties: *G8864, PVA773* [mid-alt]. IPM against stem maggot, using soil fertility measures.
Uganda	Introduced CIAT varieties: *CAL 96, MCM 5001, RR 136.* Local selection: *White Haricot.*	Introduced varieties: *Rubona 5, OBA 1, MCM 1015, MCM 2001.* Low-cost green manuring with *Crotalaria* intercropping. Intensified cropping with *Umubano* and other Rwandan climbers [W. & E. Uganda]. Bruchid control by sieving or tumbling.	Varieties resistant to *Zabrotes* bruchid. Varieties tolerant to high- manganese and to low-P soils.

Country	Technologies widely recommended and used by farmers	Technologies available to farmers on restricted scale [2]	Very promising, new technologies [3]
SADC			
Lesotho	Introduced varieties: *Harold, Nodak*		CIAT breeding lines, and Malawi landraces
Malawi	Local varieties: *Chimbamba* Bred varieties: *Bunda 93* Introduced CIAT varieties: *Kalima* (PVA 692)	Introduced CIAT varieties: *A344, A286*	CIAT introductions: *CAL 143, A197*
Mozambique	Local varieties: *INIA-10, Encarnado* Introduced CIAT varieties: *PVA 773*	Introduced varieties: *Diacol Calima, ICA Pijao, INIA Zambeze* (local)	CIAT introductions: *AND 628*
South Africa	Many varieties of following types: Speckled sugar, navy, brown/yellow haricot, Carioca	A few varieties released 1993/94	Entries in 94/95 Nat. Var. Trials
Swaziland	Introduced CIAT varieties: *BAT 1713, PVA 894, Carioca*		Introduced variety: *Puebla Cafe*
Zambia	Introduced variety: *Carioca* Stem maggot control with insecticide seed dressing	Introduced CIAT varieties: *A197, PAT 10*	Local cultivars: *Slowezi Rose, ZPV 292*
Zimbabwe	Introduced varieties: *Ex-Rico 23, C20* Bruchid control: silica dust and sun drying Plant population at sowing	Introduced variety: *H1401-Z2PE*	CIAT introductions: *MCM 5001, PVA 773, Carioca*

Notes:
[1] Information from reports of national programs, EABRN, RESAPAC, and CIAT Annual Reports.
[2] Variously defined as restricted release, or in extensive on-farm testing by farmers.
[3] Currently used in, or ready for, on-farm testing.

2.4 PABRA and the Africa Bean Networks

The Pan-Africa Bean Research Alliance is dedicated to developing technologies to increase bean productivity in Africa in a sustainable manner. The Alliance collaborates with all serious research and development efforts on common bean in Africa, and makes freely available bean germplasm and technologies developed within its activities. CIAT provides the technical leadership for the Alliance, and works in close collaboration with national scientists to develop effective research outputs.

PABRA steering committee

Pan-Africa decisions concerning bean research are made by the PABRA Steering Committee (PABRA-SC). The PABRA-SC is composed of the CIAT Pan-Africa Bean Coordinator who is also the coordinator of the committee; one representative from each of the donors (including future new donors to the network); and the regional network coordinators. The PABRA-SC meets annually to discuss issues, new initiatives, and research progress.

The responsibilities of the PABRA steering committee are:

- Develop new projects and attract other potential donors to PABRA
- Explore and catalyze inter-network, inter-IARC, and other initiatives to strengthen bean research
- Review candidates for CIAT-HQ training
- Review budgets and mid-term reports for the donors
- Organize PABRA external evaluations
- Inform networks on up-coming events
- Arbitrate regional conflicts and differences affecting network function

Support to the Networks

Within the overall PABRA budget, funds are set aside to support network activities. The newly merged network, ECABREN, encompassing the most important bean production areas of Africa, will receive direct funding from PABRA to supports it research and network activities. ECABREN/ASARECA will submit a *buy-in project proposal* to the PABRA steering committee. The PABRA steering committee, upon review of the ECABREN proposal and budget, will allocate funds to support the work plan. A regional coordinator for ECABREN will be employed to manage the network.

Other Africa bean networks, such as SADC, and non-network countries such as Cameroon, also participate in PABRA. However, at present, no network support funds are available to support research activities in these regions. CIAT will work closely with SADC to find financial support for this network, but in the meanwhile, SADC will continue to receive technical assistance from CIAT.

CHAPTER 3

PAN-AFRICA BEAN RESEARCH ALLIANCE

3.1 Project Goal, Purpose, and Outputs

Project Goal: To improve food security, protein availability, and incomes of rural and urban populations in eastern, central, and southern African countries through the development of improved common bean technologies.

Project Purpose: To increase the productivity and commercialization of common bean through adoption of sustainable production technologies developed in close collaboration with national research institutions and farmers.

Project Outputs:

1. Principal constraints that limit bean productivity and yield stability are overcome.

2. Methodologies for more efficient transfer of improved bean technology to farmers are developed.

3. Research capacity and effectiveness of national programs is enhanced.

4. Sustainability of the regional networks is increased.

5. Local and export market potential of dry and snap beans is exploited.

3.2 Plan of Work

Output 1: Principal constraints to increased bean productivity and yield stability are overcome.

Activity 1.1: *Increase yield and stability of African bean varieties*

- Bush and climbing beans are genetically improved through plant breeding for resistance to the principal biotic and abiotic constraints limiting bean productivity in Africa, and for increased yield potential. Advanced breeding lines from CIAT and some of the more advanced national programs are multiplied and distributed throughout Africa in a series of tailored nurseries.
- Segregating populations and advanced lines containing novel sources of resistance genes from research conducted at CIAT and collaborating laboratories are made available for

testing in Africa. CIAT core resources and other complementary projects will finance basic research activities aimed to understand and exploit the bean genome.

- CIAT provides on-the-job training support to national program breeders to increase their effectiveness in organizing and managing modern breeding programs.
- CIAT entomologist and plant pathologist, working with national breeders, develop effective host plant resistance breeding strategies to control major insect and disease problems. Intensive effort is made to identify and increase resistance to the bean stem maggot. IPM techniques are also developed to manage this pest.
- Pathogen races of bean diseases such as angular leafspot, anthracnose, halo blight, and bean common mosaic virus are characterized for their genetic diversity using epidemiological and biotechnological methods. Maps of pathogen diversity is used to deploy appropriate sources of stable resistance and to orient resistance breeding strategies.
- Other diseases such as root rots are controlled through a combination of resistance and integrated crop management practices.
- Highly specialized and long term research activities led by CIAT are designed to complement regional priorities and NARS-led subprojects.
- CIAT socio-economist provides training in farmer participatory research methods to NARS breeders, agronomists, and extensionists to ensure that breeder selections conform with farmer requirements.

Activity 1.2: *Maintain and enhance germplasm diversity on-farm and in NARS breeding programs.*

- A more open approach to releasing and disseminating new varieties is supported by PABRA and the Directors Committees. In areas where mixtures predominate, farmers are offered a larger number of new varieties developed to meet a range of complementary requirements. Traders are encouraged to take advantage of new market potentials for new varieties.
- Varietal-use assessments and adoption study methodologies are fine tuned for specific cropping systems (i.e. mixtures of varieties are commonly grown in Rwanda, Zaire and Malawi; maize/bean intercrops predominate in Kenya and parts of Tanzania).
- CIAT and NARS socio-economists test innovative methods to assess the impact of varietal improvement research on bean productivity.
- Germplasm collections are standardized using established IPGRI recommendations. Collections are stored in bottles containing silica gel for greater medium-term storage potential.

Activity 1.3: *Intensify and sustain production systems for both high potential and fragile environments*

- Identify high-potential areas in each country where climbing bean technology can be transferred.
- Develop low-cost prototype crop management techniques. CIAT agronomist coordinates

the Plant Nutrition Working Group of national scientists to screen germplasm for efficiency of nutrient use, and assists national programs in institutionalizing effective, low-cost approaches to on-farm soil fertility diagnosis and experimentation. An example of the latter will be farmer participatory testing of intercropping systems with *Crotalaria* and other promising green manure crops.
- Soil productivity and nutrient cycling research are used to develop more sustainable soil management systems.

Output 2: Methodologies for more efficient transfer of improved bean technologies to farmers are developed.

Activity 2.1: *Increase participation of farmers in on-farm and on-station technology evaluation*

- Low-cost participatory methods that enable farmers to contribute actively to technology design and evaluation are adapted for Anglophone countries by the CIAT Socio-economist. National programs are assisted to apply these techniques in new situations. Results are disseminated in regional meetings.
- The effect of new technologies on women and children will be assessed in adoption and impact studies. Special assessment of gender related issues are included in the design of on-farm and farmer participatory trials.
- Non-formal technology promotion methods and dissemination schemes, such as women groups, clinics, and local dancing teams, are tested for their effectiveness in reaching farmers.

Activity 2.2: *Improve national links between research and extension*

- NARS are assisted to organize review meetings on bean research and to invite participation of extension organizations including NGOs in refining national and inter-institutional strategies. Extension organizations are encouraged to invite research representatives to their planning meetings and to take joint responsibility for farmer-managed on-farm trials. CIAT and NARS provide training for extensionists in on-farm and farmer participatory research methods where needed.

Activity 2.3: *Develop improved seed systems to accelerate transfer of new varieties*

- CIAT breeders assist national programs in planning the multiplication of basic seed of new varieties to ensure adequate initial supply. CIAT Socio-economist and agronomist work with national programs to assure that this seed is systematically distributed to farmers through a network of on-farm trials.
- CIAT Socio-economist assesses formal and informal seed dissemination systems in Africa and elsewhere and encourages national systems to adopt more appropriate approaches where needed. Recent successes in Rwanda in dissemination seed through market traders,

NGOs, and among farmers is one possible model for adaptation in other regions. NARS-led sub-projects develop case studies for specific situations.

Activity 2.4: *Accelerate transfer of new technologies among member countries*

- Specialist Working Groups review and compare performance of new technologies and research methods across countries.
- Workshop proceedings are published in the CIAT African Workshop series. Other opportunities that encourage information/technology dissemination are the CIAT African Working Paper series, and traveling workshop/monitoring tours.

Output 3: Research capacity and effectiveness of national programs is enhanced.

Activity 3.1: *Train and assist national program staff in participatory and on-farm research*

- National programs, already involved in on-farm research on beans, are assisted by means of formal and on-the-job training and traveling workshops to develop partnership with farmers. CIAT socio-economist and agronomist work with national programs, NGOs and other development groups in testing and refining farmer participatory research methodologies and transfer of technologies.

Activity 3.2: *Improve national research planning*

- ECABREN conducted a national research planning review in 1995 to refine its bean research and development strategies and priorities. Feedback includes increased participation of farmers and revision of the technical advances already achieved.
- PPO methodology is routinely used both formally and informally in planning activities, workshops, and reviews.

Activity 3.3: *Provide specialized training for bean researchers*

- Biannually, senior researchers from the networks visit CIAT-HQ for 1-2 month periods. The objective of the visit is to expose researchers to the latest in scientific methodologies and techniques, new germplasm and sources of resistance, and to interact with the other Bean Program scientists working in Latin America.
- CIAT scientists participate in regional and pan-Africa training events. Training for technician staff carried out by national program scientists.
- Network workshops are held annually in different countries to review and exchange information in particular research areas.

Activity 3.4: *Develop and apply more cost-effective methods for bean research*

- CIAT Socio-economist conducts collaborative research with selected national programs to

refine techniques that minimize costs of attaining adequate farmer participation in research validation.

- Studies to improved extrapolation of soil fertility research from pilot village sites to other regions are led by the CIAT soil fertility agronomist.
- Modeling and computer-assisted mapping techniques are used, partly in collaboration with other regional and international organizations and CIAT-HQ, to chose sites and predict results.
- CIAT breeders assist national programs to identify the critical sites for multi location trials and hotspot evaluations, thus minimizing operational costs.
- Transfer of cost-saving techniques to NARS is achieved through in-service training, regional workshops, and in the planning and design of research sub-projects.

Activity 3.5: *Develop new varieties adapted to regional and national priorities*

- National program breeders become more adept at making crosses and evaluating segregating populations. The crosses are tailored to incorporate new sources of resistance supplied by CIAT into local varieties having commercial grain types.
- CIAT breeders assist national programs to avoid unnecessary duplication in the generation of new materials adapted to the region and assure that the sources of resistance needed by the national breeders are available and well characterized.

Activity 3.6: *Monitor, assess, and report impact of research*

- National program coordinators are responsible for reporting and assessing in-country activities of the network, while the Director Committees evaluate the overall strength of the national programs through use of transparent and objective criteria.
- National economists, wherever available, supported by the CIAT Socio-economist, conduct adoption/impact surveys in PABRA member countries. Survey size usually involves between 100-150 farms.
- A database is developed at national and regional levels to record germplasm evaluation scores and advanced line pedigrees, socioeconomic data from adoption and impact studies, and other research results. National programs are responsible for periodic update of the database.

Output 4: Sustainability of the regional networks is increased.

Activity 4.1: *Increase NARS management of the network*

- CIAT relinquishes network coordination activities to locally recruited regional coordinators and regional steering committees.
- National and regional planning activities are carried out using a PPO methodology to revise and update research priorities and activities.

- Steering committees receive, evaluate, and assign funds for research subprojects. Subprojects enhance sustainability of the networks by catalyzing problem sharing across national boundaries, encourages regional leadership, and minimizes duplication of efforts. NARS contribute funds to the costs of each subproject.
- Network steering committees make decisions concerning regional workshop and training events to be held and the participants attending each event.
- ASARECA and other Director Committees (DC) provide policy and political support to NARS research activities.

Activity 4.2: *Enhance technical coordination by NARS*

- Technical leadership to NARS is provided by six specialized Working Groups which advise Steering Committees on research needs and progress in the bean networks. Several Working Groups include members from other relevant international organizations (e.g. CIMMYT, ICRAF and TSBF are involved in the Soil Fertility Management in Cropping Systems Working Group of the Eastern Africa Highlands).
- The Steering Committees encourage experienced national researchers with successful regional sub-projects to become active regional leaders, eventually taking over some functions of CIAT scientists.

Activity 4.3: *Implement regional research that minimizes duplication of effort*

- National institutions conduct regional research based on regional priorities established by the SC. Resources for this research are provided by the NARS and the project. CIAT provides technical support, as well as conducts strategic research to develop materials and methods to backstop regional research (refer to Activities 1.1 - 1.3 above).

Activity 4.4: *Speed transfer of research results among national institutions*

- New breeding lines and promising germplasm are regularly exchanged among NARS through regional nurseries and by CIAT breeders. Sub-project results receive wide dissemination throughout the Steering Committee and regional workshops, and particularly in the problem-focussed Working Group meetings.

Activity 4.5: *Provide cost-effective coordination and auditing*

- ECABREN regional coordinator maintains a small office to execute the decisions of the regional SC, organize regional training events and workshops, disburse sub-project funds, prepare budget and quarterly reports for the DC and PABRA coordinator.
- The PABRA coordinator is a member of the regional steering committees as well as the coordinator of the PABRA Steering Committee. The responsibilities of the PABRA coordinator include coordination of CIAT-lead activities and information exchange, disbursement of specified funds for some regional research activities, preparation of reports

for donors, organize formal and informal project evaluations in collaboration with the regional coordinators. The PABRA coordinator is responsible for CIAT- led research and linkages with NARS.

- CIAT makes available to the networks an accounting software package to serve as a financial management tool for the networks.

Output 5: Local and export market potential of dry and snap beans is exploited.

Activity 5.1: *Identify full range of consumer preferences*

- CIAT Socio-economist work with national programs to adapt and apply low-cost participatory methods to identify the full range of consumer preferences for bean grain types. Breeders incorporate consumer preferences as selection criteria early in their breeding programs.
- Pilot feasibility studies in two countries assess new urban consumer food products that use beans in their recipes as a means of gaining greater added value and for diversifying markets for high yielding, but non-commercial small seeded varieties.

Activity 5.2: *Reduce post-harvest losses to bruchid pests*

- A NARS-led research sub-project provides a crossing service for other countries in the incorporation of a bruchid-resistance gene into local varieties. Resistant germplasm developed at CIAT-HQ will be provided, as well as training in screening methods. Simple seed management techniques for bruchid control are more widely defused.

Activity 5.3: *Assess export market opportunities*

- CIAT Socio-economist collaborates in the development of a NARS-led sub-project to assess opportunities for bean exports. Part of this research would involve assessing the existing informal trade in beans across national borders.
- Integrated pest management and genetic studies on snap beans to reduce pesticide use and pesticide residues on high value snap bean exports in Kenya and other potential exporter countries.

3.3 Work Breakdown Structure Linking Project Activities to Project Outputs

Program Goal

To improve food security, protein availability, and incomes of rural and urban populations in eastern, central, and southern African countries through the development of improved bean technologies.

Project Purpose

To increase the productivity and commercialization of common bean through adoption of sustainable production technologies developed in close collaboration with national research institutions and farmers.

Outputs / Activities	**Principal constraints to increased bean productivity and yield stability are overcome**	**Methodologies for more efficient transfer of improved bean technologies to farmers are developed**	**Research capacity and effectiveness of national programs is enhanced**	**Sustainability of the regional networks is increased**	**Local and export market potential of dry and snap beans are exploited**
	Increase yield and stability of African bean varieties	Increase participation of farmers in on-farm and on-station technology evaluation	Train and assist national program staff in participatory and on-farm research	Increase NARS management of the network	Identify full range of consumer preferences
	Maintain and enhance germplasm diversity on-farm and in NARS breeding programs	Improve national links between research and extension	Improve national research planning	Enhance technical coordination by NARS	Reduce post-harvest losses to bruchid pests
	Intensify and sustain production systems for high potential and fragile environments	Develop improved seed systems to accelerate transfer of new varieties	Provide specialized training for bean researchers	Implement regional research that minimizes duplication of effort	Assess export market opportunities
		Accelerate transfer of new technologies among member countries	Develop and apply more cost-effective methods for bean research	Speed transfer of research results among national institutions	
			Develop new varieties adapted to regional and national priorities	Provide cost-effective coordination and auditing	
			Monitor, assess, and report impact of research		

Logical Framework Matrix

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Critical Assumptions Beyond the Control of the Project
Program Goal: To improve food security, protein availability, and incomes of rural and urban populations in eastern, central, and southern African countries through the development of improved common bean technologies			
Program Purpose: To increase the productivity and commercialization of common bean through adoption of sustainable production technologies developed in close collaboration with national research institutions and farmers	Over the next ten years, new bean varieties with resistance to major constraints are grown on 20% (app. 400,000 ha) of major bean production area s in Eastern, Central and Southern Africa. Improved crop management practices are adopted by 15 % of the farmers. Average yield increases attributed to new varieties and management practices is approximately 250 kg/ha. An additional 100,000 tons of beans, having a $45 million USD value, are produced yearly.	Variety Adoption Studies Technology Impact Studies	PABRA funded for 5 years Countries are politically stable National programs continue to work on beans and participate in regional bean networks Environmental conditions are normal
Outputs: 1. Principal constraints to increased bean productivity and yield stability are overcome	1.1 New varieties resistant to principal biotic and abiotic constraints are released in 50% of PABRA member countries 1.2 25% of national programs have active bean breeding programs and are making crosses 1.3 IPM techniques developed for root rots and bean stem maggot are adopted by 15% of farmers in pilot study areas 1.4 Epidemiological maps showing distribution of specific races of anthracnose and angular leaf spot pathogens are developed for sub-Saharan Africa 1.5 Germplasm diversity is maintained on-farm through NARS strategy to have multiple variety releases in Uganda, Rwanda, Zaire, Tanzania, and Malawi. 1.6 Management and improvement of soil productivity (MISP) techniques developed for soil organic matter and P are adopted by 15% of farmers in pilot study areas. 1.7 Research on BNF initiated throughout Africa and new research methodologies are adopted by all participating national programs.	1.1 • Evaluation data from regional and pan-Africa nurseries • Varietal release bulletins 1.2 NARS Annual Report 1.3 Proceedings of Working Group Meetings and Regional Workshop; scientific papers 1.4 Proceedings of Working Group Meetings and Regional Workshops; scientific papers 1.5 Reports from adoption surveys 1.6 On-farm research reports; scientific papers 1.7 NARS Annual Reports	Environmental conditions permit adequate disease evaluations National program support breeding efforts through human and financial resources

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Critical Assumptions Beyond the Control of the Project
2. Methodologies for more efficient transfer of improved bean technology to farmers are developed	2.1 50% of NARS use farmer participatory methods to develop and test new technologies in a routine manner 2.2. Impact of new technologies on women is determined in all Technology Impact Studies carried out during the project phase 2.3 Seed production of new varieties increases by 50% over present levels in half of the member countries	2.1 NARS Annual Reports Proceedings of Working Group Meeting 2.2 Technology Impact Studies 2.3 NARS Annual Report	National program have agronomists on their bean teams National policies do not restrict seed production
3. Research capacity and effectiveness of national programs is enhanced	3.1 All PABRA member countries receive training in participatory on-farm research 3.2 PPO methodology is routinely used in all networks to plan activities 3.3 One or more network workshops are held annually to review and exchange information in particular areas 3.4 Variety Adoption and Technology Impact Studies are conducted in 4 countries 3.5 NARS develop regional database to record breeding data 3.6 Africa bean environmental data is digitized for GIS mapping	3.1 Training Reports 3.2 Steering Committee reports 3.3 Workshop proceedings 3.4 NARS Annual Reports 3.5 Programs and data made available 3.6 GIS maps of African bean growing environments available	NARS socio-economist are available to participate in adoption and impact studies
4. Sustainability of the regional networks is increased	4.1 Local coordinators are effective in managing regional bean networks 4.2 ASARECA and other Director Committees provide policy and political support to NARS research activity 4.3 Active NARS scientists take responsibility for coordinating all Working Groups 4.4 Quarantine restrictions among network member countries are eased 4.5 Networks develop budgets and quarterly reports according to donor specifications and on time	4.1 Steering committee reports; Network evaluations 4.2 ASARECA reports 4.3 Working Group reports 4.4 NARS policy documents 4.5 Internal audit reports Donor reports	Network coordinators function effectively Directors Committees support to network

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Critical Assumptions Beyond the Control of the Project
5. Local and export market potential of dry and snap beans is exploited	5.1 Bruchid resistance is incorporated into 10 popular African commercial cultivars 5.2 Pesticide applications in export snap beans are reduced by 15% in pilot-study areas of Kenya and Tanzania 5.3 Traders participate in seed workshops in Uganda, Tanzania and Malawi	5.1 Working Group Reports 5.2 NARS annual reports 5.3 Seed Workshop proceedings	National marketing and export trade regulations are favorable

3.4 Project Budget (revised May 1996)

Centro Internacional de Agricultura Tropical - CIAT
Proposed Budget in US$ (000) for the
Pan-Africa Bean Research Alliance - PABRA

	Cost Centers	1996	1997	1998	1999	TOTAL
	STRATEGIC RESEARCH					
1/.	**Personnel**					
	Senior Staff Salary and Benefits	669	754	560	588	2,571
	Research Support Staff	145	137	120	126	528
	Administrative Assistant	19	20	21	22	82
	Total Component	**833**	**911**	**701**	**736**	**3,181**
2/.	**Research Operations**					
	Supplies and Services	190	180	145	150	665
	Travel	97	93	73	77	340
	Vehicles (4) & Insurance	22	22	46	3	93
	Research Station Support	30	30	25	25	110
	Seed Shipments/Research Support from CIAT HQ	70	75	75	80	300
	Total Component	**409**	**400**	**364**	**335**	**1,508**
3/.	**Training and Publications**					
	Senior Visiting Scientists (4)	-	26	-	28	54
	Training Materials	10	10	12	12	44
	Publications	15	15	13	12	55
	Total Component	**25**	**51**	**25**	**52**	**153**

	Cost Centers	1996	1997	1998	1999	TOTAL
4/.	**Evaluations**					
	Evaluation	-	-	25	-	25
	Audit	-	-	7	-	7
	Total Component	**-**	**0**	**32**	**0**	**32**
5/.	**Indirect Costs (15%)**	**190**	**204**	**168**	**168**	**730**
	SUB-TOTAL Strategic Research	**1,457**	**1,566**	**1,290**	**1,291**	**5,604**
	SUPPORT TO NETWORKS					
6/.	**Coordination**					
	Steering Committees Meetings	21	23	24	25	93
	ECABREN Coordinator Salary and Benefits	70	40	42	44	196
	Administrative Officer (0.5)	9	9	10	10	38
	Administrative Services/Supplies	22	23	23	24	92
	Office Equipment	10	-	5	-	15
	Communication & Office Operations	18	8	9	9	44
	Travel	16	14	15	15	60
	Total Component	**166**	**117**	**128**	**127**	**538**
7/.	**Research in NARS**					
	Research Sub-projects	160	165	175	200	700
	Small Research Equipment	25	25	25	-	75
	Network Resource Persons	5	5	6	6	22
	Adoption and Impact Assessments	10	10	11	12	43
	Total Component	**200**	**205**	**217**	**218**	**840**

	Cost Centers	1996	1997	1998	1999	TOTAL
8/.	**Technology Dissemination**					
	Network Workshops	75	75	75	75	300
	Pan-Africa Conference	-	-	70	-	70
	Publications/Information	25	15	26	16	82
	Total Component	**100**	**90**	**171**	**91**	**452**
9/.	**Training**					
	Short Courses	50	55	55	55	215
	Total Component	**50**	**55**	**55**	**55**	**215**
10/	**Indirect Costs - CIAT (4%)**	**21**	**19**	**23**	**20**	**83**
11/	**NARS Equipment Support**					
	Communications	10	8	7	6	31
	Minor rehabilitation of labs and research stations	18	20	-	-	38
	Vehicles (4) for On-farm Research & Insurance	44	44	4	4	96
	Total Component	**72**	**72**	**11**	**10**	**165**
	SUB-TOTAL Networks Support	**609**	**558**	**605**	**521**	**2,293**
	GRAND TOTAL	**2,066**	**2,124**	**1,895**	**1,812**	**7,897**

Donors Support to PABRA
US $ ('OOO)

Revised May, 1996

	YEARS **				
	1996	**1997**	**1998**	**1999**	**TOTAL**
CIDA*	226	884	1286	1203	3599
SDC	1400	800	169	169	2538
USAID	440	440	440	440	1760
TOTAL	**2,066**	**2,124**	**1,895**	**1,812**	**7897**

* CIDA's contribution is Cdn$ 4,800,000. An exchange rate of 0.75 has been used to calculate the equivalent in US dollars.

** The yearly funding cycles for SDC, USAID and CIDA are:

SDC and USAID	1Oct. 1995 - 30 Sept. 1996
	1Oct. 1996 - 30 Sept. 1997
	1Oct 1997 - 30 Sept. 1998
	1Oct 1998 - 30 Sept. 1999
CIDA	1April 1996 - 31 Dec 1996
	1 Jan. 1997 - 31 Dec. 1997
	1 Jan. 1998 - 31 Dec. 1998
	1 Jan. 1999 - 31 Dec. 1999

3.5 Budget Notes

Research Support

1/. Personnel: The budget covers seven full-time CIAT senior staff positions for 1996 (year 1), reducing to five staff positions by the end of 1997 (year 2). Staff costs are average costs reflecting salary, retirement, medical insurance, cost of living allowance, hardship allowance, annual leave, dependent schooling, official vehicle, life insurance, housing costs, etc, as outlined in CIATs Guide for Project Identification, Design, Approval, and Administration (CIAT, 1995). Exact costs vary for each employed scientist. Donors are billed only for actual costs incurred for specific staff employed. Terms of reference for each position is given in Appendix 1.

Research Support Staff in PABRA are research technicians working with CIAT scientists, secretarial and clerical support for the PABRA coordination office and site offices. The Administrative Assistant is responsible for the financial reporting of PABRA expenditures to CIAT's Project Office. The CIAT Administrative Assistant will also work closely with the part-time Administrative Officer of ECABREN to set up budget reporting systems that are compatible to that of CIAT and the donors.

Note: CIAT's core contribution to bean research supports seven senior staff positions at HQ and one position in Costa Rica. The primary responsibility of the core-funded staff is to provide basic and strategic research support to global bean research efforts, emphasizing Latin America where two-thirds of the world's bean production occurs, and Africa were beans play an essential dietary role. CIAT core budget covers all salaries and benefits for CIAT-HQ staff while working in Africa, as well as for that portion of their HQ work time devoted to supporting African bean networks in research and training activities. Research output from HQ activities is generally of direct use to bean researchers in Africa, primarily in the form of breeding lines with new gene combinations for greater resistance and increased productivity. Other outputs are superior strains of Rhizobium for nitrogen fixation, biotechnological techniques for studies of genetic diversity, molecular markers for identifying genes and fingerprinting pathogen races, development of novel breeding strategies, and collaborative research projects.

2/. Research Operations: PABRA research operations costs include: field and laboratory supplies and services (e.g. field preparation, temporary labor, fertilizers or other agricultural products, laboratory chemicals and pathogen media); frequent travel by CIAT staff to visit national programs in Africa and to attend CIAT annual planning meetings and reviews; vehicles (and car insurance) for on-farm and across-station mobility; research station support to cover host country research and central service fees for use of offices, laboratories, and fields, where appropriate; twice yearly CIAT-HQ seed shipments of bean breeding lines and improved germplasm to national programs in Africa; HQ research collaboration and service activities (e.g. such as specialized crosses for national programs breeders).

3/. Training and Publications: CIAT-HQ will host specialized training events for Senior African Researchers for 1-2 month periods twice during the project phase.

4/. Evaluations: Both CIAT and Network activities will be formally evaluated by an external review team during the third year of the project.

5/. Indirect Costs: The CIAT administrative overhead of 15% applies to those funds managed directly by CIAT in the STRATEGIC RESEARCH budget section. In SUPPORT TO NETWORKS, CIAT applies a 4% overhead to allocate funds to the networks.

Support to the Networks

6/. Coordination: PABRA and Networks Steering Committees meetings will be held on bi-yearly basis. When possible, the steering committee meetings will be held in conjunction with other on-going events in Africa. A full-time Network Coordinator position is budgeted for ECABREN with regional salary and benefits, minimum essential office equipment and supplies, secretarial services, communication facilities, travel costs on a per diem basis. During 1996, the RESAPAC coordinator will overlap with the ECABREN coordinator. Funds for the ECABREN coordination position will be allocated upon approval of the candidate selection procedures by the PABRA Coordinator, the Chairperson of ASARECA, and the donor representatives. ECABREN will maintain a part-time Administrative Officer as a contracted service to manage and report network budgets and assist in the organization of training and workshop events.

7/. Research: Funds are made available for research sub-projects and some small research equipment on a competitive basis by the networks and the PABRA-SC. Periodically, a network may need to bring in a outside resource person to provide additional technical input into specific problems. When and where adoption studies and impact assessments are to be conducted is determined by the PABRA-SC in collaboration with the network coordinators.

8/. Technology Dissemination: Research results and outputs will be shared within and among networks through a series of regional workshops, Working Group meetings, and a Pan-Africa Conference held the third year of the project. The proceedings of these events are published.

9/. Training: Regional training courses for technicians and extension personnel will be organized by the network steering committees.

10/. NARS Equipment Support: For effective on-farm and farmer participatory research, four vehicles are budgeted. Distribution of the vehicles will be decided by the PABRA-SC.

3.6 Monitoring and Evaluation of the Networks

The networks will develop a Work Breakdown Structure (WBS) and Logical Framework Matrix (LFM) to outline expected outputs and activities for the five year project phase. The LFM will be the base for which overall research and output is evaluated. The WBS/LFM can be modified each year by the SC if research progress and/or unforeseen events made the original plan no longer valid or out-of-date.

The ECABREN network has funds to carry out both formal and informal adoption and impact studies with farmers/traders/consumers. The CIAT Socioeconomist will assist the national programs in the design and implementation of these studies. The final reports will be distributed to CIAT, PABRA-SC, DC, and the donors.

In addition to the LFM, proceedings from regional meetings, working groups, and subproject reports are also used for monitoring and evaluating research results. Each recipient of sub-project funds must justify their expenditures and outputs to the network SC against what was stated in the original sub-project proposal. If a recipient can not adequately justify expenditures or research outputs, the SC may decide not to continue funding that project, and those funds may be transferred to other projects.

During the third year of the project, the donors will call for an independent evaluation of the network. The donors will decide upon the number of reviewers and their discipline/specialty. The PABRA coordinator will accompany the review team during their visits. The final report with recommendations will be made available to the donors, CIAT, PABRA-SC, network SCs, and DC.

3.7 Monitoring and Evaluation of PABRA

CIAT will use a WBS and LFM to outline its research activities within PABRA that is independent, but complementary, to those developed by the networks. It is expected that the CIAT staff will devote considerable portion of their time to solving strategic production constraints and proportionately less time to network strengthening activities. This represents a change in CIAT's overall philosophy and historical perspective towards national programs, the networks, and bean research in Africa. In previous phases of the Africa bean projects, national program and network strengthening was of priority importance to CIAT. Now, after 8-10 years of network development, CIAT, the donors, and the DCs consider this activity to have been done well, and that the networks are ready for independent management. The devolution of network management will free-up CIAT scientists to concentrate more of their efforts on basic and strategic research needed to solve many complex and difficult bean production constraints. Without this concentrated effort it will not be possible for Africa to produce sufficient quantities of beans to meet the growing demands of poor consumers who depend of beans as a principal source of protein and carbohydrates in their diet.

Monitoring and evaluation of CIAT scientists and research activities in Africa occurs several times each year. CIAT scientists are required to produce annual work plans and to justify the previous year's research output to the Bean Program Leader. At the end of each year, the scientists must produce an annual report which is compiled and published by the bean program for international distribution. Each scientist also is evaluated annually for his/her performance by the Program Leader and CIAT's Director of Research.

The external evaluation of PABRA will encompass both the networks and CIAT's activities and outputs. This report will be made available to the donors, CIAT, and the PABRA-SC.

3.8 Financial Reports

CIAT will submit a quarterly report to CIDA, SDC, and USAID corresponding to the total PABRA (Research Support and Support to the Networks) budget. To reduce administrative work, only one budget statement will be prepared for the donors. The budget report will showed the expenditures charged to the total PABRA funds available for that fiscal year. No separation of expenditures by donors will be made. ECABREN will prepare a quarterly budget report of the network's expenditures. This report will be included in the PABRA report sent to the donors.

3.9 Technical Progress Reports

Technical Progress Reports will be submitted semi-annually on March 15 and September 15 by CIAT-HQ to the donors. The report will contain two sections: activities of CIAT and activities of the networks. ECABREN and SADC are responsible for submitting their report to CIAT for final compilation.

APPENDICES

1. INTERNATIONAL STAFF REQUIRED TO IMPLEMENT PABRA

PABRA Coordinator: Coordinator of the PABRA Steering Committee is also the CIAT Pan-Africa Coordinator. Plans and monitors CIAT training, research, information and germplasm exchange activities for Africa. Liaises with national program research directors to ensure consistency of PABRA activities with national and regional priorities. Represents PABRA at other events within Africa. Member of regional steering committees. As CIAT representative, the PABRA coordinator is responsible for supporting regional planning mechanisms, feedback systems and national research plans. Facilitates pan-Africa meetings and information dissemination.

Socio-Economist: Conducts research and develops methods to assist national programs in adjusting technology design and evaluation to objectives and needs of Africa growers, and to assist NARS in impact assessments. Emphasizes farmer participation and gender sensitivity in both on-station and on-farm research trials; facilitates farmer feedback to scientists on technology design parameters and performance. Designs, tests and monitors small scale seed production and distribution systems. Conducts research on marketing of beans. Participates in training events

Entomologist: Conducts strategic research and assists national programs in dealing with regional pests problems. Develops methods to improve host plant resistance and integrated pest management practices with priority given to the bean stem maggot species complex. Provides scientific and technical input to entomological working groups. Collaborates with national scientists, NGOs, and other regional projects in testing, training, and diffusion of integrated pest management systems for dry bean and snap bean cropping systems.

Pathologist: Leads strategic research on foliar diseases and root pathogens. Assists national programs in overcoming major regional disease constraints. Focuses on problems unique to Africa, including races of BCMV, halo blight, angular leafspot, anthracnose, and root rot complexes. Characterizes pathogenic diversity, develops screening methods, and appraises management strategies, especially for genetic mixtures and root pathogens. Supports pathology Working Groups and training events to develop regional expertise.

Agronomist-Soil Scientist: Conducts strategic research on management of bean based cropping systems, emphasizing fertility management to improve nutrient use efficiency and biological nitrogen fixation. Characterizes major fertility constraints and appraises effect of farmer practices on nutrient cycling and erosion; designs improved fertility management systems integrating adapted bean genotypes and improved BNF into multi-crop systems to improve sustainable bean productivity. Assists national programs in improving fertility management in bean cropping systems and strengthens plant nutrition and fertility management research capacity in the region.

Plant Breeder: Develops and selects breeding lines and segregating populations with high yield potential, multiple disease and insect resistance, and greater tolerance to abiotic constraints. Conducts strategic research on the genetics of resistance to major African biotic constraints. Conducts strategic research on resistance to drought and low soil fertiity. Supplies improved germplasm to national breeders with technical assistance in selection and evaluation methods. Develops strategies for improving traditional mixtures; participates in training events.

2. ECABREN AND SADC RESEARCH NETWORKS

EASTERN AND CENTRAL AFRICA BEAN RESEARCH NETWORK (ECABREN):

Burundi:	Institut des Sciences Agronomiques du Burundi (ISABU) Universite du Burundi
Ethiopia:	Institute of Agricultural Research (IAR) Alemaya University of Agriculture Plant Protection Research Center
Kenya:	Kenya Agricultural Research Institute (KARI) Egerton University Nairobi University
Madagascar:	Centre National de la Recherche Applique au Developement Rural (FO.FI.FA.)
Mauritius:	Sugar Industry Research Institute (MSIRI) Ministry of Agriculture (MoA)
Rwanda:	Institut des Sciences Agronomiques du Rwanda (ISAR) Universite National du Rwanda
Tanzania:	Ministry of Agriculture (MoA) Sokoine University of Agriculture
Uganda:	National Agricultural Research Organization (NARO) Makerere University
Zaire:	Institut National des Etudes sur la Recherche Agronomique (INERA)

SOUTHERN AFRICA BEAN RESEARCH NETWORK (SADC):

Angola:	Instituto de Investigacao Agronomico de Angola (IIAA) Universidad Agostino Neto
Lesotho:	Ministry of Agriculture (MoA)
Malawi:	Ministry of Agriculture (MoA) University of Malawi
Mozambique:	Instituto Nacional de Investigacao Agraria (INIA)
Namibia:	Ministry of Agriculture, Water and Rural Development (MOWRD)
South Africa:	Agriculture Research Council (ARC)
Swaziland:	Ministry of Agriculture (MoA) University of Swaziland

Tanzania:	Ministry of Agriculture (MoA) (southern highland region)
Zambia:	Ministry of Agriculture (MoA)
Zimbabwe:	Ministry of Agriculture (MoA) University of Zimbabwe

3. SCIENTIFIC PUBLICATIONS

Scientific Publications in Refereed Journals (1989-1995)

Allen, D.J. 1991. New disease records from legumes in tropical agriculture. FAO Plant Protection Bulletin 39:112-113.

Cardona, C., K, Dick, C.E. Posso, K, Ampofo, and S.M. Nahdy. 1992. Resistance of a common bean (*Phaseolus vulgaris* L.) Cultivars to post-harvest infestation by *Zabrotes subfasciatus* (Boheman) (Coleoptera: Bruchidae). II. Storage Tests. Trop. Pest Management 38(2):173-175.

Giller, K.E., G. Amijee, S.J. Broderick, S.P. McGarth, C.Mushi, O.T. Edje, and J.B. Smithson, 1992. Toxic concentrations of iron and manganese in leaves of *Phaseolus vulgaris* growing on freely drained soils of ph 6.5 in Northern Tanzania. Communications in Soil Science and Plant Analysis 23:1663-1667.

Grisley, W. 1993. Seed for bean production in sub-Saharan Africa: issues, problems, and possible solutions. Agriculture Systems 43:19-33.

Grisley, W. 1994. The bean revolution. Ceres 149:27-30.

Hanson, P.M., M.A. Pastor Corrales, and J.L. Kornegay. 1993. Heritability and sources of aschochyta blight resistance in common bean. Plant Dis. 77:711-714.

Mukishi M.P., and P. Trutmann. 1992. Managing angular leaf spot on common bean in Africa by supplementing farmer mixtures with resistant varieties. Plant Dis. 76:1144-1147.

Mukoko, O.Z., N.W. Galwey, D. J. Allen. 1995. Developing cultivars of the common bean (*Phaseolus vulgaris* L.) for southern Africa: bean common mosaic virus resistance, consumer preferences and agronomic requirements. Field Crops. Res. 40:165-177.

Pyndji, M.M. and P. Trutmann. 1992. Managing angular leaf spot on common bean in Africa by supplementing farmer mixtures with resistant varieties. Pl. Disease 76:1144-1147.

Shellie-Dessert, K.C., and G.L. Hosfield. 1990. Implications of genetic variability for dry bean cooking time and novel cooking methods for fuel wood conservation in Rwanda. Ecology of Food and Nutrition 24:195-211.

Smithson, J.B., O.T. Edje, and K.E. Giller. 1993. Diagnosis and correction of soil nutrient problems of common bean (*Phaseolus vulgaris*) in the Usambara Mountains of Tanzania. J. of Agric. Sci. 120:233-240.

Sperling, L. Climbing for the top in Rwanda. CERES 148:12-14.

Sperling, L., and M. Loevinsohn. 1992. The dynamics of adoption: distribution and mortality of bean varieties among small farmers in Rwanda. Agricultural Systems. 41(4):441-453.

Sperling, L., M. Loevinsohn, and B. Ntabomvura. 1993. Rethinking the farmer's role in plant breeding:local bean experts and on-station selection in Rwanda. Exp. Agric. 29:509-519.

Trutmann, P. and W. Graf. 1993. The impact of pathogen and arthropod pests on common bean production in Rwanda. Intern. J. of Pest Management 39(3):328-333.

Trutmann, P., and E. Kayitare. 1991. Disease control and small multiplication plots to improve seed quality and small farm dry bean yields in central Africa. J. of Applied Seed Production 9:36-40.

Trutmann, P., K.B. Paul, and D. Cishahayo. 1992. Seed treatments to increase yield of *Phaseolus vulgaris* in Africa throug control of diseases and beanfly. Crop Prot. 11:458-464.

Trutmann, P, and M.M. Pyndji. 1994. Partial replacemenmt of local common bean mixtures by high yielding angular lea spot resistant varieties to conserve local genetic diversity while increasing yield. Ann. Appl. Biol. 125:45-52.

Trutmann, P., J. Voss and J. Fairhead. 1993. Management of common bean diseases by farmers in the central Africa Highlands. Intern. J. of Pest Management 39(3):334-342.

Wortmann, C.S. 1993. Contribution of bean morphological characteristics to week suppression. Agron. J. 85:840-843.

Wortmann, C.S., C.H. Bosch, and L. Mukandala. 1995. Foliar nutrient analyses for bananas of the Eastern Africa Highlands Agron. J. and Crop Sci. (In press)

Wortmann, C.S., M. Isabirye, and S. Musa. 1995. Crotalaria ochroleuca as a green manure crop in Uganda. African J. Crop Sci. (accepted).

Wortmann, C.S., E. B. Karamura, and C.S. Gold. 1995. Nutrient flows form harvested banana pseudostems. African J. Crop Sci. (accepted).

Wortmann, C.S., J. Kisakye and O.T. Edje. 1992. The diagnosis and recommendation integratedsystem for dry bean--Determination and validation of norms. J. of Plant Nutr. 15:2369-2379.

Wortmann, C.S., L. Lunze, V.A. Ochwoh, and J. Lynch. 1995. Bean Improvement for low fertility soils in Africa. Afric J. Crop. Sci.. (accepted)

Wortmann, C.S., and T. Sengooba. 1990. Investigation of banana-bean intercropping in Uganda. Hort. Sci. 26:84.

Wortmann, C.S. and T. Sengooba. 1993. The banana-bean intercropping sysem - bean genotype x cropping systen interactions. Field Crops. 31:19-25.

Wortmann, C.S., T. Sengooba and S. Kyamanyawa. 1992. Banana and bean intercropping: factors affecting bean yiel and land use efficiency. Exp. Agric. 28:287-294.

Selected Proceedings, Book Chapters, and other Scientific Publications:

Abate, T., J.K.O. Ampofo, A. Autrique, L. Kantiki, S. Sithananthum, P. Sohati, and N. Talekar. 1991. The regional bean sten maggot resistance reconfirmatory nursery: some preliminary results. 10th Bean Research Workshop, Sokoine Universit of Agriculture, Morogoro, Tanzania, 16-18 September.

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