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Plan of Action

REQUEST TO [redacted]

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CGIAR Task Force on Sub-Saharan Africa

STRENGTHENING MAIZE AND CASSAVA RESEARCH IN ELEVEN COUNTRIES OF COASTAL WEST AND CENTRAL AFRICA:

PLAN OF ACTION

Request to Donors

December 1988

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APPENDICES

List of additional documents available on request

Acronyms

This list includes those acronyms which appear frequently in the main report and the appendices; these tend to be the acronyms which stand for regional or international institutions/organizations. In all cases, including references to national institutions/ organizations, the full name for which an acronym stands is given the first time it appears in the main report and the first time it appears in the appendices.

CAIEM	Complex Agro-Industrielle de l'Etat à Mantsoumba
CCCE	Caisse Centrale de Coopération Economique
CIDA	Canadian International Development Agency
CIMMYT	Centro Internacionale de Mejoramiento de Maiz y Trigo
CIRA	Centres internationaux de recherche agronomique
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
CORAF	Conférence des responsables de la recherche agricole africains et français
FAC	Fonds d'Aide et de Coopération
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GNP	gross national product
GTZ	Gesellschaft für Technische Zusammenarbeit
IARC	international agricultural research center
IBSRAM	International Board for Soil Research and Management
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Center for Africa
ISNAR	International Service for National Agricultural Research
ISTRC-AB	International Society for Tropical Roots Crops - Africa Branch
NARS	national agricultural research systems
ODNRI	Overseas Development Natural Resources Institute
ORSTOM	Institut français de la recherche scientifique pour le développement en coopération
SAFGRAD	Semi-Arid Food Grains Research and Development
SIAEB	Société Industrielle et Agricole d'Elevage à Boumango
SOTOCO	Société Togolaise Cotonière
SPAAR	Special Program for African Agricultural Research
SRCC	Société de Recherche sur le Café et le Cacao
UCD	University Centre, Dschang
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
WAARR	West African Agricultural Research Review
WARDA	West African Rice Development Association (=Foufou de Mantsoumba)

Executive Summary

This plan of action is the outcome of an initiative taken by the Task Force on Sub-Saharan Africa, a body set up by the Consultative Group on International Agricultural Research (CGIAR). It deals with the maize and cassava research needs of coastal West and Central Africa. Maize and cassava are the predominant crops in the region. The countries which participated in the initiative were Benin, Cameroon, Congo, Gabon, Ghana, Guinea, Liberia, Nigeria, Sierra Leone and Togo. It was not until the completion of the second phase of the initiative that Côte d'Ivoire was able to participate; discussions are continuing and details of Côte d'Ivoire's research needs will be submitted to the donors at a later stage.

Objective and implementation of the initiative

The objective and methods of implementation of the initiative are outlined in the first part of this document. The principal objective of the initiative was to draw up a plan to strengthen, in a cost-effective way, the national agricultural research systems (NARS) of the region and their capacity to collaborate with each other and with international agricultural research centres (IARCs). The proposals contained in the plan will result in a greater impact of research on maize and cassava production in the region.

The implementation of the initiative was divided into three phases: a desk study of all available documentation on the NARS; visits to each participating country and to IITA; and regional consultations. This process was supervised by a study coordinator and monitored by a steering committee, with IITA playing a central role in facilitating its implementation. During the second phase, national reports were produced on each country, and these formed the basis of the third phase in which consultations were held to draw up a plan of action.

Regional situation and needs

The economy of each participating country, its food production and consumption and its agricultural research capacity in terms of human, financial and technological resources was studied, and an inventory was made of the strengths and weaknesses of the NARS in general and of their research on maize and cassava in particular. On the basis of this information, lists of the institutional and research needs of the NARS were drawn up. These lists were then systematically refined so that, in the final drafting, only the essential needs for which external assistance was required were retained.

In response to the urgency of the food situation in West and Central Africa and to the initiative taken by the Task Force, a new spirit of cooperation is emerging in the scientific community, breaking the language barriers between the francophone and anglophone countries of the region; this spirit will be reinforced by the implementation of the proposals contained in the plan. IITA is playing a major role in promoting this cooperation, as reflected both in the nature of its involvement in the initiative and in its Medium-term Plan. An outline of the Medium-term Plan and its compatibility with the plan of action is provided in this document.

A major weakness in agricultural research in the region is the shortage of research technicians. In response to this need, the Dschang University Centre (UCD) in Cameroon was identified as a bilingual institution which could assume an expanded regional role in technician training, and the plan includes details of the resources required by the UCD to enable it to develop its training capacity.

Request to donors

The plan of action resulting from the initiative offers administrative and management advantages for the donors and for the recipients. Flexibility is required in raising and managing the funds. Bilateral as well as multilateral sources are invited and funds can be committed for any one particular action, for a particular country or for a group of countries.

Complementing such arrangements, the strong national commitments which have been made with regard to levels of staff, infrastructure, equipment and operating budgets should be maintained.

The amount being requested over a five-year period is approximately US$ 12 million. Most of the costs appear early in the plan period, particularly in the first year. Of the total amount, 73.8% would be spent on cassava research, 19.5% on maize and 6.7% on production systems (cassava and maize).

The largest item in the budget (29.4%) relates to operating costs. All NARS in the region suffer from a lack of adequate operating funds; under the plan, operating funds for research on maize and cassava research would double in all participating countries, apart from Nigeria.

The training capacity within the region is weak and, in many cases, deteriorating, and thus training is the second most important budget item (26.2%). The acquisition of essential vehicles and equipment accounts for 21% of the budget. The amount required to enable IITA to fulfil its role in implementing the plan of action accounts for 18.2% of the budget. Inflation and other contingencies account for the remainder of the budget.

Implementation of the plan of action

To implement the plan, it is proposed that a trust fund be established. This fund would be managed centrally with sufficient flexibility to satisfy both donor constraints and NARS requirements. It is suggested that this fund be set up at IITA, and that it be managed by IITA, assisted by a steering committee.

The steering committee would comprise representatives from the participating countries, the donor community, the major agricultural research networks in the region and IITA. As well as assisting IITA in managing the trust fund, the steering committee would ensure a sharing of responsibilities among the partners and a smooth implementation of the plan of action.

THE TASK FORCE INITIATIVE

The study of maize and cassava research requirements in coastal West and Central Africa was one of three initiatives taken by the Task Force on Sub-Saharan Africa. The Task Force was created by the Consultative Group on International Agricultural Research (CGIAR) in 1986. Its terms of reference, which were finalised in June 1987 at a meeting in Nairobi, Kenya, state that it should seek ways in which the CGIAR centers could contribute more effectively, both increased cooperation both among themselves and with national systems, to sustainable and increased food production in Sub-Saharan Africa.

The Task Force identified requirements and weaknesses in the centers' research activities, examined policy problems related to technology development and agricultural research, established a working relationship with the Special Program for African Agricultural Research (SPAAR) took initiatives with donors, centers and NARS towards strengthening of NARS capabilities and proposed ways to achieve its objectives.

Objective of the initiative

At its meeting in February 1987, in Harare, Zimbabwe, the Task Force decided to make two important West and Central African crops, maize and cassava, the focus of one of its initiatives. It examined methods of identifying needs, duplication and priorities in research on these crops and of seeing how national research requirements could be met.

The initiative was limited to 11 coastal West and Central African countries: Benin, Cameroon, Congo, Côte d'Ivoire, Gabon, Ghana, Guinea, Liberia, Nigeria, Sierra Leone and Togo. Five of these countries are francophone, the remainder are anglophone; breaking the language barriers was an important element of the initiative. Each country was asked to define its research needs for maize and cassava, and the Task Force then set about determining how these needs might be met from the countries' own resources, from the centers (in particular, IITA) and from the donor community.

The principal objective of the initiative was to draw up a plan to strengthen, in a cost-effective way, the infrastructure and research capacity of the NARS in West and Central Africa in order to increase their research impact on maize and cassava production and to facilitate collaboration both between the NARS, and between IARCs and the NARS.

Approach of the initiative

The approach underlying this initiative was based on a continuing dialogue within and between the participating countries, to identify the strengths and weaknesses of the NARS in general and of their research on maize and cassava in particular. In these discussions, the Strategic Plan (1989-2000) for the International Institute of Tropical Agriculture (IITA) and the World Bank's Western African Agricultural Research Review (1985-86) were taken into account.

To monitor the initiative a steering committee was constituted and the French Ministry of Cooperation was selected as executive agency. At a meeting of the steering committee in Montpellier, France, in May 1987 Mr Pierre Dubreuil of the Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) was appointed as study coordinator. It was agreed that Mr Dubreuil should work closely with the Director General of IITA, the chairman of the standing committee of center directors on Sub-Saharan Africa, and that the study would be conducted in three phases. Ten countries readily

expressed interest in the initiative; Côte d'Ivoire's agreement to participate came at a later stage.

The first phase consisted of a desk study, carried out by six consultants, of all available documentation about the NARS of the participating countries. A common methodology for the study of maize and cassava research needs was agreed upon. The study was carried out at CIRAD in Paris in September 1987.

The second phase involved a preliminary visit by the consultants to IITA in Ibadan in October 1987, followed by visits to the participating countries to obtain information on their current situation and their infrastructural and research needs. In most of the countries, an IITA researcher accompanied the consultant team. Official contact was made at the appropriate ministerial level in each country as well as with various organizations already in the region, including the Conférence des responsables de la recherche agricole africains et français (CORAF) and the Semi-Arid Food Grains Research and Development (SAFGRAD) project. CORAF network coordinators were involved in the visits to Nigeria, Cameroon and Congo. The consultants and the dates of their visits are given here:

Liberia	19-24 October 1987	S. Lyonga/P. Roederer
Togo	19-24 October 1987	P. Christensen/A. Taylor
Cameroon	19-30 October 1987	P. Prevett/E. Tollens
Nigeria	26 October-6 November 1987	P. Christensen /A. Taylor
Congo	2-6 November 1987	P. Prevett/E. Tollens
Ghana	23-29 November 1987	E. Tollens
Benin	25 November-2 December 1987	P. Christensen/A. Taylor
Gabon	30 November-5 December 1987	P. Prevett/E. Tollens
Guinea	7-12 December 1987	S. Lyonga/P. Roederer
Sierra Leone	14-19 December 1987	S. Lyonga/P. Roederer

In January 1988 Côte d'Ivoire agreed to participate in the study. Although it was not then possible to find a suitable time for the consultants to visit the country, Côte d'Ivoire did participate fully in the subsequent consultations in Lomé and Ibadan; discussions between Côte d'Ivoire and the Task Force are continuing and the results of these discussions will be transmitted to donors at a later stage.

On completion of the second phase of the initiative, 10 national reports were drafted, revised by the NARS directors, and published in separate volumes. These reports provide a detailed analysis of specific national research problems and needs; summaries of the reports were made available (Appendix 1). A synthesis of the ten country reports is available in the form of a synthesis report. This report outlines:

- the country's main climatic and ecological features, its size and population, the economic situation and the agricultural production, consumption and requirements;
- the country's achievements, needs and priorities in research on maize and cassava;
- the structure, capacity and requirements of the NARS to meet the maize and cassava research needs;
- the role of international and regional research networks in maize and cassava research being carried out by the NARS.

The third phase involved drafting the national proposals, according to an agreed set of guidelines, and producing a plan of action. In April 1988 a general consultation took place in Lomé in Togo, attended by research leaders from the 11 participating countries, the management of IITA, CORAF, SAFGRAD and the Centro internacional de mejoramiento de maiz y trigo (CIMMYT), the chairperson of the steering committee, the consultants and the study coordinator. The chairperson and secretary of the Task Force attended as observers.

At the Lomé meeting IITA presented its Medium-term Plan and the national proposals were discussed. An important feature of the Medium-term Plan was its emphasis on the

need to improve collaboration between African NARS, IARCs and other organizations in order to ensure effective implementation of the plan.

At the sixth meeting of the Task Force, held in Berlin in May 1988, IITA was given the responsibility for the follow-up of the initiative, with assistance from Mr. Dubreuil. It was agreed that the consultants would again visit the participating countries to refine and make a detailed costing of the national proposals. These visits were organised by IITA in July/August 1988.

In September 1988, during a second general consultation at IITA in Ibadan, the national proposals were finalised. They now incorporated only those items which were considered essential and which, in terms of the current and proposed capacity and funding of the NARS, were viable. Prime considerations were that the proposals highlighted the need for operating funds, that they were in accord with the proposals contained in the IITA Medium-term Plan and that they reflected the strong commitment of the NARS to make full use of their own resources, as well as external resources, to address their problems. The national proposals are reproduced in Appendix 2; the guidelines used to draw up these proposals are reproduced in Appendix 3.

At the Ibadan meeting, further discussion took place on the content and means of managing the plan, and it was agreed unanimously that IITA should play a central role in the implementation of the plan, assisted by a steering committee composed of representatives from the donor community and the participating countries. In the discussion on an explicit objective of the plan — to cut across language barriers — it was considered that the language differences in the region would not pose a problem to interaction between the NARS and the IARCs.

By the end of the third phase of the initiative, it was clear that a new type of partnership was being forged between NARS and IARCs and that, despite the social, linguistic, agroecological and cultural differences, a sense of scientific community was emerging in the region. The initiative had set in motion a process of consultation, study, review, priority setting and partnership unique in the region. Pragmatism and a spirit of cooperation, which became known as the 'Lomé spirit', prevailed in the discussions. Leaders of the NARS were enthusiastic about the potential benefits of collaboration in terms of the role that IARCs in general and IITA in particular could play in strengthening the NARS and mobilizing donor resources.

The outcome of the Ibadan meeting was discussed at a Task Force meeting in Washington in October 1988. IITA will continue to be strongly involved in the follow-up and implementation of the initiative, and should also consider intercenter collaboration for the future; e.g. International Livestock Center for Africa (ILCA) on small ruminants and International Food Policy Research Institute (IFPRI) on policy issues. The value of the results was recognized and IITA was asked to publish the plan and distribute copies early in 1989 to donors, participating countries and Task Force members.

AGRICULTURAL PRODUCTION AND RESEARCH IN THE REGION

The 11 countries participating in the initiative all lie on the Atlantic coast of West and Central Africa. Together, they cover a surface area of over 3 100 000 km^2. In the equatorial zone of this area tropical rainforest predominates and there are are two rainy seasons a year. The rest of the area is mainly savanna, with one rainy season a year.

In this overview of the economy, agricultural production, food consumption and research capacity of the participating countries, a regional rather than a national or subregional approach has been adopted wherever possible. Although the supporting tables take a country-by-country approach, they show that there are many characteristics common to the whole region.

The main sources of the statistics contained in this overview are the data compiled by the Task Force consultants, the World Bank's Western African Agricultural Research Review (1985-86) and the review of CGIAR activities in sub-Saharan Africa compiled in 1986 by the International Service for National Agricultural Research (ISNAR).

Economic situation

The disparity in the economies of the countries in coastal West and Central Africa is accounted for largely by the existence or lack of exploitable mineral and petroleum resources. Gabon has both petroleum and minerals; Liberia has mainly minerals; the Congo, Cameroon and Nigeria have mainly petroleum; and the remaining countries have little or no mineral or petroleum resources. This disparity is reflected in the countries' Gross National Product per capita: about US$ 4 000 in Gabon and US$ 1 200 in the Congo (both low-population countries); US$ 700-800 in Cameroon, Nigeria and Côte d'Ivoire; about US$ 500 in Liberia; and about US$ 300 in the remaining five countries.

Most of the countries in this region export forest products and cash crops. The predominant cash crops in the equatorial zone are coffee, cocoa and palm oil; the main cash crop in the savanna areas is cotton. Food and timber processing industries are not yet well developed, except in Nigeria and Côte d'Ivoire.

The export of raw materials plays a major role in the national economies, and thus they suffer from the instability and downward trends in commodity prices on the world market. This is true particularly of the petroleum-producing countries which, although the richest countries in the region, have been badly affected by the reduction in oil prices in the 1980s. In Cameroon and Nigeria, remarkable progress was made in the 1970s in strengthening the rural infrastructure and agricultural research but the damage to the economies as a result of falling oil prices has meant that budgets have been eroded and the resources allocated to agricultural research reduced by almost 50%.

With the exception of Gabon, all the participating countries have implemented structural adjustment policies, with the help of the International Monetary Fund (IMF) and the World Bank. State involvement in the economies has been reduced, more realistic exchange rates have been adopted in non-CFA countries, government budgets have been slashed, the number of civil servants has been reduced and greater emphasis is being put on the role of the private sector. Agricultural research is being adversely affected by this restructuring, primarily because the budgets for operating costs have been reduced and limitations on staff recruitment have been imposed.

Agricultural production

With the exception of the Congo, Gabon and Liberia, where forest is still the predominant land cover, the percentage of land used to produce crops ranges from 10 to 30% of the total land area of each country. In the equatorial zone, most of this area is devoted to the production of cash crops, either on large plantations (primarily palm oil) or on smallholdings (mainly coffee and cocoa). The area devoted to food crops represents only a small percentage of the agricultural land.

In most of the region, cassava is the leading food crop among the roots and tubers; in some countries, such as Togo and Nigeria, yams are of equal or slightly more importance. Grown mainly in the humid zones where there is a bimodal precipitation pattern, cassava is produced almost entirely on smallholdings ranging from 1 to 3 ha, and is usually grown as a mixed crop with maize and groundnuts. In general, the per capita production lies between 120 and 200 kg, but in the Congo and Gabon, the leading cassava-producing countries, per capita production is 250-300 kg. In Sierra Leone, where rice is the dominant food crop, the per capita production is 30 kg.

Maize is the most important cereal crop in the savanna areas, which are characterized by high population densities and a unimodal precipitation pattern. In general, maize is cultivated as a mixed crop by smallholders. A small proportion is produced as a cash crop on medium-sized farms and, in Cameroon, the Congo, Gabon, Ghana and Nigeria, on large-scale commercial farms, where it is rotated with other crops, usually groundnut, soybean or cotton. The per capita production in the six important maize-producing countries (Benin, Cameroon, Côte d'Ivoire, Ghana, Nigeria and Togo) ranges from 20 to 80 kg. In the remaining five countries the per capita production is less than 10 kg; in three of these countries (Guinea, Liberia and Sierra Leone), rice is the dominant cereal crop.

Table 1. Population, area and agricultural land use in West and Central Africa

Country	Population (million)	Agricultural population (%)	Area ('000 ha)	Total area cultivated ('000 ha)	Maize area ('000 ha)	Cassava area ('000 ha)
Benin	3.89	44	11 062	1 806	448	92
Cameroon	9.47	79	46 944	6 960	427	397
Congo	1.70	31	34 150	673	11	94
Côte d'Ivoire	9.47	77	31 800	3 985	552	225
Gabon	1.15	74	25 767	452	7	42
Ghana	13.04	48	23 002	2770	420	240
Guinea	5.30	78	24 586	1 575	49	90
Liberia	2.12	67	9 632	371		86
Nigeria	92.04	50	91 077	30 435	1 888	1 217
Sierra Leone	3.53	62	7 162	1 771	14	30
Togo	2.84	66	5439	1427	158	20
Total	**144.55**		**310 621**	**52 225**	**3 974**	**2 533**

Average yields of cassava and maize on smallholdings are low compared to on-station yields, mainly because of the limited use of inputs by smallholders. The average yield for maize, for example, is 1 t/ha from smallholdings and 2.5-6 t/ha from on-station plots; the corresponding figures for cassava are 3.5-9.0 t/ha and 20-40 t/ha.

Table 2 gives the 1982-84 production and yield figures for the two crops. These figures, compiled by the World Bank, are similar to those supplied by the countries themselves,

with one or two exceptions (Cameroon, for example, estimated its cassava production at 1.2 million t, which is almost double the figure given by the World Bank). The figures provided by CIMMYT for 1983-85 are generally about 20% higher than those given in the Table 2.

Table 2. Maize and cassava yield and production in West and Central Africa

Country	Maize		Cassava	
	Yield (t/ha)	Production ('000 t)	Yield (t/ha)	Production ('000 t)
Benin	0.69	311	6.67	614
Cameroon	0.98	417	1.56	620
Congo	0.64	7	6.56	617
Côte d'Ivoire	0.80	442	3.56	800
Gabon	1.43	10	6.14	258
Ghana	0.84	351	7.78	1 868
Guinea	0.98	48	7.19	647
Liberia			3.57	307
Nigeria	0.87	1 650	9.16	11 150
Sierra Leone	1.21	17	3.40	102
Togo	0.97	153	18.05	361
Total		3 406		17 344

Maize and cassava production is affected by numerous diseases and pests. Among these are maize streak disease, maize borers, Africa cassava mosaic and cassava mealy bug. During the past decade some progress has been made, particularly at IITA, in developing disease-resistant varieties and in reducing the incidence of cassava mealy bug and cassava green mite through biological control methods.

Food consumption and demand

Food crop production in West and Central Africa fluctuates from year to year, depending upon climatic and other constraints, but there is no discernible growth trend. In many areas, more and more land is being cleared for cultivation to compensate for a decrease in yields. The population growth rate in the region is now about 3%, and thus the demand for food is outstripping production.

A significant factor in the widening gap between production and demand is the rapid increase in urbanisation which has taken place in recent years. The percentage of the population now living in urban areas has reached 50% or more in Benin, the Congo, Ghana and Nigeria; in the rest of the region it is between 20 and 30%. With the decrease in food production in the rural areas, there is little or no surplus to feed the growing urban population, and recourse to food imports is becoming prevalent throughout the region.

Cassava plays an important role in the diet of most people of the region, largely because it can survive in dry years and on poor soils. Rural women play a major role both in cultivating and processing the crop. In Gabon, cassava is a staple part of the diet for 80% of the population; it is the main source of calories for 70% of Nigerians; and in the Congo and Cameroon it accounts for over 50% and 30%, respectively, of the calories in the diet of most of the population.

Cassava is consumed in many forms, the most widespread being *fufu* and *gari*. Consumers' tastes vary considerably: some prefer sweet cassava, while others favour bitter varieties, from which the cyanide has to be removed by fermentation. In Gabon few people eat *gari* but in Ghana and Sierra Leone *gari* prepared from bitter cassava is becoming increasingly popular; in some areas of Cameroon, Gabon and Sierra Leone the leaves as well as the roots are eaten. Improved varieties which take consumer tastes into account and are suited to traditional methods of processing are needed in the region. Some of the improved varieties released by IITA do not meet these requirements.

Maize forms a major part of the diet in much of West and Central Africa, particularly in Benin, Cameroon, Côte d'Ivoire, Ghana, Nigeria and Togo. It is widely traded within the region and most of the countries supplement local production by imports. Cameroon, Ghana and Nigeria are believed to import over 100 000 t/year (this represents more than 10% of their domestic production). Apart from human consumption, maize is being used increasingly as animal feed and in the brewing and large-scale milling industries.

In the high-consumption countries, the yellow floury varieties are generally preferred. In Benin, Ghana and Togo maize forms the basis of a wide range of cooked dishes, while in more humid areas it is often consumed without any processing ('on the cob'). As in the case of cassava, a number of the recently released improved varieties of maize have not accounted for consumer tastes. The large-scale commercial and state farms in Cameroon, the Congo, Gabon, Ghana and Nigeria tend to produce varieties suited for processing in the animal feed, brewing and milling industries.

Agricultural research structures

The organization of the NARS in the region, in terms of the ministries under which they operate, the main bodies responsible for agricultural research, the links with universities and the institutions which have a mandate for maize and cassava research, is given in Figure 1. In some countries, research on cash and export crops falls within this structure (for example, Cameroon); in others it is part of a separate research structure (for example, Côte d'Ivoire, Ghana, Liberia and Nigeria). The figure, however, deals only with food crops.

As Figure 1 shows, in eight of the participating countries agricultural research comes under one ministry. In Togo and Gabon, it falls under two ministries, resulting in a more complicated administrative structure; in Togo plans are under way to simplify the structure. Details of the agricultural research structure in Côte d'Ivoire are not yet available.

In some countries, particularly the smaller ones, agricultural research falls under the ministry responsible for agriculture and/or rural development. In many of the larger countries it falls under the ministry responsible for scientific research. There appears to be a trend in the region to adopt the latter structure; in early 1988 Guinea placed agricultural research under a Secretariat of State for Research.

The advantage of attaching agricultural research to a ministry of agriculture and/or rural development is that there is a single decision-making authority for both research and extension. Attachment to a ministry of scientific research results in weaker links with extension and rural development work but it has the advantage of ensuring closer interaction with universities and colleges, particularly where scientific research and higher education come under the same ministry, as is the case in many countries.

Largely because of the governments' lack of adequate resources and irrespective of which ministry has responsibility for agricultural research, in many countries maize and cassava research is carried out by rural development organizations. Although this may strengthen links between researchers, extension workers and producers, the research is usually narrowly oriented and therefore national coordination is difficult.

Throughout the region there is a need to develop stronger collaboration between researchers and smallholders. Researchers need to carry out more on-farm testing of varieties and cropping techniques; they need to devote more time to identifying smallholders' production constraints and requirements, so that these can be incorporated into their research activities; and the flow of information between researchers, extension workers and smallholders needs to be increased so that research has a greater impact on production from smallholdings.

Figure 1. Organization of NARS in West and Central Africa

Country	Responsible Ministry	National agricultural research organization	Universities/ colleges active agricultural research	Institutions with mandate for maize research	Institutions with mandate for cassava research
Benin	MDRAC	DRA		Ina Station (north) CARDERS	Niaouli Station (south) CARDERS
Cameroon	MESIRES	IRA	Dschang	IRA	IRA
Congo	MRSENV (DGRST)	CRAL; ORSTOM		CRAL; RDPs	RDPs
Gabon	MESRES; MA	CENAREST (inc. IRAF); CIAM	Gabon	CIAM RDPs	CIAM
Ghana	MIST (CSIR)	CRI; FRI	Legon-Cape Coast; Kumasi	CRI; RDPs	CRI; RDPs
Guinea	MDR (SER)	DNRA		Kilissi National Pilot Center	Foulaya National Pilot Center
Liberia	MOA (ARC)	CARI	Liberia CAF	CARI	CARI
Nigeria	FMST	6	6	NCRI; IART; Ibadan	NRCRI; FIIRO
Sierra Leone	MANRF (NARCC)	ROKUPR	Njala		
Togo	MDR; MENRS	DRA/DPV; ORSTOM		IRAT; RDPs	INPT; RDPs

Key to figure 1

Benin	MDRAC	Ministère du développement rural et de l'action coopérative (Ministry for Rural Development and Cooperative Action)
	DRA	Direction de la recherche agronomique (Directorate for Agricultural Research)
	CARDERS	Centres d'action régionale pour le développement rural (Regional Rural Development Action Centres)

Cameroon	MESIRES	Ministère de l'enseignement supérieur, de l'informatique et de la recherche scientifique (Ministry of Higher Education, Computer Services and Scientific Research)
	IRA	Institut de la recherche agronomique (Institute for Agricultural Research)
Congo	MRSENV	Ministère de la recherche scientifique et de l'environnement (Ministry for Scientific Research and the Environment)
	DGRST	Direction générale de la recherche scientifique et technique (General Directorate for Scientific and Technical Research)
	CRAL	Centre de recherches agronomiques de Loudima (Loudima Agricultural Research Centre)
Gabon	MESRS	Ministère de l'enseignement supérieur et de la recherche scientifique (Ministry for Higher Education and Scientific Research)
	CENAREST	Centre national de la recherche scientifique et technique (National Scientific and Technical Research Centre)
	IRAF	Institut de recherches agronomiques et forestiers (Institute of Agricultural and Forestry Research)
	CIAM	Centre d'introduction, d'acceptation et de multiplication du matériel végétal (Centre for Germplasm Introduction, Acceptance and Multiplication)
	MA	Ministère de l'agriculture (Ministry of Agriculture)
Ghana	MIST	Ministry of Industry, Science and Technology
	CSIR	Council for Scientific and Industrial Research
	CRI	Crops Research Institute
	FRI	Food Research Institute
Guinea	MDR	Ministère du développement rural (Ministry for Rural Development)
	SER	Secrétariat d'Etat à la recherche (Secretariat of State for Research)
	DNRA	Direction nationale des recherches agronomiques (National Directorate for Agricultural Research)
Liberia	MOA	Ministry of Agriculture
	ARC	Agricultural Research Council
	CARI	Central Agricultural Research Institute
	CAF	College of Agriculture and Forestry
Nigeria	FMST	Federal Ministry of Science and Technology
	NCRI	National Cereals Research Institute
	IART	Institute of Agricultural Research and Training
	NRCRI	National Root Crop Research Institute
	FIIRO	Federal Institute for Industrial Research
Sierra Leone	MANRF	Ministry of Agriculture, National Resources and Forestry
	NARCC	National Agricultural Research Coordinating Council
Togo	MDR	Ministère du développement rural (Ministry for Rural Development)
	DRA	Direction de la recherche agronomique (Directorate for Agricultural Research)
	INPT	Institut national des plantes à tubercules (National Institute for Tuberous Plants)
	MENRS	Ministère de l'éducation nationale et de la recherche scientifique (Ministry for National Education and Scientific Research)
RDPs	Research and development projects within parastatal organizations	

Agricultural research capacity

The factors influencing the agricultural research capacity of the region can be categorized under three main headings: human resources; financial resources; and equipment resources.

Human resources. Reliable statistics from the participating countries on the number of researchers in each country are not available and the definition of such titles as 'researcher' and 'technician' varies from one country to another. The statistics provided in Table 3, therefore, are derived from the World Bank's Western Africa Agricultural Research Review (1985-86); the term 'researcher' in this table is used in a broad sense.

Table 3. World Bank statistics on the numbers of researchers in West and Central Africa, 1984, and on projected requirements

Country	Total number of researchers		Number of researchers trained per annum by 1982 (BS/Ing level)	Number of additional researchers required by the year 2000	
				Maize	Roots/tubers
Benin	58	(3)*	45	12	15
Cameroon	225	(65)	176	15	20
Congo	94	(14)	?	3	10
Côte d'Ivoire	254	(180)	149	4	20
Gabon	38	(12)	8	2	6
Ghana	263	(12)	122	15	24
Guinea	35	(?)	?	5	15
Liberia	45	(7)	53	?	6
Nigeria	1196	(24)	846**	50	85
Sierra Leone	66	(8)	117	4	5
Togo	58	(14)	60	8	12

Note:

? No estimates available
* Number in brackets refers to number of expatriate research workers included in total
** Of this number, 28 per annum trained to PhD level

From their visits to the participating countries in late 1987, the consultants produced statistics on the number of agricultural researchers in each country. These were checked at the Lomé meeting, and the results are presented in Table 4. The figures in this table represent the number of full-time agricultural researchers (in food crops in general, and in maize and cassava in particular); they do not include research workers who are involved in agricultural research in the various countries on a part-time or temporary basis (for example, soil scientists, agronomists and socio-economists attached to universities, development organizations or parastatals who may from time to time work alongside the full-time researchers). The figures correspond fairly closely to those given in Table 3 for Cameroon, Gabon, Liberia and Togo, but for other countries, particularly Guinea, there is a significant difference.

Table 4. Task Force statistics on number of researchers in West and Central Africa, 1987

Country	Agricultural research	Food crops	Maize	Cassava
Benin	?	?	4 -5	3-40
Cameroon	180 (60)*	?	37 (13)**	10 (2)**
Congo	?	?	?	14 (7)**
Gabon	38 (12)	?	4	3**
Ghana	?	80 (12)	>15 (2)	8**
Guinea	?	?	110 (30)	110
Liberia	56 (8)	?	1	3
Nigeria	?	>270	38	32
Sierra Leone	?	?	4	12
Togo	64	?	4	3

Note:

? No estimates available

* Number in brackets refers to number of expatriate research workers included in total

** The numbers in bold refer to the numbers of researchers in cereals and roots/tubers in general, for no statistics were available for the number involved specifically in maize and cassava research

Significant points which emerged from the consultants' study of human resources in agricultural research in the region are:

- Most agricultural researchers in Nigeria and Ghana have a PhD or MSc; in Cameroon and Sierra Leone the figure is about 55%; and in the rest of the region the percentages are known to be lower, although exact figures are not available.

- Expatriate researchers make up a small proportion of the overall number of researchers. They tend to be concentrated in a few countries, working on special projects (for example, IITA staff working with USAID funding in Cameroon's national cereals research and extension project, and a team from the People's Democratic Republic of Korea working on maize and rice research in Guinea) or with NARS involved in major research on cash crops (as in Cameroon and Gabon).

- Of the estimated 140 full-time researchers on cereals, including maize, most are in Nigeria (50%). Some 50% of all CORAF staff involved in maize research are in Cameroon.

- Of the ertimated 100 full-time researchers on roots and tubers, including cassava, most are in Nigeria (33%), Cameroon and the Congo.

- It was difficult to estimate the numbers of research technicians in the various countries. The technician/researcher ratios produced by the consultants (for example, 1:1 at CRI in Ghana, 1:2 at IRA in Cameroon and 3:4 in Guinea) do not correspond with the SPAAR guidelines that indicate 2:1 as suitable ratios.

Financial resources

As in the case of human resources, reliable statistics on the allocation of financial resources to agricultural research in the region were not available. The statistics given in Table 5 are based on information acquired by the consultants during their visits to the participating countries. Generally, the figures relate to the main agricultural institutions given in Figure 1. It was not possible to obtain figures for corresponding years or, in most cases, to obtain estimates of the financial resources allocated specifically to maize and cassava research.

Table 5. Allocation of financial resources to food crop research in West and Central Africa (in US$ millions)

Country	National agricultural research organization	Budget (Year)	Salaries (% of budget)	Operating funds	Cereals and roots/tubers (% of operating funds)
Benin	DRA; RDPs	3.3 (1984)	?	2*	25
Cameroon	IRA	20 (1985-86)	62	?	?
		18 (1986-87)	85	2.7	*ca* 20
Congo	CRAL	? (1987)	?	0.1	?
		(1988)		0.2	*ca* 10
Gabon	All institutions	10	?	?	?
Ghana	CRI	10 (1988)	90	1**	?
Guinea	DNRA	0.34 (1987)	?	?	?
Liberia	CARI	1.6 (1986-87)	50	0.8	?
Nigeria	18 institutions	100 (1981)	80	?	?
		55 (1984)	90	*ca* 2***	?
Sierra Leone	NARCC	0.12 (1984-85)	80	?	?
		0.4 (1987-88)	?	*ca* 0.1	?
Togo	DRA	1.5 (1984)	?	?	?

Notes:

? Figures not available
* Including funds allocated to special projects
** Excluding funds allocated to special projects
*** Figure represents operating funds of four research institutes

Significant points which emerge from this table and from the consultants' overall study of the allocation of financial resources in the region are:

- The total amount allocated for food crop research in the 10 countries is betweem US$100 and US$150 million per annum. Nigeria accounts for two-thirds of this figure while, at the other extreme, less than one-tenth of the amount is spent by six countries together. Expenditure on food crop research represents between 0.5 and 1.0% of the agricultural Gross Domestic Product for seven countries; for Guinea and

Sierra Leone the corresponding figure is less than 0.1%, while in Gabon the figure is about 2%.

- In the two petroleum-producing countries in which, in the 1970s, a significant amount was allocated to agricultural research — Cameroon and Nigeria — fluctuating oil prices have resulted in a substantial reduction in expenditure on agricultural research.

- Throughout the region, salaries make up a large proportion (over 80%) of the agricultural research budget. The allocation for operating funds is thus very small. It has been estimated that the total regional sum allocated for operating funds is about US$ 10 million (with perhaps an extra US$ 5 million for special projects); of this, a maximum of US$ 2.5 million is used for cereals and roots/tubers research. The lack of adequate operating funds restricts many research programs to on-station work only.

- Adequate resources are always available for externally funded special projects, and thus more effective research is carried out in such projects.

Equipment resources

During their visits to the participating countries, the consultants made note of the fact that throughout the region equipment is very old, poorly maintained or out of service. Transportation equipment is in short supply and thus the mobility of researchers is severely restricted, resulting in too much concentration on on-station research. The exception is again externally funded special projects, which bring in modern equipment, cars and other vehicles.

THE RESEARCH NEEDS OF THE REGION

This overview of the research needs is divided into two parts: crop research needs; and institutional, financial and staff requirements of NARS, including requirements related to researcher-extension worker liaison.

Crop research needs

Maize. Throughout the region, both in areas where maize is the dominant food crop and in those where it is only of secondary importance, there is a need for the control of pests and diseases through the introduction of pest- and disease-resistant varieties or through biological control. The most important and widespread pest is the maize borer. The most important diseases are streak, blight, rust and mildew. Plants that are less prone to lodging and more tolerant of *Striga* and drought are needed.

In general, more research should be carried out on the response of maize varieties to fertilizers, on sustainability of production potential in terms of the physical and biological environment, and on breeding maize varieties suited to mixed cropping and to the various ecological zones.

More specifically, there is a need for varieties which: take more account of consumer tastes; incorporate resistance traits found in local varieties; take into account farmers' preferences (for example, varieties in which the cobs are well covered and thus are protected against insects, precluding the need to use insecticides); and are suited to industrial uses (such as brewing, milling and making animal feed).

Cassava. As in the case of maize, more research is needed on the genetic and biological means of protecting cassava against pests and diseases. The most important pests are mealybug and green mite, while the most important diseases are blight and mosaic disease.

Other important general requirements include establishing genetic resource units and micro-propagation facilities, and strengthening research on post-harvest technology, in relation both to processing and to storage (important factors to be taken into account are the need to lengthen the useful life of the harvested product and the need to use minimal labor).

More specifically, research must take more account of consumer tastes in the region. Important factors to consider here are the poundability of the roots, the use of the leaves as vegetables and the fact that while consumers in some areas may prefer sweet varieties, others favour bitter varieties.

Production systems. The need for on-farm production systems research for maize and cassava has long been neglected, with the exception of work done in special projects, and this should now become a major research priority throughout the region.

Such research should pay particular attention to socio-economic factors and should aim at increasing productivity while ensuring that such increases are sustainable in the long term. It should also identify the factors which influence farmers' acceptability of the proposed technologies.

Strengthening the NARS

The NARS of the region need to be strengthened in terms of their organization and management, research capacity, research-extension links and training facilities.

Organization and management. In order to improve the efficiency and effectiveness of NARS, it is recommended that:

- the structure of NARS be reorganized so that responsibility for agricultural research lies not with several ministries or isolated bodies (as in the case of the Congo, Gabon and, to a lesser extent, Benin and Togo) but with one ministry, to which is attached an umbrella organization reponsible for overall coordination;
- the consolidation of agricultural research structures incorporates long-term programs which are at present being implemented by rural development organizations (as in Benin and Togo) or by autonomous special projects (as in Ghana);
- national mandates for commodity research are assigned to appropriate institutions, with due regard for the agroecological zones.

Efforts to strengthen the NARS are now underway in several countries. The NARS in Benin, the Congo and Gabon are being restructured. Cameroon and Ghana have applied for assistance from the World Bank to strengthen their NARS. The Congo has invited the Food and Agriculture Organization (FAO) of the United Nations to draw up a master plan for agricultural research. The involvement of the International Service for National Agricultural Research (ISNAR) in improving the organization, management, planning and priority setting of the region's NARS is either planned or in progress; this work is being carried out in collaboration with IITA.

Research capacity. The operating funds of NARS are inadequate and subject to considerable fluctuation. The need to stabilize the allocation and increase the amount of these funds is paramount in all NARS of the region if the conduct of agricultural research is to be improved and if research teams are to realize their full potential.

As indicated earlier, expenditure on food crop research as a percentage of the agricultural GDP is generally low; in some countries, particularly Guinea and Sierra Leone, it is an almost negligible amount. The NARS in the Congo, Ghana and Liberia are heavily dependent on external funding. In Togo and Benin the lack of adequate financial resources has resulted in most long-term research being carried out by rural development organizations.

The need for adequate operating funds is particularly urgent in relation to on-farm research work, the provision and maintenance of adequate equipment, including transport, and the training and recruitment of personnel. In Guinea, for example, there is a need for qualified researchers in all disciplines; in the Congo, Ghana and Liberia socio-economists are needed if production systems research is to be more effective; in some countries there are no specialists on post-harvest technologies; and in many countries, particularly Cameroon, the number of research technicians is very inadequate. Funds are also needed to enable NARS to acquire scientific and technical documents in both French and English.

Research-extension links. The impact of the results of agricultural research depends largely upon the strength of the links between researchers and extension services. In many West and Central African countries these links are weak, often because of the inadequacies of the national agricultural extension departments. In those countries where agricultural research comes under a ministry responsible for scientific research rather than a ministry of agriculture or rural development, the liaison between researchers and extension services is often complicated.

An integral part of the effort to strengthen research-extension links must be to increase the number of extension workers and improve the quality of their training. However, because the agricultural research structures themselves are weak, improvements in the numbers and quality of personnel will be ineffective unless there is a simultaneous restructuring of the NARS which allows for the smooth transfer of suitable, farmer-tested and sustainable technologies. This point should be borne in mind particularly in the case of those countries,

including Cameroon, the Congo and Ghana, which have sought World Bank funding to strengthen their agricultural extension services. Such funding usually involves the adoption of the training-and-visit method of extension, which requires the services of subject matter specialists and thus puts a considerable strain on the NARS.

Training. The need to train scientists remains important throughout the region; all the participating countries expressed the wish that, as far as possible, the existing graduate and post-graduate training facilities in the countries should be used. The NARS and the training institutions also considered it important that there should be more emphasis on 'in-country' training, particularly group training. Another issue raised during the study was that much of the training in the region, at all levels, is carried out in English, and more attention should be paid to the needs of French-speaking trainees.

The main priority in the region, however, is the need to train more technicians, and it was generally agreed that, to alleviate the current shortage of trained technicians, a regional training center should be established. IITA can meet only a small proportion of the region's requirements for professionally trained technicians; expansion is constrained both by the Institute's financial resources and by the accommodation available on the Ibadan campus, which is already fully utilized. In the light of this situation, efforts were made during the study to identify a suitable regional training center.

The UCD in Cameroon appears to fulfill many of the requirements of such a center. It is a bilingual institution which has been engaged in training agricultural technicians since 1960 and which draws students from many countries in the region. Much of its funding comes from the United States Agency for International Development (USAID); it is also receiving financial assistance from France and Belgium. The training facilities comprise adequately equipped laboratories, 10 lecture rooms which can each hold up to 50 students at a time, seminar rooms, a university farm, a library and accommodation for students and staff.

Five courses have already been identified as essential for the regional technician training program. These are agronomy, plant breeding, crop protection, post-harvest technology and storage, and soil science. The plan includes the need to provide 3-month training courses for about 110 technicians over a period of five years, at a cost of US $548 400. Negotiations are underway with the UCD to assess the additional investment necessary for the institution to fulfill its role as a regional training center; a provisional estimate of the capital investment required is US$ 500 000.

The UCD authorities welcome the idea of taking on an expanded regional role and of forging stronger links with IITA in relation to curriculum development, preparation of training materials and training of the trainers. IITA is keen to assist the UCD in the development of its training capacity.

IITA'S MEDIUM - TERM PLAN

IITA's Medium-term Plan (1989-1993), which is now being implemented, is the action phase of the Institute's long-term Strategic Plan. There is a close correlation between the objectives of the Medium-term Plan and those of the Task Force's plan in terms of two particular research needs of the NARS in the region: technology generation and strengthening partnership with the NARS.

Technology generation

Cassava and maize improvement are the two main commodity improvement programs at IITA. The Medium-term Plan gives highest priority to breeding cassava for adaptation to the diverse environments and cropping systems in the region; notably, it places increased emphasis on the humid forest zone, which will be served by a new research substation. IITA is also increasing its research on the post-harvest technology and utilization of cassava.

IITA will continue to implement a full-scale maize improvement program. A maize research substation will be established in the West African moist savanna areas, where maize is replacing sorghum and where production is expected to grow most rapidly. A major research activity at the substation will be breeding *Striga*-tolerant varieties. For maize grown in the humid zone, research activities include breeding varieties which are resistant to stem borers and to pathogens such as downy mildew and ear/stalk rots.

The Medium-term Plan's major priority in resource management research is to synthesize the technologies developed at IITA for the non-acid soils of the subhumid forest/savanna transition zone and to test these technologies on-farm in collaboration with NARS scientists. At its new substation in the humid forest zone, IITA will also launch an integrated resource management research program for the acid soil environment; special emphasis will be placed on alley farming, which is considered the most promising sustainable system to emerge from IITA's research on resource management.

The results of IITA's research on crop improvement and resource management are incorporated into the work of the Institute's farming systems program, through the research carried out by working groups on crop-based systems.

The Medium-term Plan's priorities for research on cassava and maize improvement and on resource management are fully in accord with the research needs expressed by the countries participating in the Task Force initiative. This should reinforce the request to donors to commit more resources to strengthening collaboration between IARCs (particularly IITA) and the NARS in order to accelerate the generation and implementation of improved technologies.

Strengthening partnership with the NARS

One of the major goals of the Medium-term Plan is to strengthen the capability of NARS to generate technology which meets national needs. Building on past collaboration between IITA and NARS, the Medium-term Plan includes specific mechanisms for consolidating this collaboration through resident scientist teams, research liaison scientists, visiting scientists, training and information services.

It is essential that the partnership between IITA and the NARS be developed stage by stage. Figure 2 is based on the model contained in IITA's Medium-term Plan which sets out the development of the partnership in accordance with the development of NARS as they

move from technology-adaption to technology-generation. The table is followed by an outline of the specific mechanisms on which the successful implementation of this model depends.

Figure 2. Development of collaboration between IITA and NARS

Stage	Commodity improvement		Crop and resource management research		Collaboration mechanisms	
	IITA	NARS	IITA	NARS	IITA	NARS
1	Adaptive breeding of finished varieties for NARS	Multi-locational testing of IITA varieties	Joint IITA/NARS exercise to describe present systems and analyse constraints		Resident scientist teams; training technicians and MSc candidates	Counterparts of resident scientists; training selected technicians/ graduates
2	Applied breeding of parental lines for provides	Line selection; variety development and testing NARS candidates;	Providing methods and technologies for improved systems	Testing crops and technologies in national agroecological	Resident team phased out; IITA liaison scientist link; training of PhDs and trainers starts	Graduates assume responsibility; selection of PhD zones In-country technical training prepared
3	Maintenance breeding; pre-breeding research (biotech-nology)	Major breeding program for national agro-ecological zones	Long-term strategic research on crop and resource management problems	Adaptive on-farm and on-station research; new farming systems tested; parti-cipation in regional activities training	Link through liaison scientist continued; NARS visiting scientist; IITA trains trainers and provides materials	PhDs assume leadership; technical training for national and regional requirements

Resident scientist teams. There are currently 46 IITA scientists working in large teams in Cameroon and Zaire. IITA intends to replace these teams with smaller teams of two to three scientists; each team will be assigned to selected NARS and will assist in the development of IITA/NARS collaboration. Broadly, the NARS can be divided into two groups in terms of stage of development:

— those in the early stage of development which need to strengthen their adaptive research capability to solve specific problems for which IITA has developed appropriate technologies ;
— those in the medium stage of development which disseminate technologies to less developed neighboring NARS and which are involved in research problems of an applied nature.

ERRATUM

Strengthening Maize and Cassava Research in Eleven Countries of Coastal West and Central Africa:

Plan of Action

REQUEST TO DONORS

Page 18: Replace existing figure with the following figure.

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	IITA	NARS	IITA	NARS	IITA	NARS
1	Adaptive breeding of finished varieties for NARS	Multi-locational testing of IITA varieties	Joint IITA/NARS exercise to describe present systems and analyze constraints		Resident scientist team; training of technicians and MSc candidates	Counterparts of resident scientists; training of selected technicians/ graduates
2	Applied breeding of parental lines for NARS	Line selection; variety development and testing	Provision of methods and technologies for improved systems	Testing of crops and technologies in national agroecological zones	Resident team phased out; IITA liaison scientist provides link; training of PhDs and trainers starts	Graduates assume responsibility; selection of PhD candidates; in-country technical training prepared
3	Maintenance breeding; pre-breeding research (biotechnology)	Major breeding program for national agroecological zones	Long-term strategic research on crop and resource management problems	Adaptive on-farm and on-station research; testing of new farming systems; participation in regional activities	Link through liaison scientist continued; NARS visiting scientist; IITA trains trainers and provides training materials	PhDs assume leadership; technical training for national and regional requirements starts

Research liaison scientists. Three full-time IITA scientists will be designated research liaison scientists and assigned to a group of countries; the countries will be grouped according to ecological and geographic factors. The responsibilities of the research liaison scientists will include:

- studying the institutional, research and training requirements of their particular group of countries;
- putting forward proposals on how to meet these requirements through collaboration with IITA and other IARCs;
- coordinating IITA activities within their group of countries and directing the attention of IITA scientists towards solving the countries' most critical problems;
- assisting in facilitating collaboration between NARS and in improving the effectiveness of research networks.

Visiting scientists. Each visiting scientist would be a member of the appropriate IITA research team for up to one year, after which he/she will return to his/her NARS. This arrangement offers opportunities for both newly trained and experienced scientists in West and Central African NARS to conduct research of importance to the NARS and IITA, and will be an invaluable contribution to the strengthening of NARS/IITA collaboration.

Training. This is an integral part of IITA work and in the long term it may prove to be the most enduring IITA contribution to the solution of Africa's food production problems. In its Medium-term Plan, IITA states that its major priorities in training are:

- to devote more core resources to training in order to have more control over the basic decisions on training priorities;
- to shift the emphasis at IITA in Ibadan from group training to individual research training, especially for postgraduates (to achieve this, IITA has set up the African graduate research fellowship scheme for outstanding African students working for an MSc or PhD);
- to increase its efforts to pass the responsibility for group training to national institutions but to continue to provide training for trainers and to develop training materials in both English and French;
- to seek effective ways of increasing the proportion of women participants at all levels.

Information services. As NARS/IITA collaboration develops, information services will play an increasingly important role. Core elements of these services will be library services, publishing, the development of data bases, the dissemination of information to the public and video technology application; greater emphasis will be placed on the need in all these activities to cater for both English and French speakers. In addition, IITA hopes to establish a scientific literature service for NARS, to provide training in scientific editing and technical publishing, and to extend the library. The implementation of these plans will make a significant contribution towards strengthening the NARS.

RESOURCES REQUESTED FROM DONORS

The resources requested from donors to assist in strengthening maize and cassava research in West and Central Africa are based on the proposals drawn up by the countries participating in the Task Force initiative. The major features of the request are outlined below. This is followed by a summary and breakdown of the total request.

Major features of the request

Each national proposal is divided into five sections:

- National research priorities identified at the Lomé meeting (April 1988)
- Projects selected as essential at the Ibadan meeting (September 1988)
- Objectives to be achieved over a 5-year period
- National resources
- Resources requested from donors

The success of the Task Force initiative relies partly on donors meeting the requests contained in the plan and partly, and perhaps more importantly, on the strong commitment expressed by the NARS of the region to at least maintain their present efforts in terms of personnel, infrastructure, equipment and operating funds.

The national proposals do not include requests for funds for research activities which have a regional rather than national focus, nor do they refer to resources already committed by donors; they deal only with additional resources needed to achieve their objectives.

A detailed breakdown of the amounts being requested, country by country, is given in Table 6. The basis on which some of the major costs in this table were calculated is given here.

Five-year time schedule. The plan should be evaluated 3 or 4 years after implementation, at which point a decision should be taken on whether or not to draw up proposals for a second 5-year plan. The effective strengthening of NARS in terms of human and financial resources and institutional infrastructure is likely to take far longer than 5 years.

Operating funds. Following SPAAR guidelines, operating funds have been calculated on the basis of US$ 10 000 per annum per scientist. These funds cover the expenditure on such items as equipment operation and maintenance, documentation and library subscriptions, laboratory supplies and travel.

Equipment. The equipment costs given in the national proposals have been calculated on a tax-free and duty-free basis and do not take account of transport and handling costs. It is estimated that cars, including four-wheel drive vehicles, will cost, on average, US$15 000, excluding tax and duty. Equipment costs will be reduced if items are bought from a central source wherever possible.

Physical infrastructures. As the aim of this initiative is to strengthen research by capitalizing on past investment and using external finance to meet only the most essential needs, expenditure on physical infrastructures such as new buildings and new experimental stations is not included in the national proposals. Although there is a need for new buildings and for the improvement of old ones, many of which were built in the colonial era, other sources of finance such as state investment or World Bank loans may be sought to meet such costs. However, expenditure on smaller structures, such greenhouses and screenhouses, is within the scope of the plan.

Training. The current cost of MSc or PhD fellowships is estimated at US$15 000 per annum in Africa and US$20 000 per annum overseas. The expenditure on post-graduate training is calculated on the basis of an MSc degree taking 2 years and a PhD taking a further 3 years. The cost of technician training at IITA and UCD is estimated at US$ 1 500 per month per student, and the average cost of air travel per student is about US$ 500; the regional cost of training 110 technicians is estimated at US$548 400. An additional sum of about US$ 500 000 is required to enable UCD to assume an expanded regional role in research technician training.

Personnel. The cost of an IITA resident scientist posted to a NARS institution is estimated at US$125 000 per annum. This covers all overhead costs and logistics support for the scientist and his/her operating costs. The cost of a short-term IITA mission to a NARS is estimated at $15 000 per month. The budgets do not include provision for topping up the salaries of locally paid research staff; although these salaries tend to be low, they are usually tied to the salary scales of the public service. The emphasis in this initiative is to improve the research environment for local scientists, rather than to increase their remuneration.

Inflation and overheads. The budgets allow for inflation and for expenditure on overheads, such as tax, duty, transport costs, insurance, administration, travel, meetings and consultations.

Additional collaborative research activities on maize. Maize research is not included in the budgets for Benin, the Congo, Gabon and Sierra Leone because the crop is of secondary importance in these countries. However, they all have a minimum research effort on maize and might want to participate in some collaborative research and networking. It is estimated that these additional collaborative research activities will cost US$ 200 000 of the partners.

Summary and breakdown of total request

The countries of the region spend a total of about US$ 150 million per annum on food crop research. In contrast, the total amount being requested from the donors is about US$12 million, and it should be emphasized again that this amount respresents the cost of meeting only the most essential needs of maize and cassava research in the region.

The breakdown of expenditure in terms of crops is:

Cassava research	73.8%
Maize research	19.5%
Production systems research	6.7%

Cassava research is receiving the major share of the budget because most NARS already have a sizeable research program on cereals, particularly maize, whereas in much of the region cassava research has been neglected. Cereals research in some countries, especially the larger ones, receives considerable external support; in Cameroon and Ghana, for example, cereals research is supported by USAID and CIDA respectively, with additional technical assistance from IITA and CIMMYT.

The breakdown of expenditure in terms of the categories shown in Table 6 is as follows:

Operating funds	29.4%
Training	26.2%
Equipment	21%
IITA resident scientists	14.0%
IITA short-term missions	4.2%
Inflation and contingencies	4.8%

Within the equipment category, 4.3% is earmarked for vehicles, while 16.7% will be spent on other equipment, including tractors and trucks. Within the training category, 7.2% will be spent at PhD level, 12.7% at MSc level, and 5.6% on technician training.

Throughout the region, the lack of operating funds seriously constrains the conduct of trials, experiments and field work, particularly off-station. The US$ 2.88 million requested from donors will double the operating funds currently available to NARS for maize and cassava research in all countries except Nigeria.

Requests for vehicles have been kept to the minimum needed to provide mobility for researchers. The figure of 4.3% represents the cost of 28 vehicles (both two- and four-wheel drive). In most NARS few vehicles are operational and no funds are available from national sources to purchase new ones.

Essential items of equipment include tractors, trucks, motorcycles, bicycles, office equipment (including microcomputers), laboratory equipment, greenhouses, screenhouses and agricultural implements. Priority will be given to the repair and maintenance of existing equipment which is currently non-operational.

Investment in training ranks high in the list of priorities. A large proportion of the MSc and PhD fellowships have been earmarked for overseas training, as the capacity in most countries to offer higher degree training is weak. An important budget item is the US$ 500 000 investment in UCD to enable it of offer bilingual training courses for research technicians.

It should be noted that less than one fifth of the total budget is earmarked for expenditure on IITA resident scientists and short-term missions.

The breakdown of expenditure in terms of annual commitments is:

Year 1	40.6%
Year 2	21.0%
Year 3	15.8%
Year 4	12.6%
Year 5	9.9%

To lay the foundations for the success of the plan, most of the expediture occurs early in the plan period. This relates particularly to the purchase of equipment.

PROPOSED IMPLEMENTATION OF THE PLAN

In the face of the decline in food production per capita over the past two decades in West and Central Africa, an area with considerable agricultural potential, the plan offers the opportunity to address this problem in a coordinated and balanced way. The plan is the result of in-depth studies and consultations with research leaders of the NARS throughout the region, and will have a far greater impact on the production of maize and cassava than a piecemeal, country-by-country approach.

Commitment of funds

Just as pragmatism characterized the approach of the initiative, so flexibility must characterize the raising, commitment and management of funds. Bilateral as well as multilateral sources of funds are invited. Funds can be committed for a particular research activity, for a particular country or for a group of countries, but efforts should be made to ensure that no country is excluded.

Some research activities require direct IITA involvement (for example, resident scientists and short-term missions) or are transnational in character (for example, technician training at UCD). Many budget items, such as the need for vehicles and equipment, are common to most of the countries involved, and thus there would be a cost advantage in procuring these items from a central source.

Coordination and management of plan

In line with the wish expressed by research leaders of the NARS that IITA be closely involved in both raising and managing the funds, it is recommended that a trust fund be established at IITA and be managed by IITA. Amongst other things, this fund would be used to handle the bulk purchases referred to above.

To assist IITA, and in view of the complexity of the initiative and the number of countries involved, it is proposed that a steering committee be established. This committee would have the overall responsibility for the management of funds and the smooth implementation of the plan. Its members would be representatives from the donor community, NARS, IITA and the major agricultural research networks in the region and would be appointed for a fixed term.

The steering committee would define the monitoring and evaluation procedures and be responsible for their implementation, organize general consultations with all participants and ensure that responsibilities are shared among the participants, and assess the impact of the plan after five years.

Comments are invited from donors and other interested parties on the proposed mechanism for implementing this plan to strengthen maize and cassava research in West and Central Africa.

Table 6. Budget for the plan of action to strengthen maize and cassava research in West and Central Africa

	IITA scientists	IITA short-term missions	Equipment: Vehicles	Equipment: Other	Operating funds	Training: MSc	Training: PhD	Training: Technicians	Training: Total	Inflation and cont.	Total	Total national request	%	Year 1	Year 2	Year 3	Year 4	Year 5
BENIN																		
Cassava improvement	-	15.0	15.0	5.0	100.0	40.0	-	-	40.0	9.0	180.0			74.55	48.30	22.05	22.05	22.05
Cassava processing	-	15.0	-	5.0	100.0	-	-	9.0	14.0	6.7	140.7			67.25	27.30	22.05	22.05	22.05
Maize processing	-	15.0	15.0	100.0	100.0	-	-	9.0	9.0	15.4	323.4			231.80	23.10	23.10	23.10	23.10
Production systems	-	15.0	15.0	5.0	100.0	-	-	9.0	14.0	7.4	156.4	808.8	8.3	67.25	43.05	22.05	22.05	22.05
CAMEROON																		
Cassava improvement	-	30.0	30.0	225.0	200.0	240.0	120.0	35.4	395.4	50.8	1067.2			401.94	198.76	177.76	144.37	144.37
Maize storage/processing	-	15.0	15.0	40.0	30.0	-	-	-	-	6.0	126.0	1193.2	12.2	73.50	10.50	21.00	10.50	10.50
CONGO																		
Cassava improvement	500.0	45.0	45.0	97.0	221.1	-	120.0	30.0	190.5	54.9	1153.5	1153.5	11.8	440.47	358.26	165.27	101.74	87.78
GABON																		
Cassava improvement	500.0	-	15.0	20.0	30.0	30.0	60.0	30.0	160.0	37.6	790.6	790.6	8.1	339.15	294.00	52.50	52.50	52.50
GHANA																		
Cassava improvement/ storage/processing	-	30.0	45.0	251.5	120.0	200.0	120.0	35.0	355.0	42.3	888.8			450.45	144.37	139.12	70.87	84.00
Cassava protection	-	15.0	15.0	40.0	100.0	-	-	5.0	5.0	8.7	183.7	1672.6	10.9	91.87	21.00	28.87	21.00	21.00
GUINEA																		
Cassava improvement	-	45.0	-	17.0	30.0	40.0	-	18.0	58.0	8.5	178.5			38.85	61.47	32.55	54.07	11.55
Cassava protection	-	45.0	15.0	24.0	30.0	-	-	9.0	9.0	7.5	132.8			79.80	20.47	11.55	28.87	11.55
Maize improvement	-	30.0	15.0	18.0	50.0	40.0	-	-	40.0	8.0	168.6			55.65	61.47	40.42	11.55	11.55
Production systems	125.0	-	-	19.6	30.0	40.0	-	9.0	49.0	12.2	255.8	707.1	7.6	168.48	33.60	33.60	11.55	11.55
LIBERIA																		
Cassava improvement	-	37.5	15.0	120.5	50.0	120.0	60.0	50.0	230.0	22.8	478.3			231.52	128.62	69.87	69.87	18.37
Cassava storage/processing	-	7.5	15.0	24.0	100.0	40.0	-	20.0	60.0	10.8	227.3			85.84	64.89	46.20	25.20	25.20
Maize improvement	-	15.0	15.0	60.0	110.0	120.0	-	40.0	160.0	17.0	357.0	1062.6	10.8	130.99	102.64	45.94	45.94	31.50
NIGERIA																		
Cassava improvement	-	-	30.0	36.0	271.0	80.0	60.0	30.0	170.0	25.3	532.3			198.97	112.87	76.65	71.40	72.45
Maize improvement	-	-	30.0	156.0	90.0	80.0	60.0	30.0	170.0	21.7	456.7	988.1	10.1	258.82	64.57	48.30	42.52	42.52
SIERRA LEONE																		
Cassava improvement/ storage/processing	-	37.5	45.0	168.4	480.0	60.0	105.0	100.0	265.0	49.3	1035.2	1035.2	10.6	354.79	175.87	202.12	158.02	144.37
TOGO																		
Cassava improvement	-	-	15.0	25.0	200.0	60.0	-	30.0	100.0	17.0	357.0			88.20	60.37	78.22	65.10	65.10
Maize improvement	-	-	15.0	80.7	150.0	40.0	-	30.0	70.0	15.8	331.5			99.43	61.42	82.42	54.60	33.60
Production systems	250.0	-	-	-	-	-	-	-	-	12.5	262.5	981.0	9.7	-	-	131.25	131.25	-

	IITA scientists	IITA short-term missions	Equipment Vehicles	Equipment Other	Operating funds	Training MSc	Training PhD	Training Tech-nicians	Training Total	Inflation and cont.	Total	Total national request	%	Year 1	Year 2	Year 3	Year 4	Year 5
Sub Total (1)	1375.0	412.5	428.0	1689.7	2882.1	1298.0	705.0	548.6	2568.9	467.2	9804.0	9804.5	100.0	3985.8	2056.9	1552.9	1240.2	968.7
% of subtotal	14.0	4.2	4.3	16.7	29.4	12.7	7.2	5.6	26.2	4.8	100.0		100.0	40.6	21.0	15.8	12.6	9.9
Additional collaborative research activities on maize (Ilesha, Congo, Cohen and Sierra Leone)	-	-	-	-	200.0	-	-	-	-	-	200.0	200.0	-	-	-	-	-	-
Sub Total (2)	-	-	-	-	3082.1	-	-	-	-	-		10 004.5**						
Tax, duty, meetings, travel, administration 10%	-	-	-	-	-	-	-	-	-	-	-	1530.7						
Investment in UCD	-	-	-	-	-	-	-	-	-	-	-	~~300.0~~ - AID - ongoing						
TOTAL	-	-	-	-	-	-	-	-	-	-	-	12 005.2						

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Notes:

- Costs of vehicles and other equipment are calculated on a tax-free and duty-free basis
- ** Of this amount, US$7594.6 (75.9%) is allocated for maize research;
  US$1985.2 (19.9%) is allocated for maize research;
  US$94 (0.7%) is allocated for production systems research

Appendix 1

SUMMARIES OF THE MAIZE AND CASSAVA RESEARCH NEEDS IN THE COUNTRIES PARTICIPATING IN THE INITIATIVE

Benin

Benin had 3.7 million inhabitants in 1982, most of them living in the country's southern provinces, where population density is over 150 persons/km^2. Agriculture accounts for about 44% of the Gross Domestic Product (GDP), which, at US$ 320 per capita, is one of the lowest in West Africa. The agricultural sector employs 75% of the workforce and provides about 55% of the country's exports. Cotton and palm oil are the main agricultural exports. Maize, which is grown in the north of Benin and exported to Nigeria, is a major component of the country's unofficial agricultural exports.

The Ministère du développement rural et de l'action coopérative is responsible for the government's policy of support for agricultural production. Support is channelled through six Centres d'action régionale pour le développement regional (CARDERs), which are responsible for integrated development, including inputs, marketing, extension and infrastructure. Although some of CARDERs receive external funding, they do not always operate satisfactorily; for example, they often provide seeds of inadequate quality.

Only about 14% of arable land is actually cultivated, about 960 000 ha to food crops (usually mixed), and 100 000 ha to cotton. Among the food crops, maize is the most important cereal. Production has been growing by about 4% per annum over the past 10 to 15 years, reaching an average of 400 000 t per annum in recent years. Among the roots and tubers, the production of yams has recently overtaken that of cassava. The cassava output has been about 725 000 t per annum in recent years. Interannual variations in official national production statistics are caused partly by climatic factors and partly by demand from Nigeria.

Both maize and cassava are important components of the national diet. They are ingredients in numerous dishes which vary according to location but are broadly similar to those found in Togo and in southwest Nigeria.

About 45% of the maize produced is consumed on the farm, and the balance is marketed. The market is free — prices fluctuate according to season and there are many private sector traders. The role of public bodies is limited. The national cereals board has underutilized maize storage and processing facilities.

Enough maize is produced to satisfy domestic demand, but maize is no longer the preferred cereal staple: about 80 000 t of wheat and 30 000 t of rice were imported in 1986. Cassava does not receive as much attention from government as does maize, the production of which is successfully encouraged by the CARDERs. In the case of cassava, the introduction of efficient post-harvest technology for making *gari* would improve marketing efficiency without increasing prices.

The savanna zone of northern Benin, which has a unimodal rainfall pattern, is suitable for maize production, whereas the climate in the south is more suited to cassava.

After 10 years under the Ministère de l'ensiegnement supérieur, the responsibility for agricultural research was passed to a directorate within the Ministère du développement rural et de l'action coopérative in 1983. There are two research stations working on food crops — the Ina Station for the northern savanna zone, and the Niaouli Station for the

southern forest zone. There are also research stations for cotton, palm and coconuts, and a national soils research center, together with facilities for research on plant protection, food technology, and rural economic and social development.

The government is determined to increase the resources available for agricultural research, particularly through funding at the CARDER level. Staff costs of about CFAF 8 million are earmarked for this purpose in the national budget for agricultural research. Operating costs, which were about CFAF 12 million in 1986, are met mostly through external funding. Of this sum, only CFAF 1.3 million goes towards maize and sorghum and CFAF 0.3 million to roots and tubers; 90% of operatings costs is accounted for by palm and cotton. It is difficult to assess the proportion of manpower devoted to the various cash and subsistence crops, owing to conflicting data on the total number of researchers involved, which appears to vary between 41 and 88. About four to five person-years are spent on maize, and three to four on cassava.

Since 1980, Benin has introduced new varieties of maize bred from parental material supplied by IITA. Both long- and short-duration varieties have been introduced, in which tolerance to streak disease and various insects has been incorporated. After a brief evaluation period, the new cultivars have been rapidly distributed to farmers. In the cotton belt, the use of draught animals for land preparation and fertilization has been successfully introduced to smallholders.

The priorities identified for maize research are:

— the development of techniques (intercropping, alley cropping, use of organic fertilizers) for maintaining soil productivity in the densely populated south, where fallowing is on the decline;

— the development of small-seeded varieties with a high starch content, adapted to the tastes of consumers in the southern (coastal) zone;

— the introduction of varieties resistant to streak disease, rust and curl, through collaborative research with IITA;

— the problem of post-harvest attack by borers and insects, including work on the acceptability of insecticides;

— the practical application of the results of production systems research.

A number of observations can be made regarding the implementation of research on these topics:

— when collaboration with French research institutes ceased in 1977, one of the projects terminated was the evaluation of landraces; these might prove useful in future plant breeding;

— the current level of funding (around CFAF 2 million per annum) is less than 0.5% of the total value of maize production; this is a major constraint to long-term research and development, although short-term adaptive work carried out by the CARDERs appears well suited to smallholders' needs;

— the research teams working on post-harvest technology and plant protection lack the necessary capacity to participate in the priority research program;

— the buildings at Niaouli Station need renovation, and the equipment needs upgrading.

Many of the problems of maize production faced by Benin have already been partially solved through research in Nigeria and Togo, but national researchers in Benin are unaware of this.

Existing links between the Direction de la recherche agronomique (DRA) and CARDER staff, which currently consist of an annual meeting and other, informal contacts, should be strengthened, particularly in the area of farming systems research. Currently, this is led by the CARDER in Mono Province, with support from IITA.

National research on cassava has not led to the development of new technologies. Varieties from Nigeria have been rapidly adopted on smallholder farms in southern areas near the border, but these are for the most part varieties that the government has decided not to distribute because of their high cyanide content.

The research priorities for cassava are genetic improvement, including disease resistance in sweet varieties, recommendations to farmers on maintaining soil productivity in systems using intercropping or crop rotation, and improved techniques for producing *gari*. These priorities ought to be addresssed largely through collaboration with neighboring countries where relevant results have already been achieved.

To guide the breeding work, the cyanide content of all material must be carefully monitored. It would be inappropriate to attempt to introduce bitter varieties into areas where sweet ones are preferred. The research done by IITA and by scientists at Niaouli Station has resulted in too few varieties with a low cyanide content.

On-station and on-farm trials have not been carried out on a large enough scale, in terms of both the number of varieties tested and the number of sites used. More trials should be carried out, based initially on the work undertaken by IITA.

A number of research areas appear to have been neglected in the past, including soil productivity, intercropping, pest control and the use of herbicides.

Contacts with the international agricultural research centres (IARCs) have been limited, although IITA has been involved through training and visits. There has also been contact with the Semi-Arid Food Grains Research and Development (SAFGRAD) project, and with the soil science team in Togo.

Maize varieties from IITA have been successfully introduced, especially in the north. IITA's research on maintaining soil productivity in maize-based systems has been successfully transferred to some areas. Benin's geographical position and size make increased cooperation with its neighbors especially desirable, particularly in the area of maize breeding.

The IARCs should help Benin develop its research capability in plant breeding. Additional funding would enable a fruitful relationship to be developed with Togo.

Benin wishes to be an active member of the maize research networks run by SAFGRAD and the Conférence des responsables de la recherche agricole africaines et français (CORAF). The country sees these networks as important channels for additional funds, both for Benin and for the region as a whole.

The need for IITA involvement in training remains considerable. It is hoped that the French language will be used to a greater extent in training activities. If IITA were to establish a substation for maize research, local preference would be for Côte d'Ivoire rather than Cameroon.

Similar observations apply to cassava research. Benin needs increased cooperation with its neighbors, continued inputs of germplasm from IITA and from the Institut de

recherches agronomiques tropicales et des cultures vivrière (IRAT), and greater involvement of IITA in the national research program. Benin is a member of the CORAF network, but this has been ineffective to date. Linguistic barriers should not be allowed to impede contact with Nigeria or IITA.

Cameroon

Cameroon is often regarded as Africa in miniature, so diverse is it ecologically and culturally. An oil exporter, the country experienced rapid economic growth, averaging 7% per annum, from 1981 to 1985. The recent decline in oil prices has led to sharp cuts in public expenditure — 20% on average, 40% for agricultural research.

Nevertheless, the agricultural sector has first priority in the national development plan. Export crops — coffee, cocoa, cotton and rubber — account for one third of the value of agricultural production. Farm gate prices for these crops are fixed by the government.

Prices for subsistence food crops in which Cameroon is self-sufficient are not fixed. Cameroon imports wheat, rice and maize.

About 90% of the country's food and cash crops (excluding rubber) is produced on some 1 million smallholdings ranging from 1 to 4 ha in size. Commercial farming, using intensive production systems, is developing for some products. Maize is the main cereal grown in the north, in the central savanna zone, and at higher elevations in the west. Yields are low, usually between 1 and 2 t/ha. The area cultivated to maize is increasing, both in the cotton zone and further north, where maize is replacing sorghum. Maize is consumed as human food, but is also used for brewing and as animal feed.

Cassava is also widely grown. It is a major crop in the southern forest zone, where there are two rainy seasons. The average yield is about 12 t/ha. Cassava production is replacing that of other roots and tubers, and the crop now provides about 30% of the calories in the average diet. Both sweet and bitter varieties are grown. The crop is processed on a small scale, usually by women, into a wide variety of food products, including *fufu* and *gari*. Cassava leaves are also eaten.

Analysis of the wide range of cassava products consumed in Cameroon has revealed the need for research on ways to cut production time and costs. Some attempts to launch small-scale industries have been made.

Increasing maize production will require improved varieties adapted to varying environments. Long-duration varieties will be needed during the main rains in the south and at high elevations, while short-duration varieties will be required in the savanna zone, and during the second rainy season in the south. Resistance to stem borers, especially in the south during the second season, and to *Striga*, which is a severe problem in the north, will be needed. Effective systems and recommendations for conserving natural resources, particularly soil, have yet to be devised.

Increasing cassava production will require high-yielding varieties that are better adapted to consumer tastes than those currently produced by IITA. Local varieties are highly vulnerable to diseases and pests. The wide variety of ecologies in which cassava is grown, together with the diverse uses to which the crop is put, imply a need for large numbers of lines, increasing the choice available to farmers and consumers.

Agricultural research in Cameroon is the responsibility of a single institute, the Institut de la recherche agronomique (IRA), under the Ministère de l'enseignement supérieur, de l'informatique et de la recherche scientifique. The resources made available to the IRA increased considerably during the early 1980s, reaching a satisfactory level in

1985-86, only to be reduced drastically as a result of the budget cuts in 1987-88. The total funds available for agricultural research (including forestry and livestock) in 1985-86 amounted to US$ 19 million, 50% of which was from external sources. Of this, the IRA received about US$ 10 million. As a result of the cuts, the proportion of the IRA budget spent on salaries rose from 50% to 85%, with a corresponding reduction in operating funds.

Human resources are adequate in terms of research staff, who number 180 including expatriates, but inadequate in terms of technicians, who number only 90.

The IRA cereals program, two thirds of which is devoted to maize, takes 12-13% of the institute's budget and employs 37 researchers, including 11 expatriates, all from IITA. This program is supported by the United States Agency for International Development (USAID) as part of the National Cereals Research and Extension (NCRE) project. The project is scheduled to continue until 1995, with a budget of US$ 39 million over 10 years.

SARGRAD organizes on-farm research involving maize in the north, and the Société pour le développement du coton (SODECOTON) acts as an extension service in the cotton belt.

The IRA roots and tubers program has 10 researchers, including two expatriates from IITA, and 22 technicians. The program is supported by USAID and other donor agencies. External funding amounts to US$ 7.9 million over a 5-year period. Support facilities will include a tissue culture laboratory.

A project to strengthen national agricultural research has been set up by the Food and Agriculture Organization (FAO) and the World Bank. Funding for this project totals US$ 43 million over 8 years. The project will recruit 24 researchers and 54 technicians.

Links between research and extension are complicated by the fact that the two activities are the responsibility of different ministries. The IRA has set up experimental Testing and Liaison Units (TLUs), and is cooperating with various parastatal agencies. The TLUs operate at regional level and have a staff of four (two agronomists, one sociologist and one extension officer, the latter from the Ministère de l'agriculture).

Agricultural education is provided at nine colleges for technicians and at the Dschang University Centre (UCD) for scientists. Established on the model of the American land-grant universities, the UCD has 30 lecturers (including five expatriates) and a budget of US$ 8.3 million. The UCD cooperates with the IRA, especially on roots and tubers.

The NCRE project, operational since 1982, has brought progress in maize research. Improved varieties have been widely distributed, but show poor resistance to streak disease. Varieties with enhanced resistance have been introduced recently from IITA, from the International Maize and Wheat Improvement Center (CIMMYT) and from East Africa and are currently being tested. The development of hybrid varieties for the central and western plateau areas is showing promise. The same is true of free-pollinating varieties bred for the lowlands. Recommendations on the use of fertilizers and different management practices have been developed for the main maize-growing ecologies.

Research priorities for maize during the coming years are based on the need to build on this initial progress, with the emphasis on developing improved resistance to streak disease, varieties adapted to intercropping with groundnuts and cassava and drought-tolerant varieties for the north. The problem of stem borer is a priority research topic for the south. Post-harvest losses during storage appears to be a neglected research area.

Cassava research is carried out under a program started in 1978. Ten new cultivars have already been developed using local and IITA materials. Currently being tested on smallholdings, these have high potential yields of 20 to 30 t/ha, and are resistant to mosaic disease and bacteriosis. No biological control program has been launched against

mealybug and green mite because the national plant protection departments have not permitted the importation of the relevant parasitoids. Cassava processing techniques have been assessed.

Future research priorities include the breeding of high-yielding, disease-resistant varieties adapted to various environments and to varied tastes and uses. (The new cultivars available at present are not acceptable to consumers because of their long pounding and cooking times). Future breeding activities will make better use of local materials. Research on post-harvest losses caused by pests is also a priority. On-farm research, which is less advanced for cassava than for maize, will be increased. More socio-economic research is needed in the study of production systems using rotations and intercropping. Lastly, manpower needs to be increased, since at present a team of only 12 researchers (only four of whom have a PhD) must work on four roots and tubers crops.

Cameroon benefits from international cooperation in many areas. Several bilateral donors, and USAID in particular, provide support, including about 50% of the resources devoted to food crops. Most of the external support provided is of a long-term nature, and thus continuity in research is more likely in Cameroon than in some other countries of the region.

Cameroon receives more direct support from IITA than any other country in the region except Nigeria, IITA's host country. Eleven IITA scientists are outposted in Cameroon — nine on the cereals programme and two on the roots and tubers program. IITA has also trained many scientists and technicians. The institute is considering Cameroon as the possible host country for its satellite research station for maize in the wet savanna zone. Cameroon's bilinguality is clearly an incentive to the strengthening of IITA's operations in the country.

Bilinguality is also a factor in Cameroon's participation in four networks — the IITA/SAFGRAD network for maize, IITA's Western and Central African Tuberous Plant Network, and the two CORAF networks for maize and cassava. National researchers expressed the need for harmony between the operations of these networks.

The World Bank will shortly provide a loan to strengthen agricultural research, and is planning a similar approach to the extension services.

The UCD is stepping up its training activities by providing a 3-month course on production systems and training opportunities for extension officers.

To increase the effectiveness of research on maize and cassava, six measures are suggested for implementation by the government:

— the establishment of a unit to link the IRA, the Ministère de l'agriculture and other entities participating in rural development;

— the provision of greater continuity in the availability of fertilizers, so that intensive maize cultivation using hybrids can be developed;

— the restoration of the budget for operating costs to its former level;

— the reorganization of extension services;

— the establishment of wholesale marketing for maize;

— the training of senior professional staff, and especially of research technicians.

A further six measures are recommended for national research:

- the reorganization of the IRA to improve its performance in research management, including the identification of research priorities, the planning and implementation of programs, and the evaluation of research;
- the establishment of a research program on maize storage problems;
- the development of improved methods for the post-harvest processing of cassava;
- the launching of a biological control program against cassava mealybug and green mite;
- the inclusion of local varieties in the cassava breeding program;
- the increased participation of economists and sociologists in research programs, to improve the identification of constraints and monitor the impact of new technology.

Lastly, seven measures are recommended for the international agricultural research community:

- the appointment of an IITA researcher to coordinate relations with Cameroon;
- the provision of IITA support for the national maize breeding program in theidentification of sources of resistance to streak disease ;
- the joint development by IITA and IRA of new cassava varieties resistant to diseases and pests, adapted to intercropping systems and matched to consumer tastes;
- support for the IRA in developing an up-to-date scientific and technical information service in both English and French;
- support for the IRA in implementing the two recommended post-harvest research programs;
- harmonization of network operations, so as to reduce pressures on IRA staff;
- development of training and other cooperative activities for the region, using Cameroon, and particularly the UCD, as a base because of their bilinguality.

Congo

The Congo has a low population, most of whom are urban dwellers, and about two thirds of the country is covered with forest. Thus, agriculture is of minor importance, accounting for only 7% of the GDP. Oil dominates the economy, representing 40% of GDP. The high level of urbanization leads to a high level of food imports, which include wheat and maize (for animal feed), and even cassava, imported from Zaire.

Government policies towards agriculture are changing. Large-scale mechanized state farms are being phased out in favour of commercial farms, cooperatives and smallholdings. Occupying one third of the Congo's cultivated area, state farms produce only 3% of the country's food.

The traditional smallholding is 1 to 2 ha in size, and is farmed under a shifting cultivation system. A cassava-based production system normally occupies about a third of the cultivated area, where the crop is intercropped with maize and groundnuts.

Cassava is the most important food crop. The per capita production of nearly 400 kg per annum, is one of the highest in the world. Over 50% of the calories in the average diet comes from cassava, which is eaten mainly in the form of *fufu*. Yields on smallholdings are low, ranging between 5 and 10 t/ha of fresh roots. These yields may be compared with those achieved on the large-scale mechanized farm of the Complex Agro-Industrielle de l'Etat à Mantsoumba (CAIEM), which reach 15 t/ha when the crop is harvested 20 to 28 months after planting.

Maize is of minor importance in the Congo. Smallholders in humid environments have difficulty in drying the crop, and therefore eat it fresh. Large-scale farms produce maize for animal feed, but even on these farms weeds reduce yields to less than 2 t/ha. Low maize import prices discourage domestic production.

The Direction generale de la recherche scientifique et technique (DGRST) is the entity which organizes research within the Ministère de la recherche scientifique et de l'environnement.

The Centre de recherches agronomiques de Loudima (CRAL), which is the main research station under the DGRST, is responsible for food crops. The DGRST cooperates with the Institut français de la recherche scientifique pour le développement en coopération (ORSTOM) in conducting research on cassava bacteriosis and mealybug, as well as on soils.

Commodity-oriented research and development on maize and cassava also includes several field projects funded by various French bodies, including FAC and CCCE. Other externally funded projects include those of the FAO, the International Fund for Agricultural Development (IFAD) and the International Development Research Centre (IDRC). There is little coordination between the various organizations involved in maize and cassava research.

The financial resources available to national agricultural research are inadequate. CRAL's budget for operating costs was only CFAF 600 000 in 1987, although it is thought likely that this will rise to CFAF 1.4 million in 1988. Of this, only CFAF 20 000 were allocated to maize and cassava, enough to carry out a small amount of on-station research, but no on-farm work. There are virtually no technicians to support the research.

For maize, there are reported to be only two researchers, and these conduct variety trials. For cassava, there are 14 national researchers and seven expatriates. However, only 50% of the nationals work full-time in research. Only two of the nationals are breeders; the others are plant pathologists or entomologists.

The CORAF cassava network, which links national agricultural research systems (NARS) in francophone Africa with the French national research system, is based in the Congo. Its coordinator is a member of the national DGRST research team working at ORSTOM.

Over the past 10 years ORSTOM has studied various aspects of the cassava mealybug. It appears that the parasitoid suggested by IITA, *Epidinocarsis lopezi*, is less effective in the Congo than in neighboring countries, since parasitism rates of only 10-15% are recorded.

Vascular bacteriosis, the main cassava disease in savanna areas with poor soils, has also been studied at ORSTOM. Cassava mosaic disease has been studied at the M. Ngouabi University.

CRAL manages a collection of indigenous cassava cultivars. Three productive varieties tolerant to the major diseases have been obtained by crossing these with material from IITA. A further 10 varieties are currently being tested. Owing to the weak extension services of the Ministère du développement rural, there are problems in transferring this new technology to smallholders.

The CAIEM project is disseminating varieties adapted to semi-mechanized farming using chemical inputs.

On-farm experiments are the first priority for the future. Breeding activities will focus on the development of early, high-yielding varieties for cash cropping, and on long-duration (15-36 months) bitter varieties with a high leaf yield for smallholders. Also of high priority is research on production systems — social and economic studies are under-represented at present — and research on soil productivity.

Research on maize has been geared to production on large-scale farms. Long-duration varieties have been introduced, but these have so far had little impact on production. Nevertheless, CRAL retains this research as a priority, the objective being to substitute imports. Stem borers are a major constraint to maize production under this system.

Research on soil productivity and smallholder production systems are identified as important, although no priority ranking is specified.

Long-term multidisciplinary research on production systems is needed, with the emphasis on soil productivity and socio-economic evaluation of new technology. The International Board for Soil Research and Management (IBSRAM) is coordinating this research at present, but agroforestry systems and alley farming appear under-represented in the program.

The links between research and extension suffer from the fact that the two activities fall under different ministries. CRAL disseminates the products of its own research, but these reach only the Niari valley, since the problem of their transfer to other areas is not addressed.

The World Bank project for strengthening extension, currently under preparation, should avoid isolating the CRAL from rural development. On-farm trials are a prerequisite to relevant research. The lack of a capability in socio-economics is an additional barrier to the adoption of new technology. Factors such as economic incentives and risk aversion are important areas of future research.

France is the only country with a long-term commitment to fund agricultural research in the Congo. ORSTOM plays an important part in research on cassava diseases and pests, as well as on soil productivity. Other agencies, such as FAO and IFAD, provide funds for development projects, which are narrower in scope and shorter in duration.

IITA's involvement is limited, consisting mainly of the distribution of germplasm and the training of a few scientists and technicians at its headquarters in Ibadan, Nigeria. The ORSTOM and IITA teams would both gain through increased contact with each other, especially in the area of biological control of cassava pests.

IITA's mission of June 1985, proposing a collaborative research program on production systems, has not been followed up. The lack of an IITA liaison scientist at Ibadan responsible for relations with the Congo is keenly felt. Participation in the CORAF network should lead to closer links between the Congo and her neighbors (Gabon, Cameroon and the Central African Republic). Cooperation with Zaire would also be desirable.

Gabon

The population of Gabon is low (only 1.2 million) and predominantly urban. Forest covers about 80% of the country. The economy is heavily dependant on oil production, which accounted for 43% of the GDP and 83% of export earnings in 1985. Iron ore, uranium ore and forestry products, are also important. Per capita income, at US$ 4250, is very high for Africa.

The recent fall in oil prices has disrupted the country's economy. As a result, Gabon is currently re-orienting its development policy, giving priority to agriculture. The agricultural sector at present accounts for only 7% of the GDP.

The smallholder sector, consisting of some 70 000 farmers each cultivating an average of 1 ha, has been neglected. Priority in the past was given to mechanized farming using commercial inputs to produce palm oil, rubber, coffee, sugar cane and maize.

With the Franceville appeal of 1986 the government launched its campaign to revitalize village agriculture. Agricultural research was restructured, extension services were established, and smallholder associations were set up near agro-industrial units. An agricultural labor immigration policy is also planned.

About 2000 t of maize are produced annually at village level and consumed fresh by the producers. An agro-industrial company, SIEAB, produces a further 8000 t per annum for animal feed. The crop is rotated with maize and soybean, and yields are about 4 t/ha. A slash-and-burn production system is used by smallholders.

Cassava is Gabon's most important food crop, and is the staple food of about 80% of the population. The crop is grown on some 40 000 ha (15% of Gabon's cultivated area). It is pounded, and then consumed as a cooked paste; the leaves are also eaten. There is little *gari* production. Production is inadequate to meet domestic demand, and the balance is imported. Urban consumption of bread and rice is growing rapidly, with rice imports now reaching 18 000 t per annum.

Agricultural research is embryonic. The Institut de recherches agronomiques et forestiers (IRAF), administered by the Ministère de l'enseignement supérieur et de la recherche scientifique, is not yet operational. The Directoration de l'agriculture, within the Ministère de l'agriculture, has a mandate for research and would like to coordinate the restructured agricultural research system. Most research at present is carried out by the country's university and in various development projects. The Société Industrielle et Agricole d'Elevage à Boumango (SIAEB) has had a research unit since 1977. Its budget in 1987 was CFAF 12 million. IRAT and the Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) have been collaborating with the unit since 1984 and have two scientists there at present.

Research focuses on breeding for difficult environments (high rainfall and acid soils), soil productivity and soil conservation.

The Centre d'introduction, d'acception et de multiplication du matériel végétal (CIAM), an experiment station of the Ministère de l'agriculture, has a project supported by the FAO. Six researchers are involved in the project, two of whom are expatriates recruited by the FAO. The research covers maize and cassava, as well as fruit crops.

The university's laboratory coordinates the national program on the biological control of cassava pests, with support from IITA and finance from the Ministère de l'agriculture. Parasitic wasps to control mealybug have been released, and assessment of impact is required. Biological control of green mite is planned for 1989.

It was difficult to obtain information on the budgets for these scattered research activities. The overall budget is probably CFAF 50-60 million, of which SIAEB and CIAM take the largest shares. Funding is entirely Gabonese.

There are 38 researchers, of whom 12 are expatriates. The ratio of resources allocated to maize and cassava does not reflect the greater importance of the latter crop.

SIAEB has made some progress in maize research, concentrating on intensive production for poultry feed. Useful varieties have been imported from France, the USA and Zimbabwe. Many constraints to production persist, including stem borers and weeds. Erosion has been successfully countered using a terracing system.

The CIAM tests IITA varieties and adapts them to local conditions. New varieties need to be early maturing and resistant to curl and rot. Floury, non-sweet grain is preferred by consumers. No on-farm trials have been carried out, and no new varieties have been released and distributed.

Cassava research at the CIAM lacks strategic direction. Trials are carried out comparing local long-duration bitter varieties with IITA cultivars which are early maturing, high yielding and resistant to major diseases, but the needs of farmers are too poorly understood to allow breeding objectives to be clearly defined.

The university conducts research associated with biological control. Topics covered include the behavior of mealybug hosts and the impact of hyperparasites.

The priority in future research will be to increase village-level production. Cassava will take precedence over maize. Cassava research will focus on constraint analysis (in order to define breeding objectives), the characterization of local germplasm, the development of new cultivars (by crossing with IITA materials), continued biological control of mealybug and the initiation of biological control of green mite.

Intensive maize cultivation gives rise to two major problems — long-term sustainability and economic viability.

For village-level cultivation, early-maturing varieties resistant to curl and rot and which produce floury grain from a well-covered cob are needed.

Research at CIAM should concentrate less on on-station work and more on tackling constraints in the smallholder environment.

By far the most important priority is the organization of a single agricultural research structure around the CIAM as core institute.

Gabon has few links with other countries. It finances its own research, although expatriates participate in implementation. The country needs to become a more active participant in networks, and to develop stronger links with IITA.

The ecology of Gabon is very different to that of IITA's headquarters at Ibadan in Nigeria, bearing more resemblance to that of the Congo or western Cameroon. Cooperation with these neighboring countries, either directly or through the CORAF networks, would therefore be of great benefit, particularly for cassava research. Gabon could contribute its own experience in biological control and mechanized maize production to the networks.

Ghana

Since 1983 the Government of Ghana has implemented a stabilization plan comprising important measures for economic recovery. Its effects are beginning to be felt, albeit slowly, after the damaging setback of the severe drought of 1983.

Throughout the 1970s Ghana had experienced economic decline. Meanwhile, population grew by 2.6% per annum. By 1987 the country had a population of 13.2 million, 70% of whom lived in rural environments. The economy is still primarily agricultural. Agriculture accounts for 55% of the GDP, employs 55% of the labor force, and provides 80% of exports. Cocoa and forest products each contribute 12.2% to GDP.

The country has a food deficit. Only 60% of the national calory requirement was met by domestic production in 1982. The situation has improved since then, but domestic production of food staples is still inadequate.

Food self-sufficiency is the major agricultural policy objective. One instrument for achieving this is the deregulation of agricultural prices. Despite the drive towards self-sufficiency, the budget for agriculture remains inadequate. The major share of expenditure is in support of cocoa production, while research receives only 6-9%.

Under a project worth US$ 17 million, the World Bank and United Nations Development Program (UNDP) are attempting to rehabilitate the agricultural sector. The project allocates US$ 3 million to research and includes the development of a research management plan and special support for research on rice and cotton. Extension is also included in the project. Pilot projects and a new national program are planned to replace the current development projects.

There are three main ecological zones in Ghana: the forest zone, which has two rainy seasons; the coastal savanna zone, which also has two rainy seasons; and the interior savanna zone, which has one rainy season. Perennial crops predominate in the forest zone, where cassava and plantain are grown. Cassava is the main crop found in the coastal savanna zone. Maize and cotton are widely grown in the interior savanna zone, giving way to rice, sorghum, millet and groundnuts in the far north.

Smallholders growing food crops and cocoa on farms 1-3 ha in size produce 90% of Ghana's agricultural output. A few large farms produce rice and maize. Cooperatives play a part in the commercial sector. The government wishes to reduce subsidies for fertilizers, which are currently very high.

Maize is by far the most widely grown cereal, occupying 18% of the country's cultivated area (excluding cocoa groves). Average yields are low — between 0.8 and 1 t/ha. Production fluctuates around 450 000 t per annum.

The average annual consumption of maize in Ghana is high (34 kg per person, reaching 47 kg in Accra). Many different maize products are eaten, including the popular boiled fermented maize cake known as *kenkey*.

The country currently has a food deficit, amounting to 130 000 t in 1987 for both human food and animal feed. A project organized jointly by the FAO, the UNDP and Overseas Development Natural Resources Institute (ODNRI) is attempting to reduce post-harvest losses.

The GFDC, a parastatal, is responsible for the marketing of maize. It keeps security stocks of 3500 t. Maize prices are fixed by the government. Illegal exports occur in border areas, where prices are relatively high. Higher official prices and more effective marketing would probably encourage smallholders to adopt new technology to increase yields.

Cassava is the major tuber cultivated, occupying 11% of the country's cultivated area (excluding cocoa groves). Production is thought to have increased substantially since 1986, but this is owing to expansion of the area cultivated, not to increases in yields, which remain low at 7 t/ha. The crop is usually consumed fresh, without pounding, and in forms such as *fufu*. Sweet varieties are preferred.

Both cassava and maize are generally grown as intercrops. There has been less research on cassava than on maize, so little new technology is available for the former crop. Cassava varieties used at present are vulnerable to pests and diseases. The crop is the last one in the rotation, and is grown when soils are leached. The only area in which some success can be reported is that of biological control of mealybug and cassava mite.

The Council for Scientific and Industrial Research (CSIR), which is under the Ministry of Industry, Science and Technology, coordinates the activities of the country's 12 research institutes. Among these is the Crops Research Institute (CRI), based at Kumasi, which is responsible for subsistence crops. There is also a Soils Research Institute (SRI) and a Food Research Institute (FRI).

The CSIR itself plays only a small part, since each of the 12 institutes presents its own budget directly to the Finance Ministry. The Ministry of Agriculture, which is represented on the CSIR, also has a minor role in research.

The universities of Kumasi, Legon and Cape Coast have agricultural faculties and make a small contribution to agricultural research.

The CRI's draft budget for 1988 was around US$ 10 million, which is 46% of the overall budget for the 12 institutes. Ninety per cent of this is provided by external funding, mostly from IFAD and ICAD. Ninety per cent of the national contribution to the budget is absorbed by staff costs. However, salaries are low (less than US$ 100 per month), morale is poor and many scientists leave their jobs.

Ghana has a relatively high number of scientists. In 1984 a total of 263 scientists were employed in the research institutes; only 12 of them were expatriates. Agricultural research (including cocoa) accounted for 153 researchers (32 with a PhDs, 71 with an MSc) and 408 technicians. Of these, the CRI has a surprisingly small share — only 42 scientists, none of whom are economists.

Research carried out under externally funded special projects is well financed and well endowed with staff. The maize and cowpea development project of the Ghana Grains Development Project (GGDP) has been funded by ICAD since 1979. Implementation is the responsibility of CIMMYT, which subcontracts cowpea research to IITA. The aims of the project are to breed improved varieties and to develop and extend suitable agronomic practices. The project had a budget of US$ 1.5 million from 1979 to 1984. This will rise to US$ 5.5 million during the second phase. This project, administered by an independent mangement committee, is cited as a successful one.

The Gesellschaft für Technische Zusammenarbeit (GTZ) has a joint research and development project with the CRI. This project, which is located in Nyankpala and has been operational since 1977, also has an autonomous steering committee. The research encompasses all the crops grown in dry savanna conditions, together with production systems, soil productivity and socio-economic aspects.

The Volta Region Development Project (VORADEP) had a budget of US$ 42 million, about two thirds of which is from the World Bank and IFAD, over the period 1981-88. This is an integrated rural development project with a research component covering maize (with GGDP) and cassava (with IITA), employing five researchers and seven technicians.

Lastly, IFAD will soon be starting a rehabilitation project for smallholders. The project will have a budget of US$ 15 million over 5 years, US$ 1.5 million of which will be spent on research in collaboration with CRI. Roots and tubers, especially cassava, will be a major component.

There are 21 researchers at FRI in Accra. Three of these work on maize and three on cassava. Those working on cassava concentrate on processing.

The IITA project on the biological control of cassava pests is implemented by the Plant Protection Department of the Ministry of Agriculture. It has three researchers and five technicians.

The Ghanaian Seed Company has produced maize hybrids from IITA germplasm.

Some of the special projects in Ghana show that good integration with extension is possible. In general, however, links between research and extension will remain a problem area, even after the reorganization of the Ministry of Agriculture's extension services.

Research links with universities themselves are informal but effective. The universities have few resources. Kumasi University had a GTZ grant for 8 years to strengthen its Rural Engineering Department. The Faculty of Agriculture at Legon University, which has nine lecturers and two assistants in its crops research department, carries out some research, including the collection of cassava germplasm and the breeding of cassava and maize varieties.

Research at CRI, which is underfunded and spread over too many commodities and topics, produces no significant results. This is not true of special projects, however.

The GGDP project on maize has distributed many improved varieties, allowing yields to double in response to low input levels or increase fivefold using more intensive practices. Enough seeds of these new varieties are available to meet 25% of demand. Recommendations have been developed for agronomic practices and fertilizer use. The new varieties yield 4 to 5 t/ha on farmers' fields. Better coordination between on-farm and on-station research should increase the already high adoption rates.

Biological control of mealybug in cassava has been highly successful, largely because of the back-up from IITA. However, no progress has been made in controlling cassava mite. The VORADEP project has tested and distributed two high-yielding IITA varieties resistant to major diseases and pests.

Priorities identified for maize research include: the introduction of streak virus resistance into the varieties currently distributed; the problem of borer attacks on late or second-season crops; the adaptation of improved varieties to suit consumer tastes; the introduction of short-stemmed varieties with increased resistance to lodging; the development of hybrid varieties for large-scale farms; and research on production systems and the maintenance of soil productivity.

The CRI lacks the necessary critical mass for cassava research. It is hoped that the IFAD project will provide this. The first priority for future research is the development of varieties resistant to mosaic disease and blight, using IITA germplasm as a source. Tolerance to various pests is also needed. Consumer tastes must be taken into account in future breeding activities. Selection should be based on a thorough evaluation of local germplasm. More work on the biological control of cassava mite is needed.

Better coordination between the CRI and the various special projects is needed if new research is to be effectively planned and implemented. Special projects are almost too independent at present. Duplication of resources and efforts must be avoided. Systems

research should have higher priority, and the capability in socio-economics needs strengthening.

International cooperation is vital for Ghana's agricultural research. As already mentioned, both CIMMYT and IITA are involved in the GGDP/ICAD project. IFAD is also involved. IITA has been asked to increase its involvement in cassava research.

Ghanaian researchers expect a great deal from continued, long-term cooperation, especially from IITA. Large numbers of germplasm lines are now exchanged, and training activities have reached a high level.

Ghana is an active participant in regional activities, being a member of a farming systems network, the alley farming network run by IITA and the International Livestock Centre for Africa (ILCA) and the maize and cowpea network run by SAFGRAD. Its role in the SAFGRAD network is important. For language reasons, there is little exchange of information between Ghana and her francophone neighbors.

A number of measures can be recommended to increase the effectiveness of national agricultural research in Ghana. Six proposals can be put forward to the government:

— implement the research management plan expected from the World Bank project;

— increase coordination between research institutes, and ensure recognition of the leadership role of the CRI;

— provide credit and fertilizer wherever new technology is made available to smallholders;

— develop a price incentive policy for agricultural products, possibly including the reduction of imports;

— develop more efficient extension services, with effective links with research;

— improve the training in agronomy available at Ghanaian universities.

A further seven proposals are relevant for the national research system:

— ensure effective implementation of the research management plan and coordinate this with the development of efficient extension services;

— invite the International Service for National Agricultural Research (ISNAR) to evaluate the management of the CRI;

— conduct a study, possibly with the assistance of the International Food Policy Research Institute (IFPRI), of the impact of the GGDP project, the success of which should be made more widely known;

— focus current CRI research on areas in which results can be quickly achieved, published and distributed;

— continue the biological control program and associate the CRI more closely with it;

— build an increased capability in social and economic research;

— formulate a joint CRI/SRI research project on soil conservation, incorporating agroforesty and alley farming (invite IITA to participate).

Lastly, the following six proposals are for consideration by the IARCs:

— designate an IITA scientist to coordinate links with Ghana;

— channel all international cooperation through the CRI;

— continue the involvement of both CIMMYT and IITA;

— encourage IITA to provide cassava varieties suited to consumer tastes;

— develop the biological cassava pest control program;

— involve ISNAR in the reorganization of national research in Ghana.

Guinea

For political reasons Guinea has been isolated both from its neighbors and from the developed world for the past 20 years. National archives are non-existent, and the statistics given in this report are therefore unreliable.

The country has a population of about 5.5 million, over 70% of whom are rural. The contribution of agriculture to the GDP has been on the decline for the past 10 years, and currently stands at about 38%.

Production of export crops (banana and pineapple) has slumped. The share of agricultural exports in total exports was 58% in the early 1950s, whereas today it is 3%. Food production for the domestic market has also declined, albeit more slowly. Imports now exceed 100 000 t of food grains per annum.

The main cereals grown in Guinea are rice and fonio. Maize takes third place, with production currently about 50 000 t a year. Cassava is the most widely grown of the roots and tubers. Production varies between 500 000 and 600 000 t a year. Yields of both maize and cassava are lower than in neighboring countries.

Most farmers are smallholders, cultivating areas of 0.5 ha or less. The country's infrastructure, including its roads, is poorly developed. The provision of inputs and credit is virtually non-existent.

Cassava is a staple throughout the country. The leaves are eaten all year round, but most consumption is of roots, eaten in cossette form. Sweet varieties are preferred, except in the north. Yields are low, usually 4 -5 t/ha of fresh roots. No improved varieties are used.

The most widely practised cropping sequence is rice, then fonio, then cassava, followed by a fallow period. Although production falls well short of domestic demand, the crop is exported to Sierra Leone.

Maize is often intercropped with rice or fonio. Maize production is developing at the expense of millet, sorghum and fonio. Yields are low, often less than 1t/ha. Yellow-grained varieties are preferred. Variations in altitude and in the length of the growing season mean that varieties with different growth periods are used in different areas.

There is no organized marketing structure for either maize or cassava.

Until recently, responsibility for the institutes involved in agricultural research was shared by several ministries. In 1987 the institutes were grouped together within the

Direction nationale des recherches agronomiques, under the Ministère du développement rural. Then, in 1988, they were transferred to the Secrétariat d'Etat à la recherche.

Research is organized on a commodity basis, with a national pilot center and a coordinator for each commodity.

The operating budget for agricultural research was about CFAF 2 million in 1987 — only about 10% of the total budget of the Ministère du développement rural.

Large numbers of agronomists have been trained and the number of research staff is high, but they are poorly paid and lack motivation. Salaries range from CFAF 260 francs per month for an agricultural graduate to CFAF 400 francs per month for a lecturer. Staff reductions are planned.

At Foulaya, the pilot center for cassava, there are 110 researchers (only six of whom are appropriately qualified) and 70 technicians. At Kilissi, the pilot center for maize, there are 80 national staff members and 35 expatriates (North Koreans). Some of the equipment at these stations is satisfactory, but much of it is not used because there are no competent technicians.

The resources currently allocated to maize and cassava could not be determined. Rice takes the major share of resources.

Agricultural research is carried out entirely on-station. Extension is embryonic, consisting only of pilot projects.

Virtually no research results have been obtained for maize in the past few years. On-station trials of hybrids are taking place, with the assistance of the Korean team. Mosaic disease and birds have been identified as the major biotic stresses affecting maize.

The situation is similar for cassava. Varieties resistant to mosaic disease have been introduced from IITA, Liberia and Sierra Leone. Pest pressure is high, and biological control is planned.

National research in Guinea needs a new start. For both maize and cassava, priority will be given to constraint analysis, varietal improvement, and improved agronomic practices, including crop protection measures. These priorities seem sensible, but some current activities will have to be discontinued in order to make room for them. Training needs and the need for an information service should also be given high priority.

Six or seven well-trained scientists will be needed for each priority topic. Several of these should have PhDs. The operating funds needed for a national cassava program are estimated at approximately CFAF 1.5 million over 6 years.

Cooperation between Guinea and its neighbors, the IARCs and the donor agencies is developing rapidly. France funds agricultural research, and aid is also provided by North Korea, USAID and the FAO. The World Bank is funding seed production projects and the pilot extension projects.

The supply of improved germplasm from neighboring countries and IARCs is increasing. The SAFGRAD network provides Guinea with information on its trial results. This is a service not provided by the IARCs — an omission which gives rise to complaints.

Despite such reservations, Guinea wishes to cooperate with IITA, particularly on the biological control of cassava pests. The preferred mode of operation would be to integrate IITA scientists into the national system.

Liberia

The Liberian economy is highly dependant on exports, which consist mainly of iron ore. Additional earnings are provided by rubber, timber, coffee and cocoa. Export earnings have declined in recent years.

Almost three quarters of Liberia's population derive their living from agriculture, yet only 5% of the country's land is cultivated. Domestic production of cassava and rice is high, but Liberia consumes large quantitites of rice and currently imports between 30 and 40% of its requirements. Poultry and vegetables are also imported.

The 1.2 million rural inhabitants of Liberia have about 180 000 farms, the majority of which are smaller than 1 ha in size. Cassava, the country's second most important commodity after rice, is widely grown by smallholders, with average yields of 3.5 t/ha when intercropped with rice and 10 t/ha when grown as a sole crop. Annual production of cassava was over 300 000 t in 1982-84. The crop is harvested 18 months after planting. Cassava leaves and roots are consumed all year round. Both *fufu* and *gari* are made. Consumption amounts to 200 kg per person, representing about 500 calories per day.

Maize is of minor importance in Liberia. It is generally consumed green. Demand for maize as animal feed is increasing.

Agricultural research is carried out mainly by the Central Agricultural Research Institute (CARI), which comes under the Ministry of Agriculture, and by the College of Agriculture and Forestry (CAF) of the University of Liberia. The coordination of national research is the responsibility of the Agricultural Research Council. CARI has a Technical Committee responsible for program planning. Neither the council nor the committee can be said to be fully operational.

CARI's annual budget is reported to be about US$ 1.7 million, over 50% of which is spent on salaries. The institute has 56 scientists, nine of whom are expatriates working on roots and tubers under a project funded by the IDRC. National staff earn low salaries, and seem poorly motivated.

CAF has 17 lecturers, five of whom are expatriates, and an annual budget of US$ 1 million, 90% of which is spent on salaries. Three full-time senior agronomists and two part-time scientists work on cassava, including research on soil conservation and production systems.

The inadequate resources available to research do not allow on-farm work to be carried out. Research stations are poorly equipped, a modern greenhouse and an irrigation system being the two most urgent needs.

Regional agricultural development projects have been launched. CARI has effective links only with that of Nimba County, which is supported by a large project funded by the GTZ. Relations between CARI and CAF are limited, involving little more than the exchange of germplasm. Extension is carried out by the Ministry of Agriculture, but the services are underdeveloped and ineffective.

Research on maize has made no progress. For cassava, on-station trials have been carried out and three improved varieties have been released. Cassava mite is mentioned as a pest, but mealybug is not. No on-farm work and farming systems research appear to be carried out. Neither CARI nor CAF has a rural sociologist.

Future research should concentrate on providing improved varieties with a low cyanide content. Liberia also needs more crop protection specialists, and an agroclimatological zonation map.

Cassava germplasm from IITA has been used in variety trials, and three high-yielding varieties tolerant to diseases and pests have been distributed. Several Liberians have been trained at IITA.

Financial support from IDRC has been crucial to CARI's cassava programp. Five expatriates funded by USAID and nine by GTZ have helped to develop and extend cassava technology. GTZ runs a large-scale training program for smallholders in its project area.

Liberia does not participate in any of the regional networks for maize and cassava, and the country's scientists have very little contact with those of neighboring countries.

Developing maize as an animal feed implies opening up an entirely new area of research. Such research could be carried out at CAF, but at least two more scientists will be needed, together with an additional budget of US$ 250 000 over a 5-year period.

Research on casssava is the first priority. Some of this should be devoted to production systems and to post-harvest technology. The staff needed for cassava research are lacking, especially in such areas as plant pathology and entomology. About US$ 250 000 per annum will be needed for equipment, which is sadly lacking at present.

More commitment on the part of both IITA and other organizations is required if research objectives are to be met. New work would be easier to launch if Liberia were to become a member of the regional networks. More efficient planning on the part of the Agricultural Research Council and CARI 's Technical Committee would also help.

Nigeria

Agriculture was the driving force behind Nigeria's development during the 1960s, when it accounted for about 60% of the GDP. The oil boom of the 1970s relegated agriculture to a backseat role, so that by 1980 its share in GDP was down to 20%. During this period, agricultural production continued to grow at 2-3% per annum, but rapidly rising demand from a population growing at 3% per annum forced the country to rely increasingly on imports.

The oil crisis of the 1980s is forcing Nigeria to reshape its economy completely. It is now government policy to promote agriculture through appropriate incentives so that it again plays a major part in the economy, including food production for domestic consumption and the production of cash crops for export. Policies affecting agriculture are the responsibility of the Federal Ministry of Science and Technology, and the Ministry of Agriculture, Water Resources and Rural Development.

Nearly 70% of Nigeria's population is rural. The number of farm families working smallholdings is estimated at nine million. Average farm size is usually less than 3 ha. These smallholders produce most of Nigeria's food, but there are some medium-sized farms (10-100 ha, and occasionally even larger) using more intensive production systems.

Agricultural development projects supply seeds and fertilizers to smallholders at subsidized prices. Marketing is in the hands of the private sector.

Maize is the most important cereal crop grown in Nigeria. It is often intercropped with cassava. Maize production has averaged 1.7 million t per annum since 1980, and was over 2 million t in 1985. The crop is produced in the southwest, where two harvests a year are possible, and in the savanna zone, where production is increasing rapidly. Maize in the southwest is produced mainly for human food and is consumed either fresh or after processing; post-harvest losses are a problem in this humid zone. Maize from the savanna is used mainly as animal feed, but there is also a demand for white-grained varieties from

the flour milling and brewing industries. Nigeria has the potential to meet domestic demand, and perhaps even to produce a surplus for export in the near future.

Cassava and yam are the country's most important roots and tubers. Cassava is the largest single source of calories for around 70% of the population, especially in rural areas and in the southern forest zone of the country, where it is the basic crop in the farming system. Cassava leaves, *gari*, *fufu*, flour and crisps are consumed. Processed products for urban consumers include instant flour (*masseves*) and *fufu* powder. Cassava is also used as an animal feed, and there is high industrial demand for starch.

Both maize and cassava show yields considerably lower than those obtainable from improved varieties. The information and inputs reaching smallholders need to be improved.

The Federal Ministry of Science and Technology coordinates and finances all agricultural research. Agriculture receives about 9% of the total national budget of US$ 8-10 billion. The share of agricultural research was 1% in the early 1980s, falling to 0.7% by the middle of the decade, or in other words from US$ 100-120 million in 1981 to US$ 55 million in 1984 — a very sharp decline.

These resources support 18 research institutes spread throughout the country. Each institute has a fair degree of autonomy, having its own administrative council. Six of the 18 institutes have a mandate for food crops. The main programs on maize and cassava fall under four institutes: the Institute of Agricultural Research (IAR), based at Samaru in the dry savanna; the National Cereals Research Institute (NCRI), based at Badeggi in the humid zone; the Institute of Agricultural Research and Training (IART), based at Ibadan, in the pre-forest zone; and the National Root Crop Research Institute (NRCRI), based at Umidike in the humid forest zone. These institutes have commodity programs, and have recently received regional mandates for farming systems research and relations with extension services.

Besides these institutes, there are six major universities with agricultural faculties whose teaching staff devote some of their time to research.

The major institutes conducting research on maize and cassava had a combined budget of some US$ 34 million in 1981-84, but only 50% of these funds actually materialized in 1984. As a result, recurrent costs, primarily salaries, rose from 73% to 90% of total expenditure, leaving only 10% for operating costs, which amounted to US$ 2 million in 1984. Budget cuts were even more severe in 1985.

The numbers of scientists employed is relatively high for Africa. The four institutes chiefly concerned with maize and cassava research have more than 250 scientists, over a third of whom have a PhD and more than 5 years' experience. The number of technicians employed is roughly the same.

These institutes have many experimental stations. The use of these stations needs to be rationalized in accordance with the new regional mandates. The equipment available at the stations is old and poorly maintained.

Program planning is carried out mainly at institutional level, within ministry guidelines. Current programs are evaluated at annual meetings attended by university staff, representatives from IARCs and others.

The drastic cuts in funding have had their effect on the planning mechanism. However, the institutes themselves seem unable to adapt and to identify their most urgent priorities.

Links with the users of research seem quite good. In response to their new regional mandates the institutes are developing their own extension liaison units. Extension is implemented through the agricultural development projects in each state. The Federal Agricultural Coordination Unit (FACU) also plays a part in extension, organizing annual discussion workshops between research, development and extension personnel.

Traditional maize production has been improved in the southern savanna region. The main impact of research at the smallholder level has been to include potassium in fertilizer recommendations, to increase sowing densities (to 0.25 x 1 m), to introduce new varieties, and to improve cropping practices (including chemical control of stem borers).

Research priorities for the next few years are clearly defined. The first priority is research on the control of *Striga*, using cropping practices, chemicals and resistant cultivars. The possibility of transferring genes from sorghum and millet should be investigated, since these crops both show some tolerance to this parasitic weed. The second priority is to maintain soil productivity. Micro-nutrient deficiencies need to be identified for leached soils in the north, and specific fertilizer recommendations devised for irrigated crops, second-season crops grown in the south, and intercropping systems. As a third priority, maize varieties suited to flour-milling and brewing need to be developed. Fourthly, new varieties resistant to streak virus, downy mildew and blight are required. And lastly, cropping techniques to control stem borer should be devised.

The use of maize in brewing beer has been successful in other parts of the world, and it seems certain that the Nigerian breweries will be able to develop suitable processing techniques. The use of maize in bread making always leads to some reduction in quality, but investigations into degerming and other aspects of maize processing may determine a flour mix which will strike a better balance between cost and quality than the current products. The milling companies themselves will have the leading role in striking this balance, but the Federal Institute for Industrial Research (FIIRO) may be able to supply them with some useful ideas and encourage the use of locally manufactured equipment.

The radical readjustment of crop prices which has accompanied the fall of the naira has changed the economic balance between crops, and new recommendations for rotations and combinations of crops need to be worked out. Closer links between research and extension have already had an impact on the efficiency with which new technology is generated, and farming systems investigations in cooperation with the agricultural development projects will continue to be productive.

The national maize research programme has been successful, owing to close cooperation between NCRI and IITA. The recent transfer of NCRI's mandate for maize to IART is likely to cause problems, including insufficient attention to the savanna zone, where NCRI is located.

The hitherto limited amount of farming systems research is now likely to develop, given the new regional mandates and the development projects already operating in each state. Relationships between the institutes and the Ministry of Agriculture remain difficult.

The administrative councils of the institutes need to be strengthened. Greater participation by representatives from the various sectors concerned is recommended, with a view to obtaining funding for research through channels other than the ministry.

Research on cassava is highly developed in Nigeria. Cassava is the prime responsibility of the NRCRI, which holds the national mandate for the crop and conducts research on crop improvement, production and protection. Research on post-harvest storage and processing is carried out by various bodies, including the FIIRO.

Improved high-yielding varieties (25-35 t/ha) which are resistant to cassava mosaic disease and bacteriosis have been distributed by the NCRI. Forty per cent of the land cultivated to cassava in the southeastern forest zone is planted to these varieties. Biological control of mealybug, supported by IITA, has had encouraging results. The universities participate in the national cassava programme through their work on soil productivity.

The research priorities are to increase yields, reduce the effects of diseases and parasites and produce varieties better adapted to the tastes of consumers. Cropping practices suitable for different environments and for intercropping are needed.

The FIIRO is the major Nigerian institute concerned with cassava processing. It has worked for many years on the processing of cassava into *gari, fufu, lafun*, starch and other products. Processing techniques are now well developed, but the first few processing plants established had too high a capacity and are no longer operational. The institute is now working in collaboration with UNIDO on small-scale village processing units.

FIIRO's experience could be of tremendous value in training staff from other African countries in cassava processing. There are proposals for international support for such regional training in collaboration with the UNIDO project on small-scale processing. Unfortunately, funding at FIIRO has declined in the past few years. If FIIRO is to play an important role in the future, stable funding will have to be provided for both research and training.

The Products Development Institute (PRODA) has developed machinery for cassava peeling and some other processes in the production of *gari*. The approach of PRODA is to develop prototypes which can be taken up and manufactured by engineering firms. So far very few prototypes have been taken up.

The Rural Agro-Industrial Development Scheme (RAIDS) of the Federal Department of Rural Development is promoting village *gari* production units which utilize improved mechanized systems in grating, dewatering, and frying. These units are produced by local manufacturers at less than N 10 000 each and, with two people operating them, are capable of producing 500 kg of *gari* per day. In 1983, one local workshop produced about 400 such units, and it is estimated that about 600 to 700 units are currently installed in the southern states each year. These units are now widely used by Agricultural Development Project (ADP) cooperative farmers, who produce good quality *gari* that will store easily for at least 12 months. Other products from this scheme include starch, *masavee, fufu*, etc. It is important that trainees in the proposed FIIRO program become familiar with the operation of these units.

The Nigerian Stored Products Research Institute (NSPRI) does some work on cassava storage, but no viable technologies have so far been recommended. In the meantime, the present strategy of harvesting only the quantity of roots that can be processed within the shelf life of the roots is the most appropriate one for small-scale farmers. Short-term storage using technology developed by the International Center for Tropical Agriculture (CIAT) may also be appropriate.

The National Accelerated Food Production Programme (NAFPP) holds workshops which contribute to the exchange of information between researchers and users. Links between the NRCRI and the ADPs are good, enabling scientists to have access to farmers.

Research on farming systems and soil productivity should be increased. Budget limitations imply a need to reassess the priorities in cassava research.

International cooperation has played a substantial part in developing Nigerian maize production over the past 20 years, as evidenced by the successful introduction of new varieties yielding 6-10 t/ha on farmers' fields. These varieties have resulted from

cooperation with IITA as well as with CIMMYT. The presence of IITA's headquarters in Nigeria has facilitated progress.

Clearly, international cooperation should continue, although its objectives will need to change. More emphasis is needed on resistance to *Striga*, the control of stem borers, and stable resistance to diseases such as streak virus, downy mildew and blight.

Regional cooperation is still underdeveloped, although Nigeria participates in the network run by SAFGRAD. The benefits of regional cooperation are appreciated by Nigerian personnel.

Cooperation with IITA is highly developed and has undoubtedly had a substantial impact on cassava research. This cooperation should continue, especially in the areas of farming systems research and manpower development. Tissue culture techniques for the rapid multiplication of germplasm is an area warranting additional emphasis.

Informal relations with other countries in the region are developing. Seminars and workshops are organized by the African Network for Roots and Tubers coordinated by IITA. A fully collaborative network, including the joint planning and evaluation of research, should be developed to include countries other than those of West Africa. Zaire and the Central African Republic should become members.

Sierra Leone

Mining accounts for over half of Sierra Leone's export earnings. Coffee and cocoa are the major agricultural exports.

During the past 20 years agricultural production has grown more slowly (1.5-2.2% per annum) than human population (2.3% per annum). As a result, cereal imports have risen, reaching over 110 000 t in 1983. Agriculture employs 65% of the workforce, but its share in the GDP is only 30%. Most farms are smallholdings of 0.5-2 ha.

Sierra Leone is a major producer of rice (over 500 000 t per annum), but the country still has to import rice. Rice is the only crop to have a government marketing board. Cooperatives for rice production and marketing have also been set up. Other cereals are of minor importance by comparison. About 20 000 t of maize are produced annually. Among the roots and tubers, cassava is the most important, with annual production at about 110 000 t.

Subsistence farming requires very substantial support and improvement if it is to meet national demand for food staples. The government has given high priority to food self-sufficiency. Seven agricultural regions have been designated, each with its integrated rural development project.

Maize production, though still modest, is on the increase. The crop is consumed fresh, but alcohol production and animal feed are two potential future uses for the crop. Maize is grown after rice in the rice-based production system. It is often intercropped with legumes.

Cassava is consumed by most of the population, either fresh as leaves or in the form of unleavened dough. Sweet varieties are traditionally preferred, but *gari* production is on the increase, hence the growing demand for bitter varieties. The crop is grown last in the rice-based production system, and is followed by a fallow period.

Yields of both crops are low, about 1 t/ha for maize and 4-5 t/ha for cassava. Soils are poor, and receive virtually no fertilizer inputs. Production does not meet domestic demand.

Agricultural research is coordinated by the National Agricultural Research Co-ordinating Council (NARCC), under the Ministry of Agriculture, Natural Resources and Forestry. There are two main research stations: Rokupr Station, devoted mainly to rice, and the Njala Station of the new Institute for Agricultural Research (IAR), which replaces the former Adaptive Crop Research and Extension Project headquartered at University of Njala.

The budget for agricultural research was about US$ 120 000 in 1984-85, rising to US$ 400 000 in 1987-88. About 50% of this was for Rokupr. Salaries account for 80% of total expenditure. Two of the 17 scientists based at Rokupr working on rice spend some of their time on maize and cassava.

Among the teaching staff at the University of Njala, six professionals spend two thirds of their time on cassava research, while only two work part-time on maize. The Adaptive Crop Research and Extension (ACRE) project has 31 scientists. The ACRE laboratories at Njala are well equipped. In contrast, Rokupr station suffers from a critical lack of equipment. Even the electricity supply is unreliable.

The University of Njala is able to train high-level professional staff for agricultural research. It offers BSc and MSc courses.

The status of researchers and those working in higher education has recently been somewhat upgraded. Salaries now range between US$ 800 and US$ 2500 per annum.

Relations between the university and the rest of the research establishment are good. Lecturers from Njala are involved in the ACRE project. However, a weak national extension department and the lack of well trained extension staff in the regions has hampered on-farm research and the transfer of technology to the smallholder. The ACRE project is the only one to have had any noticeable effect at farm level. The government wishes to establish more efficient mechanisms for technology transfer.

Research on maize has focussed on the responses of local and exotic varieties to fertilizers, and the use of different sowing dates and plant densities. This work is carried out on station. No new varieties have been distributed.

Research priorities are local germlasm evaluation, followed by breeding with exotic material to produce new, more productive varieties resistant to streak virus and tolerant to stem borer.

Improved cassava varieties have been developed from IITA material. However, these varieties do not match consumer tastes. Also, they have high above-ground biomass and are therefore unsuitable for intercropping. Further breeding must be geared towards overcoming these problems. Sweet varieties that are easy to cook as well as being resistant to cassava mosaic disease are needed. Both short- and medium-duration varieties are required. Appropriate cultural practices for these new varieties will need to be determined.

This new research could be more effectively implemented if NARCC were to become operational, if proper research planning were carried out, and if adequate funding were allocated. Two or three additional scientists are needed to reinforce the maize team at Njala. More efforts will have to be devoted to the transfer of results.

External funding has been substantial. The GTZ has supported integrated rural development projects, USAID supports the ACRE project, and IDRC funds cassava and farming systems research.

Both CIMMYT and IITA regularly supply germplasm. Training has been provided at IITA. However, no feedback on the results of multilocational trials carried out by the international centres is conveyed to national scientists.

Sierra Leone is not a member of SAFGRAD, nor of any farming systems network. Some germplasm has been exchanged with Guinea.

Togo

Togo has two ecologies — humid in the southern half of the country, with two seasons of light rainfall, and drier in the northern half, where there is one rainy season. Three quarters of the population of 3 million is rural.

Agriculture represents 30% of the GDP. Export earnings are derived largely from coffee and cocoa. Farms are small, usually between 1 and 4 ha. About three quarters of the cultivated land is planted to food crops, of which maize is the most important, followed by sorghum and millet. Among the roots and tubers, cassava and yam are of equal importance.

Domestic food production meets about 80% of national demand. Wheat (40 000 t per annum) and rice (30 000 t per annum) are imported, mainly for urban consumption.

Agricultural development is a primary concern of the government. Under a new rural development strategy drawn up in 1985 there are plans to set up regional rural development directorates to take on all tasks related to extension. At present, responsibility for extension lies partly with the country's commodity-based companies, such as Société Togolaise Cotonière (SOTOCO) for cotton. The strategy also envisages the establishment of a national seed production service to help improve the quality, as well as the availability, of seed. Quality is poor at present, despite price incentives for producers. The official producer prices planned for cereals are high enough to provide an adequate incentive to producers. Other priorities in the new strategy are the introduction of irrigation and the use of draught animals for cultivation.

Maize is produced mainly by smallholders. Output was 140 000 t in 1983, with average yields of only 1 t/ha. Little advice on production is available in most areas, but SOTOCO provides some advice in the cotton-growing zone.

The north has higher potential for maize than the south. However, the varieties cultivated there are not always well suited to the food preferences of consumers in the south. Storage after harvest is a problem in the humid zone.

Cassava production was 340 000 t in 1983, and yields were 13.4 t/ha. Both sweet and bitter varieties are grown. Like maize, cassava plays an important part in the national diet.

Several ministries are invloved in agricultural research, the most important of which is the Ministère du développement rural. This ministry is responsible for IRAT, for the Institut national des plantes à tubercules (INPT) and for the Institut de recherches sur le coton et les fibres textiles (IRCT). Both the latter are departments of CIRAD. In addition to overseeing the work of these institutes. the ministry is also responsible for research on plant protection, soils, human nutrition and food processing techniques.

The Ministère de l'education nationale et de la recherche scientifique oversees the work of ORSTOM and the Institut national de la recherche scientifique (INRS). It is also responsible for agricultural education.

The two French institutes, IRAT and IRCT, are well integrated in the national structure, while retaining a degree of autonomy. Most of their research supports the commodity-based national development companies.

About CFAF 20 million is spent annually on agricultural research, more than a third of which goes to food crops. Research staff numbered 64 in 1985, including 14 expatriates, three of whom support the work on food crops. They were backed up by about 130 technicians. It was not possible to determine the number of researchers working specifically on maize and cassava.

A number of institutes have worked on maize improvement. Varieties resistant to streak virus disease, bred from material provided by IITA or CIMMYT, have been successfully introduced in the north. Some have been officially released and distributed. Varieties suited to the tastes of consumers in the south are derived from local material, and are not resistant to streak virus.

Fertilizer recommendations for cotton-maize systems have been followed by farmers. The introduction of fertilizers has been effectively managed by SOTOCO. The use of insecticides to protect maize during storage has proved effective in the north, but not in the south, where farmers are unwilling to remove the cob covering.

Research priorities for maize have been clearly identified. The first priority is to develop high-yielding varieties which are resistant to streak virus and have white, floury grain suited to the tastes of southern consumers. A short-duration variety tolerant to stem borer is needed for the second rainy season in the south.

The second priority is the study of maize-based farming systems, with the preservation of soil productivity and the integration of animal production as primary objectives.

The third priority is to overcome the problem of *Striga*, which is severe in the north. The ORSTOM program is to study *Striga* population dynamics and the mechanisms and extent of the damage caused.

The implementation of a coordinated national program to address these priorities is hindered by the fact that research teams are too widely dispersed at present, with each development company having its own. Both human and financial resources are inadequate at present, and the Direction de la recherche agronomique (DRA), which would be responsible for such a program, is administratively weak. It also lacks the necessary scientists (a breeder, an entomologist to investigate storage problems, and two agronomists for systems research and soil productivity work). Closer collaboration is necessary between this directorate and the directorate for soil studies and plant protection.

Links between research and extension are highly satisfactory, since both functions are carried out by the regional development companies.

In cassava research, IRAT has developed improved cultivars using genetic material from IITA. The new varieties outyield local varieties, and are tolerant to parasites. Both bitter and sweet varieties are available. Local cultivars are being evaluated.

The INPT is participating in biological control programmes for mealybug and cassava mite. Recently the institute completed a study funded by the FAO of the role of cassava in the economy of the south. Work is under way on the production of *gari* using biogas energy. Research on farming systems started only recently, and has not yet produced tangible results.

Two aspects of INPT's research are in need of strengthening: the multiplication of seed for distribution; and links with development organizations, whose extension staff have little knowledge of cassava and need training. The well-funded Société de Recherche sur le Café et le Cacao (SRCC) project, which operates in the south, is an exception.

The resources of the INPT should be strengthened in order to develop its research on cassava-based systems. Regarding the work on post-harvest processing and the design of

new plant, INPT should obtain information on activities in Nigeria with a view to adapting the technology already in use in that country.

Cooperation with neighbouring countries is poor. External funding is substantial, from IRAT and GTZ, as well as SAFGRAD, whose work on maize in the north is financed partly by the French through Fonds d'Aide et de Coopération (FAC).

Relationships with CIMMYT and IITA have so far been limited to the receipt of germplasm and training. Togo hopes to see cooperation increase in the future. The country intends to invite IITA scientists to Togo more frequently so that they can identify local needs and incorporate these into their breeding programmes. Togo also wants more IITA training activities, despite the difficulties caused by the language barrier. Research on production systems is another area in which Togo would like cooperation with IITA to increase.

Togo is an active member of three regional networks — SAFGRAD, CORAF and the network of countries participating in IITA's regional trials. The contributions of SAFGRAD and IITA in terms of new varieties are greatly appreciated. It is hoped that the CORAF network will soon begin to pay more attention to national needs. None of these networks are felt to have proved very effective in terms of facilitating collaborative research between countries.

Given Togo's maize research priorities, participation in regional collaborative research would be most beneficial. IITA could assist in the development of maize for northern environments, while relationships with neighbouring countries would help to produce appropriate white-grained varieties for bimodal rainfall patterns.

National scientists working on cassava have high expectations of the continuing cooperation with IITA. They hope that the EEC will fund the INPT program as part of the CORAF network. Togo wishes to cooperate, directly or through IITA, with Côte d'Ivoire, where higher education is available in French.

Appendix 2

NATIONAL PROPOSALS

Benin

Priorités retenues à la réunion tenue à Lomé (avril 1988) pour la recherche nationale

Maïs

1. **Fertilité et régénération des sols.**
2. **Amélioration de la qualité des grains.**
3. **Amélioration de la résistance aux parasites et maladies.**
4. **Utilisation industrielle du maïs.**
5. **Conservation de semences de base.**

Manioc

1. **Teneur en acide cyanhydrique.**
2. **Résistance aux maladies et parasites.**
3. **Fertilité et régénération des sols.**
4. **Transformation et utilisation industrielle.**

Systèmes de production (pérennité)

1. **Etude des systèmes faisant intervenir maïs et manioc.**
2. **Evaluation et identification des techniques, expérimentation en station et milieu paysan.**

Structure et gestion de la recherche agronomique

1. **Consolider les structures de recherche agronomique.**
2. **Assurer un accroissement des liens avec les CARDER.**
3. **Assurer une meilleure liaison avec les pays voisins.**
4. **Assurer un meilleur transfert en milieu paysan.**

Formation

1. **Formation et recyclage des cadres.**

2. Recrutement des cadres supérieurs.

Ressources et soutien des donateurs

1. Accroître le financement national.

2. Financement par les donateurs de la formation d'équipements et participation au fonctionnement des programmes.

Projets retenus comme essentiels à la réunion tenue à Ibadan (septembre 1986)

Ces projets réduits ont fait l'objet d'études et représentent des priorités affichées avec énergie par les structures nationales.

Maïs

Transformation après récolte et utilisation industrielle. La commercialisation du maïs représente un goulot d'étranglement pour des raisons de goût des consommateurs, de stockage, et d'utilisation industrielle (brasserie par exemple). Il est donc urgent et primordial de prendre des mesures pour améliorer le débouché des productions.

Manioc

1. Transformation après récolte et utilisation industrielle. Une transformation plus efficace du manioc en produits stables contribuera à stabiliser la demande en manioc brut et il est nécessaire de mettre en place de nouvelles technologies à partir de technologies extérieures, en particulier pour les agriculteurs sachant traiter les variétés amères.

2. Teneur en acide cyanhydrique (HCN). Selon la technicité et les objectifs de la culture de manioc, la teneur en HCN revêt une grande importance. Ainsi, l'évaluation des variétés les plus consommées, la recherche des variétés améliorées de la sous-région accompagnée d'expérimentation en milieu paysan est-elle indispensable.

3. Résistance aux parasites et maladies. Les recherches sur les variétés à faible teneur en HCN doivent s'accompagner d'études sur leur comportement et aboutir, par des croisements avec des variétés résistantes, à des résultats satisfaisants quant à leur résistance.

Systèmes de production (pérennité)

Evaluation des systèmes existants, identification des techniques agronomiquement et économiquement viables et expérimentation en milieu paysan.

Objectifs à atteindre après 5 ans

Au niveau de la recherche agronomique:

1. Consolider les nouvelles structures qui prennent en compte la transformation des produits après récolte, former du personnel compétent, se mettre au courant de ce qui se fait dans la sous-région, donc améliorer les liens avec les pays voisins.

Au niveau des résultats de la recherche:

2. Améliorer qualitativement et quantitativement les transformations après récolte et contrôler la teneur du manioc en HCN pour éviter de fournir des variétés amères à des paysans non préparés à leur traitement.

Effort national

Maïs

Personnel. Le pays s'est engagé à maintenir à son niveau actuel son personnel chercheur et escompte la formation de ses techniciens spécialisés. Au total, cinq chercheurs et 20 techniciens dans des conditions de travail médiocre.

Infrastructures. Une station dans le nord avec sept points d'essais, une station dans le sud avec six points d'essais, dont une partie est consacrée aux études sur le maïs et le manioc.

Equipement. Relativement sommaires, tant en moyens de laboratoire qu'en matériel roulant.

Fonctionnement. Un effort non négligeable est fait, mais reste insuffisant. Le manque de moyens de fonctionnement est préoccupant, en particulier pour les moyens de déplacement.

Manioc

Personnel. Cinq chercheurs, 15 techniciens, dans des conditions de travail médiocre.

Infrastructure. *Voir* Maïs.

Equipement. *Voir* Maïs.

Fonctionnement. *Voir* Maïs.

Systèmes de production (pérennité)

Personnel. Aucun personnel n'a été identifié comme travaillant uniquement dans ce domaine. On peut admettre deux chercheurs affectés à ces études.

Infrastructures. Elles existent, mais sont mal équipées.

Equipement. Laboratoire mal équipé, manque de moyens de transport.

Fonctionnement. Moyens insuffisants.

Effort demandé aux donateurs

Les programmes prévus en priorité n'ont pas de financements extérieurs et sont donc liés à l'intervention de donateurs. Voir les tableaux 1 et 2 pour les budgets demandé aux donateurs.

Maïs

Personnel. Une mission d'appui IITA est demandée pour mettre en route ces activités.

Equipement. Equipement d'un laboratoire pour le rendre opérationnel: étuve, séchoir, groupe électrogène, centrifugeuse, distillateurs, spectrocolorimétrie etc.

Fonctionnement. Deux scientifiques: un agrotechnologue, un agro-économiste.

Formation. Un technicien de laboratoire 6 mois à IITA; un voyage d'études pour un spécialiste en technologie alimentaire.

Manioc: transformation après récolte

Personnel. Une mission d'appui IITA pour encadrement.

Equipement. Post-messicole (*Voir* Tableau 1).

Fonctionnement. Deux scientifiques: un agronome, un agro-économiste.

Formation. Un technicien de laboratoire 6 mois à IITA; un voyage d'études en technologie alimentaire.

Manioc: amélioration variétale

Personnel. Une mission d'appui IITA pour la mise en place des essais.

Equipement. Un véhicule 4 x 4.

Fonctionnement. Deux scientifiques: un sélectionneur, 0.5 agro-chimiste, 0.5 entomo-pathologiste.

Formation. Une formation niveau DEA, 2 ans; un technicien sélectionneur, 6 mois; un voyage d'études dans la sous-région pour la sélection du manioc.

Manioc: systèmes de production

Personnel. Une mission d'appui pour encadrer au début les techniciens.

Equipement. Un véhicule 4 x 4 pour assurer les tournées.

Formation. Une formation technicien pendant 6 mois; un voyage d'études.

Montant total

Pour tous ces programmes, une documentation de base est à prévoir. L'aide totale souhaitée s'élève à $US 809 550.

Tableau 1. Transformation du maïs après récolte: budget demandé aux donateurs (en US$).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	15 000	-	-	-	-	15 000
Equipement:						
Microordinateur	9 000	-	-	-	-	9 000
Laboratoire	150 000	-	-	-	-	150 000
Véhicule 4 x 4	15 000	-	-	-	-	15 000
Fonctionnement	20 000	20 000	20 000	20 000	20 000	100 000
Documentation	2 000	2 000	2 000	2 000	2 000	10 000
Formation	9 000	-	-	-	-	9 000
Total	220 200	22 000	22 000	22 000	22 000	308 000
Inflation et imprévus (5%)	11 000	1 100	1 100	1 100	1 100	15 400
Total général	231 000	23 100	23 100	23 100	23 100	323 400

Tableau 2. Amélioration variétale du manioc et transforamtion après récolte: budget demandé aux donateurs (en $US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	30 000	-	-	-	-	30 000
Equipement:						
Laboratoire	-	-	-	-	-	-
Vehicule 4x4	15 000	-	-	-	-	15 000
Fonctionnement	40 000	40 000	40 000	40 000	40 000	200 000
Documentation	2 000	2 000	2 000	2 000	2 000	10 000
Formation:						
DEA	20 000	20 000	-	-	-	40 000
Mission	9 000	10 000	-	-	-	19 000
Technicien	9 000	-	-	-	-	9 000
Total	116 000	72 000	42 000	42 000	42 000	314 000
Inflation/imprévus (5%)	5 800	3 600	2 100	2 100	2 100	15 700
Total général	121 800	75 600	44 100	44 100	44 100	329 700

Tableau 3. Etudes des systèmes de production: budget demandé aux donateurs ($US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	-	15 000	-	-	-	15 000
Equipement:						
Véhicule 4x4	15 000	-	-	-	-	15 000
Fonctionnement	20 000	20 000	20 000	20 000	20 000	100 000
Documentation	1 000	1 000	1 000	1 000	1 000	5 000
Formation:						
Technicien	9 000	-	-	-	-	9 000
Voyage d'études	-	5 000	-	-	-	5 000
Total	45 000	41 000	21 000	21 000	21 000	149 000
Inflation/imprévus (5%)	2 250	2 050	1 050	1 050	1 050	7 450
Total général	47 250	43 050	22 050	22 050	22 050	156 450

Cameroon

National research priorities identified at the Lomé meeting (April 1988)

Maize

1. **Establishment of an effective post-harvest component to the NCRE project in order to investigate the vulnerability of new maize varieties to pest infestation during storage and to study different storage and drying methods in the different climatic zones of Cameroon.**

2. **Strengthening on-farm testing of maize technology by the TLUs.**

3. **Strengthening the economic capacity of the NCRE project in order to undertake constraint analysis for plant breeders and agronomists and to monitor the impact of new technologies.**

Cassava

1. **Evaluation of local materials for their potential in breeding programs.**

2. **Improvement program relying more on local cultivars.**

3. **Strengthening on-farm research through the TLUs.**

4. **Research on processing and storage of cassava, and the inclusion of expertise in processing and storage in the breeding program.**

5. **Establishment of a biological control program and participation in IITA'sIntegrated Biological Control Program (IBCP) to control cassava mealybug and green mite.**

6. **Strengthening expertise in agricultural economics and sociology in the roots and tubers program.**

Production systems (sustainability)

Work on the development of sustainable production systems will be integrated with the commodity-based research.

Research management and liaison

1. Improvement of research planning.

2. Instituting on-going program evaluation.

3. Determination of research priorities.

4. Establishment of a mechanism for linking the IRA and the Ministry of Agriculture, and for coordination between the various parastatals, regional development organisations, etc.

5. Strengthening and restructuring the extension service for food crops, with improved research-extension links.

6. More collaboration in the exchange of scientific information and germplasm in Central Africa, with the member countries of SAFGRAD, as well as with non-member countries such as Zaïre, Rwanda and Burundi.

Training

1. Training agricultural scientists at graduate and post-graduate level in order to meet future manpower requirements.

2. Curriculum development at agricultural colleges in order to satisfy the demand for trained technicians.

3. Development of a salary and benefits package for technicians and other lower level support staff.

Resources

1. Human:
   more scientists in the roots and tubers program;
   more technical support staff at IRA.

2. Equipment:
   more vehicles, particularly for on-farm research and TLU activities;
   specialized laboratory equipment, particularly for post-harvest research.

3. Operating funds:
   better continuity is required.

Contribution of the IARCs

1. IFPRI could help in a study of fertilizer policies and the economics of hybrid maize.

2. IFPRI could contribute to a study on the marketing of maize in Cameroon.

3. IITA should step up its work on stem borer, *Striga* and hybrid maize development.

4. IITA should help IRA set up screening facilities for streak resistance.

5. IITA should accord higher priority to developing improved varieties of cassava suitable for intercropping and with more desirable consumer characteristics.

6. IITA should appoint a desk officer for Cameroon.

7. The IARCs should recognize the unique potential of Cameroon as a bilingual country and the special role that the UCD could play in training agricultural technicians.

Contribution of donors

1. Better documentation in both French and English at IRA.

2. Support for networks in order to establish better links between them or, preferably, a single network for each commodity.

3. Support for regional research and training at the UCD.

Projects selected as essential at the Ibadan meeting (September 1988)

The projects selected represent essential research which capitalizes on past national and donor investments and which is vital for a cost-effective national program over the next 5 years.

Maize

Establishment of an effective post-harvest component in the NCRE project.

Cassava

1. Breeding of new varieties with good disease and pest resistance, suitable for intercropping and with desirable consumer characteristics.
2. Evaluation of local materials for their potential in breeding programs.
3. Strengthening on-farm research through the TLUs.
4. Research on processing and storage.
5. Establishment of a biological control program and participation in the IBCP for control of cassava mealybug and mite.
6. Strengthening expertise in economics and sociology in the roots and tubers program.

Objectives to be achieved over a 5-year period

Maize

The objectives for maize are modest, since IRA already has a comprehensive research program on cereals, the NCRE project.

In operational terms, it is proposed to make the post-harvest research unit at Dschang fully operational by providing the laboratory with the necessary machinery and equipment for research on storage pests and drying and storage methods. Operating funds will also have to be made available.

As regards research results, post-harvest research on maize will result in reduced post-harvest losses through improved storage and the breeding of varieties less susceptible to insect attack.

Strengthening the on-farm research capacity to include more economic analysis will result in better maize technology which is more readily adopted by farmers.

Cassava

In operational terms, Cameroon should, after 5 years, have a strengthened cassava research team, including an additional six Cameroonian staff trained with the support of IITA. Support staff should also have been strengthened, with the addition of 16 technicians, also trained by IITA. In the light of the country's economic crisis and the

reduced level of expenditure on agricultural research, it is unlikely that additional operating funds will be forthcoming.

As regards research results, by the end of the 5-year period it is hoped that new, high-yielding cassava varieties will have become available. These varieties will be adopted by farmers provided appropriate extension efforts are made and opportunities exist for marketing surpluses. In the longer term, improved storage and processing will also be an outcome of the research.

National resources

The national resources outlined here represent commitments made by the Government of Cameroon.

Maize

Personnel. No additional staff are required for the post-harvest research unit as there is already one MSc level researcher at IRA, who will be maintained.

Infrastructure. *See under* Cassava.

Equipment. *See under* Cassava.

Operating funds. *See under* Cassava.

Cassava

Personnel. IRA plans to maintain the present research staff and to engage a further six scientists over the next 5 years, namely one cassava breeder (PhD), one agronomist (MSc), one agricultural economist (MSc), one pathologist (PhD), one extension specialist (agronomist; MSc), and one food technologist (storage, processing; MSc). In addition, six technical support staff will be recruited and trained.

Infrastructure. The upgrading and extension of the existing infrastructure is planned under the World Bank-supported national agricultural research project.

Equipment. No additional equipment will be acquired using national resources apart from that
under the World Bank project.

Operating funds. As operating funds are likely to remain at their current level, these will be insufficient to keep the research staff productive.

Resources requested from donors

The resources requested from donors for maize and cassava are presented in Tables 1 and 2.

Maize

Expatriate personnel. One person-month's worth of consultancies from IITA is requested over a 5-year period.

Equipment. The first three items are for a post-harvest research laboratory. The request for vehicles comprises one four-wheel drive vehicle, at a cost of US$ 15 000, and two motorcycles at US$ 2 500 each.

Training. The funds requested refer to training technicians and training at MSc and PhD level.

Operating Funds. These are estimated at US$10 000 per year per scientist at UCD, totalling US$ 50 000.

Cassava

Expatriate personnel. No additional expatriate personnel will be needed since two IITA scientists are already working at IRA. However, short-term missions from IITA scientists will be needed, totalling 2 person-months over a 5- year period.

Equipment. Two 4-wheel drive vehicles are requested, one in year 1 and one in year 3. The implements required for the tractor are a plough, harrow, ridger and trailer. The aquisition of two microcomputers and software is planned, including printer, plotter and accessories, at a cost of US$ 8000 per unit. Office equipment includes a typewriter, photocopying machine, desks, chairs, tables, filing cabinets, etc. Requested for the biological control program are a screenhouse, at US$ 10 000; a greenhouse at US$ 10 000; cages, insect rearing facilities, etc, at US$ 10 000; a microscope, etc, at US $10 000. Ten motorcycles are requested for field staff, at a cost of US$ 2500 per unit. The costs of equipping a food technology laboratory are estimated roughly.

Operating funds. These are estimated at US$ 10 000 per scientist. There are at present five researchers working on cassava improvement. Six additional scientists will be recruited during the first 3 years of the plan, bringing total operating costs to US$ 330 000 over the 5-year period.

Training. Of the six scientists to be recruited, two will complete a PhD and four an MSc. If training takes place outside Africa, this brings the cost of MSc and PhD training to US$ 240 000 and US$ 120 000 respectively. Some thesis research will be done at IITA or in Cameroon, in liaison with IITA. For the six technicians, 3 months training each is anticipated at IITA or UCD, at a cost of US$ 1500 per technician per month, plus air travel, bringing the total cost to US$ 29 400. In-country training is also planned, and the budget allowed for this is US$ 1000 per technician, or a total of US$ 6000.

Grand total

The budget requested from donors for strengthening maize and cassava research in Cameroon over a 5-year period amounts to US$ 1 193 220.

Table 1. Budget for establishment of a post-harvest component in the NCRE project, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	7 500	-	7 500	-	-	15 000
Equipment:						
Microscopes	5 000	-	-	-	-	5 000
Drying,weighing	5 000	-	-	-	-	5 000
Analysis	20 000	-	-	-	-	20 000
Vehicle (4WD)	15 000	-	-	-	-	15 000
Motorcycles	2 500	-	2 500	-	-	5 000
Office	5 000	-	-	-	-	5 000
Operations	10 000	10 000	10 000	10 000	10 000	50 000
Total	70 000	10 000	10 000	10 000	10 000	120 000
Inflation/contingencies (5%)	3 500	500	1 000	500	500	6 000
Grand total	73 500	10 500	21 000	10 500	10 500	126 000

Table 2. Budget for strengthening cassava research in Cameroon, inUS$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	7 500	7 500	-	7 500	7 500	30 000
Equipment:						
Vehicles	15 000	-	15 000	-	-	30 000
Tractor	70 000	-	-	-	-	70 000
Microcomputers	16 000	-	-	-	-	16 000
Office	10 000	-	-	-	-	10 000
Bcp*	20 000	20 000	-	-	-	40 000
Motor cycles	12 500	-	12 500	-	-	25 000
Ftl**	50 000	-	-	-	-	50 000
Office	20 000	-	-	-	-	20 000
Operations	30 000	30 000	90 000	90 000	90 000	330 000
Training						
MSc	120 000	120 000				240 000
PhD			40 000	40 000	40 000	120 000
Technicians	11 800	11 800	11 800			35 400
Total	382 800	189 300	169 300	137 500	137 500	1 016 400
Inflation /contingencies (5%)	19 140	9 465	8 465	6 875	6 875	50 820
Grand total	401 940	198 765	177 765	144 375	144 375	1 067 220

Note:
* Biological control program
** Food technology laboratory

Congo

Priorités retenues à la réunion tenue à Lomé (avril 1988) pour la recherche nationale

Maïs

1. Sélection et amélioration du maïs jaune destiné à la consommation animale et aux brasseries.

Manioc

1. Une intervention directe de l'IITA au Congo pour l'étude des systèmes de production à base de manioc; conduite d'essais au champ chez des agriculteurs, étude des pratiques culturales/systèmes de culture et renforcement de la liaison recherche-vulgarisation.

2. Renforcement de l'hybridation/sélection du manioc.

3. Continuation de l'effort en matière de lutte biologique à l'IITA et recherche de variétés résistantes en collaboration avec les systèmes nationaux.

Systèmes de production (pérennité)

Favoriser davantage la sédentarisation et l'intensification de l'agriculture paysanne; améliorer par une fertilisation rationnelle chimique et biologique la productivité du milieu, tout en assurant le maintien à long terme de ces améliorations.

Structure et gestion de la recherche agronomique

1. Définir un plan de la recherche agronomique.

2. Définir un dispositif cohérent du système national de recherche agronomique dans lequel le Centre de Loudima serait intégré en tant qu'entité.

3. Mieux fixer les priorités de recherche agronomique selon des critères objectifs.

4. Améliorer la coordination entre les programmes financés par des fondsextérieur et ceux financés par le gouvernement.

5. Augmenter le nombre de chercheurs au CRAL, surtout les agro-économistes et les agronomes.

6. Associer aux chercheurs en place des adjoints de recherche et des techniciens selon un rapport de 2:1.

7. Développer un programme de recherches hors-station.

8. Entreprendre des recherches sur la socio-économie des systèmes de production.

9. Initier une meilleure liaison fonctionnelle entre la recherche agronomique et les services de vulgarisation.

10. Développer des relations scientifiques avec les pays voisins ou dans des écologies similaires et développer les relations avec les centres internationaux de recherche

agronomique (CIRA), en particulier IITA et ISNAR et, dans une moindre mesure, CIMMYT et Centro internacional de l'agricultura tropical (CIAT).

11. Inviter ISNAR pour l'étude d'une meilleure structure de recherche agronomique et pour améliorer la gestion de l'ensemble.

Formation

1. Favoriser davantage la formation des cadres nationaux en leur offrant des bourses d'étude et des séjours dans des CIRA et les services nationaux de recherches agronomiques (SNRA) et d'enseignement universitaire.

2. Etablir un plan de formation de niveau PhD, MSc et techniciens.

3. Développer davantage les liens avec l'université.

Contributions des CIRA

1. Rendre opérationnel l'accord de coopération signé entre le Congo et l'IITA en 1984.

2. Une intervention directe de l'IITA au Congo en renforcement du CRAL.

3. Poursuivre l'effort des CIRA, et en particulier l'IITA, en matière de lutte biologique et en recherche de variétés résistantes en collaboration avec les SNRA.

4. Une intervention de l'ISNAR pour l'étude d'une meilleure structure de recherche agronomique et pour améliorer la gestion de l'ensemble.

5. Le Congo devait faire partie du Alley Farming Research Network.

Ressources et soutien des donateurs

1. Augmenter considérablement le budget de fonctionnement pour la recherche agronomique.

2. Organiser les essais multilocaux sous forme de réseaux coopératifs de recherche effectifs.

3. Une action concertée des donateurs en faveur du UCD.

4. Un accroissement des moyens financiers pour l'équipement et le fonctionnement de la recherche sur manioc et maïs.

5. Les donateurs devraient faciliter l'échange de chercheurs et d'informations scientifiques et de matériel végétal par l'intermédiaire des réseaux de recherche.

Projets retenus comme essentiels à la réunion tenue à Ibadan (septembre 1988)

Au Congo, le manioc occupe une place prédominante parmi les cultures vivrières. Plus de 90% des Congolais consomment le manioc tous les jours, et la production nationale ne couvre pas tous les besoins. Les rendements en culture paysanne sont de 5 à 10 tonnes de racines frais à l'hectare, tandis qu'on peut obtenir entre 25 et 30 tonnes en station de recherche agronomique.

Le maïs vient en deuxième priorité parce que la consommation humaine de maïs est peu élevée. On consomme le maïs à l'état frais pendant quelques mois par an, et sous forme transformée comme alcool, bière et produits animaux. En culture familiale, le maïs apparaît dans les champs en culture mixte. Le maïs est également cultivé en culture industrielle, particulièrement dans la vallée du Niari, pour l'alimentation animale.

En ce qui concerne la restructuration de la recherche agronomique et la définition d'un plan de la recherche agronomique, le Congo vient de signer un accord avec la FAO (référence TCP/PRC/8852) pour le financement des études dans le cadre de cette restructuration.

Après discussions et concertation, il apparaît clairement que le projet retenu comme urgent et essentiel au Congo concerne les recherches sur le manioc. Le projet peut être défini comme suit: Manioc: Tenforcement de l'amélioration variétale, des essais en milieu rural et des recherches sur les systèmes de culture à base de manioc.

En ce qui concerne les recherches sur le maïs jaune en culture paysanne pour l'amélioration animale et les brasseries, le Congo, à travers le réseau associatif de recherche sur le maïs bénéficiera d'un financement limité dans le cadre du plan global.

Objectifs à atteindre après 5 ans

Au niveau de la recherche agronomique:

1. A la fin de la période de 5 ans, la recherche agronomique congolaise doit avoir une capacité suffisante en sélection et amélioration du manioc et en recherche sur les systèmes de culture à base de manioc. Le nombre de chercheurs manioc au CRAL sera doublé et toutes les stations de recherche agronomique de la DGRST vont avoir au moins un chercheur manioc appuyé par un technicien, formé à l'IITA. Des relations de travail régulières seront établies avec l'IITA et l'impact des techniques améliorées de production de manioc mises au point à l'IITA sera plus grand.

2. Le Congo sera capable de mener de façon autonome des recherches appliquées et des recherches adaptatives sur le manioc, aussi bien en station qu'au champ chez des paysans. De cette façon, la liaison avec les services de vulgarisation agricole du Ministère de l'Agriculture sera plus facile et le transfert de technologies en milieu paysan plus aisé.

3. Le déséquilibre qui existait avant entre l'effort sur la protection du manioc d'une part, et l'amélioration et l'agronomie du manioc d'autre part sera corrigé. L'équipe de recherche sur manioc entreprendra des thèmes prioritaires de recherche et pourra aboutir aux résultats voulus, étant donné que les contraintes d'équipement et de fonds de fonctionnement seront levées et que le personnel aura suivi une formation adéquate.

Au niveau des résultats de la recherche:

4. L'objectif principal est l'augmentation des rendements du manioc en milieu paysan. Actuellement, les rendements sont de l'ordre de 5 tonnes/ha. Il doit être possible de doubler ces rendements pour arriver à une moyenne de 10 tonnes/ha. Si ceci peut être réalisé, le Congo sera entièrement autosuffisant en manioc, et la sécurité alimentaire des populations rurales et urbaines sera renforcée. Non seulement les rendements en manioc doivent être augmentés sérieusement, mais tout le système de culture basé sur manioc doit être rendu plus productif tout en préservant la fertilité des sols et la conservation de l'environnement.

Effort national

Personnel. Au CRAL, il y a actuellement trois chercheurs manioc, dont deux pour l'amélioration variétale et un s'occupant de problèmes agronomiques et de systèmes de culture. Ils sont épaulés par deux techniciens.

Les stations d'Odziba et Kindamba sont sous la responsabilité d'un technicien supérieur qui s'occupe également des essais multilocaux.

A l'ORSTOM/DGRST à Brazzaville, quatre chercheurs nationaux s'occupent de la culture *in-vitro* du manioc et des problèmes phytotechniques de la culture, y compris des essais sur le terrain. Deux chercheurs travaillent sur la lutte biologique du manioc et un troisième est en formation. De plus, deux chercheurs français étudient la bactériose du manioc. Il y a à la section de phytopathologie également trois techniciens. Le complexe agro-industriel de l'Etat à Mantsoumba bénéficie d'un projet de recherche-développement sur le manioc avec un coopérant français et un chercheur congolais. Finalement, six enseignants-chercheurs de la Faculté des Sciences de l'Université Marien N'Gouabi sont engagés dans des recherches sur le manioc, notamment la phytopathologie, la cochenille du manioc et la teneur en acide cyanhydrique.

Lors de la mission au Congo en novembre 1987, on estimait que sept expatriés et 14 nationaux dont 7 à temps plein étaient engagés dans des recherches manioc.

Comme on peut le constater, il y a un déséquilibre entre, d'une part, la protection du manioc contre les maladies et ravageurs qui absorbe un potentiel scientifique important, et l'amélioration et l'agronomie du manioc qui reçoivent relativement peu d'attention, d'autre part.

Les perspectives en personnel pour les 5 années à venir sont les suivantes:

— l'équipe de recherche en amélioration et en systèmes de culture manioc au CRAL sera renforcée avec trois chercheurs et trois techniciens;

— les stations d'Odziba, Kindamba et Ewo seront renforcées en y affectant un chercheur manioc avec un technicien dans chacune d'elle.

Ceci représente un renforcement en personnel de six chercheurs et six techniciens.

Infrastructures. Les infrastructures au CRAL seront maintenues et réfectionnées là ou c'est nécessaire, entre autres, pour la documentation. Les laboratoires d'amélioration manioc et de fertilité de sols sont opérationnels mais manquent un complément d'équipement. Pour les stations d'Odziba, Kindamba et Ewo, une extension est nécessaire pour le logement des chercheurs et techniciens supplémentaires.

Equipement. Il existe à Loudima un pool de véhicules pour tous les programmes de recherche. Actuellement, il n'y a qu'un seul véhicule dans le pool et il est très difficile d'acquérir des véhicules sur fonds congolais.

Les laboratoires ont tous un équipement de base, mais ils ont besoin d' un complément d'équipement. La crise économique que traverse actuellement le pays ne permet pas d'espérer obtenir ce complément sur le budget national.

Fonctionnement. A part le salaire des chercheurs et des techniciens, le CRAL reçoit à peu près 1 millions FCFA par chercheur et par an (± $US 3300) en fonctionnement. Le salaire moyen d'un chercheur est d'environ $US 6500 par an. On peut donc constater que l'effort gouvernemental est déjà substantiel. Néanmoins, pour mener à bien les recherches dans de bonnes conditions, un complément de fonds de fonctionnement est nécessaire pour arriver à un minimum de $US 10 000 par chercheur et par an. Les augmentations des fonds de

fonctionnement sur budget national dépendent surtout de la conjoncture économique du pays, et il est malheureusement illusoire d'espérer une amélioration sensible dans les années à venir.

Formation. Les jeunes chercheurs sont engagés au niveau ingénieur agronome. Un complément de formation et de stage est nécessaire, de préférence dans un CIRA et, en l'occurrence, à l'IITA.

Les techniciens ont reçu une formation théorique dans les collèges d'agriculture et ont besoin de cours de perfectionnement et de stages, soit dans le pays même ou, à défaut, dans un CIRA ou dans une institution bénéficiant de la collaboration d'un CIRA, par exemple, le UCD au Cameroun.

Effort demandé des donateurs

L'ORSTOM fait au Congo un effort important sur les maladies et parasites du manioc: la bactériose et la cochenille du manioc font l'objet de recherches approfondies. Plusieurs chercheurs nationaux sont détachés par la DGRST à l'ORSTOM.

L'IRAT intervient au Congo dans un projet de recherches sur le manioc grâce à des financements FAC et Congolais et en collaboration avec l'ORSTOM et le projet de la ferme de Mantsoumba (BDPA-Caisse Centrale de Coopération Economique (CCCE).

Un projet de vulgarisation agricole entièrement financé par le Congo est exécuté par la FAO. Ce projet se trouve au nord du pays dans la cuvette à Ewo Abala, où des essais de variétés de manioc sont en cours.

Un projet de développement rural intégré et de vulgarisation d'une durée de 5 ans est situé à Kindamba, et est financé sur fonds Congolais et sur un emprunt du Fonds international pour le développement agricole (FIDA). Une recherche appliquée et adaptative sur le manioc est prévue en station (Odziba et Loudima) et hors-station: L'IITA intervient dans ce projet par la formation d'un agronome de recherche (8 personnes-mois) et de trois techniciens pendant 6 mois, par l'assistance technique (4 personnes-mois de missions de courte durée en méthodologie de recherche adaptative et une personne-mois en lutte biologique) et par la fourniture d'insectes pour la lutte biologique. L'intervention de l'IITA se chiffre à $US 374 900.

Un project de recherche financé par le CDRI (17 million FCFA sur 3 ans) est en cours; il s'agit des essais de nouvelles variétés de manioc en milieu paysan et la sélection de ces variétés. Finalement, une recherche appliquée sur le manioc et le maïs est également en cours au projet vivrier de Kounzoulou avec l'assistance technique de l'AGRI-CONGO.

Personnel. Selon le plan d'action élaboré à Lomé, une intervention directe de l'IITA est souhaitée pour une période de 2 ans. Par cette intervention, les lacunes en amélioration variétale et en essais [illegible] chez des agriculteurs et en système de culture à base manioc peuvent être comblées. C'est également par l'action de l'IITA que la formation sur place peut se faire, surtout au niveau des techniciens.

Le profil souhaité des chercheurs IITA est: un améliorateur manioc; un agro-économiste spécialisé en conduite d'essais chez des paysans et en analyse des systèmes de culture.

Sont également demandées, des missions de courte durée (1 à 2 semaines) de chercheurs de l'IITA pour un total de 3 personnes-mois sur 5 ans. Leur intervention est surtout demandée pour l'analyse des systèmes de production, la culture en couloirs et les façons culturales.

Equipement. Le complément d'équipement qui est demandé comprend: trois véhicules, dont deux en première année et un en troisième année; des motos pour les déplacements des

techniciens (10 motos x $US 2000 = $US 20 000); deux micro-ordinateurs avec accessoires et logiciel (2 x $8000 = $US 16 000); équipement de bureau (machines à écrire, photocopieuses, stencileuses) $US 6000; équipement laboratoires (pour compléter l'équipement d'analyse des sols et des plantes) $US 30 000; une serre (pour l'acclimatation des cultures *in vitro*) $US 6000; un screenhouse (insect-proof) $US 4000; équipement des champs (petit matériel d'expérimentation, de mesure des superficies) $US 5000; documentation de base $US 10 000.

Fonctionnement. Les fonds de fonctionnement demandés se limitent aux activités au CRAL et dans les autres stations. L'équipe complète est composée de six chercheurs manioc au CRAL et un chercheur dans chacun des trois autres stations. Comme la contribution gouvernementale est d'environ $US 3300 par chercheur et par an, un complément de $US 6700 est à prévoir. En tenant compte du renforcement graduel de l'équipe de recherche manioc, le budget de fonctionnement sollicité des donateurs et de $US 221 100 (année 1: cinq chercheurs; année 2: sept chercheurs dont un en formation PhD pendant 3 ans; année 3 et suivantes: neuf chercheurs dont deux en formation PhD pendant 3 ans).

Formation. Les six chercheurs qui seront recrutés et les trois chercheurs en poste ont besoin d'une formation complémentaire de courte durée, par exemple, par un stage de 2 mois à l'IITA. Le budget nécessaire est de 9 x 2 x $US 2000/mois = $US 36 000 plus les voyages avion estimés à 9 x $US 500 = $US 4500. Les deux meilleurs chercheurs partiront en formation PhD: coût estimé $US 120 000. Leurs travaux de recherche pour la thèse seront faits en tenant compte des besoins de recherche au Congo et en collaboration avec l'IITA. Les deux techniciens à Loudima ont déjà participé aux stages de formation à l'IITA. Il faut donc prévoir la formation des techniciens qui seront recrutés: six techniciens x 3 mois x $US 1500/mois = $US 27 000. Voyages avion: 6 x $US 500 = $US 3000.

Montant total

Le montant total demandé aux donateurs est de $US 1 153 530.

Tableau 1. Renforcement des recherches manioc au Congo: budet demandé des donateurs (en $US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel de l'IITA	250 000	250 000	-	-	-	500 000
Missions IITA	7 500	7 500	10 000	10 000	10 000	45 000
Equipement:						
Véhicules	30 000	-	15 000	-	-	45 000
Motos	10 000	-	10 000	-	-	20 000
Micro-ordinateurs	16 000	-	-	-	-	16 000
Equipement de bureau	6 000	-	-	-	-	6 000
Equipement de labos	20 000	-	10 000	-	-	30 000
Serre	6 000	-	-	-	-	6 000
Screenhouse	4 000	-	-	-	-	4 000
Equipement des champs	3 000	-	2 000	-	-	5 000
Documentation	10 000	-	-	-	-	10 000
Fonctionnement	33 500	40 200	46 900	46 900	53 600	221 100
Formation:						
Stages chercheurs	13 500	13 500	13 500	-	-	40 500
Bourses Ph.D.	-	20 000	40 000	40 000	20 000	120 000
Techniciens	10 000	10 000	10 000	-	-	30 000
Total	419 500	341 200	157 400	96 900	83 600	1 098 600
Inflation et imprévus (5%)	20 975	17 060	7 870	4 845	4 180	54 930
Total général	440 475	358 260	165 270	101 745	87 780	1 153 530

Gabon

Priorités retenues à la réunion tenue à Lomé (avril 1988) pour la recherche nationale

Maïs

Sélection de variétés de maïs plus productives et résistantes aux maladies et insectes aussi bien pour la consommation humaine que pour l'alimentation animale.

Manioc

1. **Appui scientifique et technique de l'IITA dans l'élaboration d'un Programme National Manioc, dans la formation des chercheurs et des techniciens nationaux, et dans l'élargissement de la base génétique du matériel végétal.**

2. **Participation aux divers réseaux de recherche et relations scientifiques plus intenses avec des instituts de recherche agronomique situés dans des pays voisins et des écologies similaires.**

Structure et gestion de la recherche agronomique

1. **Création d'une structure unifiée de recherche agronomique nationale.**

2. **Détermination des priorités de la recherche agronomique nationale.**

3. **Etude stratégique des besoins en recherche.**

4. **Programmation technique et financière des projets de recherche par principale spéculation.**

Formation

Faciliter l'accès aux structures de formation existantes dans le monde (bourses).

Ressources et soutien des donateurs

1. **Les donateurs devraient faciliter l'acquisition d'équipements et de documentation pour les structures nationales de recherche agronomique.**

2. **Les donateurs devraient financer l'organisation d'ateliers, séminaires, colloques et symposium pour faciliter la communication entre chercheurs.**

Projets retenus comme essentiels à la réunion tenue à Ibadan (septembre 1988)

Un seul projet concernant la recherche nationale sur le manioc a été retenu comme prioritaire et essentiel, après beaucoup de discussions. Un autre projet, le renforcement du programme de lutte biologique contre la cochenille et l'acarien vert du manioc, n'a pas été retenu à cause de l'importance et de la qualité du programme déjà existant dans le pays. Aucun projet maïs n'a été retenu après beaucoup de délibérations à cause de l'importance secondaire du maïs au Gabon pour la consommation humaine. Néanmoins, le Gabon, à travers le réseau associatif de recherche sur le maïs pourra émarger aux fonds disponibles pour le renforcement des recherches sur le maïs dans le cadre du plan global.

Manioc

Développement de variétés améliorées de manioc résistantes aux maladies et aux insectes et adaptées aux besoins des consommateurs; amélioration des systèmes de production à base manioc en agriculture familiale.

Objectifs à atteindre après 5 ans

Au niveau de la recherche agronomique:

1. **Les objectifs généraux sont la création, à moyen terme d'un Programme National Manioc *dimensionné aux capacités Gabonaises.* Ce programme devra développer et prévulgariser des variétés améliorées de manioc et des systèmes de production à base manioc plus productifs à long terme dans la zone forestière humide. Ce programme sera établi en collaboration avec l'IITA.**

Au niveau des résultats de la recherche:

2. **L'analyse des contraintes des systèmes de production à base manioc et de la commercialisation de manioc dans les différentes régions du pays.**

3. **Le recensement systématique et la caractérisation (description) du matériel local.**

4. **L'introduction et l'évaluation de matériel *exotique* venant de l'IITA et d'autres institutions.**

5. **La création de nouvelles variétés améliorées.**

6. **L'évaluation des nouvelles variétés par des essais multilocaux en station et hors station au champ chez des paysans, y compris l'aptitude à la conservation et à la transformation et les caractéristiques organoleptiques.**

7. **La conservation des ressources génétiques (germoplasme) en collection au champ et en culture *in vitro*; la multiplication rapide des variétés les plus intéressantes, y compris la multiplication *in vitro*.**

8. **La prévulgarisation des variétés et des techniques culturales améliorées, y compris des démonstrations au champ chez des paysans.**

9. **Une collaboration étroite avec les CIRA, et en particulier l'IITA, et les institutions similaires des pays à écologie semblable.**

Effort national

Personnel. En l'absence d'une structure nationale unifiée, plusieurs chercheurs Gabonais travaillent sur le manioc d'une manière non-coordonnée. A moyen terme, une nouvelle structure de recherche agronomique émergera et un programme cohérent de recherche sur manioc, réunissant toutes les capacités locales dans ce domaine, sera monté (le Programme National Manioc). L'équipe de recherche devrait comprendre: un biochimiste-physiologiste; un phytopathologiste; un agronome; un agro-économiste et/ou agro-sociologue; un améliorateur-généticien

A part l'améliorateur-généticien, toutes ces disciplines scientifiques sont présentes au Gabon, soit au CIAM, à l'Université Nationale du Gabon, à l'USTM ou à l'IRAF. Il est prévu de mobiliser ces capacités locales avec l'aide de l'IITA et de les coordonner dans un Programme National Manioc sous l'impulsion du Ministère de l'Agriculture. Ceci

faciliterait ultérieurement la vulgarisation des acquis de la recherche en milieu paysan, étant donné les responsabilités dans ce domaine du Ministère.

L'essentiel des travaux de terrain en station sera conduit au CIAM à Ntoum, à 40 km de Libreville, avec des essais multilocaux dans les six stations provinciales.

Le plan de développement du CIAM prévoit déjà l'affectation de 7 ingénieurs agronomes, 13 contrôleurs d'agriculture, 2 diplômés IITA, 4 techniciens de laboratoire et 1 agent technico-commercial pour l'ensemble des spéculations. Une fois le Programme National Manioc mis sur pied, le personnel à recruter y sera affecté en priorité. Ceci concerne en particulier les techniciens de recherche et de laboratoire car il n'y en a pas actuellement. Il est prévu de joindre à chaque chercheur un technicien qui devra être formé à l'IITA.

Infrastructure. Il est prévu de transférer la section des cultures vivrières à l'extension du CIAM à 7 km de Ntoum sur un site de 300 ha hérités de la SONADECI (ex-bananeraie). Actuellement, il n'y existe pas d'alimentation en eau potable et en électricité et tous les logements disponibles au CIAM sont affectés.

Le gouvernement Gabonais a l'intention d'améliorer l'infrastructure du CIAM en y construisant des habitations et en raccordant l'extension à l'eau et à l'électricité (estimatif pour les raccordements: 120 millions FCFA, soit $US 4 million).

Equipement. Les laboratoires du CIAM sont déjà bien equipés, en particulier en équipement de culture *in vitro* et d'analyses chimiques. Il y manque une serre pour la culture de jeunes plants issus de la culture *in vitro* (pépinière). Le gouvernement Gabonais complétera l'équipement du laboratoire, des bureaux et des champs (tracteurs et accessoires, petit outillage) en vue de l'établissement du Plan National Manioc.

Fonctionnement. Le financement du CIAM (toutes spéculations) coûte au gouvernement annuellement entre 400 et 600 millions FCFA. Actuellement, la crise économique frappe durement le Gabon et toutes les dépenses gouvernementales sont en régression. Néanmoins, étant donné l'appel de Franceville (cfr. raport principal) et l'accent mis sur l'agriculture villageoise et les cultures vivrières, il est prévu de maintenir les dépenses de fonctionnement du CIAM. Toute nouvelle activité, y compris le Programme National Manioc, doit être financé à partir de réductions dans d'autres programmes ou de l'extérieur. Il est donc indiqué de prévoir un complément de fonds de fonctionnement de sources extérieures, car ceci aurait comme conséquence positive un co-financement plus facile des Autorités Gabonaises.

Effort demandé aux donateurs

Le Gabon ne reçoit actuellement pas de fonds de la part des donateurs pour ses recherches sur le manioc. L'effort qui est demandé aux donateurs est modeste et prend en compte les capacités Gabonaises d'auto-financement.

Personnel. Deux chercheurs expérimentés IITA recrutés internationalement sont demandés pendant 2 ans pour aider au développement d'un Programme National Manioc, pour former des chercheurs Gabonais et pour assurer efficacement la liaison avec l'IITA. Idéalement, ce serait un sélectionneur-améliorateur (breeder) et un agronome avec une bonne expérience en zone forestière humide. Ils doivent animer la jeune équipe Gabonaise et assumer le leadership scientifique de celle ci.

Le coût annuel moyen est estimé à $US 125 000 par chercheur, y compris le véhicule et tout le support logistique et opérationnel nécessaire au bon fonctionnement de l'expert.

Equipement. Véhicules: un véhicule tous terrains est prévu sur 5 ans en complément des véhicules à acheter sur fonds Gabonais. Micro-ordinateur: une unité est prévue, en support aux experts IITA et du Programme. Equipement champs: il s'agit de l'achat d'équipements spécialisés pour les essais au champ. Equipement laboratoire: un montant de $US 10 000 est prévu en complément des équipements à acquérir sur fonds Gabonais.

Fonctionnement. Le fonctionnement d'un chercheur, à raison de $US 10 000 par chercheur et par an est prévu, le fonctionnement des autres chercheurs étant à la charge du gouvernement Gabonais.

Formation. Au niveau de la maîtrise, un total de $US 50 000 est prévu en complément des frais de formation qui sont à supporter par le gouvernement Gabonais.

Pour le doctorat, $US 30 000 sont prévus, de préférence pour un généticien-sélectionneur de manioc et un agronome, afin d'assurer la continuité des travaux après le départ des experts IITA.

Les travaux de recherche pour la maîtrise et le doctorat seront faits à l'IITA ou au Gabon sur un sujet retenu comme prioritaire dans le programme de travail de l'équipe Gabonaise-IITA.

Pour les techniciens, deux bourses par an pour une durée de 3 mois, soit au total 2 x 3 x 5 ans = 30 personnes/mois. Ceci permettrait aux techniciens Gabonais qui sont à recruter de suivre des stages de formation à l'IITA ou ailleurs, par exemple à Dschang au Cameroun, en collaboration avec l'IITA.

Montant total

Un montant total de $790,650 est sollicité des donateurs pour la mise sur pied d'un Programme National Manioc avec l'assistance de l'IITA.

Tableau 1. Développement de variétés améliorées de manioc resistantes aux maladies et aux insects et adaptées aux besoins des consommateurs; Amélioration des systèmes de production a base manioc en agriculture familiale, Programme National Manioc: budget demandé aux donateurs (en $US)

	Année 1	Année 2	Année 3	Année 4	Année 5	TOTAL
Chercheur IITA	250 000	250 000				500 000
Equipement:						
Véhicules 4WD	15 000					15 000
Micro-ordinateur	8 000					8 000
Equipement de champs	10 000					10 000
Equipement de laboratoire	10 000					10 000
Sous total	293 000	250 000				543 000
Fonctionnement	10 000	10 000	10 000	10 000	10 000	50 000
Formation:						
Maîtrise	10 000	10 000	10 000	10 000	10 000	50 000
Doctorat			20 000	20 000	20 000	60 000
Techniciens	10 000	10 000	10 000	10 000	10 000	50 000
Total	323 000	280 000	50 000	50 000	50 000	753 000
Inflation et imprévus à 5%	16 150	14 000	2 500	2 500	2 500	37 650
Total général	339 150	294 000	52 500	52 500	52 500	790 650

Ghana

National research priorities identified at the Lomé meeting (April 1988)

Maize

1. Study of maize marketing.
2. Development of fertilizer and credit policies to encourage the adoption of improved maize technologies.
3. Strengthening of the economics research component of on-farm research at CRI.
4. Impact study of the GGDP.
5. Study of how to ensure a continuous supply of improved seeds.

Cassava

1. Monitoring and evaluation of the biological control program, in collaboration with the Ministry of Agriculture.
2. Marketing study on cassava and cassava products.
3. Strengthening the CRI roots and tubers improvement program; developing high-yielding cassava varieties with good disease and pest resistance and with desirable consumer characteristics (poundability for *fufu* making); on-farm testing of such varieties.

Production systems (sustainability)

1. Study of sustainable cropping and farming systems, including alley farming and agro-forestry, in collaboration with the SRI.
2. Research on appropriate agricultural implements and equipment for production, harvesting, transport, processing and storage of maize and cassava, in order to increase labor productivity.

Research management and liaison

1. Development of a national master plan for agricultural research, with the support of the World Bank.
2. Better overall coordination of agricultural research.
3. Better research-extension links.

Training

1. Training of agricultural scientists at graduate and post-graduate level (training will have to be carried out abroad given the limited resources available in Ghana).

Resources

1. Human:
   more scientists and technicians in the roots and tubers program.

2. Equipment:
   vehicles for the roots and tubers program (currently there are none); other equipment for the roots and tubers program.

3. Operating funds:
   the allocation of sufficient operating funds, and reasonable continuity of funding, for the roots and tubers program.

Contribution of the IARCs

1. IITA should appoint a desk officer for Ghana.

2. All links between the IARCs and Ghana should be channelled through the CRI.

3. Research at IITA on stem borers, *Striga* and hybrid maize should continue; germplasm development at CIMMYT should also continue.

4. IITA should develop improved cassava varieties having good disease and pest resistance and more desirable consumer characteristics.

5. IITA should increase its work on cassava mite through the Integrated Biological Control Program (IBCP).

6. ISNAR could help review the agricultural research system and prepare a national master plan for research.

7. IFPRI could do an impact study of the GGDP.

Contribution of donors

1. Financing collaborative research networks across linguistic barriers and ecological zones.

2. Financing key research projects through networks.

3. Investments in infrastructure, scientific equipment, vehicles and facilities at CRI research stations.

4. Increased funding of cassava improvement.

5. Provision of fellowships for MSc and PhD studies abroad.

6. Increased funding for the FRI, to enable it to assume an expanded regional role, particularly for research on post-harvest technology.

Projects selected as essential at the Ibadan meeting (September 1988)

Because Ghana already has a strong research capacity in maize, the projects selected as essential cover cassava only. The following three projects are proposed:

1. Strengthening the CRI root and tuber improvement program.

2. Research on cassava storage and processing, in collaboration with the CRI.

3. Monitoring and evaluation of the biological control program.

Objectives to be achieved over a 5-year period

In operational terms, the number of national researchers will increase to seven, supported by seven technicians. At the same time, facilities at the five research stations where cassava research will take place will be made fully operational or extended to cater for the increased research effort. A major training effort will be made, including MSc studies for five researchers and PhD training for two. The seven technicians will attend IITA training courses. Equipment and operating funds will also be available.

By the end of the plan period new, high-yielding cassava varieties with good disease and pest resistance and desirable consumer characteristics should become available for the various agroecological zones of Ghana. Eventually, this will result in increased labor and land productivity, and lower consumer prices. The development of modern methods for producing traditional foods should reduce post-harvest labor requirements, stimulating both production and consumption. The biological control unit will be contributing to the global research effort, focussing on the population dynamics of mealybug and its parasite, *Epidinocarsis lopezi*, and on the green spider mite, on which no research has been carried out in Ghana.

National resources

Cassava improvement

Personnel. Over the next 5 years, the CRI plans to recruit and maintain two agronomists, one breeder, one pathologist, one entomologist, and one agricultural economist. Four technicians will also be added, bringing the ratio of scientists to technicians to 1:1. The Ministry of Agriculture will release technicians to the CRI.

Infrastructure. The research on cassava will be carried out at Kumasi/Fumesua, Nyankpala, Pokuase, Aiyinase and Ohawu Stations. The new main station at Kumasi/Fumesua is almost complete. Installation of fittings, utilities and furniture has been budgeted for 1988-90. However, there is no housing on site; the CRI will provide accommodation allowances. Aiyinase Station will probably be upgraded to include staff housing, and extended under an FAO/World Bank project; presently, there are only two bungalows there. Pokuase Station has only one bungalow and an office/laboratory; the old buildings will be rehabilitated and two new bungalows will be built. At Ohawu Station, there are two bungalows anda small office and laboratory; one bungalow and accommodation for technical staff quarters will be built. The facilities at Nyankpala Station were funded with German aid and do not need upgrading.

Equipment. Two new four-wheel drive vehicles will be acquired through the IFAD project, together with six motorcycles, standard laboratory equipment, office equipment and farm tools and machinery. One tractor with implements will be bought from the national budget. This equipment will be used for research on yams, sweet potatoes and cocoyams, as well as cassava. Expenditure on equipment under the IFAD project will be only about US$ 4000, mostly for tissue culture work.

Operating funds. The requirement for operating funds from national resources is minimal once housing allowances and staff benefits have been accounted for. Operating costs for such

items as the two vehicles, the motorcycles, the laboratory equipment, the conduct of field trials and the IITA researcher have been requested under the IFAD project.

Cassava processing and storage

It is proposed that research on cassava storage and processing be carried out at the FRI, in collaboration with the CRI. The FRI has been involved in such research for many years and thus has a comparative advantage in this area. At least one researcher will be engaged full time, backed up by a technician. The FRI is equipped with the standard analytical equipment for food technology analysis, but lacks operating funds.

Biological control of cassava pests

Personnel. The biological control unit at CRI will be adequately staffed in terms of researchers.

The CRI plans to recruit one technician in support of the research staff.

Infrastructure. *See under* Cassava improvement.

Equipment. The CRI has no specialized equipment for research on biological control. However, general-purpose laboratory equipment, including microscopes, will be acquired through the IFAD project. The unit has no vehicle at present.

Operating funds. The unit has almost no operating funds.

Resources requested from donors

The budget request to donors is shown in Tables 1 and 2.

Cassava improvement, processing and storage

Expatriate personnel. No additional expatriate staff are required since an IITA researcher

is already posted at the CRI under the IFAD project. However, short-term missions of IITA scientists will be needed for backstopping. Two person-months are requested over the 5-year period.

Equipment. Three four-wheel drive vehicles are requested, two in year 1 and one in year 3. The implements for the tractor are a plough, harrow, slasher and trailer. Two microcomputers with software and accessories are needed, at US$ 8000 per unit. The cost of the two air-conditioners requested will be US$ 1500 per unit. Three motorcycles are required at US$ 2500 each.

Operating funds. Some scientists are already supported under the IFAD project. Operating funds are requested only for the remaining researchers, taking into account the time they are away on training. Thus, total operating costs are estimated at US$ 120 000. Of these, US$ 50 000 are earmaked for a scientist at the FRI.

Training. The two researchers in the cassava program have an MSc. The five additional scientists will be recruited at BSc level and will need to go on to MSc training, preferably abroad as Ghanaian universities do not have adequate facilities for high-quality training. Of the seven researchers, it is estimated that two will do a PhD. On the basis that MSc training takes two years and costs US$ 20 000 per annum per student, and PhD training takes three years and costs US$ 20 000 per annum per student, the training costs will amount to US$ 200 000 and US$ 120 000 respectively. Thesis research will be

conducted at the CRI or IITA, even when graduate training take place overseas. Three-month training courses for seven technicians, at a cost of US$ 1500 per month per trainee, will amount to US$ 31 500; including air travel estimated at US $500 per student, the total amount is US$ 35 000.

Biological control of cassava pests

Expatriate personnel. Short-term visits from IITA staff estimated at 1 person-month over a 5-year period.

Equipment. As in Table 2. One four-wheel drive vehicle and a greenhouse are requested.

Operating funds. Estimated at US$ 10 000 per researcher per year.

Training. Technicians will be trained through the IBCP for a period of 3 months at a total cost of US$ 5 000.

Grand total

The total budget request to donors for strengthening cassava research in Ghana over a 5-year period amounts to US$ 2 072 575.

Table 1. Budget for cassava improvement, processing and storage, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	7 500	7 500	7 500	7 500	-	30 000
Equipment:						
Vehicles	30 000	-	15 000	-	-	45 000
Tractor/implements	70 000	-	-	-	-	70 000
Microcomputers	16 000	-	-	-	-	16 000
Air-conditioners	3 000	-	-	-	-	3 000
Tissue culture lab:						
Greenhouse	20 000	-	-	-	-	20 000
Air-conditioner	5 000	-	-	-	-	5 000
Fan	10 000	-	-	-	-	10 000
Other	5 000	-	-	-	-	5 000
Motorcycles	7 500	-	-	-	-	7 500
Office	20 000	-	-	-	-	20 000
Truck	70 000	-	-	-	-	70 000
Fumensua station	20 000	-	-	-	-	20 000
Storage and processing lab	50 000	-	-	-	-	5 000
Operations	20 000	20 000	20 000	20 000	40 000	120 000
Training:						
M.Sc.	60 000	100 000	40 000	-	-	200 000
Ph.D.	-	-	40 000	40 000	40 000	120 000
Technicians	15 000	10 000	10 000	-	-	35 000
Total	429 000	137 000	132 500	67 500	80 000	846 500
Inflation/contingencies (5%)	21 450	6 875	6 625	3 375	4 000	42 325
Grand total	450 450	144 375	139 125	70 875	84 000	888 825

Table 2. Budget for biological control of cassava pests, inUS$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	7 500		7 500			15 000
Equipment:						
4WD vehicle	15 000					15 000
Greenhouse etc	40 000					40 000
Operations	20 000	20 000	20 000	20 000	20 000	100 000
Training	5,000					5 000
Total	87 500	20 000	27 500	20 000	20 000	175 000
Inflation/contingencies (5%)	4 375	1 000	1 375	1 000	1 000	8 750
Grand total	91 875	21 000	28 875	21 000	21 000	183 750

Guinée

Priorités retenues à la réunion tenue à Lomé (avril 1988) pour la recherche nationale

Maïs

1. **Amélioration variétale: variétés locales et introduites, sélection.**
2. **Techniques culturales: densité de semis, cultures associées et intercalaires.**
3. **Essais en milieu paysan.**

Manioc

1. **Amélioration variétale.**
2. **Techniques culturales.**
3. **Défense des cultures: lutte biologique terrestre.**
4. **Essais en milieu paysan.**
5. **Technologies après récolte.**

Systèmes de production (pérennité)

Etude des systèmes faisant intervenir maïs et manioc; aspects socioéconomiques.

Structure et gestion de la recherche agronomique

1. **Confirmer et renforcer les structures qui viennent d'être mises en place, en particulier le système des filières.**
2. **Approche intégrée par équipes multidisciplinaires; meilleur transfert en milieu paysan.**

Formation

1. **Formation et recyclage du personnel sur place par l'assistance technique.**
2. **Formation à moyen et long terme, en particulier des gestionnaires de centres et des documentalistes.**

Ressources et soutien des donateurs

Les chercheurs sont en nombre à peu près suffisant eu égard aux moyens limités à leur disposition actuellement, mais ils manquent de métier et leur niveau doit être amélioré. D'où l'importance de l'action des donateurs pour la formation et les moyens de travail; les demandes sont d'ailleurs très raisonnables.

Projets retenus comme essentiels à la réunion à Ibadan (septembre 88)

Seuls trois projets ont été retenus comme indispensables dans les prochaines années. Le manioc étant la deuxième culture après le riz, le maïs est considéré comme culture d'avenir.

Maïs

Amélioration variétale: poursuite et intensification des introductions de variétés améliorées, collecte d'écotypes locaux. Définition des idéotypes, notamment le cycle et la couleur.

Manioc

1. **Amélioration variétale: sélection de variétés locales et introduction de variétés résistantes aux principales maladies, en insistant sur l'importance des feuilles dans la consommation.**

2. **Défense des cultures: les principales attaques proviennent des cochenilles, acariens verts et singes dans certains régions. La mosaïque se développe surtout sur le manioc doux, d'où la nécessité d'effectuer des sélections massales pour les variétés locales et d'avoir recours contre les parasites à la lutte biologique.**

Systèmes de production (pérennité)

Etude des différents systèmes existant, en mettant l'accent sur les aspects sociologiques et économiques. Importance des essais en milieu paysan.

Objectifs à atteindre après 5 ans

Au niveau de la recherche agronomique:

1. **La recherche a été réorganisée récemment et travaille essentiellement par filières. Il s'agit donc de consolider ces structures et de renforcer les moyens des stations, et d'améliorer la liaison avec les services de vulgarisation pour assurer une bonne adéquation de la recherche aux besoins et un retour des résultats vers les utilisateurs.**

Au niveau des résultats de la recherche:

2. **Pour le maïs, le but est de produire ou identifier des variétés adaptées aux différentes zones écologiques. Définition des idéotypes (cycle, qualité du grain, couleur, texture etc) avec les utilisateurs. Cela permettra la production de semences de base et la mise en place d'une collection de variétés améliorées.**

3. **Pour le manioc, on espère obtenir des variétés indemnes de mosaïques, résistantes à la cochenille et à l'acarien vert, hautement productives et à faible teneur en HCN. Mise en place d'une collection.**

Effort national

Maïs

Personnel. Deux chercheurs, cinq techniciens, six observateurs.

Infrastructures. La station de Kilissi, avec quelques essais en Moyenne Guinée.

Equipement. La station de Kilissi a reçu une partie de son équipement de la Corée du Nord. Les crédits nécessaires sont très insuffisants.

Fonctionnement. C'est l'un des principaux points faibles du système national, et une amélioration n'est pas prévisible dans l'immédiat.

Manioc

Personnel. Un chercheur, cinq techniciens, cinq observateurs.

Infrastructures. La principale station est Foulaya, mais des essais sont menés dans toute la Guinée, en particulier aux stations de Bordo et Bareng.

Equipement. Très insuffisant, fourniture d'une partie des équipements par l'aide extérieure (USAID, FAC, FED).

Fonctionnement. *Voir* Maïs.

Systèmes de production (pérennité)

Personnel. Peu de personnel formé.

Infrastructures. Pour le moment à Conakry.

Equipement. Pas de données.

Fonctionnement. Pas de moyens.

Effort demandé aux donateurs

A part quelques équipements fournis par la coopération bilatérale (voir plus haut), il n'y a pas de crédits extérieurs affectés à ces programmes, d'où l'importance de l'assistance demandée.

Maïs: amélioration variétale

Personnel. Pas d'affectation IITA demandée, mais des missions d'appui d'1 mois en 1e année et de 2 semaines en 2e et 3e années.

Equipement. Petit matériel pour points d'essai; un véhicule 4 x 4.

Fonctionnement. Pour deux chercheurs.

Formation. Longue durée pour un généticien pendant 2 ans.

Manioc: amélioration variétale

Personnel. Missions d'appui d'un généticien (1 mois en 1ere année), d'un phytotechnicien (2 semaines en 2eme année), d'un généticien (2 semaines en 4eme année), d'un phytotechnicien (1 semaine en 4eme année).

Equipement. Matériel pour points d'essais.

Fonctionnement. Pour un chercheur.

Formation. Longue durée: un généticien niveau maîtrise pendant 2 ans. Courte durée: 1 sélectionneur pendant 6 mois.

Manioc: défense des cultures

Personnel. Mission d'appui d'un entomologiste et d'un phytopathologiste (1 mois en 1ème année), d'un entomologiste (2 semaines en 2ème année) et d'un phypathologiste (2 semaines en 4ème année).

Equipement. Petit matériel pour points d'essais; un véhicule 4 x 4; 10 vélomoteurs pour vulgarisateurs.

Fonctionnement. Pour un chercheur.

Formation. Courte durée: 6 mois en 4ème ou 5ème année.

Systèmes de production (maïs et manioc)

Personnel. Affectation pour 1 an d'un spécialiste pour permettre la mise au point du programme et la formation sur place des équipes.

Equipement. Douze motos ou vélomoteurs pour les essais en milieu paysan et la vulgarisation.

Fonctionnement. Pour un chercheur.

Formation. Longue durée: un phytotechnicien, 2 ans; courte durée: un technicien, 6 mois.

Montant total

La documentation est pratiquement à reconstituer pour tous les programmes. L'aide totale souhaitée s'élève à $US 747 100.

Tableau 1. Amélioration variétale du manioc et défense des cultures en Guinée: budget demandé aux donateurs (en $US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	45 000	15 000	-	30 000	-	90 000
Equipement:						
Petit matériel	20 000	-	-	-	-	20 000
Véhicule 4x4	15 000	-	-	-	-	15 000
Motos	8 000	-	-	-	-	8 000
Fonctionnement	20 000	20 000	20 000	20 000	20 000	100 000
Documentation	5 000	4 000	2 000	2 000	2 000	15 000
Formation	-	20 000	20 000	27 000	-	67 000
Total	113 000	59 000	42 000	79 000	22 000	315 000
Inflation et imprévus (5%)	5 650	2 750	2 100	3 950	1 100	15 750
Total général	**118 650**	**61 950**	**44 100**	**82 950**	**23 100**	**330 750**

Tableau 2. Amélioration variétale du maïs en Guinée: budget demandé aux donateurs (en $US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	15 000	7 500	7 500	-	-	30 000
Equipement:						
Petit matériel	10 000	-	-	-	-	10 000
Véhicule 4x4	15 000	-	-	-	-	15 000
Fonctionnement	10 000	10 000	10 000	10 000	10 000	50 000
Documentation	3 000	2 000	1 000	1 000	1 000	8 000
Formation	-	20 000	20 000	-	-	40 000
Total	53 000	39 500	38 500	11 000	11 000	153 000
Inflation et imprévus (5%)	2 650	1 975	1 975	550	550	7 650
Total général	55 650	41 475	40 425	11 550	11 550	160 650

Tableau 3. Etudes des systèmes de production (maïs et manioc): budget demandé aux donateurs (en $US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	125 000	-	-	-	-	125 000
Equipement:						
Motos	9 600	-	-	-	-	9 600
Fonctionnement	10 000	10 000	10 000	10 000	10 000	50 000
Documentation	4 000	2 000	2 000	1 000	1 000	10 000
Formation:						
Maîtrise	-	20 000	20 000	-	-	40 000
Technicien	9 000	-	-	-	-	9 000
Total	157 600	32 000	32 000	11 000	11 000	243 600
Inflation et imprévus (5%)	7 880	1 600	1 600	550	550	12 180
Total général	165 480	33 600	33 600	11 550	11 550	255 780

Liberia

National research priorities identified at the Lomé meeting (April 1988)

Maize

Improvement of maize varieties and maize agronomy.

Cassava

1. **On-station and on-farm testing of cassava varieties and research on the improvement of cassava-based cropping systems; strengthening of extension links.**

2. **Strengthening of research on post-harvest technology, particularly storage and processing at village level.**

Production systems (sustainability)

Research to develop sustainable production systems will be integrated with the commodity-based research.

Research management and liaison

1. **Work jointly undertaken by CARI and CAF.**

2. **Dissemination of research information and strengthening of research-extension links.**

Training

1. **Long-term overseas training of researchers.**

2. **Short-term training of technicians at IARCs, and in-country training with the help of IARCs.**

Resources

1. **Human:**
   more scientists and technicians in cassava and maize research and training.

2. **Equipment:**
   funding is needed to procure equipment.

3. **Operating funds:**
   needed for on-farm research and the exchange of scientists and technicians.

Contribution of the IARCs

1. **The IARCs should continue to provide germplasm.**

2. **The IARCs should continue to provide training at all levels.**

3. They should assist in identifying funding sources.

4. They should help finance the exchange of scientists and technicians, and stimulate regional cooperation (information, plant material, scientists), especially cooperation with neighboring countries.

Contribution of donors

1. The provision of funds for on-farm research and the procurement of equipment.

2. Training.

3. Funds for visiting and exchange programs.

Projects selected as essential at the Ibadan meeting (September 1988)

Maize

In Liberia maize is not as high a priority crop as rice or cassava, but it does form part of traditional cropping systems. Recent trends in the demand for livestock feed have drawn attention to the potential of maize as a cash crop. The poultry industry in Liberia has grown substantially over the past 10 years, but it is still dependent on imported feed. The selected project is therefore:

Improvement of maize varieties and maize agronomy, with special reference to the use of maize for animal feed.

Cassava

1. On-station and on-farm testing of cassava varieties and research on the improvement of cassava-based cropping systems; strengthening of research-extension links.

2. Strengthening research on post-harvest technology, particularly storage and processing at village level.

Objectives to be achieved over a 5-year period

Maize

In operational terms, by the end of the 5-year period the maize team should have been strengthened to number six researchers and two technicians. The new crop science building constructed by the government should have been equipped to house the maize program effectively. A new seed lab should have been constructed and the fencing of all research plots completed.

As regards research results, the collection and on-station screening of local and exotic germplasm should be well under way. A number of new varieties should have been produced. Agronomy trials should be well enough advanced to allow some indication of planting dates, sowing density, etc.

Cassava

In operational terms, by the end of the plan period a functioning cassava improvement team consisting of 11 scientists and 14 technicians should be in place. A screenhouse and a greenhouse should be fully operational, and all the other necessary equipment should also be in use. On-station resarch should be well under way, and an on-farm testing program should also have been launched. As a result, research-extension links should begin to strengthen towards the end of the period. The existing extension liaison unit within CARI will have been further strengthened, so that research results will reach a larger group of end users. Cooperation between IITA and the national program should have been strengthened.

As regards research results, the post-harvest technology research program should have been strengthened sufficiently to allow at least one storage and/or processing package to have been developed for dissemination to farmers. This will encourage the adoption of the higher-yielding new varieties that should also have been developed by the end of the plan period.

National resources

Maize improvement

Personnel. The national maize research team currently consists of a plant breeder (PhD), a soil scientist (MSc), an agronomist (BSc), a socio-economist (BSc), and eight technicians. Over the plan period, another plant breeder (BSc), a physiologist (MSc) and an agronomist (BSc) will be added. No newtechnicians will be added to the team, however.

Infrastructure. A new seed laboratory will be built at CARI.

Equipment. *See under* Cassava improvement.

Operating funds. Being less important than rice and cassava, maize receives only US$ 10 000
annually in operating funds. This sum is not likely to change in the near future.

Cassava improvement

Personnel. The staff currently engaged in cassava research consists of three agronomists (MSc), a socio-economist (BSc), an entomologist (MSc) and a soil scientist (MSc). Each of these scientists is supported by two or three technicians. A breeder and a pathologist (BSc) will be added over the next 5 years. No increase in the number of technicians is planned. Thus, by the end of the plan period, the cassava research team will consist of eight scientists supported by the present 16 technicians. Close collaboration with the CAF at the university already exists, and links with extension will be strengthened.

Infrastructure. There is already a laboratory for cassava at CARI; no additional infrastructure is planned, apart from the fencing of research plots.

Equipment. Equipment procured from the government budget has to come out of the operating budget. No vehicles or tractors will be acquired from this source. Some laboratory equipment and farming implements will be bought from operating funds. The Root Crop Project funded by the IDRC will be extended for 3 years, allowing two vehicles to be acquired, but no laboratory or farm equipment, except small tools.

Operating funds. The entire research institute has an annual operating budget of US$ 500 000, including research on tree crops and livestock. No increase is planned over the next

5 years; indeed, a decrease is likely. Cassava is the second most important food crop after rice, and currently has an operating budget of about US$ 50 000 per annum — half that of rice.

Cassava post-harvest technology

Personnel. The post-harvest research team currently consists of a food technologist (MSc), an agriculturalist (BSc), and three technicians. Over the plan period, a researcher in food processing (BSc) and one technician will be added.

Infrastructure. CARI already has a post-harvest storage and processing laboratory. No expansion of facilities is planned.

Equipment. The existing post-harvest laboratory is poorly equipped and chemical analyses are done at CARI's analytical laboratory. No additional laboratory equipment will be acquired from national funds, however.

Operating funds. Post-harvest storage and processing currently receive low priority, having an annual operating budget of only US$ 6000. No increase in this budget is planned.

Resources requested from donors

The resources requested from donors are presented in Tables 1, 2 and 3.

Maize

At present, donors provide no funds for maize research.

Expatriate personnel. One person-month of IITA visits is requested, mainly in maize physiology and pathology.

Equipment. One four-wheel drive vehicle and four motorcycles are required, the latter at a unit cost of US$ 2000. The maize analysis equipment consists of a moisture meter, a dryer, a grain counter and shellers.

Operating funds. These take into account the time staff are away on training, and the government's contribution of US$ 10 000.

Training. Three MSc fellowships are requested for a breeder, an agricultural economist and an agronomist. The eight technicians will participate in IITA 3-month training courses, at a cost of US$ 1666 per month per trainee.

Cassava improvement

The IDRC plans to donate about US$ 216 000 for the period 1989-91.

Expatriate personnel. Two person-weeks per year of visits by IITA staff are requested, mainly for breeding and pathology.

Equipment. A four-wheel drive vehicle is requested, together with 10 motorcycles. Ten knapsack sprayers are needed, at a unit cost of US$ 1000. The tractor requested is a two-wheel drive, 80-hp tractor, together with implements. Two hand-operated 20-hp tillers are also needed. The laboratory equipment required includes two Ph-meters, two sets of sieves, two Mettler balances and a microscope.

Operating funds. Taking into account that a number of researchers will be on training elsewhere in Africa or overseas, the number of person-years of research staff will be 28. IDRC will provide US$ 80 000 for operations, leaving a further requirement of US$ 200 000 (on the basis that each scientist incurs US$ 10 000 expenditure). The annual operating budget from the government is about $50 000, leaving only US$ 10 000 per year to be provided by donors.

Training. Three MSc fellowships are requested for a pathologist, an agronomist and a socio-economist. Two PhD fellowships are needed for a cassava breeder and an agronomist. IDRC will support one PhD fellowship (breeder). Some technicians have already been to IITA for training; a further 10 will attend over the next 5 years at a cost of US$ 5000 each.

Cassava post-harvest technology

No resources are currently provided by donors for research on post-harvest technology.

Expatriate personnel. Two person-weeks of visits by IITA staff are requested, to offer advice on the work plan and on the research methods.

Equipment. One four-wheel drive vehicle and two motorcycles are needed, in addition to the laboratory equipment.

Operating funds. Thirteen person-years' worth of operating funds are needed altogether. The annual operating budget provided by CARI is about US$ 6000, so a further US$ 100 000 is requested for the plan period.

Training. One MSc fellowship in food engineering is requested, together with the training of four technicians for 3 months at IITA.

Grand total

The total budget requested from donors for strengthening maize and cassava research in Liberia is US$ 1 062 600.

Table 1. Budget for maize improvement and agronomy, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	3 750	3 750	3 750	3 750	-	15 000
Equipment:						
4WD vehicle	15 000	-	-	-	-	15 000
Motor cycles	4 000	4 000	-	-	-	8 000
Screenhouse	4 000	-	-	-	-	4 000
Microcomputer	8 000	-	-	-	-	8 000
Analysis	10 000	10 000	-	-	-	20 000
Operations	10 000	10 000	30 000	30 000	30 000	110 000
Training:						
MSc	60 000	60 000	-	-	-	120 000
Technicians	10 000	10 000	10 000	10 000	-	40 000
Total	124 750	97 750	43 750	43 750	30 000	340 000
Inflation/contingencies (5%)	6 237	4 887	2 187	2 187	1 500	17 000
Grand total	130 987	102 637	45 937	45 937	31 500	357 000

Table 2. Budget for cassava improvement, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	7 500	7 500	7 500	7 500	7 500	37 500
Equipment:						
4WD vehicle	15 000	-	-	-	-	15 000
Motorcycles	10 000	10 000	-	-	-	20 000
Screenhouse	4 000	-	-	-	-	4 000
Greenhouse	6 000	-	-	-	-	6 000
Microcomputer	8 000	-	-	-	-	8 000
Knapsack sprayers	5 000	-	-	-	-	5 000
Tractor/implements	40 000	-	-	-	-	40 000
Tillers	20 000	-	-	-	-	20 000
Laboratory	20 000	-	-	-	-	20 000
Operations	10 000	10 000	10 000	10 000	10 000	50 000
Training:						
MSc	60 000	60 000	-	-	-	120 000
PhD	-	20 000	20 000	20 000	-	60 000
Technicians	15 000	15 000	10,000	10 000	-	50 000
Total	220 500	122 500	47 500	47 500	17 500	455 500
Inflation/contingencies (5%)	11 025	6 125	2 375	2 375	875	22 775
Grand total	231 525	128 625	49 875	49 875	18 375	478 275

Table 3. Budget for cassava post-harvest technology, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	3 750	3 750	-	-	-	7 500
Equipment:						
4WD vehicle	15 000	-	-	-	-	15 000
Motorcycles	4 000	-	-	-	-	4 000
Laboratory	15 000	-	15 000	-	-	30 000
Operations	14 000	14 000	24 000	24 000	24 000	100 000
Training:						
MSc	20 000	20 000	-	-	-	40 000
Technicians	10 000	5 000	5 000	-	-	20 000
Total	81 750	42 750	44 000	24 000	24 000	216 000
Inflation/contingencies (5%)	4 087	2 137	2 200	1 200	1 200	10 825
Grand total	85 837	44 887	46 200	25 200	25 200	227 325

Nigeria

National research priorities identified at the Lomé meeting (April 198)

Maize

1. Strengthening the Nationally Coordinated Maize Improvement Program.
2. Research on *Striga* and stem borer resistance, further development of improved hybrids and open-pollinated varieties.
3. Strengthening research on maize storage and processing technologies, and the marketing and utilization of maize.

Cassava

1. Continuation and strengthening of cooperation between national and international programs, in particular with IITA.
2. Varietal improvement for yield, acceptability and resistance to major diseases and pests.
3. Improving the quality of recommended varieties.
4. Further improvement and application of the techniques for rapid multiplication of improved materials.
5. Strengthening research on cassava storage and processing.

Production systems (sustainability)

Development of stable and sustainable production systems that will optimize returns to investments in improved seed, nutrients and management.

Research management and liaison

1. Strengthened links between research and development.
2. Review of the overall organization and management of the national research system with a view to strengthening the interaction of research with development.
3. Strict observance of national priorities and continuity in the pursuit of identified research topics and programs.
4. Strengthened planning processes at both federal and institutional levels in order to avoid overlapping mandates and duplication of efforts, and to encourage efficient use of scarce resources.

Training

1. More emphasis on in-service and reorientation training to update skills and knowledge in new and evolving research fields.

2. Improved ratio of research technicians to scientists, and greater emphasis on staff quality.

Resources

1. Human: a greater proportion of funds devoted to operating costs compared to staff costs.

2. Financial: more adequate and more stable funding over a long enough period for operating costs and the required applied and adaptive research.

Contribution of the IARCs

1. The CGIAR could request ISNAR and IFPRI to carry out an external review of research policies in order to establish research priorities and programs.

2. The other IARCs could help with training in specialized fields, and through exchange visits between scientists.

3. IITA should continue to participate in the Nationally Coordinated Maize and Cassava Research Program. The IARCs will be important in addressing the priority issues, such as

   Striga tolerance and stem borer resistance in maize and biological control of pests in cassava.

4. IITA should continue its research on the development of sustainable production systems that will lead to increased and stable productivity and improved soil/crop management.

Contribution of donors

1. More operating funds for the national maize and cassava research programs.

2. Funding for a national center to train research technicians.

3. Assistance to facilitate participation in networking, the organization of workshops, information exchange and other forms of cooperation.

Projects selected as essential at the Ibadan meeting (September 1988)

Maize

The Nationally Coordinated Maize Improvement Program has been an important mechanism for the development and coordination of research on maize, and this should be strengthened to address the following priority problems in maize research:

1. Development of improved hybrids and open-pollinated varieties, together with systems of production that will optimize returns to investment in improved seed, nutrients and management.

2. Development of methods for combatting *Striga*, including possible application of biotechnology approaches such as gene transfer (from sorghum and millet).

3. Development of fertilizer and micronutrient recommendations for specific soil types and crops in different ecological zones and production systems.

4. Studies on marketing, storage, processing and utilization, including bread and beer production.

5. Studies on disease and pest control, including more widespread use of streak-resistant varieties, increased resistance to foliar diseases, development of varieties resistant to downy mildew, and continued evaluation of chemical control methods, especially for stem borer.

6. Socio-economic evaluation of new technology and the study of maize production systems, including relative economic advantages of different crop combinations.

The overall project title covering these priorities is: Increasing Maize Production through a Strengthened National Research Program.

Cassava

1. Breeding for high yields, resistance to pests and diseases, high dry matter and starch content (for making *gari*), and low cyanide content (sweet varieties).

2. Studies on adaptation to ecological zones, time of planting, nutrient requirements, soil management, weed control and intercropping.

3. Pests and diseases management, including control of cassava mealybug and mite, grasshoppers, termites, cassava mosaic disease, bacterial blight, anthracnose and tuber rot.

4. Processing and utilization studies, including the production of *gari*, bread flour, starch, alcohol and other products used as human food or animal feed; development of small-scale processing, including implications of mechanization for drying, harvesting, peeling, slicing and grating.

5. Development of stable and sustainable cassava-based production systems, and of improved seed production methods and facilities.

The overall title of the project selected to encompass these priorities is: Strengthening of Research on Cassava and Cassava-based Production Systems.

Objectives to be achieved over a 5-year period

In operational terms, by the end of the 5-year period new equipment will have been acquired and additional training of staff will have taken place. The ratio of technicians to scientists will have been improved. The national research programs for both crops will have been strengthened and intensified considerably so as to develop a continuous stream of improved, ecologically adapted, high-yielding varieties with desirable consumer qualities and resistance to pests and diseases.

As regards research results, high-yielding hybrids and open-pollinated varieties of maize will be in extensive use by farmers. Progress will have been made in research on *Striga* tolerance and stem borer resistance. Considerable experience will have been gained with the application of appropriate storage and processing technologies to increase the production and consumption of maize. Improved cassava varieties with a high yield potential, a high degree of consumer acceptability, resistance to the major diseases and pests, and low cyanide content will have been developed and diffused. Biological control will have substantially reduced damage by pests. Management of cassava-based cropping systems will have improved. The processing and utilization of cassava will have become more efficient, resulting in higher labor productivity, particularly for small-scale farmers.

National resources

Personnel. Nigeria currently has an adequate number of scientists engaged in maize and cassava research in various national institutes. Staff are generally well trained, with 30-50% holding a PhD and having more than 5 years experience. No additional scientists are planned, but the ratio of scientists to technicians, which currently varies from 1:0.7 to 1:1.4, should be increased to reach the optimum ratio of 1:2.

Infrastructure. The Nigerian research system has had considerable financial support from the government in the past decade and has reached a stage at which an adequate infrastructure has been built up.

Equipment. The equipment available at most of the national research institutes is old and has ceased to function efficiently owing to inadequate maintenance and shortage of spare parts.

Operating funds. The funding of maize and cassava research has been inadequate and unstable. A very high proportion of expenditure has been devoted to staff costs compared to operating costs. Productivity is now badly affected by the inadequacy of operating funds.

Resources requested from donors

Cassava and cassava-based production systems

Expatriate personnel. No additional staff members or consultancies are requested.

Equipment. Funds will be required for the provision of growth chambers and a glass house. An insectary will need to be built at Vom. The program will also require two four-wheel drive vehicles. All three items will be acquired during the first year of the plan.

Operating funds. Over the plan period, additional operating costs will be incurred in cassava breeding, rapid multiplication of breeder stock, multilocation evaluation in 12 locations and the multiplication of foundation seed. The operating funds requested for biological control will be required for the mass rearing and release of parasitoids, followed by monitoring. Studies on the population dynamics of pests and parasitoids will also be carried out. Under cassava-based cropping systems provision is made to cover multilocation trials and studies of sowing density, as well as work on maintaining soil productivity.

Training. Two cassava researchers will be trained to MSc level during the first 2 years. One cassava researcher will be trained to PhD level, starting during the third year. Ten technicians will be trained during the plan period.

Maize and maize-based production systems

Expatriate personnel. No new staff members or consultancies are requested.

Equipment. During the first year screenhouses and irrigation facilities will be installed, together with an out-station generator. Two four-wheel drive vehicles will be needed. The processing equipment will comprise 30 drying units, 30 shellers and 30 hammer mill/grinders.

Operating funds. These are required to support one scientist in storage improvement studies and just under half a person-year in soil productivity studies on maize-based cropping systems. A recipe book will be produced during the third year and distributed during the fourth and fifth years.

Training. Two maize researchers will be trained to MSc level during the first 2 years. Starting in the third year, one maize scientist will be trained to PhD level. Five maize

technicians will be trained for 6 weeks in various aspects of maize research and production. This training will be spread over the plan period.

Grand total

The budget requested from donors for strengthening maize and cassava research in Nigeria is US$ 989 100.

Table 1. Budget for cassava and cassava-based production systems, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Equipment:						
Growth chambers/ glass house	20 000	-	-	-	-	20 000
Insectary	16 000	-	-	-	-	16 000
4WD vehicles	30 000	-	-	-	-	30 000
Operations:						
Cassava breeding	14 000	14 000	14 000	15 000	15 000	72 000
Biological control	38 000	22 000	22 000	22 000	23 000	127 000
Production systems	15 000	15 000	5 000	5 000	5 000	45 000
Processing/utilization	9 000	9 000	7 000	1 000	1 000	27 000
Training:						
MSc	40 000	40 000	-	-	-	80 000
PhD	-	-	20 000	20 000	20 000	60 000
Technicians	7 500	7 500	5 000	5 000	5 000	30 000
Total	189 500	107 500	73 000	68 000	69 000	170 000
Inflation/contingencies (5%)	9 475	5 375	3 650	3 400	3 450	25 350
Grand total	198 975	112 875	76 650	71 400	72 450	532 350

Table 2. Budget for increasing maize production in Nigeria, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Equipment:						
Screenhouse	18 000	-	-	-	-	18 000
Irrigation	40 000	-	-	-	-	40 000
Generator	10 000	-	-	-	-	10 000
Processing:						
Drying units	30 000	-	-	-	-	30 000
Shellers	30 000	-	-	-	-	30 000
4WD vehicles	30 000	-	-	-	-	30 000
Operations:						
Storage improvement	10 000	10 000	10 000	10 000	10 000	50 000
Soil productivity	4 000	4 000	4 000	4 000	4 000	20 000
Recipe book	-	-	7 000	1 500	1 500	10 000
Training:						
MSc	40 000	40 000	-	-	-	80 000
PhD	-	-	20 000	20 000	20 000	60 000
Technicians	7 500	7 500	5 000	5 000	5 000	30 000
Total	219 000	61 500	46 000	40 500	40 500	435 000
Inflation/contingencies (5%)	12 325	3 075	2 300	2 025	2 025	21 750
Grand total	258 825	64 575	48 300	42 525	42 525	456 750

Sierra Leone

National research priorities identified at the Lomé meeting (April 1988)

Maize and cassava improvement

1. Cassava and maize improvement through the introduction of exotic germplasm, screening on station at different locations, and on-farm testing.
2. Research on post-harvest technology, especially local storage methods.

Cassava and maize processing

Development of small-scale processing units for use at village level.

Production systems (sustainability)

Establishment of alley cropping trials on-station and on-farm and research into the sustainability of production systems.

Contribution of the IARCs

1. The IARCs should continue to introduce new germplasm.
2. They should continue their training programs.
3. They should help identify sources of funding.
4. They should provide consultant scientists and technicians.
5. They should provide assistance in the dissemination of information.

Contribution of donors

1. Funds for on-farm research.
2. Training.
3. Provision of scientific and technical equipment.
4. Exchange programs and visits to review and plan activities.

Projects selected as essential at the Ibadan meeting (September 1988)

Because maize is a crop of minor importance in Sierra Leone, the projects selected as essential concern cassava only. Although cassava is the country's second most important food crop after rice, research on it has so far been modest. The projects, which are intended to place cassava research on an equal footing with that of rice, are as follows:

1. Cassava improvement through the introduction of exotic germplasm.
2. Development of improved post-harvest technology, especially storage at village level.

Objectives to be achieved over a 5-year period

Operationally, Sierra Leone will, by the end of the 5-year period, have a greatly strengthened national cassava research team. Six professionals (one being part-time) and 10 technicians are currently engaged in research to improve cassava production, while five professionals (including one part-time) and five technicians conduct research on the storage and processing of cassava and other food products. In 5 years, the numbers of research personnel and support staff will have risen to eight professionals and 13 technicians for cassava production, and seven professionals and seven technicians for post-harvest technology. These increases will result from training two scientists to MSc level and two to PhD level. In addition, 20 technicians will be trained. Training at post-graduate level will be obtained both within and outside Africa, while that for technicians will be obtained at IITA, or at an IITA-supported regional training centre. Infrastructural improvements will be made at the Njala and Rokupr Stations in order to create a satisfactory working environment. A national network for on-farm testing will have been established.

As regards research results, new varieties of cassava will have been released that have good disease and pest resistance, are more acceptable to consumers, and are adapted to various cropping systems and environments. Work on post-harvest technology will have led to the development of more efficient methods for storing and for processing cassava into a range of products with longer shelf life. These results will lead, in the long term, to increased labor and land productivity. A surplus may become available for export.

National resources

Personnel. The government will maintain its current research team, adding an agronomist, a socio-economist and three technicians to work on crop production, and an agricultural engineer, a processing specialist and two technicians for post-harvest research.

Infrastructure. The Njala Station, where the ACRE project was located, is to be upgraded to a major research institute. Two laboratories will be added, one for crop analysis and one for research on post-harvest technology. At the Rokupr Station, also recently upgraded, a laboratory for research on processing will be constructed. Attempts will be made to ensure a continuous supply of electricity at both stations. A 200-ha rice farm attached to Rokupr will be made operational. The proceeds from the production of rice and other crops will be used as operational funds for research and for infrastructural development. The government has agreed to this scheme, which is intended to reduce dependence on government financing. At Njala, cassava cuttings and seeds of sweet potato and maize will be sold to generate funds.

Equipment. To assist station development, the government has agreed to provide four tractors together with implements for Rokupr and two for Njala. In addition, 10 small-scale hand-operated power tillers will be made available. It is expected that one four-wheel drive vehicle will be acquired from the government. However, no equipment for research on storage and processing will be provided.

Operating funds. For Rokupr , the operational budget request for 1988-89 is US$ 73 333, about 20% of which should go to cassava and maize. For Njala, US$ 50 000 has been requested, 60% of which is for maize and cassava. Only about 25% of the total request is expected to be honored, bringing operating funds for cassava and maize research to a total of US$ 11 167 (US$ 3667 at Rokupr and US$ 7500 at Njala). These dollar values are expected to remain constant over the coming years.

Resources requested from donors

No donor support is currently provided for research on cassava improvement, storage and processing. Faced with a severe economic crisis, the government urgently requests support from the donor community for this essential research on the production of a major food staple.

Expatriate personnel. A total of 2.5 person-months of visits from IITA scientists is requested over the plan period. Most visits will be 1- to 2-week consultancies. The major areas covered will be breeding, plant protection, agronomy, food technology and nutrition.

Equipment. Three four-wheel drive vehicles are requested, two in year 1 and one in year 3, and 20 motorcycles (for technicians). Two diesel generators, 10 knapsack sprayers, two greenhouses (one at each research station), two microscopes, three microcomputers, two ridgers, two slide projectors and equipment for a food technology laboratory are also requested. One of the microcomputers will be used for administration at the NARCC Secretariat, which will coordinate research at the two institutes. The equipment for the food technology laboratory consists of such items as ovens, sieves, weighing equipment, drying equipment, analysis equipment and cassava graters.

Operations. Taking into account present staff availability, the years during which staff will be away on training, a contribution of US$ 10 000 per annum from the government and US$ 10 000 per annum from proceeds of the rice farm, operating funds are needed for 45 person-years over the 5-year period, or US$ 450 000. This is a large sum, but it is in line with the staff numbers at the two research stations.

Training. According to the training plan, two scientists will be trained in Africa to MSc level and one to PhD.level; one will be trained to PhD level in Europe/USA. The costs of training 20 technicians are estimated at US$ 1500 per month per technician over a 3-month period; with air travel expenses added, the total amount is US$ 5000 per technician.

Grand total

The total budget request to donors for strengthening cassava research in Sierra Leone over the plan period is US$ 1 035 195.

Table 1. Budget for strengthening cassava research in Sierra Leone, in US$.

Items	Year 1	Year 2	Year 3	Year 4	Year 5	Total
IITA visits	7 500	7 500	7 500	7 500	7 500	37 500
Equipment:						
4WD vehicles	30 000	-	15 000	-	-	45 000
Motorcycles	22 000	-	10 000	8 000	-	40 000
Diesel generators	50 000	-	-	-	-	50 000
Knapsack sprayers	5 000	5 000	-	-	-	10 000
Screenhouses	10 000	-	-	-	-	10 000
Greenhouses	16 000	-	-	-	-	16 000
Microscopes, etc	8 000	-	-	-	-	8 000
Ridger	10 000	-	-	-	-	10 000
Food technology laboratory	20 000	-	-	-	-	20 000
Slide projectors	400	-	-	-	-	400
Operations:						
Cassava production	50 000	40 000	50 000	50 000	60 000	250 000
Storage and processing	30 000	30 000	40 000	50 000	50 000	200 000
Training :						
MSc	15 000	30 000	15 000	-	-	60 000
PhD	20 000	35 000	35 000	15 000	-	105 000
Technicians	20 000	20 000	20 000	20 000	20 000	100 000
Total	337 900	167 500	192 500	150 500	137 500	985 900
Inflation/contingencies (5%)	16 895	8 375	9 625	7 525	6 875	49 295
Grand total	354 795	175 875	202 125	158 025	144 375	1 035 195

Togo

Priorités retenue à la réunion `a Lomé (avril 1988) pour la recherche nationale

Maïs

1. **Amélioration variétale.**
2. **Résistance aux parasites et maladies.**
3. **Fermeture des épis.**
4. **Variétés à cycle court.**

Manioc

1. **Collection et évaluation du germplasme local.**
2. **Résistance aux parasites et maladies.**
3. **Faible teneur en HCN.**
4. **Technologies post-récoltes.**

Systèmes de production (pérennité)

Etude des systèmes faisant intervenir maïs et manioc.

Structure et gestion de la recherche agronomique

1. **Meilleure collaboration entre organismes dépendant de tutelles différentes et collaboration étroite avec les organismes de développement.**
2. **Création d'un Comité de recherche sur les systèmes de production.**

Formation

Assurer la mise en place ou le recyclage du personnel scientifique nécessaire pour les programmes de recherche.

Ressources et soutien des donateurs

Malgré le nombre insuffisants de chercheurs, les moyens financiers dont ils disposent sont trop faibles pour être efficaces. D'où la nécessité de recevoir des fonds additionnels dans les différents postes de dépenses, de coopérer avec les pays voisins pour améliorer les ressources opérationnelles par une répartition des coûts fixes et d'assurer une plus grande souplesse pour l'utilisation des crédits.

Projets retenus comme essentiels à la réunion à Ibadan (septembre 1988)

Trois projets ont été retenus comme étant indispensables au développement des cultures intéressées.

Maïs

Amélioration variétale. Création synthétique de variétés à cycle court, à spathes fermées, à grains de texture farineuse, résistantes à la striure. Le volet pour la résistance au streak se poursuivra avec le renforcement du volet élevage de cicadelles.

Manioc

Amélioration variétale. Evaluation variétale pour criblage sur la base des critères suivants:
résistance aux maladies et parasites, faible teneur en HCN, bonne aptitude pour le foufou et port érigé du plan convenant à la culture associée.

Systèmes de production (pérennité)

Evaluation des systèmes existants, identification de techniques agronomiquement et économiquement viables.

Objectifs à atteindre après 5 ans

Au niveau de la recherche agronomique:

1. **Renforcement de la capacité de recherche des structures togolaises. Renforcement des relations entre les programmes nationaux, les CIRA et les pays membres des réseaux SAFGRAD et CORAF.**

Au niveau des résultats de la recherche:

2. **Les résultats des études sur les systèmes de production doivent permettre une meilleure adaptation des techniques aux conditions du milieu et faciliter le transfert en milieu paysan.**

3. **Pour le maïs, une vingtaine de variétés résistantes à la striure, productives, devraient pouvoir être mises à la disposition des utilisateurs. De telles variétés devraient intéresser les pays voisins, tandis que les mécanismes génétiques des caractères étudiés seront mieux compris.**

4. **Pour le manioc, la sélection de variétés résistantes à la cochenille et l'acarien vert, de faible teneur en HCN, permettra de fournir aux consommateurs des produits de qualité aptes à la fabrication du *foufou*, de *gari* etc.**

Effort national

Maïs

Personnel. Six chercheurs ou techniciens supérieurs et 30 agents d'exécutions.

Infrastructure. Construction récente de la station d'Ativémé utilisée conjointement pour le maïs et les tubercules.

Equipements. Certains équipements ont été fournis en même temps que la station; d'autres devront être achetés.

Fonctionnement. Vingt pour cent du budget nécessaire est disponible, d'où la nécessité pour obtenir les équipements et les moyens supplementaires nécessaires, de se tourner vers l'aide extérieure.

Manioc

Personnel. Equipe de recherche: six; personnel d'exécution: 15.

Infrastructures. *Voir* maïs pour la station d'Ativémé. Les études sur le manioc bénéficient aussi des stations de Togodo, Soutouboua et Dayes.

Equipements. Surtout matériel de transformation.

Fonctionnement. Très insuffisant aussi.

Systèmes de production

Personnel. Non-identifié, le programme n'ayant pas débuté. Ceci est aussi vrai pour les autres rubriques, et la mise en place de ce programme repose sur la collaboration active de l'extérieur.

Efforts demandés aux donateurs

A part le début du programme manioc (phase projection et mise en place de la collection), financé par la CEE et le FAC à la CEE et le FAC à hauteur de $US 46 000, et la construction de la station d'Ativémé à laquelle le FAC a participé pour $US 400 000, les actions retenues n'ont pas de soutien extérieur.

Maïs

Personnel. Aucuns fonds demandés aux donateurs sous ce rubrique.

Equipement. Serre pour l'élevage des cicadelles; renforcement des installations d'élevage; système d'irrigation; véhicule break ou bâché.

Fonctionnement. Pour trois scientifiques.

Formation. Longue durée: un agronome, 2 ans; courte durée: niveau chercheurs: un agro-éeconomiste, 5 mois; niveau technicien: un informaticien: 5 mois; un biométricien: 5 mois; un sélectionneur: 5 mois.

Manioc

Personnel. *Voir* Systèmes de production.

Equipements. Equipement laboratoire, matériel de station, et véhicule 4 x 4 de tournée.

Fonctionnement. Pour quatre scientifiques.

Formation. Longue durée: un sélectionneur niveau DEA, 3 ans. Courte durée: niveau chercheur: un biometricien, 5 mois; un pathologiste, 5 mois; niveau technicien: un technicien de labo, 5 mois;
un sélectionneur, 5 mois; deux voyages d'études dans la sous-région pour les transformations aprés récoltes.

Systèmes de production

Personnel. Affectation d'un agro-économiste IITA pour prendre la suite dans la zone maïs-manioc d'un assistant technique prévu en 1989-1990 sur le programme vulgarisation agricole. Ce chercheur devra assurer la mise au point du programme et la formation sur le terrain des équipes.

Montant total

Pour tous ces programmes, une documentation de base est demandée. Le total de l'effort souhaité est de $US 950 985.

Tableau 1. Amélioration du maïs au Togo: budget demandé aux donateurs (en $US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	-	-	-	-	-	-
Equipement:						
Serres, installations d'elevage, irrigation	32 700	19 000	19 000	-	-	70 700
Véhicule break ou bâché	15 000	-	-	-	-	15 000
Fonctionnement	30 000	30 000	30 000	30 000	30 000	150 000
Documentation	2 000	2 000	2 000	2 000	2 000	10 000
Formation	15 000	7 500	27 500	20 000	-	70 000
Total	94 700	58 500	78 500	52 000	32 000	315 700
Inflation et imprévus (5%)	4 735	2 925	3 925	2 600	1 600	15 785
Total général	99 435	61 425	82 425	54 600	33 600	331 485

Tableau 2. Etudes manioc et systèmes de production au Togo: budget demandé aux donateurs (en $US).

Rubrique	Année 1	Année 2	Année 3	Année 4	Année 5	Total
Personnel IITA	-	-	125 000	125 000	-	250 000
Equipement:						
Laboratoire	7 000	3 000	-	-	-	10 000
Matériel de station	5 000	-	-	-	-	5 000
Véhicule 4x4	15 000	-	-	-	-	15 000
Fonctionnement	40 000	40 000	40 000	40 000	40 000	200 000
Documentation	2 000	2 000	2 000	2 000	2 000	10 000
Formation:						
Maîtrise	-	-	20 000	20 000	20 000	60 000
Technicien	15 000	7 500	7 500	-	-	30 000
Voyage d'études	-	-	5 000	5 000	-	10 000
Total	84 000	52 500	199 500	192 000	62 000	590 000
Inflation et imprévus (5%)	4 200	2 625	9 975	9 600	3 100	29 500
Total général	88 200	55 125	209 475	201 600	65 100	619 500

Appendix 3

GUIDELINES FOR DRAWING UP NATIONAL PROPOSALS

This set of guidelines was drawn up before the second visit by the Task Force consultants to the countries participating in the initiative; within the framework of these guidelines, the national proposals were compiled.

1. The plan is to be implemented over a 5-year period.
2. All values are expressed in US $.
3. The allowance for inflation and other contingencies is 5% per annum.
4. Major infrastructures (such as buildings and new experiment stations) are outside the scope of the plan.
5. Topping up the salaries of local personnel and the recruitment of additional permanent local staff is excluded from the plan. However, occasional and casual labor costs are within the scope of the plan.
6. The plan is limited to strengthening research on maize and cassava.
7. In the budget proposals, on-going activities which are planned or foreseen should be taken into account as far as possible in order to avoid duplication.
8. Minimum operating funds for a researcher are estimated at $10 000 per annum.
9. An IITA senior researcher posted to a participating country costs $ 125 000 per annum; short-term consultancies cost $ 15 000 per month.
10. The cost of MSc or PhD scholarships is estimated at $ 20 000 per annum.
11. Costs for MSc and PhD training should be calculated on the basis that the former takes 2 years and the latter takes a further 3 years.
12. Training technicians at IITA costs $ 1500 per month, excluding an allowance for international travel.
13. Networking, including seminars and workshops, will be part of the plan and should not be included in the national proposals.
14. Contributions from IARCs such as ISNAR should be listed as p.m.
15. Costs for work to be done at IITA Headquarters should not be included if such work is already part of the Medium Term Plan.
16. Specialized equipment can be included if it is necessary to achieve high priority research objectives. The training needed to operate such equipment should also be part of the budget.
17. Vehicles or transport equipment should be listed in a separate category. The budget cost for vehicles is estimated at $ 15 000 per unit.