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REPUBLIC OF CAMEROON
MINISTRY OF HIGHER EDUCATION, COMPUTER SERVICES AND SCIENTIFIC RESEARCH
(MESIRES)
INSTITUTE OF AGRICULTURAL RESEARCH
(IRA)

# National Cereals Research and Extension Project (NCRE)

# Four Year Work Plan 1991-1994

United States Agency for International Development
(USAID)
Institute of Agricultural Research
(IRA)
International Institute of Tropical Agriculture
(IITA)

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Perhaps the greatest contributions to the success of the NCRE Project have come from the farmers of Cameroon. Without their cooperation and receptiveness, this project could not have been successful. To them we say thank you.

# INTRODUCTION

The purpose of the National Cereals Research and Extension (NCRE) Project is to develop Cameroonian institutional capacity to provide high quality research on cereals and to develop necessary linkages between farmers and researchers to facilitate the transmission of research results.

The NCRE project is co-sponsored by the Government of the Republic of Cameroon and the United States Agency for International Development (USAID). Through the NCRE Project, the International Institute of Tropical Agriculture (IITA) has been contracted to provide technical assistance to the Institute of Agricultural Research (IRA) since 1981. IITA technical assistants work collaboratively with IRA national counterparts in cereals breeding, agronomy, farming systems research and pre-extension.

This plan of work gives the basic work plan for the project during the next four years of activities. The report is divided into ten substantive chapters, covering project administration, the four commodity research units (Maize, Rice, Cereals and Sorghum/Millet), the Testing and Liaison Units (TLUs) and the support units of economic analysis, pathology and entomology.

The Maize Research Unit consists of the Highland Maize Program based in Bambui and the Lowland Maize Program at Nkolbisson. The Rice Research Unit encompasses a Rice Breeding Program based at Dschang Garoua and Maroua. The Cereals Agronomy Research Unit consists of a single research program based at Garoua. The Sorghum and Millet Research Unit has a breeding program at Maroua. Testing and Liaison Units are the farming systems research and extension component of the project. There are four TLUs based at Bambui (Western Highlands), Ekona (Humid Forest), Maroua (Sudano-Sahelian) and Nkolbisson (Semi-humid forest).

During these four years three new units will function as part of the project: The Economic Analysis Unit at Nkolbisson, Soil Agroforestry Unit at Bambui and the Legume Unit at Maroua.

In addition to these programs there are support units within IRA such as plant pathology (Bambui) and cereals entomology (Dschang and Nkolbisson) which work with several cereal crops.

Each program has prepared a summary of unit plans, details of their strategic approach to solving problems in their domain, a list of Operations, Objectives and Indicators of Progress for their program and finally the expected costs and impact of their activities. This last section is the most important and will serve as a basis to judge efficiency of each programs resource allocation and effectiveness. The report format is designed to integrate with the reporting format adopted by IRA.



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## EXECUTIVE SUMMARY

The NCRE Project is now in its phase-out period. During the next four years all expatriate researchers will be replaced by trained IRA researchers. Emphasis during these four years will be on extending existing research to farmers and handing over research operations to national counterparts.

Both Highland and Lowland Maize Breeding programs will continue their variety development operations. They will place increased emphasis on maintenance of breeder and foundation seed supplies. The Highland program will introduce streak virus screening. Lowland Maize Breeding will continue to concentrate on resistance and tolerance to Striga, drought and acid soil tolerance.

The Rice Research Unit at Dschang will reduce its operations as emphasis is shifted to the north at Maroua and Garoua. It will continue to concentrate on varieties for the Mbo and Ndop plains. Activities in Maroua will be expanded to increase work on variety development and testing as well as cultural management. The areas of major production in the north are Yagoua, Maga and Kousseri.

The Cereals Agronomy Unit at Garoua will continue work on Maize and Sorghum Agronomy research but on a reduced scale. Work will be increased on soil conservation and Striga control.

Sorghum and Millet research will continue at a reduced level of activity in Maroua. Hybrid development has been reduced but Striga and drought tolerance research continue for Sorghum. Work to find short cycle and non-photoperiod sensitive Pearl Millet lines continue.

The Bambui TLU will give more emphasis on soil conservation and soil fertility improvement. Survey work will continue but with emphasis on assessing technology retention, diffusion and impact.

During 1991-1994 the basic approach of the Ekona TLU will continue to be a combination of on-station trials, researcher and farmer managed trials in focus villages, and minikit distribution. Increased emphasis will be given to biological technologies for enhancing and sustaining farm productivity through agroforestry and fallow management studies.

Although on-farm testing of improved technologies remains the main thrust of Maroua TLU activities, diagnostic studies of existing farming systems will be initiated. Special purpose surveys will give more emphasis on technology verification such as regional testing, minikits and adoption studies.



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The Nkolbisson TLU has begun shifting the emphasis of its program from varieties and external inputs to low input, sustainable technologies such as agroforestry and planted fallow. It will continue with selected diagnostic surveys but with emphasis on technology verification and promotional activities.

The Economic Analysis Unit is a new program. The top priority of the unit is to carry out economic studies for institute-level priority setting and programming and to measure research benefits. It will also assist IRA researchers through research collaboration, advisory services and training.

The Bambui Soils/Agroforestry Unit is also a new program within NCRE. It will work on six agro-ecological sites to determine the site characterization, species evaluations and management of soil fertility and crops. Prototype trials will be developed to evaluate agroforestry alternatives.

The Grain Legume Research Unit at Maroua is new within NCRE but complements work started under a Bean Cowpea CRSP. Research in this unit will concentrate on breeding Cowpeas resistant or tolerant to insects, Striga and diseases. Attention will also be given to dual purpose varieties and seed quality.

Work in the Plant Pathology unit at Bambui will continue on Maize, Sorghum and Millet. Activities will focus on development of varieties resistant to blights, leaf spots and stalk and ear rots. Epidemiology studies of smuts, downy mildew and dead heart will be initiated for both maize and sorghum.

Cereals entomology in the highland location at Dschang will give more attention to the use of natural plant materials for stored grain protection. Laboratory methods for rapid screening of varieties for stored grain insect resistance will be introduced. The lowland cereals entomology unit will give more emphasis on identifying and establishing the role of natural parasites and predators on the suppression of pest populations and to screen maize varieties for resistance to insect pests. Less emphasis will be placed on cultural practices and chemical control.



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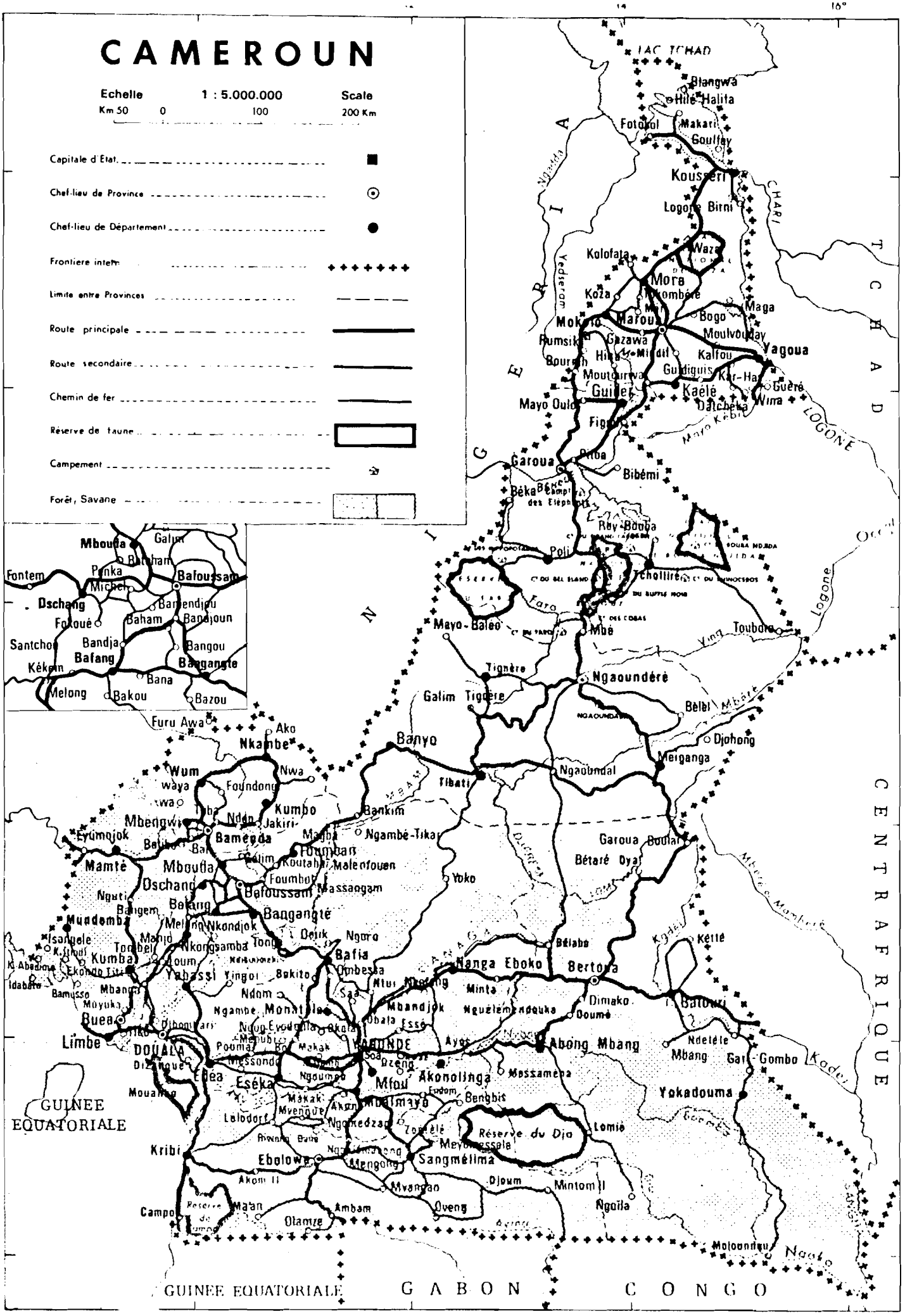


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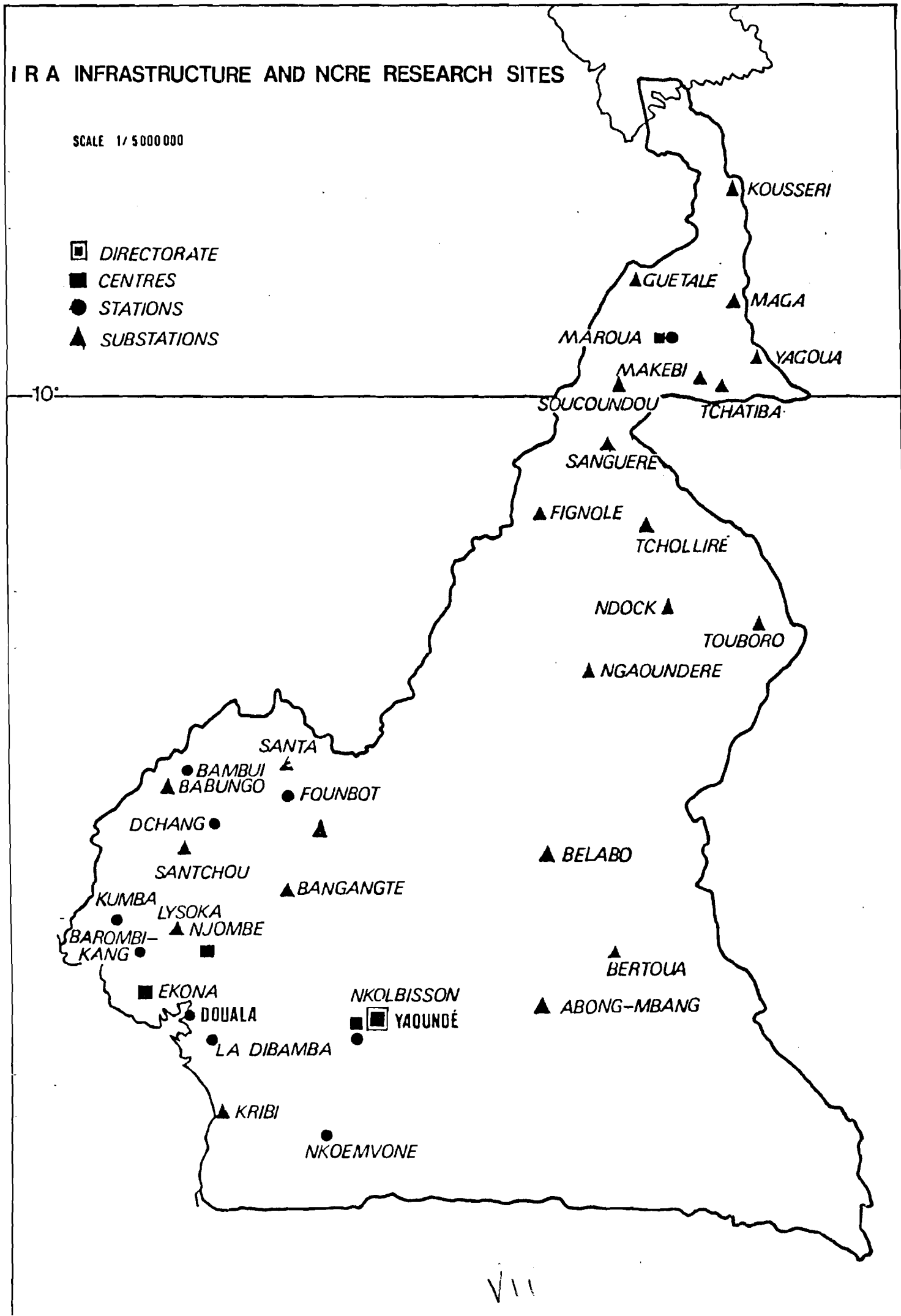
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# DISTRIBUTION MAP OF THE MAIN CEREAL PRODUCING AREAS IN CAMEROON

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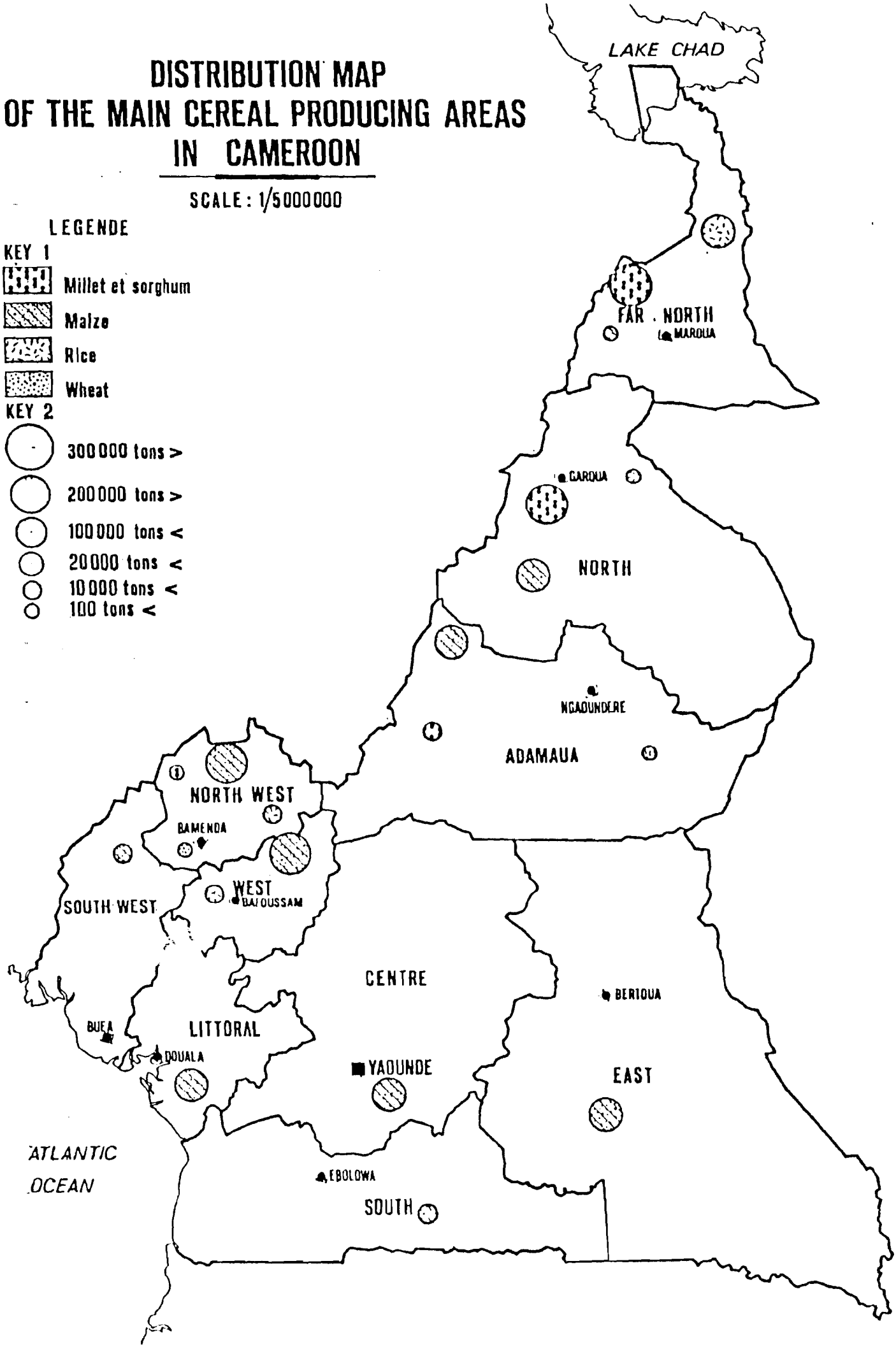

# 1. ADMINISTRATION

## 1.1 IN[illegible]DUCTION

The NCRE Administration is responsible for administrative coordination of the project. Primary activities are centered at Nkolbisson. Administrative staff at each NCRE location are supervised by NCRE staff at their respective locations.

The overall goal of project administration is to assist researchers in their achievement of project goals and objectives. The administration also maintains liaison among the sponsoring organizations; IRA, IITA and USAID. The project administration consists of the Chief of Party, Deputy Chief of Party and Administrative officer. The Administrative officer is in charge of daily details of accounting, inventory and staff supervision. The Deputy Chief of Party coordinates publications, counterpart training, and reports. The Chief of Party is in charge of overall project coordination and staff productivity.

During the first 10 years of project activities the administration concentrated on addition of programs and streamlining administrative procedures for an increasing number of technical staff. During the period 1991-1994 emphasis will be placed on phasing out of expatriate staff and takeover of existing programs by IRA researchers.

A major constraint determinant to the success of this phase will be the amount of budget available to IRA. Lowered program expenditures are expected after the end of NCRE funding but the exact level is not known at this time.

## 1.2 STRATEGIC APPROACH

Administration interfaces with four organizations: IRA, IITA, Winrock and USAID. Financial reporting is done directly to IITA who then reports to USAID. Technical assistance is primarily the responsibility of individual research programs of IITA. Management of purchasing and long term degree training is coordinated through Winrock International. USAID-Yaounde is concerned with larger management issues and project performance. All aspects of project performance and management are coordinated with IRA-Nkolbisson.

Detailed plans have been developed to phase-out expatriates and hand over research programs to national researchers. Program budgets are also coordinated with the phase out plan. Project work plans and reports will be compatible with IRA plans and reports. Greater emphasis will be placed on results which can be applied by farmers and actual adoption of technology. Publication of results in researcher and farmer oriented formats will be encouraged.



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## 1.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Planning and supervision of project performance. | 1.1 Publish reports of work to be done and work accomplished. | 1.1 Publish Annual Work Plans, Semi-Annual Progress Reports and Annual Reports. |
| | 1.2 Review work in progress. | 1.2 Regular field visits and meetings with counterparts. |
| | 1.3 Review work in progress with IRA and USAID officials. | 1.3 Present reports and regular field visits. |
| | 1.4 Plan project actions involving IRA officials. | 1.4 Daily consultation. |
| | 1.5 Consult with IITA and Winrock staff. | 1.5 At least bi-monthly or yearly meetings. Arrange Consultant visits. |
| 2. IRA counterpart training. | 2.1 Determine short term training needs and plans. | 2.1 Arrange IITA visits and course participation by counterparts. |
| | 2.2 Determine long term training needs and plans. | 2.2 Arrange in-country preparation for degree training. Liaise with Winrock and counterparts during university degree training. |
| 3. Financial and materials management. | 3.1 Researchers have adequate funds for research. | 3.1 All imprest accounts have sufficient cash on hand. |
| | 3.2 Expenditure of project funds properly documented. | 3.2 Monthly expense reports filed as required. |
| | 3.3 Needed equipment is ordered and received. | 3.3 Purchase orders prepared and equipment distributed. |
| | 3.4 Equipment use is properly documented. | 3.4 Inventory and use records kept up to date. |
| 4. Publication of results. | 4.1 Publications available for researchers and farmers. | 4.1 Farmer information leaflets and research bulletins available. |



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## 1.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Timeframe |
|---|---|---|---|---|---|---|
| 1.1 | 300 | 10 | 10 | na | na | na |
| 1.2 | 1,500 | 5 | 10 | na | na | na |
| 1.3 | 500 | 5 | 0 | na | na | na |
| 1.4 | - | 10 | 0 | na | na | na |
| 1.5 | 5,000 | 4 | 0 | na | na | na |
| 2.1 | 5,000 | 5 | 0 | na | na | na |
| 2.2 | 10,000 | 10 | 95 | na | na | na |
| 3.1 | - | 1 | 0 | na | na | na |
| 3.2 | 2,000 | 20 | 10 | na | na | na |
| 3.3 | 30,000 | 10 | 90 | na | na | na |
| 3.4 | 500 | 10 | 0 | na | na | na |
| 4.1 | 3,000 | 10 | 10 | na | na | na |

## 2.1 HIGHLAND MAIZE BREEDING

### 2.1.1 INTRODUCTION.

The highland Maize Breeding Unit is responsible for the development of varieties adapted to improved and current farming systems between 1000 and 2500 meters of altitude. The target zones are found in the Northwest, West and Adamawa Provinces and include a large range of soil types and farm sizes. The Western Highland, comprising the North West and West Provinces, cover less than 10% of the land area in Cameroon, but contain 25% of the population, and produces over 60% of the national maize crop.

The goal of the unit is to further develop a comprehensive breeding program which will continuously provide seed of new varieties to the seed multiplication and distribution organizations, well past 1994. Past work by this unit has emphasized basic germplasm development which has been improved to the point of producing open-pollinated, hybrid and synthetic varieties. After confirmation by the TLU, the best of these varieties will be available for foundation seed production.

While the unit has in recent years put an emphasis on selecting inbred lines for hybrids, we will gradually return the emphasis to population improvement. The proposed installation of a maize streak virus screening facility means an emphasis will be placed on developing virus resistant germplasm.

The rapid spread of varieties in farmer fields depends in large part on the ability of the seed production system to provide sufficient quantities of good quality seed, and of the extension system to disseminate the seed and the appropriate information on its use. The success of hybrids in Cameroon is likely, in the next four years, to depend on the success of the private seed industry in the country. The success of the streak screening nursery will depend on the ability of national scientists to learn the necessary techniques and to manage the facilities. Guidance for this will be provided by the TA with technical backstopping provided by IITA.

### 2.1.2 STRATEGIC APPROACH

Highland maize breeding is aimed at two major research domains comprising the high altitude (1600-2400m) zone of the Western Highlands and the mid-altitude (1000-1600) zones of the three target provinces. The mid-altitude zone can be further subdivided into high fertility and acid, P-fixing, soils.

The approach used in strengthening the breeding program will include the introduction of new early maturing germplasm, the use of recurrent selection (including streak screening) to improve source populations and the use of ear-to-row selection to maintain breeder seed of existing varieties. The hybrid program will consist, predominantly, of testing the recently selected inbred lines in test cross, preliminary hybrid and advanced hybrid trials.

While certain selection criteria, such as tight ear husk cover, leaf disease resistance and flinty grain will be common to populations targeted to all zones, other criteria will be target zone specific. Selection for tolerance to acid soils will be applied only to certain populations, and grain color will depend on the preferences of the consumer in the target zones, as identified by the TLU.

The shift in strategic approach away from testing inbred lines for hybrids and towards improving open-pollinated source populations will eventually lead to release of better open-pollinated varieties, but will also allow, in the future, for inbred line extraction for synthetics and hybrids. Particular emphasis will be given over the next four years to breeding for early maturity, establishing routine maize streak virus screening, and to better understanding how to select for the difficult soils of the highlands.

### 2.1.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Develop germplasm. | 1.1 Introduce and screen early, mid-altitude germplasm. | 1.1 Best adapted material identified and recombined by 1993. |
| | 1.2 Convert open-pollinated and synthetic varieties to streak resistance and differentiate by grain color. | 1.2 Kasai and coca converted to SR by 1992. ATP Early white, Synthetic 3 and Synthetic 4 converted by 1993. HAP, Early White and synthetic 4 color conversion by 1993. |
| | 1.3 Improve acid tolerant,32,43 SR and early white source populations by recurrent selection. | 1.3 Second cycles of selection begun by 1994. |
| 2. Test varieties and hybrids. | 2.1 Identify open-pollinated varieties for TLU to test in high and mid altitudes | 2.1 Test new synthetics and converted varieties in 1993. |
| | 2.2 Identify hybrids and /or inbreds for pilot production. | 2.2 Propose 1 to 4 new hybrids per year. |



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| Operations | Objectives | Indicators |
|---|---|---|
| 3. Maintain true-to-type breeder seed of best varieties and inbreds. | 3.1 Maintain seed of existing "released" highland varieties. | 3.1 Production of 100 kgs of Coca, Bacoa, Kasai and Shaba each year. |
| | 3.2 Describe and "release" best new open-pollinated varieties. | 3.2 Preparation of "fiches techniques" for ATP, Early White HAP, and Synthetic 3 by 1992 and others as they are "released". |
| | 3.3 Produce sufficient seed of new varieties, hybrids and inbreds for TLU testing and variety maintenance. | 3.3 Produce 100 kgs of ATP, Early White, HAP, Synthetic 3 and Synthetic 4 each year. Produce 10-25 kgs of new hybrids for testing by TLU. |

### 2.1.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Time Frame |
|---|---|---|---|---|---|---|
| 1.1 | 1,235 | 10 | 70 | 20,000 | 50,000 | 8-18 |
| 1.2 | 1,850 | 15 | 50 | 30,000 | 50,000 | 7-17 |
| 1.3 | 1,850 | 15 | 60 | 30,000 | 50,000 | 7-17 |
| 2.1 | 3,303 | 10 | 60 | 30,000 | 50,000 | 3-13 |
| 2.2 | 2,470 | 20 | 60 | 10,000 | 100,000 | 4-14 |
| 3.1 | 826 | 10 | 90 | 30,000 | 50,000 | 0-5 |
| 3.2 | 200 | 5 | NA | NA | NA | NA |
| 3.3 | 1,032 | 15 | 80 | 40,000 | 50,000 | 1-9 |

## 2.2 LOWLAND MAIZE BREEDING

### 2.2.1 INTRODUCTION

The Lowland Maize Breeding covers all areas in Cameroon that are less than 1000m above sea level in elevation. The main objective is to provide farmers with acceptable high yielding and stable varieties in each of the agro-ecological zones.

Up to 1990 more than 10000 new genotypes had been tested. 87% of those genotypes were created by the program. Two varieties have undergone international testing in 1989 and 1990. From 1991 to 1994, there will be a 20% reduction in the number of introductions. In addition an effort will be made to create varieties with special purposes e.g. Striga tolerant, drought tolerant, acid tolerant soft endosperm and high yielding hybrids, the heterotic group created during the second phase of the project will be refined and used for variety crosses and line development.

From 1991 to 1994, emphasis will be put on production and maintenance of quality Breeder and foundation seed. Finally, National as well as international cooperation will received special attention.

### 2.2.2 STRATEGIC APPROACH

The Lowland Breeding Unit comprised four distinct target zones.

I The Lowland Humid Forest
II The Lowland Moist Savanna
III The Sudan Savanna Zone
IV Second Season Maize

In addition to this targeted domain, some emphasis will be made in developing varieties and or hybrids adapted to irrigation for the Agri-Lagdo area. So far, varieties have been developed to suit all these zones. From 1991 to 1994, special attention will be devoted to each area which has a specific problem. e.g. Striga Tolerant varieties will be the main objective in the Moist Savanna Zone and drought tolerant varieties will be made for the Sudan Savanna Zone.

With the creation of a seed industry (Pioneer Seed Company) in Garoua and with the development of Maïs-Cam using maike to made corn oil and grits for brewery, it's expected that more medium size farms will be created. Therefore, more time will be devoted during 1991 to 1994 to inbred/hybrid development. All developed inbred lines will be screened for tolerance to striga, drought and acid soil. In addition they will be recombined in heterotic pools for further uses.

Population improvement will continue. Besides $S_1$ and Half-Sib improvement schemes, the use of complementary inbred lines will be increased to improve on agronomic characteristics and or yield potential of released varieties.



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- Cooperation with IITA will be stepped up in screening for borer and striga tolerance.
- Cooperation with Pioneer Seed Company will also be improved on varietal testing and recommendation as well as in Breeder and Foundation Seed Production.
- Cooperation with Safgrad will be continued through breeding for drought tolerance and for early maize.

### 2.2.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Testing of Introductions. | 1.1 To identify new germplasm. | 1.1 Variety trial on 2 to 4 locations 2 to 4 reps. |
| | 1.2 To identify new trait donor source. | |
| | 1.3 To collect data for international cooperation | |
| 2. Population Improvement. | 2.1 To improve plant and ear aspect, disease resistance, stress tolerance. | 2.1 Better varieties with better agronomic characteristics. |
| | 2.2 To develop new experimental varieties. | 2.2 Increase in total yield. |
| | 2.3 To increase yield potential. | |
| | 2.4 To develop drought tolerant varieties. | |
| 3. Inbred Line Development. | 3.1 To identify or select new trait donor sources | 3.1 Inbred lines evaluation under different biotic and abiotic stress. |
| | 3.2 To improve the genetic background of heterotic pools. | 3.2 Combining ability studies. |
| | 3.3 To improve populations already released by introduction of complementary genes. | 3.3 Variety cross trials. |

| Operations | Objectives | Indicators |
|---|---|---|
| | 3.4 To develop Synthetic varieties. | 3.4 Hybrid trials and variety trial. |
| | 3.5 Hybrid development. | 3.5 Testcross evaluation. |
| 4. Special Maize. | 4.1 To create soft endosperm maize. | 4.1 Evaluation of maize quality. |
| | 4.2 To create a variety adopted to intercropping. | 4.2 Intercropping Agronomic Trial. |
| | 4.3 To create acid tolerant pool. | 4.3 Feeding test in collaboration with IRZ. |
| | 4.4 Pop corn and Sweet corn. | |
| | 4.5 Maize for Brewery | |
| | 4.6 Maize for feed (O.P.M) | |
| 5. National Varieties Trials. | 5.1 To identify variety for release. | 5.1 Variety trials on 10 to 16 locations. |
| | 5.2 To collect data for scientific papers. | 5.2 Acceptance trial by the TLU. |
| | 5.3 To test stability of new varieties. | 5.3 Recommendation by evaluation team. |
| 6. Breeder Seed and Foundation Seed. | 6.1 To maintain the purity of released varieties. | 6.1 Quantity and quality of seed available. |
| | 6.2 To produce enough seed for Agronomic and on farm trials. | |
| | 6.3 To supply seed to seed company. | |

### 2.2.4 EXPECTED COSTS AND IMPACT

| Objec-tive | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Ben-efit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1.1 | 300 | 5 | 15 | - | - | - |
| 1.2 | 300 | 5 | 15 | - | - | - |
| 2.1 | 2,000 | 10 | 15 | 70,000 | 100,000 | 0 - 8 |
| 2.2 | 500 | 2 | - | - | - | 0 - 8 |
| 3.1 | 1,500 | 9 | 0 | - | - | - |
| 3.2 | 1,500 | 9 | 10 | 100,000 | 140,000 | 0 - 8 |
| 4.1 | 1,000 | 10 | - | - | - | 0 - 8 |
| 4.2 | 500 | 5 | - | - | - | 0 - 4 |
| 4.3 | 500 | 5 | - | 200,000 | 120,000 | 0 - 4 |
| 4.4 | 500 | 5 | - | 100,000 | 150,000 | 0 - 4 |
| 4.5 | 1,000 | 10 | 20 | 200,000 | 150,000 | 0 - 8 |
| 5.1 | 300 | 5 | - | 20,000 | 50,000 | 0 - 6 |
| 5.2 | 500 | 5 | - | 100,000 | 20,000 | 0 - 5 |
| 5.3 | 300 | 3 | 10 | 20,000 | 30,000 | 0 - 8 |
| 5.4 | 200 | 2 | - | 5,000 | 100,000 | 0 - 4 |
| 6.1 | 800 | 8 | 10 | 200,000 | 40,000 | 0 - 2 |
| 6.2 | 200 | 1 | - | - | - | - |
| 6.3 | 100 | 1 | 50 | - | - | - |

# 3. RICE RESEARCH UNIT

## 3.1 MAROUA RICE

### 3.1 INTRODUCTION

Rice is nowadays, a very common food in our country. It's cultivation is no longer forced by the government, but rather wanted by the peasant who now understand the importance of this cereal. Among the 3 main rice growing organizations, the biggest is based in the Far North province covering about 11,000 ha per crop season. SEMRY based at Yagoua but whose activities cover 3 units of production. Two other units in Garoua were earlier identified by the NCRE rice research team in Dschang. Varietal selection was done by the breeders and some limited agronomic work was also done using the elite selections.

| Units | Area under Production/Season |
|---|---|
| Yagoua | 5,000 ha |
| Maga | 5,500 ha |
| Kousseri | 500 ha |
| Karewa | Unknown |
| Lagdo | Unknown |

The agro-ecological factors here' mainly specially the soil types, the big dam of Maga and the Logone and Chari river are very suitable for irrigated rice. SEMRY produces 3/4 of the total national rice production per annum.

One variety, IR 46, has been grown for more than 13 in Yagoua, Maga and Kousseri. The variety is well adapted, gives high and stable yields but lodges at the maximum fertilizer level. The grain type also makes it less competitive with imported rice. However, varieties tested by the NCRE team formally based in Dschang have some potentials of adaptability not only in the Yagoua area but also in the Karewa/Lagdo area in Garoua.

### 3.2 STRATEGIC APPROACH

According to what we have just mentioned, activities in the next 4 coming years should be based on:

- Identification and confirmation of the performance of potential varieties through observational nurseries, preliminary, advanced and elite yield trials.
- Observations on multilocational trials
- Observations on adaptive farmer's field trials
- Providing information on elite varieties



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- Establishing a program for the maintenance of genetic purity and breeder's seed for elite varieties.
- Fertilizers and fertility management (nitrogen, phosphate, micronutrient response).
- Soil testing for rice production and adapted cropping systems in Yagoua, Kousseri, Maga, Karewa and Lagdo
- Cultural management
- Soil and crop residue management
- Suitable herbicides for effective weed control.
- Appropriate weed management practices for best yield of irrigated rice.

**The characteristics for increased attention would then be:**

- High yield potential
- Tolerance to disease
- Resistance to lodging
- Short/medium duration to allow two crops per year
- Soil testing and management practices
- Rice-based cropping systems.

## 3.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1.1 Hybridization program. | 1.1 To overcome the deficiency of potential lines or existing varieties. | 1.1 Incorporate added resistance or overcome deficiencies of materials already adopted in the country. |
| 2. Observations on multi-locational trials. | 2.1 To evaluate the plasticity of adapted lines from experimental station across the country. | 2.1 Assess adaptability and stability at different locations. |



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| Operations | Objectives | Indicators |
|---|---|---|
| 3. Maintenance of genetic purity and breeder's seed of elite lines. | 3.1 To provide pure seeds to researchers and farmers when necessary. | 3.1 Germplasm conservation. |
| | 3.2 Off-season multiplication of foundation seed for rice, sorghum and maize in Karewa and Lagdo | |
| 4. Soil testing and management. | 4.1 To find best fertilizer products and fertility management, practices for optimum rice yields. | 4.1 Variety nutrient trials in Yagoua, Kousseri, Maga, Karewa and Lagdo |

## 3.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1.1 | 1,000 | 15 | 10 | Parastatals (12.000 ha) | Grain quality improved | 3 |
| 2.1 | 1,000 | 25 | 10 | -"- | | 3 |
| 3.1 | 1,000 | 20 | 10 | -"- | | |
| 3.2 | 2,000 | 10 | 10 | -"- | -"- | -"- |
| 4.1 | 4,000 | 30 | 10 | -"- | 2,5 t/ha over check | 4 |



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## 3.2 DSCHANG RICE

### 3.2 INTRODUCTION

The activities of the Rice Research Unit should be focused on varietal improvement through the development and maintenance of high and stable yielding rice varieties for release to the farmers associated with the SODERIM and UNVDA project, and on the effect of management levels on the cost of cultivation and yield performance of elite rice cultivars. Since the inception of the NCRE Rice Research Program in 1982, the researchers based in Dschang have been conducting rice research in Cameroon. Activities of the team were concentrated at Mbo plain (700m) in the West Province and Ndop plain (1200m) in the North West Province to solve problems that affected rice production in the two rice corporations namely SODERIM and UNVDA, and to a lesser extent at Lagdo (300m) and Yagoua (250m) in the North and Far North Provinces respectively.

The major research goal was to develop new high and stable yielding agronomically improved rice varieties with better resistance to major stress and to maintain a pure stock of recommended and promising germplasm. During the past nine years of research on varietal rice improvement, thousands of introduced lines have been widely tested and many have been identified for use as varieties or as breeding lines for the above location. A package of cultural practices have been developed which can now be used by farmers on the released varieties.

Since 1988, the major shift in the emphasis of varietal improvement has been to develop suitable, stable and high yielding materials from local crosses to alleviate the major constraints prevailing in Mbo plain (blast disease) and Ndop plain (low temperature, sheath rot disease, poor grain quality). Several segregating populations are now at an advanced stage of selection for the above locations, necessitating that research efforts should continue in 1991-1994 so as to complete the main objectives of the program.

Among the constraints that might hinder the success of these activities, it can be noted that the IITA/NCRE expatriate research assistance was stopped in December 1990. Emphasis on rice research has been shifted to the North Cameroon. This has contributed to a drastic reduction in financing the research activities there by leaving some of the constraints earlier identified in Mbo and Ndop plains unsolved. The national research counterparts have been selected for further studies starting in 1991; however, a young researcher trained in the USA has completed a master degree program and is back to continue the ongoing activities with collaborators at the experimental site up to 1994.

### STRATEGIC APPROACH

The rice research unit is targeted toward distinct research domains: the low altitude humid zone of Mbo plain (700m) where blast disease incidence is prevalent, and the mid-high altitude cold zone of Ndop plain (1200m) where low temperatures contribute to higher panicle sterility, with associated diseases of sheath rot and spikelet discoloration.



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From 1982 to 1987, varietal selection was based on testing various rice introductions from international and/or national institutions. Observational nurseries were established in single plots of two to four rows of 5 meters longs; selected lines were tested in observational yield trials conducted in single plots of 2 to 3m x 5m. In the above two nurseries, test entries were each planted in single plots, but check entries were replicated after every 10 lines. The replicated yield trails such as the preliminary yield and the advanced yield trials were conducted in randomized complete block design with three to four replications, each plot size being 3m x 5m. Elite varietal trials were carried out on single large plots of 10m x 20m. Breeder's seed production trials were planted one seedling per hill with a large spacing of 25cm x [illegible]. In agronomic experiments, strategies were aimed at defining cultural practices to support the varietal program. The activities were focused on the two ecologies (Ndop and Mbo plains) on the determination of the types, rates and frequency of fertilizer application and suitable green manure under irrigated rice conditions. Other activities involved the effect of plant spacing, date of planting and harvesting on the yield of promising irrigated rice cultivars. Under Upland conditions in Mbo plain, a cropping pattern trial comprising several species and cultural practices was designed to find the best sequence to optimize the second season upland rice cultivation. Randomized complete block design were usually used.

Between 1988 and 1990, emphasis was put on selecting materials in segregating progenies from local crosses using the pedigree selection method. From 1991 elite varieties will be further tested under farmers conditions.

### 2.2.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Screen gerplasm of local and exotic sources for release as varieties or for donors in hybridization, and sele[illegible]w lines from segregating populations. | 1.1 Promising selection for further yield testing in later use in the breeding program. | 1.1 From over 10.000 entries tested at the end of 1990, several selected good lines are now being evaluated in advanced trials under upland and irrigated conditions in Ndop and Mbo plains. |
| | 1.2 Development of new locally created lines. | 1.2 Over 200 $F_3$-$F_5$ line selected for cold tolerance good grain characteristics, disease resistance undergo further testing in Mbo and Ndop plains. |



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| Operations | Objectives | Indicators |
|---|---|---|
| 2. Assess yield potential and test adaptability at different locations. | 2.1 Promising lines for breeding and for future use as variety per se. | 2.1 Twenty five and Twenty seven selections made under irrigated conditions in Mbo and Ndop plains respectively. Twelve entries selected under upland condition in Mbo plain. |
| | 2.2 Section for advanced yield trials and elite variety trial. | 2.2 Several selections were made under irrigated conditions in Ndop plain, under both irrigated and upland condition in Mbo plain. |
| | 2.3 Confirm adaptability and suitability of elite lines. | 2.3 High yielding varieties for Ndop and Mbo plains under upland and irrigated ecologies are known. |
| 3. Assess the yield potential of elite varieties. | 3. Evaluate adaptability & yield potential of promising selections under farmers' managed conditions. | 3. Promising varieties are known for replacement of the released varieties in Ndop and Mbo plains irrigated fields. |
| 4. Produced breeders' seed of recommended and promising elite lines. | 4. Availability of pure genetic stock of elite lines and varieties. | 4. Breeders' seed of elite lines and released varieties successfully produced. The seeds are available in small quantities under request. |
| 5. Evaluate varietal yield performances as affected by management levels. | 5.1 Determine the effect of management levels on the costs of cultivations and yield performance of selected rice cultivars. | 5.1 Results of the trial available from 1991. |
| | 5.2 Estimate the costs of production and benefit/cost ratio at each management level. | 5.2 Results of the trial available from 1991. |



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### 2.2.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1.1 | 750 | 9 | 100 | na | na | na |
| 1.2 | 1,125 | 16 | 46 | na | na | na |
| 2.1 | 675 | 6 | 100 | na | na | na |
| 2.2 | 2,262 | 20 | 100 | na | na | na |
| 2.3 | 450 | 4 | 100 | na | na | na |
| 3. | 3,750 | 17 | 100 | na | na | na |
| 4. | 925 | 12 | 29 | 1500 | 11,4 | 4-5 |
| 5.1 | 1,200 | 14 | 30 | 1500 | 5,7 | 3-5 |
| 5.2 | - | 2 | | | | |

na=non applicable

# 4. CEREALS AGRONOMY RESEARCH UNIT

## 4.1 INTRODUCTION

The NCRE Cereals Agronomy Research Unit has as primary responsibility to conduct agronomic research on maize in the three provinces of North Cameroon, and on sorghum in two Provinces (North and Adamaoua). Since its creation in 1982, this Unit has devoted 70% of its research efforts to maize agronomy and 30% to sorghum agronomy. In Northern Cameroon (6 to $13^0$ latitude North ; 160,000 $kms^2$), the maize area under traditional and intensive cultivation is estimated to be around 70,000 hectares while the total area under sorghum production is estimated to be around 430,000 hectares.

The main goals of this research program are : a) to identify and alleviate the main agroclimatic and management constraints to cereals production in the major cereals - growing zones of the mandated area of Northern Cameroon. b) to develop improved and adapted packages of agronomic practices for maize and sorghum and for sustainable cereals - based cropping systems. The researchers of this Unit have conducted during the last 9 years more than 400 fields trials at 8 different IRA antennas and on-farm trials on maize and sorghum agronomy. The research themes and results have been reported in several annual reports, technical papers, production guides. Many varieties and agronomic practices have been extended to farmers in cooperation with development and extension agencies. A lot of progress regarding several research subjects has been accomplished. However much remains to be learned in order to achieve and maintain the high potential of this region for cereals production.

Some major constraints which will affect the probability of success of this research work are : 1) the severe budgetary constraints imposed on the Cereals Agronomy Unit at the start of phase III. 2) The termination of USAID special funds (which had allowed for travel expenses and casual labor. 3) The possible termination of the T A Cereals Agronomist position in 2 years (instead of 4 years as originally planned). 4) The departure for long-term training of our two counterparts. This will adversely affect research continuity and reduce the impact of this critical research program.

## 4.2 STRATEGIC APPROACH

Our team used a production, development oriented research approach. Since 1982, we have conducted agronomic research on maize mainly on the subhumid lowland and highland savannas while the sorghum study was concentrated mainly in the subhumid lowland savanna. We conducted both on station and on-farm research. We use a teamwork approach including researchers, development and extension agents, and progressive farmers who are involved in the planning and implementation of the research work. A multidisciplinary team participates in the development of the agronomic technologies.



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The main research themes studied so far include : fertilization management, land preparation, minimum tillage, plant population densities. planting dates, crop establishment, variety testing, weed and Striga management, intercropping, graded steps of improved technologies. The on-farm testing (verification and pre-extension trials) has been conducted mainly with the Development Agency SODECOTON (Nord) and with the MINAGRI (Adamaoua).

During the 1991 - 1994 phase, the Cereals Agronomy Unit will continue to study the above mentioned themes on a reduced scale, particularly with the newly available maize and sorghum varieties. In recent years soil degradation and Striga have become major constraints which constitute a threat to the sustainability of the systems. There is a need to emphasize agronomic research aimed at developing appropriate conservation farming technologies and Striga control on maize and sorghum particularly in the lowland savanna. This study will include minimum tillage technologies, crop rotations, interplanted fallow/cereals, improved fallow management, integrated Striga management methods. Because of the complexities of the issues involved, a long term program, regional cooperation and teamwork efforts are necessary in order to tackle these difficult and challenging research subjects.

## 4.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Develop minimum tillage systems in farmers' fields. | 1.1 Determine the appropriate fertilization and weed management for minimum tillage systems at different locations. | 1.1 More than 60 on-farm trials on fertilization and weed management (1991 - 1994). |
| 2. Develop agronomic practices for maize and sorghum - based cropping systems. | 2.1 Identify appropriate crop rotations and improved fallow management systems. | 2.1 Minimum of 12 rotation experiments with 6 crops to be conducted on-station (1991-1994). |
| | 2.2 Evaluate the impact of several interplanted legumes fallow/cereals, and alley cropping systems | 2.2 Minimum of 16 experiments with 4 different strategies on-station and in farmers fields (1991 - 1994). |
| 3. Develop agronomic practices to alleviate Striga constraints. | 3.1 Evaluate the differential impact of trap crops against Striga on maize and sorghum. | 3.1 Minimum of 8 trap crop experiments against Striga will be tested on-station (1991 - 1994). |



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| Operations | Objectives | Indicators |
|---|---|---|
| | 3.2 Evaluate different methods of Striga control on maize and sorghum. | 3.2 Minimum of 10 experiments on intercropping, fertilization, tillage, herbicides against Striga (1991 -1994). |
| 4. Help extend tested agronomic technologies to the farmers. | 4.1 Communicate research findings and provide technical assistance to development and extension agents and farmers. | 4.1 Prepare at least 5 fiches techniques for extension agents and conduct 6 field days for farmers (1991 - 1994). |
| | 4.2 Provide improved varieties to extension agents and farmers. | 4.2 More than 500 farmers will receive samples of the new maize variety every year (1991 - 1994). |

## 4.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1.1 | 4 000 | 34 | 50 | 11 000 | 20 000 | 5 - 10 |
| 2.1 | 2 000 | 18 | 40 | 8 000 | 25 000 | 6 - 12 |
| 2.2 | 2 000 | 17 | 40 | 8 000 | 30 000 | 7 - 12 |
| 3.1 | 1 500 | 10 | 60 | 7 000 | 20 000 | 7 - 12 |
| 3.2 | 1 500 | 15 | 40 | 7 000 | 20 000 | 7 - 12 |
| 4.1 | 400 | 4 | 0 | na | na | na |
| 4.2 | 100 | 1 | 0 | na | na | na |

# 5. SORGHUM AND MILLET RESEARCH UNIT

## 5.1 INTRODUCTION

Sorghum and Pearl Millet are the major cereals cultivated throughout the three provinces of North Cameroon. the Adamaoua, North and Far North provinces. The importance of these cereals within this region decreases as one moves from the Far North to the Adamaoua province, corresponding closely with the increase in rainfall and longer growing season. Sorghum is grown during the rainy season and in post rainy season. The latter crop, known as "Muskwari", is a transplanted sorghum grown on the residual soil moisture. Millet is grown only in the rainy season.

The goal of sorghum breeding is to increase sorghum and millet production through the development of high yielding cultivars resistant to various pest and diseases. Efforts have been directed toward developing short-term breeding strategies which included screening of available germplasm and introduction of exotic germplasm from the International Rice esearch Center and developing long-term breeding strategies which include crossing and screening of segregating materials. More than 450 crosses have been attempted, involving local x local, local x exotic, and exotic x exotic, which are at present in F1, F2, F3, F4 and F5 generation. Results so far are very encouraging. The sorghum CS-54, S-35, and CS-95 have been identified as being tolerant/resistant to striga. These varieties have been consistently higher yielding than other varieties. S-35 and C-54 have already been released and adopted. Other promising lines are being tested by on-farm researchers. In addition, two cultivars of pearl millet, IKMV 8201 and ITMV-83V03 are identified as promising under no fertilizer. They are high yielding, high tillering, short cycle and medium in plant height.

Breeding activity is a long process in which priorities are frequently updated. In 1991 emphasis was towards breeding sorghum for drought tolerance, striga resistance/ tolerance; identifying sources of resistance by screening additional germplasm (local and exotic) and identifying short cycle and non photoperiod sensitive lines for pearl millet. This program is expected to be carried throughout the 1991-1994 phase. The overall goal remains the development of high yielding cultivars acceptable by farmers and consumers. The hybrid program has been considerably reduced but not terminated.

The major challenge facing the sorghum breeding program is the inadequate training of the scientist. The program is currently managed by a MSc scientist; a second MSc is expected to join very soon. It is hoped that opportunities will be given to them to complete the PhD program and by doing so the sorghum program will be stronger and have an effective performance of sorghum and millet research activities.



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## 5.2 STRATEGIC APPROACH

### 1. Rainy Season Sorghum

Research activities are carried out over two distinct zones corresponding to two rainfall patterns. Zone I has a rainfall range of 300-800 mm per year and both sorghum and millet are grown. Zone II has a rainfall range of 800-1000 mm per year where sorghum is mainly grown. Research activities in Zone III (Adamaoua province) where rainfall is above 1100mm have been stopped.

### A. Sort-term strategies

1. Screening of available local germplasm to identify lines to be released as varieties, or parents for future hybridization program.

2. Introduction and screening of exotic germplasm from international centers and national institutions for release as varieties, or use as parents for future hybridization programs.

3. Screening of segregating material introduced from other institutions where appropriate parents have been used.

4. Yield trials and multilocational trials in order to evaluate the yield potential of newly selected lines and their stabilities across environments.

5. Seed production

   Emphasis at all levels is given to:
   - high yield potential
   - drought tolerance
   - striga resistance
   - short and medium cycle
   - grain quality
   - acceptance as food

### B. Long-term Strategies

Crossing, development and testing (F2's and advanced generation)

1. Crossing program to improve local varieties and some exotic through hybridization followed by selection.

2. Identify the best combiners among the parents involved in the crossing program.

3. Generate variabilities from crosses as and combine desirable traits to develop breeding lines for various climatic conditions and maturity cycles.



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4. Study and screen the newly generated materials.

5. Characterization of lines for future use.

6. Multilocation trials for yield stability.

7. Seed production.

The following attributes will be given major importance as selection criteria:

- low tannin contents
- high grain yield potential
- early maturing varieties (85-95 days)
- medium duration varieties (100-120 days)
- photoperiod insensitive
- drought resistant/tolerant
- striga resistant
- disease resistant
- grain quality

This strategy approach will go along with the development of "value-added" food products for the industrial utilization of sorghum. Many universities and research centers will be involved in this last aspect.

The off-season sorghum (Muskwari)

1. The major activities remain the collection, screening of available germplasm within the muskwari growing area.

2. Introduction and screening germplasm of related sorghum from other regions, or countries having comparable climate.

3. Characterization of various collections already made.

4. Yield potential evaluation.

5. Seed multiplication.

The following attributes are of major importance.

- plant establishment/vigor
- cycle: 70-80 days (transplanting to harvest)
- high grain yield potential
- grain quality
- panicle shape



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**Pearl Millet**

Millet yields have been declining sharply. This sharp decline is parallel to the decline in rainfall. Because of these environmental factors, it is necessary to develop varieties for the 400-800 mm rainfall zone by selecting varieties with two growth habits:

- photoperiod sensitive full season (120-150 days) varieties that the farmer can sow with the early rains as is normally practiced and
- photoperiod low sensitive/insensitive early maturing (80-110 days) variety.

**Strategic approaches include:**

1. Screening available local germplasm to identify lines to be released as varieties.

2. Screening exotic germplasm from international research centers and national institutions.

3. Screening of segregating materials introduced from other institutions where appropriate parents have been used.

4. Preliminary yield trials and varietal trials to identify suitable materials.

5. Multilocational trials to evaluate yield potential and stability.

**Solution criteria are:**

- drought tolerance
- high grain yield potential and stability
- food quality
- greater tolerance to smut, ergot, downy mildew
- high tillering capacity
- bird resistance (bristle head)
- lodging resistance



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## 5.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Development of suitable cultivars of sorghum for different ecological zones. | 1.1 Provide improved varieties to various users. | 1.1 Number of released varieties. |
| | 1.2 Increase sorghum productivity. | 1.2 Vast area of improved varieties being cultivated. Multilocation test. |
| | 1.3 Improve farmer yield and income | 1.3 Yield potentials on-station and on-farm. |
| 2. Development of varieties resistant to striga | 2.1 Develop high level of resistant to striga | 2.1 High yielding varieties with very low striga emergence. |
| | 2.2 Provide range of resistant entries. | 2.2 Number of varieties developed. |
| 3. Maintain, test, and evaluate hybrid parents. | 3.1 Maintain genetic resources for hybrid development | 3.1 Hybrid and open pollinated varieties available. |
| | 3.2 Identify suitable male and female parents. | 3.2 Number of parents available. |
| 4. Nuclear seed multiplication. | 4.1 Obtain uniform and pure seed of promising selections, produce adequate seed quantity to meet the requirements of on-farm testing program, agronomy and seed multiplication project. | 4.1 Quantity of seed produced vs quantity of seed needed by various users. |
| | 4.2 Small quantity may be distributed to farmers who can't afford commercial seed. | 4.2 Number of farmers who have adopted improved seed. |
| 5. Muskwari germplasm collection, maintenance, and evaluation. | 5.1 Evaluate the various muskwari collection. | 5.1 Number of accessions collected and evaluated. |



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| Operations | Objectives | Indicators |
|---|---|---|
| 6. Development of suitable pearl millet cultivars. | 6.1 Identify agronomically superior lines with stable source of downy mildew resistance. | 6.1 Performance of selected lines and levels of resistance. |
| | 6.2 Develop cultivars of different maturity cycle. | 6.2 Number of varieties selected with different cycle. |

## 5.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1.1 | 2,500 | 30 | 90 | na | 130,000 | na |
| 1.2 | 3,100 | 15 | 80 | 10,000 | 110,000 | 3-10 |
| 1.3 | 1,000 | 5 | 0 | na | 120,000 | 0-10 |
| 2.1 | 1,500 | 15 | 75 | 25,000 | 100,000 | na |
| 2.2 | 1,000 | 5 | 0 | - | - | 3-12 |
| 3.1 | 500 | 5 | 30 | na | na | 2-6 |
| 3.2 | 300 | 2 | 0 | na | na | na |
| 4.1 | 1,800 | 10 | 80 | 10,000 | 90,000 | 0-9 |
| 4.2 | 300 | 1 | 0 | na | na | 0-4 |
| 5.1 | 400 | 5 | 10 | na | na | 3-10 |
| 5.2 | 400 | 5 | 10 | 4,500 | 60,000 | 4-15 |
| 6.1 | 2,000 | 8 | 0 | 2,000 | na | na |
| 6.2 | 500 | 4 | 0 | na | na | 4-20 |

## 6.1 BAMBUI TLU

### 6.1.1 INTRODUCTION

The TLU at Bambui is responsible for farming systems research in the Western Highlands, with an emphasis on maize and rice based cropping systems. The Western Highlands, comprising the North West (NWP) and West Provinces (WP), cover less than 10% of the land area in Cameroon, but contain 25% of the population, and produces over 60% of the national maize crop. The zone is mostly derived savannah, ranging in altitude from 400 to 3000 m, with annual rainfall between 1500 and 2500 mm.

The goal of the Bambui TLU is to increase and/or stabilize the productivity of cereal-based farming systems in the NWP & WP through the development, release and adoption by farmers of appropriate agronomic packages. Since 1982, significant progress has been made toward achieving this goal with the generation of farmer recommendations for maize and rice, built around new high yielding varieties that have been released and adopted by large numbers of farmers. In farmer managed trials, these recommended practices yielded marginal rates of return well above levels necessary to compensate farmers for the risk associated with adoption of a new technology.

Criteria for maize and rice variety testing originally emphasized productivity and disease resistance (on-farm trials, 1982-85). A second generation of varieties, that entered on-farm testing in 1989, have incorporated additional characteristics desired by farmers, as a result of TLU feedback to the breeders. These included: harder (flinty) grain for longer storage life, earliness, shorter plants, tolerance to low pH soils, and adaptation to the high altitude zone for maize; and, enhanced grain quality (long, narrow, translucent grains) for rice, to make it more competitive in the market with imported rice from Asia. An ever growing population, leading to higher crop:fallow ratios, combined with increased farming of steeply sloping and marginal lands, has caused considerable soil erosion losses, a general degradation of soil fertility, and steadily declining food crop yields, only partially offset by increasing use of chemical fertilizers. In response, the TLU has initiated a program of researcher-managed on-farm soil conservation (mainly use of contour bunds for erosion control) and soil fertility improvement (Tephrosia fallow) trials in 1991, in collaboration with the Provincial Delegation of Agriculture Adaptive Research Service and the U.S. Peace Corps 10-year Agroforestry Project. TLU farmer surveys in the next 4 years will be less oriented toward diagnosis and systems description, and more toward assessing technology retention, diffusion and impact.

Anticipated constraints in Phase III include: 1) the imminent departure of the national economist counterpart for PhD training in the U.S., with his expected return being too late to overlap with the TA economist, who leaves the project in February 1993; and 2) the departure in mid-phase of the T.A. TLU systems/soils agronomist, after only 2 years, well before an adequate characterization of soils in the highlands can be accomplished.



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### 6.1.2 STRATEGIC APPROACH

Research domains or zones in the Western Highlands are first demarcated by altitude, because no single maize or rice variety is adapted over the wide range of altitudes found in the 2 Provinces. Three major zones have been defined: the low altitude (400-1000 m), mid-altitude (1000-1500 m), and high-altitude (1500-2400 m) zones. Within each altitude zone, sub-zones are essentially designated on the basis of soil fertility and existing cropping patterns. Low soil pH and strong P-deficiency have been identified as important soil fertility problems.

The major thrust of the TLU's on-farm trial work to date has been in the area of varietal screening and verification. In the past, the TLU used a dispersed trial site approach, to better measure the variation (physical, biological and human choice) in the adaptation and acceptance of new maize and rice varieties. Varietal testing was supplemented by fertilizer and cropping pattern trials. The trial program followed a sequence from researcher to farmer managed, from fairly complex to simple designs, and from few to progressively more sites. Establishment of strong linkages with extension is perhaps the most significant accomplishment of the Bambui TLU. Extension agents were involved in all TLU on-farm research activities, including farmer surveys, and the minikit trial program; culminating in the signing of a formal convention between MIDENO and IRA, specifying the TLU as the primary facilitator of research-extension liaison.

In Phase I and II the TLU concentrated on straight-forward yield enhancing technologies (improved varieties and agronomic practices requiring significant investment in external inputs, mainly fertilizer), to maximize the probability of rapid and measurable project impact. In Phase III, the emphasis will be on developing low input, resource preserving, yield sustaining technologies. The activities of the TLU will be expanded to include studies on 1) the release of plant nutrients tied up in soil organic matter which sometimes is as high as 15%, 2) maintenance of adequate soil P, and 3) development, in collaboration with the agroforestry/soils unit, of soil resource preserving technologies through use of improved fallows and alley cropping. On-farm varietal testing will continue, with greater attention to varieties with characteristics desired by farmers (grain quality, plant height, earliness, husk tip cover, etc.), to increase adoption levels. A second area of emphasis will be adoption and impact studies.



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### 6.1.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Identify farmers' circumstances and practices. | 1.1 Evaluate maize storage losses in farmers' traditional stores. | 1.1 Survey of 40 farmers stores in mid and high altitude zones, to be completed in 1992. |
| | 1.2 Assess soil fertility over a wide range of sites in the Western Highlands. | 1.2 Soil sampling from over 60 on-farm trial sites in the NWP & WP. |
| | 1.3 Identify factors affecting technology adoption and research impact. | 1.3 Yearly maize and rice recommendation retention surveys beginning in 1991; diffusion surveys in 1991 (1st generation maize and rice varieties) and 1994 (2nd generation varieties); baseline survey in agroforestry research villages, for future impact study. |
| | 1.4 Produce a map of the Western Highlands based on soil fertility characteristics. | 1.4 Collation of information from publications from previous soil mapping studies in the NWP & WP; with compensatory soil sampling and analysis where necessary. |
| 2. Identify improved and well adapted varieties. | 2.1 Assess the performance of new foodcrop varieties (maize, rice, potato, etc.) | 2.1 Joint researcher-farmer managed trials of 2nd generation maize and rice varieties to be completed in 1992; followed by farmer-managed trials in 1993 and 1994; all incorporate farmer assessments. |

| Operations | Objectives | Indicators |
|---|---|---|
| | 2.2 Confirm value and acceptability of IRA/ NCRE maize varieties. | 2.2 Continued yearly distribution of 300 maize trial minikits to extension agents. |
| 3. Identify appropriate technologies for enhancing and sustaining soil fertility. | 3.1 Evaluate the effect of improved soil conservation practices. | 3.1 Long term (1991-94) soil erosion control (contour bunds and hedgerows) trials in collaboration with Peace Corps Volunteers in 4 villages. |
| | 3.2 Evaluate the yield benefits from planted fallow. | 3.2 Long term (1991-95) planted fallow (relay planted green manure crops and alley cropping) trials in collaboration with Peace Corps Volunteers in 4 villages. |
| | 3.3 Determine fertilizer recommendations for specific recommendation domains. | 3.3 on-station pot, greenhouse and field fertilizer response trials; followed by on-farm adaptive trials. |
| 4. Increase knowledge of improved crop production materials and methods. | 4.1 Developing technical bulletins. | 4.1 Completion of maize technical bulletin in collaboration with UCD, and preparation of other extension bulletins as needed. |
| | 4.2 Training of extension staff. | 4.2 Participation of TLU researchers in training courses for AVV (Agents de Vulgarization de Village) in the West Province, as National Extension and Training Program gets under way (1992-94). |

### 6.1.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Time Frame |
|---|---|---|---|---|---|---|
| 1.1 | 500 | 10 | 50 | na | na | na |
| 1.2 | 1,000 | 5 | 0 | na | na | na |
| 1.3 | 500 | 10 | 20 | na | na | na |
| 1.4 | 1,000 | 10 | 75 | na | na | na |
| 2.1 | 2,500 | 15 | 80 | 10,000 | 50,000 | 1-9 |
| 2.2 | 1,000 | 5 | 50 | 20,000 | 50,000 | 0-8 |
| 3.1 | 750 | 10 | 80 | 5,000 | 20,000 | 3-20 |
| 3.2 | 750 | 10 | 80 | 5,000 | 30,000 | 3-20 |
| 3.3 | 1,500 | 15 | 50 | 20,000 | 30,000 | 3-10 |
| 4.1 | 250 | 5 | 0 | na | na | na |
| 4.2 | 250 | 5 | 0 | na | na | na |

## 6.2 EKONA TLU

### 6.2.1 INTRODUCTION

Ekona TLU is responsible for the Coastal Humid Forest Region of Cameroon. The TLU works to improve food crop production of smallholders in South West Province through diagnosis of agricultural constraints and opportunities, testing of improved varieties and agronomic cultural practices, and informational liaison between the extension service and IRA.

Since its creation in 1986, TLU work at Ekona has focussed on (a) provision of baseline data on smallholder agriculture to guide IRA researcher in food crop and soils, (b) on-farm testing of NCRE maize and IRA/IITA cassava varieties, (c) soil and weed management trials on-station, and (d) post-harvest problems of maize (storage) and other food crops (marketing). Liaison with extension has been effected through annual training-and-planning workshops, collaborative research and minikit distributions.

During 1991-1994, the basic approach of the TLU-involving a combination of on-station trials, researcher and farmer managed trial in focus villages, and minikit distributions will continue. However, the operational objectives have been reformulated to more clearly signify TLU priorities. Increased emphasis have been given to biological technologies for enhancing and sustaining farm systems productivity. Throughout 1991-94, agroforestry and fallow management studies will constitute the primary technology development focus of TLU Ekona.

The challenges facing TLU Ekona are a) departure of the IITA Socio Economist and Extension Agronomist in December 1990; b) the departure of a national for long term training; c) incorporation of the yet to come IITA Extension Agronomist. In the light of the above challenges, the TLU might not be able to achieve all its objectives within the mandate period. The Toyota land cruiser need to be replaced with new vehicle. It continuously needs repairs.

### 6.2.2 STRATEGIC APPROACH

TLU research is targeted towards the humid forest zone which covers Littoral and South West Province. For logistic reasons, we have not yet started work in the Littoral Province. But in the South West we are concentrating on four research zones; a) the Lower Volcanic with recent volcanic soils in Fako; b) Kumba Corridor with older volcanic soils, Central Meme; c) Sands, with sedimentary sandy clay loam in Fako, Meme and Ndian; d) Mamfe with granitic and heavy clay soils.

Initially, TLU activities covered only Fako and Meme Divisions. Beginning in 1989 the activities were expanded to the other two divisions - Ndian and Manyu. The TLU strategy is to concentrate testing activities in eight representative villages across the four zones. All along our work has been in collaboration with the MINAGRI extension service and related services such as the Ministry of Women and Social Affairs.



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For 1991-94, the TLU plans to concentrate in three main themes:- agroforestry, fallow management, impact and adoption. Nevertheless, varietal testing will continue. It is assumed that pay off from these will include better weed control, sustained soil fertility as well as erosion control.

### 6.2.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Diagnosis of farmers' circumstances and practices. | 1.1 Feedback information on farming systems and markets. | 1.1 Research monographs on S.W.provincial farming systems and markets to be completed by 1991. Other studies as needed. |
| | 1.2 Evaluate land productivity in farmers' mixed cropping pattern. | 1.2 Productivity Study to end in 1991. Findings compiled same year. |
| | 1.3 Assess Technology use and factors affecting research impact. | 1.3 Resource Management survey in 1992. |
| | 1.4 Generate price data for use in economic analysis, including technology evaluation and policy. | 1.4 Monthly market monitoring. Essentially a reliable source of this vital information. |
| 2. Identify biological technologies for improving & sustaining soil fertility. | 2.1 Assess alley hedgerows for performance at farm level. | 2.1 Demonstration farm and project farmers identified for on-farm trials. |
| | 2.2 Select appropriate leguminous species for use in agroforestry and rotation fallow trials. Establish in seed lots. | 2.2 Selected legumes species established as sources of seeds for agroforestry and rotational fallow management studies. |
| | 2.3 Assess benefits from short term leguminous fallows. | 2.3 Two planted fallow strategies evaluated. |

| Operations | Objectives | Indicators |
|---|---|---|
| | 2.4 Evaluate maize/cassava response to complete package. (Variety, fertilizer, weed control) | 2.4 First on-station then as kits (test) with farmers. |
| 3. Identify appropriate crop protection practices. | 3.1 Assess the effectiveness of Marshall seed treatment for egusi beetles. | 3.1 Finish in 1991. Findings given by end of the year. |
| | 3.2 Identify and evaluate, low cost weed control methods for maize and cassava intercrop. | 3.2 Weed control trials to continue through 1992. Continue in complete package evaluation through 1993. |
| | 3.3 Assess effectiveness of furadan in controlling stem borers. | 3.3 Continue through second season of 1992. Findings by 1993 |
| 4. Identify improved & well-adapted crop varieties. | 4.1 Expand areas of improved varieties in S.W. Province and Littoral (Maize, Cassava, Sweet potatoes). | 4.1 Continue with minikit variety trials and assess adoption. 250 sites each year. |
| | 4.2 Establish improved crop varieties and test their adaptability and general performance on farmers' level (maize, cassava, sweet potato, cocoyam (ROTREP)). | 4.2 Establish test kits at 100 sites each year. Quality test to finish in 1991. |
| | 4.3 Evaluate maize variety retention rates and determinants of retention. | 4.3 Annual retention surveys beginning 1991. |

| Operations | Objectives | Indicators |
|---|---|---|
| 5. Increase knowledge of IRA technologies. | 5.1 Communicate TLU findings to extension agents and farmers. | 5.1 Focus village meetings each year. TLU annual workshop. |
| | 5.2 Train MINAGRI chiefs of Posts in regional testing and demonstration methods. | 5.2 Annual training of MINAGRI chiefs of posts and trial supervisors |
| | 5.3 Distribute improved materials to farmers and extension agents. | 5.3 Over 500 farmers provided with improved maize varieties each year. Collaboration on cassava/sweet potatoes/maize distribution. Feedback by adoption and impact studies. |
| 6. Confirm Research zone characterization. | 6.1 Soil profile dug and described. | 6.1 Classify by horizon, physical and chemical properties; soil reaction and texture. |

### 6.2.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Timeframe |
|---|---|---|---|---|---|---|
| 1.1 | 650 | 2 | 0 | na | na | na |
| 1.2 | 350 | 3 | 0 | na | na | na |
| 1.3 | 350 | 4 | 0 | na | na | na |
| 1.4 | 400 | 4 | 0 | na | na | na |
| 2.1 | 1200 | 12 | 50 | 1000 | 50000 | 4-20 |
| 2.2 | 400 | 2 | 90 | na | na | na |
| 2.3 | 1500 | 12 | 40 | 20000 | 40000 | 2-15 |
| 2.4 | 400 | 3 | 75 | 1500 | 90000 | 1-10 |
| 3.1 | 400 | 5 | 10 | 3000 | 25000 | 1-5 |
| 3.2 | 800 | 10 | 70 | 1500 | 75000 | 2-10 |
| 3.3 | 300 | 5 | 50 | 400 | 55000 | 3-10 |
| 4.1 | 400 | 7 | 80 | 2500 | 78000 | 0-8 |
| 4.2 | 600 | 5 | 90 | 6000 | 90000 | 0-10 |
| 4.3 | 400 | 10 | 0 | na | na | na |
| 5.1 | 2000 | 10 | 0 | na | na | na |
| 5.2 | 500 | 3 | 0 | na | na | na |
| 5.3 | 250 | 3 | 0 | na | na | na |
| 6.0 | 250 | 2 | 0 | na | na | na |

## 6.3 MAROUA TLU

### 6.3.1 INTRODUCTION

Maroua TLU has responsibility to improve the knowledge of farming systems in Northern Cameroon through diagnostic studies and to contribute to the development, testing, evaluation and dissemination of technologies proven under farmers' conditions. The zone of action of the Maroua TLU is the Far North and the Department of Mayo-Louti in the North Province. Pre-extension activities have so far been limited to the cotton-growing (SODECOTON) zones of this region, an area known as the "Centre Nord" where sorghum, groundnut, cowpea and millet are the major food crops. Efforts are underway to cover the Mayo-Sava and Mayo-Tsanaga Departments where the National Extension Project has become operational.

The goal of Maroua TLU is to increase food crop production, improve yield stability, maintain soil fertility and increase incomes of more than 200 thousand farm families in the mandate region.

Although on-farm testing of improved technologies remains the main thrust of Maroua TLU activities, diagnostic studies of existing farming systems have been initiated. Activities in this domain include (a) identification of major constraints to stable increases in production as well as of areas of flexibility in the systems which may allow intervention and change; (b) delineation of farming systems zones which require different research approaches and (c) economic analysis of on-farm tests which is now an integral part of the evaluation of improved techonogies.

The Maroua TLU will continue to conduct special purpose surveys as needs arise; but the resources invested in diagnostic research over the 1991-1994 period will decrease in favour of technology verification (regional testing, minikits and adoption studies).

A major challenge facing this TLU during the 1991-1994 phase will be personnel shortages and turnover. The TLU counterpart agricultural economist is expected to leave by fall 1991 for long-term training, and may not be replaced before his scheduled return by late 1993. The TLU systems agronomist contract is for two years. On-station sorghum agronomy program may suffer if the counterpart now in-training at Zaria (Nigeria) is not back to overlap for a sufficient amount of time. Maroua TLU activities have so far been seriously constrained by the lack of senior technicians. The difficulties will be compounded if one or two more technicians are not assigned to the unit.

### 6.3.2 STRATEGIC APPROACH

Although 8 farming systems zones have been identified, Maroua TLU activities will remain clustered in four SODECOTON regions (Maroua and Mora-Mokolo, Kaele, Mayo-Danay and Mayo-Louti) which constitute principal agro-ecological zones in the Centre Nord. The 4 research villages (Djoulgouf, Djinglya, Gatouguel and Zouaye) represent each of these zones. Much of the Mayo-Sava and Mayo-Tsanaga Departments is part of the Plateau and the Mandara Mountains, delimiting a distinct research domain



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where IRA has so far had a spotty presence. This zone and the Logone Chari department now fall under the mandate of the National Extension Project (PNVFA). The Maroua TLU hopes to extend its technology verification program to these areas in collaboration with the PNVFA, first concentrating on simple extendable themes (minikits, variety tests, etc) until a research antenna or similar IRA facility is established in the mountain/plateau zone and Logone Chari to evaluate improved technologies.

For the 1991-1994 phase, Maroua TLU has initiated some specific changes in orientation. First, the TA systems agronomist now has responsibility for both on-farm and on-station activities. Technology development on-station will focus on soil moisture and striga management for stable sorghum yields. TLU is also closely collaborating with the new NCRE cowpea breeder/agronomist to ensure complementarity between on-station cowpea research and on-farm testing. Second, the balance between diagnostic surveys and technology verification is expected to shift toward more regional testing of proven technologies. Third, with the expansion of PNVFA activities across the E.N. province, the regional test program will gradually move away from collaboration with SODECOTON in favor of the PNVFA.

### 6.3.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Improve knowledge of farmers' circumstances, practices, and institutional framework. | 1.1 Provide baseline data on farming systems of EN for evaluation of impact of improved technologies. Research priority setting. | 1.1 Survey of agricultural practices ending in 1991-92. Market survey for sorghum in 1991; other crops as needed. Working papers by 1992. |
| | 1.2. Identify farmers' strategy against drought and long term approach to sustainable agriculture. | 1.2 Survey on farmer's attitude toward cover crops, agroforesty, use of animal manure in 1991. Working papers by 1992. |
| 2. Create technology to stabilize yields of sorghum | 2.1 Identify practices to reduce striga populations in rainfed sorghum. | 2.1 Trials to examine long term benefits of past treatments and continued trials with crop associations. |
| | 2.2 Identify viable practices to protect soil and conserve soil moisture in rainfed sorghum. | 2.2 Observation of cover crops and hedgerow species in 1991. Subsequent introduction to sorghum cropping system. |



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| Operations | Objectives | Indicators |
|---|---|---|
| | 2.3 Identify viable practices to conserve moisture in Mouskwari sorghum. | 2.3 Observation and multiplication of promising species in 1991. Introduction into Mouskwari cropping system starting 1992. |
| 3. Identify improved varieties, cropping patterns and soil moisture conservation techniques. | 3.1 Assess yields, acceptability and profitability of new sorghum, cowpea and peanut varieties under farmers' conditions across EN province. | 3.1 Regional variety tests at 60 sites each year; more than 200 tests (PNVFA)in adoption plots and minikits each year. |
| | 3.2 Assess yields, acceptability and profitability of sorghum/cowpea associations to improve total grain yield, combat striga under farmers' contions | 3.2 Farmer managed tests at 16 sites in 1991. Regional tests at 60 sites by 1993; proposed recommendation by 1994. |
| | 3.3 Assess performance and acceptability of improved land preparation techniques to conserve moisture under farmers conditions. | 3.3 Farmer managed test at 16 sites in 1991. Components of this technology added to cropping pattern in regional tests at 60 sites starting 1992. |
| | 3.4 Monitor farmers preferences and utilization of IRA varieties, attitudes toward proposed sustainable cropping techniques. | 3.4 Retention surveys following variety and cropping patterns tests in TLU villages beginning 1992; additional surveys on cover crops, hedge row use and soil and water management by farmers as needed. |

| Operations | Objectives | Indicators |
|---|---|---|
| 4. Identify low cost practicable post-harvest technologies for reducing food grain losses. | 4.1 Determine and assess profitability of improved storage techniques for cowpea in collaboration with IRA/CRSP project. | 4.1 60 farmers to participate in tests with ash, solar, triple bagging and danki treatment in 1991; retention surveys and regional tests beginning 1992. Extension leaflets written by 1993. |
| | 4.2 Monitor farmer techniques to reduce storage losses for sorghum and ground nuts in collaboration with IRA post-harvest technology | 4.2 Storage survey in 1991; experiment led by IRA post harvest technology unit in 1992, 1993. On farm tests as appropriate by 1993 and 1994. |
| 5. Disseminate knowledge of improved crop production. | 5.1 Communicate TLU findings to extension agents and farmers. | 5.1 Research finding of diagnostic surveys, on varieties, cropping patterns, soil and water management methods, storage techniques, seed treatment, and adaptation presented in TLU working papers, research notes and extension leaflets by the end of 1992. |
| | 5.2 Intensify collaboration with National Extension Project (PNVFA) | 5.2 More than 810 farmers each year provided with new compound maize seeds and seed dressing chemicals. |
| | 5.3 Increase capability of SODECOTON and PNVFA extension agents to transfer TLU results. Training IRA counterparts. | 5.3 Annual meetings, workshops and training in regional testing and field demonstration methods. 1-2 counterparts degree training. |

### 6.3.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Timeframe |
|---|---|---|---|---|---|---|
| 1.1 | 1,250 | 3 | 0 | na | na | na |
| 1.2 | 225 | 1 | 0 | na | na | na |
| 2.1 | 1,200 | 12 | 75 | 9,500 | 16,000 | 3-8 |
| 2.2 | 800 | 8 | 60 | 9,500 | 8,000 | 5-20 |
| 2.3 | 600 | 4 | 60 | 1,200 | 2,000 | 5-15 |
| 3.1 | 2,925 | 14 | 80 | 22,000 | 54,000 | 2-8 |
| 3.2 | 1,875 | 14 | 80 | 19,000 | 32,000 | 3-8 |
| 3.3 | 1,675 | 13 | 80 | 11,000 | 20,000 | 4-9 |
| 3.4 | 400 | 3 | 75 | na | na | na |
| 4.1 | 825 | 8 | 70 | 1,200 | 50,000 | 2-10 |
| 4.2 | 300 | 3 | 60 | 500 | 20,000 | 4-9 |
| 5.1 | 650 | 6 | 10 | na | na | na |
| 5.2 | 650 | 6 | 10 | na | na | na |
| 5.3 | 2,500 | 5 | 0 | na | na | na |

## 6.4 NKOLBISSON TLU

### 6.4.1 INTRODUCTION

Nkolbisson TLU has responsibility for farming systems diagnosis, on-farm testing, and extension liaison in the Center and South provinces. Since its creation in 1986, the TLU has concentrated on the Center Province. The Center Province encompasses Yaounde--the second largest urban market in Cameroon--and nearly 75 percent of farms in the mandated research zone.

The goal of Nkolbisson TLU is to enhance rural incomes and food security through more productive and sustainable crop production systems. Research has thus far focused on improved materials and practices for maize, cassava, and groundnut. With respect to agronomic practices, the top priorities have been cropping patterns, maize fertilization, and weed control. Research on these themes is near completion and promising alternatives will be verified during the 1991-1994 phase through regional testing and demonstrations in conjunction with the extension service of the Ministry of Agriculture.

In 1990, the TLU began shifting the emphasis of its testing program from varieties and external inputs to low input, sustainable technologies. Work on agroforestry and planted fallow now constitutes the primary technology development focus of the TLU and this is expected to be the case throughout the 1991-1994 phase. The TLU will continue to complement its technology testing program with selected diagnostic surveys but the resources invested in diagnostic research is expected to be small relative to technology verification and promotion activities.

A major challenge facing the Nkolbisson TLU during the 1991-1994 phase will be personnel shortages and turnover. In July 1991, the TLU's economist and TLU Coordinator will be replaced. Later during 1991 and early 1992, three TLU members will depart for long-term training. At the end of 1992, the IITA Senior Agronomist and TLU founder will end his assignment. In the face of these changes and reductions, the TLU may be forced to delay or eliminate otherwise desirable activities.

### 6.4.2 STRATEGIC APPROACH

TLU research is targeted toward two distinct research domains--the semi-humid forest zone and the forest-savanna transition zone. Within the forest zone, the TLU distinguishes between the more intensified, market-integrated zone north of Yaounde and the less populated and developed area south of Yaounde.

Between 1987 and 1990, all TLU testing was carried out on-farm in a small number of representative research villages. Research was concentrated in research villages in order to reduce costs, create focal points for technology diffusions, and enable development of researcher-farmer relationships. Beginning in 1989, the TLU developed a regional testing program--first in collaboration with SODECAO and more recently



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with the Ministry of Agriculture--in order to verify diagnostic findings and testing results from the research villages.

For the 1991-94 phase, the TLU has initiated two changes in its strategic approach First, the TLU has taken over responsibility for on-station systems agronomy research in order to ensure complementarity and continuity between IRA's on-station and on-farm research. Second, the level of activity in research villages has been reduced in order to accommodate a greatly expanded regional testing and demonstration program. The TLU's emphasis on large scale regional testing and demonstration reflects a commitment to getting closure and increasing research impact.

The TLU is also changing its strategic approach with respect to research themes. Since its creation in 1986, the TLU has stressed variety introduction, along with complementary external (often chemical) inputs. This approach was based on a conviction that such interventions held promise for the quickest impact. Since the TLU has already identified the most promising "quick" interventions, the TLU will now focus its efforts on achieving system sustainability through agroforestry and planted fallow.

### 6.4.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Farming systems diagnosis. | 1.1 Provide information and identify research needs. | 1.1 Surveys on resource management and extension by 1992. Other surveys as needed. |
| | 1.2 Evaluate technology adoption and impact. | 1.2 Retention surveys beginning in 1992. Other surveys as needed. |
| 2. On-farm technology evaluation. | 2.1 Identify well-adapted and acceptable varieties. | 2.1 Farmer managed variety tests every season. Farmer evaluation surveys following variety tests. |
| | 2.2 Testing support for IRA researchers. | 2.2 One or more collaborative trials each year. |



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| Operations | Objectives | Indicators |
|---|---|---|
| 3. Technologies for sustainable soil improvement. | 3.1 Evaluate benefits from leguminous hedgerows. | 3.1 Species, patterns, and rotation trials maintained on-station. More than 30 on-farm hedgerow sites planted by 1991. |
| | 3.2 Identify species and practices for legume fallow. | 3.2 At least four species and three following strategies tested in 1991 and 1992. Minimum of 20 on-farm fallow trials each year. |
| | 3.3 Finalize maize fertilization recommendation. | 3.3 Finish regional testing by 1992. |
| 4. Dissemination and extension liaison. | 4.1 Validate on-farm test results. | 4.1 Maintain regional testing program in Center and South provinces. |
| | 4.2 Communicate TLU findings to extension agents and farmers. | 4.1 Extension leaflets on varieties, fertilization and weed control by 1993. Farmer field days. |
| | 4.3 Provide improved materials to farmers. | 4.2 More than 1000 adoption plots each year. Collaboration on cassava and maize multiplication. |
| | 4.4 Train MINAGRI personnel. | 4.4 Annual training courses. |

### 6.4.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Hectares Where Adoption | Net Benefit per Hectare (FCFA) | Adoption Timeframe |
|---|---|---|---|---|---|---|
| 1.1 | 1,500 | 8 | 0 | na | na | na |
| 1.2 | 1,200 | 7 | 0 | na | na | na |
| 2.1 | 400 | 5 | 95 | 25,000 | 120,000 | 0 - 12 |
| 2.2 | 800 | 5 | 70 | na | na | na |
| 3.1 | 3,000 | 26 | 60 | 10,000 | 60,000 | 4 - 20 |
| 3.2 | 1,500 | 16 | 30 | 25,500 | 50,000 | 3 - 15 |
| 3.3 | 400 | 5 | 85 | 15,000 | 120,000 | 0 - 10 |
| 4.1 | 2,000 | 14 | 0 | na | na | na |
| 4.2 | 1,200 | 6 | 0 | na | na | na |
| 4.3 | 500 | 4 | 0 | na | na | na |
| 4.4 | 500 | 4 | 0 | na | na | na |

# 7. ECONOMIC ANALYSIS UNIT

## 7.1 INTRODUCTION

The function of the Economic Analysis Unit (EAU) is to provide IRA with a capacity for economic analysis relative to its research and development mandate. Project support is being given for establishment and operation of an Economic Analysis Unit in recognition of the challenges being faced by IRA as a result of Cameroon's on-going economic crisis and structural adjustment.

The goal of the Economic Analysis Unit is to increase IRA's research efficiency, productivity and impact. The top priority of the unit is carrying out economic studies for institute-level priority setting and programming and for measuring research benefits. To complement its own studies, the EAU assists IRA researchers through research collaboration, advisory services and training.

## 7.2 STRATEGIC APPROACH

Unlike other project units, the Economic Analysis Unit does not have an area or commodity mandate. Its primary client is IRA's Directorate. Thus, the EAU will focus on the Directorate's information needs and efforts to implement IRA's Performance Contract. To the extent possible, the EAU will also give high priority to information needs of NCRE Project research units and USAID.

At least to begin with, the EAU will work on a balanced portfolio of analytical studies covering policy-technology demand linkages, research priorities, and research impact. Studies related to these topics are identified as responsibilities of the EAU in IRA's Action Plan as well as in Contract III of the NCRE II Project. Priorities for specific follow-up studies will be established in collaboration with the Director of IRA and NCRE Project Chief of Party.

The potential contribution of EAU studies to improved IRA performance is constrained by limited personnel and resources. To extend and sustain its impact on IRA research performance, the EAU will operate as a service unit as well as an economic research unit. Service activities will encompass reviewing operation proposals, developing research methodology and guidelines, training and backstopping.



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## 7.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Analyze economics of IRA research. | 1.1 Evaluate policy and other factors affecting technology demand. | 1.1 Analytical paper on research policy in 1991. Resource management survey completed by end 1992. Additional studies as needed. |
| | 1.2 Determine research priorities. | 1.2 IRA priority setting study completed before end of 1992. Follow-up studies as needed. |
| | 1.3 Appraise research benefits. | 1.3 Pilot NCRE Project rates of return studies in 1991; extended to additional NCRE Project units in subsequent years. Methodology developed for measuring farmer benefits before end of 1992; tested on pilot basis in 1993. |
| 2. Institute economic analysis support services. | 2.1 Improve economic budgeting and analysis skills of IRA researchers. | 2.1 Research budgeting guidelines developed. Training workshops organized. |
| | 2.2 Help IRA researchers plan and implement economic studies. | 2.2 Design and analytical support given for two or more studies per year. |



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## 7.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Timeframe |
|---|---|---|---|---|---|---|
| 1.1 | 1,250 | 25 | 0 | na | na | na |
| 1.2 | 750 | 15 | 0 | na | na | na |
| 1.3 | 2,000 | 35 | 0 | na | na | na |
| 2.1 | 1,250 | 10 | 0 | na | na | na |
| 2.2 | 750 | 15 | 0 | na | na | na |

# 8. SOIL/AGROFORESTRY UNIT

## 8.1 INTRODUCTION

Relative to others, the Bambui Agroforestry/soils (ASB) program is new even though some alley cropping and improved fallow studies have begun in the West and North-West provinces. In this area, population pressure is severe, hillside cultivation is commonplace and erosion of fertile top soil is rampant. In addition, previous fertilizer trials have given mixed results.

The overall goal of the ASB is to restore the fertility of impoverished farmlands and to maintain the level of fertility of productive ones using agroforestry and related fallow techniques. This would allow small farmers to increase production on a sustained basis. Given the above objective, the earlier work jointly elaborated by PAFSAT, MIDENO and Bambui TLU although extension-oriented, was useful. Limited quantities of seeds and seedlings of selected woody species were available and managed by Peace Corps Volunteers, Training and Demonstration Center (TDC) supervisors on a "let's try and see if it works" basis. Requests for additional seeds have been placed.

An understanding of factors that cause soil acidity and nutrient deficiencies is essential for soil fertility management. Therefore, the major responsibilities of the ASB are 1) to characterize and identify key soil fertility constraints at micro level and 2) to design and test appropriate agroforestry/fallow techniques to overcome them.

## 8.2 STRATEGIC APPROACH

Our initial effort is concentrated in the North-West province. Six locations have been chosen to cover the Bambui Plains, Ndop plains, Menchum Valley and the Bui Highlands. Exact research points are: Nfonta (mid-altitude), Babungo (mid-altitude), Befang (low-altitude), Upper farm (high-altitude), Mbiyeh (high-altitude), and Dzeng (high-altitude). Sequentially, research follows:

1) Detailed site characterization (soils, rainfall and temperature).
2) Species evaluation (growth, biomass, nutrient yield, decomposition of biomass, nutrient cycling etc.).
3) Management (effect of biomass on soil fertility conservation and crop yield).
4) Prototype trials.

The above pathway is however flexible and is subject to modification based on adequacy of existing information. Also, to better demonstrate the potential of agroforestry in checking ground erosion, most of the management studies will be sited on slopes outside IRA antennae preferably on communal lands or in collaboration with the TDCs.



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Some earlier reports and our present study on micro level site characterization indicate predominance of extremely high P fixing soils. Our first season exploratory trials unequivocally show widespread phosphorus and nitrogen deficiency symptoms on maize and beans at all the test sites. N deficiency will be tackled through Biological Nitrogen Fixation (BNF) i.e agroforestry and improved fallow systems and P with the use of inorganic fertilizers. P fertilizer is not cheap, therefore, its management for efficient utilization constitutes another thrust for research during the upcoming years. We hope to increase P availability in these soils by combining it with organic materials from herbaceous and shrub legumes.

## 8.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Site characterization | 1.1 Provide understanding of soil behavior to help design future fertility management trials. | 1.1 Detailed soil analyses of six sites by end of 1991. |
| 2. Evaluation of herbaceous legume species | 2.1. To identify suitable herbaceous legume species for use as green manure and cover crops for different agroecological zones. | 2.1 Field trials at 3 locations beginning in April 1991 will expand to 5 sites. |
| | 2.2 Determine N contribution of herbaceous legumes. | 2.2 Field trial at 5 locations beginning in April 1991 will increase to 10 sites. |
| 3) Evaluation of legume species for agroforestry. | 3.1 Assess the potential of selected woody leguminous species as soil improvers. | 3.1 Trials will begin in April 1992 at 3 sites. |



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| Operations | Objectives | Indicators |
|---|---|---|
| | 3.2 Management of woody species for soil fertility conservation. | 3.2 Trial will begin in 1992 at 5 sites |
| 4 Phosphorus studies in Agroforestry and improved fallow systems. | 4.1 Gain understanding of P fixation of soil in the region. | 4.1 Started in April 1991 in laboratory as part of the micro level site characterization exercise. |
| | 4.2 Design management practices using biomass from prunings to minimize P fixation. | 4.2 Field trial begin in April 1992. |
| 5 Prototype trials on soil fertility conservation practices. | 5.1 Assemble information from 1-4 above to establish functional form of Agroforestry and improved fallow systems for the various agroecological zone. | 5.1 Trial will be established at least 20 sites by December 1994. |

## 8.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Timeframe |
|---|---|---|---|---|---|---|
| 1.0 | 500 | 5 | 30 | Na | Na | Na |
| 2.1 | 1000 | 10 | 20 | Na | Na | Na |
| 2.2 | 1500 | 15 | 30 | 25000 | 50000 | 1-10 |
| 3.1 | 1500 | 15 | 20 | Na | Na | Na |
| 3.2 | 2000 | 20 | 30 | 10000 | 40000 | 3-20 |
| 4.1 | 250 | 5 | 70 | Na | Na | Na |
| 4.2 | 1500 | 10 | 40 | 20000 | 5000 | 1-10 |
| 5.1 | 2000 | 20 | 40 | 50000 | 45000 | 3-20 |

# 9. GRAIN LEGUME RESEARCH UNIT

## 9.1 INTRODUCTION

The main objective of the grain legume program of the NCRE Project is to develop and identify grain legume varieties, mainly cowpea, adapted to the northern ecologies of Cameroon. It has been shown that cowpea is one of the most important grain legumes which constitute the main source of cheap protein for most Cameroonians.

In the early stages of cowpea research in Cameroon, emphasis has been put on varietal development and pest management.

During Phase I of the Bean Cowpea CRSP project (1982-1987), high yielding varieties have been developed, yield losses have been documented and effective storage methods have been recommended (drums, double bagging, fumigants, etc). Although the released varieties are high yielding, they did not have good levels of resistance to aphids, striga and virus. During the second phase of the Bean cowpea project since 1987, the activities have been narrowed down to developing varieties resistant to storage insect pests (Callosobruchus maculatus and bruchidius atrolineatus). Therefore, a new approach needs to be developed.

## 9.2 STRATEGIC APPROACH

The new approach of the Grain Legume program of NCRE project is to develop a broad base system of research on cowpea and minor activity on other grain legumes. In addition to breeding for resistance to storage insect pests, emphasis will be put on other aspects such as:

- Field insect pests (aphids, thrips, maruca)
- Parasitic weeds (Striga)
- Diseases (virus)
- Dual purpose (grain + fodder)
- Seed quality: * color (white or brown)
  * size (large seed)
  * Testa (rough or smooth)

In order to get quick impact on this approach, a strong backstopping from IITA headquarters, especially the Kano sub-station is needed. Also an increased interaction with the TLU is crucial. The overall strategy for the next four years will be to follow the new research approach on the basis of the problems identified in previous studies. Special attention will be paid to the utilization of local materials, the organization of foundation seed multiplication systematic seed renewal for extension services, and the purification of varieties under extension.



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## 9.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Maintain germplasm and develop new varieties. | 1.1 Assess the importance of other legumes in northern Cameroon. | 1.1 Survey and collect minor legumes in 4-5 villages in collaboration with TLU in 1992. |
| | 1.2 Maintain a working collection for selection of parents for varietal trials or hybridization. | 1.2. Field testing in 1992 of new introductions along with the best performing lines of the 1991 test. |
| | 1.3 Create new variability for selection of varieties. | 1.3 Crossing of local material with elite improved lines and advancing generations. |
| 2. Identify high yielding varieties of cowpea and Soybeans adapted to the agricultural systems of Northern Cameroon. | 2.1 Develop new varieties of cowpea resistant to insect, diseases, and good seed quality. | 2.1 On-station and multi-location testing of series of different varieties for two years 1992 and 1993. |
| | 2.2 Develop dual purpose varieties of cowpea (grain + fodder). | 2.2 Testing and selection from 1992 of appropriate varieties identified in 1991. |
| | 2.3 Evaluate adaptation of selected elite varieties of cowpea to the different ecologies on farmers' field. | 2.3 On-farm testing of best performing varieties identified from on-station trials in 1992, in collaboration with TLU. |
| | 2.4 Develop Soybean varieties and assess the importance of the crop in Northern Cameroon. | 2.4 Replicated varietal trials and survey on Soybean production and utilization in collaboration with TLU in 1992 and 1993. |

| Operations | Objectives | Indicators |
|---|---|---|
| 3. Identify effect of cropping systems on cowpea genotypes. | 3.1 Evaluate performance and variability of cowpea genotypes under minimum insecticide application in combination with soil fertility. | 3.1 Field testing of different genotypes under minimum insecticide application on different soil fertility level in 1992 and 1993. |
| | 3.2 Evaluate performance of selected genotypes in mixed cropping with cereals. | 3.2 Field testing from 1992 of limited number of selected cowpea lines in mixed cropping with sorghum. |
| | 3.3 Evaluate effect of date of planting on the ratio grain yield in selected fodder yield cowpea genotypes. | 3.3 Testing in 1992 and 1993 2 or 3 presumed dual purpose varieties at 3 different dates of planting starting from the beginning of the rains and at two weeks intervals. |
| 4. Screen for resistance to *Striga* in cowpea. | 4.1 Identify sources of resistance to be used in varietal trial or hybridization. | 4.1 Field testing of selected lines on *Striga* sick plot. |
| | 4.2 Assess the importance of *Striga* on cowpea in Northern Cameroon. | 4.2 Survey of 2-3 locations in collaboration with TLU each year from 1992. |
| 5. Seed multiplication and variety purification. | 5.1 Provide foundation seed periodically to extension services for multiplication. | 5.1 On-station production of the best four varieties on 1/4 hectare. |

| Operations | Objectives | Indicators |
|---|---|---|
| | 5.2 Purify the released varieties for seed renewal. | 5.2 Single plant selection of best looking plants from seed multiplication plot in 1991, and plant to row method of planting in 1992 followed by bulk planting of best lines in 1993. |

### 9.3.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1.1 | 440 | 2 | na | na | na | na |
| 1.2 | 500 | 6 | na | na | na | na |
| 1.3 | 1,300 | 9 | na | na | na | na |
| 2.1 | 3,000 | 25 | 70 | 2,400 | 80,000 | 4-10 |
| 2.2 | 480 | 4 | 30 | 5,000 | 45,000 | 4-10 |
| 2.3 | 840 | 7 | 40 | 2,400 | 80,000 | 1-6 |
| 2.4 | 960 | 8 | 80 | 950 | 90,000 | 6-12 |
| 3.1 | 940 | 8 | 20 | 7,000 | 64,000 | 3-8 |
| 3.2 | 940 | 8 | 70 | 7,000 | 70,000 | 4-10 |
| 3.3 | 640 | 5 | na | na | na | na |
| 4.1 | 960 | 9 | 20 | 5,000 | 80,000 | 4-10 |
| 4.2 | 480 | 3 | na | na | na | na |
| 5.1 | 480 | 4 | na | na | na | na |
| 5.2 | 240 | 2 | na | na | na | na |

# 10. MAIZE PATHOLOGY

## 10.1 INTRODUCTION

**The Plant Pathology unit at Bambui (PPB) has responsibilities:** to identify maize , sorghum and millet diseases in their growing zones, and to assess the importance of these diseases in collaboration with the maize, sorghum and millet improvement teams and develop varieties and/or cultural practices to control diseases in collaboration with the agronomy teams. The unit covers all the agroecological zones where these three commodities are grown.

The goal of PPB is to enhance production of maize, sorghum, and millet in Cameroon by reducing yield losses due to diseases through development of resistant/tolerant genotypes and or appropriate cultural practices. Sources of resistance to some of the main diseases have been identified, through adequate field screening techniques and incorporated into selected genotypes or elite lines.

A major challenge facing the PPB during 1991-1994 as during the previous years will be personnel shortages and restricted budget. Of the two pathologists now available, the most senior will leave for Ph.D. training in December 1991. A technician and laboratory attendant are the only available personnel. Because of this situation, some of the activities though necessary may not be carried out.

## 10.2 STRATEGIC APPROACH

The Pathology Unit research activities are targeted towards main agro-ecological zones in which maize sorghum, and millet are grown. After setting priorities in term of diseases incidence and severity in each agro-ecological zones, the PPB, as from 1987, started screening varieties/lines for resistance to major diseases such as blights and rusts. Research was concentrated on the search for sources of resistance and severity of new diseases. Activities in 1991-1994 will focussed the development of resistant varieties to blights, leaf spots, and stalk and ear rots. The understanding of the biology of rusts will be emphasized. Epidemiology of smuts, downy mildew, and dead heart will be initiated for both maize and sorghum.



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## 10.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Effect of inbreeding depression on the resistance to rusts and blights. | 1.1 Assess the efficiency of early generation selection on the resistance to rusts and blights. | 1.1 The S1, S2 cycles are formed and selfing will continue until S4 before field testing. |
| 2. Epidemiology and etiology of stalk rots. | 2.2 Asses the importance of stalk and ears rots and their study in relation to etiology, interaction with plant nutrition and element status. | 2.2 Inoculation of genotypes with a combination of rots pathogens in 1992-1993. |
| 3. Epidemiology of head smuts (sorghum and maize) and common smut. | 3.1 Understand the biology of the causal agents of head and common smuts. | |
| | 3.2 Screen NCRE advanced lines and incorporate genes of resistance to these diseases. | 3.2 Develop the technique of artificial inoculation by 1992. |
| 4. Characterization of the races of collectatridrum on sorghum in Cameroon. | 4.1 Identify the existing races of this pathogen. | 4.1 Get the differentials and nurseries set up by 1992. |
| | 4.2 Determine relationship between the different phases of the disease described for resistance in Cameroon. | |
| | 4.3 Screen for resistance to possible physiologic races. | |
| 5. Study of the biology of highland and lowland rusts in Cameroon. | 5.1 Look for alternate hosts to maize rusts conditioning over seasoning. | 5.1 Survey rusted hosts during dry season. |
| | 5.2 Continue selection for resistance in areas where the disease is endemic. | |



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| Operations | Objectives | Indicators |
|---|---|---|
| | 5.3 Characterize the races existing in Cameroon. | |
| | 5.4 Understand source of primary infection and type of primary propagules. | 5.4 -in vitro inoculation of infective propagule and early in 1992, set up spore trap. Using 1991 survey. |
| | 5.5 Evaluate possible control based on the destruction of the over seasoning alternate hosts. | |
| 6. Epidemiology of Phaeosphaeria leaf spot and Diplodia leaf stripe. | 6.1 Understand the biology of the diseases. | 6.1 field monitoring of each disease. |
| | 6.2 Develop cultural methods and/or resistant varieties. | 6.2 1990 and 1991 results will be used. |

## 10.4 EXPECTED COSTS AND IMPACT

| Objec-tive | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Ben-efit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1. | 600 | 8 | 20 | 20000 | 5600 | 3-4 |
| 2. | 600 | 8 | 30 | 12000 | 75000 | 3-4 |
| 3.1 | 900 | 12 | 10 | 24000 | 95000 | 1-3 |
| 3.2 | 500 | 8 | 30 | 10000 | NA | 0-2 |
| 4. | 800 | 10 | 10 | 5000 | NA | 2-5 |
| 5.1 | 400 | 6 | 30 | 1000 | NA | 1-3 |
| 5.2 | 600 | 8 | 30 | 3000 | 1000000 | 2-8 |
| 5.3 | 300 | 8 | 30 | 1000 | NA | 2-5 |
| 5.4 | 300 | 6 | 10 | 1000 | NA | 2-5 |
| 5-5 | 300 | 6 | 10 | 2000 | NA | 2-5 |
| 6-1 | 400 | 8 | 20 | NA | NA | NA |
| 6-2 | 600 | 10 | 15 | 15000 | 50000 | 3-6 |

## 11.1 HIGHLAND CEREALS ENTOMOLOGY

### 11.1.1 INTRODUCTION

The cereals entomology research unit in the Western Highland region was created in October 1985 with the posting of the present cereals entomologist to Dschang who returned from graduate further studies. He was given the mandate by the Director of IRA to design and execute research operations geared towards solving the post harvest handling and storage problems of the major cereal grain crops of Cameroon including maize, rice, sorghum and millet. The mandate did not limit the researcher to any ecological zone or region. Recently the researcher was told to include legume seeds (i.e. beans, cowpeas and soybeans). Some limited research is also carried out on rice field insect problems following a special request by the rice research team.

The goal of the cereal entomology research unit in Dschang is to reduce post harvest losses of food grain to the barest minimum. Research has therefore been focused towards quantifying losses associated with the various storage methods and evaluating improved methods to minimise losses which are possible cheap and easily adaptable. Work has concentrated on maize which is the most important cereal in the Western Highlands and has the greatest post harvest problems as compared to the other cereals and grain legumes. Storage of dried threshed maize in tightly covered plastic containers with very limited air circulation (including Actellic 2%, SUFAGRAIN and SUMICOMB) has proved successful. The chemicals and improved methods of storage that have proved successful for maize will be tested for other grains to confirm the results or make necessary adjustments.

With effect from 1991 more attention will be given to the use of natural plant materials for stored grain protection. Laboratory methods of rapid screening of grain varieties for stored insect resistance will be introduced.

The major constraint hindering the smooth progress of research activities in the unit is shortage of technical staff and transport. In the absence of an expatriate researcher the unit depends on the general IRA transport pool which is most of the time not available. The researcher uses his only family car for most of his missions and when it is bad, he cannot move.

The activities of the unit must necessarily extend to several ecological zones in order to obtain more adequate research findings but there are no competent technical staff in locations outside Dschang who are attached to the unit.



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### 11.1.2 STRATEGIC APPROACH

Cereals post harvest entomology presently is targeted towards quantifying and documenting the grain storage losses associated with the various traditional and introduced storage methods of each type of grain in order to recommend the storage methods with the least losses, assessing the effectiveness of using stored grain insecticides in traditional storage methods and the use of natural plant materials for stored grain protection. Activities will be concentrated in the Western Highlands for maize, rice beans and cowpeas ; limited activities in the South West for maize and the Sahel zone for sorghum and millet.

Since the best way to tackle any problem is to study the type of problem and its extent or gravity, the first operation planned by the unit when it started in October 1985 was a survey of cereal grain post harvest handling, storage and marketing problems of peasant farmers in Cameroon, types of stored grain insects present in barns and their distribution. It has never been possible to systematically execute the operation nationwide because of lack of staff and budget. However, some surveys have been carried out in some divisions of the N.W. and S.W. Provinces in collaboration with the TLU teams of Bambui and Ekona in 1987 and 1988 respectively. Screening of maize varieties for natural resistance to grain storage insect pests at various ecological sites started in 1986 using some 15 - 20 popular varieties will be concluded in 1991 and laboratory methods for quickly screening of breeders' varieties introduced. Some maize storage methods (including hermetic and non-hermetic methods) and four grain storage insecticides have been tested and special reports written in 1989 and 1990 with special recommendations for adoption by farmers. A survey and documentation of rice field insects was carried out in Santchou and Ndop Plains from 1987 - 1989 and screening of rice varieties for stem borer resistance started in 1989 will continue with breeders' selections.

For the 1991 - 1994 phase a more detailed survey and documentation of the use of natural plant materials for stored grain protection will be carried out and their active principles studied as well as new locally available species. The stored grain chemicals already tested as well as new candidates will be tested on grain under various traditional and introduced storage methods. Monitoring of farmers grain barns will be carried out in several ecological zones in order to assess losses for various storage methods at various ecological zones during the storage period and to identify methods that minimize losses. The limited survey that has been done only gave a situation at a particular time and not over a period. Sorghum/millet storage problems including insect species present and level of storage losses shall be surveyed and proposed solutions tested for adoption.



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### 11.1.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| 1. Identify the use of Natural plants by farmers for grain storage pest control. | 1.1 Document plants and their products presently used by farmers for stored grain pest control. | 1.1 Design farmers' questionnaires, contact TLUs and Agric Extension Agents to help collect the information in 1991/92. |
| | 1.2 Identify the mode of action of the various plants and their products and their efficacies. | 1.2 Conduct laboratory tests with the different plants and their products to identify whether they are insecticides or repellents. |
| | 1.3 Identify other plants with insecticidal properties | 1.3 Identify and test other plants reported by other workers to have insecticidal properties. |
| | 1.4 Identify the active ingredients in the different plants. | 1.4 Collaborate with Biochemists to extract and identify the active ingredients and test their efficacies by 1993/94. |
| 2. Identify grain post harvest losses associated with each storage method and agro-ecological zone. | 2.1 Document the major grain storage methods in the various agro-ecological zones. | 2.1 Design farmers' questionnaires and collaborate with TLUs and Agric-Extension Agents to collect information. |
| | 2.2 Quantity losses associated with each method and eco-zone and recommend improved methods. | 2.2 Monitoring barns of stratified random samples of farmers over the traditional storage period. Also evaluate various storage methods in the laboratory in Dschang. |

| Operations | Objectives | Indicators |
|---|---|---|
| | 2.3 Document stored grain species and their intensities. | 2.3 Identify insects present in each barn sample during surveys and monitoring. Calculate intensities per kg of grain and relate to storage method and eco-zone. |
| 3. Identify varieties of the major grains with resistance to storage pests at various ecological zones. | 3.1 Identify maize varieties resistant/tolerant to natural infestations of storage, pests at different ecological zones. | 3.1 Some 20 popular maize varieties have been grown and stored at 3 sites in 1988, 1989 & 1990. 1991-1994 breeders' varieties will be screened in the lab. |
| | 3.2 Identify rice beans and cowpeas varieties resistant/tolerant to storage. | 3.2 The major insects of each type of grain and legume seed will be cultured in the laboratory and used to screen several varieties of each from 1992-1994. |
| 4. Identify rice field insects. | 4.1 Document insects present in rice fields in different agro-ecological zones. | 4.1 Collections and documentation of insects in upland and irrigated rice fields has already been done from 1988-90 in Santchou and Ndop Plains. Collections are planned for Menchum Valley and 2 or 3 sites in Northern Cameroon from 1991-1994. |

| rations | Objectives | Indicators |
|---|---|---|
| | 4.2 Identify rice varieties resistant to rice stem borer. | 4.2 Rice stem borer nurseries were superimposed on rice breeders' advanced yield trials in Santchou and Ndop in 1989 and 1990. More stem borer nurseries have been planned for the same areas plus Northern Cameroon for 1991, 1992 and 1993 when conclusions will be drawn. |

### 11.1.4 EXPECTED COSTS AND IMPACT

| Objec-tive | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Ben-efit per Hectare | Adoption Time-frame |
|---|---|---|---|---|---|---|
| 1.1 | 1,800 | 20 | 60 | 20,000 | 50,000 | 0-8 |
| 1.2 | 800 | 9 | 50 | na | na | na |
| 1.3 | 600 | 8 | 40 | 100,000 | 50,000 | na |
| 1.4 | 1,000 | 5 | 60 | na | na | na |
| 2.1 | 1,200 | 10 | 40 | na | na | na |
| 2.2 | 1,400 | 12 | 0 | 400,000 | 50,000 | 0-3 |
| 2.3 | 500 | 8 | 0 | na | na | na |
| 3.1 | 400 | 5 | 0 | 500HA | 100,000 | 0-8 |
| 3.2 | 500 | 5 | 30 | 500HA | 100,000 | 1-8 |
| 4.1 | 1,200 | 8 | 10 | na | na | na |
| 4.2 | 1,500 | 10 | 20 | 1,000HA | 100,000 | 3-6 |



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## 11.2 LOWLAND CEREALS ENTOMOLOGY

### 11.2.1 INTRODUCTION

The lowland Cereals Entomology unit is charged with carrying out basic and applied research on insect pests of maize in the forest region of Southern Cameroon englobing the South West, Littoral, Centre, South and East provinces. The main entomological constraints to maize production are Lepidoterous field insect pests followed by Coleopterous storage pests. A large proportion of maize in this region is consumed fresh and only small quantities are stored as grain Consequently priority should be given to solving field pest problems. Storage insects cause most of their damage indoors (relatively stable environment) and control methods developed elsewhere could be applicable here.

The goal of the Lowland Cereals Entomology unit is to develop environmentally sound and economically profitable maize insect pest control methods for the rural farmer through an integration of suitable and appropriate cultural, biological, host plant resistance and chemical methods. In 1987, 88, 89, 90, 91 research activities carried out by Mrs. Aroga at Minkomeyos consisted of assessing Furadan (insecticide) for control of stem borers, effects of intercropping peanut and manioc with maize on the dynamics of borer populations and influence of land preparation method on borer incidence. In 1989 Dr. Bosque-Perez (I.I.T.A) provided seeds (rating scale also) of some maize genotypes with known resistance to some stem borer species. Mrs. Aroga in collaboration with Dr. Thé is using this scale to assess the performance of these materials vis-à-vis natural infestations of Busseola fusca at Minkomeyos. So far, no results or recommendations are available from these activities for on-farm assessment.

In 1990 an additional Entomologist Ms R.N Ndemah joined the project and was attached to the Nkolbisson TLU. Second season 1990 sampling for stem borers in farmers' maize fields in two agroecologies; semi-humid forest and forest/savannah transition by the Nkolbisson TLU team revealed marked differences in incidence, severity, impact on yield and field management practices between these two zones. This implies that stem borer research should be ecologically circumscribed as results obtained in one zone are likely to be in appropriate in another. To complement the above findings, the TLU Entomologist is carrying out on-station monitoring during 1991 in three agroecologies represented in the lowland forest. This is to determine the composition of the borer complex and the species largely responsible for losses in each zone.

At the moment, there are two intermediate level (MSc) Entomologists based at Nkolbisson working on maize stemborers. The I.I.T.A senior maize Entomologist based at Ibadan carried out a consultancy for the project only once in June 1989. There is urgent need for the senior Entomologist to be more involved in the orientation, design and supervision of basic and applied research activities. The unit needs a vehicle, driver, short and long term training for its members and frequent interaction with other scientists.



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### 11.2.2 STRATEGIC APPROACH

Lowland Cereals Entomology research should be divided into three distinct agroecologies with farming practices and socio-economic considerations as well: the deep humid forest, semi-humid forest and forest/savannah transition zones. Importance and trends for maize production in these zones vary, mostly fresh consumption in the two forest domains and dry harvest in the forest/savannah transition zone.

Up to 1990, entomology research has been based on-station in one location (Minkomeyos) and carried out with very little interaction between the disciplines of breeding, agronomy and pathology. It is only by interacting very closely with these other disciplines that sound and low-cost control methods can be developed.

For the 1991-1994 phase, entomology research will be ecologically circumscribed with more emphasis on identifying and establishing the role of natural parasites, predators (Biocontrol agents) on suppression of pest populations and screening maize varieties for resistance to insect pests. Less emphasis will be placed on cultural practices and chemical control because it may be difficult changing farming practices that people have been used to and chemicals are often very expensive. They will be prescribed only as short term solutions. Biocontrol and breeding for resistance will need a lot of collaboration from the I.I.T.A maize program and Biocontrol substation which are already carrying out some work in these domains.

### 11.2.3 OPERATIONS

| Operations | Objectives | Indicators |
|---|---|---|
| I. Pest Monitoring and studies on pest biology. | 1.1 Provide information on incidence, severity and losses | 1.1 Sample for stemborers in farmers' fields in Ekona TLU mandated area in 1992. |
| | 1.2 Determine borer complex distribution and relative abundance of species at various ecologies and assess zonal significance | 1.2 Intensive samplings in 1991 and 1992. |
| | 1.3 Develop fast, suitable and appropriate methodologies to accurately estimate pest populations in pest management trials on-farm and on-station. | 1.3 Relate various infestation measures to yield. |



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| Operations | Objectives | Indicators |
|---|---|---|
| | 1.4 Characterize biology of pests. | 1.4 Studies on oviposition sites and life cycles of species. |
| 2. Identify role of natural enemies in dynamics of pest populations | 2.1 Monitor and document incidence of natural enemies of various stemborer stages. | 2.1 Extensive sampling beginning 1992 |
| | 2.2 Assess selectivity of insecticides vis-à-vis parasites at trial sites | 2.2 Sampling at insecticide protected versus unprotected plots |
| 3. Assess efficacy of various insecticide | 3.1 Identify cost-effective insecticide rates for quickest impact | 3.1 On-farm insecticide trials in 1991, 1992. Findings given by 1993 |
| | 3.2 Generate data on insecticide residues in protected crop | 3.2 Residue analysis in harvested crop |
| 4. Assess effect of some field management practices | 4.1 Identify suitable and appropriate agronomic practices that reduce stemborer incidence | 4.1 Trials on spatial arrangement, plant spacing, density, seed treatment, time of insecticide application, intercropping, fertility etc. in 1992, 1993. Findings by 1994 |
| 5. Identify maize varieties with some resistance to stemborers. | 5.1 Collaborate with breeders to identify insect pest resistant varieties. | 5.1 Screening of varieties at least twice yearly. |
| | 5.2 Develop suitable infestation method for use in breeding for resistance. | 5.2 Adaptation or elaboration of rating scales to accuratly characterize damage in various locations. |



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### 11.2.4 EXPECTED COSTS AND IMPACT

| Objective | Annual Budget ('000) | Percent of Time Required | Percent Cost Not Budgeted | Adoption Level (Ha) | Net Benefit per Hectare | Adoption Timeframe |
|---|---|---|---|---|---|---|
| 1.1 | 1500 | 20 | 0 | na | na | na |
| 1.2 | 300 | 5 | 0 | na | na | na |
| 1.3 | 200 | 3 | 0 | na | na | na |
| 1.4 | 100 | 5 | 0 | na | na | na |
| 2.1 | 2000 | 20 | 0 | na | na | na |
| 2.2 | 1500 | 5 | 0 | na | na | na |
| 3.1 | 1250 | 10 | 10 | 20000 | 80000 | 3-10 |
| 3.2 | 200 | 2 | 0 | na | na | na |
| 4.1 | 1000 | 4 | 0 | 5000 | 20000 | 3-20 |
| 4.2 | 500 | 3 | 0 | na | na | na |
| 5.1 | 2000 | 20 | 60 | 25000 | 100000 | 5-20 |

# 12 LIST OF NCRE RESEARCHERS

## 12.1 International Staff

| Name | Nationality | Position | Location |
|---|---|---|---|
| 1. Dr. Emmanuel A. Atayi | Togolese | Chief of Party | Nkolbisson |
| 2. Dr. Thomas C. Stilwell | American | Deputy Chief of Party | Nkolbisson |
| 3. Mr [illegible]egory Servant | American | Administrative Officer | Nkolbisson |
| 4. Dr. Menwyellet Moussie | Ethiopian | Agric. Economist | Nkolbisson |
| 5. Dr. John Poku | Ghanaian | Ext. Agronomist | Nkolbisson |
| 6. Dr. Doyle Baker | American | Agric. Economist TLU Coordinator | Nkolbisson |
| 7. Dr. Noel Beninati | American | Maize Breeder | Bambui |
| 8. Dr. Olu. Osiname | Nigerian | Syst. Agronomist | Bambui |
| 9. Mr. Dermot McHugh | American | Agric. Economist | Bambui |
| 10. Dr. Charles Yamoah | Ghanaian | Soils/Agroforester | Bambui |
| 11. Dr. Humphrey Ezumah | Nigerian | Syst. Agronomist | Ekona |
| 12. Dr. Jean Detongnon | Beninois | Legume Specialist | Maroua |
| 13. Dr. Robert Carsky | American | Syst. Agronomist | Maroua |
| 14. Dr. Mulumba Kamuanga | Zairois | Agric. Economist | Maroua |
| 15. Dr. Henri Talleyrand | American | Cereals Agronomist | Garoua |



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## 12.2 National Counterparts

### In Country

| | Name | Position | Location |
|---|---|---|---|
| 1. | Dr. Jacob A. Ayuk-Takem | Maize Breeder, NCRE<br>National coordinator<br>Director of IRA | Nkolbisson |
| 2. | *Dr. Charles Thé | Maize Breeder | Nkolbisson |
| 3. | Mrs. Regine Aroga | Entomologist | Nkolbisson |
| 4. | Ms. Rose Ndemah | Entomologist | Nkolbisson |
| 5. | *Mr. Jean Bosco Zangue | Maize Breeder | Nkolbisson |
| 6. | Mr. Georges Dimithe | Agric. Economist | Nkolbisson |
| 7. | *Mr. Celicard Zonkeng | Maize Breeding | Nkolbisson |
| 8. | Mr. A. Blaise Nguimgo | Maize Agronomist | Nkolbisson |
| 9. | Ms. Regine Mankolo | Ext. Agronomist | Nkolbisson |
| 10. | Mr. Michel N. Ndoumbe | Ext. Agronomist | Nkolbisson |
| 11. | Mr. Nkoa Mewoli Ondoa | Maize Breeding | Nkolbisson |
| 12. | Mr. Pierre Boumtje | Agric. Economist | Nkolbisson |
| 13. | *Mr. Edward Ngong-Nassah | Ext. Agronomist | Bambui |
| 14. | Mr. Isidore Tabi | Maize Breeding | Bambui |
| 15. | Mr. Christopher Ngong | Maize Agronomist | Bambui |
| 16. | Mr. Jean Enam | Agric. Economist | Bambui |
| 17. | *Mr. Marc Samatana | Agric. Economist | Bambui |
| 18. | *Mr. Claude Nankar | Cereals Pathologist | Bambui |
| 19. | *Mr. Francois Meppe | Ext. Agronomy | Bambui |
| 20. | *Mr. Fabien Jeutong | Rice Breeder | Dschang |
| 21. | *Mr. Cletus Asanga | Entomologist | Dschang |
| 22. | Mr. Joseph Fokou | Rice Agronomist | Maroua |
| 23. | *Mr. Richard Kenga | Sorghum Breeder | Maroua |
| 24. | Mr. Julius Takow | Rice Agronomy | Maroua |
| 25. | Mr. Martin Fobasso | Ext. Agronomist | Maroua |
| 26. | Mr. Charles Njomaha | Agric. Economist | Maroua |
| 27. | Mr. Jacques Beyo | Sorghum Breeding | Maroua |
| 28. | Mr. Mbeng Ebete | Cereals Agronomist | Garoua |
| 29. | Mr. Blaise Mongmong | Maize Breeder | Garoua |
| 30. | *Mr. Titus Ngoumou | Ext. Agronomist | Garoua |
| 31. | *Mrs. Christine Poubom | Ext. Agronomist | Ekona |
| 32. | *Dr. Manfred Besong | Agric. Economist | Ekong |
| 33. | Mr. Mboussi A. Messia | Extension Agronomist | Ekona |
| 34. | Mrs. Ateh nee Amba | Agronomist | Ekona |

* Indicates degree received through NCRE financing



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In Training

| Name | Specialization | | University |
|---|---|---|---|
| Miss Pauline Zekeng | Ext. Agronomy | PhD | Michigan State U. |
| Mr. Pascal Ngninbeyie | Rice Agronomy | MSc | LSU Rice Res station |
| Mr. Andre Djonnewa | Sorghum Breeding | MSc | Nebraska State U. |
| *Mr. Edward Ngong-Nassah | Ext. Agronomy | PhD | S. Dakota State U. |
| Mr. Ndioro a Mbassa | Maize Breeder | MSc | Univ. of Minnesota |
| Mrs. L. A. Enyong | Socio-Economist | PhD | Virginia Polytech |
| Mr. Ranava Ndikawa | Sorghum Agronomist | MSc | Ahmadou Bello Univ. |

* Indicates previous degree received through NCRE financing.