

ECA/FSSDD/S&T/98/1m

**S&T RESEARCH/INNOVATION IN CAMEROON**

David A. Mbah, 1998

**ECONOMIC COMMISSION FOR AFRICA**  
**FOOD SECURITY AND SUSTAINABLE DEVELOPMENT DIVISION**

**Food Security and Sustainable Development:  
Selected Science and Technology Research and Applications  
in Cameroon**

**David A. Mbah**

*Department of Valorisation and Development Support  
Ministry of Scientific and Technical Research  
Yaounde, Cameroon*

## THE STATE OF FOOD SECURITY AND SUSTAINABLE DEVELOPMENT IN CAMEROON

Cameroon, a bilingual (English and French) republic, occupies an area of 475 000 km<sup>2</sup> between latitudes 2 and 13 N and longitudes 8 and 16 E. It has a population of 13 million with an annual growth rate of 2.9%. There are 5 major agro-ecological zones determined by altitude and rainfall: sudano-sahelian (0-500 m, 500-1500 mm), guinea savanna (900-1500 m, 1000-1500 mm), high plateau (1200-1800 m, 1500-2500 mm), humid forest (monomodal, 0-500 m, 2500 mm), humid forest (bimodal, 500-850 m, 1500-2500 mm). Seventy thousand km<sup>2</sup> of the area is arable land while 83,000 km<sup>2</sup> is pasture land.

Yields (x1000 tons), of major crops (1995) include plantains (1250), bananas (651), cassava (1781), cocoyams/taro (750), yams (120), groundnuts (118), paddy rice (25), sorghum/millet (350), maize (750) and irish potatoes (35). Meat yields (tons) by major species (1995) include beef (64358), mutton (7818), goat (7695), pork (11184) and chicken (14000). Food production index (1979/80 = 100) tumbled to 77 in 1994. Food availability (consumption) per capita has reduced from 2297 kcal (crops, 2180 kcal; animal products, 117 kcal) in 1970 to 1981 kcal in 1992. In terms of proteins, it has gone from 60g (crops, 48.9g, animal products, 11.1g) to 48g (crops, 36.7g; animal products, 11.3g) during the same period. This is a decrease in energy and protein availability of 15% and 20%, respectively, between 1970 and 1992. This situation is certainly worse in 1998. In terms of covering needs, the rate of cover age went from 150% in 1970 through 148% (1980) and 129% (1990) to 95% (1992). Clearly, the food security situation is worse than it was 18 years ago. The contribution of agriculture to the GDP is 25% of which 66%, 19%, 0.6% and 15% are from crops, livestock, fisheries and forestry, respectively. Industry contributes 75% GDP (petroleum, ≈ 60% of this). There are 6 institutions involved in agricultural research. These include the Institute of Agricultural Research for Development (IRAD) (plant production, forestry/environment, animal production and health, fisheries, food technology and "agricultural development"; Faculty of Agricultural Sciences, Dschang (FASA) (agricultural education, agricultural research, "extension"; National Advanced School of Agro-industrial Sciences (ENSSAI)(agricultural education, food technology, agricultural research); Institute of Medical and Medicinal Plants Studies (IMPM) (nutrition, food technology); National Veterinary Laboratory (LANAVET) (livestock development, vaccine production, "livestock research"; National Centre for Studies and Experimentation on Agricultural Machinery (CENEMA)(agricultural mechanization, agricultural development, "agricultural research").

Cameroon has 6 State Universities (The University of Yaounde I, The University of Yaounde II, The University of Dschang, The University of Buea, The University of Douala and The University of Ngaoundere). However, only the Universities of Dschang (FASA) and Ngaoundere (ENSSA) are involved in agriculture. At a lower level, there are 6 colleges that produce technicians and veterinary nurses. Following agenda 21, Cameroon produced an environmental management plan (NEMP) under the Ministry of Environment and Forestry. Similarly, a national forestry action plan (NFAP) has been elaborated following a law governing forestry activities. A national biodiversity strategy and action plan (NBSAP) is near completion. The number of scientists, engineers and technologists per 1000000 population is about 231 while consumption of power per capita is such that 30% of the population has access to electricity on the average while less than 5% of the rural inhabitants have such access. Telephone density is 5.4‰ (i.e. 5.4 lines per 1000 or 186 people per line).

## **1-Title of Project: National Cereals Research and Extension (NCRE)**

### **A. Background and Problem Specification**

The project was born out of the necessity (Government initiative) to "increase food production and rural development through the development of the Nation's institutional capacity to generate high quality research on cereals (maize, rice, sorghum and millet), to provide necessary linkages between farmers, extension agents and researchers, and to facilitate the transmission of research results to famers". The choice of maize and rice for emphasis was based on significant research on these crops in other countries and it was thought that such results could be applied to Cameroon once "tested, adapted and modified" to suit local conditions. IRAF (Institute of Agricultural and Forestry Research) had earlier produced some results on maize which required field testing and rice research was under- developed in Cameroon.

### **B. The Innovation Process**

To achieve the preceding objective, the project was implemented in 3 phases:

#### *Phase I, contract I (1981-1985):*

1. Development of high yielding varieties and agronomic practices of cereals (maize, rice, soghum and millet),
2. Development of programme for testing improved technological packages on farms,
3. Establishment of a mechanism for linking research, extension and farmers using a 2-way communication system,
4. Provision of formal and informal training to extension agents and institutes' research staff.

#### *Phase II, contract II (1986-90):*

Continuation of phase I objectives with the following additions:

1. Strengthening and institutionalization of the concept of Testing and Liason Unit (TLU's) as integral and on-going components of institutes activities,
2. Strengthening the institutional capacity of the institute to conduct high quality research on maize, rice, sorghum and millet that will "improve sustainable crop production systems with particular attention to soil management, agro-forestry and crop association",
3. Provision of the institute with the capacity to carry out economic analysis relevant to research priorities and agricultural policy research.

#### *Phase III, contract III (1991-94):*

Continuation of phase II with new objectives and change of scope.

Two new components added were:

- (i) Sustainable crop production research,
- (ii) Economic analysis.

During the project life, technical components included were:

Maize improvement and breeding, maize agronomy, rice improvement and breeding, rice agronomy, sorghum and millet improvement and breeding, sorghum and millet agronomy, Testing and Liason Units, human resources development, research linkages and development, agro-forestry and soil improvement, economic analysis, training.

Cooperation resulted from Government initiative leading to meetings with IITA and subsequent submission of joint project for funding to financing agencies. USAID accepted the NCRE concept and agreed to fund it. Funding was then by USA (USAID) and Cameroon.

Major progress towards meeting the objectives includes:

*Institutional development:* Number of cereals researchers increased from 7 to 40 (training involved 2 PhD, 29 MS, 4 BS, etc). All are back and working; infrastructure improved laboratories, offices, warehouse, cold room, staff at houses, adequate scientific equipment provided as well as vehicles; effective maintenance systems established, effective administrative system established (small core staff headquarters assisted by some personnel at stations and centres. Good inventory, accounting and evaluation systems established; active collaboration and linkages developed with International Agricultural Research Centres, Regional Centres, Ministry of Agriculture and related parastatal organizations/projects as well as several regional networks/projects, etc. Such links enhanced acquisition of new technologies and information from abroad; research management systems improved setting up economic analysis unit institutionalized strategic planning and priority setting, annual workplan institutionalized, publication of 8 research bulletins and 100 leaflets.

*Variety improvement:* Multidisciplinary in approach (breeders, pathologists, entomologists worked with agronomists, economists and extension agents to develop and release varieties). About 50% of the funds were spent on varietal development. Breeding research was conducted according to agro-ecological zones. Recommendation of varieties was follows:

Maize: highland and mid altitude, 7; lowland, 15;

Rice: Sahel zone, 4; uplands, 3; south, 5; rainfed uplands, 2 for Mbo plain and 2 for Ndop plain.

Sorghum and millet: semi-arid zone, 5.

Chemicals were recommended for control of identified maize diseases/pests. Farming Systems Methodology/TLU was set up to link Ministry of Scientific and Technical Research (Institute) with Ministry of Agriculture (Extension) as mechanism linking research, extension and farmers. Eventually, the TLU's evolved into the Farming Systems Research Extension promoted by the International Institute of Tropical Agriculture (IITA). Surveys show that NCRE maize and rice varieties are widely adopted. Noticeable success was recorded with sorghum and millet. There was no success with agronomic practices.

The project is an excellent case of good practices considering the various components (capacity building, Research, extension and research extension-farmer interactions, etc).

C. Lead Institutions: Institute of Agricultural Research for Development (IRAD)

D. Contact person: Dr. J.A. Ayuk-Takem

Director General, IRAD

P.O. Box 1457, Yaounde, Cameroon

Telefax: 237. 23. 35. 38

E. Collaborating Institutions: IITA (Cameroon)

F. Funding Sources

USA (USAID), Government of Cameroon.

## 2. Title of Project: Roots and Tubers Research

### A. Background and problem specification

Roots and tubers (cassava, yams, cocoyams, sweet potatoes and irish potatoes) constitute major food of Cameroonians in 4 of the 5 agro-ecological zones (high Western plateau, Guinea savanna, humid forest, monomodal rainfall; humid forest bimodal rainfall). While irish potatoes are limited to the plateau (Western plateau and Guinea savanna), the other crops are important in virtually all of the remaining 3 ecologies. Major problems farmers have with the crops include: low yields, losses due to diseases and pests and high post-harvest losses. To solve these problems, the Government of Cameroon (GOC) initiated research with the assistance of several donors over the years. The specific objectives included: to identify and incorporate (into high-yielding genotypes) genes of resistance and tolerance to major diseases/pests, to develop rapid multiplication techniques utilizable by the small farmers (vitro-culture and miniset techniques), to develop planting techniques for small farmers, elaborate transformation and conservation technologies aimed at reducing post-harvest losses, to study commercialisation of tubers and derived products and to train national researchers and technicians to constitute a team allowing for continued research activity.

### B. The Innovation Process

Research on each species was/is done on station and on farm (researcher managed or farmer-managed) in each of the ecological zones of importance for the species/variety. Each variety was selected on the basis of adaptability and productivity in a given agro-ecological zone as compared to "local variety".

The results by species were:

(i) Cassava: After several years of introduction, selection and evaluation, 3-5 high yielding varieties have been recommended and disseminated in 4 out of 5 ecological zones. On station yields vary from about 17t/ha in Sudan zone through about 30t/ha in Guinea savannah to more than 30 t/ha in the humid monobimodal rainfall ecologies. These yield figures are vary from 1/3 to 1 2/3 times those of local unimproved varieties. At farmer level, these yield figures reduce to about 50% of station values.

(ii) Sweet potatoes: After several years of introduction, selection and evaluation, 2 varieties (TIBI 1113) are widely disseminated nationwide. Yields vary from 21t/ha - 27t/ha depending on the ecology. 450 clones (USA) introduced (IRA/CIP) are still under evaluation against diseases/pests. 17 clones and some local cultivars are maintained in collection plot (Babungo) since 1990.

(iii) Irish potatoes: Of the 20,000 genotypes evaluated in different ecologies (700-2000 m between 1988 and 1992, two varieties (CIPIRA, maturity is medium at 100 days and yield is 20-25t/ha, fair resistance to leaf blight but moderate susceptibility to tuber blight and TUBIRA, maturity is medium at 100 days and yield is 20-30t/ha, resistance to tuber blight but moderate susceptibility to leaf blight) were released in 1992. A seed production scheme has been developed (tissue culture laboratory, screen houses and a good field at 2000m asl for high quality seed production. Annual seed production averages 20t. More than 350 farmers, farming groups and neighbouring countries (Gabon, Congo Republic and Central African Republic, etc, have got seed from the project. Some of the farmers involved now export potatoes from the cultivation of CIPIRA and TUBIRA.

On-going work involves evaluation of 10,000 genotypes introduced in 1994 against late blight, bacterial wilt, viruses, etc, as well as impact assessment and farmers seed production scheme.

(iv) Yams: Research on yams since the 1970s has led to recommendation and dissemination of 2 varieties in the Sudan ecology through 3 varieties for the high plateau ecology to 5 varieties in the humid mono/bimodal rainfall ecologies. Yields vary from 13-15t/ha through 23-30t/ha to 25-40t/ha, respectively. These are local species/varieties.

The major problem involved shortage of funds as GOC had an economic crisis since 1986/87 and cut funding for research. Work continued thanks to the multilateral funding arrangement. Shortage of funds also led to electricity stoppages which rendered cold rooms/stores non-functional at the expense of seed.

Features of good practices include farmer participation in variety development and evaluation, seed production scheme, multi-lateral funding arrangement and cooperation with international agricultural research centres.

C. Lead institution(s): Institute of Agricultural Research for Development (Research) and Ministry of Agriculture (Extension).

D. Contact Person: Dr. M. NGEVE, Chief, Roots and Tubers Programme  
P.O. Box 2123., Yaounde,  
Telephone: 237. 23 35 38,  
Fax 237. 23. 35. 38.

E. Collaborating Institutions: IITA (Cameroon). CIP (Peru)

F. Funding Sources:

Funding came from the GOC as well as international organisations through conventions between the former and the latter USAID-(Rotrep at Ekona, Gastby/IITA at Nombe, CIP/IRA at Bamenda, EEC/IITA at Ekona-Nkolbison).

### 3. Title of Project: Dairy Research Programme

#### A. Background and problem specification

Faced with the problem of high demand for dairy products coupled with low productivity of local cattle, the Government, through the Institute of Animal and Veterinary Research, initiated research on dairy improvement in the 1960s based on local cattle. By the 1970s it was evident that crossbreeding local cattle with exotic dairy cattle had more potential in meeting national dairy needs. Contact between one of the researchers, Dr Tebong (late), and Heifer Project International (USA) led to the introduction of exotic dairy cattle (Holsteins, Jerseys) with the objective of producing a productive and adapted dairy cow for the Cameroon highlands. This is a great imperative today given the requirement of 4% annual growth rate for milk production if national needs in the sector must be met.

#### B. The Innovation Process

The approach was multi-disciplinary (involving geneticists(2), reproductive physiologists(1), veterinarians(3), nutritionists(1) and economists(1).

*Breed development:* To achieve the preceding objective a crossbreeding programme was started at Bambui (1974) on the Bamenda plateau and Wakwa on the Adamawa plateau (1976). At Bambui there were Holstein x Red Fulani and Jersey x white Fulani crossbreeding with the purebred locals and purebred exotics serving as controls. At Wakwa, there were Holstein x Gudali and Montbeliard x Gudali crossbreeding with purebred Holsteins and purebred locals serving as controls. Backcrossing of crossbred females to exotic dairy sires was practiced. The traits measured included milk yield, growth rate, adaptability to local stresses (ticks and heat), reproduction and mortality. Breeding was generally artificial. Milking was twice a day (am, pm). Machine milking was the general case. Calves were separated from dams within 24hr and weighed at birth and monthly thereafter. They were bucket fed. Concentrate locally produced was fed according to production level. Corn silage and *Brachiaria* hay were fed lactating cows in the dry season.

After initial introduction of animals and semen, the Institute regularly imported Hostein semen from the USA and Montbeliard (beef-diary) animal from France.

*Husbandry development:* Forage/feeding and health packages were developed along with the breed development.

*Progress towards meeting the objective* was as follows (a) F1 crosses out-performed locals in most traits (3-4 times more milk, higher reproductive rate, higher growth rate) and were more tolerant to heat and tick load than exotics. They were better than the purebred exotics in mortality but were inferior to locals in this trait. Benefit-cost analysis gave a figure of about 4, suggesting economic soundness of the technological package developed and applied.

(b) A dairy laboratory (Bambui) and 2 milking parlors (Bambui and Wakwa) were constructed and equipped. The results were adopted by the state (Ministry of Livestock, Fisheries and Animal Industries) in a Pilot Dairy Project (Ngaoundere) which was subsequently privatised. The resulting SOGELAIT ("Dairy Management Comapnay") is owned by SITABAC Group (51%), Federation of Livestockmen of Adamawa (34%), Government of Cameroon and Canada (15%). In the Northwest Province, two dairy cooperatives were born to exploit the results. These are

Bamenda Dairy Cooperative Society which markets its milk through SOTRAMILK (Milk Transformation Company) (The cooperative has shares in SOTRAMILK) and Tadu Dairy Cooperative. Artificial breeding services are offered by Tadu Dairy Cooperative.

(c) Manpower development included training of 3 MS, 4 technicians by HPI, farmer training, etc.

Farmers now produce improved forages (legumes and grasses) and conserve feed for the difficult period (dry season/"winter"). This may be fed green (Guatemala grass) or as silage (maize) or as hay (Brachiaria or Stylosanthes). They also have a greater knowledge in handling milk.

The adoption of results by breeders was facilitated by the introduction/setting up of transformation and commercialization outlets.

Major problems encountered include high perishability of milk under rural conditions and high transportation costs. Abundance of milk in the rainy season and corresponding scarcity in the dry season creates some strain in the farmer - customer(transformation facility) relations. Artificial insemination is not a simple activity given problems related to availability and cost of liquid nitrogen for semen storage.

This work is thought to be a case of good practices considering the partnership with an international NGO (HPI) which works with the farmers (hence facilitating extension), the adoption by cooperatives and the improved husbandry practices by breeders. The involvement of farmers in funding guaranteed some sustainability.

C. Lead institution(s): Institute of Agricultural Research for Development

D. Contact Person(s): Dr. D.A. Mbah, Head, Dairy Research, IRAD, BP. 1457, Yaounde,  
Telefax: 237 23 54 67/237 23 60 43.

E. Collaborating Institution(s): Heifer Project International (Cameroon). Ministry of Livestock, Fisheries and Animal Industries, Tadu Dairy Cooperative, Bamenda Dairy Cooperative Society, SOGELAIT.

F. Funding Sources

Funding was by the Cameroon Government, farmers(animal housing and pasture development on own land) and HPI (USA).

#### **4. Title of Project: Regional Research Project on Small Ruminants(Cameroon - Niger - Chad)**

##### **A. Brief background.**

Small ruminant populations are estimated to be 2,900,000 in North Cameroon (1,400,000 sheep, 1,500,000 goats), about 8,000,000 in Niger (3,000,000 sheep, 5,000,000 goats) and 5,000,000 in Chad (2,000,000 sheep, 3,000,000 goats) giving a total of 16,000,000 sheep and goats. Small ruminants production is therefore of socio-economic importance to the human population of the region. Despite their importance, research on these species is recent in sub-saharan Africa and consequently knowledge on them is little and fragmentary. Hence, most research protocols in the framework of the project had as major objectives the improvement of knowledge on small ruminant production and the development of technologies useful to producers and development services. It may be noted that the initiative for the project was by CIRAD-EMVT and the French Ministry of cooperation.

##### **B. The Innovation Process**

To achieve the stated objectives, a scientific committee composed of researchers from the North and South was constituted to "administer" the work of African and French researchers working on themes of regional importance. The Institut National de Recherche Agronomique (INRA) (France) gave methodological support and laboratory analysis (genetic component). Research was conducted in the following domains: genetic characterization of local breeds; epidemiology and health; production systems, market studies and commercialisation, evaluation of the potentials and productivities of small ruminants; feeding and nutritional status of animals; milking, dairy production and transformation of milk. While emphasis was on capacity building in Niger and Chad, research received more attention in Cameroon.

Steps towards providing solutions to the problems indicate that important results were obtained in practically all the research domains. The most economically interesting so far come from the monitoring experiment in North Cameroon. Monitoring of 60 farms (12,500 small ruminants) during a period of 6 years in North Cameroon has resulted in the improvement of the husbandry of these animals. The results indicated that the productivity of these species is handicapped by very high mortality rate. The 0-1 year age group is the most affected with a mortality rate above 50%. Studies on-Station (supplementary feeding and prophylaxis) led to very significant reduction of mortality (53% to 17%). Such results were of interest to "Projet Développement Paysannal et Gestion des Terroirs" (DPGT) which subsequently funded a protocol on the technico-economic impact of vaccination against "peste des petits ruminants" (PPR) and deworming on mortality on-farm in North Cameroon. The results indicated significant reduction of mortality (26.1% to 12.6% and 31.6% to 16.7% for goats and sheep, respectively). These results were adopted by development services and are being disseminated widely in the region.

The project was a case of good practices given its operation on-farm and North-South cooperation (if sustained). However, since the initiative came from the North, the project could not continue since the North stopped funding.

##### **C. Lead Institution(s)**

CIRAD-EMVT (France), IRAD(Cameroon), LRVZ Farcha(Chad), Université de Niamey (Niger).

D. Contact Person(s)

Dr. A. Njoya, National Project Coordinator (Cameroon)  
IRAD, B.P. 1073, Garoua, Cameroon  
Tel.: 237 27 20 84 Fax.: 237 27 15 42

E. Collaborating Institutions

INRA (France)  
Université Paris II (France).

F. Funding Sources

Funding (1991-1995): France (Fonds d'Aide et de coopération, CIRAD-EMVT)  
Cameroon, Niger, Chad (salaries, infrastructure and equipment).

## 5. Title of Project: Garoua Project (Use of local resources: The conservation of onions in the rural areas).

### A. Brief background and problem specification:

National consumption of onions is about 3.5 to 4.3kg per inhabitant. This represents national need/demand in the order of 47 000 to 58 000 tons/year for the population of 13. million. Production is seasonal (between February and April in the semi-arid Far North Cameroon. The period of scarcity goes from September to November. Traditional conservation methods are very risky usually leading to post-harvest losses greater than 50% in less than 3 months of storage. Hence, storage of onions constitutes a major problem for the farmer. The general objective of the project in this commodity was to develop, with the operators, technical or organizational innovations to over-come the constraints of onion production in general and onion conservation in particular. The specific objective was therefore to reduce post-harvest losses through improved storage conditions which allow for longer storage periods and less fluctuation of prices during the year.

### B. The Innovation Process

To meet the objectives above, the approach of theTheThe Innovation Process was based on partnership between researchers, producers and extension agents. It involved 3 essential steps: diagnosis, experimentation of technical options, evaluation and dissemination. The diagnosis allows for a choice of technical actions (for research) in consonance with the farmers needs. Experimentation on technical options comprises two steps: local on-farm research and regional research (measure diversity of situations of onion production).

Evaluation and dissemination of innovations involved the training of extension agents, visiting producers and exchange of experiences, dissemination of information (production of technical leaflets in local language, radio communique of prices). improved store capacity was evaluated as a function of average storage needs of farmers determined by number of ha cultivated (0.25 ha  $\Rightarrow$  60 bags  $\Rightarrow$  5.4 tons of onions).

Improved store: The technique consists storing onions in ambient temperature in a well-ventilated store. The model used is characterized by 4 walls of sun-dried bricks provided with holes allowing for circulation of air in the store, a roof made of straw (properly sloped to control rain water. Inside is found 4 modules of storage each of which is made of a series of 4 "sieves", total storage surface in the order of  $1.75\text{m}^2$ /"sieve" (i.e.  $28\text{m}^2$ ). Onions are spread on the "sieves" at the rate of  $70\text{kg}/\text{m}^2$  (i.e. =  $122\text{kg}$ /"sieve") (purpose is to have a "thin layer").

A central corridor and a passage around the modules allow easy access to the bulbs. Rotting or germinating bulbs are removed to reduce the risks of spread. Experimentation is made with the collaboration of volunteer producers who participate in the construction of the store and supply of part the onions stored.

Results show that generally, after 21 weeks of storage, bulb losses in the traditional storage system were two times those of the improved system. Losses due to rotting were more important regardless of storage system. Rate of rotten bulbs in the improved system is 50% of that of the traditional system. Losses by germination are reduced by 1/3 compared to the traditional system. In general, coloured varieties (Violet de Galmi & Goudami) are more "tolerant" of losses than white varieties (Blanc de Galmi).

Regionally, losses after 5 months of storage were less than 10%. In the traditional storage system, losses were 4-6 times those of the improved system.

Economic analysis on the basis of .25ha cultivation (60 bags: 38 bags x 20,000FCFA to pay charges, 23 bags - 10% losses leaves producer with 276 000 FCFA in year 1).

The innovation was rapidly adopted by farmers even before the end of the project. Aspects of good practices include involvement of users at all levels of technology development (problem identification, experimentation, evaluation, etc.) and funding.

C. Lead Institutions: Institute of Agricultural Research for Development (IRAD)

D. Contact Persons: Seiny Boukar  
Chief of Garoua Project  
IRAD, B.P. 33, Garoua  
Fax: 237 29 29 76

E. Collaborating Institutions: CIRAD (Cameroon, France)  
ORSTOM (Cameroon, France)

F. Funding Sources

Funding was by Cameroon Government, farmers and the FAC (1988-1990), CCCE (1988-1990), FAC (1991-1995), CCCE (1991-1995).

## **6. Title of Project: Transformation of fruits into jams and juices.**

### **A. Brief background and problem specification**

Cameroon's ecology allows for abundance of fruit production (oranges, guavas, pawpaws, pineapples, mangoes, etc.). Post-harvest losses are great if the fruits are not sold immediately. Hence the need for transformation/preservation technologies adapted to local conditions. The government, through the Institute of Agricultural Research, Njombe Station, initiated development of the needed technologies.

### **B. The Innovation Process**

To develop the desired transformation/preservation technologies, a laboratory was constructed and equiped. Manpower was trained and put at the disposal of the laboratory. Processing and preservation technologies have been developed as follows: various formulation of jam from local fruits - pineapple, mango, orange, pawpaw, grapefruit, pineapple-mango, pineapple-grapefruit, pineapple-pawpaw, pineapple-pawpaw-ginger; various processes of production and conservation of juices and nectars of various fruits without the use of chemical preservatives (pineapple jus, nectars of lemon, oranges, grapefruit, guavas, mangoes, etc.) These products and component quantities are: pawpaw jam: 130kg pawpaw pulp, 130kg sugar, 13 kg lemon juice; mango jam; 140kg mango pulp, 140kg sugar, 6kg lemon juice; pineapple jam: 150 kg pineapple pulp, 150kg sugar; pawpaw-pineapple jam: 75kg pineapple pulp, 75kg pawpaw pulp, 160kg sugar, 10kg lemon juice; pineapple-pawpaw-ginger jam: 70 kg each of pawpaw and pineapple, 140kg sugar and 700 g ginger; pineapple-guava jam: 75kg each of pineapple and guava pulp, 150kg sugar; pineapple-mango jam: 75kg each of pineapple and mango, 150kg sugar, 5kg lemon juice. While these quantities may be varied, the proportions should be maintained. For extraction and conservation of juices, average yields are pineapple 50%; grapefruit (pulp+nectar), 28%; orange (pulp + nectar), 37.6%; lemon (pulp + nectar), 32%; mango (pulp + nectar), 65%; guava (pulp + nectar), 71-77%. Various techniques of production of plantain and/or banana chips have been developed. These results are disseminated and are used by women (plantain chips), small and medium size industries/individual enterprises (production of jam from local fruits) and production and conservation of juices and nectars from local fruits. The various processing/conservation technologies are available in technical leaflets/factsheets with sufficient details in flow charts.

Features of good practices include transformation of locally produced fruits into products consumed locally with added value and reduction of post-harvest losses.

### **C. Lead Institution(s)**

Institute of Agricultural Research for Development (IRAD)

### **D. Contact Person(s)**

Dr. Tchango Tchango  
Laboratoire de Technologie Alimentaire  
Station de Recherche Agricole de Njombe  
B.P. 13, Njombe Cameroon.  
Tel.: 237 42 71 29  
Fax.: 237 42 57 86

E. Collaborating Institutions

Centre Regional de Recherche sur Bananiers et Plantains (CRBP), Njombe, Cameroon.

F. Funding Sources

Funding upto 1986 was by the state but thereafter, largely external funding has supported further work (AUPELE-UREF, 1995-1996).

## **7. Title of Project: National Veterinary Laboratory ("Laboratoire National Veterinaire") (LANAVET)**

### **A. Brief background and problem specification**

The country's livestock industry which contributes 19% of the agricultural domestic product is composed of cattle, sheep and goats, poultry and pigs essentially. Meat production is respectively 61.3%, 14.7%, 13.3% and 10.6%. The industry was seriously threatened by endemic diseases when the Farcha Laboratory (in Chad) which supplied vaccines for the region (Francophone Africa) collapsed as a result of prolonged civil war. To confront the resulting livestock disease challenge, the Government created LANAVET in 1983. It was reorganized in 1990 as a public establishment of industrial and commercial character. The objectives of the laboratory include analysis of samples of animal origin (whether pathologic or not) from all over the country or from abroad aimed at diagnosis and participation in taking adequate therapeutic and prophylactic measures; production and supply of biological products (vaccines, sera, etc.), chemotherapeutic products (health and hygiene) of veterinary and human use at affordable prices; epizootiological studies and surveillance of animal diseases (transmissible or non transmissible) in Cameroon; scientific and technical cooperation with national and international organizations involved in animal or human health aimed at creating and developing clinical laboratory services; training/retraining of cadres and laboratory technicians.

### **B. The Innovation Process**

The first step was the construction of a modern vaccine production laboratory (LANAVET) in Garoua. It is well equipped and staffed.

LANAVET is provided with a board consisting of a chairman, a representative from the ministries of Finance, Public Health, Industrial and Commercial Development, Scientific and Technical Research and the Department of Veterinary Services (MINEPIA) and representative of livestock farmers. The board has the widest administrative powers. Among other attributes, it determines the general policy of the laboratory as well as control of its activities. It approves the budget, action plans, accounts and results, etc. The resources of the laboratory are derived from sales of products, subventions, gifts and legacies, etc. The laboratory is also provided with a finance commission.

Major progress includes the construction of the laboratory (early 1980) with 3 departments: Dept. of Animal Health, Department of Production (which also has quality control and commercial services), Department of finance and Administration which also includes maintenance and husbandry services).

The Animal Health Department carries out diagnosis (parasitology, virology, bacteriology) as well as epidemio-surveillance. Research is also conducted in these areas.

The Production Department produces viral, bacterial and human vaccines. Among these are vaccines against rinderpest and contagious bovine perineumonia (for cattle), vaccines against Newcastle disease, avian typhoid and cholera, vaccines against blackquarters, hemorrhagic septicemia, anthrax etc. These may be regrouped as follows: Avian vaccines (multivax, avipestorax, sotavax, avibronchovax), Ruminants (pérvax, symptorax, bivax, pastovax, bovipestovax, anthravax, bruvax, etc.). A new vaccine against "peste des petits ruminants" (PPR) has just been completed for goats and sheep.

Vaccines are currently sold within West and Central Africa (Francophone and Anglophone countries).

Minor problems have involved the late disbursement of state subventions (due to economic crisis) and low demand of poultry vaccines given the domination of poultry sector by small/poor farmers. However, given its qualified manpower, infrastructure and high quality vaccines due to good laboratory practices, LANAVET is excellent fortification against major livestock diseases nationally and regionally.

C. Lead Institution(s)

Ministry of Livestock, Fisheries and Animal Industries (MINEPIA)

D. Contact Person(s)

Dr. Abdoukadiiri Souley  
Deputy Director General  
LANAVET, P.O. Box 503, Garoua, Cameroon

Tel. 237 27 13 05

Fax. 237 27 15 42

E. Collaborating Institutions

- Institute of Agricultural Research for Development (IRAD), Cameroon.
- CIRAD-EMVT, France.
- Panafrican Vaccine Control, FAO, European Union, IAEA

F. Funding Sources

Initial funding was by Government of Cameroon and French Cooperation.

## 8. Title of Project: IRAD-ICRAF Agro-forestry Programme

### A. Brief background and problem specification

Poor agricultural practices in West and Central Africa (shifting cultivation accompanied by burning) lead to environmental degradation through deforestation and soil impoverishment. Despite the gravity of the problem, knowledge of agro-forestry is inadequate given the relative marginalization of agro-forestry research. The primary objectives were to develop alternatives to shifting cultivation and to institutionalise research in agro-forestry and strengthen IRAD's capability, etc.

### B. The Innovation Process

To provide the knowledge necessary to address the problem of deforestation and soil infertility, the Institute of Agricultural Research for Development, IRAD, went into cooperation with the International Centre for Research in Agro-forestry ICRAF. Under the IRAD Farming Systems Programme, IRAD-ICRAF agro-forestry unit is designed to cover research and training needs of the West and Central African region. Five specific research areas include diversification of land use systems through domestication, cultivation and marketing of agro-forestry trees and cropping systems, soil fertility management and replenishment through environmentally sustainable and economically sound agro-forestry systems, policy research useful to farmers, increase impact through on-farm validation of on-station research results and technology transfers capacity building through training and equal partnership.

Progress made towards solutions includes manpower development: the training of 3 PhD, 5MS, 35BS and more than 100 technicians and extension agents in agro-forestry research and development; contribution to the capacity building of the University of Dschang for agro-forestry teaching/education; and technology generation: adapted and suitable fallow species for short- and long-term identified, improved fallow and rotational fallow management technologies, high-value indigenous agro-forestry trees targeted for domestication and genetic improvement prioritized, capable and strong national agro-forestry research now in place. So far, improved fallow and rotational fallow management technologies are being disseminated with the collaboration of non-governmental organizations (NGOs) and the national agricultural extension project (PNVA). Genebanks have been established for prioritized trees for domestication and genetic improvement (e. g. *Irvingia gabonensis*, "bush mango"; *Dacryodes edulis*, "plum tree"; *Prunus africana*; *Ricidendron heudelotii*, "njangsang"). Features of good practices include strong and equal collaboration between national and international research institutes, involvement of farmers and extension service in technology generation and validation at a regional level.

C. Lead Institution(s)  
IRAD, ICRAF

D. Contact Person(s)

1. Dr. Nsangou Mama  
Tel. 23 31 05  
Or

2. Dr. Duguma B.D.  
IRAD-ICRAF Agro-forestry Programme  
P.O. Box 2067(Messa), Yaounde Cameroon  
Tel. 237 23 75 60 Fax: 237 23 74 40  
E-mail: ICRAF-Cameroon @ cgnet.com

E. Collaborating Institution(s)  
Ministry of Agriculture.

F. Funding Sources

The project started in 1987 with funding by the Government (salaries of IRAD staff) and ICRAF. More funding input is now required from the government to guarantee continued adaptive research component by IRAD as ICRAF will concentrate on the strategic research component.

## 9. Title of Project: Conservation of Genetic Resources

### A. Brief background and problem specification

The research and extension objectives of developing and disseminating high yielding crop varieties and livestock breeds have led to recommendation and adoption of few varieties or breeds for food production. This use of few improved genotypes, coupled with the elimination of unimproved or local varieties/breeds, results in loss of biodiversity or reduced genetic base. This in turn reduces the national capacity to respond to future challenges or stresses (climate, diseases, pests, etc.) since desired genes might have been lost through reduction of the genetic base. Hence, sustainable food production is endangered by use of few improved genotypes coupled with the elimination and loss of local/unimproved genotypes/varieties/breeds. The Institute of Agricultural Research for Development (IRAD) whose predecessors promoted the use of few genotypes recognized this danger and initiated a programme of genetic resources conservation in 1984. Other objectives included identification, characterization and evaluation of the resources concerned.

### B. The Innovation Process

Collections of cultivated and related wild plants were made as follows: cereals (maize, millet and sorghum, rice: 30, 1933, 227 accessions), Legumes (cowpea (local + wild), bambara groundnuts, beans (all varieties), groundnuts (old cultivars): 462, 238, 309, 96 accessions), tubers (yams (traditional + wild), cocoyams (old + wild): 32, 115 accessions), coffee (wild varieties): 63 accessions, plums ("safoutiers"): 55 accessions. fruits (wild assorted): 33 accessions. For cocoyams, of 300 accessions collected from Cameroon, Central America, Ghana, Togo and Equatorial Guinea, 64 were selected for preservation *in vitro* at Njombe. For plantains (130 accessions) and bananas (270 accessions), 400 accessions have been collected at Njombe as well.

These collections are conserved on Research Stations in 5 agro-ecological zones (*Ex Situ*) as follows:

- dry seed in cold, air conditioned rooms, refrigerators or freezers (cold stores: 3 at Maroua for cereals, and legumes, 1 at Dschang for legumes; air conditioned rooms: 3 at Bambui, Nkolbisson and Dschang for cereals; refrigerators/freezers at almost all stations to assist weak storage systems in place)
- field seed/genebanks (maintenance of plots, arboretums, botanic gardens) : 40 plots distributed among all IRAD stations as well as some private and parapublic structures. Several species are involved (legumes, tubers (yams, cocoyams), cassava, bananas, plantains, coffee/cocoa/tea, wild fruit trees, pastures (grasses & legumes)).
- *in vitro* plants (methods for *in vitro* (tissue culture) conservation are being developed by IRAD at Ekona for roots and tubers and at Njombe for bananas and plantains.

*In situ* conservation is possible only in national parks (7) and game reserves (8) totalling 2,578,895 ha. There are about 13 forest reserves in addition.

To complement national conservation/preservation facilities, some collections are distributed between national and international facilities.

For livestock, collections of some threatened but disease resistant/tolerant breeds are on research stations (Yagoua: Namchi and Kapsiki cattle; Nkolbisson; black belly sheep).

Characterization work is fairly advanced for *Gnetum africana* ( a widely consumed liana) and cattle( Namchi and Kapsiki ).

Major problems involved shortage of qualified man-power, insufficient infrastructure and frequent power failures. Near absence of *in situ* conservation imposes adaptation problems for conserved material.

The project, was, however, a case of good practices given the possible insurance against future genetic challenge (availability of genetic variability for use when necessary).

C. Lead Institution(s)

IRAD

D. Contact Person(s)

Mr. Fondoun Jean-Marie (Plant Genetic Resources)

IRAD, B.P. 1457, Yaounde, Cameroon

Telefax: 237 23 35 38

Dr. D.A. Mbah (Animal Genetic Resources)

DVDT/MINREST, B.P. 1457, Yaounde, Cameroon

Telefax 237 23 60 43/237 23 54 67

E. Collaborating Institutions (not in Cameroon)

IPGRI, FAO, IITA, ILRI, WARDA, ICRISAT.

F. Funding Sources

Funding was mainly external (FAO, AUPELF-UREF) and by the State

## 10. Title of Project : Promotion of Adapted Farming Systems based on Animal Traction in the Northwest Province of Cameroon.

### A. Brief Background and Problem Specification

The Northwest province is a densely populated rural, hilly plateau region with a high food production potential. The cultural patterns are such that women, using labour intensive methods with the hand-hoe as the main farming instrument, produce most of the food. Shifting cultivation, slashing, burying and burning are widely practiced. The result has been increasing soil degradation and decreasing yields on increasingly scarce land coupled with an ever increasing population and poverty. To reverse the trend, the governments of Cameroon and Germany negotiated a technical cooperation project with emphasis on soil conservation and improvement, **integration of women into agricultural development**, use of animal traction for farm work and self-reliability among the farmers in the hope of improving the living conditions of the rural population in general. The objectives were to promote farming which is adapted to ecological (reduction of erosion and destruction of soils), social (accepted and appreciated by farmers) and economic (affordable and profitable methods) conditions; farming which is mechanized by use of draught oxen (reduction of labour burden, acceleration of farm work, increase in farm size, production and income) and improvement of the living conditions of the farmers (less and easier work, more time for other activities, more and better food, more income for school fees, health care, etc).

### B. The Innovation Process

Participating farming families, groups or individuals possessed land (about 1.5ha) as the farms had to be permanent with cropping "every year continuously and forever without shifting to another farm". A pair of oxen (cattle : Red Fulani, White Fulani) yoked and supplied with a plough had to be owned or hired for work. A cowshed had to be provided for the cattle during the night (protection and production of dung). A loan scheme was put in place to enable farmers meet these necessary requirements. Elements of the system included contour bonds (big ridges) along contour lines (prevention of erosion), planting of permanent and seasonal crops (reinforcement of contour bonds and production of food and income), small ridges (between contour bonds for prevention of erosion between the contour bonds and provision of optimum growing conditions for seasonal crops), mixed cropping and crop rotation (of seasonal crops) (conservation of soil, protection against diseases and guarantee of good yields), planting of legumes (improvement of soil fertility), draught oxen (labour reduction and acceleration of work and increase income), use of cowdung and green manure (reduction of expenses on chemical fertilizers), etc.

**To enable the rural women benefit from the project, a special support programme for women was introduced.** Women were encouraged to organise themselves into groups. To guarantee continuation of the Permanent Farming System, both men and women were trained and oriented together. From 1986-1991, 1025 farmer families were trained and equipped with oxen/tools, 2050 oxen were involved, **72 women groups (1440 women) were involved, and about 2000 women farmers were involved in the project.** Today, more than 800 farmer families (adoption rate =  $\approx$  75%) still own their oxen hools and are working. Many farmers are waiting to be trained in animal traction.

Funding : The project ran from 1982 to 1994. Funding was by Germany (GTZ) and Cameroon. Continuation of the project is assured by the Northwest Development Mission (MIDENO) with an African Development Bank loan.

Major problems encountered include the inability of some farmers to repay the loans, the arrival of the economic crisis which reduced government's ability to fund the project, and acute shortage of manpower (trained) in the face of GTZ departure.

Despite the problems, the project was a case of good practices given its inclusion of women (major component of project, grassroots organizations, sustainable) « mechanization » of agriculture in the province, major stockholders and a credit scheme.

C. Lead Institutions

- . Northwest Development Authority (MIDENO)
- . Ministry of Agriculture
- . German Technical Assistance (GTZ)

D. Collaborating Institutions

- . Presbyterian Rural Training Centre (RTC), Fonta
- . Institute of Agricultural Research for Development (IRAD)
- . University of Dschang
- . Bafut Village Community Project
- . INADES FORMATION

E. Contact person(s)

- . Mr. John Ndeh
- . Director General
- . Northwest Development Authority (MIDENO)
- . Northwest Province, Cameroon
- . P.O Box 442, Bamenda
- . Tel/Fax: (237) 36 16 61.....

F.

Funding Sources

Funding was by Germany (GTZ) and Cameroon. (Africa Development Bank)