

Bibliothèque UA/SAFGRAD
01 BP. 1793 Ouagadougou 01
Tel. 30 - 60 - 71 / 31 - 15 - 28
Burkina Faso


ORGANIZATION OF AFRICAN UNITY
SCIENTIFIC, TECHNICAL AND RESEARCH COMMISSION
(OAU/STRC)



FARMING SYSTEMS RESEARCH PROGRAMME

FSR PROJECT PROPOSAL
(1988 - 1990)
DRAFT

SAFGRAD
SEMI-ARID FOOD GRAIN RESEARCH AND DEVELOPMENT

631.2
SAF / 5H

Bibliothèque UA/SAFGRAD
01 BP. 1783 Ouagadougou 01
Tél. 30 - 60 - 71/31 - 15 - 98
Burkina Faso

ORGANIZATION OF AFRICAN UNITY
SCIENTIFIC, TECHNICAL AND RESEARCH COMMISSION
(OAU/STRC)

FARMING SYSTEMS RESEARCH PROGRAMME

631.2
SAF

FSR PROJECT PROPOSAL
(1988 - 1990)
DRAFT

Submitted to :
International Fund for Agricultural Development
(IFAD)

The Coordination Office
OAU/STRC/SAFGRAD
B.P 1783
Ouagadougou, Burkina Faso

3456

October, 1987

TABLE OF CONTENTS

	<u>PAGE</u>
I. BACKGROUND INFORMATION	
FSR objectives	2
Highlights of project activities	4
II. SUMMARY OF RESEARCH HIGHLIGHTS	8
Benin	8
Burkina Faso	11
Cameroon	17
III. PROGRAMME PROPOSAL	20
Benin	20
Burkina Faso	31
Cameroon	49
IV. IMPLEMENTATION STRATEGY	61
V. BUDGET PROPOSALS	64

OAU/STRC/FSR RESEARCH PROJECT PROPOSAL
(1988 - 1990)

I. BACKGROUND INFORMATION

The Semi-Arid Food Grain Research and Development (SAFGRAD) of the OAU/STRC Project was conceptualized to effectively mobilize and coordinate available regional research resources to enhance food grain production among small farmers. The SAFGRAD collaborative research, training and technology transfer activities have been implemented in cooperation with International Agricultural Research Centers such as IITA for developing short cycle, drought and pest resistant varieties of maize and cowpea, with ICRISAT to develop suitable production technologies for sorghum and millet in semi-arid tropical regions of sub-Saharan Africa. In 1977, the SAFGRAD programme was thus realized with premise that regionally oriented research could facilitate the strengthening of national research programmes.

Until recently it was assumed that advanced technology was neutral in terms of the production scales in which it was applied. This fact ignored the structural differences in the rural sector of Africa in types of farms, tenancy, size of holding and access to complementary inputs needed with this technology. Clearly, the emphasis was on the increase of physical yields rather than on economic profitability. Therefore, the investment in research did not often yield the expected dividends in terms of productivity and production, since the research results lack relevance to the vast majority of the farmers. Corrective measures including those which take fully into account the farming systems, especially the farmers' decision-making process with respect to the allocation of scarce resources among competing activities and the production constraints, were required. It was particularly stressed that the physical, biological and social scientists should collaborate in Farming Systems , in all phases of the implementation of the research programmes including design and evaluation. Where such modifications took place, the introduction of appropriate technological packages led to significant and self-sustained increase in productivity and on-farm production.

The target groups of this project are small farmers, with poor resources. The emphasis of the FSR is to develop and adopt suitable technologies taking into consideration salient production determinants such as climatological, social

and economic environments in which the production process takes place. In addition, FSR approach attempts to reinforce or rejuvenate areas of linkages that have become weak or ineffective within many systems of agricultural production. The IFAD-supported FSR programmes structured within the existing national agricultural research and extension development system provide an opportunity to promote multidisciplinary research that enables the identification of constraints of food production that could evolve relevant research activities and appropriate strategies and linkages. The FSR is therefore viewed as part of the broader research-extension rural development system.

FSR activities is much influenced by specific climatological and socio-economic interactions that systems of production operate. Each national FSR supported through this programme varies accordingly. From the OAU/STRC/SAFGRAD perspective through IFAD funding, the FSR development in Benin, Burkina Faso and Cameroon could attain the following important functions :

- The development of understanding of current systems of food production or the total farm environment and to identify major constraints of food production among small farmers.
- The formulation of priorities based on major constraints and sequencing of the problem solving in the long-term development of farming systems by utilizing farmers' knowledge of the environment and resources, and knowledge from analogous situations to evolve solutions of problems faced by farmers.
- The evaluation of new production technologies through on-farm trials which directly investigate most apparent obstacles to increase food production.

FSR Objectives

The overall objective is to ensure that the farming systems which research is intended to benefit, are fully understood and taken into account so as to create conditions which could stimulate farmers' initiative for production, and induce technologies in order to adopt better management practices for increasing food production.

From the OAU/STRC perspective the general objectives of the FSR project are :

- . to improve the national FSR capacity in order to evaluate and to adopt appropriate technologies ;
- . to integrate current commodity-oriented research programmes into inter-disciplinary research activities by assisting national FSR programmes to develop holistic research approach ;
- . to enhance agricultural development in rural areas by identifying constraints and technologies which could alleviate them ;
- . to influence research priorities, approach and strategy so that emphasis would be on farmers' need ;
- . to influence national agricultural policies (research and production) by providing feed back of technical and institutional constraints that impede acceptance and adoption of technology to increase food production; and
- . in collaboration with IARCs and donors support, to develop FSR network design to link scientists and institutions involved in FSR activities in the semi-arid zones of Africa for active coordination and cooperation among them.

Highlights of Project Activities

Research Co-ordination

Since the first year of the IFAD's support to SAFGRAD, substantial progress has been made in the improvement of research co-ordination between the national research programmes and those of international agricultural research centres (IITA and ICRISAT). A comprehensive review of the project was carried out, and SAFGRAD management mechanisms revitalized. In order to evaluate the SAFGRAD programme as well as to provide policy guidelines, three meetings of the Consultative Committee and two meetings of the Technical Advisory Committee were held. To strengthen research networking activities among member countries, regional annual workshops on sorghum and millet, maize and cowpea, have been held in cooperation with IITA, ICRISAT and national research programmes.

Evaluation of SAFGRAD Phase I, was made between January and March 1984. Since the OAU/STRC management gave priority to this final evaluation of the project, the International Coordinator and Director of Research became increasingly involved. Following a series of workshops and programme evaluations the marked improvement in research co-ordinating capacity as well as in SAFGRAD's technology promotion and transfer activities became evident.

As indicated earlier, SAFGRAD II was initiated with major orientation to strengthen collaborative research networks among participating NARS. The technical input of IFAD to the Coordination Office had substantially contributed to the realization of SAFGRAD II by working with USAID consultants and design team in 1985 and 1986.

Launching of the FSR Programme

a. Fielding of consultants

The search for consultants took considerable time. In January, 1984, three consultants were able to undertake the FSR programme's initial study. From 14 to 28 February 1984, the Director of Research accompanied the consultants on a study tour to Mali, Senegal and Nigeria (IITA headquarters in Ibadan). The

consultants' report was received on 21 February, 1984.

b. Recruitment of FSR professional staff

Between March and August 1985, six scientists were recruited : an agricultural economist, a soil scientist and an animal production specialist for Burkina Faso ; an agricultural economist and a soil scientist for Cameroon FSR and one agronomist for the Republic of Benin FSR programme. The economist for the Benin FSR was finally recruited in July 1986 and senior agronomist of Benin FSR programme resigned and was replaced in January, 1986.

c. Establishment of the FSR programme implementation Monitoring Mechanisms

The Project Management Committee (PMC) as conceived within the IFAD project document, provided both administrative and technical management of the FSR activities. Since 1984, this committee met five times and made major decisions with regard to programme content, management and professional staff recruitment. Based on the last three years' experience, restructuring of the composition of this committee was proposed.

As the programme was fully developed, the In-House FSR Review Committee comprised largely of technical scientists, external consultants, the SAFGRAD management and donor representatives was established. This committee met twice to review the technical feasibility of the proposed FSR programmes. Furthermore, the coordination and implementation of the FSR programme was monitored through consultancy meeting, field tours of scientists and the Director of Research.

d. ICRAF/SAFGRAD cooperative research activity in agroforestry

The main objectives of an ICRAF and SAFGRAD initiative would be to integrate the agroforestry dimension into on-going IFAD-supported FSR programmes in the three countries. ICRAF provided backstop support to recruit and train the three agroforesters for six months; to strengthen the capabilities of the SAFGRAD scientists in order to :

- (i) evaluate existing land-use systems, vis-a-vis the potential of agroforestry technologies, in order to improve productivity and/or sustainability ;

- (ii) derive from such evaluation the corresponding agroforestry research projects, and to design agroforestry research to generate technologies for overcoming the diagnosed constraints ; and
- (iii) launch the implementation phase of research projects aimed at developing location-specific agroforestry technologies.

The scientists have currently initiated agroforestry research within FSR framework in the three countries.

e. Institutional support

Improvement of research capacity to further evaluate and verify promising technologies by most national programmes is much influenced by their respective research institutional framework and functional linkages with development agencies. The focus of the FSR support in each country has been to facilitate the institutionalization and practice of multidisciplinary research among thematic research programmes. Institutional support in Benin, Burkina Faso and Cameroon, through IFAD financial assistance covered the following areas :

(i) Elaboration of appropriate farming system methodologies

With the addition of an agroforester to each country FSR programme in 1987, the technical professional input by IFAD to Burkina Faso (4 staff), Benin (3 staff) and Cameroon (3 staff) would be completed. These scientists, in cooperation with respective national research scientists, and international agricultural centres (IITA, ICRISAT), provide technical assistance for the elaboration and development of suitable farming system methodologies in each country. These experts also advised national researchers and administrators with regard to the institutionalization of FSR to be the focal link to undertake multidisciplinary research.

(ii) Training and seminars

To improve research skills, short-term training would be carried out. The themes of training needs will be identified by FSR teams of each respective country. Participants for training although would largely be selected from Benin, Burkina Faso and Cameroon, the service could be extended also to the other member countries of SAFGRAD, provided financial support from other sources is

made available. National scientific staff as well as SAFGRAD technical staff are encouraged to participate in various seminars and workshops in FSR, on crop commodities, soil-water management, etc... Institutionalization of FSR also largely depends on long-term training support for promising scientists. The national research programmes of Benin, Cameroon and Burkina Faso have already made requests for long-term training for strengthening their respective national FSR programmes. To minimize costs of long-term training advanced training could be pursued in selected African Universities.

(iii) Acquiring equipment supplies

Very few research equipments have been acquired. To facilitate the implementation of the programme at field level, vehicles, mopedettes, some farm implements and supplies were made available through the project funds. The major share of operational cost thus far, in each country is born by the project.

II. SUMMARY OF RESEARCH HIGHLIGHTS

1.0 BENIN

During the first year (1985) the following surveys were conducted : information/reconnaissance surveys in the two provinces ; a detailed baseline survey covering crops and the cropping calendar, rainfall patterns, vegetation, livestock, marketing infrastructures, credit, source of farm power and a review of available research results for Northern Benin. In 1986 the focus was on survey of farmers' agricultural practices and agronomic studies to measure field level environmental and managerial variables on selected farms.

- . The following major constraints, technology needs and observations for Northern Benin were identified : research in Benin is disciplinary/thematic and there is need to conduct research programmes with a farming systems perspective. Drought in the extreme north and the need to search for drought resistant and short cycle varieties of major food grains as well as water conservation techniques. Major foodcrops are grown in association, yet no data exist on the performance of intercropped systems. Soil conservation and improved agroforestry techniques need to be developed especially for Ouake and Boukoumbé districts in the Atacora province. Animal feed is a problem especially during the dry season ; investigations are required to increase fodder production for animal traction. Labour bottlenecks at planting (yams) weeding (cereals) and limited use of animal traction, inadequate market infrastructures and input delivery for foodcrops.
- . Data and results from the 1986 survey on agricultural practices were used in part to refine the design of some agronomic trials in 1987.
- . A comprehensive study of resource utilization (input/output data) is currently underway on a sample of 15 farmers/village in all sites. The purpose is to generate parameters that characterize the existing farming systems (cropping, livestock and agroforestry systems) and to determine their biological and economic productivity under current technology.

Researcher managed trials have been established at Ina, Sokka, Bensekou, Birni-Lafia in Borgou province. The trials involved the evaluation of crop associations, land preparation, fertilizer application and variety testing on sorghum, maize, cowpeas, groundnuts, millet, cotton and yams. The following preliminary results have been achieved :

- (i) For two consecutive years results showed that maize growing in association with cotton did not benefit from fertilizer normally applied to cotton.
- (ii) Growing crops in association cereal/cereal or cereal/legume (sorghum/millet) reduces the yield of individual crops. The economic advantages of crop associations is being evaluated.
- (iii) There are some indications that appropriate leguminous green manure could improve the performance of maize.
- (iv) Effect of ridging and cultivation on flat on performance of food grain crops is still being evaluated ;
- (v) There was no significant difference between yields of yams grown on mounds or ridges. Consequently economic gains (in terms of labour saving) are being evaluated under farmers' management.
- (vi) The improved varieties of maize (TZB) and sorghum (Ghana 1) out-yielded local varieties ; TZB responded more positively to fertilizer application than the local variety. Consequently economic evaluation of variety x fertilizer use is being evaluated on maize under farmers' management.

In the Karimama district (Borgou) researcher managed trials are being evaluated to address the drought constraint. These involve variety testing for drought tolerance and water use efficiency technique.

At Ouaké and Boukoumbe in the Atacora province researcher managed trials are being evaluated to address the soil degradation constraints. These trials involve : studies on suitable crop rotation and alternative sources of fertilizer.

The constraints related to agroforestry (severe lack of fodder, soil degradation and shortage of wood for various uses especially in the extreme north) were addressed in 1986 following the reconnaissance and baseline surveys. This resulted in the establishment of two preliminary trials with Leucaena leucocephala and Acacia albida in association with sorghum and cowpea at the station; with the arrival of the FSR Agroforester in March 1987, a more elaborate survey of the traditional agroforestry and livestock systems was initiated.

At the same time agroforestry practices such as alley cropping system developed by IITA, with Leucaena and Cajanus Cajan, were established and are being evaluated for Northern Benin conditions.

Preliminary results look promising both in terms of soil regeneration and fodder production.

The FSR team has also been involved in the development and production of fodder for livestock during the dry season. A programme of forage legume and grass introduction and evaluation has been initiated. Presently, species such as Panicum maximum, Pennisetum purpureum and Stylosanthes hamata show good potentials for fodder in the Guinea Savanna zone and are also being evaluated in the drier northern zones.

Contacts and plans have been advanced with CARDER and Projet Elevage Borgou for on-farm evaluation and management of these species under farmer conditions for the most nutritionally stressed animals.

(d) Institutional linkages

- . The integration of the SAFGRAD/FSR programme into the Ina Station research curriculum is complete. Current efforts are aimed at enhancing the interface between FSR and thematic/commodity research at the station level.
- . Collaboration with the regional development agencies (CARDER and UNSO) is currently in the form of a joint experimentation and demonstration on agroforestry studies. The support of CARDER field Officers has been essential in 1986.

2.C BURKINA FASO

The first year of the IFAD-supported FSR activities (1985) in Burkina Faso were carried out in the former FSR villages where adequate socio-economic data and field infrastructures existed. Following major review of the national research programme, the FSR activities were moved into new village sites within the Mossi Plateau. As a result, reconnaissance survey was carried out and the three meso-regions that represent farming system practices of the Mossi Plateau were described. The major agricultural production constraints of the region were identified. Furthermore, the technological development needs, as expressed by farmers themselves were documented. As indicated earlier, three primary research village sites were selected. The findings of this study were published.

Based on the above-mentioned socio-economic exploratory survey, the FSR programme was developed and largely included crop and animal production systems, socio-economic baseline on-farm studies, soil-water management studies, and an agroforestry component which was initiated in 1987.

In-depth surveys in the newly selected NFSR villages were conducted in 1986 on samples of twenty-four to thirty-five households in each village. The major areas of investigations included crop and livestock production systems (input-output, resource endowment, management, etc.), marketing, off-farm income generating activities and income allocation to expenditures (consumption, purchase of inputs of investments) characteristics of varieties, utilization and adoption criteria.

Parts of the crop production and livestock production data have been analyzed and special studies are partly completed. Collection of the other data will continue until the 1987 harvest time before analysis begins. Using partial budget analysis approach, the yield difference acceptability to farmers, at various levels of assumed risk aversion, of major elite varieties and of promising management techniques, has been evaluated on the basis of the 1986 researcher managed agronomic trials.

Using computing facilities obtained with a USAID/SAFGRAD grant to the economist, existing baseline survey data have been analyzed. The research focused on understanding of farmers' soil and crop management practices in Burkina Faso. This led to the modelling of cropping systems in the area (in an outside Mossi Plateau) on the basis of a ring management theory ; measurements of the basic

resource endowment and resource management parameters of the farming systems ; analysis of major input-output coefficients of the cropping systems ; soil fertility management effects on labor return ; farming systems adjustment mechanics vis-a-vis land use intensification pressure, major agricultural research and policy implications of the research findings.

The soil fertility investigation included, the evaluation of fallow fields that had very low levels of organic matter, available phosphorus and exchangeable bases. Samples from compound fields, adjacent to Nere and Acacia albida trees, and those from termite mounds had higher values of exchangeable bases (K, Ca and Mg). In addition, compound fields and samples from nearby Nere trees had higher values of organic matter and available phosphorus. Application of Burkina phosphate up to 200 kg/ha for four years, did not influence available phosphorus noticeably. Localised fertilizer application, leading to heterogeneity, may prevent detection of any changes by soil sample analysis. The introduction and proper utilization of useful leguminous forage shrubs and trees would be fully investigated in restoring the fertility of the soil.

Millet fertilization with manure was also conducted at Diapangou in 1985. Manure application up to 3.1 t/ha each year for two years, did not influence millet yields significantly. Similarly, there was no significant effect on yield of Burkina phosphate applied during the first year. There was a significant response of millet grain and stalk yield to the application of 110 kg/ha NPK. The results were consistent with those obtained in 1984 for the same site. The mean grain yield was 611 kg/ha without fertilizer and 784 kg/ha with 100 kg/ha of NPK. Corresponding stalk yields were 5130 and 8110 kg/ha on air dried weight basis. Farmer managed trials were carried out in Poedogo with Framida (an improved variety) and local red sorghum. Framida outperformed the local variety with and without inputs in grain, and stalk yield.

Still higher yields are recorded for Framida with inputs. Stalk yields were 3450 kg/ha for local variety and 4060 kg/ha for Framida. Net revenue gain of as much as 10,000 CFA/ha could be obtained if Framida were grown in place of local variety. This involves no additional labour or fertilizer use. Return on additional labour and improved management level was more than twice as much as the labour opportunity cost, of 50 CFA/hour for Framida. With local variety, returns to additional labour were less than the labour opportunity cost.

An evaluation of a mechanical ridge tier (developed by IITA/SAFGRAD) indicated that more work on improvement of the machine was needed to reduce its weight for establishing soil conditions suited to tied ridging and increasing adaptability of the machine. Work along this line needs to continue.

Leucaena leucocephala and pigeon pea planted on fallow marginal land established well. Pigeon peas stayed green up to four months after the rains, grew to height of 160 cm and provided good soil cover with leaf fall. Leucaena leucocephala seedlings survived the dry season after browsing by animals to bare stem. The next rainy season plants continued to have vigorous regrowth. It is concluded that legume shrubs or trees which could provide soil cover during most of the year for multiple purpose could be identified. Work was planned to be pursued over several seasons but due to change of sites the trials were abandoned.

Experiments with cereal response to tied ridging and fertilizer application were pursued in 1986 on several locations in three new village sites. The results were similar to previous findings. Grain and straw yields of white sorghum, red sorghum and grain yields of maize were significantly higher with improved management than under traditional practice. That straw yields can substantially be increased by soil water and fertility improvement implies that scarcity of mulch material can be partially alleviated.

Variety performance difference with respect to yield was less marked as the soil-water management effect. Some varieties that perform as well as the locals under traditional practice but excel the locals under improved management are Framida (red sorghum for Soudanian zone), IRAT 204 and SPV 35 (white sorghum for Soudanian zone) and ICSV 1002 and ICSV 16-5 (white sorghum for Soudanian zone).

Experiments of legume grains trials on several location were conducted in 1986. Where the rainfall was low (Soudanian-Sahelian zone, 468 mm) grain yields of cowpeas and peanuts were low. Bambara nuts failed. In the Soudanian zone (663 - 818 mm) legume grain yields responded to phosphate application. The introduced cowpea variety (TVX3236) outperformed local varieties.

Red sorghum intercropped with cowpea gave yields comparable to sorghum monocrop. As a bonus some cowpea grain (less than 300 kg/ha) and cowpea straw

(for hay) can be harvested. Intercropped millet grain and straw yield was comparable to that of monocropped millet. At the same time some grain legume can be harvested. More work on species, space and time arrangements to increase benefit from legumes without substantially reducing cereal yields in cereal/legume association, is being carried out.

The livestock component experiments comprised evaluation of forage legumes, assessment of the establishment on abandoned land and conservation of forages for dry season feeding. The work has emphasized the use of abandoned fallow land to grow forage legumes for animal feed and partial regeneration of soil fertility. It was hypothesized that such work could demonstrate, with overtime the benefits of regenerating the soil to lead to higher crop productivity and stable agriculture in the area.

Availability of feed both quantitatively and qualitatively is the most limiting to improve the productivity of animals. Emphasis was therefore given to research on feed resources in the first two years and lately followed by a preliminary feeding trial on sheep. The investigation, during the rainy season covered aspects of agronomic performance, biomass yield, nutritive value, nodulation and regrowth performance of forage and dual purpose legumes.

Natural pastures properly managed could be an important source of livestock feed. Forage legume could serve as a source of nitrogen supplement. Based on digestibility and nitrogen content the optimum stage of cutting of forage legumes for conservation was about 75 days (± 12 days). This coincided with the period at which the labour requirement for cereal crops is at a low ebb, thus allowing the conservation of forages at the desired stages of growth.

Forage legumes are important as livestock feed as well as for rejuvenating the fertility of the soil. D. lablab, M. atropurpureum and S. hamata stayed vegetatively green with good soil cover, for over four weeks after the rainy season. The deep rooting system of these spp might have contributed to the improvement of the physical structure of soil.

Besides, the regrowth organic matter (5130, 7805 and 3825 kg/ha) and Nitrogen (115,274 and 82 kg/ha) yields of D. lablab, V. unguiculata (cv. KN1) and P. aureus respectively after conservation as feed, indicated the potential that exist to green manure the soil for subsequent cropping.

S. hamata and M. atropurpureum made good regrowth, the former with increased density, in the subsequent rainy season after having been completely grazed by stray animals. These forage legumes could be grown in mixture with grass to improve natural pastures.

Without insecticide application, cowpea varieties, tested as dual purpose legume, failed to produce grain due to insect attack but could fit into the system as forage crop. They out-performed all other legumes in the number, size and characters of nodules.

Amongst the legumes tested D. lablab with its good drought tolerance, vegetative growth, delayed onset of flowering, and constancy in its nitrogen content as it matures, is the legume of choice as forage. However, its failure to set seeds is a disadvantage probably due to its photoperiod sensitivity, unless residual moisture is available after the rains have stopped.

Conservation of natural pasture and cultivated forage legumes as hay was technically possible under farmers' conditions. The conservation as silage demands further investigation .

48. Intercropping D. lablab with sorghum out-performed the sole crop of sorghum in Nitrogen yield and the sole crop of Dolichos in total forage dry matter. Intercropping resulted in a decrease or loss in sorghum crop NP.

Lambs responded to D. lablab and cowpea supplementation of natural pasture hay by increasing the total dry matter intake. The responses in live weight gain, D. lablab and cowpea (cv. KN1) supplementation at low or high levels, were below the expected and slightly higher than maintenance. Further investigation was required.

The feeding trial enabled the making of compost, using sheep faeces, feed refuse and purchased manure to which was added Burkina rock phosphate to improve its solubility.

The agroforestry component started with pre-diagnosis survey work based on synthesis of existing bibliography and information collected from development and research services since March 1987. Complementary knowledge of the socio-economic and biological environment of the Mossi Plateau which would lead to agroforestry intervention was synthesized.

A diagnosis survey work was conducted in Kamsi (one of the village sites) and surrounding villages. The survey work (pre-diagnosis and diagnosis) has resulted in proposals to identify agroforestry alternatives to alleviate identified constraints.

The FSR programme is developed through full participation of other research units of INERA. The programme is discussed every year at the meeting of national research committee and scientists as well as with rural development agencies located in the Mossi Plateau. In order to stream-line the FSR project activities within the OAU/STRC global objectives, the annual FSR activities is also reviewed by the In-House Review Committee and the Project Management Committee .

Good linkages have been established with IITA and ICRISAT/SAFGRAD collaborative research programmes, the University of Ouagadougou and rural development agencies, in order to facilitate the implementation of the programme. While the technical and administrative back-up support is also provided by OAU/STRC/SAFGRAD Coordination Office and INERA, the field activities is implemented by technical and administrative support personnel based mostly at the primary villages.

The testing and evaluation of technologies and integration of FSR components is first elaborated at the primary sites throughout the season. Long-term research at such permanent sites is expected to lead to restoration of soil fertility and recycling of resources.

Through farmer-managed trials and interaction with extension agents, the diffusion of suitable technologies would be attained. Major effort would be pursued on this aspect of FSR activities during Phase II of IFAD support.

3.0 CAMEROON

The existing farming systems in the area consist of (a) a cotton-based cropping systems where farmers plant cotton-sorghum or cotton-maize-groundnuts in rotation and (b) a sorghum-groundnut-based cropping system where farmers plant sorghum-groundnuts-maize-sorghum in single rotation or in various associations.

When cropping activities are correlated with the rainfall pattern, planting time is the most critical period to farmers. With the onset of the rains in May, the first crops to be planted are sorghum and groundnuts. This is followed by cotton, maize and cowpea. Generally planting is done between mid-May and mid-June. In the Sahelian zone (600-800 mm of rain), however, farmers stagger the plantings from mid-May to early July. This is probably due to unreliable rainfall patterns.

Farmers' agronomic practices include digging with a hoe. They also use ox-plough or tractor and harrow for soil preparation. About an equal number of cotton and non-cotton farmers use ox-plough and/or dig with a hoe. Planting can be done with a hoe, with finers or a stick. Cotton farmers plant in lines and make mounds or ridges at weeding time in order to increase the soil moisture retention capacity. Cotton farmers also apply fertilizers and use insecticides on their crops.

Livestock production is an important activity in the FSR project area. There are some farmers who are just herders and other who keep cattle and cultivate crops. The average farm family has 8 cattle, 2 of which are oxen for animal traction, 6 goats and 3 sheep. The feeding of livestock, especially during the dry season, poses a problem to farmers who must move their animals further south or to valleys in search of grazing ground and water. Farmers use various sources of animal feed, crop residues, tree leaves, grain husks and hay. Dried sorghum residue and groundnut stalks are fed to animals when other sources have been exhausted during the dry season.

Tree planting is popular in North East Benoue and West Benoue where 10 to 20% of the farmers consider the planting of trees an important farm activity. Farmers plant Nime, Guava, Eucalyptus, Mango, Citrus, and Acacia trees. The main reasons which farmers give for tree planting are to stop desert encroachment and to provide fruits.

In order to address some of the identified production constraints, a number of agronomic trials were conducted in 1986, including researcher-managed on-farm trials and/or farmer-managed trials with development agents, extension workers and farmers. The on-farm trials involved one to three levels of management including soil fertility, soil water conservation and crop management.

All together there were 2 fertilizer and manure trials, 14 soil moisture conservation trials on maize production, 14 soil moisture conservation on sorghum production, 12 maize density, 24 maize variety trials and 22 groundnut variety trials. Thus, there were 94 trials of which 83 (88.3%) were successfully harvested and recorded.

With one year of agronomic data, no conclusion can be drawn. Some trends however, were observed in the agronomic results and some of these trials need to be repeated in subsequent years.

For fertilizer and manure trials, the yields obtained with 100 kg N/ha were almost the same as those obtained with 5 tons of animal manure + 50 kg N/ha at two sites. This suggests that animal manure can substitute for chemical fertilizers to some extent and could be beneficial in the long run. This experiment was done in two types of soils. At Badjouma, soils are quite heavy with a higher cation exchange capacity and exchangeable cations, organic carbon, total N and available-P. The soils at Ngong are sandy in nature, low in exchangeable cations and cation exchange capacity and quite low in available phosphorus and total nitrogen.

For the soil moisture conservation trials on maize production, there were significantly higher yields at Ngong with its sandy soils and tied ridging at 2 m intervals after one month of planting. There were no significant yield differences at Bajouma with its heavy soils. This suggests that the benefit of ridging and/or tied ridging is location specific depending on soil type and rainfall pattern. Results from the on-farm trials in Hamkousson and Tchollire also gave no significant yield differences. However, the results from on-farm farmer-managed trials at Ngong and Baikwa indicate that ridging one month after planting does give about 37.3% higher maize yields than flat.

Results from the soil moisture conservation trials on sorghum production from the on-farm researcher-managed trials showed no significant difference between treatments, although, at Pitoa ridging was found to be quite beneficial.

The non-significant sorghum yields could be because sorghum is a hardy crop which is quite tolerant to moisture stress as compared to maize.

For maize variety on-farm managed trials, there were no significant differences between the maize varieties tested. Farmers in North East Benoue, however, showed a preference for CMS 8501 because of its earliness, resistance to streak virus and cycle of 90-100 days. Among the tested maize varieties with a 120 days cycle, TZPB-SR appears to have greater advantages because it is streak-resistant.

For sorghum variety on-farm researcher-managed trials, S-34 out-yielded the local check, followed by CS-63. Although S-34 yields higher than CS-63, the two sorghums were not significantly different. Because S-34 is a short cycle variety of 90-95 days, its planting date must be adjusted to avoid decoloration of grain, grain moulds and extensive bird damage.

In the two sets of groundnut variety farmer-managed trials, the variety K1-441 is promising in West Benoue because of earliness and higher shelling percentage. Variety K1 332-78 is promising in South Benoue because of its better shelling percentage. Variety K1-332-78 was not significantly different from the local check, 28-206.

Fertility status of the soils

Soil samples were collected from 94 trials and analysed for PH, organic carbon, total nitrogen, exchangeable Ca, Mg, K, Na and available phosphorus. Chemical analysis data show that most of the soils are almost normal in soil reaction (PH), but are slightly on the acidic side. Most of the soils are low in organic carbon and total nitrogen content with a declining trend of exchangeable K. If continuous and intensive cropping in the area is to be followed, there is a great need to apply sufficient amount of K fertilizer or to ensure the return of crop residues to the field. The available P content in most of the soil varies between low to medium range, suggesting a need for a more balanced scheduling of P fertilization.

III. FSR - PROGRAMME PROPOSAL

1.0 BENIN

1.1 Introduction

The Northern Provinces of Benin (Borgou and Atacora) have been affected by the reduction in rainfall as a result of the extension of the sahelian drought. In the extreme north (Sudano-Sahelian zone) insufficient moisture and deteriorating soil resources (certain areas in Atacora) have rendered traditional farming systems very risky. In addition, the lack of improved crop technologies for farmers to adopt and binding socio-economic constraints have made it difficult for them to achieve high levels of production and incomes.

In view of the present weakness of the agricultural research system in Benin as compared with its strong extension organization, the OAU/STRC/SAFGRAD project operating in other countries of the Sahel - agreed to enhance its regional research coordination role by supporting farming systems research (FSR) programme through IFAD financial support.

The implementation of the FSR programme in Northern Benin followed the signing of an agreement in March 1985 between the People's Republic of Benin and the OAU/STRC/SAFGRAD. The FSR programme was set up as an integral part of the Ina agricultural research station located 70 km north of Parakou, the capital of Borgou province.

The People's Republic of Benin (on the West African Coast) covers a land area of 112,600 km² with a population of 3.6 million people. It is situated between latitude 6°30' and 12°30', thus stretching across five agro-climatic zones with the following long term average rainfall : coastal forest zone (1300 mm); Southern Guinea Savanna (1200 mm) ; Northern Guinea Savanna (1100 mm) ; Sudano-Savanna (1000 mm) and Sudano-Sahelian zone to the extreme north (900 mm).

The SAFGRAD/Benin FSR project covers the two northern provinces - Borgou and Atacora - totaling 82,200 km² (73% of Benin territory) and a population of 1,011,500 people (28% of total population). Major ethnic groups in Borgou (51,000 km², 481,500 inhabitants) are Dompango, Pila-Pila, Dendi and Somba.

Major food crops grown in Borgou and Atacora provinces are sorghum, maize yams, cassava. The existing production systems consist largely of intercropping cereal crops and shifting cultivation (3 to 4 years of fallow). Yams and sorghum are staple-food in Borgou. Cowpea is grown in association with maize or sorghum. Cotton and groundnuts are the major cash crops with a marketing infrastructure in both provinces. Livestock plays an important role in the traditional production systems in Northern Benin. About 39% of farmers in the region own cattle for draught power and as stock value. Most cattle however belong to nomads who do little or no farming and mainly move in search of grazing grounds. Animals graze on natural vegetation during the rainy season ; in the dry season they are fed on crop residues or moved southward for grazing.

Benin's agricultural research, development and extension services are under the Ministry of Rural Development and Cooperatives. The Department of Agricultural Research (DRA) supervises 13 research centers scattered around the country, eight of which have a commodity mandate. The Ina station has a mandate for foodcrops research in the 2 northern provinces of Borgou and Atacora.

At the provincial level extension activities are under the responsibility of the Centre d'Action Régionale pour le Développement Rural (CARDER). These activities are organised to match the territorial administrative structures. Benin is unique in that it has a strong and decentralized extension service reaching every village.

In the last three years the programme objectives include : conducting baseline surveys in representative sites to generate information on existing crop, livestock and agroforestry production systems ; the identification of location specific biological, physical and socio-economic constraints to increase agricultural production ; conducting on-farm adaptive trials designed to remove the identified constraints ; and the development of production methods that integrate trees, crop animals as well as techniques to conserve soil moisture and other resources.

SAFGRAD/Benin FSR activities have been initiated at 6 sites and three agro-ecological zones (Northern Guinea, Sudano-Savanna and Sudan-Sahel zones). Five sites are located in Borgou province at Sokka (Sinende district), Bensekou (Kandi district), Birni-Lafia (Karimama district) and the Ina research station. In the Atacora province the sites are at Koukoulounda (Ouaké district) and Koumagou (Boukoubé district).

1.2 Justification and rationale

At the current stage of development of the Benin FSR programme, diagnostic studies of the cropping systems in the three major agro-ecological zones are well advanced (see SAFGRAD/Benin annual reports 1985, 1986). The agronomy programme has just begun the testing stage by moving into farmers' managed trials those experiments repeated in 1986 which confirmed the 1985 trends.

For lack of expertise in the first 2 years, the agroforestry programme is presently at the diagnostic and design stages. Baseline surveys to identify existing agroforestry systems and determine appropriate technologies are still to be completed. As for the integration of crops, livestock and trees, more productive technologies have yet to be designed and tested.

Although the addition of farming systems research structure has raised awareness and interest on the part of thematic/disciplinary researchers, the interface between the two complementary approaches still needs to be enhanced. There are still many tasks to be accomplished in the next 3 to 4 years ; among them : the need to test and evaluate the developed technologies under farmer management ; to involve as actively as possible the development and extension agencies in the transfer of improved technologies ; and to interact with all interested organizations (local, national, regional and international) in the building of a broader and effective research, extension and rural development system for Northern Benin.

The continuation of the SAFGRAD/Benin FSR is also necessary in view of the current institutional and research development context in Benin : a weak national researcher system, extensively compartmentalized (see Annex on Benin agricultural research establishments in 1986) ; a strong extension organization ; awareness and commitment on the part of the nationals of the role FSR can play in reorienting research approach and priorities in the medium and long-term.

Furthermore the following roles can be envisaged for the FSR project in Phase II : the development of an understanding of the total farm environment and of the farm household system with its motivations and objectives. This will facilitate the conception of commodity/thematic research programmes with a farming systems perspective. The facilitation and formalization of effective linkages with participating development/extension institutions (for CARDER

in particular, our excellent working relationships have been entirely on the individual's goodwill and willingness to cooperate). Increasing the number of national researchers affiliated to the FSR programme will be essential to ensure continuity even when project funding comes to an end. Finally the FSR programme, through its sequence of testing-transfer of technologies, will generate results with important macro-policy implications (pricing credit, input delivery, etc) to sustain the adoption of improved technologies.

1.3 Objectives and goals

Within the broader long-term objectives of the Benin/FSR project defined above, and building on what has been achieved in the last three years, specific objectives of this phase include :

- continuation of the diagnostic/design studies of improved agroforestry/livestock production systems ;
- conduct of more on-farm adaptive trials as the development of improved cropping technologies continues ;
- to move on the extension stage, those technologies that will prove biologically viable, technically feasible, economically profitable, socially (culturally) acceptable and within the capacity of the farmers to adopt ; and
- to reinforce the interface between thematic/disciplinary research and FSR programme at the station level, improve and formalize the links with the development/extension institutions in Borgou and Atacora provinces.

1.4 Planned FSR (activities)

Monitoring on-farm resource

(S1). Delineation of the project area into major farming systems zones will be completed by the end of 1988. This involves the use of criteria beyond agroclimatic aspects (socio-cultural, cropping systems, land utilization and tenure, soil characteristics, etc.). This research activity will require the involvement of CARDER field personnel and preferably University graduating students.

- (S2) The project will continue to monitor the production activities of the master sample farmers (90 at 15/villages) and to update resource inventory data every year through 1991. A computerized file of selected farmers will be built in order to assess the changes affecting the structure and use of resources over the project life and beyond.
- (S3) Every year, data will be collected as required for the analysis of verification trials, with special emphasis on the socio-economic factors (in each zone) that can be expected to directly affect farmers' acceptance of the technology being tested by agronomy and agroforestry/livestock components of the SAFGRAD/FSR programme.
- (S4) Identification of existing traditional agroforestry systems and practices.
- (S5) Investigation into traditional manure production practices in Northern Benin.
- (S6) A special emphasis will be put on the economics of animal traction use and its effect on crop production.
- (S7) Marketing, credit and availability of inputs will be studied. The findings will help in proposing macro-policies that will facilitate adoption of new technologies.

Proposed FSR Trials (1988-1991) : Summary of major constraints and research themes.

Major Constraints	Zones/area	Themes (t)
1. Soil degradation and low fertility	Northern-Guinea Sudan Savanna, Sudano-Sahelian	(T1) Association of crops and trees in developed agroforestry systems. (Alley cropping and mixed cropping) (on-farm) (T2) Improvement of existing traditional agroforestry practices (researcher-managed) (T3) Introduction, modification and evaluation of agroforestry practices (researcher-managed) (T4) Improvement of the existing manure production practices (researcher-managed and on-farm) (T5) Investigation, evaluation and testing alternative sources of fertilizer. (researcher-managed and on-farm)

Major constraints	Zone/area	Themes (T)
Shortage of fodder	Atacora (only) Sudan Savanna Sudano-Sahelian Atacora.	(T6) Evaluation and testing different land cultivation practices (researcher-managed and on-farm). (T7) Investigation into and evaluation of suitable crop rotation (researcher-managed and on-farm). (T8) Introduction and evaluation of local and improved forage species adapted to Benin conditions (researcher-managed and on-farm) (T9) Development of fodder resources for small scale farmers : Especially for work animals 1. fodder banks 2. forage legume based cropping (on-farm).
Drought	Sudano Sahelian	(T10) Testing for drought resistance in food grain crops (researcher-managed and on-farm).
Low land and labour productivity	Northern Guinea Sudan Savanna	(T11) Evaluation of crop associations 1. Cereal/cereal 2. Cereal/legume 3. Food crops/leguminous herbs (researcher-managed and on-farm). (12) Evaluation and testing different land cultivation practices 1. Ridges versus flat on food grain crops (on-farm). 2. Ridges versus mounds on tubers (on-farm) . Testing improved varieties and fertilizer use (on-farm)

Implementation Strategies

Involvement of the nationals, collaboration with CARDER

At the end of every season, February to April will be devoted to discussions of results (surveys, on-farm and researcher managed trials) with heads of other programmes at the station. Protocols and surveys scheduled for the coming season will also be discussed to detect their relevance. The programme agreed upon will then be discussed with the director of research and team members from other FSR country programmes in Ouagadougou.

Effective collaboration with the extension agency (CARDER) is expected to materialize in a variety of forms. First, the on-going exchange of survey data covering different aspects of farming in the two provinces will be maintained and encouraged. The complementary nature of such efforts has already proved beneficial to the two parties. Second, the FSR programme intends to use CARDER's cotton farmers in Borgou and Atacora as members of a panel to be used at the extension (transfer) phase for the on-farm adaptive trials which will be screened at a later stage (1989 - 1991). These farmers will be selected in villages to be treated as SAFGRAD secondary sites for diffusion of improved technologies. Third, to ensure effectiveness in the testing and extension of developed technologies, the FSR programme intends to rely on CARDER field personnel who have been instrumental in monitoring on-going field activities in their respective villages.

The SAFGRAD team counterparts will be involved in the conduct of follow-up studies and interviews with farmers to provide the needed feedback to on-station research programmes and to initiate other diagnostic/testing studies.

Consolidation of research on primary and secondary sites

Although the FSR programme is currently operating in 7 sites (researcher managed trials), this number will be reduced to 4 or 5 sites. Three sites will represent the 3 agro-ecological zones in the Borgou province (Northern Guinea, Sudan Savanna and Sudano-Sahelian zone); the site in Atacora will represent an increasing number of villages with soil degradation and low fertility as a major problem. On the other hand the programme intends to increase the number of secondary villages (1 per two districts) in collaboration with CARDER as suggested above, for the period of 1988/1991.

Focus on strengthening national FSR

At the Ina station level

- . The first step towards achieving the objective of enhancing the national FSR capacity is to provide to the national counterparts, real opportunities to gain wide experience in the design, the conduct and analysis of FSR projects. It is therefore imperative to have Beninese scientists assisting each SAFGRAD expert before the end of the first phase of the project (April 88). The Benin Government should also provide the Ina station with one cereals agronomist, one entomologist and one soil scientist.
- . Although FSR has been recognized as one of URP/Ina research programmes, a formal link with CARDER needs to be arranged. This arrangement can naturally be worked out with the CARDER division of Recherche - Developpement
- . In addition to laboratory equipments (ordered in 1987), a computer (with at least 512 K), one complete set of visual aids, camping equipment and a new-motor pool should be acquired soon. Office space, one hangar and cribs have already been requested.

At the local, regional and national levels

Field work days will be organized once a year between September and October as crops are still standing. This will involve CARDER extension agents in the research or secondary sites selected by the SAFGRAD/FSR programme.

- . Links with the Faculty of Agronomy at the National University of Benin need to be initiated. Senior students could contribute to specific research projects as part of their field training.
- . Workshops at the local level need to be organized twice a year with CARDER to discuss FSR activities and results. Also at the national level the SAFGRAD/FSR programme should play an important role in sponsoring seminars to exchange experience and discuss methodology issues with all interested institutions (other FSR projects, IITA, University, etc...) Such gathering should take place once every two years.

Human resource development

- . Staffing needs for the 1988-9⁰ period (as discussed with the nationals)

For each of the three FSR component programmes (socio-economics, agronomy and agroforestry/livestock) the following positions need to be staffed :

- . one senior staff (as counterpart) at the Ingenieur agronome level
- . one research assistant, at the Technicien supérieur level
- . one field assistant as supervisor

The FSR project secretariat needs to be reinforced with an experienced bilingual secretary assisted by one secretary/typist and data entry operator (computer)

- . Training

- . Short term (1 - 6 months)

- . Planned to be extended to all junior staff affiliated with the FSR programme according to discipline and area of specialization. The themes of training needs will be identified every year. The SAFGRAD Coordination Office in Ouagadougou will be requested to assist in identifying opportunities for such training at IITA or ICRISAT. The librarian and the secretary will be trained to use the word processor.

- . Long term training for research scientists

Improvement of the national FSR capacity is ensured if this training component is included within FSR activities in Phase II. Request has already been made for long-term training of one research scientist leading to a Ph.D degree in the West Africa region (University of Ibadan). It is necessary to envisage further training at the Masters' level for 2 or 3 other scientists before the end of the second phase.

Project output and expected benefits

It is still evident today that technical advancements in agriculture will be generated through thematic/commodity research. In the context of Northern Benin, the FSR project will reinforce the linkages between the research system, the development/extension organization and the farmers. Through continuous collaboration, training and association with national scientists and development agents, a national research organization will evolve with a farming systems perspective to address problems faced by small farmers. This will improve the welfare of a large section of the rural population involved in agriculture.

Although population densities in Northern Benin are lower 10 to 15/km² as compared with 84/km² in the South, soil degradation, erratic and insufficient rains in many parts are serious problems with obviously long-term implications. The FSR approach will lead to the development of improved production techniques that integrate crops, animals trees and shrubs to conserve soil moisture and maintain soil fertility.

The FSR work will also play an important role in bringing to the attention of policy makers and planners, issues that might require a modification of existing, pricing, investment and other social policies.

Table 1.

Schedule of research activities (1988 - 91)

Agro-ecological zones	1988 - 89	1989 - 90	1990 - 91
Northern-Guinea	S1 S2 S3 S4 T2 T3 T4 T5 T11 T12	S5 S6 S7 T2 T3 T4 T5 T11 T12	T1 S2 S3 S6 S7 T4 T5
Sudan Savanna	S1 S2 S3 S4 T4 T5 T11 T12	S5 S6 T8 T4 T5 T11 T12	T1 S2 S3 S6 S7 T8 T9 T4 T5 T11 T12
Sudano-Sahelian	S1 S2 S3 S4 T2 T3 T4 T8 T10	S5 S6 S7 T2 T3 T4 T5 T8 T9 T10 T11	T1 S6 S7 T8 T9 T10 T4 T5
Atacora	S1 S2 S3 S4 T6 T7 T8	S5 S6 S7 T6 T8 T9	T8 S2 S3 S6 S7 T9 T6 T7

BURKINA FASO

2.1 Introduction

During the last decade FSR has been carried out mainly by FSU, ICRISAT and IRAT, each with its own objective and approach. (1) The FSU programme largely focused on cropping systems and was not integrated within the national research system. (2) The ICRISAT Economics Unit viewed its primary role as helping to guide the research of ICRISAT's biological and physical scientists. (3) Although it has collaborative links with the regional development agency (ORD) of the Yatenga province, the French "rechercher-development" approach is mostly geared toward the extension of what the researchers feel to be a scientifically valid technological package. It is less experimental than the other two approaches and places less emphasis on socio-economic factors in technology development and application.

These previous FSR programmes have carried out mostly cropping systems research. Other major components of farming systems in the region, such as forages, to improve animal production and agro-forestry, have been completely ignored. These programmes focused their attention mostly on the improvement of crop productivity and have given relatively little attention to the amelioration of the farm resource base which is being severely degraded as a result of increasing demographic pressure.

Objectives

The global objective of the National FSR programme is to induce the development of technologies and rural development policy actions that could be adopted to the actual conditions of farmers so as to increase food production and enable the country to achieve a greater food security. The specific objectives of the programme may be summarised as follows to :

- study current farming systems in Burkina Faso with multi-disciplinary teams of scientists so as to acquire more knowledge on the farming systems conditions in order to identify small farmers' problems and particularly the technical and socio-economic constraints to new technology adoption ;
- develop a system of communication and concertation between farmers, thematic (or station based) researchers and developers so as to influence priorities and

methodology of research and rural development programmes in a way that would enable such programmes to address the actual problems and needs of small farmers ;

- . propose to development policy makers, appropriate agricultural development policies which could be adapted to the farming systems conditions ;
- . train national scientists and technicians to assume full responsibility in the implementation of the national FSR programmes.

Moreover, the current FSR team is expected to play a key role to launch National FSR networks in collaboration with researchers based at Farako-Bâ and other research stations. Similarly, there could be more national joint research activities with scientists that could be affiliated with FSR - in order to facilitate the integration of production systems. Pre-extension studies of screened technologies will be carried out jointly with the extension department.

More emphasis would also be placed : on-farmer-managed trials and over performance of technologies :

- . to improve collaborative linkages with research and development agencies. This should be further strengthened to permit INERA to address farmers' need and development objectives ;
- . a successful completion of the FSR goals during the second phase will demonstrate the usefulness of the interdisciplinary approach and promote it within INERA ;
- . there is a need for more institutional strengthening through acquisition of equipments and special training of national staff (research technicians and extension personnel) to permit continuity of programme.

The IFAD supported FSR activities is largely based in the Mossi Plateau. The Mossi Plateau is the most populated region of Burkina Faso, covering an area of about 94,000 sq km in the central portion of the country (or 34% of the total area of the country).

The highest population densities in Burkina Faso are to be found on the plateau where there is an average of 20 to 70 inhabitants per sq km. The mean density

of rural population per sq km of useful agricultural area was estimated at 107 individuals in 1975/76.

On the other hand, soils and agroclimatic conditions in this zone are less favourable to agriculture than in other regions of the country. Consequently, the problem of meeting the food requirements of rural populations is much more acute than in most of the remaining portion of the country. In addition, the Mossi Plateau already hosts at least two old agricultural research stations where technologies designed for farmers have been developed. These are Kamboinse station, 12 km from Ouagadougou and Saria station, 40 km from Koudougou, West of the Mossi Plateau. Traditional farming systems practice and physical characteristics of the project area were described elsewhere

Constraints

The major constraints that limit agricultural production regions in the Mossi Plateau are drought stress, labour bottlenecks, poor land use system that accrued in the decline of soil fertility, insufficient input supply and extension services, animal feed, etc.

Collaborative linkages

Besides the farmers with whom the regional teams are expected to work, each regional team is expected to establish close working relationship with two other types of partners. These are the research partners and the development partners working in the region.

The research partners of the regional team include the thematic research programmes of INERA, the faculty of Agriculture of the University of Ouagadougou and the local branches of the international agricultural research centres. The development partners include the regional rural development agencies (or ORDs) and the agricultural development policy makers. The collaborative links with the regional development agencies are mostly established through the Recherche-Developpement units of the ORDs where they exist, such as the ORD of Yatenga, and through the extension services of the ORDs.

2.2 FSR activities

A. Socio-economic studies within the INERA/SAFGRAD project started in 1986 and need to be continued during the Phase II to reach appreciable results.

The objectives are :

- . to study the current agricultural production systems so as to acquire more data base and knowledge on small farmers socio-economic, institutional and technical agricultural problems/constraints, with particular emphasis on the constraints to technology adoption.
- . to identify the adjustment mechanisms (strategies, technological innovations and others) utilized by farmers as solutions to cope with their agricultural problems.
- . To identify and define the technological needs of farmers "appropriate technologies", and the appropriate types of development actions needed to resolve the existing problems and satisfy farmers' and national goals, and objectives in the agricultural sector.

. These objectives are attained by monitoring farmers' economic activities in the three primary study sites, by reviewing the results of previous economic studies and FSR programmes in Burkina Faso (i.e FSU/SAFGRAD and ICIRSAT), and by analyzing some of the unanalyzed data of such programmes.

To meet those objectives the following studies will be carried out :

A-1 Production and resource management studies

- (i) evaluation of farm resource endowment, accessibility and accumulation ;
- (ii) studies on inter-activity and inter-temporal from resource allocation studies within season and between seasons ;
- (iii) studies of resource allocation within activity (crop production, animal production, off-farm income generating activities, etc.) ;

- (iv) identification of traditional technologies and of farmers' technological innovations ;
- (v) identification of basic input-output and output-output relationships and parameters.

A-2 Transaction studies

- (i) farm inputs acquisition and financing ;
- (ii) crop and livestock prices and marketing (sales and purchases) at village, regional and national levels ;
- (iii) evaluation of off-farm income.

A-3 Agricultural products transformation/consumption studies

- (i) basic agricultural product transformation and consumption/nutrition parameters ;
- (ii) household budget allocation, energy consumption ;
- (iii) special surveys from hypothesis and model information ;

the four studies will result in formulation of a series of hypothesis regarding for instance :

- . farmers goals and decision making process,
- . constraints and their modes of operating (conditions in which they occur at different level and what may occur) ,
- . adjustment mechanisms in strategies used by farmers to alleviate constraints,
- . technology adoption conditions and evaluation criteria.

The studies result (parameters, hypothesis, etc.) will lead to dynamic models of typical farming systems and farming units representing different domains of recommendation.

Brief special studies will be carried out to confirm the model specification and parameters.

Specific expected output

- . The development of models of the farming systems and farming units in the study region ;
- . specific constraints and their mode of operation ;
- . farmers solutions/strategies to deal with the constraints (adjustment mechanisms) ;
- . technological needs, development and policy actions needed and their domain of recommendation ;
- . farming systems parameters, criteria for technology evaluation and for development project evaluation ;
- . methodology for farming systems socio-economic studies.

B. Improvement of Animal production

Another focus of FSR is to maximize the utilisation of available resources (within the smaller farmer environment) to increase food production. The various constraints indicated earlier could be alleviated if both resource and economic complementarity among on-farm components is established. Livestock and natural pastures are important resources. Due to increasing pressure for the expansion of crop production, fallow land has continued to dwindle which also affected the availability for natural pastures for livestock production. Concurrently, the degradation of resource base for productive agriculture is exacerbated. The challenge of FSR is to translate research findings into sustained food production system in which the output of one production system could be the input to increase the production of a particular component.

Research on forages and crop residues show that the acute shortage of livestock feed could be alleviated in qualitative and quantitative aspect. This could lead to intensify agricultural production by using animals for traction, manure, fuel, etc..

Improvement of feed resource availability and animal productivity

- B-1 Study on the improvement of fallow land with forage browse species
- continue assessing effect of oversowing fallow pasture with species such as S. hamata and M. atropurpurium on the quantity and quality forage produced.
 - assess the influence of annually sown forage legumes on the replacement of fallow by forage legumes/cereal rotation.
 - determine the frequency of cutting of browses, grown on fallow land, for use by animals.
- B-2 Study on the production and conservation of forages for periods of inadequate feeding
- assess the performance of selected forage or dual purpose legumes under different levels of management to exploit their potential in biomass yield, nutritive quality and contribution to soil productivity.
 - continue assessing the techniques of conservation of forage legumes and natural pasture in the form of hay or silage at small scale farm levels.
 - Determine strategies for optimizing utilization of crop residues and other poor quality roughages by ruminants using forage legumes as supplements.
 - assess the influence of nutrition on the productivity of :
ewe lambs from weaning to end of first lactation, and adult ewes during the last stage of pregnancy and lactation .
 - assess the influence of nutrition on the milk yield of zebu cows
 - assess the influence of nutrition on fattening of beef cattle.
 - assess the influence of frequency of watering on the performance of beef cattle or sheep under a given level of feeding.
 - assess the influence of nutrition on the performance of cattle in draught power.

Specific output

- . Identification of a variety of sources of forage nitrogen that are compatible with cropping systems, to optimize the utilization of crop residues and other locally available poor quality roughages by ruminants.
- . Knowledge of methods of conservation of forages for periods of inadequate feeding.
- . Knowledge of the nutrient requirements of animals that could lead to the establishment of a feeding system that will be sound biologically and will fit into the economic realities of the farms.
- . A network of nation-wide collaborative research to strengthen the national programme in animal production research.

B-3 Effect of management practices on dual purpose legumes for grain and forage yield.

The legume crops offer a means to link the integration of crop production, animal production and soil fertility amelioration work through provisions of forage and grain as well as enhancing nitrogen fixation and improve subsequent crop production. The following investigations will be carried out:

Effect of soil moisture storage (tied ridging, mulching) on legume performance with regards to production (grain and forage) and N - fixation ;

effect of rock phosphate making compost of legumes and other shrubs ;

performance of cereal following legumes under different management levels.

Sites

On fixed sites (fallow field under researcher managed (1988 - 1991), on farmer managed, results found promising above (1989 - 1990)

Specific expected output

- . Promoting dual purpose legume crops that fit into the farm resource base through better soil-water management and application of readily available phosphorus source.
- . Increasing cereal grain yield through rotation with legumes and use of residual phosphorus from composted rock phosphate previously applied on legume crops.

B-4 Testing of cereal/legume association technologies

In the Mossi Plateau cowpeas are rarely sole cropped. Crop association is expected to be the first step in intensifying production of dual purpose cowpea or other legumes. Some research results are available (IITA/SAFGRAD) indicating feasibility of such a practice.

- . Testing cereal/legume association for optimal yield (grain and forage) in the two zones ;
 - (i) varieties of crops and recommended arrangement in time and space will be tested.
 - (ii) effect of management levels on productivity of cereal/legume association. Management levels include soil moisture storage and fertilization.

Researcher managed trials on research station and fixed sites.
Farmer managed trials of technologies judged suitable and fitting the farm resource base).

Specific expected output

- C. Cereal/legume association technologies that are suited to the different environments and farm resource base of the area.
- C-1 . Testing of improved cropping practices
Variety and management combinations .

Some promising varieties (introduced and local) of sorghum and cowpea have been identified. These will be tested in combination with management practices

found promising where improved varieties are not available and only local variety response to management will be tried.

. Crop to be tested

White sorghum, millet, red sorghum, maize, peanut, bambara nuts,

. Management

Tied-ridging, mulching, tillage, insect control, etc.,

Both research managed (on fixed, sites) and farmer managed trials will be carried out.

. Expected output

Recommendation of crop and management technologies for given environmental complex to achieve food self sufficiency

Testing of technologies to improve soil productivity

Crop productivity potential cannot be expressed if the soil does not provide suitable medium for plant growth. There is a serious problem of soil erosion and runoff water losses in parts of the Mossi Plateau. FSR has until recently, neglected the area to the advantage of crop performance evaluation, although farmers of the area show initiative in soil conservation work. Due to lack of the instability of the first phase of the programme such work was not undertaken. More alternatives would be looked into improving the productivity of the soil.

The following activities will be undertaken :

- (i) study on the efficiency of traditional soil conservation practices in controlling soil erosion and effect on crop yields.
- (ii) efficiency of mechanical barriers (with and without vegetative cover) on soil erosion and runoff control and subsequent effect on crop yield. The vegetative cover consist of legume forage and tree/shrub species alley or strip cropping.

Specific expected output

- . Indicative soil conservation recommendations for different levels of investment in two zones of the Mossi Plateau (Soudano-Sahel and Soudan).
- . Promote crop intensified production so that cultivated area can be reduced in the long run. This will lead to increased fallow area for improved pasture, and soil restoration.
- . Lead to awareness that soil degradation can be arrested.
- . Promote ability of farmers to accept other production technologies (fertilizer, crop selection, tillage, etc.), which they cannot on degraded environment.

D. Agroforestry

- D-1 Research on the modalities of introducing tree species in the village space.
- D-2 Use of tree/crop association to improve soil fertility and to meet fruit, forage, energy and construction material needs.

Activities are :

- (i) revegetation of diguettes
- (ii) strip planting of trees along contour lines ;
- (iii) use of tree for alley cropping and for mulching purposes ;
Leguminous trees/cereals intercropping
- (iv) fruit-tree establishment and improvement of fallow field by establishing forage tree species.
- (v) tree planting along field borders and around dwellings
- b. Establishing live fences around fields, gardens and enclosures
- c. Study on composition, dynamics and density of agro-forestry species in the village, and management recommendations

- E. Research on simplifying nursery operations and seedling transplanting to promote creation of nurseries and reforestation activities at the individual, family and village community level.

Specific expected output

The specific output are :

to provide farmers with technologies that allow :

- . to meet their needs in fruit, wood and energy needs ;
- . to shelter crops effectively using live fences
- . to enable farmers to produce and manage seedlings themselves ;
- . to control soil erosion effectively with minimum labour requirement for maintenance of structures ;
- . to enable farmers maintain fertility of their land.

E-1 Description of the bio-physical environment and micro-variations at the village levels

There is marked differences in soil moisture regime and soil fertility within farms at the village levels e.g as a result of toposequence or differential management of fields. Rainfall is also highly variable within the season and between years.

The investigation will attempt to describe quantitatively the micro-variations at the village level using secondary long term data (soils and long-term rainfall), with additional soil parameters to be collected.

Specific expected output

Delineation of biophysical environments at the village level and implications on technology adoption

F. Socio-economic evaluation of technologies

Objectives and Justification

. The test and the evaluation of proposed technologies on the farm enable agricultural research scientists to appraise the actual performance of the designed technologies. The results of the evaluation enable them to efficiently screen and improve such technologies. As such, technology evaluation is an indispensable tool which enables agricultural research to make substantial progress toward the desired goals.

The objective is to evaluate recommended or promising technologies and resource management systems for their socio-economic feasibility at the farm or village level, and in terms of their ability to enable farmers to meet their objectives with "acceptable" levels of risks and benefits.

. The technology evaluation will be carried out primarily with the results of farmer managed trials. The thirty five farmers in each village will be involved in the evaluation of technologies. The on-farm technology evaluation will be focused on technologies which are capable of alleviating the major constraints which have been identified.

- . inadequate moisture availability (drought)
- . low and degrading soil quality
- . labor bottlenecks and low productivity of implements
- . inadequate feed resource availability for ruminants

The type of technologies which will be evaluated are as follows :

- (i) evaluation of labor saving mechanical/animal traction implements such as :
 - . ~~seed~~ seed preparation implement
i.e ridge tier and ditchers for soil-water conservation
 - . seed drillers
 - . mechanical weeders
 - . polyvalent implements
- (ii) evaluation of agronomic and soil-water conservation techniques

- . test of improved traditional soil-water conservation techniques (stone bunds, grass-strips, zai, mulching, etc.)
- . test of introduced soil-water conservation techniques (i.e tied-ridges, earth dykes)
- . test of fertilizer recommended intercropping practices

(iii). evaluation of elite crop varieties

the tests will be focused on cereal and legume varieties from the International Agricultural Research Centers and from the National Agricultural Research Institute (INERA).

- (iv) evaluation of recommended or promising forage production and conservation techniques
- (v) evaluation of livestock feeding techniques
- (vi) evaluation of manure production techniques
- (vii) evaluation of agro-forestry techniques
- (viii) evaluation of promising integrated technological packages

Specific expected output

- . Criteria for technology evaluation to determine acceptability costs/benefits of promising technologies and their domains of recommendations.
- . a set of adapted technologies for pre-extension and extension.

. As indicated earlier the SAFGRAD support FSR scientists (provided additional fund is made available) could assist INERA to activate national FSR networks that would be based at the major national research station. As advisor to INERA, SAFGRAD scientists will assist to train national scientists, conduct reconnaissance baseline survey, planning, technology evaluation and data synthesis. Provide consultancy services for INERA on development projects.

Table 2 - SCHEDULE OF ACTIVITIES.

<u>ACTIVITY</u>		<u>1988-1989</u>	<u>1989-1990</u>	<u>1990-1991</u>
A.	<u>Baseline studies</u>			
	. Production and resource management studies (a1)	***	**	*
	. Transactions studies (a2)	***	**	*
	. Agr. product transformation/consump. studies (a3)	*	*	-
	. Special surveys (a4)	*	**	**
B.	<u>Improvement of feed availability and animal productivity.</u>			
B1.	Improvement of fallow pasture	R ***	R ***	R **
(a)	Continue assessment of effect of oversowing of <u>S. hamata</u> and <u>M. atropurpurium</u> .	-	F *	F **
(b)	Replacement of fallow with forage legume/cereal rotation.	R *** -	R *** F *	R ** F **
(c)	Determine frequency of cutting of brouses for use by ruminants	R *** -	R *** -	R * -

SCHEDULE OF ACTIVITIES.

	<u>ACTIVITY</u>	<u>1988-1989</u>	<u>1989-1990</u>	<u>1990-1991</u>
B2.	<u>Production and conservation of forage</u>			
	(a) Performance of selected legumes in biomass yield nutritive quality and contribution to soil productivity	R *** F *	R ** F **	R * F ***
	(b) Continue assessing techniques of conservation	R * F ***	R * F ***	R * F ***
B3.	<u>Nutrition of ruminant animals.</u>			
	(a) Influence of nutrition on productivity of eive lambs and adult eives.	R *** -	R *** -	R *** -
	(b) Influence of nutrition on milk yield of Zebu cows	R *** F *	R *** F **	R ** F **
	(c) Influence of nutrition on fattening beef cattle	R *** -	R *** -	R *** -
	(d) Influence of nutrition on cattle draught power	R *** -	R ** -	R * -
	(e) Influence of frequency of watering on cattle & sheep performance	R *** F	R ** F *	R * F **
C.	<u>Management practices on dual purpose legumes</u>	R *** F *	R ** F **	R * F ***
D.	<u>Cereal/legume association</u>	R *** F *	R ** F **	R * F ***
E.	<u>Variety & Management Trials</u>	R ** F **	R * F ***	- F ***
F.	<u>Technologies for Improved soil productivity</u>	R *** F *	R ** F ** P	R ** F ** P

SCHEDULE OF ACTIVITIES.

<u>ACTIVITY</u>		<u>1988-1989</u>	<u>1989-1990</u>	<u>1990-1991</u>
G.	<u>Research on introduction of tree species.</u>			
G1.	Tree/crop association of multipurpose use			
	(a) Revegetation of diguettes	F *	F **	F ***
	(b) Strip planting of trees along contour lines in a crop field	F *	F **	F ***
	(c) Use of tree for alley cropping in mulching purpose leguminous trees/cereals intercropping	R ***	R ***	R ***
	(d) Fruit trees establishment and improvement of fallow field by establishment forage tree	F *	F **	F ***
	(e) Tree planting along field borders and around dwellings			
G2.	Live fencing	F **	F **	F **
G3.	Agroforestry population dynamics	R ***	R **	R *
G4.	Simplifying seedling production	R ***	R **	R *
H.	Bio-physical environment description	***	***	***

SCHEDULE OF ACTIVITIES.

<u>ACTIVITY</u>		1988-1989	1989-1990	1990-1991
I	Socio-economic evaluation of technologies			
	I-1 Labor saving devices	*	**	**
	I-2 Agron. & soil water mngt technologies	*	***	**
	I-3 Variety	*	**	*
	I-4 Forage production and conservation)			
	I-5 Livestock feeding systems)	*	***	*
	I-6 Manure production)			
	I-7 Integrated packages	-	*	**

Notes. Where appropriate R signifies Research Managed, F, Farmer Managed Trials.
In general R decreases with years, while F goes up. P signifies pre-extension trial.

* start - ** medium activities - *** heavy emphasis.

3.0 CAMEROON

3.1 Introduction

The Farming Systems Programme of IRA in Cameroon began with the creation of Testing and Liaison Units (TLU) in North West, West and Central Provinces supported by USAID, IITA, and with studies on cropping systems at Djalingo and Soucoundou in North East Benoue of the North Province. The general aim of the IRA/FSR programme is to improve the effectiveness of National Research by evaluating and transferring appropriate technologies to farmers.

Normally Farming Systems Research covers crops, soils, cropping systems, livestock, socio-economic studies and other aspects at the farm level. To date, the research activities of IRA/FSR programme have only included (a) agro-economic studies, and (b) cropping systems research. For coordination of research the country has been divided into three regions : the Sudano-Sahelian in the North, the Highlands in the West and the Lowland high rainfall forest in the Central and South-East.

In November 1985, the Republic of Cameroon and the OAU Scientific, Technical and Research Commission - Semi-Arid Food Grain Research and Development, signed an agreement to provide an agricultural economist and a soil scientist to strengthen the National Farming System Research Programme in the semi-arid zone of the country.

Overall objectives of SAFGRAD/FSR

After the signing of an agreement between OAU/STFC and the Cameroun Government in November 1985, the activities of SAFGRAD/IFAD funded Farming Systems Research Programme started in North/Cameroon in March 1986 with the following main objectives :

- a. To determine agricultural production technologies suitable to conditions and need of small scale farmers, with emphasis on developing soil-water, soil-moisture, soil-fertility and other resource conservation techniques in the semi-arid zone of North Cameroon.

- b. To strengthen National Farming Systems programme by working with National researchers and extension agents while the project is jointly administered by both SAFGRAD and the host Institution I.R.A.
- c. To foster the transfer of agricultural research results by conducting on-farm trials, socio-economic studies, etc... in collaboration with farmers and providing a feedback between station researchers, development agents and farmers.
- d. To integrate agroforestry practices within the existing farming practices i.e alley cropping, etc.

Specific short term objectives

In order to achieve these overall objectives 1986 FSR activities pursued specific objectives set up to be accomplished in defined periods of time. Thus :

- a. to conduct socio-economic baseline surveys for obtaining some basic information on the existing crop animal production and identifying location - specific physical, economic and social constraints to agricultural production ;
- b. to test the performance of sorghum, maize, groundnut and cowpea improved varieties and assess their suitability into the farming systems in Northern Cameroon and also to study the economics of animal manure and chemical fertilizers and their effect on crop yields ;
- c. to reduce soil-water losses through surface run-off and increase soil moisture conservation ;
- d. to evaluate several shrubs, trees and forage legumes that could compliment existing cropping systems.

The SAFGRAD Project area covers North Province and Southern part of Extreme North Province. The North Province lies in a large depression of the Benoue river basin consisting of the lower Benoue valley on the West with an altitude of less than 1000 m and the intermediate Benoue valley in the north

east with an altitude of 1000 m and 2000 m above sea level. The area then extends into the Mandara highlands on the north west side and Diamare plains on the north east side and bordered by Adamaoua highlands on the southern side. The North Province lies between longitude 12°30' E and 15° E and latitude 7°N and 10°N.

Considering the variations in temperatures for the region stretching from Ngaoundere in Adamaoua Province in the South to N'Djamena in Tchad on the far Northern side, Garoua has the hottest climate, followed by N'Djamena, then Maroua and finally Ngaoundere. The temperature around Garoua where the SAFGRAD/FSR Project is based, ranges from a minimum of 17°C in January to a maximum of 45° C in March. Whereas the temperature in N'Djamena ranges from a minimum of 13.9°C in January to 41.2°C in March. The temperature in Maroua ranges from 16.9° in January to 41°C in March while those in Ngaoundere range from 11°C in January to 33.2° in March.

At Garoua the climatic conditions are hot and humid. The average annual temperature is 28°C with monthly averages ranging between 26.5° C in January to about 34°C in March. The hottest months at Garoua are March, April and May. At Ngaoundere, the average temperature is 22°C with monthly average ranging between 21°C in January and 25°C in March. The temperatures even during the hottest month of March, are moderate.

According to rainfall pattern and vegetation, the project area can be divided into sahelian-savanna zone with mean annual rainfall of 800-600 mm, sudan-savanna zone with 1000-800 mm and guinean -savanna zone with 1200-1000 mm. The sahelian savanna zone covers the Extreme North Province and part of North Province. The guinea-savanna zone stretches from Fingole southwards to Adamaoua Province. Along the soudano-savanna zone there are pockets where annual rainfall is less than 800 mm. In considering the rainfall patterns of the last twenty years, overall rainfall in each of the zones has declined by 5 to 10 per cent, with frequent occurrences of serious drought during certain years.

In the Guinea-savanna zone, the rains usually begin in April and last till end of October. In the sudan-savanna zone, rains begin at the end of April or early May

and last till the end of October. In the sahelian zone, the rains begin at the end of May and are over by the beginning of October.

The total population of Cameroon is about 10.68 million (1986), with a growth rate of 2.4% per annum. The population distribution by age is 24.1% (2.58 million) between the ages of 0 and 5, 23.8% (2.55 million) between the school ages of 6 and 14, 47.5% (5.07 million) between 15 and 59 and 4.5% (0.0479 million) 60 years and above. In other words, 47.9% of the population are children under 15, 47.5% are workers between 15 and 59 and 4.5% are over 60 years. Approximately 50.1 per cent are female and 49.9 per cent are male.

The population density in Cameroon is 21 persons per km². It is highest in West Provinces followed by North-west and then Littoral Provinces with 95.2, 66.9 and 47.2 persons per km², respectively. The average population density in the Northern region is 16.5 persons per km². The three Northern province together contain 27.6 per cent of the total population with 21.1% in Centre-South and 13.9% in West Province.

Some parts of the country suffer from uneven distribution of the population. For instance, there are three zones that have relatively high density population which, put together, englobe 61% of the population of Cameroon and yet constitute only 13.3% of the territory. The areas with high population density are Dismare, Margui-Wandala in the Far North, Bamenda to Douala in Western and Lekie to Yaounde in the Central-South.

There is a high rate of rural-urban migration in the country. About 38% are Urban dwellers, whereas 62% are rural dwellers. Some of the large Urban Centres in Cameroon are Douala (750.000 inhabitants), Yaounde (530.000 inhabitants). As a whole there are 17 urban Centres in the country with more than 20.000 inhabitants. However in the North and Extreme North Provinces, about 80% of the population are rural dwellers; Garoua (64,000 inhabitants) and Maroua (67,000 inhabitants).

Major constraints of food production

From the reconnaissance trips by the SAFGRAD/FSR team and review of previous literature suggest that the major constraints of food production in North Cameroon are (a) drought and/or prolonged dry spells at the time of planting (b) poor soils and declining soil fertility and (c) uneven distribution of the population. Diamare and Margui-Mandara areas of the Extreme North Province are relatively more populated than other parts of both the North and Adamaoua Provinces. In the Extreme North Province where there are older settlements and due to population pressure on the land plus the effect of soil erosion caused by torrential rains, winds and human cultivation, soils have become extremely poor, sandy, hard pans or even just bare rocks. As a result, the upper Benoue valley Development Survey Authority has among its aims to open up new settlement in Benoue Valley and to settle in Migrants from the more populated areas of far North parts of the country. The other constraints include inavailability of inputs and/or lack of appropriate small farm tools to circumvent critical land preparation and planting periods. It was also noted that striga weeds, particularly against, maize, millets and sorghum pose a major problem. Post harvest losses due to inadequate storage, transportation and marketing facilities create additional bottlenecks to food supplies.

Institutional setting and linkages

All scientific Research in Cameroon, is under the Ministry of Higher Education and Scientific Research and research is organised into six institutes such as Institute of Agricultural Research (I.R.A), Institute of Animal Research (I.R.Z), Institute of Human Sciences (I.NH.S), Institute of Geological and Mineral Research (I.R.G.M), and so on, each with centres scattered all over the country.

Within the Institute of Agricultural Research (IRA) there are three regional centres namely Maroua for the Northern region, Njombe for the Western region and Ekona for the Eastern region. There are three professional centres based at Nkolbisson for Agronomic, Forestry and Soils Research respectively. These have all together 16 research stations plus over 30 antennae. There are 22 research programmes one of which is the Farming Systems. Each of the 22 research programmes for example cereal crops, tuber crops, Farming Systems, etc... is treated as a separate department or section with IRA as a whole.

3.2 Justification and rationale

Phase I of the IFAD funded Farming System Research in North Cameroon started in February 1986. Two scientists (a soil scientist and an agricultural economist) initially based in Maroua moved to Garoua in April 1986. Work on socio-economic baseline survey and Agronomic studies was initiated in the month of April, 1986. For the lack of expertise in 1986, the agroforestry programme is presently at the diagnostic and design stages. Baseline surveys to identify existing agroforestry systems and determine appropriate technologies are still to be completed. As for the integration of crops, livestock and trees, more production technologies have yet to be formulated and tested.

Although the presence of SAFGRAD/FSR in North Cameroon has raised awareness among the disciplinary researchers, still the interaction between the two complementary approaches need to be enhanced.

There are still many aspects of FSR which need to be tackled effectively in the coming 3 or 4 years. Such aspects are testing and evaluation of developed technologies under farmers' condition, involvement and participation of parastatal and extension agencies, feedback information to researchers through extension and/or farmers for modification and/or change of technologies etc. needs greater attention.

Since the national farming system research in Cameroon is very young and SAFGRAD/FSR has been there only from 1986 season, whatever little information in the short period of 1 to 2 years have been gathered by SAFGRAD staff and national FSR will be a total waste if the theme of FSR, relevant to North Cameroon is not pursued.

The IFAD-funded FSR is more complete in terms of integrated approach and clearly defined goals and objective which is very relevant to the semi-arid part of North Cameroon. In phase II it is essential to ensure that national scientists are attached to the programme for the continuity of the project even when project funding comes to an end. Also the FSR through its testing and transfer technologies will generate results with important macro-policy implications to sustain the adoption of improved technologies.

3.3 FSR work programme

To carry out the research activities, six primary and 18 secondary sites have been identified in the North Province of Cameroon (all these sites fall in an area having less than 1000 mm annual rainfall). The four components (crop production, socio-economic activities, livestock and agroforestry) will be integrated together according to the needs of the farmers in the area and research methodology will be adopted on the basis of identified constraints. Most of the research activities will be concentrated in the North East Benoue and West Benoue regions of North Province. Depending on the severity of a constraint affecting the farmers and farming system, particular activities will be carried out in a given area or region.

Based on research results, the following research themes (T) would be investigated :

T1 Socio-economic baseline/verification survey

Ten farmers in each primary site and four from each secondary site will be interviewed to carry out the survey work.

T2 Storage and marketing survey

As in a semi-arid region like in North Cameroon, there is only one short agricultural season, then storage and marketing activities are important in order to ensure that farmers have food reserves all through the year. Moreover, post-harvest crop losses during storage and marketing may greatly reduce what was otherwise a good harvest.

T3 Economic evaluation of technologies :

To assess the economics of certain improved technologies adapted by farmers

T4 Studies on soil moisture conservation techniques :

Different soil moisture conservation technologies available will be tested on farmers' fields, either under researcher-managed and/or farmer-managed trials.

T5. Soil fertility management trial

Different crop residues, animal manure and industrial refuse available in the area will be evaluated in comparison with chemical fertilizers in order to maintain the soil fertility and crop production.

T6. Studies on land preparation practices

Traditionally farmers are using small hoes to till their land but with the development of technologies farmers have started using oxen plough/donkey plough, and to a limited extent tractors, provided by development agencies on hire basis. Still the majority of farmers follow minimum tillage for land preparation.

T7. On-farm crop variety testing (farmer-managed)

Sorghum, maize, groundnut and cowpeas varieties will be tested on the farmers' field in collaboration with SODECOTON.

T8. Agroforestry demonstration trial :

this trial has been laid out in August 1987 on 1.5 ha area at Kismatari (20 km South of Garoua). This trial will serve as guideline for farmers and researchers to develop the techniques of incorporating crops with different species of trees under a given set of condition.

T9. Agroforestry trials on primary sites

Three different areas with different soil types are being identified close to the farmers' field to start these trials in 1988. Also the agroforestry survey will be initiated almost at the same time or towards the end of 1987.

T10. Soil fertility evaluation under different cropping system

As soon as the laboratory facilities are made available this study will be taken up particularly to evaluate the soil nutrient changes under different agroforestry, cropping system and fertility management system.

Implementation strategy

Involvement of nationals and collaborators

After the end of every cropping season, February to April will be devoted to discussion of results (on-farm, survey and research managed trials) with heads of each programme at the station. Protocols and survey schedules for the next coming season will also be discussed to determine their relevance, the agreed programme will then be discussed with the national coordinator of FSR and director of research of IRA Cameroon, and finally, the country programme in Ouagadougou at SAFGRAD headquarters.

120. Effective collaboration with extension agency (SODECOTON) and other parastatal is expected to enhance, in terms of coverage of different research themes, crops, survey, agroforestry research, etc.

The SAFGRAD scientists and counterparts will be involved in the conduct of follow up studies and interviews with farmers to provide the needed feedback to station researchers and to initiate other diagnostic and testing studies.

Consolidation of research activities on primary and secondary sites.

Currently FSR programme in North province of Cameroon is scattered in very wide and relatively unmotorable areas and our efforts will be to concentrate the research activities in the areas which are representative to the time situation of small scale farmers. The primary sites may be reduced from six to four and then secondary sites will be increased depending on the collaboration, inputs and finances available with the SAFGRAD team.

Focus on strengthening national FSR

The SAFGRAD/FSR in Cameroon is institutionalised within the framework of IRA and is based in Garoua, an antenna of Northern regional IRA Centre, Maroua.

The first steps towards achieving the objective of enhancing the national FSR capacity is to provide the national counterparts the real opportunities to gain wide experience in the design, conduct and analysis of FSR projects. It is therefore, necessary to have Cameroonian scientists involved in SAFGRAD/FSR

programme and assisting the expert before the end of the first phase in April 1988.

Development of laboratory and office space is urgently needed. It is very likely that some laboratory equipments, a computer, some visual aids etc. will be available by the end of 1987 to strengthen the programme.

Field days will be organized once a year during the cropping season in collaboration with SODECOTON and the Ministry of Agriculture etc...

Workshop at regional level, as well as national level needs to be organized. The appropriate technological achievements by the SAFGRAD team should be discussed in the gathering of other organisations, extension agents and government representative.

Project output and expected benefits

- . The FSR project will re-inforce the linkages between research system, the development/extension agencies and farmers.
 - . With the continuation of FSR of SAFGRAD funded by IFAD, the national farming system research will develop, through the training of manpower and on the spot training and learning.
 - . The FSR approach will lead to the development of improved production technique that integrate crops, animals tree shrubs, etc.
 - . The policy makers and planners in the area will be benefited by the socio-economic study and they can modify their existing policy on investment, marketing and other socio-economic activities.
-

Table 3.

SCHEDULE OF RESEARCH ACTIVITIES (1988-1991).

ECOLOGICAL ZONE	1988-89	1989-90	1990-91
North Guinean Savanna	T1 T2 T4 T5 T7 T8	T1 T2 T3 T4 T5 T6 T7 T9 T10	T1 T2 T3 T6 T7 T9 T10
Sudan Savanna	T1 T2 T4 T5 T7 T8	T1 T2 T3 T4 T5 T6 T7 T9 T10	T1 T2 T3 T6 T7 T9 T10

T = themes

SAFGRAD/ICRAF FUTURE COLLABORATIONS

Initially FSR efforts were, however, concentrated on cropping systems. The role and use of indigenous trees were not brought to forefront. Information on tree/crop mixed farming is too diffuse and too little known with the possibility to incorporate agroforestry sub-system with on-going FSR activities in the three countries.

SAFGRAD/ICRAF agroforestry research collaboration focussed for joint action in recruiting scientists and training concepts and research methodology. Upon completion of the specialized course, the scientists have joined the Benin, Burkina Faso and FSR teams.

With regard to the future collaboration :

1. SAFGRAD could assist in the promotion of agroforestry research network in the semi-arid regions of West Africa while ICRAF is expected to continue to provide the technical backstop support to the agroforestry component of the SAFGRAD FSR in the three countries.
2. To participate (ICRAF) in the FSR plan and the programme review (during the annual In-House Review of SAFGRAD FSR).
3. Training - ICRAF could assist SAFGRAD in providing a short-term training for some project technicians in order to promote multidisciplinary research with focus to improve existing land use systems.
4. Occasionally to organize joint specialized workshop with major focus to incorporate the agroforestry sub-system as a component of FSR.

Details of the programme on above collaborations could be developed jointly by SAFGRAD/ICRAF.

IV. IMPLEMENTATION STRATEGY

In the three countries, the OAU/STRC/SAFGRAD FSR programme has taken the approach that could facilitate and enable the national research team to evolve their own FSR programmes based on the national needs and priorities. The process involved : first, conducting exploratory, socio-economic and the technical verification surveys in order to identify the major constraints of food production of the area. Second, to establish the villages' representative that could serve as primary and secondary sites for FSR activities, and third to delineate the major agricultural zones of the region based on variation of rainfall, vegetation, economic and cash crops, livestock, etc.. Fourth, the FSR programme is further elaborated through diagnosis of constraints, in order to define major themes of operation. Finally, the design and formulation of the FSR programme was based on the identified major constraints and technologies available to resolve them.

The FSR activities or research stages have already been defined. Because the research "activities" or "stages" are often executed simultaneously, it has been decided to employ the following FSR stages :

ACTIVITY

SUBACTIVITY

- | | |
|---------------------------|---|
| 1. Diagnosis | <ul style="list-style-type: none"> . constraint identification . farmers' own solutions . current systems description . literature review . hypothesis formulation |
| 2. Design | <ul style="list-style-type: none"> . as function of the need expressed by the farmer |
| 3. Testing and evaluation | <ul style="list-style-type: none"> . farmers' objectives . integration components |
| 4. Transfer and extension | <ul style="list-style-type: none"> . pre-extension . extension . adoption of technologies |

The transfer stage also includes the transfer of farmers' production problems to policy making decision.

Programme management

The IFAD supported-FSR programme uses the following structured mechanisms for the management and implementation of the programme in the three respective countries :

The SAFGRAD coordination office

The director of research, being responsible for the timely execution of the FSR programme development and pursued the implementation of the general plan of action, whereas the financial controller supervises the disbursement of IFAD funds to the FSR programmes in Benin, Burkina Faso and Cameroon. All administrative and technical services to the above-mentioned FSR activities is provided by the SAFGRAD coordination office of the OAU/STRC.

Each year, elaboration of the FSR programme in the three countries is carried out through the following technical and management meetings :

1. Project Management Committee (PMC)

OAU/STRC has set up a project management committee, under terms of reference approved by IFAD, which includes :

- . representatives of donor agencies to the SAFGRAD project (IFAD, USAID, FAC, etc.) ;
- . the implementing agencies ; and
- . representatives from each of the three participating FSR countries, SAFGRAD coordination office and invited scientists.

Functions of the Committee

The major activities of the committee are :

- a. To review and recommend SAFGRAD FSR work plans and provide guidance for the effective administration implementation.
- b. to review and provide guidance as to the technical implementation of FSR programme.

- c. to review and guide the management of SAFGRAD-supported FSR programme to ensure effective coordination within and among country programmes and with other related projects.

2. An In-House Annual Review and Planning Committee

This committee meets once a year. The purpose of the meeting is for a technical review of previous season's results, and also to conduct detailed planning session to examine the 1988-1990 FSR programme (to be elaborated) of the three countries. The participants of this session would be SAFGRAD FSR management, scientists working within the project, IFAD representative and one or two invited outstanding FSR practitioners from other agencies.

3. FSR consultancy meeting (team leaders, director of research and SAFGRAD management)

The purpose of this meeting is to follow-up the implementation of the FSR programmes in the three respective countries. The FSR programme proposal for each year would also be discussed. The meeting is normally held in June in order to schedule monitoring tours or visits by prospective review missions. Administrative matters that were encountered during the execution of the programme would also be sorted out.

4. Workshop

As a mechanism to facilitate the exchange of technical information and also to assess and appreciate various FSR programmes, the IFAD-supported FSR will interact with other FSR programmes in the region. At the 1986 FSR consultancy meeting, it was recommended that the 1988 workshop would be held in Parakou, Benin. Regional FSR workshop not only could provide mechanism for reviewing and evaluating research methodologies, but could also help to strengthen the national FSR programmes in scope and approach. This activity would be augmented by on-site observation in the above three or other countries where such workshops would be held.

5. Monitoring tours

Every other year Farming System Research tour is organized to assess field activities of the three countries (Cameroon, Benin, and Burkina Faso respectively). The FSR monitoring tour comprised of national scientists of the three countries and the SAFGRAD FSR field staff and is led by the director of research. The purposes of the FSR monitoring tour is to appreciate the diversified socio-economic, institutional and environmental constraints of food production in each respective country ; to comprehend the prevailing farming practices of the project area ; to share field experiences among the three country FSR teams ; to appreciate problems encountered in the execution of FSR protocols at field level ; to make technical assessment of current FSR activity and to compare FSR institutional arrangements that is is being evolved in each respective country.

Linkages

SAFGRAD as a regional agency for research coordination and development is the hub for research linkages among NARS, IARCs and other research institutes. Within the SAFGRAD framework, the IFAD-supported FSR activities are linked to :

- a. Crop commodity research networks implemented through SAFGRAD/IITA/ICRISAT i.e sorghum, millet, maize and cowpea.
- b. Resident research programme of IITA/SAFGRAD.
- c. Resident research of ICRISAT/SAFGRAD
- d. The West African Farming Systems Networking among 18% West African Countries. The project is administered by the SAFGRAD coordination office.
- e. ICRAF/SAFGRAD research collaborations.
- f. ILCA and SAFGRAD linkage currently limited to analytical services and provision of technical information by the latter could further be developed.

Furthermore, each national FSR being integrated with the respective NARS (Benin, Burkina and Cameroon), has both horizontal (with various departments research programmes) and vertical linkages (with research administrators, policy makers and farmers). Linkages among the three FSR programmes and with other national FSR activities is attained through workshops, monitoring tours and finally at various functional meetings organized by SAFGRAD coordination office. Another component of SAFGRAD is the Accelerated Crop Production Officers (ACPO) Programme, (operational in Burkina, Cameroon, Mali and Togo) which conducts on-farm testing and pre-extension demonstrations multilocation trials. Direct linkage between on-station research and extension, and between extension and farmers is known to function better in the developed countries than in WASAT due to differences of farmers' educational level, better availability of agricultural information-system ; financial institutions to provide credits, etc..

Since farmers' decision is made for multiple objectives and constraints and also operate their farm as a system in allocation of resources, etc., FSR could provide better linkages of on-station research to farmers in collaboration with extension and rural development agencies. The national extension system (or its equivalent) in Benin, Burkina Faso and Cameroon is the major link and vehicle to transfer and diffuse relevant FSR technologies through farmer-managed and researcher-managed trials at different FSR village sites.

IFAD T.A GRANT N) 110 (PHASE II)
1988 - 19991
FSR BUDGET PROPOSALS

Required inputs

The financial assistance of IFAD to OAU/STRC could enable SAFGRAD to continue support of three national (Benin, Burkina Faso and Cameroon) farming system programme in the following areas of activities :

1.0 Professional staff

Ten professional technical staff are currently based in the three countries : Benin (agro-economist, agronomist and agroforester/livestock specialist) ; Burkina Faso (animal production specialist, agroforester, soil scientist/agronomist and agricultural economist), and Cameroon (soil scientist, agricultural economist and agroforester).

X The financial support would be used for salaries, travelling and related research costs for FSR team based in the three countries. In order to improve the research capabilities, of promising national research counter parts provision for short and long-term training within Africa is made in the budget.

2.0 Operational expenses

The project during the last two years was under budgeted to contain the implementation of the FSR components. This proposed budget reflects minimum financial requirements. Due to financial constraints the pace of the FSR development was altered since certain essential research activities were not carried out.

Elucidation and broader interpretation of FSR results was not attained since equipments were not timely purchased to improve analytical capacity of the FSR teams. Often the cost of having analysis done by service centers has become expensive. This budget proposal have taken into account for investment on essential research equipments to be utilized by the three national FSR teams.

Technical and administrative backstopping is provided by the coordination office. This involves programme development, monitoring the implementation of various aspects of FSR in the three countries. Provision is also made for coordination and research management through the SAFGRAD Coordination Office located in Ouagadougou, Burkina Faso by the director of research, financial controller and administrative assistant.

Each country programme budget provides for national programme research support staff.

The increased budgets over the three year period of Phase II reflect the inclusion of agroforestry research in each country programme and also increasing research activities resulting from the encouraging results and successes achieved from Phase I of the farming systems research programmes.

IFAD T.A. GRANT N° 110
OAU/STRC/SAFGRAD - FSR - PHASE II
BUDGET PROPOSALS FOR 1988 - 1991
(IN US \$ 1,000)

S U M M A R Y

	1987/88 Actual	1988/89 Request	1989/90 Request	1990/91 Request	Total 1988/91
I (a) International Staff	675	820	860	910	2,590
(b) National, Programme Staff	192	302	330	361	993
II Operational Expenses	130	434	454	419	1,307
III Farming Equipment and Vehicles	190	260	129	63	452
IV Coordination and Regional Networking	55	80	88	96	264
V Training	70	194	181	190	565
VI Local and International Travel	62	164	178	196	538
VII Consultancy	10	10	10	10	30
VIII Contingency	16	114	111	113	338
TOTAL US \$	1,400	2,378	2,341	2,358	7,077

BUDGET PROPOSALS FOR 1988/89

(IN US \$ 1,000)

	SCO	Benin	Burkina	Cameroon	Total
I (a) <u>International Staff</u>					
Director of Research 1	75				75
Financial Controller 1	65				65
Agric. Economist 3		65	65	65	195
Soil Scientist 2			65	65	130
Agronomist 1		65			65
Animal Scientist 1	30		65		65
Agroforester 3		65	65	65	195
Admin. Assistant 1					30
	170	195	260	195	820
I (b) <u>National Program Staff</u>	50	68	73	111	302
Research Associates					
Enqueteurs					
Field Assistants					
Technicians					
Secretaries					
Accounts clerks					
Drivers					
II <u>Operational Expenses</u>	40	95	173	126	434
Inputs					
Office Supplies & communications					
Fuel & Maintenance					
III <u>Equipment</u>	30	54	60	116	260
Vehicles					
Motor Cycles					
Farm Equipment					
Laboratory Equipment					
Office Equipment					

BUDGET PROPOSALS FOR 1988/89
(IN US \$ 1,000)

	SCO	Benin	Burkina	Cameroon	Total
V <u>F.S.R. Coordination & Net Working & Workshops</u>	80				80
In-House Review					
Regional Workshops					
V <u>Training</u>	50	42	60	42	194
VI <u>Travel</u>	30	42	50	42	164
Local					
International					
VI <u>Consultancy</u>	10	-	-	-	10
TOTAL COSTS	460	496	676	632	2,264
II <u>Contingency (5%)</u>	23	25	34	32	114
TOTAL REQUEST	483	521	710	664	2,378

BUDGET PROPOSALS FOR 1989/90
(IN US \$ 1,000)

	SCO	Benin	Burkina	Cameroon	Total
I (a) <u>International Staff</u>					
Director of Research	80				80
Financial Controller	68				68
Agric Economist		68	68	68	204
Soil Scientist			68	68	136
Agronomist		68			68
Animal Scientist			68		68
Agroforester		68	68	68	204
Administrative Assistant	32				32
	180	204	272	204	860
I (b) <u>National Programme Staff</u>	53	82	73	122	330
Research Associates					
Enqueteurs					
Field Assitants					
Technicians					
Secretaries					
Accounts Clerks					
Drivers					
II <u>Operational Expenses</u>	44	105	170	135	454
Inputs					
Office Supplies & Communi- cations					
Fuel & Maintenance					
II <u>Equipment</u>	-	58	50	21	129
Vehicles					
Motor Cycles					
Farm Equipment					
Laboratory Equipment					
Office Equipment					

BUDGET PROPOSALS FOR 1989/90
(IN US \$ 1,000)

	SCO	Benin	Burkina	Cameroon	Total
V <u>F.S.R. Coordination and Networking</u>	88	-	-	-	88
In House Reviews					
Regional Workshops					
V <u>Training</u>	55	43	40	43	181
VI <u>Travel</u>	33	46	53	46	178
Local					
II <u>Consultancy</u>	10	-	-	-	10
TOTAL COST	463	538	658	571	2,230
II Contingency 5%	23	27	32	29	111
TOTAL REQUEST	486	565	690	600	2,341

BUDGET PROPOSALS FOR 1990/91
(IN US \$ 1,000)

	SCO	Benin	Burkina	Cameroon	Total
I (a) <u>International Staff</u>					
Director of Research	84				84
Financial Controller	72				72
Agric Economist		72	72	72	216
Soil Scientist			72	72	144
Agronomist		72			72
Animal Scientist			72		72
Agroforester		72	72	72	216
Administrative Assistant	34				34
	190	216	288	216	910
I (b) <u>National Programme Staff</u>	56	98	73	134	361
Research Associates					
Enqueteurs					
Field Assistants					
Technician					
Secretaries					
Accounts Clerks					
Drivers					
II <u>Operational Expenses</u>	50	115	110	144	419
Inputs					
Office Supplies & Commu- nications					
Fuel & Maintenance					
III <u>Equipment</u>	-	7	50	6	63
Vehicles					
Motor Cycles					
Farm Equipment					
Office Equipment					
Laboratory Equipment					

BUDGET PROPOSALS FOR 1990/91
(IN US \$ 1,000)

	SCO	Benin	Burkina	Cameroon	Total
IV <u>F.S.R. - Coordination and Networking</u>	96	-	-	-	96
In house Review					
Regional Workshops					
V <u>Training</u>	60	45	40	45	190
VI <u>Travel</u>	36	51	58	51	196
Local					
International					
VII <u>Consultancy</u>	10	-	-	-	10
TOTAL COST	498	532	619	596	2,245
VIII Contingency	25	27	31	30	113
TOTAL REQUEST	523	559	650	626	2,358

REFERENCES

1. OAU/STRC/SAFGRAD report Programme review of the IFAD FSR Grant Support n°110, 2 - 6 March 1987.
2. Nagy, J.G ; Sanders, J.H ; et al 1986. Technology development to increase cereal production in the WASAT (In) Proceedings of the International Drought Symposium and Production of Food Grains (editors J.M. Menyonga, Taye Bezuneh, and Anthony Youdeowei).
3. Matlon, P.J, 1984. Technology evaluation five case studies from West Africa (In) coming full circle : Farmers participation in the development of technology Ottawa, Ont, IDRC 95-118.
4. Ngambeki D.S and B.J. Ndunguru 1986. An approach to increasing crop productivity under drought. A case of Northern Benin (In) Proceedings of the International Drought Symposium on Production of Food Grains. (Editors J.M. Menyonga, Taye Bezuneh and Anthony Youdeowei). An OAU/STRC SAFGRAD Publication (In press).
5. Prudencio Y.C, 1986. Reconnaissance survey of farming systems in the Mossi Plateau of Burkina Faso.
6. SAFGRAD/Benin FSR project. Annual reports 1985 and 1986.
7. SAFGRAD/Burkina Faso FSR project. Annual reports 1985 and 1986.
8. SAFGRAD/Cameroon FSR project. Annual report 1986.
9. Purdue University, IPIA 1986. Cereal Technology Development - West African Semi-Arid Tropics : A Farming System^SPerspective : End of Project Report.
10. OAU/STRC/SAFGRAD 1987 FSR proposal.

11. Mc Namara, R.S 1985. The Challenges for Sub-Saharan Africa. Sir John Crawford Memorial Lecture N° 1, Consultative Group on International Agricultural Research, Washington, D.C.
 12. Nagy, J.G and H.W Ohm, 1986. FSU/SAFGRAD 1985 annual report. International programmes in Agriculture, Purdue University, West Lafayette, Indiana.
 13. Lang, Mahlon G. et al, 1984. FSU/SAFGRAD annual report 1983. International programmes in Agriculture, Purdue University, West Lafayette, Indiana.
 14. Matlon , P.J, 1985. A critical review of objectives, methods and progress to date in sorghum and millet improvement. A case study of ICRISAT/Burkina Faso. In : appropriate technologies for farmers in semi-arid West Africa. (Editors H.W. Ohm and J.G Nagy) International programmes in agriculture, Purdue University, West Lafayette, Indiana.
 15. Collinson, M.P, 1982. Farming systems research in Eastern Africa. The experience of CIMMYT and some national agricultural research services 1976-1987. International agriculture development paper n° 3, Michigan State University, East Lansing.
-

AFRICAN UNION UNION AFRICAINE

African Union Common Repository

<http://archives.au.int>

Department of Rural Economy and Agriculture (DREA)

African Union Specialized Technical Office on Research and Development

1987-10

FARMING SYSTEMS RESEARCH PROGRAMME FSR PROJECT PROPOSAL

AU-SAFGRAD

AU-SAFGRAD

<https://archives.au.int/handle/123456789/8947>

Downloaded from African Union Common Repository