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FARMING SYSTEMS RESEARCH PROGRAMME
IFAD GRANT SUPPORT n° 110

1987
RESEARCH PROPOSALS

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SAFGRAD
SEMI-ARID FOOD GRAIN RESEARCH AND DEVELOPMENT

TABLE OF CONTENTS

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Tél. 30 - 60 - 71/31 - 15 - 98
Burkina Faso

	<u>PAGE</u>
INTRODUCTION	1 - 3
CONSTRAINTS	4
TECHNOLOGICAL OPTIONS	5 - 9
I. BURKINA FASO FSR PROGRAMME	9
Background Information	9 - 17
1987 FSR Programme	17 - 18
Areas of Interventions - agronomy and soils	18 - 22
Towards integrating forage and animal resources into existing cropping systems.	23 - 28
Areas of Intervention in Socio- Economic Research	29 - 32A
II. BENIN FSR PROGRAMME	33
Background Information	33 - 41
Description of Research Activities	41
Agronomy and Soils Interventions	41 - 42
Towards integrating forage and livestock resources	42 - 46
Socio-economic studies	46 - 47
Agro-forestry Interactions	47 - 48
III. CAMEROON FSR PROGRAMME	49
Background Information	49 - 52
1987 Planned Project Activities	53
Socio-economic studies	53 - 54
Agronomic On-farm trials	54 - 57
Agro-forestry	57
IV. PROGRAMME MANAGEMENT AND IMPLEMENTATION	58 - 60
1987 GENERAL PLAN OF ACTION	61
FSR BUDGET PROPOSAL FOR 1987	62 - 65

ACRONYMS AND ABBREVIATIONS

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Tél. 30 - 60 - 71/31 - 15 - 98
Burkina Faso

CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
FAC	Fonds d'Aide de Cooperation
FSR	Farming Systems Research
FSU	Farming Systems Unit
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Centre for Africa
INERA	Institut d'Etudes et de Recherche Agricoles (Burkina Faso)
IRAT	Institut de Recherche Agronomique Tropical
IRA	Institut de la Recherche Agronomique
N	Nitrogen
OAU	Organization of African Unity
OM	Organic Matter
ORD	Organisation Régionale de Développement
P	Phosphorous
SAFGRAD	Semi-Arid Food Grain Research and Development
STRC	Scientific, Technical and Research Commission
TR	Tied Ridges
USAID	United States Agency for International Development
WASAT	West African Semi-Arid Tropics

INTRODUCTION

The main task of FSR would be to introduce technological innovations into the current farming systems that could transform the dominant cereal based farming systems into a more intensified and integrated cereal-forage/livestock cash crop farming system. The technology components considered within this programme would have multi-disciplinary interventions that could increase food production by restoring the fertility of the soil, conservation of soil and water. Available crop production technologies (improved and traditional - local systems) would be evaluated to enable farmers to make adjustment to prevailing physical constraints such as erratic rainfall, drought, etc.

One of the emphasis of the programme is to intensify cereal/legume rotations within an integrated production system, that could provide biological nitrogen fixation and reduce the period of fallowing and dependency upon outside sources for nitrogen. Livestock plays a very important role in the production system in the sudano-sahelian zone of Burkina Faso, Benin and Cameroon. The animal component of the FSR would evaluate (local and exotic) feed resources, since feed availability could enable farmers to intensify an integrated animal and crop production systems.

Animal traction provides options, i.e. to intensify food production depending on particular environmental conditions and population pressure. For example, in the northern guinea savanna zone, where least animal-traction is currently employed, extension of cultivated area could be better achieved by animal traction as long as the population/land-ratio is low and availability of fallow land is not limiting.

In the sudano-savanna zone, particularly in old settlement areas like the Mossi Plateau where the population/land-ratio is relatively high (on the apparent poor soil), intensification of agricultural activity seem to be the option since fallow land is nearly minimized. The migration of people to another region during peak season for on-farm and non-farm work is also known to create labour shortages. Animal traction as one of labour saving technology would be explored.

Feed availability would improve the nutrition of livestock, the major source of energy (traction, fuel, organic matter) and food (protein). Mainly due to the constraints of feed resources, farmers are discouraged from integrating large ruminants into the production system. One of the major objectives of the FSR programme is to create the conditions (i.e. availability of feed resources) for effective integration of animals into the production system. The forage legume programme currently initiated (Burkina Faso FSR since 1985 and Benin FSR in 1986 and to be started in Cameroon) could not only enhance the soil-fertility restoration process, but also improve the nutrition and growth of the animals for effective animal traction. The agro-forestry FSR component to be started in 1987 could contribute towards prevention of soil erosion, improve soil fertility and water conservation in addition to providing fuel. The purpose of the IFAD FSR-support programme is to enable the national programmes to face the challenge of food production by developing appropriate resource management systems. The achievement of such goals requires a good knowledge of farmers' goals and objectives, of the specific technical, social and economic constraints that set limits on farmers' objectives and which impede farm income stabilisation and the adoption of newly developed technologies.

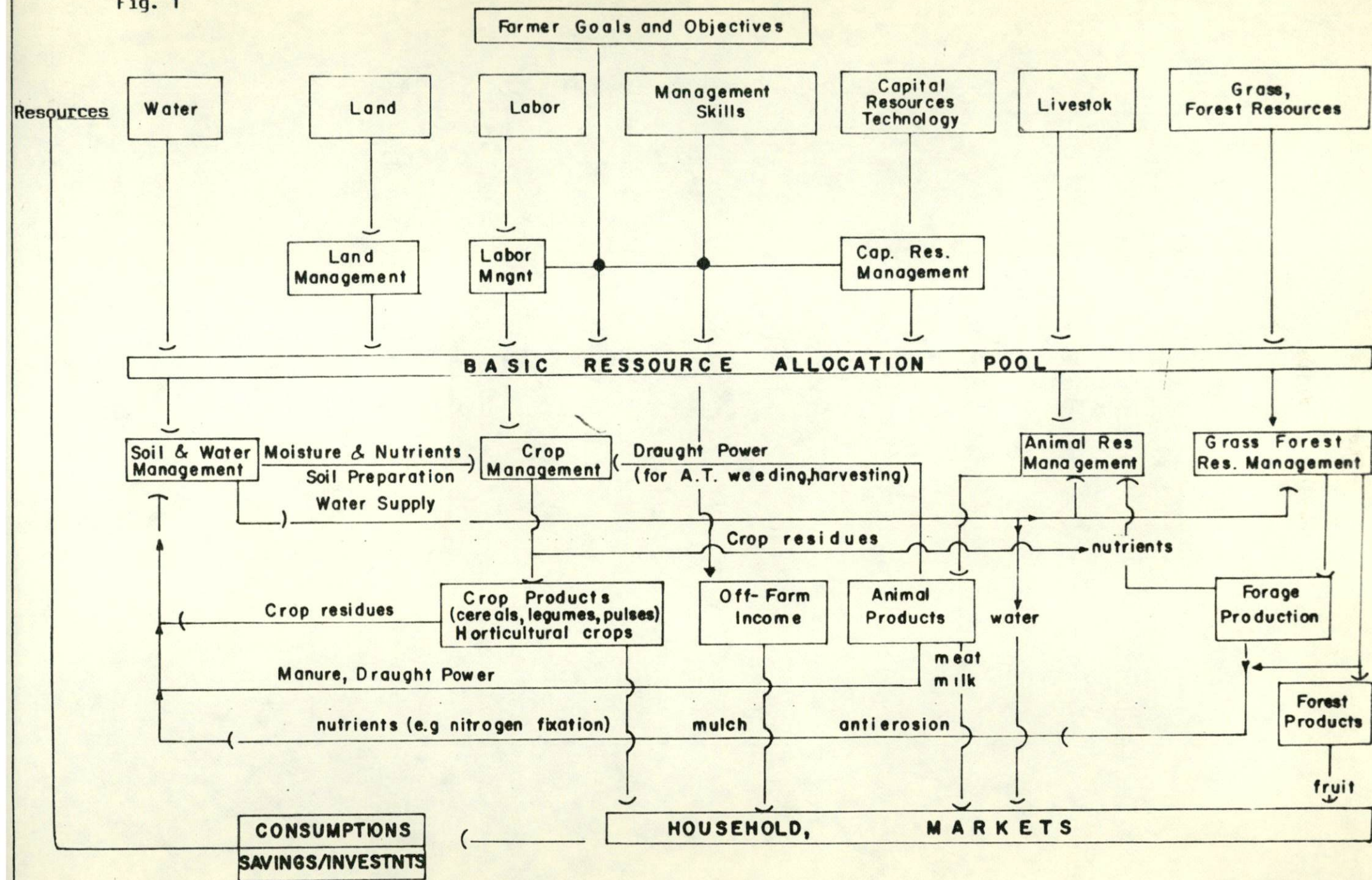
It is well-known, for instance, that the major physical constraints to traditional rainfed farming systems in the West African Semi-Arid Tropics (WASAT) are drought and low soil fertility. It has also been established that labour is generally the most limiting economic constraint and that increasingly limited availability of land, lack of sufficient capital resources, poorly organised and poorly equipped extension support and marketing systems, also set serious limits on small farmers' ability to adopt new high-yielding technologies

to increase their farm incomes. These constraints combined with the increasing demand for cultivating land, for energy (woods) and for pasture are suspected to lead to a destabilization of most current farming systems through desertification and declining soil fertility. In order to reverse such a trend, one generally accepted solution would be to develop improved and feasible farming systems which will help to reinforce and improve the farm resource base through a better integration of the crop production, animal production and agro-forestry components of the traditional farming systems as depicted in Fig.1.

However, such a solution also faces many technical and socio-economic constraints. The specific constraints in every case of farming systems need to be identified as well as the way such constraints act to limit the feasibility of the solution. Regarding the economic constraints for instance, it has been well established that labour is, in general, the most limiting factor for small farm income growth, and that most technologies designed to help small farmers such as tied ridges for instance, have a tendency to be labour intensive and to worsen the labour bottlenecks that occur on the farm generally during the planting and weeding periods.

The practical implication of these specific constraints is that in designing technological packages and farming systems for the farmers, a special attention should be paid to peak labour saving innovations that are risk reducing or are characterised by "reasonable" levels of risk and enable the small farmer to achieve his objectives, the most important of which is generally to ensure food security.

Fig. 1



CONSTRAINTS

Climatological

Exhibited by unpredictable level and erratic distribution of rainfall, drought, etc., the WASAT as a whole had 100 to 150 mm of rain below the long-term average within each isohyet during the last fifteen years. The climatical and physical constraints faced by farmers in combination with low labour availability have resulted in low input farming systems.

High population/land ratio

Due to rapid growth of population particularly in the old settlement areas access to fallow land is limited and as a result food production cannot keep pace unless agricultural production is intensified. The present man/land ratio in the West African region, which generally averages 15 persons per sq. km. (World Bank 1985), are extremely low than compared to 600 persons per sq.km. in Asia (McNamara 1985). The poorer agricultural resource base of WASAT, however, cannot support the high man/land/ratio like of Asia. A case in point is the Central Mossi Plateau of Burkina Faso with population of 60 persons per sq.km. high (World Bank 1985) man/land/ratio relative to poor resource base, have already caused a change in the traditional bush-fallow farming system. The technological option in heavily populated areas seem to be the intensification of agriculture. The increased population has therefore meant limited access to new land, a shortening of the fallow rotation and cultivation of more marginal land (Norman et al, 1982, Dugue 1985).

Deterioration in the quality of land

Exhibited by low organic matter, low water retention - due to runoff, erosion, and crusting of soil surface that minimizes infiltration of water and crops establishments. The red alfisols and sandy soils, which constitute 35 to 40% of WASAT are low in organic matter, cation exchange capacity and exchangeable cations.

Lack of input application on traditional food crops.

Commercial fertilizers, improved farm tools, pesticides, herbicides, etc., are rarely used on traditional food crops since these parameters of production are risk averse.

Lack of systems approach to research and food production

Crop production is the dominant agricultural research and production activity in three ecological zones (Sudan, northern Guinea savana and even Sudano-sahelian zone). Both at thematic research and farmers' level combination and integration of production systems (animal and crop production, soil fertility and soil-water management, agro-forestry, etc.), could lead to self sustaining system of food production, since the resource base for agricultural production could continuously be rejuvenated.

TECHNOLOGICAL OPTIONS

In considering technological intervention, the largest impact on yields and production is realized when various technologies are used in combination. In order to alleviate the major food production constraints, the IFAD-supported FSR programme in the three countries have considered the following technological options where applicable:

1. Soil-water conservation technologies

- (a) Tied Ridges - have been shown to significantly increase yields (Rodriguez 1982, Nicou and Charreau 1985). FSU on-farm, researcher-managed trials have shown significant yield increase and economic returns to the additional labour required to do TR on maize, sorghum and millet (FSU Annual Reports 1982 and 1983; OHM et al 1985, a and b). The FSR components considered i.e. animal and crop production system, and socio-economic research would conduct more research in order to refine the TR technology which currently is very labour intensive. For example, the manual tying of animal traction made ridges requires at least 40 man hrs/ha

with very efficient labourers (FSR report 1983) and on the average 75 man/hrs/ha. The construction of TR completely by hand requires at least 100 hours/ha (OHM et al, 1986b). The technology has advantage that no cash outlay is required if family labour is utilized. Availability of labour is the limitation to the adoption of the technology. Another limitation of the TR technology is that it does not work well on sandy soils because the ties tend to break down in heavy rain. On the alfisols, an estimated 30 to 40% of the presently cultivated land in WASAT appears to be suitable for tied ridging. Since tied ridging has been shown to be both agronomically and economically feasible as a technology applicable at present time to increase cereal yields. The FSR teams in the three countries will search for labour-saving technologies in order to overcome labour constraints.

- (b) Diguettes/dykes - the construction of diguettes, although not as effective in retaining water as tied ridges, is a water conservation method that has been investigated. Diguettes are barriers 10 to 15 cm high mainly made of rocks and placed on field contour lines 10 to 50 meters apart. The barriers, although permeable, slows rainfall runoff to allow increased infiltration. The technology has increased yields in the northern (Yatenga) region of Burkina Faso (Wright, 1985). Provided that rocks, the principal material for the construction of diguettes are available, these barriers can be constructed in off peak labour periods with the family labour and is not as labour intensive as tied ridging.

- (c) Mulch - crop residues can reduce rainfall runoff and increase water infiltration. The principal limiting water factor of mulch is its finite supply especially in the northern half of WASAT.

The crop residue and other biomass produced have demand for use as animal feed, fuel and construction materials. Whatever remains of crop residues and natural vegetation -the prevalent custom is to burn this -and this practice leaves most of the fields bare by planting time. Particularly in the Sudan and Sudano-Sahelian zone the biomass produced from crop residues are not sufficient by themselves (3 to 5 tons/ha) to increase soil fertility and water retention capacity appreciably.

2. Soil fertility restoration technologies.

- (a) The deterioration of the land quality, i.e. fertility and related resources have been exacerbated of increasing population. The interaction of FSR components, that of animal production, legumes, green manuring, agro-forestry and soil-conservation technologies, would be employed in an integrated approach in order to speed up the process of the restoration of the soil fertility.
- (b) Animal manure and composting - are already being used effectively on the fields near the compound although application and composting techniques could be more efficient. The prevailing conditions is that use of manuring and composting is limited to its unavailability in adequate quantity since few organic waste materials are left once the household and animal feed requirements are met. The animal production component of the FSR in Burkina Faso, Benin (to be initiated) and possibly in Cameroon, to be looked into, will improve fallow and cropping lands by integrating forage legumes and raising of animals in limited area.

By improving the natural pasture and proper management of crop residue manure and compost availability could increase since animals could be penned to make collection possible. Forages, legumes and trees are known to restore the fertility of the soil. This innovation has been introduced at on-farm level by the IFAD(supported FSR programme in Burkina Faso and Benin. The prevailing problems of this technological option, however, are grazing on fallow land away from living quarters, and the labour involved with confined rearing of animals, is too great.

In the Mossi Plateau of Burkina Faso, and in the sudano-sahelian zone of Benin and Cameroon, cattle are entrusted to herders or nomads (usually to Fulani or peuhl ethnic group) because of feed shortages close to the villages as fallow land declines in the old settlement areas, since it is increasingly difficult to support cattle near the village. Although animal manure and composting are agronomically and economically feasible for use around the compound area at present, they do not represent farm management practices that will substantially increase cereal production in the WASAT in the short and immediate run because of the finite supply. Their potential could only be realized in the long run when farming systems evolve from dominant cereal-based system to a more intensive cereal-forage/cash crop system that is able to support more livestock near the village.

(c) Green manuring and plowing

Deep plowing green manuring, other tillage practices have been observed to increase yield, due to change of the structure of the soil, allows better root establishment and improved water infiltration and storage. (Nicou and Charreau, 1985). About 85% of the farmers in / 9.....

WASAT do shallow manual or animal traction cultivation. Green manuring can also increase the fertility of the soil and add to water retention capacity of the soil. This practice also requires deep ploughing to incorporate the plants into the soil.

(d) Chemical fertilizers

Fertilizer use is riskier in the more northern region (sudano-sahelian zone) due to lower rainfall. Yield response to fertilizer, however, is highly variable between sites and years (Spencer; 1985). There is, however, considerable risk for a farmer for losing the cash outlay when fertilizer is used alone. When tied ridging and fertilizer are used in combination, both yield and profitability are substantially increased.

I BURKINA FASO FSR PROGRAMME

Background Information

Burkina Faso extends from 9°20' to 15°5N and between 5°30' West to 2°20' East. The topography is flat with average elevation of 400m and the highest elevation of 600m above sea level. Rainfall decreases from South to north of the country. Rainy season starts in April in the South, reaches the North by the end of June and rainfall stops rather abruptly at the end of September. The vegetation is determined by rainfall amount. In the Sudano-Guinea zone, primary forest cover is still present. In the Sudan zone of the central part shrub and/or tree cover is prevalent, while the sahelian zone of the North has grass steppes with some shrubs. There is substantial reserve of water. Estimates of water reserves range from three to four billion m³ of annually renewable resources. Some of the aquifers lie between 10m and 80m of the surface.

/10.....

Climate

The climate over a major portion of Burkina Faso is dry. The rainy season lasts for 3½ months in the North to 6 months in the Southern part of the country. The corresponding number of rainy days range from 30 to 60 days and 60 to 90 days. Similarly, the average rainfall amounts to 400-500mm in the North to more than 1000mm in the South. The start of the rainy season extends over two months, from April in the South to June in the North. In contrast, rainfall stops rather abruptly by the end of September.

Potential evapo-transpiration is high throughout the country with mean annual values of 1900mm compared to 700 mm of rainfall for the Central Plateau. Temperatures are high just before and after the rainy season. The mean maximum value around March and April is 37° for the South and 41° for the North. Corresponding values at the end of September are 34°C and 38°C. The hot dry winds from the Sahara (Harmattan) further aggravate the drought.

Rainfall is highly variable with location and time. Thus, long term mean values have limited value in understanding the status of crop moisture supply. Although rainfall exceeds evapo-transpiration during some months of the year, periods of drought are frequent throughout the rainy season. This is even more pronounced during plant establishment and grain formation stage. Significant proportion of the rainfall occurs in few showers. In the centre and North of the country up to 10% of the annual rainfall can be expected to occur in one day and up to 50% in eight rainy days (BUNASOL, 1985). Evidently, such intense storms contribute to serious runoff losses and soil erosion hazard.

The climate hazard seriously limits agricultural production. Crop production is risky, the livestock carrying capacity of the area is reduced and adoption of improved technologies is delayed. Any strategy that can reduce the climate risk, such as improved soil moisture storage and supplemental water use, could markedly increase agricultural productivity.

It is estimated that more than half of Burkina Faso lies within climatic zones favourable to agriculture. Of the total area rainfed cultivation makes up 23.2% (88,290m²), pasture land 47.3%, timber and forest 12.7% and the rest miscellaneous land. Irrigated area currently makes up a very small fraction of the cultivated land (87,000 ha). The irrigation potential within the entire country is much higher. Of the nine million hectares of arable land only one-third is currently being cultivated. However, there is little likelihood that the cultivated land in certain regions can be increased due to poor soils, lack of adequate water or over-population. General reconnaissance study and some investigations indicate that sandy gravel soils of low fertility prevail in the area. In contrast fertile soils make up for a small part of the country.

Soils

The soils of the country are not studied in detail to allow design of suitable management practices at the farm level. General reconnaissance study (Boulet 1976) and some investigations (El-Swaify et al 1984), indicate that sandy gravel soils of low fertility prevail in the area. The soil's physical constraints include :

low water storage capacity due to low organic matter, content (less than 1%),
high erodibility and excessive runoff potential, and
excess gravel and coarse fraction on the surface with
compacted sub-surface clay lenses.

Similarly, some of the predominant chemical constraints are :

- low content of organic matter, poor iron retention and buffering capacity,
- low nutrient supplying capacity especially nitrogen and phosphorous.

/12.....

Some exhaustive management practices accentuate the degradation of the soil resource base. Some of these practices are removal of crop residues for fuel, fodder or in situ burning - and this results in near total removal of nutrients contained in the biomass and exposes the soil to serious erosion hazard; over-exploitation of forests deprives the soil of perennial vegetative cover; and inadequate soil conservation practices degrade the soil's physical condition and contributes to a substantial runoff loss of the limited rainfall.

Major crops in the area include cereals, (sorghum, millet, maize and rice), cowpeas, groundnuts, cotton, sesame, rice and some fruits and vegetables. Mixed cropping is the norm in the area. Livestock products account for nearly half of the agricultural export. Livestock population was traditionally highest in the north of the country. However, due to drought in the past decade, the area of livestock concentration has shifted to the heavily cropped Sudanian and north guinea zones. Mixed farming is the prevalent practice among the farmers with regional variations in the emphasis given to the crop or livestock component. There is strong inter-dependence between the predominantly herder community and the cultivators throughout the country. Intensive crop production as well as livestock, has contributed to depletion of the natural vegetation in the Central Plateau. The low crop productivity obliges farmers to expand the area under crops, thereby diminishing grazing land. Despite the multiple uses of livestock, capacity to maintain animals on the farm is low. Intensification of agricultural production per unit area remains the only viable alternative to sustain food self-sufficiency. This can be achieved through utilization of local resources which promoted increased complementarity of crop and livestock production systems.

The FSR experience in Burkina Faso

Farming Systems Research (FSR) commenced in Burkina Faso since the last decade and has been carried out mainly by FSU, ICRISAT and IRAT, each one with its own objective and approach. The FSU programme largely focussed on cropping systems and was not integrated within the national research system. The ICRISAT

Economics Unit viewed its primary role as helping to guide the research of ICRISAT's biological and physical scientists. Although it has collaboration links with the national agricultural research institute (INERA), and with the regional development agency (ORD) of the Yatenga province, the French "recherche-developpement" 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 have also concentrated their attention mostly on improvement of crop productivity and have given relatively little attention to the improvement of the farm resource base which is being severely degraded as a result of increasing demographic and livestock pressures.

In a report issued in January 1984, an OAU/STRC/IFAD consultative mission recommended that SAFGRAD strengthens the FSR programme in Burkina Faso with a new FSR team composed of an agricultural economist, a soil scientist and an animal production specialist. The mission recommended a much more active programme of resource management systems studies which involve trees, livestock, crop and other inputs (Couprie, et al, 1984). The mission proposed that the new FSR programme in Burkina Faso pursue the following objectives :

- To evolve sustained systems of production in the semi-arid zone for small or poor farmers whose systems have major cereal (maize, sorghum, millet) and/or grain legume (cowpea) components.
- To develop an effective communication system between farmers, extension workers, research scientists and others, to ensure that agricultural research is relevant to the short and long-term needs of poor farmers.

Realization of National FSR

The SAFGRAD support (through IFAD funds) to the National FSR Programme started in 1985 by providing the programme with technical and financial assistance. Three OAU/STRC/SAFGRAD scientists currently constitute among the members of the national FSR team and are based at Kamboinse. All three scientists have the responsibility for carrying out FSR activities primarily on the Mossi Plateau with possible extension to the west or to the east of the plateau, depending on availability of funds and the needs of the programme. The Kamboinse based team is also expected to collaborate closely with the Farako-Ba based team in the southern part of the country.

Advantages over previous FSR programmes

The National FSR Programme is one of the integrated department of national research system. It has, therefore, direct administrative and technical links with all the national thematic or commodity research programmes of INERA and also with the international agricultural research programmes in Burkina Faso. As a national programme, it has more than previous FSR programme, broader responsibility to facilitate agricultural research and development in the country so as to increase their relevancy vis-a-vis farmers' needs.

Furthermore, unlike most previous FSR programmes the SAFGRAD-supported national FSR programme takes into account the animal production and agro-forestry components and places more emphasis on the development of technologies to stabilize and improve the farming systems resource base (particularly soil fertility, water, livestock and forest resources) than on the development of technologies to increase only crop productivity.

/15.....

Project Site

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 they average 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 agro-climatic 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 agronomic research stations where technologies designed for farmers have been developed. These are Kamboinsé Station, 12 km from Ouagadougou and Saria Station, 40 km from Koudougou, West of the Mossi Plateau.

The Mossi Plateau is located between the 600 mm and 1000 mm isohyets. The climate on the Mossi Plateau is in general sudan type with a transitional sudan-sahelian climate north of the 800 mm isohyet. Ouahigouya and Kaya are located in the sudano-sahelian zone with an average annual rainfall between 600 and 800 mm whereas Koupela are in the typically sudan climate zone between 800 and 1000 mm isohyets/year.

According to Virmani, Reddy and Bose (1980, the long-term average of annual rainfall is approximately 692 mm/year in Ouahigouya, 706 mm/year in Kaya, 877 mm/year in Koudougou and 826 mm/year in Koupela.

The Mossi Plateau is mostly covered in its central and northern parts by tree and shrub savannas. This is the type of vegetation which characterizes the four pre-selected zones. The southern part of the plateau is characterized by tree and woody savannas.

The Ouahigouya zone is characterized by hardly evolved eroded soils on a gravel base. The same types of soils are found west of the Koudougou region, whereas the eastern region of Koudougou from which most migrants leave is covered with slightly leached and leached tropical ferruginous soils on top of sand, sand-clay or clay-sand mixtures. These types of ferruginous soils are dominant in Koupela region whereas both of the aforementioned two types of soils are to be found in the Ouahigouya region with some predominance of slightly evolved soils (Peron and Zalacain, 1975).

Agriculture is traditional and hardly varies on the whole Mossi Plateau. In general, sorghum and millet are raised as major crops, and cowpeas, peanuts and maize, etc., as secondary crops.

Livestock husbandry on the Mossi Plateau is generally characterized by the sedentary husbandry of small ruminants on farm and by cattle raising through collaboration between Mossi farmers and Fulani herdsmen, whereby the cattle belonging to the Mossi farmer are entrusted to the Fulani herdsmen. The main difference between the four zones lies in the density of the livestock population. This density is relatively higher in the Ouahigouya zone, moderate in the Kaya and Koupela zones and relatively low in the Koudougou zone.

The northern part of the Ouahigouya zone is characterized by a predominance of transhumance pastoralism. Given that this is a rather characteristic feature of the northern part of the country and given the marginal character of the northern part of the Ouahigouya zone on the Mossi Plateau, it was decided that only the southern part of the Ouahigouya zone would be considered in the selection of primary sites.

The characteristics of livestock populations are the most determinant factors of the agricultural meso-regions of the Plateau. As indicated in Figure 2, three meso-regions are recognized ; one meso-region south of Ouahigouya, a second formed by the west of the plateau where Koudougou is located and the third formed by the whole eastern region (North-east,

central and south-east) of the plateau where Kaya and Koupela are located .

One primary site was selected in each of the three meso-regions. That is :

- one primary site in the region immediately south of Ouahigouya (Yalka village);
- one primary site in the region east of Koudougou (Kamsi village), in order to have one site on ferruginous soil different from the type of soil in the Ouahigouya region;
- one site either in the Kaya region or in the Koupela region (Kamsaoghin).

The Koupela region was selected because it is apparently a region where the largest rural migration takes place and where agriculture is more diversified and includes off-season crops (market gardening). Furthermore, the Kaya region hosts a former FSU/SAFGRAD village which could be used as a secondary site by the FSR programme.

1987 FSR Programme

Within an integrated FSR activity, the soil scientists will provide technical leadership in implementing the soil fertility conservation, water management and the evaluation of varieties and agronomic practices, research components.

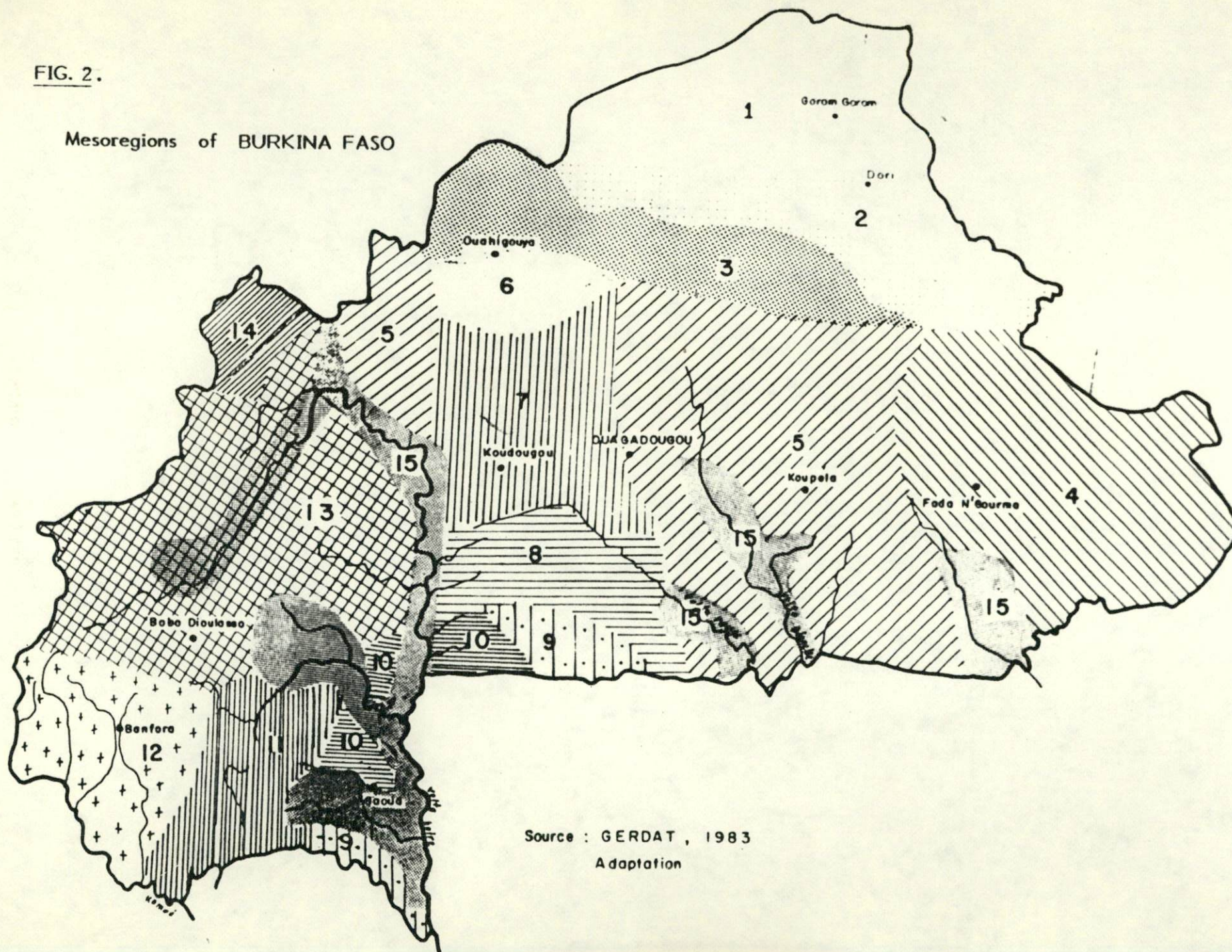
Objectives

The objectives of soil-water and soil fertility management component of the FSR is to introduce technologies that could minimize the degradation of soil resources and build up the resource base for productive agriculture at the farm level.

/18.....

FIG. 2.

Mesoregions of BURKINA FASO



Source : GERDAT , 1983

Adaptation

Further objectives of the soils and agronomic FSR component would be :

- To define the soil and climatic environment under which agricultural production is carried out in the Mossi Plateau in order to delineate various recommendations for the different land management practices.
- To evaluate the feasibility of agronomic and land management interventions in order to identify technologies that would promote security in food production and soil resource conservation.

The agronomic component is aimed at searching for technologies that promote self-sufficiency in food production.

1. Areas of Interventions - agronomy and soils

(a) Investigations on soil moisture regime:

Information on soil moisture regime is needed to match crop growth characteristics to the expected moisture supply in an area. The study will evaluate the moisture supplying capacity of the major soils in the area based on climatic data and soil moisture characteristic determinations.

Location - Primary village sites.

(b) Evaluation of soil fertility status under different land use -intensity and management practices:

The influence of traditional management practices, land morphology, and land use intensity on the nutrient supplying capacity of the soils will be determined. Analysis of data would indicate management practices that would maintain soil fertility.

Location - Primary village sites (Continuation of 1985, 86 activity)

- (c) Effect of contour bunds on soil moisture conservation and on cereal yields:

Contour bunds have been traditionally used in the Mossi Plateau to control soil erosion and thereby conserve moisture. The specific soil-climatic conditions under which the practice is effective have not been identified. The study will evaluate the soil conditions under which contour bunds would be technically feasible. Other soil conservation measures such as tied ridging and/or mulching will also be tested within the same experiment.

Location - Primary village sites. This is continuation of preliminary investigation started in 1986. The 1987 work will include more detailed study on permanent site.

- (d) Investigation on Land preparation practices:

The study will evaluate the effect of different levels of seed bed preparation on crop yields. The land preparation intensity ranges from direct planting to plowing and cultivation practices. In collaboration with the economist, the technical and economic feasibility of different tillage practices will be determined.

Location - Primary village site. The study to be carried out for several seasons.

- (e) Investigations on Increasing Water conservation on village sites:

Discussions with the farmers indicate lack of water both at the field and village levels. Water is the principal factor limiting agricultural production and effort to increase agricultural productivity needs to consider aspects that could increase water conservation at the village level by employing different soil-water conservation measures. In collaboration with the economist, animal production specialist and the

agro-forester, the technical and economic feasibility of increasing water supply at the village level, the impact of additional water conservation on agricultural production during off-season for vegetable production, for raising tree nurseries and for livestock production, would be determined.

Construction of ponds is planned in the primary villages early 1987 and its impact on the total production output would be carried out over several seasons.

- (f) Identification and evaluation of multi-purpose grass or tree species for alley cropping:

This programme would be further evaluated as soon as the agro-forester joins the FSR team. One of the most feasible ways of promoting soil resource conservation in the long term and, subsequently maintaining satisfactory agricultural productivity, is through integration of suitable perennial vegetation with annual crops.

Shrubs, trees or grass species that are suitable as soil cover and/or provide supplementary animal feed or firewood will be planted on border areas between crop fields in the villages. Growth establishment of the species and survival during the dry season will be recorded. At a later stage, trials will be designed to test tree/crop arrangement that would control soil erosion without substantially reducing crop yield per grain area.

Multi-purpose tree species recommended by the Department of Forest and Seed have been planted on station and village sites in 1986. Based on 1986 results more intensive trials will be conducted in 1987. This is a long-term study. The study would be conducted jointly with agro-forester and

animal production specialist while the economist will monitor the long-term economic feasibility and complementarity with crop and animal production systems of this intervention.

- (g) Crop variety performance evaluation under traditional and improved management levels:

The objective is to evaluate the performance of crop varieties (cereal and/or legumes) recommended by research station vis-a-vis the corresponding varieties grown locally under levels of minimum input and with some purchased inputs.

The crops considered are :

Cereals: maize, sorghum and millet.

- Legumes: peanuts, cowpea and bambara nut.

Traditional management level denotes the cultural practices commonly followed by farmers of the area, while improved management denotes improved soil-water management, fertilizer and/or other input applications.

The study helps :

- to expose farmers to promising varieties and/or technologies;
- to evaluate adoption prospects of technologies by farmers;
- to establish response of crop varieties to low and medium management levels; and
- to provide feedback information on technology performance, acceptance to researchers and development partners.

A series of such trials are on-going in 1986. This is a study continued yearly.

Location - Station and primary village sites. /22:.

(h) Crop production intensification trials:

The study is aimed at finding out suitable cereal/legumes intercropping combinations for specified soil and climatic conditions that would meet the multiple production objectives of the farmer such as food grain, cash crops, forage production and soil fertility maintenance. Such experiments are underway in 1986 on station. In 1987 the work will be carried out both on stations and village sites.

The 1987 activities follow the general line of work initiated in 1986, with possible modifications if necessary, based on results of 1986.

(i) Farmer-managed trials:

Trials will be elaborated based on 1985 and 1986 research results and would be conducted in three primary villages. The technical and economic feasibilities of innovations managed by the farmer would also be determined in collaboration with the socio-economist.

(j) Strategies for implementation :

The strategy for the programme implementation are :

- Conducting research activities on village sites and on station. The village sites studies comprise, farmer-managed and researcher-managed trials.
- Collaboration with thematic researchers and development organisations. Information will be transferred to and fro, through direct interaction, publication, workshops and/or seminars.

2. Towards Integrating Forage and Animal Resources
into existing Cropping Systems.

(a) Research on Food Resources :

Within an integrated FSR programme the animal production specialist will provide technical leadership for the implementation of the following research programmes -

- Effects of different sources and levels of P fertilizers on biomass yield, nutritive value and nodulation of forage legumes.

From the 1985 results of forage trials the concentration of Phosphorus (P) in the legumes was below the level of P in the soil (see 1985 report). In order to exploit the potential of legumes in Nitrogen fixation (N) through effective nodulation, and in the supply of readily available energy and N to ruminant animals through increased biomass yield, the fertilization of the soil P appears to be necessary.

The purpose of this study will be to assess the effects of different sources and levels of P on the productivity of selected forage legumes in terms of biomass yield, nutritive quality nodulation. In collaboration with the soil scientist and agronomist, the following sources of P will be considered: Super phosphate, Burkina rock phosphate, composted Burkina rock phosphate, manure from rock phosphate supplemented animals. The proportion of P in each source will be determined prior to the commencement of the trial. The study would be elaborated based on 1985 and 1986 research results.

Site: - Station and village sites.

- (b) Effects of incorporation of the regrowth of legumes into soil with or without composted rock phosphate on the biomass yield of forage legumes and cereals in the subsequent year:

One of the main reasons for introducing forage legumes on a fallow land is to increase the N content of the soil, not only through N fixation but also through incorporation of the regrowth of legumes after conservation of feed. The mineralization of the incorporated legumes into the soil is expected to increase the quantity of N and OM for the subsequent crops of cereals and/or legumes. Since harvesting of the legumes for conservation will undoubtedly deplete the already low level of P in the soil, the application of P fertilizer will be considered. In collaboration with the economist and soil scientist the influence of the various inputs at the different stages of farming systems development with regard to recycling of resources to increase the yield of forage biomass, animal and cereal grain production would be monitored.

Site: - Station and village sites.

- (c) Effects of date of planting and plant population on forage and grain yield in a legume/cereal intercropping at different levels of management:

So far farmers have not given due importance to the incorporation of forage crops in their production system of the arable land. Establishing a system of intercropping of forage legumes with cereal crops without affecting the yield of the latter could serve as a possible means of increasing the feed budget to help integrate animals and crops.

The purpose of this study is to investigate the conditions that will minimize the competition for nutrients by the legumes and cereals to produce 'acceptable' levels of forage biomass and grain.

Site: - Station and village sites.

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- (d) Studies on the productivity of new indigenous and introduced forages and browses (continuation of 1986).
- (e) Studies on the problems of conservation of forages in the form of silage and hay at small scale farm levels (continuation of 1986).
- (f) Studies on the effects of further oversowing of fallow pasture with suitable perennial legumes on biomass yield and soil fertility regeneration (continuation of 1986).
- (g) Studies on the effects of alley cropping of C. cajan on the yield of biomass (continuation of 1986).
- (h) Research on Animals:

Influence of the inclusion of various sources and levels of forage proteins on the utilization of crop residues:

One of the specific goals of the Feed Resources Research is the efficient utilization of crop residues as the basal diet of ruminant animals. Their utilization is dependent on the rate of digestion of the cell wall components by the rumen microbes. The bacteria in the rumen that adhere to the cell walls of such materials are associated with the later stages of digestion (Stewart et al, 1979). This indicates the need to identify a slowly degradable protein source which could maximize animal output from the basal diet of crop residues.

The 1985 results on forage trials have indicated that the different legumes tested are degrading in the rumen at varying rates. With this it may be possible to identify the protein source that may allow manipulate the supply of nitrogen to the microbes in the rumen and tissues of the host animal for effective and efficient utilization of the cellulosic energy of crop residues.

The purpose of this study is :

- to assess the influence of supplementation of crop residues with forage proteins on the rate of digestion of the cell wall components in the rumen, the voluntary intake of food, and the retention of nitrogen and live weight gain; and
- to estimate the nutrient requirements of animals with crop residues as basal diets.

Site: - Station

- (i) Growth and nutrition of female lambs from weaning to end of first lactation:

The existence of a biological link between the pre-breeding and post breeding physiological state of the animal is well recognized. That is, pre-breeding nutrition might have an influence on the age of first breeding and nutritional state during pregnancy.

From the verification surveys at Yalka, Kamsi and Kamsaoghin the age of ewe lambs at first lambing is not less than 2 years. Feeding ewe lambs for more than 18 months between weaning and first lambing is a long period and costly too. Sow et al (1985) reported that the average age of Peuhl ewes at first lambing to be 740 days and the season of birth, the most favourable period being the post rains, was the only factor that had significant effect on the lambing age. Lambing intervals averaged 342 days.

In Burkina Faso, particularly in the Mossi Plateau, the sale of male lambs immediately after weaning while keeping the ewe lambs for breeding is a common practice. Information is lacking on the nutrient requirements of ewe lambs from the time of weaning

to end of lactation. Developing a feeding scheme that will allow the realization of optimum reproductive performance without impairing the growth of the ewe lamb and her own upspring until birth and from birth to weaning is necessary. This might enable one to exploit the breeding potential of the ewe lamb as of the earliest possible age.

Series of experiments will be set up with the objective of studying the influence of various densities of energy and protein, obtained from locally available feed resources, on -

- The live weight change of ewe lambs between the time of weaning and mating;
- The effect of nutrition during pregnancy on the birth weight and subsequent performance of lambs from birth to weaning;
- The live weight change of ewes during the period of lactation; and
- The pattern of intake of nutrients by the ewe lamb at the various physiological states.

Site: - Station and village sites.

- (j) Effect of feeding lactating cows with crop residues supplemented with C. cajan, in a cut-and-carry feeding system, and conserved legume forage on milk production:

In areas where the practise of fallowing is limited, suitable leguminous browse species such as C. cajan alley cropped with sorghum and millet and/or planted on contour bunds built for soil conservation, and around the compound fields, could be used as sources of protein to supplement crop residues fed to lactating cows. Considering the participation of farmers in the production of forage on the arable land in 1986, some are expected to continue in 1987.

The purpose of this study is to assess the contribution of C. cajan, in a cut-and-carry feeding system, and conserved forages on the performance of the local milking cows. Attempts will be made to use the lactating cows owned by the participating farmers on their own holdings kept in simple sheds. Efforts will be made to have acceptable number of animals for statistical analysis.

Site: - Village sites.

- (k) Preliminary investigation on the effect of use of cows for draught purposes on milk production and fertility:

The use of draught oxen is usually associated with the burden of feeding during periods of non-activity, which could be long. With draught cows, however, the burden could be reduced for they could be producing calves and milk during such periods if planned breeding is practised. This will require the availability of adequate nutrients that could satisfy power throughout the year.

In order to establish the effects of draught on the life time performance of the cow a continuous assessment of long duration will be required. However, with the assumption that adequately fed draught cows might perform better than non-draught cows fed in the traditional method, preliminary investigation will be made to assess the effect of draught on milk production under a given level of nutrition.

Site: - Station.

Other Studies

Studies on the nutrition of draught oxen (continuation of 1986).

Studies on the fattening of cattle (continuation of 1986).

3. Areas of Intervention in Socio-Economic Research.

Within an integrated FSR programme the agricultural economist will provide technical leadership for the implementation of the following socio-economic FSR activities:

(a) Baseline Studies

The objectives :

The objectives are -

- . To study the current agricultural production systems so as to acquire more data base on small farmers' social, economic, institutional and technical problems, with particular emphasis on technology adoption;
- . To identify and define the technological needs of farmers (appropriate technologies), and the appropriate types of development actions needed to satisfy farmers' and national goals and objectives in the agricultural sector;
- . An evaluation of traditional and promising technologies to be adopted with minor modifications at the farmers' environmental and socio-economic conditions.

Methodology

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 ICRISAT).

In order to determine the economic feasibilities of FSR technologies, the socio-economic baseline studies will encompass the following economic activities of farmers:

- crop production
- livestock production
- crop and livestock transaction and marketing
- input purchases
- financial transactions (including credit)
- off-farm income generation
- fuel energy production and consumptions
- general expenditures.

In the three primary study sites, the necessary data is recorded through formal and informal interviews, accompanied by some direct input and output measurements and field observations. The surveys are carried out with a sample of thirty-five farmers in each village.

Expected Output

The survey will generate sufficient information on the technical and socio-economic parameters of the studied farming systems. It will lead to the identification and the ranking of the major technical, institutional and socio-economic constraints to the realisation of more stable and productive farming systems. It will also permit the identification of the adjustment mechanisms of the farming systems vis-a-vis changes in their physical and socio-economic environments. Such adjustment mechanisms include indigenous technological innovations that will be very helpful in the development of appropriate and improved technologies and resource management systems. The survey will also permit the identification of specific recommendation domains or groups of farming units with different technological needs. Furthermore, the socio-economic research would contribute to :

- clear definition of farmers' technical and socio-economic constraints and their ranking by priority order;
- the economic feasibilities of proposed technologies;
- the farmers' adjustment mechanisms or alternative solution to resolve particular constraints to production;
- definition of technological and institutional needs to alleviate particular sets of constraints; and
- enhance the technical and economic integration of food production systems.

(b) Test and evaluation of technologies

The technological packages will be evaluated for 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 risk.

Both research-managed and farmer-managed trials will be carried out in 1987 in all the three primary research sites. The socio-economic component will be mostly involved in designing and monitoring the farmer-managed tests in collaboration with the agro-forestry, agronomy, soil science and livestock production components. Detail protocol would be formulated based on the 1986 data analysis.

Areas of Investigations

- (i) Definition, objectives, socio-economic structures and organization of farming units.
- (ii) Resource endowment and resource accessibility of farming units (including land tenure).
- (iii) Local farming technologies, resource management practices and technological innovations.
- (iv) Resource allocation (particularly labour and land allocations) across economic enterprises and over time during the year.

GENERAL SCHEDULE PLAN OF ACTIVITIES

1987

ACTIVITES	TASKS	J	F	M	A	M	J	J	A	S	O	N	D	1988		
														J	F	M
1. Data Collection	A. Instrumentation			-----												
	B. Farm surveys	-----														
2. Testing and evaluation of Technologies	A. Selection of technologies	-----														
	B. Management of Trials				-----											
3. Data Processing and analysis	A. Data analysis		-----													
	B. Report writing				-----									-----		
4. Seminars and Field trips	A. Field trips								-----							
	B. Seminars			-----												
5. Workshop and Training	A. Workshop				-----											
	B. Training									-----						
6. Field visit to FSR Programmes					-----											
7. Consulting to INERA etc. as arranged																

- (v) Input-Output parameters and budgets of crop livestock and agro-forestry enterprises.
- (vi) Crop, livestock and energy consumptions.
- (vii) Crop and livestock prices and marketing (marketing channels, stocks, sales and purchase).
- (viii) The extension system at the village and regional levels.
- (ix) The feasibility of proposed or adopted technologies by small farmers, on the basis of the results of current and previous baseline studies in Burkina Faso.
- (x) The profitability (costs and benefits) of proposed technologies.
- (xi) Farmers modification/adaptions of the proposed technologies.
- (xii) The modification, research and development alternatives needed to improve the chances of adoption of the new technology.

Agro-forestry - To be elaborated.

II BENIN FSR PROGRAMME

Background Information

The experiences todate in Northern Benin have clearly revealed that for any positive trend to occur in the welfare of the peasant farmer, there is a need to appreciate the very intricate as well as the intimate integrated relationship that exists between the peasant, crop and livestock production systems and closely related socio-economic factors, that influenced overall land use and management.

Unlike the majority of countries where research is normally considered to be relatively stronger than the extension services, the reverse is true in Benin.

FSR concentrated more on the cropping systems and more recently (1986), recognising the role of livestock in northern Benin, preliminary evaluation of pasture materials has been initiated. The ultimate objective is to integrate these components aimed at increasing the productivity and substantiability of the prevalent farming systems.

Project Area

The People's Republic of Benin is a West African country with an area of 112.600 km², and a population of 3.567 million people. It is situated between latitudes 6°30' and 12°30' North, thus stretching across several ecological zones. These are from the coast forest zone with an annual rainfall of 1.300 mm, through the southern and northern guinea savannas with mean annual rainfall of 1200 and 1100 mm' respectively, to the sudan savanna with rainfall of 100 mm up to the sahelian zone to the extreme north of the country with annual rainfall of less than 900 mm.

Administratively, the country is divided into six provinces, each province headed by a prefect and subdivided into 11 to 16 districts which in turn are subdivided into either urban or rural communes. The northern provinces are Atacora and Borgou, each with 14 districts. Then the southern provinces are Mono, Atlantique, Oueme and Zou with 11, 14, 16 and 15 districts respectively.

The SAFGRAD/BENIN FSR project covers the two northern provinces, namely, Borgou and Atacora. Borgou province has an area of 51,000 km² (45% of R.P. of Benin) with a population of 530.00 (1983) inhabitants. While Atacora province has an area of 31,200 km² with a population of 481,509 (1979) inhabitants. The SAFGRAD/BENIN FSR project activities have been initiated in six villages.

SAFGRAD/BENIN FSR Programme Development

Overall Objectives:

In March 1985 the People's Republic of Benin and the OAU/STRC/SAFGRAD signed an agreement with the following main objectives :

- to develop rural areas through research of production technologies adaptive to conditions and needs of farmers;
- to promote coordination of Farming Systems Research programmes in the People's Republic of Benin in order to minimize duplication of resources;
- to strengthen the National Farming Systems Research programme so as to develop a method of production to integrate crop and animal production as well as techniques to conserve soil moisture and other resources;
- to assist the National Farming Systems in establishing a functional link between research, development and farmers, in order to ensure that agricultural research answers to the farmers' short and long-term needs.

Farming Systems Research must be operated with a strong applied effort and should not be presented as an alternative to the traditional agricultural research. A close integration of the FSR into the existing national programmes is considered essential if the development of appropriate FSR is not to be hindered. For FSR to succeed there must be a strong commitment and programme integration at the national level. This could facilitate coordination of FSR activities and enhance communication between research teams, station researchers and extension workers.

Research Progress

Prior to formulation of the technical aspect of the FSR programme, preliminary exploratory surveys completed in 1985 indicated the following traditional production systems:

Cropping Systems

Moving across the ecological zone of Northern Benin, the existing farming systems can be characterized by cropping systems consisting mostly of inter-cropping cereal crops; shifting cultivation where exhausted lands are left fallow for 3 to 4 years before being cropped again, and a high interaction between crop and livestock production.

In the guinea savanna zone, maize-sorghum intercrop is grown by 75% of the farmers, followed by cotton which is grown by 46%, yams 44%, sorghum 40%, groundnuts 35%, cassava 33% and cowpeas 31% of the farmers. Millet and yam intercropped with beans are also grown by 22 to 10% of farmers. In the sudan savanna, cotton is the dominant crop, followed by cassava, groundnuts, millet, maize intercropped with sorghum and beans being grown by respectively 85, 64, 57 and 35% of the farmers. In the sahelian zone, at the extreme north, the important crops in the farming systems are millet and cotton, each being grown by 76% of the farmers, sorghum and groundnuts each grown by 69% of the farmers, followed by sorghum inter-cropped with maize, millet or beans.

In the whole region the average farm size is 7.46 ha per family with 6.5 ha under crop and 0.9 ha under fallow. In other words, in the sahelian savanna zone, an average farm family plants 1.36 ha (22% of the farm) to sorghum; 1.06 ha (17% of farm) to millet; 0.7 ha (12% of farm) to cotton and 0.5 ha (8% of farm) to groundnuts.

A farm family in the sudan savanna plants 3.8 ha (49% of farm size) to cotton, 0.64 ha (8% of farm) to maize intercropped with sorghum, 0.39 ha (5% of farm) to cassava and 0.37 ha (5% of farm) to groundnuts. In the northern guinea savanna, an average family plants 1.66 ha (17% of farm) to maize intercropped with sorghum, 1.58 ha (16% of farm) to cotton, 0.9 ha (9.4% of farm) to maize/yams/beans and 0.77 ha (8% of farm) to yams.

Cropping Calendar

In the sahelian zone, cropping activities start with soil preparation and planting of food crops in May, whereas cotton is planted in early June. In the sudan savanna, soil preparation and planting are done in May/June, depending on the on-set of rains. In the northern guinea savanna, soil preparation is done in April and planting of crops in May, again, depending on how the rains stabilize. However, in the three agro-climatic zones, the optimal planting date is around end of May, but not later than first of June.

Agronomic practices used by farmers.

There are some agronomic practices and small farm equipments recommended by extension agents for cotton, maize and groundnuts. Cotton production in the area is supported by a strong extension service and economic incentives including free cotton seeds, credit facilities for ox-plough, fertilizers and insecticides, on-farm purchase and transportation of cotton lint at harvest. Most farmers in the area have therefore adopted greater portions of the cotton recommendations, namely, improved cotton seed varieties, fertilizers, insecticide

application of five to six sprayings and two to three weedings. Whereas, in cases of maize and groundnuts, farmers mainly picked up improved varieties and ignored the other recommendations for food crops.

The most common agronomic practices used by farmers for food crop production are slash and burn, plough ridging the land, plant with fingers on the flat or on ridges, and on mounds for yams and cassava, hand weed with a traditional hoe.

In the sahelian savanna zone, sorghum is often planted in compound farms around the homes or in bottom valleys where soil fertility levels are higher. Millet and maize are planted in valleys and bottom lands, while cotton is planted on plateaus since it must receive fertilizer application. In both sudan and northern guinea savanna zones, most food crops are planted on plateaus.

For land clearing, most of the farmers in the sahelian zone use light clearing which implies that there is very little vegetation to slash and burn; while both in the sudan and northern guinea savanna, farmers slash or cut bush with trees and burn. Wide-scale bush burning during the dry season is thus a common practice in the area.

Soil preparation in the sahelian zone is mostly done by oxen, where 84% of the farmers use ox-plough for millet, 61% use it for cotton, groundnuts and sorghum. In the sudan savanna, 42% of the farmers use ox-plough for groundnuts, 36% for cotton and 14% use ox-plough maize/sorghum and millet. In the northern guinea savanna, ox-plough is very rarely used. Only 16% of the farmers use ox-plough for cotton, while 10% use it for maize/sorghum and groundnuts.

The most common methods used for land preparation in the northern guinea savanna are to dig with a hoe to make ridges, especially for cotton and groundnuts or make mounds for yams and cassava.

Planting in rows without ridging is mostly used in both the sahelian and northern guinea savanna and rarely used in sudan savanna, whereas planting on ridges is more popular in the sudan and northern guinea savanna. Farmers in the other two zones plant in pocket holes with a hoe, a stick or "roullete", a rotating castor wheel.

Livestock Production

Livestock plays an important role in the production systems in Northern Benin. In the sahelian, sudan and guinea savanna zones, 54, 50 and 60 per cent of the farmers keep a stock of cattle, goats and sheep. The interaction between crop and livestock production is becoming increasingly significant due to the use of animal traction. In the sahelian savanna zone, practically every farmer has oxen for draught power, while 78 and 12 per cent of the farmers in the sudan and guinea savanna respectively have animal traction giving an average of 39% of the farmers who use cattle in the sahelian and sudan savanna zones, most of the cattle belong to nomads who do little or no farming and have probably moved there in search of suitable grazing pasture.

Feeding of livestock during the rainy season is usually by grazing. During the dry season when most vegetation is dried up, often burnt down by bush fires, feeding of livestock becomes a problem. In the sahelian savanna, livestock is moved further south in search of grazing grounds or tree leaves and crop residues are used to feed their livestock. In the sudan savanna, 57% of the livestock are grazed in wet bottom lands and 20% are moved further south.

In the northern guinea savanna, about 20% of farmers graze their livestock in wet bottom lands, 10% move their livestock south-wards and 32% use tree leaves or inedible parts of crops, like peels, to feed the livestock.

Efficient use of farm resources.

Apart from land, other important farm resources are family labour, animal traction and ox-plough. Cash income for purchased inputs including small farm tools, fertilizers and seed are also important.

In Northern Benin, the size of a farm family ranges from 2 to 19 with an average of 10 persons. Of these 51% are children between 0 and 15 years old and 49% are adults with ages between 16 and 72 years old. The availability of family labour for farm work is 4.94, 5.23 and 2.69 man-units per farm family in guinea, sudan and sahelian zones respectively.

In the sahelian zone each farmer has at least a pair of oxen and uses up to 66.8 hrs of ox-plough. In the sudan savanna zone, a farmer has 3 oxen for draught power and uses up to 78.9 hours of ox-plough. A farmer in the Guinea savanna has access to at least one oxen and uses about 37 hours of ox-plough.

Considering crop production activities during the agricultural season; a farmer in the sahelian savanna zone spends a total family and non-family labour of 485.8 man-days of which 55.8 are used for land clearing, 56 for planting, 138 for weeding and 188 man-days for harvesting. The farmers in the sudan savanna spend 806.95 man-days for all crop production activities compared to farmers in the northern guinea savanna who spend 917.8 man-days.

The most labour-demanding crop production operation in each of the agro-climatic zones is harvesting, followed by weeding, soil preparation and planting. The labour requirement for soil preparation, ridging, mounding and planting are 104, 256.95 and 226 man-days in the sahelian, sudan and Northern guinea savanna, respectively.

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If the availability of family labour in man-units is taken as 2.69, 5.23 and 4.94 for the sahelian, sudan and northern guinea savanna, respectively, and a working week is 6 days, the farm family in the sahelian savanna needs 7 weeks to complete the crop production activities up to planting, whereas the family in the sudan savanna or northern guinea savanna requires over 8 weeks. This analysis implies that if the last planting date is the first week of June, then soil preparation and planting activities should be started in March, which is impracticable since March is still in the dry season. Thus, analysis also suggests that whenever the rains begin late and/or if there is prolonged dry spell, farmers in those zones face a high risk of late planting.

The cost of farm inputs suggest that apart from ox-plough and cotton fertilizers, farmers in that area have limited use of purchased farm inputs.

In order to examine the relative importance of farm resources that are available to farmers in Northern Benin, the principal component analysis was used to analyse the survey data.

The most important set of farm resources were land, total farm labour and labour inputs for critical farm operations (soil preparation, planting and weeding). Next in importance were the use of ox-plough and animal traction, followed by availability of family labour.

Agronomic practice evaluation.

Based on the preliminary socio-economic surveys, evaluation of available crop production technologies was carried out. The study included research-managed and farmer-managed trials. Research-managed trials have been established at INA, SOKKA, BENSEKOU AND BIRNI LAFIA in BORGOU Province. Local and improved maize and sorghum varieties were evaluated in pure stand and in association. At INA area, the highest yield was obtained when TZB-maize, an improved variety, was grown in monoculture although the aggregate relative yield of mixed cropping could minimize the risk of the farmer in relatively

erratic rainfall conditions. The best yields at SOKKA was obtained when TZB was grown either on monoculture and in association with local sorghum if fertilized. The findings at BENSEKOU were similar to that of INA and SOKKA although the yields in general were lower due to striga infestation. Considering the yield performance at all sites TZB maize variety gave highest yield when fertilized. With ridge planting similar yield was obtained.

Improved or local maize grown in association with groundnut gave higher income than monoculture of maize. Application of fertilizer consistently increased the cash return when cereal was associated with groundnut.

At INA, intercropping maize and cotton reduced yield of the individual crop and also the aggregate yield was not in any case higher than monoculture maize and there seems to exist little advantage in growing these crops in association unless some other factors are taken into consideration. In the INA region the performance of sorghum and cowpea in association, and in monoculture, was evaluated. Fertilization increased the yield of pure stand sorghum than intercropped sorghum. Highest income was, however, realized when cowpea was grown in monoculture. The cash income was the second highest when cereals were grown in association, than in monoculture.

Description of Research Activities.

The 1987 FSR programme will be further elaborated based on 1986 FSR results. It is realized that during the last two years, FSR programme emphasized cropping systems. Whereas the evaluation of forage resources have been initiated in 1986, further integration of relevant FSR components would be attained at different stages of the farming system (FS) development.

Agronomy and Soils Interventions

The agronomist, as a member of the FSR team, will evaluate crop production technologies by conducting research and farmer-managed trials. Since farmers prefer to plant more sorghum, millet, maize, cassava, yam and beans, cropping system would focus increasingly on these crops.

Considering the resources of the small farmer, technological innovations to be evaluated would focus on low purchased inputs. Promoting agronomic practices (monoculture vs. associations, low and medium input application, manual tillage, etc.), suggested by 1985 and 1986 trial results, would be conducted. Various technical options would be considered (tied-ridging vs. flat cultivation, green manuring, tied ridges and mulch, cereal-legume crop association, manual tillage, animal traction, etc.). The performance of local and improved varieties would be evaluated under different tillage practices and levels of management. Some of the crop association and relay-cropping agronomic intervention would be continued.

Studies on the striga problem at Bensekou will receive particular attention. The introduction of resistant/tolerant maize and sorghum varieties appear to be a logical strategy supplemented with field sanitation and fertilization.

Greater attention is planned for a more intensive involvement of the farmers. The experience gained today with our collaborating farmers (those that were given seeds and fertilizers) will be utilized to further explore the performance of the introduced varieties when managed by farmers.

Towards integrating forage and livestock resources.

With increase of population (within the long-term), the amount of fallow land to expand cultivated area for food production is expected to dwindle. Research on forage resources to establish a system of intercropping of forage legumes with natural pasture and even cereal and other food crops would serve as a source of livestock feed and also partially restore the fertility of the soil. The major constraints associated with the production of animals is the provision of quality forage. Improving the quality of natural pasture could lead to realizing maximum benefits of animal production.

The interaction between crop and livestock production is becoming increasingly significant due to the use of animal traction. Feeding of livestock during the dry season is usually by grazing

and becomes a problem because of poor quality of natural pasture and the common practice of bush fires. Animals as a source of draught, power, fuel, improving the fertility (if properly managed) and food (protein) are essential FSR components.

The overall objective of the integration of animals and crops is to allow the energy component (solar energy captured by photosynthetic process) in crop residues, natural pastures, leguminous forages and trees to be converted efficiently into draught power, milk and meat, while recycling manure organic matter, nitrogen and other mineral components for the improvement of soil structure and fertility. Based on this sound conceptual framework specific research, that will help alleviate the major constraints of animal production and enhance its integration with crops, will be designed.

For effective integration of animals and crops the problem of quantity and quality of nutrients needs to be alleviated. In general, natural pasture forms the basal diet of the animals in all the regions. Adequate rainfall could alleviate the shortage of materials for grazing quantitatively. However, the rapid growth of the pasture during the rainy season is accompanied with a rapid decline in its quality, particularly in the proportion of the nitrogen content. Crop residues, constituting the largest agricultural by-products, are the other sources of feed used as basal diet during the dry season despite their low organic matter digestibility and low nitrogen content. For the efficient utilization of such quality roughages, industrial by-products such as cottonseed cake, groundnut cake, etc., could be used as nitrogen supplements. Unfortunately, these by-products are produced in limited quantity and are not easily available to the target farmer.

An alternative approach to improve the utilization of the abundant low quality roughages is to exploit the potentials of tropical leguminous forages and browses as sources of nitrogen and energy. The incorporation of such materials could serve as vital link between the crop and animal components of the production systems.

Use of animal draught power is a technological improvement that could allow reduce the drudgery of labour. It does also serve as a means of improving the efficiency of available labour and intensification of the production system. Draught power is required for soil and water conservation work such as tillage, building of terraces, tied and contour ridges, drawing of water for consumption by humans and animals, for animal powered irrigation, etc.

Most of these activities are expected to occur before the rains, i.e. during the dry season when the animals are usually in poor condition for draught work. As noted above, the available basic feed resources to the animals are mainly dry/mature natural pasture and crop residues. The sole use of these materials is rarely sufficient to maintain the liveweight of the animals mainly due to the low energy and nitrogen intake. It is recognized that the physiological nutrient demand for body maintenance and draught power can only be satisfied when the nutritional factors limiting intake are removed and adequate levels or nutrients are supplied.

The study in animal traction will also constitute improvement in plough, implements and harnesses to increase the efficiency of utilization of animal energy. This, supported with improved feeding system, might allow deeper and more thorough tillage and cultivation of soils before the rains begin and permit earlier saving of seeds. Thus reducing the risk of missing the first few rains while preparing the land.

The improvement in the efficiency of utilization of animal energy might also encourage the use of cows for draught purposes. Cows, as multi-purpose animals, can provide draught power in addition to the production of calves and milk as sources of income to help reinvest in the cropping system for further intensification.

In areas where shifting cultivation is the norm, the farmers practice fallowing from three to seven years as a means of restoring soil fertility. While under fallow the pasture is used for grazing. Under such conditions, where length of fallow period is long, a relatively higher level of regeneration of the soil may be a possibility by incorporating leguminous forages and browses. The system will also allow the achievement of increased animal productivity by alleviating the problems of quantity and quality of nutrients. The economic benefits generated by the increased animal production could enhance the intensification of the production system and help reduce the rate of indiscriminate clearing of bush to expand the cultivated land.

In areas where the practice of fallowing is limited, suitable leguminous browse species alley cropped with sorghum and millet, and on contour ridges built for soil conservation, could be tested. Investigation for the suitable browse species, the distance that will minimize the competition for nutrients by the cereal and the alley crop, the biomass yield for mulching, N and energy yield for animal feed, suitability for soil conservation, etc., is of paramount importance.

Establishing a system of intercropping of forage legumes with cereals to serve as source of nitrogen and energy to be conserved for the dry season feeding is a possible means of increasing the feed budget.

The introduction of forages is expected to be accompanied with conservation measures. Developing a technique of conservation that suits the objective conditions of the farmers is a necessity. Recognizing the nutrient contribution of the natural pasture, establishing the right stage of cutting for conservation also requires an emphasis.

After the grain harvest crop residues are left standing or lying on the ground. By the time these materials are fully available to the animals they are mostly very dry. It may be possible to harvest the residues at a stage with a relatively higher nutritive value while the grain is still fully matured

for harvest. The contribution of such improvements in the management of crop residues to the feed budget will be assessed.

Most farmers, except in the northern guinea savanna zone, practice animal traction.

Socio-economic studies.

Within an integrated FSR activity, the agricultural economist will provide leadership for the implementation of the following research activities :

- (a) Collection of general farm level resources data and production practices will continue in aspects where there is a need for updating the information.
- (b) A comprehensive study of resource utilization (input/output data) will be conducted on a small sample of 3 to 4 farms per village purposely selected, to generate parameters that will characterize the existing farming/ cropping systems and determine its biological and economic productivity under current technology. A typology of farm, according to farming systems zones, will be elaborated for use in modelling exercise (Linear programming) for the purpose of evaluating farmers' income increasing opportunities under improved technologies now being tested.
- (c) Special purpose surveys and studies will also be undertaken in response to the need to learn more about a particular problem/issue. These will include surveys on animal traction, live-stock production systems in collaboration with the agro-forestry programme.

- (d) In addition, data will be collated as required for the analysis of verification trials and experiments; emphasis will be particularly placed on those socio-economic factors (in each farming systems zone) that can be expected to directly affect farmers' acceptance of the technology being tested by the agronomic and agro-forestry programme of the SAFGRAD/BENIN FSR Project.

Evaluation of labour saving techniques.

As indicated earlier, one of the major constraints in the production systems of the semi-arid area is the amount of labour required to complete the farming operations in a very limited time. Because of the unique conditions in this area where soils are hardened and difficult to dig before the rains, and the need to complete planting soon after the on-set of the rains, the period of tilling the soil and planting is extremely very critical. There are strong indications that the use of ox-plough for soil preparation may have significant results on total production. The use of small planting tools like "roullete" and grain seeder is also being incorporated. The other labour saving techniques being considered are use of ridger, ridge-tyer, herbicides, particularly in cotton, use of groundnut sheller and encouraging setting up of tractor hiring services.

Agro-forestry Interactions

The integration of trees, and leguminous shrubs into crop and animal production systems could enhance the improvement of the farm environment with regard to conservation of the soil and water, and restoring the fertility of the soil. Furthermore, the establishment of wood lots and its selective use as fuel could prevent haphazard denudation of natural shrubs and trees. Selected species such as Acacia abida is known to improve the fertility of the soil by fixing nitrogen. Trees or pasture shrubs species would be chosen also to serve as feed for animals.

The agro-forestry component of FSR would be elaborated as soon as the agro-forester joins the FSR team early in 1987. The global objective of this component, however, would be to induce improvement of the farm environment and also to establish both technical and economic complementarity to existing crop and livestock production systems.

/49.....

III. CAMEROON FSR PROGRAMME

Background Information

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 a two-man team consisting of agricultural economist and soil scientist, through IFAD funding, for strengthening the National Farming Systems Research Programme in the Semi-arid zone of the country. The main objectives of the OAU/STRC/SAFGRAD/IFAD-funded Farming Systems Research Programme are:

- To develop, through research in rural areas, production technologies adapted to conditions and needs of small farmers in Northern Cameroon;
- To enhance the co-ordination of FSR programmes especially in Northern Cameroon in order to minimize the duplication of resources;
- To reinforce the National FSR programme (in North) and foster the integration of cropping systems with socio-economic environment, animal production systems and agro-forestry as the essential components of a farming systems.
- To improve linkage between national research and extension system by providing feedback on adoption of technological innovations by farmers so that research and development efforts focus on farmers' needs.

The FSR team, working on SAFGRAD/Cameroon programme arrived in Northern Cameroon in January/February 1986. From March through April, the SAFGRAD FSR/Cameroon project activities started with :

(a) Review of existing information

Review of existing information is important in formulating an FSR programme that has a logical link with other national research programmes and also helps to avoid duplicating efforts. In early March, the SAFGRAD FSR team had the opportunity to attend, interact with IRA scientists and obtain a global picture of national research activities at a cereals and farming systems programme review and planning meeting in Yaounde. Then the team held other series of meetings and individual discussions with IRA scientists working at IRA Maroua Centre and other IRA centres.

The reviewing process also covered previous survey data and analysis of rainfall data over time and across sites in order to determine the probabilities of rainfall and estimate farmers' risk at various intervals of the agricultural season.

(b) Reconnaissance trips around the North and Extreme North Provinces

Reconnaissance trips were made around North and Extreme North Provinces in order to delineate the major zones in the area on the basis of agroclimatic characteristics - that is, rainfall patterns, rainfall distribution, vegetation, major soil types and cropping patterns.

(c) Development of the SAFGRAD FSR/Cameroon Programme

For the proper development of the farming systems research programme, the SAFGRAD FSR team solicited cooperation, technical back-stopping and professional inputs from basic breeding, agronomic, soils and forestry researchers.

The SAFGRAD FSR team also works in close collaboration with SODECOTON (which is collaborating in some of the agronomic trials) Project Semencier, MINAGRIC., Karewa Experimentation farm and Project North East Benuoé.

From the preliminary investigations, it has been observed that :

- (i) Sorghum, millet, maize, groundnuts and cowpeas are important food crops and cotton is an important cash crop.
- (ii) Soil fertility is declining at a very fast rate. Chemical fertilizers are quite expensive and many farmers are unable to afford to buy them for their food crop production activities. During the planting season, it was also observed that not all progressive farmers could find adequate amounts of chemical fertilizers to buy. Such farmers resorted to applying half to quarter doses of the recommended rates.
- (iii) That soil moisture is a limiting factor and yet soil erosion after torrential rains is quite a problem for farmers. The local sorghum varieties have a long cycle of 150 to 200 days and the maize varieties cycle range from 120 to 150 days, due to the

unreliability and shortness of the rainy season, when the rainfall tends to cutoff before the local sorghum and maize varieties mature. Meanwhile, breeders have come up with improved sorghum and maize varieties of shorter cycle duration.

- (d) Livestock, particularly cattle, play an important part in the farming system of the study area, whereas tree shrubs are being cleared at a fast rate.

Project Area

The SAFGRAD/IFAD-funded Farming Systems Research Project is based at Garoua and covers both North and Extreme North Provinces of Cameroon which lie in the basin river of Benoué and Lake Tchad basin respectively. The climatic conditions are hot and humid with an average temperature of 28°C around Garoua and an annual rainfall of about 800 mm. The area has a relatively high population density ranging between 12 to 50 persons/km² as compared to a national population density of 19.2 persons/km² (Jam et al 1985).

However, the farming population in parts of the Extreme North Province is immigrating into the North Province in search of more fertile land. Besides the region supports a large number of livestock. In the region SODECOTON and SEMRY are important development agencies responsible for cotton and rice respectively.

The National Institute of Agronomique (I.R.A.) has one regional centre at MAROUA to serve the Northern part of Cameroon. The I.R.A. Maroua Centre has Garoua as a sub-station and many other small substations scattered in the region. The SAFGRAD FSR which is based at Garoua (216 km to Maroua) therefore operates its project account and other administrative logistics from Maroua.

1987 Planned Project Activities

Socio-economic studies

Baseline Survey - to obtain supplementary baseline information and assess economics of existing production systems :

- (a) Socio-economic baseline survey will include:
types of farmers, existing crop and animal production systems, crop combinations, population densities, crop sequence, farm inputs, farm yields, inputs and output prices, consumption pattern and food preferences, farmers' priorities and goals, farmers' socio-economic environment, farmers' production constraints, causes of crop losses and crop failure, labour constraints and peak periods of labour demand and the farmers' infra-structural facilities and marketing.

Socio-economic verification surveys will be carried out in order to ascertain the major production constraints in the project area.

Areas of Intervention

Studies on economics of some selected production technologies will be done during 1987 cropping season. These studies will include :

- (1) Conducting socio-economic baseline surveys for obtaining some basic information on the existing crop and animal production systems and identifying location - specific physical, economic and social constraints to agricultural production.
- (2) Assessment of the economic feasibility of soil moisture conservation techniques such as tied ridges, bunds, water harvesting catchments for supplementary irrigation.

- (3) Studying the effects on crop yields and the economics of animal manure vis-a-vis chemical fertilizer.
- (4) Determining productivity of farm labour and labour-saving technologies; economic evaluation of improved varieties of sorghum, maize and cowpea under low and medium level management and to determine the potential impact and assessing the implications of certain agricultural technological packages on rural economy under sahelian conditions.
- (5) Economic feasibility of animal traction for land preparation and soil conservation, by using different implements.

Objectives

- (a) To test the performance and assess the economics of food crop production under sole crop and mixed cropping, at low, medium and high technical input, under major soil types.
- (b) To examine effects of different cropping systems on soil properties in the long run.

Agronomic On-farm trials

Areas of Intervention

Work on use of crop residues and animal manure will be expanded and intensified. Work on moisture conservation techniques will be continued and expanded to include land preparation and planting techniques. Work on the use of animal power in land preparation, weeding and threshing of grain will be initiated. Evaluation of soil fertility status under different cropping systems will be done through agronomic trials and laboratory analytical tests.

Some of the suggested trials are as follows :

- (1) Researcher-managed trials at different locations.
- (2) On-farm trials to evaluate the performance of sorghum and other cereals in pure stand and in association.
- (3) Intensification of crop production in the area of extended rainy season or with residual moisture and/or with supplementary irrigation whenever it is available.
- (4) To evaluate the performance of sorghum when grown on residual fertilizer after cotton.
- (5) To test the performance of sorghum, maize, groundnuts and cowpea improved varieties and assess their suitability into the farming systems in Northern Cameroon.
- (6) To find out ways and means of minimising soil and water losses through surface runoff, and enhancing soil moisture conservation in different types of soils existing in Northern Cameroon. That is, examining the use of flat ploughing, bunding, ridging and tied-ridging techniques.

Cotton is an important cash crop in the Northern Provinces of Cameroon. The research on cotton is relatively more advanced and there are certain cultural recommendations which are practiced by the farmers, whereas the research findings on other important crops like sorghum, maize, cowpea, millet, groundnuts, etc., are scanty, and the available information/recommendations are not practiced by the farmers.

Some of the on-farm trials that may be continued during the 1987 growing season are :

- (1) Investigation on the agronomic requirements of improved sorghum varieties in comparison to local variety at pre-release stage.

There are several promising varieties of sorghum which have been identified and which are likely/..

to perform well in the sub-humid tropics of Cameroon. It is always advisable that agronomic requirements of the varieties should be worked out in collaboration with breeders, side by side, so that time is not lost in releasing the full package of promising varieties in the zone.

(2) Preliminary survey/study on soil fertility and soil erosion problems in Benoué zone.

This preliminary survey is aimed primarily at knowing the problems of soil fertility maintenance and soil erosion in the locality.

In the discussion with the researchers at Garoua and Maroua, it was evident that the decline of the soil fertility was one of the major constraints to crop productivity in certain parts of the Benoué area. Erosion of topsoil, continuous cropping without fallowing and uncontrolled grazing of cattle have been mentioned as some of the existing farming practices that aggravated the deterioration of the soil.

(3) Production potential under sole and mixed cropping systems in the Benoué zone and its impact on soil properties.

In general, small farmers prefer to grow more than one crop variety in the same field each year as mixtures. Growing more than one crop on some land has both advantages and disadvantages. Substantive farmers' need of food supply both quantitatively and qualitatively is the determinant in favour of mixed cropping. Another reason is to minimize risk of crop failure due to shortage of delay of rains. Also, mixing legume with cereals or deep rooted crops like cotton, with surface feeding crops and legumes, have their merits in terms of production and exploitation of soil nutrients. With this brief background it is proposed to have few trials at

representative locations to work out the production potential of each system in the Benoué zone of the northern province of Cameroon.

The objectives of this intervention are :

- (a) To investigate the production potential of cereal grains in mono-culture compared to mixed cropping of cereal-legumes; cereal-cereals; cotton-legumes and cotton-cereals; and
- (b) To find out the impact of different cropping systems on soil properties in the long run.

Agro-forestry - To be elaborated.

/ 58

IV. PROGRAMME MANAGEMENT AND IMPLEMENTATION

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 timely execution of the FSR programme development will pursue the implementation of the General Plan of Action (attached to this report), whereas the Financial Controller will supervise the disbursement of IFAD funds to the FSR programmes of 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 programmes in the three countries is carried out through the following technical and management meetings :

1. Project Management Committee (PMC)

OAU/STRC had 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 administrative implementation.
 - b) To review and provide guidance as to the technical implementation of FSR programmes.
- /.....

- c) To review and guide the management of SAFGRAD-supported FSR programmes 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 meeting is for a technical review of previous season's results, and also to conduct detailed planning session to examine the 1987/88 FSR programme of the three countries. The participants of this session would be SAFGRAD FSR scientists working within the project, IFAD representative, 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. Status of the Interim Report and FSR programme proposal for 1988 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 1987 workshop should be held in Parakou, Benin. Regional FSR workshop not only could provide mechanism for reviewing and evaluating

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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. Training

Short-term training for the technical staff would be continued based on the FSR programme needs of the three countries. Short-term training at higher level or specialized research technologies would be conducted in collaboration with International Agricultural Research Centres (IITA, CIMMYT, ILCA, ICRISAT, etc.), and at national universities.

1987 GENERAL PLAN OF ACTION

N°	A C T I V I T I E S	ACTION PERIOD
1.	1987 FSR Programme Elaborations Reviews and Diagnosis	February/March
2.	Technical and Administrative Sessions (FSR-Team Leaders/Management)	January
3.	Project Management Committee Meeting	February
*4.	Elaboration of Agroforestry FSR Component	March/April
5.	Training	March/April
6.	Submission of 1986 Annual Report	May/June
7.	Consultancy Meeting with FSR Team Leaders to follow-up execution of FSR programme at field level	June/July
8.	Submission - Interim Report	June/July
9.	Design and formulation of the 1988 FSR programme	July/August
10.	Field-Monitoring Tours	September/October
11.	Workshop and Special Seminars	October/November

*Collaborative activities with ICRAF.

IFAD T.A GRANT N° 110
F.S.R BUDGET PROPOSAL FOR 1987

The proposed budget for 1987 amounts to US \$ 1,565.000 as compared to US \$ 1,200.00 in 1986. Increase within the proposed budget is due to three main factors: first the introduction of agro-forestry in each of the three country Farming Systems Research Programmes by the appointment of three agroforesters. Secondly, Farming Systems Research is now fully operational in Burkina, Benin and Cameroon and there is the need to increase research inputs particularly laboratory and farm equipment including vehicles and research supplies. Thirdly, all operational costs have been adversely affected by the sharp decline in the value of the US dollar from over 500 to 330 CFA since the commencement of the Farming Systems Research Programmes in 1985. All the FSR programmes are located in Francophone African countries where disbursements are made in the CFA currency.

The budget provides technical and institutional support for the three countries farming system research and development as well as for the project management by the OAU/STRC-SAFGRAD Coordination Office located in Ougadougou, Burkina Faso. More funds will also be required to meet the training costs of local support staff in research activities.

OAU/STRC/SAFGRAD/OUAGADOUGOU
 IFAD-SUPPORTED FARMING SYSTEMS RESEARCH
 T.A. GRANT N° 110
 BUDGET REQUEST - 1987

	P A R T I C U L A R S	COORDINATION OFFICE	BENIN	BURKINA FASO	CAMEROON	REQUEST 1987	BUDGET 1986
A	<u>INTERNATIONAL STAFF</u>						
1.	Research Director	70,000	-	-	-	70,000	56,000
2.	Financial Controller	60,000	-	-	-	60,000	50,000
3.	Administrative Assistant (1)	25,000	-	-	-	25,000	23,000
4.	Agricultural Economists (3)	-	60,000	60,000	60,000	180,000	150,000
5.	Soil Scientists (2)	-	-	60,000	60,000	120,000	100,000
6.	Agronomist (1)	-	60,000	-	-	60,000	50,000
7.	Animal Scientist (1)	-	-	60,000	-	60,000	50,000
8.	Agroforesters (3)	-	55,000	55,000	55,000	165,000	60,000
		155,000	175,000	235,000	175,000	740,000	539,000
B	<u>LOCAL PERSONNEL</u>						
1.	Research Associates (12)	-	4) 13,000	5) 15,000	4) 13,000	13) 41,000	9) 39,000
2.	Enqueters (12)	-	4) 11,000	5) 15,000	4) 11,000	13) 37,000	9) 30,000
3.	Field Assistants (18)	-	6) 9,000	8) 12,000	6) 9,000	20) 30,000	15) 27,000
4.	Secretaries (5)	2) 12,000	1) 4,000	1) 4,000	1) 4,000	5) 24,000	5) 26,400
5.	Accounts Clerk (4)	1) 6,000	1) 5,000	1) 5,000	1) 5,000	4) 21,000	4) 14,400
6.	Drivers (9)	2) 6,000	3) 9,000	5) 15,000	3) 9,000	13) 39,000	9) 20,000
		24,000	51,000	66,000	51,000	192,000	157,000

	P A R T I C U L A R S	COORDINATION OFFICE	BENIN	BURKINA FASO	CAMEROON	REQUEST 1987	BUDGET 1986
C	<u>OPERATIONAL EXPENSES</u>						
1.	Inputs etc.	-	20,000	30,000	20,000	70,000	48,000
2.	Supplies (Office)	9,000	3,000	5,000	3,000	20,000	20,000
3.	Communications	2,000	2,000	3,000	2,000	9,000	5,000
4.	Fuel And Maintenance	10,000	10,000	12,000	10,000	42,000	38,000
		21,000	35,000	50,000	35,000	141,000	111,000
D	<u>EQUIPMENT</u>						
1.	Vehicles (3)	1) 10,000	1) 15,650	1) 19,100	1) 20,000	4) 64,750	40,000
2.	Motocycles (6)	-	5) 3,125	-	-	5) 3,125	8,400
3.	Farm Equipment	-	16,360	11,000	17,400	44,760	60,900
4.	Laboratory Equipment	-	24,865	27,840	25,000	77,705	13,000
5.	Office Equipment	4,000	10,000	9,040	20,000	43,040	20,000
		14,000	70,000	66,980	82,400	233,380	142,300
E	<u>FSR COORDINATION AND NETWORKING</u>						
1.	In-House Programme Review	15,000	-	-	-	15,000	10,000
2.	Regional Workshops	50,000	-	-	-	50,000	30,000
		65,000	-	-	-	65,000	40,000
F	<u>TRAINING</u>	30,000	10,000	16,000	24,000	80,000	75,000

	P A R T I C U L A R S	COORDINATION OFFICE	BENIN	BURKINA FASO	CAMEROON	REQUEST 1987	BUDGET 1986
G	<u>TRAVEL</u>						
1.	Local	1,000	6,000	6,000	8,000	21,000	18,000
2.	International	15,000	8,000	8,000	10,000	41,000	40,000
		16,000	14,000	14,000	18,000	62,000	58,000
H	CONSULTANCY	30,000	-	-	-	30,000	45,000
I	BASE REQUEST	355,000	355,000	447,980	385,400	1,543,380	1,167,700
J	CONTINGENCY	21,620	-	-	-	21,620	32,300
K	TOTAL REQUEST	376,620	355,000	447,980	385,400	1,565,000	1,200,000

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1987-06

1987 RESEARCH PROPOSALS (FSRP)

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