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FIELD TRIAL RESEARCH PROGRAM WITH IT'S RATIONAL AS DEVELOPED FROM SOCIO-ECONOMIC AND AGRONOMIC DATA GATHERING EXPERIENCES & OBSERVATIONS IN 1980 IN UPPER VOLTA

Zones of interest: Ouagadougou
Ouahigouya, Zorgho, Kaya,
Fada N'Gourma, Houndé

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13. SAFGRAD/FSU 1981 Research Program, May 1981 (Christensen- Agronomist; Swanson - Anthropologist).

14. Field Trial Research Program with Rational as Developed from Socio-Economic data gathering Experiences & Observations of 1980. (Swanson - Anthropologist, Christensen - Agronomist).

Field Trial Research Program With Rational as Developed from Socio-economic and Agronomic Data Gathering Experiences and Observations of 1980 in Upper Volta.

1.0. INTRODUCTION

This document attempts to outline briefly some observations we have made during the past two years concerning some of the priorities involved in farming systems research, particularly for Upper Volta. The major food crops involved are sorghum, millet, maize, peanuts, cowpeas. Other crops which have drawn our attention are sesame, roselle, cotton, and earth peas. From SAFGRAD/FSU experience has evolved a series of tentative recommendations and technical packages which form the substance of our 1981 field trial program. This program is outlined at the end of this document.

1.1. Goals of Farming Systems Research

The Goals of farming systems research correspond with the general goals of applied research for agricultural development:

1. Identification of the principal constraints to production as ranked by the economic return to alleviating them;
2. Generation of outlines for new strategies for improving the well being of small farmers, specifically in terms of increasingthe profitability of crop production;
3. Generation of statistics relating to the characteristics of small farm production technologies allowing the evaluation of the proposed strategies;
4. Design and execution of on-farm trials for specification of physical response characteristics of proposed production techniques; and

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5. Evaluations of the strategies within the context of the small farm production systems where they are expected to be adopted.

During 1979, 1980, and 1981, the Farming Systems Unit (F.S.U.) of the OAU/STRC J.P. 31 Semi-Arid Food Grains Research and Development Program has concentrated on developing and evaluating production strategies for the central region of Upper Volta. The general outlines of these strategies should have a certain degree of validity in other West African countries where land is relatively cheap, labor relatively expensive from small farmer's point of view, and where inter-nation trade is inhibited by high overland transport cost.

Methodological questions related to Farming Systems Research have not been included in this report. Nonetheless, the methodological approach to solving Farming Systems problems used by the SAFGRAD/FSU will be of interest to researchers working in other SAFGRAD member countries.

2.0. WORKING OBSERVATIONS ON CROP PRODUCTION

This section contains observations on several principal crops. These observations are not intended to be complete, but are intended to provide a background for the development of technological change hypotheses to be tested.

Before beginning to discuse crops however, we would like to point out the usefullness of the concept of intensiveness versus extensiveness. Intensive implies that a relatively large portion of the inputs for production are supplied from the exterior. Intensive production is usually associated with high yields. Large scale cotton, rice and maize programs in the south-western part of the country best represent this orientation. Extensive implies that a large portion of the resources for production are generated internally or naturally. Yields will be relatively low. These

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are general terms and they can be applied not only to comparisons of regions and their agricultural economics, but also to different production activities within the same farm.

To the extent which intensiveness is associated with the use of materials from the world market, intensiveness will be relatively less desirable for inland Sahelian countries because of the high cost of transporting these materials in and the high cost of transporting the products out. There will be opportunities for intensive production in the inland Sahel, such as dam projects, but one would expect these opportunities to be relatively limited compared to other regions which have relatively better transport possibilities and more local resources. Thus extensive production techniques can be expected to be particularly important here.

This is not to say that intensification will not exist here, only that extensive production will be relatively more important. One of the principal tasks of farming systems research here is to indicate how the intensive and extensive crop production activities will balance, depending on the nature of the resources (land, equipment, capital, plant varieties, markets) available to different groups of farmers. We are concerned to understand what kinds of technology will be the easiest to implement and most profitable in the modernization process for these farmers, whether the end result of modernization is intensive crop production or a more efficient kind of extensive production.

The observations which follow relate to the importance of improving extensive production. The potential for the intensive production of certain crops within a largely extensive farming system is also reviewed. Within the context of extensive production, varietal improvement is relatively less important than it is when one is proposing to radically

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modify the crop micro-environment, as one does in many intensive production schemes. Techniques which increase the efficiency of existing production resources are particularly important. In central Upper Volta it is the labor saving aspects of donkey traction for weeding which seem to make it relatively more attractive to farmers than ox traction used for pre-planting plowing. The low proportion of commercial crops produced makes fertilizer purchase economically unattractive and limits the agronomic advantages of plowing.

In order to make maximum use of the physical resources of local soils and to maintain their fertility, some fertilization will need to be done, but the relative amounts of fertilizer must remain small due to economic considerations. All of these topics will be treated in a more specific fashion in Section 3. Here they are meant to support the arguement that the micro-environment may not change radically, and that the local crop varieties which are so well adapted to this micro-environment may continue to be the best alternatives for some period of time.

Other observations on the difficulties of varietal change are included below.

2.1. Sorghum: Qualitative considerations

Sorghum cultivation by small farmers poses a number of qualitative considerations. A first distinction must be made between red and white sorghum varieties. Though sometimes eaten, particularly during years of lack, red sorghums can most frequently be associated with areas where beer drinking holds an important role in many social events. In a strongly Moslem area such as Ouahigouya, little red sorghum is cultivated. At the opposite end of the country, among the Gourmantché, white sorghum generally predominates over millet, with a little red sorghum cultivated for use in beer making.

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The attention by research scientists, on white over red sorghum seems justified, given the former's more significant role in food needs of most farmers. However some varieties of red sorghum possess important genetic characteristics (such as early maturation under humid conditions) which might be transfered to white varieties. Most farmers would cultivate more white sorghum than they do in predominately millet zones if they were able to do so.

The types of soils either red or white local sorghums are found on - as compared to millet - can be seen to be above average in fertility, deeper, and generally lower on the topographic sequence. As a result, yield levels can be expected to be higher. The problem is that, for most parts of the Mossi plateau, consisting of more than half of the land area presently cultivated in Upper Volta, such soils are fairly scarce. Any one farming household does not have much such land, perhaps as little as 10% or .7 ha. on an average. About a third to half of this is represented by the even more fertile compound plots. Here, sorghum will clearly take second place to corn. The remaining portions of this type of soil can be found in fertile pockets or strips in villages and bush fields (termite hills, low spots, along water course-ways).

A major question research must answer concerns the economics of transforming millet growing land (which might be suitable for sorghum if they were fertile enough) to sorghum (in many cases such soils were once good for sorghum). For many Voltaic farmers, being able to do this would be desirable. Some farmers do transport some of their limited quantities of household refuse to village or bush fields, often planting sorghum there. Ouahigouya farmers have been observed to maximize their valuable animal manure resources on sorghum bush fields by placing a handfull of fertilizer into a recently planted pockets.

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In some regions of the country sorghum must be considered a major cash crop (ie. Eastern region, Bobo region). The future for sorghum as a cash crop seems assured. With the massive (more than 35 millions persons) and demanding market in Northern Nigeria, prices for cereals have shot up in Niger. Sorghum has recently reached a high of 140 CFA/kg in Niamey (personal communication, Bill Morris) and this promises to put pressure on the productive eastern region of Upper Volta where prices average about 70-85 CFA/kg. Varieties that have long storage potential need to be selected for by those purchasing in such regions. This in turn gives some focus to plant breeders to pay special attention to the many good local varieties with these characteristics.

Furthermore, farmers distinguish many local varieties of particularily white sorghum on the basis of where they can be grown best. Some do better on heaver soils, others on lighter ones-though always the question of fertility is predominant. Some varieties are found only on the compound plots; others on bush fields. Some varieties have higher resistance than others to plant parasites such as striga, diseases such as ergot, water logging. Strong stalks giving wind resistance are often considered important on the windward side of some fields.

Farmers everywhere, will give the advantages and disadvantages of their various crops and varieties (often to the frustration of the researcher). Such frustration is especially accute when one encounters, as is often the case, different farmers in the same village holding out for their own varieties and rejecting that of others in the same village. Their reasons are sometimes no more than a matter of personal preference. Yet these are the problems one faces in trying to introduce a new variety into a village. Farmers everywhere do ask for earlier maturing varieties. That these varieties should also prove more productive than present ones would be an added benefit.

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Given the complexity of most farming systems, all of which operate in number of environmental nitches, one must ask what it is that the crop breeders are working towards when they say they are developing 'improved" varieties. It is important to understand the basic assumptions upon which research is subsequently orientated. Does one assume that various types of fertilizers are going to be available and economically within the limits of most of the farmer? Does one assume more of a particular type of land being available to farmers than is the case in reality? Does one assume that a specific crop improvement technology will be feasible for most poor farmers? Does one assume that the extension service will work efficiently? If the answer is no to any of these types of questions, one needs to assess priorities in research in terms of what is most likely to pay off in increasing farmer productivity for the greatest number of farmers in the shortest period of time.

If a sorghum variety capable of doubling, tripling yields is dependent on a level of extension not likely to be seen in the forseeable future, then it might be more important to emphasize varieties and techniques which at least give some significant increase in yield given the resources of most farmers.

The layman is often impressed when the agronomist proclaims how much an improved variety will yield over a local one. One must be particularily cautious in overplaying the importance of yield statistics for sorghum, millet, maize and cowpeas as yield increases of new varieties are often associated with increased risk to the farmer. Field station yield levels are not realistic to real conditions or potentials of most poor farmers. Farmers would do well to realize 50% of these levels.

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E 35 1, for instance is an improved white sorghum variety (1). Under the best of controled situations it can yield up to 4000 kg/ha. One is often told in the same context that local varieties only give about 500 Kg/ha, which makes a farmer look irrational for not immediately adopting it. To be fair, one is also told that under "farmer conditions" one can expect yields of about 2000 kg/ha. The problem, of course, is that these conditions do not adequately represent the land resources available to farmers. It is probably true, that planted on the compound plots, E 35-1 would give about 2000 kg/ha or slightly better. However, given a good season, a local sorghum variety planted on compound plot soil would also yield up to 2000 kg/ha or better. Furthermore, planted upon less fertile soils than the compound plots, the improved sorghum may yield less than the local that might have been planted there.

E 35-1 is a superior variety but its limitations are clear. It does need fertile soils. It is sensitive to drought so does best planted during the last half of June. It should be planted in plowed soils at 4 cm. Depth. Most farmers in Upper Volta, excluding the higher rainfall and lower population density zones of Bobo and more south, only have a very limited amount of land around the village compounds really good for E35-1. These soils already represent the major source of most of the corn production of the household. Farmers already cultivate rapid maturing, fairly high yielding varieties of sorghum about such plots - some of which are eaten green at the same time corn is being harvested in early-to-mid September. Furthermore, by the end of June, farmers usually have finished all their cereal planting. It might be difficult to expect farmers to leave some of their best soils for such late planting - especially since this would interfere with some of the other crops either associated or relay-cropped on this land (cotton tobacco, roselle, okra, dâ, sesame).

(1) ICRISAT/Upper Volta Economist Peter Matlon has recently completed a more detailed economic analysis of E35-1 under farmer conditions: Farmers Tests of New Technology - A case study. April 1981.

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E35-1 could not replace local sorghums around corn plots on household/village fields (or in rows through such fields, or on each side of village paths) unless, like the local sorghums planted here, it could be planted at the same time or 1-2 weeks earlier than the maize. However, not only is E35-1 very drought sensitive, but maturation during August could cause considerable loss from mildew and rot. E35-1 crosses with some local varieties may result in overcoming some of these problems.

As a sorghum variety, E35-1 would seem to fit into the following nitches best:

1°) In the more humid zones where rainfall patterns are more dependable. For larger scale cultivation, fertilizers would certainly be necessary. Here again, E35-1 must first compete with productive local varieties.

2°) Associated with cotton on village and bush fields where the necessary cost of fertilizers could be met by sale of the cotton cash crop. One would have to check performance of locals too.

3°) Corn plots are often destroyed by drought. In some of these cases farmers could still obtain an important harvest from this land if E35-1 were to be quickly planted.

Research needs to concentrate on a high-yielding variety of sorghum which performs better than local varieties under fertility conditions only slightly better than currently the case (as with the application of about 200 kg/ha rock phosphate with perhaps some urea). A better organized system of rotation with peanuts, cowpeas, earth peas and soybeans might be possible. Though combined, the total area of these crops is presently much smaller than the average cereal field. Greater research should be focusing on long term varieties of sorghum with higher yields for both heavy and light sandy soils.

2.2. Millet

Research has not to date come forward with millet varieties superior to local ones. Given adequate rains, fertile soils, local millet can give up to 1000 kg/ha and more. Given high population density across most of the Mossi plateau, a major portion of the land is low in fertility and little enrichment of soils is ever achieved (except for small segments of fields which had a leguminous crop there the previous year). Given the current market prices, it is hard to conceive farmers ever being able to significantly upgrade their soils through high dose fertilizer application, though this might change as cereal prices continue to rise. Perhaps by increasing the scale of a cash crop such as peanuts with fertilizer some progress could be made.

Efforts could perhaps be made to introduce some non-photosensitive varieties of early maturing millet into regions which presently do not have them. Varieties, such as those cultivated by farmers in the far east of the country could be of great benefit to farmers in many regions of the country.

2.3. Maize

For maize production, one needs to make a sharp differentiation between the bulk of Upper Volta, with the greatest number of farmers, and the south, some areas of which grow corn as their principal cereal crop. The potentials for innovation in the two regions are very different.

In the zones with rainfall generally lower than 1000 mm/year, one finds that most farmers cultivate less than 3-4 % of their total land under maize. Most of this is located right around the compounds in village fields or in spots outside the village where a household animals were kept during the

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night throughout the dry season months. Maize is not seen as a cash crop, and is rarely sold. Its most important role in the past seems to have been as an early maturing cereal crop capable of tiding the family over some deficit months (should food reserves be low) before the major millet/sorghums fields were ready for harvest.

If one were simply interested in producing more maize in Upper Volta, it would seem clear that the real potential lies in the south, especially where cotton is the source of much income and where fertility of soils can more easily be maintained through application of fertilizers. Maize production in the Houndé sector of Bobo is impressive for these reasons.

For other regions of Upper Volta, only a limited number of options for increased production seem possible.

1°) Increase the productivity of the small units of land presently under cultivation of maize. This would mean an improved variety which would permit greater population density and perhaps more ears per stalk. This would imply fertilizers, payment of which would have to come from better maize prices or an associated crop, such as cotton, sesame or tobacco. The latter however, probably would not be acceptable because of desired density. More study is needed about the economics of such a system.

2°) Increase the area cultivated under maize by additional fertilizer application in the less fertile soils (ie. increase radius around the compound for example). As households gain animal traction, they do become more prosperous. This usually results in ownershop of more animals, including oxen. These animals increase the amount of land capable of being manured. Well manured fields will most certainly by planted under maize.

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Questions which need to be answered are whether farmers want to have more maize than they presently have, assuming what they do plant comes to maturity. It is a fact that farmers could grow, even now, a little more maize than they do, if they were willing to decrease some of the early maturing sorghum cultivated around their compounds. We would like to suggest that:

A - Most Mossi & Gourmantché farmers seem to plant maize on all the land they possess which is really capable of more production. A few rows of tall, early maturing sorghum varieties will be placed at the borders - often as a wind break more than its value as a food. Marginal maize land will be put into sorghum. Most Mossi & Gourmantché farmers seem to plant about the amount of maize they presently can consume soon after harvest. This is not to minimize the importance of what is planted, much of which is eaten green.

In the SAFGRAD/FSU village laboratory for Nedogo last year, the relative percentage (3%) of maize cultivated in relationship to total area cultivated by a household remained about the same despite size of household or use/non-use of animal traction equipment. Well-off households cultivated six times more maize than poorer households, with only twice the labor force, plus animal traction. However, for both groups, maize only represented about 3% of the total area cultivated.

B - Corn, once properly dried, is more difficult to convert into flour than sorghum or millet. Since people do not have access to a mill, or a proper mill, this constraint is important.

2.4. Cowpeas/Peanuts

Non-photosensitive sole-cropped, cowpeas compete for the same ecological farm nitch as soybeans, peanuts, and earth peas, for most Voltaic farmers. They are planted at the same time (first half of July), weeded at the same time, harvested at about the same time. They use the same land.

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Non-photosensitive cowpea varieties must be sprayed for insect control at bud/flower formation. For KN-1, this is 33-39 days after planting depending on soil and moisture conditions, and again about 9 days later. Without spraying, insect damage, particularly from thrips, would be almost total. To economize on spraying, the use of sole-cropped fields seems necessary.

The farming Systems Unit has found on the bases of a subjective evaluation, that intensive production of cowpeas as a cash crop for export may be particularly promising. On a short term basis even the local in-country market appears favorable. The principal constraint to intensive cowpea production is not soil fertility, but insect control. Nevertheless, cowpea production as a cash crop may allow farmers to make the substantial purchases of fertilizer which are necessary if intensive production techniques such as of traction plowing are to be successful. It would only be able to do so if the insect control problem can be resolved economically.

On an extensive basis, farmers presently seem to cultivate enough local cowpeas in association on their sorghum/millet fields for their own household use. Very little is sold and there is no added cost of insecticide spray, because the cowpeas are thinly spread over a field, thus reducing insect infestation. Extensive cowpeas are also planted early, along with sorghum + millet and so do not compete with peanuts.

The question is: are farmers going to plant cowpeas upon land which they presently grow peanuts if they can be assured of a ready market for their peanuts, though perhaps not a better price? Present cowpea prices however are indeed favorable, with cowpeas selling for 50% to 60% higher per kilogram than peanuts. Once again one can anticipate sustained or increasing prices because of the food demands of countries like Nigeria. Ivory Coast, Togo, possibly Ghana, could develop into important markets.

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Several years ago, soybeans were highly promoted in some parts of Upper Volta. When the price of soybeans was at a subsidised 1500 CFA/a tin and the ORD was buying up the production, farmers in the Eastern region turned to this new crop in large numbers. It was not so much that more land was cultivated by farmers for this crop, but that less land was cultivated for others, particularly peanuts.

When the price fell to 800 CFA/tin, interest also fell. Land was returned to the more profitable peanuts. Because soybeans (a new crop for the region) did find an acceptable place, though small, in the food needs of many households (for making soumbala), some farmers continue to grow a little for their own use, and limited sale.

A cowpea variety which could be planted early in the season along with the sorghum and millet and which would flower earlier during the rains might be what is needed where cowpeas-cereal associations are desired by farmers. Varieties are needed that can be planted in such fields and still use animal traction equipment. One needs upright or climbing types and not those which spread out across the ground. This would also facilitate the usually arduous and time consuming process of harvesting.

2.5. EarthPeas

Earthpeas may be one of the most under-exploited legume crops in the country. No research that we know of has been done to determine the potential for increased productivity of this crop under various production strategies.

Earthpeas are non-photosensitive and as stated above compete for the same land and labor as the other leguminous crops. They are cultivated throughout the country on small plots, almost always under the management of women. Earthpeas can be easily planted with a mechanical planter

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at high density (10 cm) ; they require no insect control spraying and the grain stores better than any of the other leguminous crops. Because of rapid maturity (90-100 days), earthpeas often serve along with maize and early maturing varieties of sorghum as food used to bridge the gap when food reserves are at their lowest before the large fields are harvested. In the major Ouagadougou market in June, earth peas sold for 115 CFA/kg (white variety) and 150 CFA/Kg. (Black and red mixed varieties), compared to 165 CFA/kg for shelled peanuts and 70 CFA/Kg for white sorghum. Eart-peas have a higher protein content than peanuts.

2.6. Crop Economics

In relation to the various crops discussed, FSU/SAFGRAD is concerned to identify the economics of various crop combinations, both in sole and associated stands. It is also our concern to determine now much a particular crop would have to sell for (what price the farmer would have to receive) for it to compete favorably with another crop. For corn to be considered a cash crop, what price would farmers need to receive to cover their expenses of land improvement, etc.. ? For cowpeas to be competitive with peanuts, how much would they have to be sold for. These are questions, the answers to which would seem to have important implications for the respective crops during the coming years.

3.0. BASIC OBSERVATIONS AND TECHNICAL RECOMMENDATIONS

SAFGRAD/FSU research experience in Upper Volta has led to the conceptualization of system of interlinking agronomic recommendations for those zones of the country where rainfall is under 100 mm/year. Our confidence of their potential favorable reception by a majority of subsistance farmer in many zones, will be evaluated this year through large-scale farmer controlled verification field trials in laboratory villages. The production strategies to be promoted involve the following themes:

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1°) The understanding of small farmer production constraints requires careful distinction between intensive and extensive agricultural systems and the implications of such systems existing separately or combined on the same farm (2). Special attention must be given to which groups of farmers in a particular village or zone have access to land particularly suited to intensive cultivation and which do not.

2°) Animal traction farmers cultivating sandy soils should not be encouraged to plow their major sorghum/millet fields in anticipation of planting. Rather, these farmers should be encouraged to adopt as quickly as possible first planting in rows and weeding with animal drawn cultivators and then animal drawn planters.

3°) Farmers should use their mechanical planters on their major unplowed fields starting the first day of the first planting rain. With the subsequent use of donkey or ox drawn weeders and low fertilizer application, Voltaic farmers may realize an immediate reinforcement of their extensive sorghum and millet production capacity. Increasing labor productivity while maintaining yields in this way could in itself end the national cereal deficit.

4°) Long term maintenance of soil fertility levels through the use of relatively small amounts of locally produced rock phosphate fertilizer on fields used for extensive production, without imported nitrogen or potassium. Nitrogen levels will be maintained through the use of legume rotations and associations as is the current practice. Because these cereal fields are not plowed, this fertilizer would have to be applied at time of first weeding.

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(2) See Document n° 13, SAFGRAD/FSU 1981 Research Program, April 1981, Christensen & Swanson.

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5° Use of the planter during the critical early days of the season will permit farmers to reallocate their time to other, under-exploited, agricultural activities. Intensive use of the planter during the first three or four days of the season's first planting rain should allow farmers to accomplish about 80 % of their extensive cereal planting. Rather than continuing planting during the second and third rains of the seasons, farmers can concentrate on plowing and incorporating fertilizers into the smaller (usually village) fields. Into these fields are planted the household's maize, peanuts, some sorghum, cotton, sesame, and sole-cropper' cowpeas. Presently this land to be plowed represents about 15%-20% of a household's cultivated land resources (about 1 hectare).

6° Increasing cash crop production of peanuts both by improved tillage and fertilization, and by increasing areas planted to peanuts at the expense of areas planted to extensive sorghum and millet.

7° Increasing cash crop production of cotton, sesame, and cowpeas through improved insect control using low toxity insecticides which can be used on any crop with minimal danger. These crops, like maize, involve intensive production systems. In intensive production systems, maintenance of high yield levels requires good fertilizers. Therefore, expansion of the areas of intensive production beyond the area permitted by internally produced manures (the compound plots) requires the production of a cash crop to pay for the fertilizer. Therefore, the primary constraints linked with intensive production are commercial in nature. A major expansion of intensive crop production in Upper Volta will require increase in the efficiency of marketing of fertilizers and of the products for export.

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8° The Farming Systems Unit has found on the basis of a subjective evaluation that the intensive production of cowpeas as a cash crop for export may be particularly promising for Upper Volta. The principal constraints to intensive cowpea production is not soil fertility, but insect control.Neverthless, cowpea production as a cash crop may allow farmers to make the substantial purchases of fertilizer which are necessary if intensive production techniques such as ox traction plowing are to be successful. It would only be able to do so if the insect control problem can be resolved economically.

9° Increasing the integration of animal and crop production is much more important for intensive production than it is for extensive production. This is because of the role of the manure in increasing responsiveness to chemical fertilizer, because of the increased importance of plowing (before planting) in increasing responsiveness to fertilizer, and because the animals themselves represent a cash"crop."

10° More than any other cereal crop, maize will respond best to proper land preparation and fertilizer application. It is therfore essential that farmers have the time to do this. This must mean that extensive sorghum/millet fields will not be plowed but quickly planted with a planter.

11° The productivity of animal traction will be increased by its use on non-plowed fields for weeding and planting and by increasing the amount of plowing done for intensive crops, using the time saved during the first weeding and the land made available through moderate sorghum and millet yield increases.

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12° The success of the proposed changes does not depend on the replacement of local crop varieties. This is particularly true for the extensive production systems where yield increases are not expected to be large. In the intensive production sub-systems, introduction of new cultivars may lead to higher yields and greater efficiency of resource use, but in most cases germplasm in not currently the most important constraint to increasing the productivity of resources. One hopes that this situation will change as other production constraints are eleminated.

4.0 SAFGRAD/FSU FIELD TRIALS

Sites at which our field trials are located and the differentiation we make between different types of trials and different types of experimental sites are described below.

4.1 The Laboratory Village Concept

The Farming Systems Unit Field staff in a village laboratory includes the following:

- One research supervisor having under his responsibility control of the socio-economic survey work, the agronomic field trial sites, and who is responsible to present qualitative reports on the research in progress.

- One agronomic assistant who is responsible for the placement of the field trials and their everall management. He must have understanding of the technical themes being employed.

- One farmer interviewer who is responsible for the questionnaires on all aspects of on-farm crop production activities, including labor time

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data of household members on their respective fields.

- One farmer interviewer who is responsible for the questionnaires concerned with non-agricultural activities of a sample of farmers, including household transactions (purchases, sales, credit).

Two local village assistants to help with field trial placement, field measurement. Two or more are added at peak trial supervision periods (planting, harvest).

Laboratory villages in 1981 are:
Nedogo, Ouagadougou, Zone 1
Digré, Zorgho, Zone 3
Tamporé, Kaya, Zone 4 (with ADRK) (presently understaffed).

4.2 Field Trial Villages

A number of other villages are covered which in subsequent years could become village laboratories, given adequate funds and personnel. In such villages, SAFGRAD has placed at least one farmer interviewer responsible to follow all household agricultural activities as well as initiating a general base-line survey of at least ten farm households.

Field Trial Villages in 1981 are:
Sodin, Ouahigouya, Zone 2
Dohoun, Houndé, Zone 6
Diapangou, Fada, Zone 5

Field trials are conducted in all these villages under the control of either a SAFGRAD agronomic assistant or participating scientists from the local regional development organization. Table 1 describes the location and nature of all SAFGRAD/FSU 1981 field trials, to be described briefly later. In Diapangou, for instance, our agronomic assistant has placed the same set of pre-extension trials that we have in our village laboratories.

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In Sodin, a Dutch agronomist Volunteer working with the ORD gives local guidance and consel in the absence of one of the FSU team scientists. Our Houndé zone villages are receiving the least attention this year for field trials.

4.3 Principal Sites of Agricultural Production on the Small Farm

In the zones mentioned above, we have observed the presence of at least five categories of sites designated for agricultural production. Production techniques (crops, equipment, inputs, management techniques, etc..) can be very different in each of these areas. These sites are:

1. Compound Plot
2. (Within) Village Field
3. Fields Surrounding the Village
4. Bush Fields
5. Fields located in a bas fonds low area.

Different ethnic groups within Upper Volta vary in the possession of these types of fields. The compact nature of the village in the southwest leads to the presence of very few compound plots (if any) and within-the-village fields. Scattered Mossi and Gourmantché villages will possess at least the first four above.

Our verification (pre-extension) field trials are concerned with the first four above. We perceive compound plots and (within) village fields as one agricultural production zone (a compound is a special type of village field). We have also placed fields surrounding a village and the more distant bush fields as another production zone (again seeing the fields surrounding the village as special types of bush fields).

4.4 Principal Objectives of the Verification Field Trials

In one sense, our reason for existence as a farming systems unit

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TABLE 1: SAFGRAD/FSU 1981 FIELD TRIALS BY ZONE/VILLAGE; NUMBER OF REPLICATIONS PER VILLAGE

	FIELD TRIALS \ ZONE OF VILLAGE	Zone 1 : OUAGA-DOUGOU Village: NEDOGO	Zone 2: OUAHI-GOUYA Village: SODIN	Zone 3: ZORGHO Village: DIGRE	Zone 3: ZORGHO Village: TANGHIN	Zone 4: KAYA Village: TANPOORE	Zone 5 : FADA Village DIAPANGU	Zone 5: FADA Village: NYINDUUGA	Zone 6: HOUNDE Village: TIORO	OBSERVATIONS
VERIFICATION TRIALS	Sorghum-Maize Cotton on compound Plots	10	0	10	0	10	10	2	0	Plot sie: 360 m2
	Sorghum-Millet on Bush Fields	10	10	10	0	10	10	7	0	Plot size: 3000 m2
	Peanut-Cowpeas on Bush Fields Village fields	10	6	10	0	1	10	1	0	Plot size: 2400 m2
DEMONSTRATION TRIALS	Commercial Scale Cowpea Plot	9 plots Total: 2 1/4 ha.	1 plot Total: 1/4 ha.	4 plots Total: 86 ha.	35 plots Total: 4.1225 ha	0	19 plots Total: 4.5 ha.	16 plots Total: 2.064 ha.	0	Total ha: 14 ha
	Earth Pea Variety Plot	1	0	0	0	0	0	0	0	Plot size: 525 m2
	Non-photosensitive Local Earth Millet Plot	1	0	0	0	0	0	0	0	Plot size: 2500 m2
	Non-photosensitive Local Early Millet-Earth Pea Relay Plot	0	0	1	0	0	0	0	0	Plot size : minimum 750 m2

FIELD TRIALS \ ZONES OF VILLAGE	Zone 1: OUAGA-DOUGOU Village: NEDOGO	Zone 2: OUAHI-GOUYA Village: SODIN	Zone 3: ZORGHO Village: DIGRE	Zone 3: ZORGHO Village: TANGHIN	Zone 4: KAYA Village: TAMPOORE	Zone 5: FADA Village: DIAPANGU	Zone 5: FADA Village: NYINDUUGA	Zone 6: HOUNDE Village: TIORO	OBSERVATIONS
EXPERIMENTAL TRIALS: Long Term Fertility Trial	6	4	5	5	0	0	0	0	Plot size: 224 m2
Maize-Cotton Tied Ridge Trial	3	0	2	0	0	2	1	0	With assistance of SAFGRAD/IITA Plot size: Minimum 2500 m2
Sesame Trial	5	3	0	0	0	0	1	0	Plot size: 2500 m2
Cowpea Trial	5	5	5	0	0	5	4	0	With assistance at spraying of SAFGRAD/IITA Plot size: 900m2
Earth Pea Trial	5	0	5	0	0	4	4	0	Plot size : 450 m2
Maize Variety Trial	0	0	0	0	0	0	0	1	With assistance of SAFGRAD/IITA Plot size: 400 m2
Maize-Cowpea Relay Trial	0	0	0	0	0	0	0	2	With assistance of SAFGRAD/IITA Plot size: 816 m2
Sorghum variety Trial	0	0	0	1	0	0	0	0	With assistance of ICRISAT Plot size: 500 m2

is to demonstrate at the village level, after earlier surveys and trials work, the existence of appropriate technology for increased agricultural productivity. We seek to accomplish three principal objectives:

1° To demonstrate that the total package of recommendations as followed by the verification trial, for a certain crop or association of crops, in a well defined production zone is in fact acceptable to the farmers of the region (as represented by the village laboratory). We hope that the farmers with whom we work will themselves adopt this production package for the relevant areas of their farming enterprise.If we observe problems among our farmers concerning a particular point of the verification field trials, we will modify the trials with their help and have something better for the coming year.

The village laboratory becomes a site at which national extension personnel from the regional development organizations (ORDs) can become involved in and trained in the new systems being developed for their zones of concern.

2° Verification field trials which have been successful among the farmers of the research village will be suggested for wider application and extension within the concerned agricultural zone. It is for this reason that we consider it important that there be from the very beginning a direct collaboration between the regional development organization personnel in which the village laboratory is located and the SAFGRAD research personnel.

In this way when a verification trial has proved a success, the concerned ORD will already understand what has been undertaken

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and will appreciate the reasons for the success with the farmers. We have not asked the ORDs to place one of their extension agents in our village laboratories to be involved in the trial work and its extension at the village level, though this could be quite useful. We do seek to involve the extension personnel however at various stages of the program to keep them informed of progress. Eventually, we hope the village laboratories will become integrated into a national research program and maintained over the years as a site for continued research and evolution in the farming systems packages for the region.

We wish to compare the real costs for the farmers of the area of different production systems. We are comparing new techniques with local techniques and crop varieties to give us a valid base for comparison. All this assumes a number of criteria will be met concerning these trials:

(a) they will be large enough to give us precise information on inputs, labor time necessary for various activities (planting, weeding, harvest), use of farm implements, etc... Such data are necessary if comparison is to be made with other potential production systems which could replace or modify the present system.

(b) they will be large enough so that the farmer will place serious efforts on the success of the trial, that it won't be neglected. The trial plot would be too big to pass as simply "a little plot given to the use of the researchers" and which as a consequence, is the responsibility of the researcher.

(c) they will be large enough so that the farmer can easily observe the advantage of one production system over another.

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The six villages are Nedogo, Digré, Tampooré, Diapangu, Nyinduga (Fada), Sodin.

The three major verification trials and their respective treatments, found in each of the ten households for these villages are:

5.1. Sorghum/Maize with associated Cotton on Village Fields

This trial is being conducted in 5 zones, at 46 sites with a minimum plot of size of 360 m2. Each treatment averages about 90 m2, all under improved management.

Objectives: Evaluate performance, yields, and profits of local sorghum/improved sorghum and maize/improved maize on compound plots without chemical fertilizers (plots have high organic fertilizer inputs from household refuse and animal manures).

: Evaluate economic cost of extending the crop combinations above to less fertile village fields, with use of phosphate and urea fertilizer applications.

: Evaluate the cotton-sorghum/cotton-maize mix needed to pay for fertilizer inputs.

The treatments:

1. Traditional Sorghum
2. Improved Sorghum (E35-1)
3. Traditional Maize
4. Improved Maize (Poll 17)

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SAFGRAD/FSU suggest that all recommendations from whatever source (regional agricultural station, agricultural scientist located at the sub-regional level), must first pass through the verification trial stage at the laboratory village level in different zones (from the agronomic, ecological, and socio-economic points of view) before one consider extension to farmers of a concerned zone. Our village laboratories are not similar to the ICAT concept of PAPIN where research and the land cultivated is under the control of the researchers.

4.5 Major Themes of Field Trial Research for 1981

The important themes of research as carried but though our erification or pre-extension field trials are the following:

1° The use of the mechanical planter among those who possess animal traction (donkey or ox) in the extensive cereal fields of the household, without prior plowing: ie.minimum tillage. Even in the presence of some weed growth, the planter serves as a means of some weed control until a true weeding can be achieved. We believe moisture retention in the soil around the planted seed is increased, giving the seedling better survival potential over traditional methods.

2° The use of the white sorghum variety E35-1 on the compound plots/village fields. Comparing its response to local sorghum varieties given similar management practices.

3° The use of an improved maize variety on the compound plots/village fields. Comparing its response to local maize varieties given similar management practices.

4° An attempt to determine the economic costs and benefits of increasing the land given to intensive maize/sorghum cultivation.

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This involves raising what we have defined as (within) village field type soils to the productivity of compound plot type soils capable of maize cultivation.

5° The use of locally produced rock phosphate on:
(a) compound plots/village fields with urea (maize, sorghum)
(b) bush fields with peanuts or cowpeas (KN-1) with sorghum or millet.

6° The use of animal traction (donkey or ox) for pre-planting cultivation of maize, cowpea (KN-1) peanut, and earth pea plots; followed by planting with mechanical planter.

7° Comparing the interaction of agricultural techniques with different local and improved crop varieties (maize, sorghum, millet, cowpea, peanut, earth pea). The improvement of the mechanical planting discs so that all these various crops can be successfully planted with a minimum of trouble.

8° Comparing methods of application of fertilizer for different types of production systems (pre-planting cultivation with fertilizer application, followed by planting of maize or peanuts, followed by weedings...) (planting of sorghum or millet with planter, followed by first weeding and fertilizer application). This is being done on different types of soils and at different production sites.

5.0. THE VERIFICATION FIELD TRIALS

This years, we have placed three major types of pre-extension trials, corresponding to major cropping systems or zones of production. Protocole for these field trials are described in SAFGRAD Document N° 10, in French: Essais de Pré-Vulgarisation pour la campagne 1981, Avril 1981. In each of six villages, in five agro-climatic zones, trials were placed with ten households from out of our research sample from last year.

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5.2. Sorghum/Millet on Fields Surrounding Villages/Bush Fields

This trial is being conducted in 6 zones, at 60 sites with a minimum plot size of 3000 m2 (3 ha). Each treatment averages about 1000 m2, though many greatly exceeded this.

Objectives : Evaluate the appropriateness of group of techniques concerning cereal production on the farmer's principal sorghum and millet extensive fields (minimum tillage, mechanical planter, low fertilizer inputs, and animal traction weeding). These fields characteristically are low in fertility, sandy, rareiy receive fertilizer treatment, are one or more kilometers from farmer's home. On the Mossi Plateau, these fields have few stumps.

: By using our package of recommendations, we believe cost per kilogram of cereals will be reduced (reduced labor per hectare combined with low level application of fertilizer will reduce production cost).

: Evaluate the labor time allocation needs of these packages and compare them with traditional methods.

The Treatments:

1. Traditional Millet (local managemnet)
2. Traditional Millet (imporved management)
3. Local Sorghum (improved management)

5.3. Peanut/Cowpea Trial on Fields Surrounding Village/Bush Fields

This trial is being conducted in 6 zones, at 60 sites with a minimum plot size of 2400 m2. Each treatment is 800 m2.

Objectives: Economic evaluation between local peanuts under traditional and improved management.

: Evaluate the improved management of peanuts with KN-1 cowpeas under improved management and insect control.

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The treatments:

1. Peanuts (local variety and management)
2. Peanuts (improved variety, or good local variety and improved management)
3. Cowpeas (improved management and insecticide treatment).

6.0. EXPERIMENTAL AND DEMONSTRATION TRIALS

In addition to the pre-extension (verification) type trials described above, SAFGRAD/FSU is also conducting a series of other experimental and demonstration type trials, in many of the village laboratories and field trial villages. (3) Some of these trials may move into the pre-extension category next year. Of particular interest are the cowpea (KN-1) demonstration plots which have been very well received by farmers.

6.1. Experimental Trials:

(1) Long Term Fertility Trials

Three zones; 15 sites; plot size 5.2. m x 43 m.

Objectives: Compare long term cost benefits of low levels of locally available rock phosphate on shallow, low fertility sandy soils typical of Mossi plateau major millet fields.

(2) Maize-Cotton Tied Ridge Trial (with assistance of SAFGRAD-IITA - Rodriguez).

Three zone; 10 sites; minimum plot size: 0,25 ha.

Objectives: Evaluate economic return of associated maize/Cotton given fairly high applications of rock phosphate and urea; comparing returns in presence or absence of tied ridges; non-maize soils are used.

(3) For a description of SAFGRAD/FSU terminology for classifying various types if field trials, see Document n° 8, Observations on the Major Classification of Field Trials Used in Farming Systems Research, January 1981.

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(3) Sesame Trial.

4 zones; 15 sites; plot size 0,25 ha.

Objectives : Demonstrate levels of production possible at village level given proper insect control through spraying.

(4) Cowpea Trial (KN-1 versus Local) (with assistance of SAFGRAD/IITA - Aggarval).
3 Zones; 20 sites; plot size (split) : 1056 m2.

Objectives : Compare local and KN-1 varieties with and without insect control through spraying.

(5) Earth Pea (Bambara Groudnut) Trial.

5 zones; 25 sites; plot size: 450 m2.

Objectives: Compare performance of local varieties with and without improved management (fertilizer application, plowing and weeding with animal traction, mechanical planter), evaluate levels of production possible.

(6) Maize Variety Trial (with assistance of SAFGRAD/IITA - Asnani.

1 zone; 1 site; plot size: 400 m2.

Objectives: Evaluate performance of several local and improved varieties under improved management at village level.

(7) Maize-Cowpea Relay Trial (with assistance of SAFGRAD-IITA - Brockman).

1 zone: 2 sites; plot size: 816 m2.

Objectives: Evaluation of (agronomic and economic) performance of the relay at village level.

(8) Sorghum Variety Trial (with assistance of ICRISAT - Root)
1 zone; 10 sites; plot size: 500 m2.

Objectives: Compare 4 experimental improved sorghum lines and introduced varieties with local shite sorghum cultivars under both improved and traiditonal management.

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6.2. Demonstration Trials:

(1) Commercial Scale Cowpea Demonstration Plots

(2) Earth Pea Variety Demonstration Plots
1 zone; 1 site; Plot size: 525 m2

Objectives: Evaluate performance of six local varieties under improved management.

(3) Non-Photosensitive Local Early Millet Demonstration Plot (Niadi)
3 zones; 3 sites; plot size: minimum 0,25 ha.

Objectives: Evaluate performance under improved management on appropriate soils in zones which are not presently familar with this variety.

(4) Non-Photosensitive Local Early Millet/Earth Pea Relay Demonstration Plot.
1 zone; 10 sites; plot size: 750 m2

7.0. CONCLUSION

In 1981, SAFGRAD/FSU expects to make a major effort to interest agricultural researchers and Voltaic extension service agents to visit the village laboratories and discuss with us and the farmers the implications of the various experiments discussed above.

The Farming Systems Research Unit is convinced that there are ways to raise the productivity of Voltaic Agriculture, mainly through increasing the efficiency with which local resources are used. Success of this plan depends on a number of key issues being successfully resolved.

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(1) There must be an increase in efficiency at the farm level using animal traction systems and fertilizers in a balanced way for both intensive and extensive production systems. (2) There must also be an increase in the efficiency with which agricultural inputs (rock phosphate fertilizer, low toxicity insecticides and pesticides and planting and weeding equipment) are madereadily available to farmers, and there must be increased efficiency in the manner in which agricultural products (local grain surpluses, cowpeas for export, and other cash crops) are marketed at the national and international level.

The Farming Systems Research Unit will continue to emphasize the importance of low production cost and high proportions of domestic cost in the technology recommendations for Sahelian countries. We will give particular emphasis on labor savings during planting and first weeding, and the alternatives of pre-planting plowing for extensive production systems.