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PROGRESS REPORT

ON

FERTILIZER INVESTMENT FOR SOIL FERTILITY RESTORATION PROJECT (SFRP)

For the Period July 1988 to July 1989

Submitted

By

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PROGRESS REPORT ON FERTILIZER INVESTMENT FOR SOIL FERTILITY RESTORATION PROJECT (SFRP)

Introduction

This progress report covers the period July 1988 to July 1989. The previous report dealt in some detail with the background to the Fertilizer Investment for Soil Fertility Restoration Project (SFRP). In sections 1, 2, and 3 the rationale, objectives, and outputs of the project are outlined. The remainder of the report describes the activities of 1988/89 and plans for 1990.

The upland soils of sub-Saharan Africa are generally low in fertility and fragile. Small farmers in this region have traditionally coped with these problems by resorting to a bush fallow rotation, which has permitted low but relatively stable levels of crop production. However, with rapid increases in population, the bush fallow system is less feasible, marginal lands are being brought into production, and continuous cropping is being practiced on soils of low fertility without use of fertilizers or manures. The average use of fertilizers in sub-Saharan Africa has been estimated at 7 kg/ha of nutrients. Crop yields have therefore declined steadily, and there is an urgent need to develop and test systems of soil fertility management that will boost crop production substantially, help small farmers increase incomes, and also prevent environmental degradation. The main capital of many small farmers in West Africa is land. The SFRP is needed to intensify cultivation on productive lands, take the pressure off marginal lands and bush fallows, and protect the natural resource base for agriculture in the region.

According to the FAO report Agriculture: Toward 2000 published in 1987, "attempts to increase productivity without adding nutrients to the soil will ultimately fail, especially when soils are on the verge of degradation." The report emphasized that technologies of the future must continue to use fertilizers or relatively large dressings of organic manure to restore soil structure and fertility.

Material resources for agricultural development in sub-Saharan Africa are scarce and should not be used indiscriminately; thus whereas low

input agricultural technologies are appropriate for lands of low economic potential, higher input technologies are more suited to potentially productive lands in market-oriented economies.

IFDC-Africa recognizes that in sub-Saharan Africa there are agroecological areas where the economic potential for fertilizer use is low and others where the potential is high. The reasons for low economic potential for fertilizer use may include poor fertilizer-crop response and poor return on fertilizer investment relative to other investments.

In 1987 IFDC initiated a 5-year project titled Fertilizer Investment for Soil Fertility Restoration (SFRP) funded by USAID, World Bank, Rockefeller Foundation, IRAT/CIRAD, and members of the fertilizer industry (IMPHOS and APF).

The project is presently being conducted in pilot villages in the sahel, savanna, and humid zones of West Africa. These villages are characterized by (1) well-defined and functional power structures, (2) farmers willing to participate in the SFRP, (3) good contacts with extension agents, (4) good road networks to markets and fertilizer supplies, (5) soils that are deficient in phosphorus and often in nitrogen and potassium, and (6) lands that are potentially productive.

The approach of the SFRP is based on the premise that it is necessary to study the socioeconomics of fertilizer use beyond small test plots that are characteristic of conventional fertilizer trials in West Africa and focus on large tracts of farmland and whole villages.

This approach allows for the socioeconomic evaluation of the impact that interventions to restore and maintain soil fertility can have on villages, farmers, consumers, and institutions involved in agricultural research, extension, and the marketing of agricultural inputs and products. Implementation of this research at the village-level will facilitate the identification and design of economically and socially sound public policies to restore soil fertility and promote agricultural development. The SFRP seeks to identify soil fertility restoration strategies that promote the economic and social well being of women engaged in agriculture.

Objectives

Development Objectives

The long-term objective of the SFRP is to increase the availability of food, increase rural income, and promote agricultural and rural development in Africa through the reclamation and conservation of fertility depleted croplands.

Specific Objectives

The specific objectives of the SFRP are to study the agronomic and socioeconomic viability of using soil amendments and fertilizers as investment strategies in soil fertility restoration and maintenance in West Africa. The terms of reference required the identification of experimental and control villages in three agroclimatic and socioeconomic regions of West Africa, where the effectiveness of fertilizer/amendments to maintain or increase productivity over time (sustainability) will be measured through annual agro-socio-economic surveys.

To accomplish these objectives, the SFRP is engaged in the following activities:

1. Training of national program personnel to conduct and monitor the soil fertility restoration project in pilot areas.
2. Studying the consequences of fertilizer use and other soil amendments on:
   - Soil fertility restoration/maintenance and crop yields.
   - Land use and farming practices.
   - Disposal and use of agricultural production.
   - Income of farmers.
   - Employment.
   - Use of labor, animal traction, and other inputs.
   - Farmers' investment behavior.
   - The role of women in agricultural development.
3. Studying the effects of agroecological factors on the adoption of fertilizers and soil amendments.
4. Studying farmers' perceptions about constraints to fertilizer/soil amendment use and agricultural production.
5. Studying the effect of a simulated "subsidy reduction" scheme on fertilizer adoption in the experimental villages.

6. Disseminating information generated by the project to national and international organizations involved in agricultural development.

Expected Benefits of the Project

Based on progress to date and future work, the following benefits are expected to be achieved at the village and regional levels.

In the experimental villages of the pilot areas, the project will provide:

1. Improved soil fertility status.
2. Increased income of farmers.
3. A situation where farmers begin to purchase and use fertilizers on a self-sustaining basis.
4. Increased crop yields.
5. Increased crop production on a farm basis.
6. Improved storage and marketing of crop produce.

At the regional level the project is expected provide the following:

1. National research/extension staff in each participating country trained in conducting research and extension activities related to various aspects of the soil fertility restoration project.
2. An extensive data base on fertilizer use, agroclimatic, and socioeconomic variables that facilitates the design and formulation of government policies to promote agricultural development in the West African region.
3. Development of agro-socio-economic models that facilitates the transfer of fertilizer-based technologies to sites that are similar to the sites where the project is currently being conducted.
4. Identification of soil fertility restoration strategies that is economically and socially beneficial to farmers, consumers, and the environment.

Administration and Staffing

An agro-economist, Mr. D. Pouzet on secondment from IRAT, joined the SFRP team in IFDC-Africa, Lomé, in November 1988. Thus completing the three-man core staff of Dr. E. Rhodes, Agronomist/team leader, and Dr. K. Acheampong, Sociologist. Dr. C. Baanante (Economist) and Dr. T. Thompson (Sociologist), who are based at IFDC, Muscle Shoals, continue to provide technical advice and assistance.

Pilot Areas and Collaborating National Institutions

The three pilot areas are located within a 40-km radius of Maradi, Niger (Sahel zone); Dapaong, Togo (Savanna zone); and Kumasi, Ghana (humid zone), respectively. The pilot areas and the experimental and control villages where current activities of the SFRP are being conducted are listed below.

Pilot Area	Experimental Village	Control Village
Maradi	Tchizon Kouregue	Maiguero
Dapaong	Naki Est	Kpembona
Kumasi	Adjamesu	Hwidiem

There are two-three other villages in each pilot area where on-farm fertilizer trials are being conducted. The results of these trials will be used to refine the village-level fertilizer investment options currently being tested in the experimental villages. The inclusion of additional experimental and control villages in each pilot area is under consideration.

A memorandum of understanding (MOU) with the Ministry of Rural Development, Togo, was signed on September 15, 1988. Thus MOUs have been signed with all three participating countries. Appendix Figures 1 and 2 show the organizational charts of the SFRP in Togo and Niger, respectively.

The organizational chart for Ghana was presented in the Progress Report for 1987/1988. It is worth noting that in all three countries linkages between research and extension institutions have been strengthened through the

SFRP. Mr. E. Melebou the National Coordinator of the project for Togo was appointed by the government as Prefect on May 8, 1988. A replacement is expected.

Activities of 1987/88 and Development of a Workplan for 1988/89

Appendix Figure 3 shows the schedule of activities conducted by the SFRP in Ghana, Togo, and Niger during 1987/88, and the tasks planned for the second half of 1988/89.

The IFDC, American Phosphate Foundation (APF) and World Phosphate Institute (IMPHOS) SFRP Steering Committee held an annual meeting in Niamey, Niger, during August 30-31, 1988. At this meeting the progress report for 1987/88 and an outline of the workplan for 1988/89 were reviewed. The following persons participated in this meeting.

World Phosphate Institute (IMPHOS)

Mr. A. Benchkroun

Mr. A. Benjelloun

Mr. A. Belmehdi

American Phosphate Foundation (APF)

Dr. K. M. Pretty

Dr. J. A. Stewart

Mr. U. H. Fogt, Jr.

International Fertilizer Development Center (IFDC)

Dr. D. L. McCune

Dr. P. L. G. Vlek

Dr. E. R. Rhodes

Dr. K. Acheampong

Dr. A. U. Mokwunye

Dr. T. P. Thompson

Dr. A. Bationo

National Institute of Agronomic Research Niger (IRAN)

Mr. I. Soumana

Mr. M. Goube Gaoh

Mr. M. Kadi

Ministry of Agriculture, Ghana

Mr. S. Opoku

Ministry of Rural Development, Togo

Mr. E. Melebou

Dr. McCune and Mr. Soumana presented opening addresses that emphasized the importance of the SFRP in sub-Saharan Africa. Dr. Rhodes presented the annual progress report 1987/88, plans for future work, and a conceptual model of the SFRP (Appendix 6). The model has as one of its goals the development of structures that will permit farmers to increase crop production and farm income on a self-sustaining basis. Mr. Opoku, Mr. Melebou, and Mr. Gaoh presented country reports for Ghana, Togo, and Niger, respectively. Background presentations on research conducted by IFDC-Africa on experimental stations and farmers' fields were given by Dr. A. Bationo.

The Steering Committee approved the model as presented, the schedule for Project activities 1988-1992 (Appendix 7), and the outline of the workplan for 1989. Suggestions for modifying the proposed fertilizer investment options were made by the committee and accepted by IFDC. On-farm trials on P sources were also approved.

The detailed workplans were developed with the National Coordinators of the three countries at Workshops held in Lomé. These workshops involved the review of progress and problems of 1987/88 and the preparation of budgets for 1988/89. The workshops were held as follows:

Ghana	November 4-11, 1988
Togo	November 30-December 1, 1988
Niger	January 6-12, 1989

Appendices 4, 5a, 5b, and 5c show information on (1) major activities, (2) the rationale of the fertilizer/manure investment options,

(3) the number of households where the options will be evaluated, (4) sources and rates of P materials to be tested in researcher- and farmer-managed on-farm trials, (5) socioeconomic surveys, (6) farm budget studies, (7) development of local institution and support services, (8) monitoring of the environmental effects of fertilizer use, and (9) development of Fertilizer Revolving Funds.

The major activity for 1989 was to supply fertilizers to sample farmers in the experimental villages in quantities sufficient to plant as much as 1 ha of maize/cassava in Ghana, 2.5 ha of sorghum/millet in Togo, and 3 ha of millet in Niger.

The actual acreage to be cropped was determined by farmers who received fertilizers on request. Farmers were to manage their own plots, but the type of fertilizer material received and the rate of application were to be determined by IFDC-Africa in consultation with national collaborators.

Baseline Agroecological and Socioeconomic Surveys in 1988

Togo

Exploratory Survey--It will be recalled that the purpose of the exploratory surveys was to determine the willingness of farmers to participate in the SFRP and to obtain insight into the socioeconomic circumstances, climate, soils, and cropping systems within the pilot area in order to select the experimental and control villages. It was recognized that the exploratory survey was to be followed by a more rigorous baseline survey. The report of the exploratory survey of the pilot area of Togo is shown in Appendix 8. It was prepared in the same format as that for Ghana which was a part of the 1987/88 Progress report. The tentative conclusions and implications of this report for the SFRP in Togo are as follows:

1. Farmers reported soil infertility as a major constraint to increasing food cro pilot area were depleted in nitrogen and phosphorus. Thus, nitrogen and phosphorus fertilizers are crucial for restoring soil fertility. Potash fertilizers will also be required but the degree of need is less than that for N and P.

2. There is no fallow period in the pilot area because of pressure on the land, and therefore the soils are under continuous cropping. Phosphate fertilizer investment options should compare the application of single relatively large doses of P versus smaller annual applications.
3. There is potential for use of animal manure, but because the amounts produced locally are insufficient, supplemental commercial fertilizers are needed.
4. Sorghum and millet are the major food crops in the area; therefore, fertilization of entire villages should be based on sorghum/millet farms.
5. Fertilizer recommendations of the extension service for sorghum and millet in the Savanes of Togo emphasize the use of 15:15:15 compound fertilizer. The benefits of compounds and single nutrient carriers should be compared as investment strategies.
6. There has been an increase in the use of TSP and DAP by West African countries because of savings in transportation costs. However, these materials have undergone limited testing in West Africa. Therefore, there is a need for economic and agronomic evaluations of high-analysis P fertilizers like DAP and TSP in OFT in the pilot area.
7. There is need to maintain close contacts with the Direction Régionale du Développement Rural (DRDR) because their extension workers are very familiar with the pilot area and farmers. Improved practices such as use of good seed, correct plant population, and weeding will improve crop response to the fertilizer investment treatments.
8. The villages of Naki-Est and Kpembona have similar soils and easy access to markets. Land tenure arrangements are not a problem. Soil fertility is a major constraint to increased food production. These villages were therefore chosen for the baseline survey. Naki-Est is the experimental village and Kpembona serves as the control village.
9. Farmers reported labor shortages during the period of peak agricultural activity. To help minimize the problem, the Project will work in collaboration with the local leadership and extension to strengthen existing labor pools or encourage farmers to form such pools where none exist. Such groupings would also serve as nuclei for the development of viable farmers cooperatives or credit unions.
10. The current system of fertilizer distribution in the pilot area is biased against farmers who do not grow cotton or cannot appropriate the

use of more land. The SFRP strategy whereby all farmers in the experimental village are eligible for fertilizers, regardless of their scale of production for sorghum/millet, will not only help address the problem of inequity but will also serve as a "headstart" for those farmers who would otherwise have no access to fertilizers.

11. As a first step towards sustained fertilizer use in the experimental village, the project should work in collaboration with the local leadership, extension services, and farmers to explore the possibility of using part of the returns from the initial use of fertilizer to create a village level Fertilizer Revolving Fund. This Fund would be used to make future bulk purchases of fertilizers for use by contributing farmers.

12. The wide fluctuation in food prices suggests that farmers may increase their earnings if stocks were held over an extended period of time and sold at peak prices. Therefore, efforts should be made to evaluate and improve current storage systems.

13. Heads of Soukhala play a significant role in the social and economic life of their villages. Indeed their role as custodians of group property, including farmlands, places them in a position to exert significant influence over the organization of agricultural production. Therefore, their involvement in the project has been cultivated and encouraged.

Baseline Farm Survey--As stated in the progress report for 1987/88, the purposes of the baseline survey were to ascertain whether the information obtained through the exploratory surveys was representative and generate agronomic and socioeconomic data for future monitoring and evaluation of project interventions.

The baseline survey was conducted in September and October of 1988 and consisted of the training of interviewers, preparation of sampling frames, selection of samples, and administration of the questionnaires in the villages of Naki Est and Kpembona. Sixty farmers were interviewed at Kpembona and 60 at Naki Est. A total of 30 women were interviewed. The chiefs were also interviewed to provide an overview of the villages. The data has been coded, analyzed, and the report is under preparation.

Niger

Exploratory Survey--The exploratory survey was conducted in May 1988 and information obtained was used to select the experimental and control villages. Location maps, etc., will be incorporated into the report of the baseline survey, which is under preparation.

Baseline Farm Survey--It was conducted in September 1988 in the villages of Tchizon Kouregue and Maiguero. A total of 129 farmers, including 37 females, were interviewed in both villages. The chiefs of the villages were also interviewed. The data has been coded and analyzed, and the report is under preparation.

Ghana

Exploratory Survey--The report has been written and included as a part of the 1987/88 Progress report.

Baseline Farm Survey--A report of the baseline farm survey conducted in Ghana in 1988 is presented in Appendix 9. The summary of this report is as follows:

1. The 1988 SFRP baseline data for Ghana were collected in the Ashanti region in the village of Adjamesu and Hwidiem. A total of 121 farmers were interviewed, 67 of whom are women. The survey generated data on gender; cultural groups; marital status; household location and composition; education; employment; land availability and tenure; the use of machinery; animals, equipment, and credit; sources of informations about fertilizers; crop areas and managements; the use and costs of fertilizers; organic manures; crop residues; the use and cost of labor; disposal and use of crop production; and finally, the perceptions of farmers about constraints to fertilizer use and agricultural production.
2. The sample households are mostly comprised of nuclear families with age and gender distributions that allow meaningful comparisons between men and women farmers in various age groups. The households headed by women are somewhat larger than those of men in Hwidiem but in Adjamesu the reverse is the case.
3. The salient feature of schooling in the Ashanti region of Ghana is that although men have attained more years of education than women, younger Ashanti women have more schooling than older ones. This is evidence of real and meaningful social change for women.

4. The households headed by women are closer to markets for agricultural products than those of men as is the distance to stores for household goods and fertilizer. However, the distances from households to household and individual plots managed by women are uniformly greater than for men.
5. Among adult household members, women are more likely than men to be engaged in off-farm employment but the number of months per year of off-farm off-farm earnings of men are greater than that of women.
6. Among farmers that are heads of households, women are again more often engaged in off-farm employment except for Adjamesu, where the frequency off-farm employment among men exceeds that of women. The duration and earnings from off-farm employment are again greater among men than women farmers. Most of the off-farm employment is within the village of residence of men and women. However, the proximity of Adjamesu to Kumasi provides greater urban off-farm employment than in Hwidiem.
7. Although men and women predominantly manage their own plots each gender may manage plots of the other. There are differences between the sizes of crop areas managed by women and men, however, the differences are not significant.
8. The data on land tenure in the Ashanti region of Ghana show that among men and women about 80% of plots are family owned with secure tenure rights. Women farmers are more likely to rent plots in Hwidiem than in Adjamesu.
9. The ownership of agricultural equipment is limited to men in Hwidiem. Women are somewhat less likely than men to own handtools and no women reported owning agricultural equipment. Thus, women are more likely than men to borrow tools for agricultural work.
10. Animal ownership is greater among men and women in Adjamesu than in Hwidiem. The average sample figures show that men own 16 animals and women 8. But animal ownership in Hwidiem is greater among women than men.
11. In the control village of Hwidiem, maize and cassava as sole crops and as bases for intercrops account for 84% of the crops on 106 sampled plots and 66% of 129 sampled plots in Adjamesu. For the total sample these crops account for 75% of the cropping systems.

12. The average size of the 235 plots included in the sample in both villages is 0.6 acres. The average plot size for men is 0.76 acres and 0.55 acres for women.

13. The total sample figures show that disregarding gender, 32% of the sample plots are allocated for the intercrop of maize and cassava. The sole crop of cassava is second in importance for both men and women, 17% and 16% of all plots, respectively. A striking contrast in crop choices by gender in Adjamesu is evident in that men allocate 30% of the area under their management to various cassava intercrops and diverse other crops but only 9% of the women show this pattern.

14. Both villages rely heavily on household labor. Specifically, 77% of all workdays are performed by household labor in Hwidiem and 87% in Adjamesu.

15. Women hire more labor than men for the difficult task of land preparation and use more workdays of labor than men for the tasks of land preparation, planting, weeding, fertilizer application, and other activities.

16. Use of household and hired labor by men and women farmers varies between villages and among crops and activities. For instance, farmers in Adjamesu rely more on household labor for the production of maize, but use more hired labor for weeding cassava than those in Hwidiem. Farmers in Hwidiem are twice as likely as those in Adjamesu to hire labor for the maize-cassava intercrop. The use of hired labor for maize-cassava in Hwidiem (38 workdays/acre) exceeds that of Adjamesu (19 workdays/acre).

17. In Hwidiem 56% of all workdays for all activities were performed by men, 41% by women, and 3% by children. The corresponding figures for Adjamesu are 38%, 41%, and 21%, respectively. There is no evidence in this study that food production is the sole or exclusive responsibility of women or men. Although, men do most of the land preparation activity, neither gender does agricultural tasks without the help of the other.

18. The total sample figures show 14% of all farmers used fertilizer during the survey season and that men (21%) are more likely to use fertilizer than women (9%). Adjamesu showed more gender equality of fertilizer use than Hwidiem, but farmers in Hwidiem are somewhat more likely to use fertilizer than in Adjamesu.

19. Lack of Knowledge is an important constraint to the adoption of fertilizer. Twenty-nine percent of the men in Hwidiem and 42% of the men in Adjamesu reported having no knowledge about use of fertilizer. Among women farmers, 42% in Hwidiem and 35% in Adjamesu reported no knowledge about fertilizer use.

20. The perception about the lack of need for fertilizer is still present among some farmers. Men (29%) in Hwidiem are more likely than women (12%) to report that fertilizers are not needed. No men in Adjamesu reported that fertilizer are not needed but 13% of the women reported no need.

21. The cost of fertilizer is another important constraint to fertilizer use. Twenty-one percent of the farmers in Hwidiem and 14% of those in Adjamesu cited the expense of fertilizer as a reason for discontinuing use. Eighteen percent of the total sample cited this reason. Women are less likely than men to report that price is a constraint to fertilizer use.

22. Regardless of gender, Ashanti farmers are clear about their aversion to handling organic waste. The words the farmers used to describe organic manure were dirty, filthy, and unhealthy. Thus the use of organic manure in the Ashanti region of Ghana is minimal.

23. The use of agricultural credit in both sample villages is very limited. Only 26% of the farmers in the sample reported using some sort of agricultural credit during the survey year. Farmers in the Adjamesu were somewhat more likely than in Hwidiem to use credit, 30% and 21%, respectively. It is noteworthy that 76% of the farmers in the sample that did not use credit made no attempt to obtain a loan for the 1988 cropping season.

24. Most crop output is produced for the dual purposes of household consumption and sale. Seventy-one percent of the farmers in Hwidiem and 50% of those in Adjamesu cultivated maize for the dual purpose of house hold consumption and sale. Eighty percent of the cassava in Adjamesu was used for these purposes. The data for all crops show that crops grown for these purposes are more frequent in Hwidiem (69%) than Adjamesu (53%).

25. Sales of crops take place mostly in the village of the farmers' residence. Sixty-seven percent of all farmers reported that all crops were sold in the village of residence and 23% made sales in Kumasi.

26. Farmers themselves are most often responsible for crops sales This is the case for 73% of the total sample, 71% of the farmers in Hwidiem, and 75% of the farmers in Adjamesu.

27. A significant number of farmers are uncertain about the value of information from agricultural cooperatives. The total sample figures show that 56% of the farmers are uncertain about the value of information received from agricultural cooperatives and 17% perceive information from this source as not helpful.

28. There is an apparent lack of confidence among some farmers about the information that extension workers provide; 54% of the farmers view information from extension workers as not helpful, 34% view such information as very helpful, and 12% find such information somewhat helpful.

29. Thirty percent find information from other farmers very helpful and 18% find such information helpful to some degree.

30. Overall, farmers in the Ashanti region of Ghana find information from fertilizer dealers and cooperatives least helpful.

31. The problem of integrating women into agricultural cooperatives is evident in that 90% of the women farmers are uncertain about the value of information from this source. Seventy percent of the women in Hwidiem are uncertain about the value of information from extension workers. These figures almost certainly indicate the exclusion of women from extension and cooperatives services. The value of information received by women in Adjamesu generally follows the same pattern.

32. The access of farmers to the extension service is rather limited in the survey region. Fifty-six percent of the farmers in the sample did not receive extension service visits during the survey year. The lack of extension service visits is more frequent among women than men farmers. In Hwidiem, 52% of the men farmers and 87% of the women farmers received no extension visits. In Adjamesu, 30% of the men and 51% of the women did not receive service visits.

33. A small but significant proportion of farmers has access to television programs concerned with agricultural development. Twenty-four percent of the farmers in Hwidiem and 35% of those in Adjamesu reported having seen at least one television program concerned with agricultural products. In Hwidiem 38% of the men and 10% of the women reported

seeing fertilizer information on television. The corresponding figures for Adjamesu are 43% and 30%, respectively.

34. The data clearly show that low soil fertility is perceived as the most important constraint to agricultural production in both villages, regardless of gender. This uniformly important constraint shows that the goals of the SFRP clearly address the most important constraint to agricultural production as perceived by farmers in the Ashanti region of Ghana.

35. Regardless of gender, the lack of rain and a combination of pests and diseases are perceived as the second and third most important constraints to agricultural production.

36. The major constraint to fertilizer use cited by both men and women is lack of knowledge, followed by high prices, lack of available supplies, and lack of money. Some women think that fertilizer changes the taste and texture of cassava and cite this as a constraint to fertilizer use.

Estimates of production functions for maize-cassava intercropping show the following:

37. Total productivity in Hwidiem was significantly higher than in Adjamesu. Thus, holding other factors constant, crop yields of the maize-cassava intercrop were significantly higher in Hwidiem than in Adjamesu.

38. The farmer's gender did not have a statistically significant effect on total crop productivity. Although men farmers have a higher level of productivity the difference was not statistically significant. Therefore, the hypothesis that men and women farmers have the same level of total productivity cannot be rejected.

39. The use of fertilizer had a positive effect on yields of maize/cassava; however, this effect was statistically significant mainly because of very limited fertilizer use among farmers (less than 4% in the subsample).

40. The level of education of farmers, measured by the number of years of schooling, had a positive impact on crop yields and total productivity, but the coefficients of this variable were not statistically significant. The lack of statistical significance may be due to the apparent correlation of this variable with the gender and labor use variables.

41. Coefficients of labor use variables in the linear models show that (a) although the average productivity of the labor of men (8.4 kg of maize per workday) is somewhat higher than the productivity of labor for women (5.9 kg of maize per workday), the difference is not statistically significantly and (b) the average productivities of men, women, or children are not significantly different, but rather equal to about 7-8 kg of maize per day of work. At the average price of maize (Cedis 45/kg), the value of this average (marginal) product is Cedis 360 per day, which is very close to the average wage rate paid in the region. This shows that farmers in the region use labor at levels that are consistent with the price environment.

The estimated elasticity of crop yields with respect to labor, 0.49, indicates the percent change in crop yields associated with a 1% change in the use of labor, i.e., on the average 10% increase in labor use resulted in about 5% increase in yields. The use of fertilizers should bring about an increase in the average productivity of labor but not necessarily in the magnitude of its elasticity.

42. The negative sign of the coefficient for the variable area cultivated per farm, although statistically significant in only one model, shows diseconomics of scale in crop production, i.e., that crop yields decrease as the area cultivated per farm increases. Such diseconomies may be associated with difficulties farmers have in managing several plots which are often located at considerable distances from each other.

Estimates of the function of farmers' income show the following:

43. Gross crop and household incomes of farmers in Hwidiem were significantly higher than in Adjamesu. Coefficients of the dummy 0-1 variable for village were statistically significant at 0.05 level of significance in all models.

44. Men have significantly higher levels of income than women farmers. Coefficients of the dummy 0-1 variable for gender of the farmer were statistically significant at the 0.10 level of significance in all models.

45. The use of fertilizer has a positive impact on farmers income. The coefficients of the dummy 0-1 variables for fertilizer use were positive but not statistically significant, probably as a result of the small number of farmers using fertilizer (about 4%).

46. The intensity of labor use (workdays/acre) of men, women, and children had a statistically significant impact on the levels of farmers' income. Parameter estimates show that on the average, a workday of a man, woman, and child per acre of cultivated land increased the annual income per farm by Cedis 912, 775, and 878, respectively. Differences among these estimates were not statistically significant.

47. Elasticity estimates of crop income and total household income with respect to intensity of labor use in crop production were 0.55 and 0.47, respectively. These estimates were statistically significant at 0.01 level of significance and show that on the average a 10% change in the intensity of labor use in crop production changed crop and total income by 5.5% and 4.7%, respectively.

48. Coefficients of the variable crop area per farm reflected the statistically significant impact of increased cultivated area on the levels of income per farm. The coefficients in the linear models show that, holding "constant" other variables included in the model about Cedis 50,000 of increment in annual income per farm was associated with an additional acre of cultivated land. The magnitude of these estimates should increase with the use of fertilizer.

Estimates of the labor use models for Hwidiem and Adjamesu show the following:

49. In both villages men farmers on the average use less labor per acre than women, however, differences were not statistically significant.

50. Fertilizer use had a positive impact on the use of labor per acre of cultivated land. This impact was statistically significant in Hwidiem but not in Adjamesu.

51. Off-farm employment by farmers had a positive effect on the intensity of labor use in crop production in Hwidiem but a negative one in Adjamesu. This is not surprising because off-farm employment as a source of income may increase the use of labor in crop production by providing financial means to hire farm labor (income effect), but also it may decrease the use of labor by diminishing the availability of family labor to work in the farm (substitution effect).

52. Education of farmers measured in terms of number of years of schooling had a positive and statistically significant effect on the intensity of labor use in Adjamesu. However, in Hwidiem the coefficients of this

variable were very small and not significant and were deleted from the models.

53. Coefficients estimating the effect of the variable area cultivated per farm on the intensity of labor use were statistically significant in all models. These effects, however, were positive in Hwidiem but negative in Adjamesu. These results are probably because of the smaller areas of cultivated land per farm in Hwidiem (average of 1.24 acres) than in Adjamesu (average of 1.96 acres). There is an apparent positive relationship between intensity of labor use and area cultivated when farms are small and include no more than one plot. This relationship becomes negative when farms are larger and have more than one plot. For large-scale farmers, negative relationships may be explained by the presence of constraints in family labor and by difficulties in the management of several plots of land.

The value of the information and results presented in this report will be substantially enhanced when compared with similar results that will be obtained on the basis of the 1989 farm survey to be conducted after fertilizers are extensively used by farmers in the experimental village.

Agroecological and Socioeconomic Surveys in 1989

New questionnaires are under preparation and involve a revision of the questionnaires used for the 1988 surveys.

Farm Budget Studies in 1989

These studies were initiated at the beginning of the 1989 cropping season. They are being conducted in a few carefully selected households for the most important cropping systems in the three pilot areas. The purpose is to prepare detailed budgets (Costs and returns) for maize/cassava in Ghana, millet/sorghum in Togo, and millet/cowpea in Niger.

The budget data will be used with data on the availability of farm resources (land, family labor, financial constraints, etc.) to develop whole farm budgets. Such budgets would provide insights into the impact of the SFRP

interventions on the use of farm resources and farmers' income. The schedules to record farm budget data in Ghana, Togo, and Niger are shown in Appendix 10a, b, and c.

On-Farm Trials in the Kumasi and Maradi Pilot Areas in 1988

The first year for the implementation of the SFRP was the cropping season of 1988. The SFRP activities in the pilot areas prompted farmers to get involved in activities of the project. Fertilizer demonstrations on relatively large plots showed farmers the potential of fertilizer treatments in anticipation of the large-scale applications of fertilizers in the experimental villages in 1989.

Appendix 11 is a draft report on the agronomic evaluation of the on-farm trials in Ghana and Niger. On-farm trials were conducted in five villages in the Kumasi pilot area of Ghana and in 4 villages in the Maradi pilot area of Niger. A total of 40 households participated in these trials. In Kumasi, all fertilizer treatments were superior to the check, and differences between treatments involving SSP were not significant. The 100 N 40 P_2O_5 30 K_2O kg/ha treatment as Urea + KCl + SSP was the most promising in terms of physical response. An average maize yield of 3271 kg/ha was obtained with this treatment as compared with the yield of 2,057 kg/ha from the control plot. In Maradi all fertilizer treatments were also superior to the check, but ground Tahoua phosphate rock + Urea was inferior to all treatments involving SSP. The most promising treatment in terms of grain and stalk yield was 45N 20 P_2O_5 kg/ha as Urea + SSP. An average grain yield of 1,172 kg/ha and stalk yield of 2,394 kg/ha was obtained with this treatment. The grain yield of the control plot was 588 kg/ha with a stalk yield of 1,383 kg/ha.

The trials were a useful demonstration to farmers in the pilot areas about the potential benefits of fertilizer use. The trial results with previous knowledge of crop response to fertilizers were useful in formulating the initial fertilizer options at the village level. Future OFT will evaluate higher analysis phosphate materials.

On-Farm Trials in 1989 in the Pilot Areas

There is an increasing interest by international donors to replace low-analysis fertilizers with higher analysis materials in sub-Saharan Africa. With reference to the Workplans (Appendix 5a, b, and c) researcher-managed trials in the control and experimental villages are being conducted, in each pilot area. The trials will evaluate the relative agronomic and economic effectiveness of single superphosphate, sulfur fortified triple superphosphate, triple superphosphate, diammonium phosphate, and mixtures of single superphosphate with triple superphosphate, in terms of direct and residual values. The economic benefits of the use of these higher analysis materials (reduction in transportation costs) will be evaluated vis-a-vis the sulfur problem in some agroecologies in West Africa. Several farmer-managed on-farm trials are being conducted in a few villages in each pilot area. These trials will help maintain the interest of farmers in the pilot area and have the following objectives:

- To complement results from the researcher-managed OFT.
- To determine variations in P source response and associate these variations to soil fertility.
- To determine variations in crop management practices and their relationships with fertilizer response.
- To upgrade the village level fertilizer options.

Ghana

- Twenty farmer-managed trials on maize/cassava were planted in April/May in Hwidiem, Adjamesu, and Anyinasuso.
- Four researcher-managed maize trials were planted in June at Hwidiem and Adjamesu.

Togo

- Twenty farmer-managed millet/sorghum trials were planted in June in Naki-Est and Kpembona.
- Four researcher-managed millet/sorghum trials were planted in June in Naki-Est, Kpembona.

Niger

Sites for eighteen farmer-managed trials in Tchizon, Maiguero, Zaboua, and for four researcher-managed millet/cowpea trials in Tchizon and Maiguero, have been planted.

Village-Wide Agronomic Studies in 1989 in the Experimental Villages

Farmers growing the major food cropping systems in each experimental village are eligible to receive fertilizers and are responsible for managing their own fields. The options being tested include the use of compounds and single nutrient fertilizers and indigenous materials such as ground Tahoua phosphate rock, SAB Togo PAPR 50, a material made through a low-cost processing of Togo phosphate rock, and also the use of indigenous animal manures. The options were based on results of the on-farm trials conducted in 1988 by the SFRP and previous results obtained by IFDC and other research in Niger, Togo, and Ghana.

Ghana

1. S. Opoku and staff members organized a field day in Adjamesu in April. Methods of fertilizer application were demonstrated to groups of farmers. The field day was covered by the Peoples' Daily Graphic, a Newspaper in Ghana.
2. Soil samples were collected from OFT plots and from plots receiving the fertilizer options. Field site characterization is underway.
3. About 200 farmers in the experimental village requested and received fertilizers for the fertilizer options and have completed the first application on the maize/cassava crop. Fertilizers sufficient for 1 ha/household were supplied. The workplan (Appendix 5a) shows details on the options.

Togo

1. Soil samples have been collected from plots receiving fertilizer options and from OFT plots. Field site characterization is underway.
2. Two hundred and ninety-nine households requested and received fertilizers for the options selected in this pilot area. The first

application for the sorghum/millet crop has been completed. Fertilizer quantities sufficient for 2.5 ha/farm were supplied. Appendix 5b shows details on the options, and Appendix 14 shows details on the distribution completed as of June 1989.

Niger

1. Soil samples have been collected from the plots receiving options and the OFT plots. Field site characterization is underway. Three hundred and thirty-eight farmers have received fertilizers (SSP) in quantities sufficient for 3 ha/farmer.

Selection of an Irrigated Site for Implementation of SFRP

A fourth pilot area for the implementation of the SFRP on irrigated land is being selected. It is generally recognized that the benefits of irrigation cannot be fully realized without the use of fertilizers. Recently researchers and development workers have given attention to the technical, economic, and social problems that have appeared in many irrigation projects in West Africa. Since October 1988 the SFRP team has been searching for a suitable irrigated area. For this purpose visits were made to Benin, Togo, and Ghana. However, a site has not yet been selected.

Training of Collaborating National Staff

1. As stated earlier, meetings to prepare workplans with the national coordinators were held between December 1988 and January 1989. These meetings provided opportunities to work closely with national counterparts in fertilizer options, and socioeconomic studies.
2. Six training workshops, two in each country (one before planting and one before harvesting) are planned (see Appendix 4). The training workshops before planting were held as follows:

Ghana - March 8-10
Togo - April 12-14
Niger - May 2-4

The objective was to guide the field staff in the execution of the agro-socio-economic studies. The number of participants in the workshops held at Ghana, Togo, and Niger were 20, 24, and 25, respectively. Appendix 12a, b, and c are the lists of participants.

3. The national coordinators and their key assistants attended an IFDC training program on statistical and economic analysis of fertilizer experimental data held in Lomé from April 17-28, 1989.

Operating Problems

1. Mr. E. Melebou, National Coordinator of Togo, was promoted by the Government of Togo to the post of Prefect (District Officer). Concerning the schedule of field activities for 1989 (Appendix 4), it is clear that this created a problem. Besides the need for a National Coordinator to supervise the technical aspects of the fieldwork, it should be understood that a project involving whole villages can have political repercussions, which a National Coordinator can handle.
2. In the Kumasi area, there can be very early rains (February). Some farmers take the risk and plant. Others wait for the start of the more sustained rains in March/April. After the February rain of 1989 there has been only sporadic rain. Thus the steady rain has been delayed. In Togo on the other hand, the first rains came about 3-4 weeks earlier than anticipated.
3. A four-wheel-drive vehicle and four motorbikes purchased in 1988 for field activities in the Maradi pilot area were still with Customs at Niamey at the start of the growing season of 1989.

Project Monitoring

1. Special and more costly than expected arrangements had to be made for the acquisition of fertilizers for Ghana.
2. In the case of the earlier than expected rains, workplans had to be adjusted to advance the dates for soil sampling, weighing, and distribution of fertilizer. The vagaries of weather in West Africa require that fertilizers be delivered to the experimental villages at the earliest possible date.
3. The SFRP unit based at Lomé was obliged to carry out the duties of the National Coordinator in the pilot area in Northern Togo. A replacement has not yet been appointed.
4. Project staff made several visits to the pilot areas to ensure that activities were going according to schedule and to work closely with our collaborators. Appendix 13 shows a list of 24 field trips made by staff from Lomé and Muscle Shoals, the purpose of each trip, and the personnel involved.

Plans for 1990

1. The agro-socio-economic studies involving the major food crops included in the fertilizer options of 1989 will continue in 1990. However, in 1990, it will be possible for farmers to use fertilizers on other crops.
2. The National Coordinators and the emergent farmer associations will make efforts to strengthen the operations of the fertilizer revolving funds and improve crop and fertilizer storage facilities.
3. The reports of agro-socio-economic surveys initiated in 1989 will be completed.
4. Field work is expected to begin on an irrigated site.
5. In-country training of national counterparts will continue.
6. Consideration of baseline surveys of a second set of experimental and control villages.

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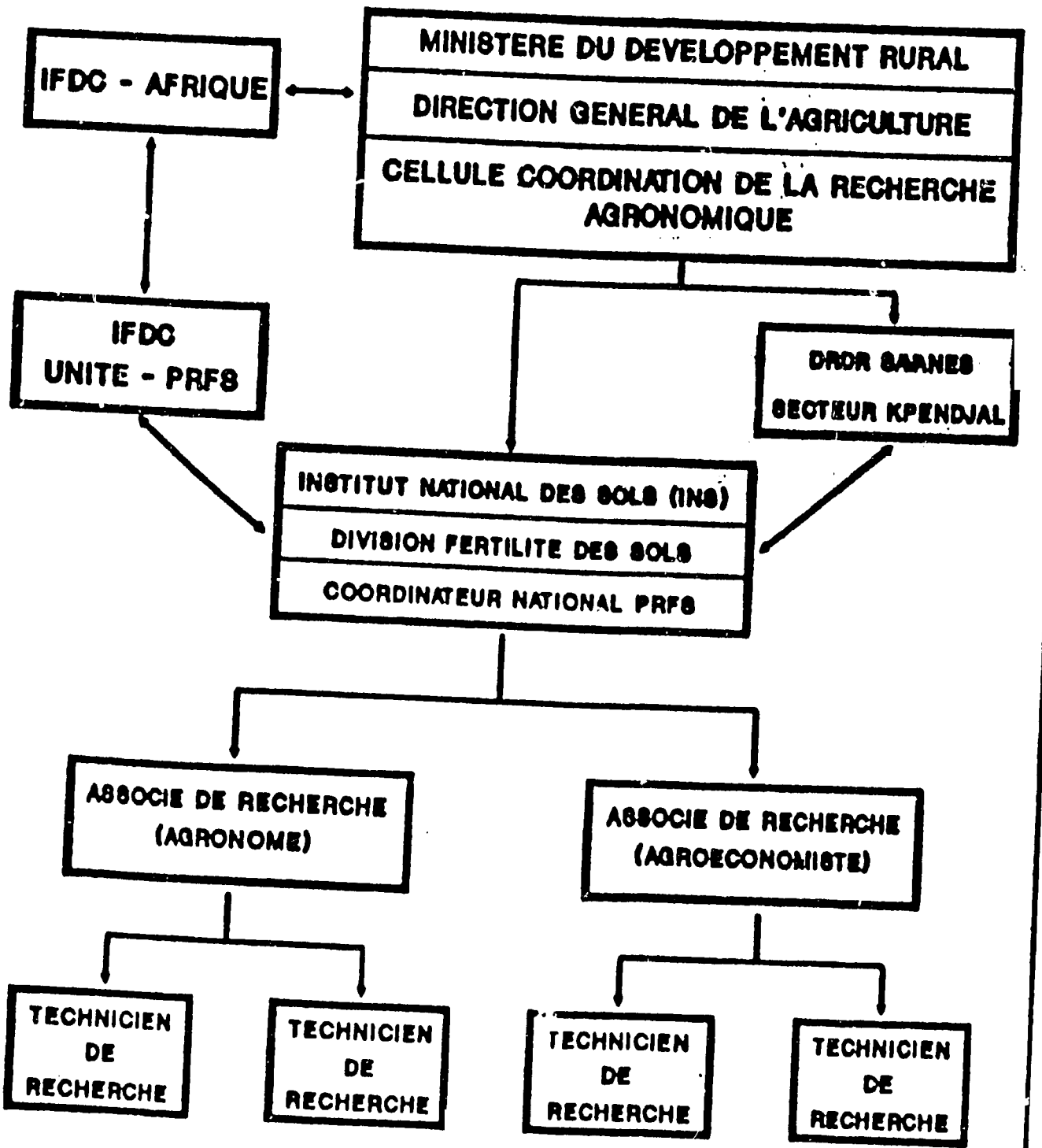
Appendix 1

SOIL FERTILITY RESTORATION PROJECT
- TOGO -

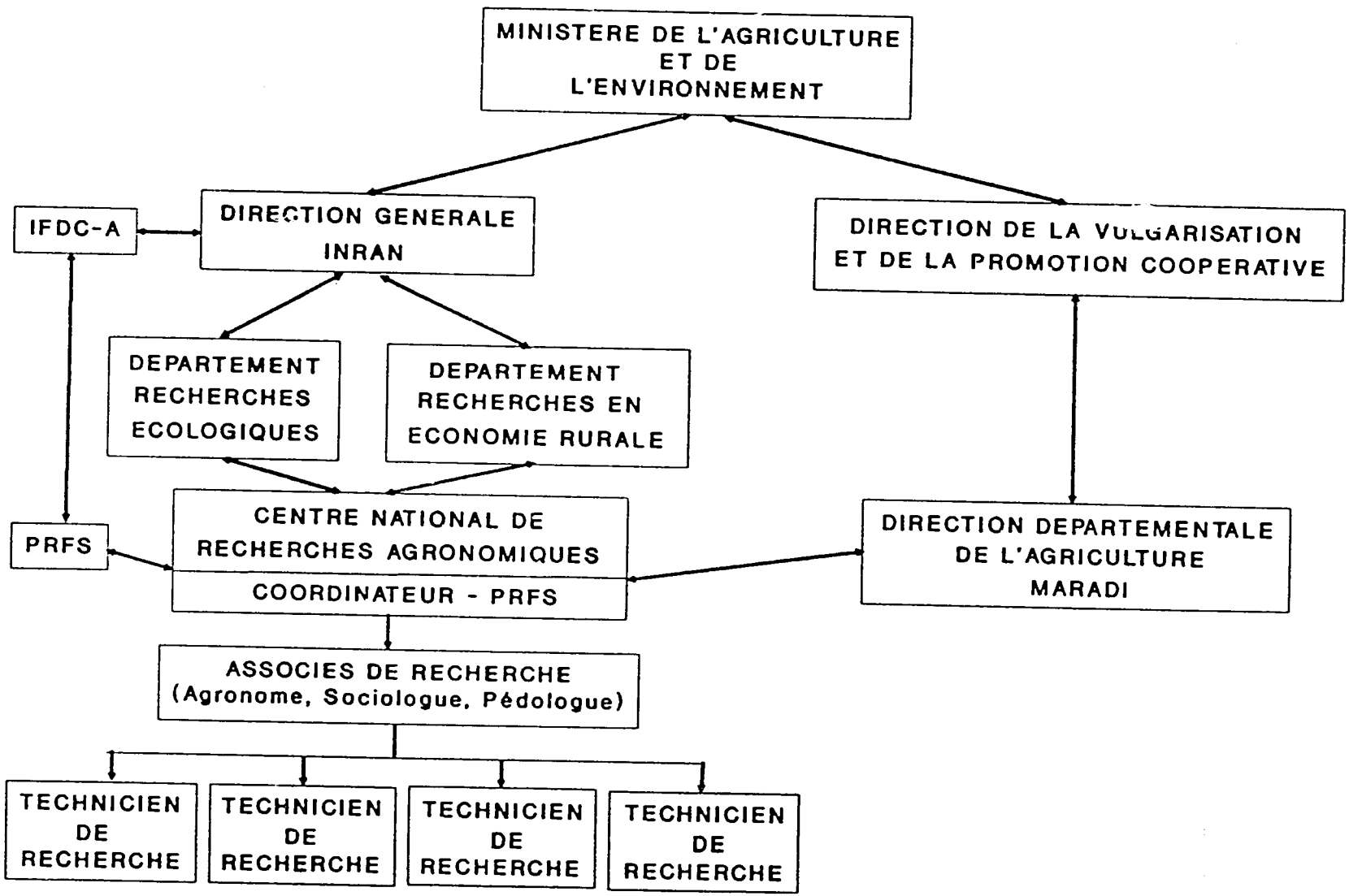
ORGANIGRAMME



Appendix 2

SOIL FERTILITY RESTORATION PROJECT - NIGER

ORGANIGRAMME



Appendix 3- SCHEDULE OF WORK FOR THE SOIL RESTORATION PROJECT IN GHANA, TOGO, AND NIGER

November 1987 - October 1988 - Year 1

Activity	Time Period											
	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
Exploratory Surveys												
Ghana (complete)												
Togo												
Niger												
Farm Trials												
Ghana												
Togo (none)												
Niger												
Reports on Exploratory Surveys												
Ghana												
Togo												
Niger												
Verification Surveys Baseline												
Ghana												
Togo												
Niger												
Data Processing and Analysis												
Report Writing												
Work Plan - Workshop												
In Country Training												

Appendix 4

SCHEDULE OF WORK FOR THE SOIL RESTORATION PROJECT IN GHANA, TOGO, AND NIGER
November 1988 - October 1989 - Year 2

Activity	Time Period											
	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
Exploratory Surveys												
Ghana (complete)												
Togo (complete)												
Niger (complete)												
Farm Trials (OFT & Village Scale Fertilization)												
Ghana												
Togo												
Niger												
Reports on Exploratory Surveys												
Ghana (complete)												
Togo (complete)												
Niger (complete)												
Verification Surveys												
Ghana (complete)												
Togo (complete)												
Niger (complete)												
Reports on Baseline Verification Surveys and OFT												
Ghana												
Togo												
Niger												
Agro & Socioeconomic Monitoring & Evaluation												
Ghana												
Togo												
Niger												
Identification & Exploratory Surveys of Irrigation Projects												
In-Country Appraisal of Crop Storage Facilities, Farmer Work Groups and Credit Schemes												
Data Processing and Analysis												
Report Writing												
Training + Workshops												

Appendix 5(a)

Work Plan of the Fertilizer Investment for Soil Fertility Restoration Project (SFRP) 1988/1989

1.0 Work Plan Ghana

Following the acceptance of an outline work plan for 1988/89 by the IFDC/APF/IMPHOS Steering Committee in August, 1988, Mr. S. Opoku the In-Country Coordinator met with E. Rhodes, K. Acheampong and D. Pouzet of the SFRP unit in Lomé from 4th to 11th November and worked out the details of the plan of work. The document consists of a descriptive summary of key activities to be undertaken.

1.1 Fertilizer Investment Options in the Experimental village

Adjamesu and Hwidiem were identified in 1988 as the first experimental and control villages respectively on the basis of the exploratory surveys conducted within a 40 km radius of Kumasi.

The system of cultivation in the pilot area, is about 2-3 years cropping period followed by 4-5 years of bush fallow. Maize-based cropping systems will be fertilized (at the village level).

The economics of the following investment options will be compared in the experimental village (Adjamesu). The control village (Hwidiem) will not receive any fertilizers options.

Option 1 15:15:15 at 40 kg N | P_2O_5 | K_2O | ha
+ Urea at 40 kgN | ha

This is based on the National Extension Services recommendationof balanced N. P. K. using compound 15:15:15 supplemented with Urea. However the initial investment is about 2 times the locally recommended dose of P_2O_5. The underlying principle of P fertilization in this and other is to gradually restore the level of soil P by 2 annual moderate doses of application.

Option 2	Togo PAPR 50	40 kg P_2O_5 |ha
	Urea	80 kg N|ha
	Kcl	40 kg K_2O |ha

This option is also based on a balanced application of N, P and K but a material obtained from low cost processing of raw materials indigenous to West Africa (Partially acidulated Togo PAPR 50) is used to supply P.

Option 3	SSP	40kg P_2O_5 | ha
	Urea	80 kg N | ha

Here the emphasis is on the use of commercially available fertilizers, to correct initially the 2 most critical macronutrient deficiencies in the pilot area. SSP is being used initially to supply the P. Depending on the out come of the On-farm trials on P sources, high analysis P fertilizers easily available on world markets may be used in subsequent years or in new experimental villages in the pilot area.

Internal check plots

Within the experimental villages there will be the following internal check plots each of size 50 m² to 100 m²

Check 1. No fertilizer

Check 2. 45:19:19 kg N| P_2O_5| K_2O per hectare formulated with 15:15:15 plus sulphate of ammonia. (this is the standard National Extension fertilizer recommendation for the pilot area)

1.1.1 Distribution of Investment Options in the Experimental Village

Treatments 1 to 3 will be randomized among households with each household receiving one option. Maximum acreage per household will be 11 ha. The idea is to find initially, the treatment which averaged across households in the village as a whole is best.

To avoid the practical problem of farmer discontent at being assigned a check treatment for his entire farm in a situation where a neighbouring household may have a superior treatment, each household will have the 2 small check plots.

1.1.2 Agronomic Monitoring and Evaluation in the Control and Experimental Villages

The following will be assessed in a sample of farms, (a) relatively close to dwellings and (b) relatively far from dwellings:

- Cropping patterns, fallow length, cropping period crop variety use.
- Crop performance

- Types of land cleared (slope, depth, soil association or family, soil chemical and physical properties)

Notes Economic analysis will be done on the appropriate agronomic data.

1.2 On Farm Trials

These trials will over time help to upgrade the treatment options being tested in the first experimental village for use in the pilot area. A total of 4 researcher managed trials, 2 in Adjamesu and 2 in Hwidiem are planned. Twenty farmer/researcher managed trials (5 in each of 4 villages in the pilot area) are planned. The exploratory survey indicated that P is the most limiting essential nutrient in the pilot area. The trials will compare P sources, and the test crop will be maize.

Researcher managed trials

TSP/SSP	0,30	60	90 kg P_2O_5/ha
SSP	0, 30	60	90 kg P_2O_5/ha
DAP	0, 30	60	90 kg P_2O_5/ha
TSP	0, 30	60	90 kg P_2O_5/ha
TSP-S	0, 30	60	90 kg P_2O_5/ha
TOGO PAPR 50	0, 30	60	90 kg P_2O_5/ha

2 replications per site. Main plots are P sources.

Farmer/Researcher managed trials

SSP	40	40	80 kg P_2O_5/ha
TSP	40		
TSP-S	40		
Togo PAPR 50	40		

1 Farmers check
1 P check (N & K no P)

Randomized complete block, single replication per site.

1.2.1 Agronomic Monitoring and Evaluation of OFT

Data will be collected on soil conditions and crop performance for each treatment. Economic analysis will be done on relevant agronomic data.

1.3 Environmental Monitoring of Fertilizer Use

A researcher managed trial at Adjamesu will be used to obtain approximations of Nitrogen and Phosphores budgeets in the soil/plant system. Water samples will also be collected from streams draining the area and analysed.

1.4 Identification and Evaluation of Irrigation Projects in West Africa

The SFRP has been implemented in rainfed farming systems in Ghana, Togo and Niger. The project paper requires that the project be also implemented in irrigated lands in a savanna ecology. A few irrigation projects in West Africa will be evaluated with a view of identifying a project where soil fertility is a constraint and which has the potential of being socio-economically viable. The following criteria will be used in the evaluation at the exploratory level.

- Ecology
- History
- Objectives
- Management, staffing and farmer involvement
- Cropping systems - crop varieties, time of planting, time of harvesting, herbicide use, insecticide use, fertilizer use, yields etc
- Soil analytical data, soil type
- Acreage under present cropping and potential acreage
- Irrigation system
- Socio-economic viability.

The first year's field activities in the selected project may consist of On Farm Trials and detailed socio-economic base line studies.

1.5 Collection and Analysis of Socioeconomic Data

The main objective of the series of planned surveys is to put together a broad range of socioeconomic data to serve as a basis for (a) the effective monitoring and evaluation of overall project performance and (b) the development of simulation models for possible replication elsewhere in the subregion. Two categories of surveys each using the farm family/household as the unit of analysis will be conducted; namely: (a) general socioeconomic and attitudinal survey, and (b) preparation of farm budgets.

(a) General socioeconomic and attitudinal survey

(i) Purpose: To build on the preparation of individual farm family's socioeconomic and attitudinal profile initiated in the previous year to facilitate future qualitative and quantitative assessment of project impacts on the participating farmers in particular and the communities in general. Items to be covered include individual sociodemographic characteristics, resource availabilities, constraints and possible development opportunities, attitudes and perceptions about fertilizer use etc.

(ii) Methodology: In general, the approach will be longitudinal, involving the same panel of 120 heads of households (60 each from the experimental and control villages) interviewed in 1988. Where necessary, however, additional respondents will be brought in to make up for possible sample attrition.

As part of the preparations towards the planned surveys and subsequent data analysis, questionnaires will be prepared and pretested after which interviewers will be recruited and given a short training in interviewing techniques and procedures.

(b) Preparation of farm budgets:

(i) Purpose: To prepare detailed budgets (costs and returns) for the most important crops/cropping systems in the experimental village. Then, use them in conjunction with the availability of farm resources to develop whole-farm budgets. Such whole-farm budgets should provide important insights about the direct and indirect impacts of SFRP intervention. This normative approach is to complement the results of the socioeconomic surveys and also to provide the basis for the development of planned simulation models.

(ii) Methodology: The study will involve a sub-sample of farm families (households) from the experimental and the control villages. It will also involve the preparation of appropriate forms to collect data through periodic interviews during the entire cropping season.

Data on both endogenous and exogenous factors pertinent to the farming operation will be collected. The former shall include resource availability type and cost of labor, crop yields, harvest disposal etc. while rainfall distribution and intensity, incidence of pests and diseases, farmers access to institutionalized credit and markets etc. will come under the latter. The data will be subjected to vigorous computer analysis to evaluate the potential impact of relaxing some of the constraints to be identified.

1.6 Training/Workshop for Counterpart Staff

i)Purpose: To strengthen the capability of counterpart staff to implement and monitor the pilot projects through the collection, analysis and interpretation of relevant agronomic and socioeconomic data.
Consequently, two formal training sessions, each lasting about three days are planned - the first session is to be held just before planting and the second during the harvest. Among other things both sessions will cover principles and techniques of collecting and handling agronomic and socioeconomic data.

In addition, counterpart staff will be actively involved in the field work throughout the growing season particularly in monitoring the OFTs and the conduct of socioeconomic surveys.

1.7 Appraisal and Development of Local Institutional Services and other Support Network

i) Purpose: To identify and strengthen local associations/work groups as a first step towards the formation of viable cooperatives and other support groups.

Cognizant of the labor demand associated with fertilizer use and the wide variation in food prices between the time of harvest and the lean season, two major activities will be initiated to assist farmers to reap maximum benefits from their efforts.

a. Formation/strengthening of local associations

The in-country coordinator will provide the initiative in identifying local leadership for the formation of labor pools to counteract possible labor bottlenecks particularly during the mass application of fertilizers. Where such associations exist effort will be made to identify and relax existing constraints to make them socially and economically productive.

b. Improvement of storage facilities

Again, the coordinator will provide the leadership in evaluating current storage systems with the view to identifying their merits and demerits as well as suggestions for improvements. The ultimate objective here is to help develop systems that can store reasonable quantities of grain long enough for farmers to cash in on the high off-season food prices.

Establishment of Fertilizer Revolving Fund

The In country coordinator will work out with farmers o, Adjamesu a scheme of repayment of a portion of the costs of fertilizers supplied in 1989, into a revolving fund. Cash will be obtained from sale of produce harvested in 1989. The proportion of repayment of fertilizer costs will increase to the point where the full of costs of fertilizers is met annually from a revolving fund.

Appendix 5(b)

2.0 WORK PLAN TOGO

Mr. E. Melebou the In-Country Coordinator met with E. Rhodes, D. Pouzet and K. Acheampong of the SFRP unit from 30th November to 1st December and worked out the detailed plan for 1989, as follows:

2.1 Fertilizer Investment Options in the Experimental Village

Naki-Est and Kpembona were identified in 1988 as the first experimental and first control villagers on the basis of Exploretary survey conducted within a 40 km radius of Dapaong. Naki-Est will therefore receive fertilizers in 1989.

Continuous cropping with no fallows is generally practised in the pilot area. Millet/Sorghum based cropping systems will be fertilized. The economics of the following investment options will be compared in the first experimetal village. Kpembona will not receive fertilizer options.

Option 1. 15:15:15 at 35 Kg N/P_2O_5/K_2O per ha + Urea at 25 kg N/ha. This is based on the DRDR Savanne Extension Service balanced N.P.K recommendation However the P investment involved is 1.5 times more than the usual recommendation. Soil P fertility is restored in 2 annual applications.

Option 2. Togo PAPR 50 at 35Kg P_2O_5/ha

+ Urea at 60KgN/ha

This option utilizes a material obtained from low cost processing of Togo PR. Partially acidulated Togo Phosphate rock is used as the P source. Soil P fertility is restored in 2 annual applications.

Option 3. SSP at 35 Kg P_2O_5/ha
Urea at 60 kg N/ha

Emphasis here is on the use of commercial materials to correct initially the 2 most critical macro nutrient deficiencies in the pilot area. Two annual applications of P are used to restore gradually the soil P status.

Option 4. SSP at 70 Kg P_2O_5/ha
Urea at 60 Kg N/ha

This option differs from 3 in that a single relatively large dose fertilization is used to restore the P fertility of the soil.

Option 5. SSP at 35 Kg P_2O_5/ha
+ Manure at 5 t/ha

This emphasizes the use of locally available manure supplemented with a commercial material.

Internal Check Plots

Within the experimental village there will be the following internal check plots each of size 50 m² to 100 m².

Check 1 No fertilizer
Check 2 15:15:15: at 23 Kg N/P_2O_5/K_2O/ha
Urea at 23 Kg KgN/ha (This is the local DRDR extension recommendation).

2.1.1 Distribution of Investment Options in the Experimental Village

Option	Number of Households	Maximum area to be fertilized per Household (ha)
1	77	2.5
2	77	2.5
3	77	2.5
4	77	2.5
5	308	0.1-0.3

Treatment 1 to 4 will be randomized among households with each household receiving one option. The objective being to find as a first step the treatment which averaged across households in the village as a whole is best. Each household will receive option 5 plus the 2 small internal check plots.

2.1.2 Agronomic Monitoring and Evaluation in the Control and Experimental Villages

The following will be assessed in a sample of farms, (a) relatively close to dwellings and (b) relatively far from dwellings:

- Cropping patterns, fallow length, cropping period, crop variety use
- Crop performance
- Types of land cleared (slope, depth, soil association or family, soil chemical and physical properties)

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2.2 On Farm Trials

These will over time, help to upgrade the treatment options being tested in the 1st experimental village for use in the pilot area. A total of 4 researcher managed trials in Naki-Est and Kpembona are planned. Farmer/Researcher managed trials in 4 villages will also be conducted. P is very limiting in the pilot area. The trials will evaluate P sources, on sorghum.

Researcher Managed Trials

SSP	0, 25, 50, 75 Kg P_2O_5/ha
DAP	0, 25, 50, 75
TSP	0, 25, 50, 75
TSP-S	0, 25, 50, 75
Togo PAPR 50	0, 25, 50, 75
SSP/TSP	0, 25, 50, 75

Split plot, 2 replication per site, main plots are P sources.

Farmer/Researcher managed Trials

SSP	15, 30, 60, kg P_2O_5/ha
TSP	30
TSP-S	30
Togo PAPR 50	30
1	Farmers check
1	P check (N, K, no P)

Randomized complete Block, single replicate per site.

2.2.1 Agronomic Monitoring and Evaluation of OFT

Data will be collected on soil conditions and crop performance for each treatment. Economic analysis will be done on the relevant agronomic data.

2.3 Environmental Monitoring of Fertilizer Use

Same as for Ghana.

Note: Collection and analysis of socio-economic data, Training/workshop for counterpart staff, Appraisal and development of local institutional services and other support network, Establishment of fertilizer Revolving Fund are as described for Ghana.

ER/am

Appendix 5(c)

3.0 Work Plan Niger

Messrs. M. Gaoh and M. Kadi the In Country Coordinator and economist respectively, met with E. Rhodes, D. Pouzet and K. Acheampong of the SFRP unit from 6th to 12th January and worked out the detailed plan for 1989 as follows :

3.1 Fertilizer Investment Options in the experimental village

Tchizon-Kouregue and Maiguero were identified in 1988 as the first experimental and control villages on the basis of the exploratory survey conducted within a 40 km radius of Maradi town. Continuous cropping is practised in the pilot area. Millet based cropping systems will be fertilized in Tchizon-Kouregue. The economics of the following investment options will be compared.

Option 1 SSP at 30 kg P_2O_5/ha + Urea at 45 kg N/ha. This is INRAN's recommendation to farmers, to correct the 2 most critical macro nutrient deficiencies. Soil P fertility is restored in 2 annual applications.

Option 2 SSP at 60 kg P_2O_5/ha + Urea at 45 kg N/ha. In this option a single relatively large dose fertilization is used to restore the basic P fertility of the soil.

Option 3 Tahoua phosphate rock at 45 kg P_2O_5/ha + SSP at 15 kg P_2O_5/ha + Urea at 45 kg N/ha. The underlying principle is similar to option 2. However locally available ground Niger phosphate rock + a small quantity of "starter" SSP are used as carriers of P. Soil P fertility is restored in 1 application.

Option 4 SSP at 30 kg P_2O_5/ha + manure at 5t/ha. This emphasizes the use of locally available manure supplemented with commercial material. Soil P fertility is restored in 2 annual applications.

Internal check plots

There will be internal check plots of size 50-100 m² within the experimental village. The check plots will not be fertilized.

3.1.1 Distribution of Investment Options and Checks in the Experimental Village

Option	Number of Households	Maximum Area to be fertilized per household
1	169	3 ha
2	169	3 ha
3	338	0.2 ha
4	338	0.1 - 0.3 ha
check	338	50 - 100 m²

Options 1 and 2 will be randomized among households such that 50 % of households receive option 1 and 50 % option 2. Each household will receive option 3, 4 and the internal check.

3.1.2 Agronomic Monitoring and Evaluation in the Control and Experimental Villages

The following will be assessed in a sample of farmers (a) relatively close to dwellings and (b) relatively far from dwellings :

- Cropping patterns, fallow length, cropping period, crop variety use
- Crop performance
- Types of land cleared (slope, depth, soil association or family, soil chemical and physical properties)

3.2 On Farm Trials

These will over time, help to upgrade the treatment options being tested in the 1st experimental village for use in the pilot area. A total of 4 researcher managed trials in Tchizon and Maiguero are planned. 18 Farmer/Researcher managed trials in 3 villages will also be conducted. P is very limiting in the pilot area. The trials will evaluate P sources, on millet.

Researcher Managed Trials

SSP	0, 20, 40, 60 kg P_2O_5/ha
DAP	0, 20, 40, 60
TSP	0, 20, 40, 60
TSP-S	0, 20, 40, 60
Tahoua PR	0, 20, 40, 60

Split plot : main plots are P sources, 2 replication per site.

Farmer/Researcher managed Trials

SSP	15, 30, 60 kg P_2O_5/ha
TSP	30
TSP-S	30
Tahoua PR	30

1 Farmers check

1 P check (N, K, no P)

Randomized complete Block, single replicate per site.

3. 2. 1. Agronomic Monitoring and Evaluation of OFT

Data will be collected on soil conditions and crop performance for each treatment. Economic analysis will be done on the relevant agronomic data.

3.3 Environmental Monitoring of Fertilizer Use

Same as for Togo.

Note: Collection and analysis of socio-economic data, Training/workshop for counterpart staff, Appraisal and development of local institutional services and other support network, Establishment of fertilizer Revolving Fund are as described for Ghana.

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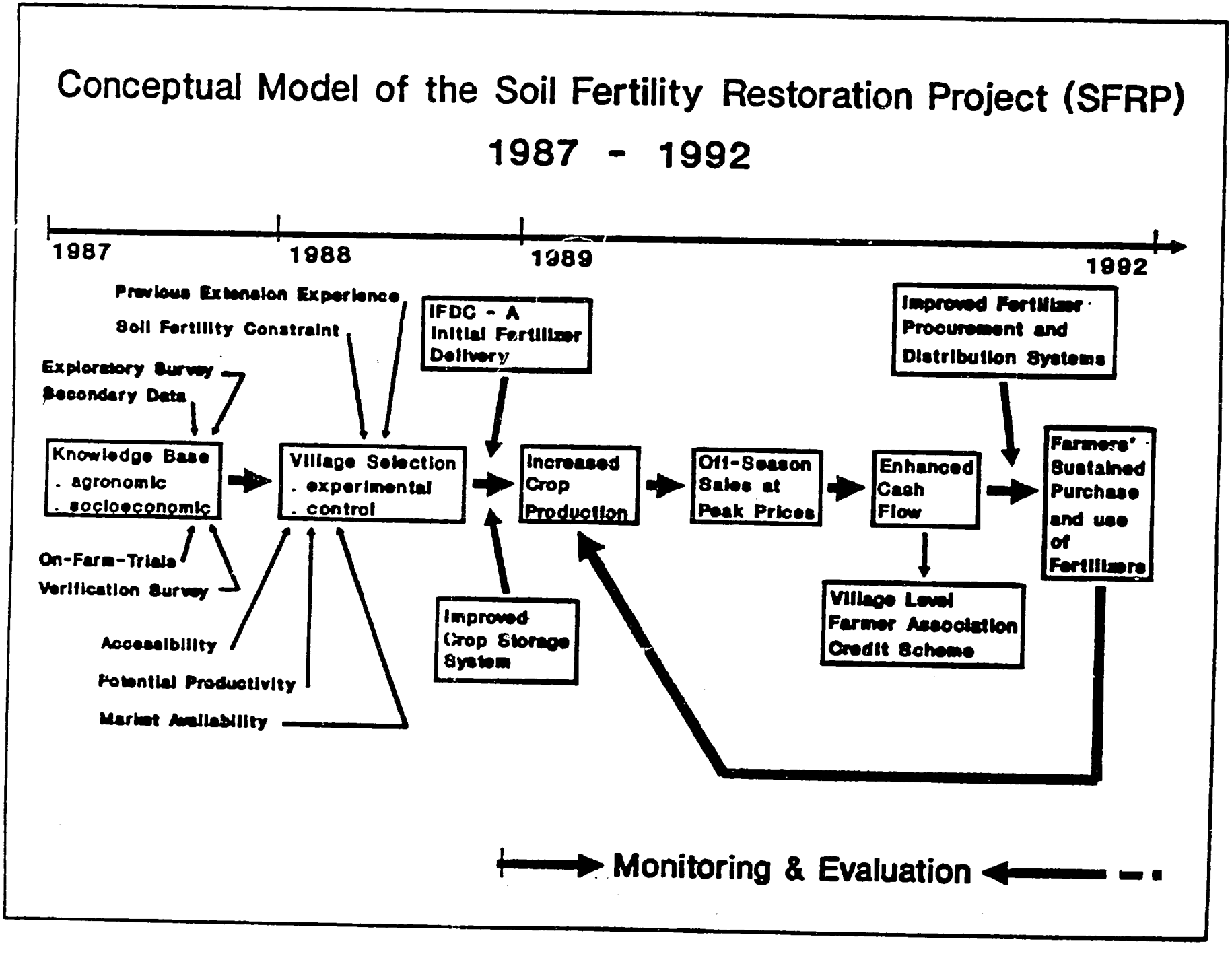
Conceptual Model of the Soil Fertility Restoration Project (SFRP)
1987 - 1992
1987
1988
1989
1992
Previous Extension Experience
Soil Fertility Constraint
Exploratory Survey
Secondary Data
Knowledge Base
. agronomic
. socioeconomic
On-Farm-Trials
Verification Survey
Accessibility
Potential Productivity
Market Availability
Village Selection
. experimental
. control
IFDC - A
Initial Fertilizer
Delivery
Improved
Crop Storage
System
Increased
Crop
Production
Off-Season
Sales at
Peak Prices
Enhanced
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Farmer Association
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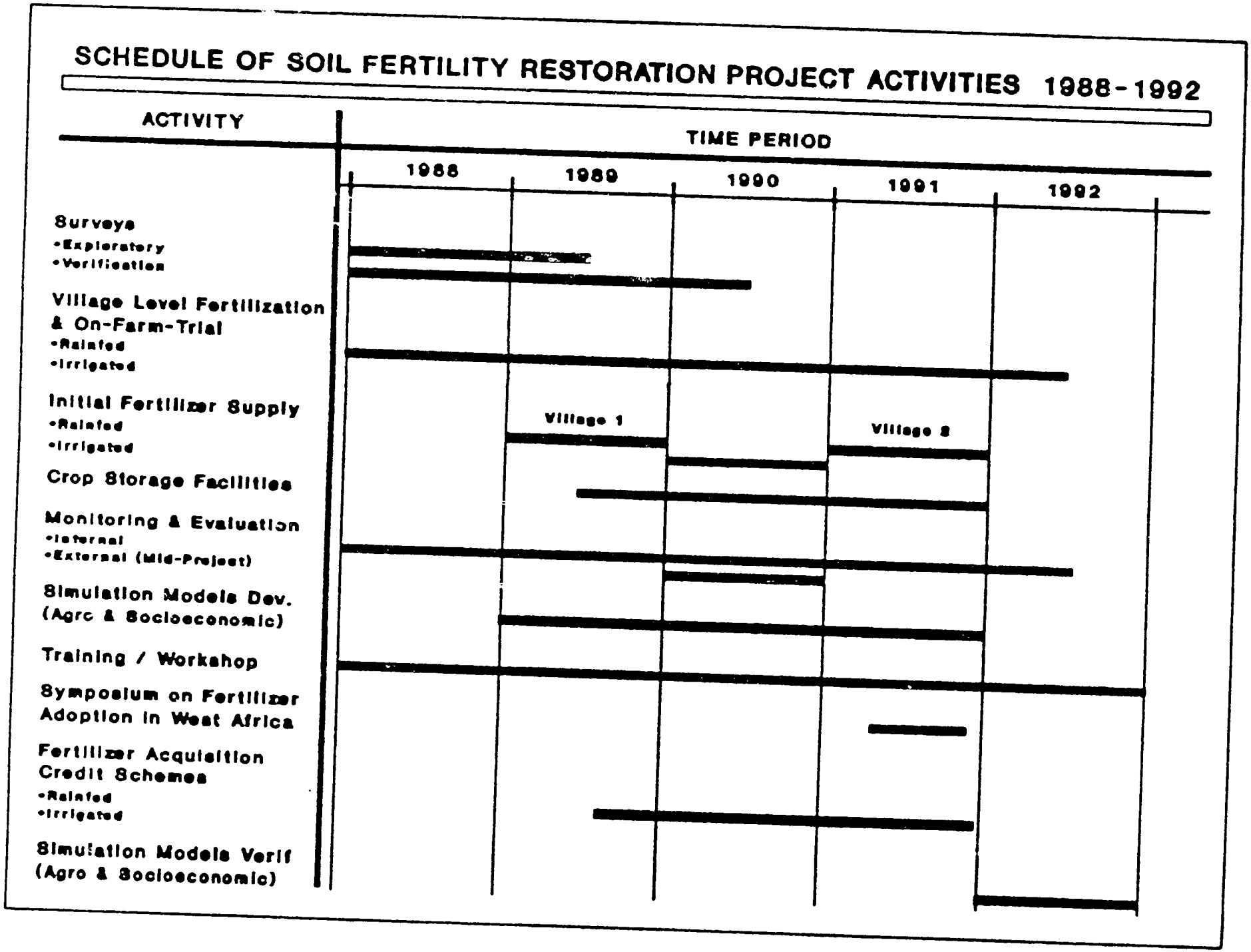
Improved Fertilizer
Procurement and
Distribution Systems
Farmers'
Sustained
Purchase
and use
of
Fertilizers
Monitoring & Evaluation

Appendix 7


SCHEDULE OF SOIL FERTILITY RESTORATION PROJECT ACTIVITIES 1988-1992
ACTIVITY
TIME PERIOD
1988
1989
1990
1991
1992
Surveys
•Exploratory
•Verification
Village Level Fertilization & On-Farm-Trial
•Rainfed
•Irrigated
Initial Fertilizer Supply
•Rainfed
•Irrigated
Village 1
Village 2
Crop Storage Facilities
Monitoring & Evaluation
•Internal
•External (Mid-Project)
Simulation Models Dev. (Agro & Socioeconomic)
Training / Workshop
Symposium on Fertilizer Adoption in West Africa
Fertilizer Acquisition Credit Schemes
•Rainfed
•Irrigated
Simulation Models Verif (Agro & Socioeconomic)

APPENDIX 7. LIST OF FIELD TRIPS AND CONSULTANCIES

DATE	DESTINATION/PURPOSE	PERSONNEL
1-3 Aug.	- Kumasi, Ghana. To participate in field day and visit the Dahwenya irrigation Project.	E. Rhodes
1-13 Aug	- Kumasi, Ghana. To participate in field day and supervise the verification survey.	K. Acheampong
25 Aug-3 Sep	- Niamey, Niger. To make arrangements for, and participate in Steering Committee Meeting.	E. Rhodes
28 - 3 Sept.	- Niamey, Niger to participate in Steering Committee Meeting	A. U. Mokwunye and K. Acheampong
28 - 1 Sept	- Niamey, Niger to participate in Steering Committee Meeting	P. L. G. Vlek
8 - 15 Sept.	- Dapaong, Togo. To train, determine sampling frame and supervise the conduct of the verification survey	K. Acheampong
12 Sept. - 4 Oct.	- Dapaong, Togo. To assist in conduct of the verification survey.	K. Alognikou and A. Sakiti
Aug. 12 - 21 Sept.	- Lom, Togo ; Niamey, Niger ; Maradi, Niger. To supervise the conduct of the verification survey	T. Thompson
4 - 18 Nov.	- Lom, Togo. To supervise the coding of the data obtained from the verification surveys.	C. Baanante and T. Thompson

13 Nov. - 10 Dec.	- To assist in designing of OFT for 1989 and do the statistical analysis of OFT for Ghana.	J. Henao
21á22 Dec 88	- Zio Prefecture. To evaluate CARE/APP Irrigation Project.	D. Pouzet and K. Acheampong

DATE	DESTINATION/PURPOSE	PERSONNEL
16-18 Feb 89	- Accra/Kumasi (Ghana). To evaluate Dahwenya irrigation project and collect background information for the design of the farm budget studies.	K. Acheampong D. Pouzet and C. Baanante
07-11 Mar 89	- Accra/Kumasi (Ghana). To evaluate Dahwenya irrigation project, to train field staff and launch 1989 field programs.	E. Rhodes D. Pouzet K. Acheampong
31 March	- Deve/Lokossa (Benin). To evaluate irrigation project site in Mono region.	E. Rhodes D. Pouzet K. Acheampong
11-15 April	- Dapaong/Naki-Est (Togo). To train field staff, to launch 1989 field programs.	E. Rhodes K. Acheampong, D. Pouzet
30 April to 6 May	- Niamey/Maradi (Niger). To train field staff, to launch 1989 field programs.	E. Rhodes K. Acheampong, D. Pouzet
17 May to 2 June	- Dapaong/Naki-Est (Togo). To collect soil samples, delineate parcels of lands, distribute fertilizer options.	K. Alognikou and A. Sakiti
23-27 May	- Dapaong/Naki-Est (Togo). To monitor progress in implementation of field programs and supervise distribution of fertilizer options.	K. Acheampong D. Pouzet A. N'Danou

23 May to 2 June	- Dapaong/Naki-Est (Togo). To monitor progress in implementation of field programs and supervise distribution of fertilizer options.	K. Acheampong A. N'Danou
24-26 May	- Accra/Kumasi (Ghana). To assist in planning of film on SFRP and to inspect field work.	E. Rhodes M. Connolly
1st June	- Accra (Ghana). To discuss problems in the implementation of the SFRP with Director Crops Services, Ministry of Agriculture.	E. Rhodes
7 - 9 June	- Accra/Kumasi (Ghana). To monitor fertilizer distribution and make a few changes on the instruments for the collection of data for the farm budget studies.	K. Acheampong & D. Pouzet
10 - 20 June	- Dapaong /Naki Est (Togo). To assist in planting/fertilizing of researcher managed trials and to oversee fertilizer application at the village scale.	A. Alognikou and A. Sakiti.
18 - 24 June	- Niamey/Maradi (Niger) to monitor field activities.	D. Pouzet
10-13 July	- Dapaong/Naki Est (Togo) to check the farm budget survey, prepare subplots for yield evaluation, organize collection of data on food prices and utilization of crop residues.	D. Pouzet

Appendix 8

DRAFT

AN EXPLORATORY SURVEY

OF THE

SOIL FERTILITY RESTORATION PROJECT PILOT AREA IN THE SAVANES REGION OF TOGO

By

E. R. Rhodes
K. Acheampong

And

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SFRP TECHNICAL REPORT NO. 2

February, 1989

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ACKNOWLEDGEMENTS

The reviews and comments on the initial draft provided by our colleagues at Lomé and Muscle Shoals are gratefully acknowledged. We are especially indebted to Dr. C. A. Baanante and Dr. T. P. Thompson for reviewing drafts of the "checklist" for information gathering used in the survey.

Thanks are also due do the staff of the Direction Régionale du Développement Rural (DRDR) in the Savanes Region, especially Mr. P. Abo, Zonal Extension Director, for his invaluable assistance during the surveys.

Finally the effort put in by our assistants Messrs K. Alognikou, A. Sakiti and F. Dali during the surveys and the preparation of this report is gratefully acknowledged.

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INTRODUCTION

Although the relationship between efficient use of fertilizers and above average agricultural production has been well recognized by agricultural scientists and policy-makers the world over, fertilizer use in West Africa remains very low.

West African soils are low in fertility and fragile ; they are readily exhausted through cropping, and prone to erosion. These characteristics of West African soils underscore the use of fertilizers, soil amendments as well as the adoption of other soil management practices.

However, the complexity and diversity of the physical and human environments of West Africa dictate that technological packages meant to improve soil productivity must always be tailored to suit the varying ecosystems. This is one of the central objectives of the Soil Fertility Restoration Project (SFRP). Specifically, SFRP is an applied agronomic and socioeconomic research and development program that seeks to identify means of introducing fertilizer practices in various agroecological zones of West Africa by evaluating various fertilizer investment options, and assessing their impacts on soil productivity restoration and sustainability, and the economics of local communities.

This report is on the exploratory survey of the Savanna ecology of Northern Togo -- one of three agroecological zones of West Africa where the project is being implemented. It is organized in the following manner : the first three sections provide an overview of the Republic of Togo, the methodology used in the study, and some general aspects of the pilot area including the physical, biological and human environments. An analysis of the farming systems and the study's implications for SFRP are covered in sections four and five.

THE REPUBLIC OF TOGO: AN OVERVIEW

The Republic of Togo, a long, narrow francophone West African country, stretches about 570 km from the Bight of Bénin into the interior. Bordered on the north, east and west by Burkina Faso, the Republics of Benin and Ghana in that order, Togo has a total surface area of 56.785 km² (see fig.1).

As in neighboring Ghana and Bénin, Togo is characterized by coastal lowlands stretching for about 40 km inland. The rest of the country consists primarily of two savanna plains separated by a southwest-northwest range of hills, notably the Togo-Atacora mountains.

Togo's climate is influenced principally by the interaction of two main air masses: the moist, relatively cool air mass or monsoons from the southwest across the Atlantic Ocean and the hot dry continental airmass (harmattan) from the northeast. Consequently, the climate varies northwards from sub-tropical to savanna. Temperatures are generally high ranging from 24°C to 36°C in the relatively dry north and between 23° and 30° in the humid south.

Vegetation in Togo is determined largely by climate, soils and the extent of human activities. The southwest-northeast area of heavy annual rainfall broken by one or two relatively short dry seasons is covered with evergreen forest particularly in the wetter portions, and semi-deciduous forest in the drier zone. This area supports food crops such as maize, plantain and yam and cash tree crops especially, cocoa, coffee and oil palm. The rest of the country, except the coastal scrub land, is covered with Savanna vegetation. The Guinea-Savanna vegetation which covers the southern two-thirds of the country grades imperceptibly into the Sudan-Savanna to the north. Crops grown in the former include cassava, maize and cotton while millet, groundnuts, sorghum and cotton are grown in the latter.

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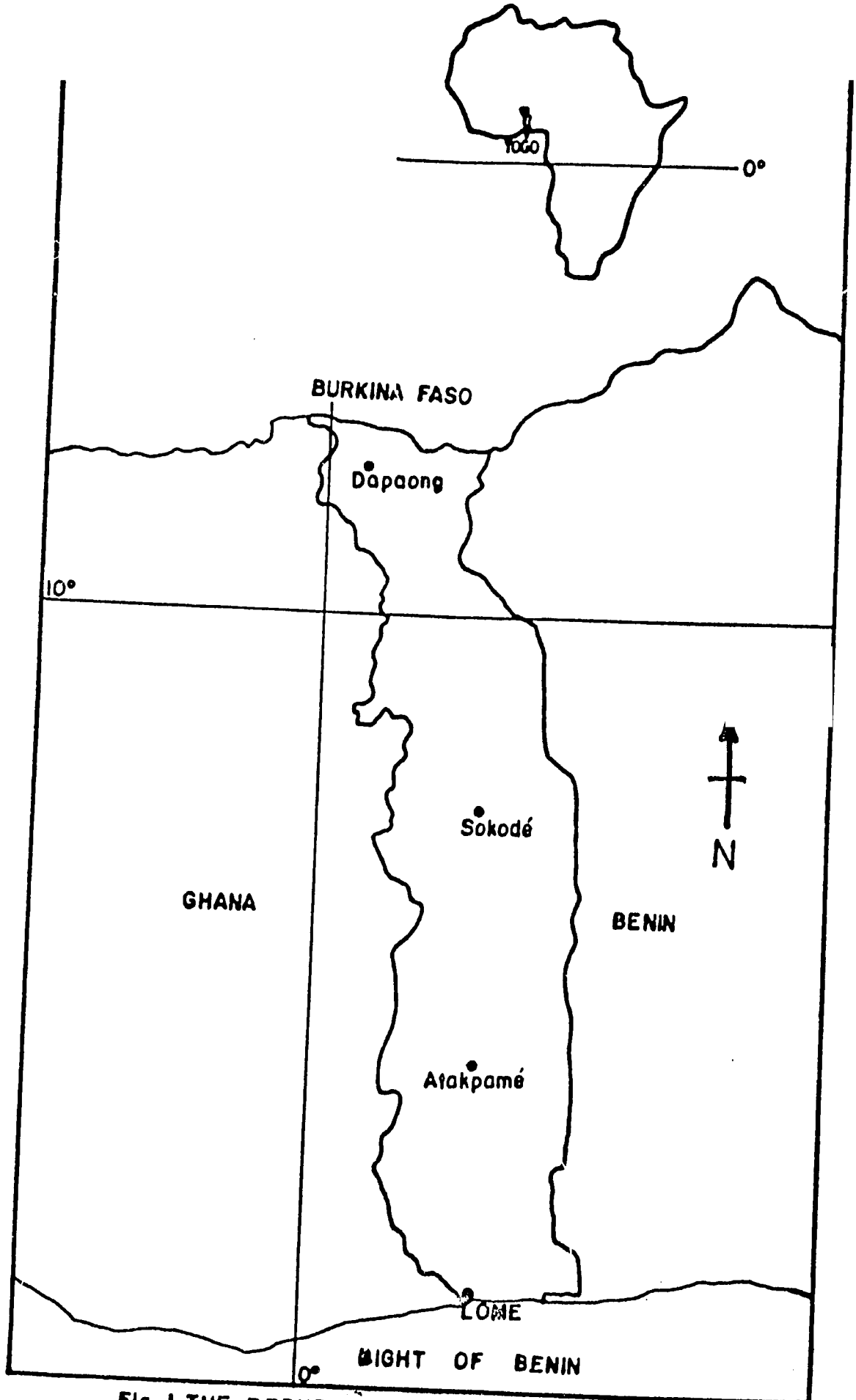

Fig. 1. THE REPUBLIC OF TOGO

However, as a result of prolonged farming activities, the original closed forest vegetation has been severely reduced. Also prolonged cultivation and bush burning have caused serious degradation of vegetation and soils in the Savanna environment.

An estimated 75 per cent of Togo s 3 million people live in rural areas and are engaged in agriculture and related industries (USDS, 1987). Densities range from 24 persons per km² in the central zone through 42 persons per km² in the north to over 165 persons per km² in the south. With an estimated 2.9 per cent growth rate, Togo's current population is projected to double in less than two decades.

For purposes of administration and socio-economic development, Togo has been divided into five regions - Maritime, Plateaux, Centrale, Kara and Savanes - each of which, is divided into districts (prefectures).

The Savanes Region

Covering the northernmost part of the country, the Savanes region (8602 km²) exhibits most of the ecological elements characteristic of the Soudano-Guinea Savanna environment. Temperatures, for example, fluctuate between 24°C and 36°C; the mean annual rainfall of about 1200 mm is unimodal (April-October Fig. 2 and appendix Table 1) followed by a relatively long dry season. The vegetation is predominantly tall grass interspersed with short trees, particularly, along river courses.

About 91 per cent of the estimated 330.000 people in the Savanes region depend on agriculture (Direction de la Statistique, 1981). Rural population densities range from 15 persons/km² in the sparsely populated plains of River Oti to 70-100 persons/km² in the area east of Dapaong.

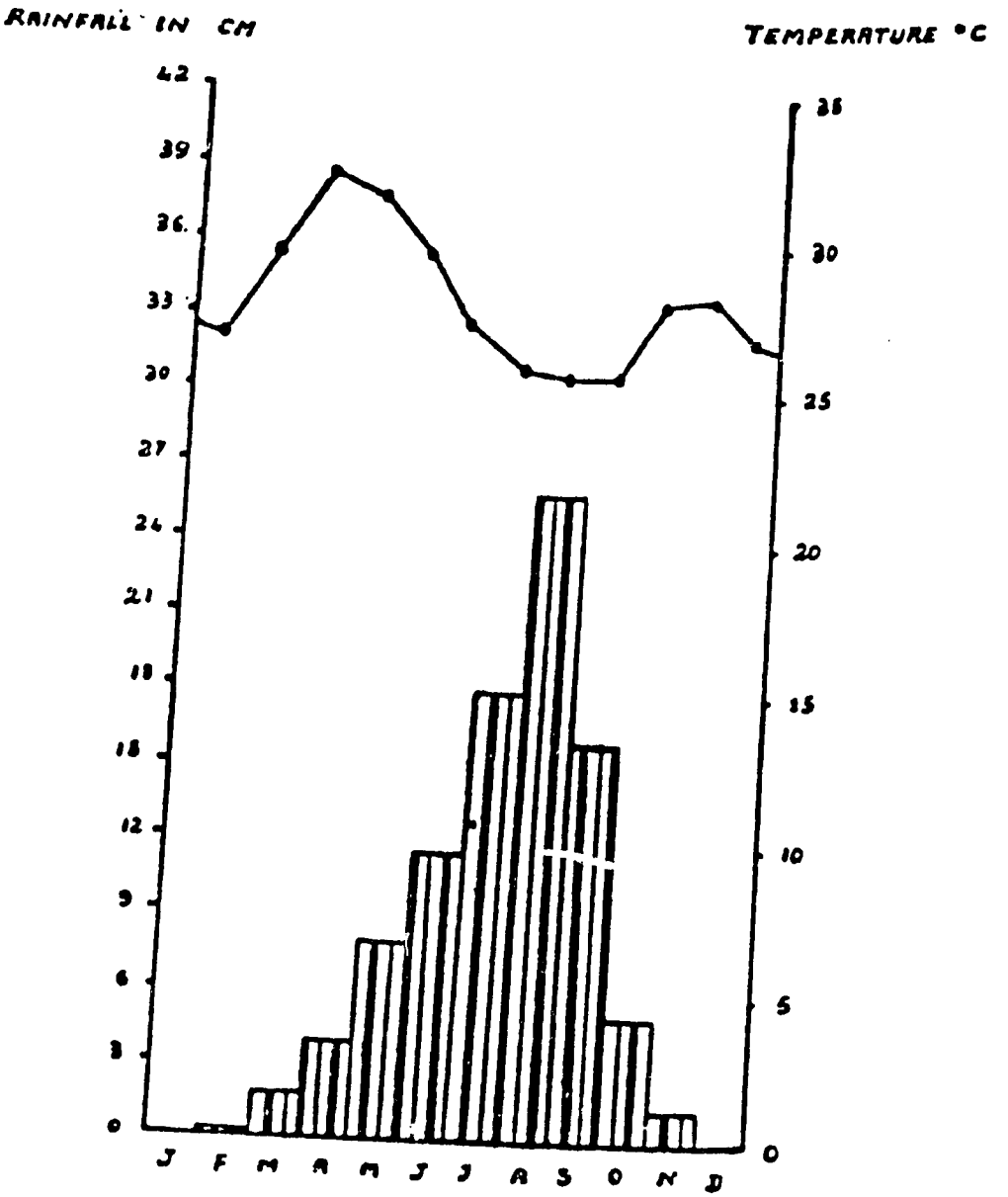

FIG.2 - DAPAONG - MEAN MONTHLY RAINFALL AND TEMPERATURE 1980-1987

SOURCE : SERVICE DE LA METEOROLOGIE.

LOME 1988.

Agricultural extension services in the region are provided principally by two governmental agencies - the Direction Régionale du Développement Rural (DRDR) and the Société Togolaise du Coton (SOTOCO). A third organization engaged in agricultural development in the region is the Fonds Européen de Développement (FED). All the three institutions have resident extension officers in villages that fall within their respective zones of operation.

Dapaong, the regional capital (pop. about 10.000) is the commercial center of the Savanes region. The important all-weather, north-south road linking Lomé and Ouagadougou, in Burkina Faso, converge on the city. Next in the hierarchy of settlements are several smaller market centers - Korbongou, Naki-Est, Bogou, Kpembona, Papri, etc - most of which are within 40 km radius of Dapaong. Almost all these smaller towns are linked to Dapaong by second or third class roads. Thus the bioclimatic, infrastructural and existing institutional arrangements make the area around Dapaong (i.e; the Tône Prefecture) the most potentially productive area in the Savanes Region (Fig.3).

METHODOLOGY

Data for the compilation of this report derive from several sources. Primary diagnostic information was collected through village and farm visits, interviews with community leaders, extension workers and a small sample of farmers. Also included are the analyses of soil samples collected from farmers' field at two different depths. Secondary data sources included census publications, published rainfall and temperature data from the meteorological services department; and fertilizer use and agriculture production data from the DRDR, SOTOCO and the Enquêtes et Statistiques Agricoles.

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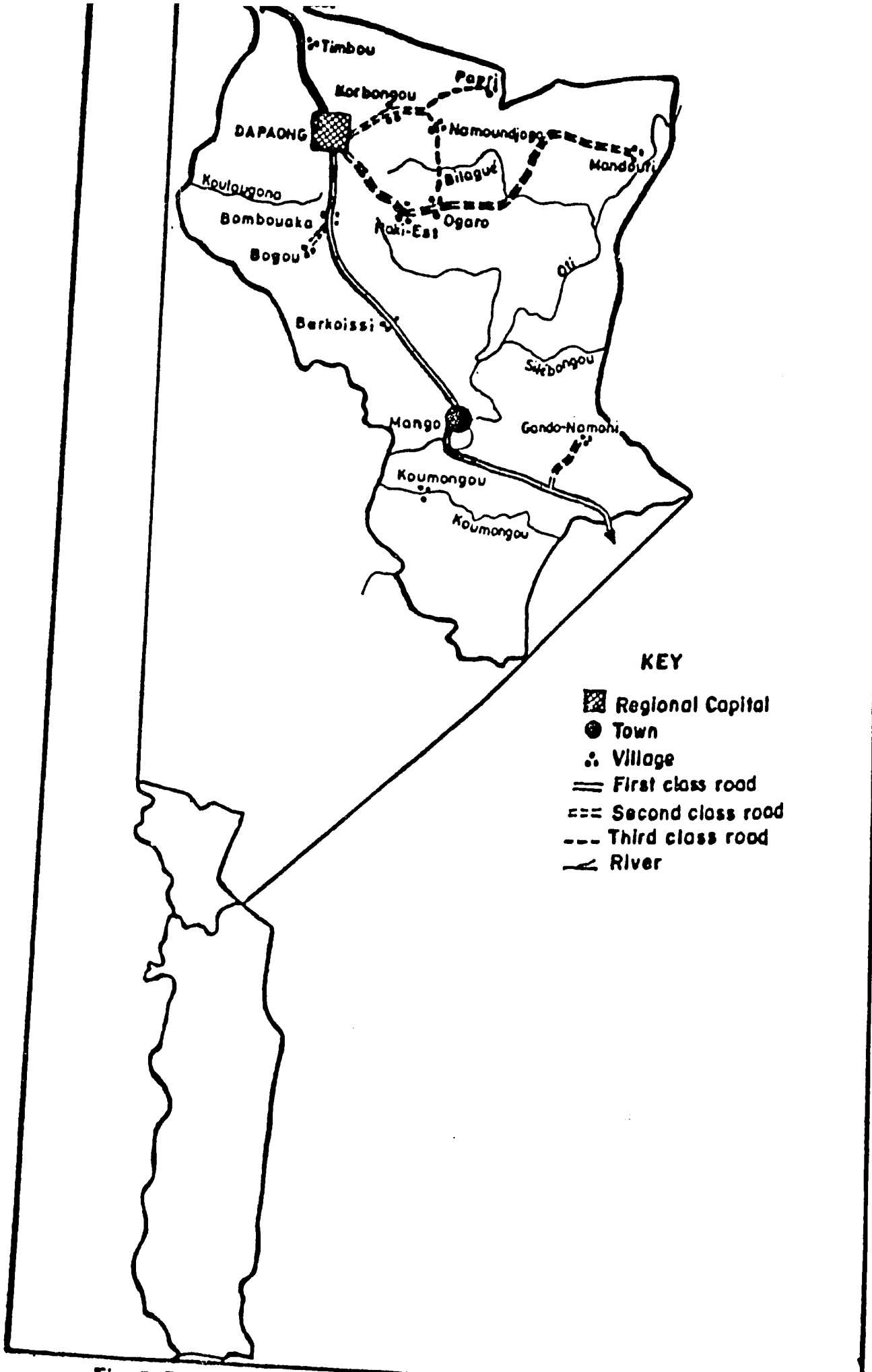


Fig: 3. THE SAVANES REGION OF TOGO

Selection of Pilot Villages

The initial phase of the selection process involved discussions with regional agricultural extension personnel as well as analysis of secondary data on population distribution ; evaluation of physical and institutional structures operative in the region; review of previous studies on crop response to fertilizers, and the overall agricultural potential of the region.

Following the discussions and extensive review of available literature on the region, the Tône Prefecture (Dapaong area) was selected on the basis of population density, "homogeneity of agroclimatic" factors and the availability of relevant institutional support services. And to ensure representativeness of the sample, all villages having between 800 and 2000 inhabitants and located within 40 km radius of Dapaong constituted the study population. From a list of several villages compiled in collaboration with personnel from DRDR, seven villages were selected on the basis of the following criteria for extensive survey.

- Accessibility to / availability of large markets and fertilizer distribution depots.

- Willingness of farmers to participate in project activities.

- Previous experience of extension workers in the village.

- Location and good spread to enhance the demonstration effect of field programs.

Interviews and farm visits

With the assistance of local extension workers, a convenient sample of 2 farmers (a male and a female) were selected from each of the seven villages for intensive interviewing. However, the female respondent for one of the selected villages could not be reached. This resulted in a total sample of 13 respondents - 7 males and 6 females.

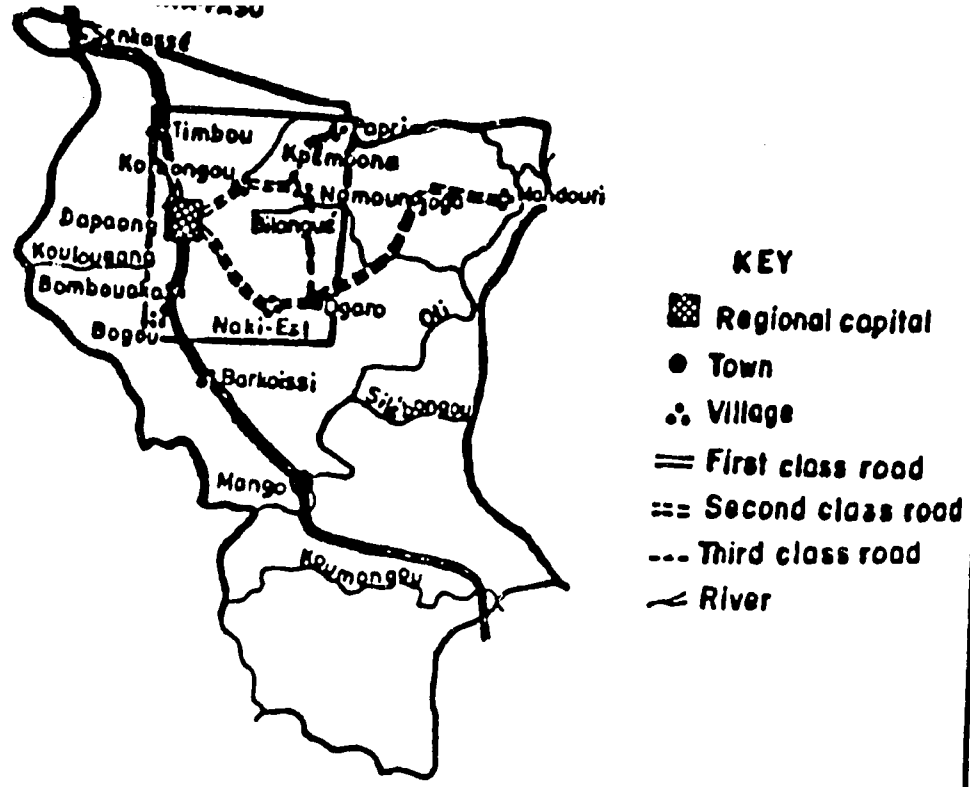
The week-long interviews and farm visits focused on farmers perceptions about the physical and biological environments their opinions about available institutional services, the prevailing farming systems, existing crop storage systems and marketing outlets as well as several other socioeconomic and cultural issues.

Also, soil samples at the 0-20 and 20-50cm depths were collected from farmers' fields for analysis at the Institut National des Sols (INS) in Lomé. The sites were characterized in the field with respect to slope, presence or absence of gravel and/or concretions.

GENERAL ASPECTS OF THE PILOT AREA

As stated earlier, all the seven pilot villages - Papri, Kpembona, Kowampit-Bong, Naki-Est, Ogaro, Bombouaka and Bogou- are in the Tône Prefecture of the Savanes region and are within 40km radius of Dapaong, the regional capital (see fig. 4).

In general, the villages have been sited on valley bottom lands where the water table is close to the surface of the soil. This apparently gives farmers easy access to water during the long dry season. Also, the sites facilitate the use of the relatively more fertile soils that collect from the top soil washed off uphill areas. Millet, groundnuts sorghum, and cowpeas are the main food crops while cotton is grown for the market. Some cattle, sheep, goats, pigs and poultry are raised for domestic consumption and also for the market.



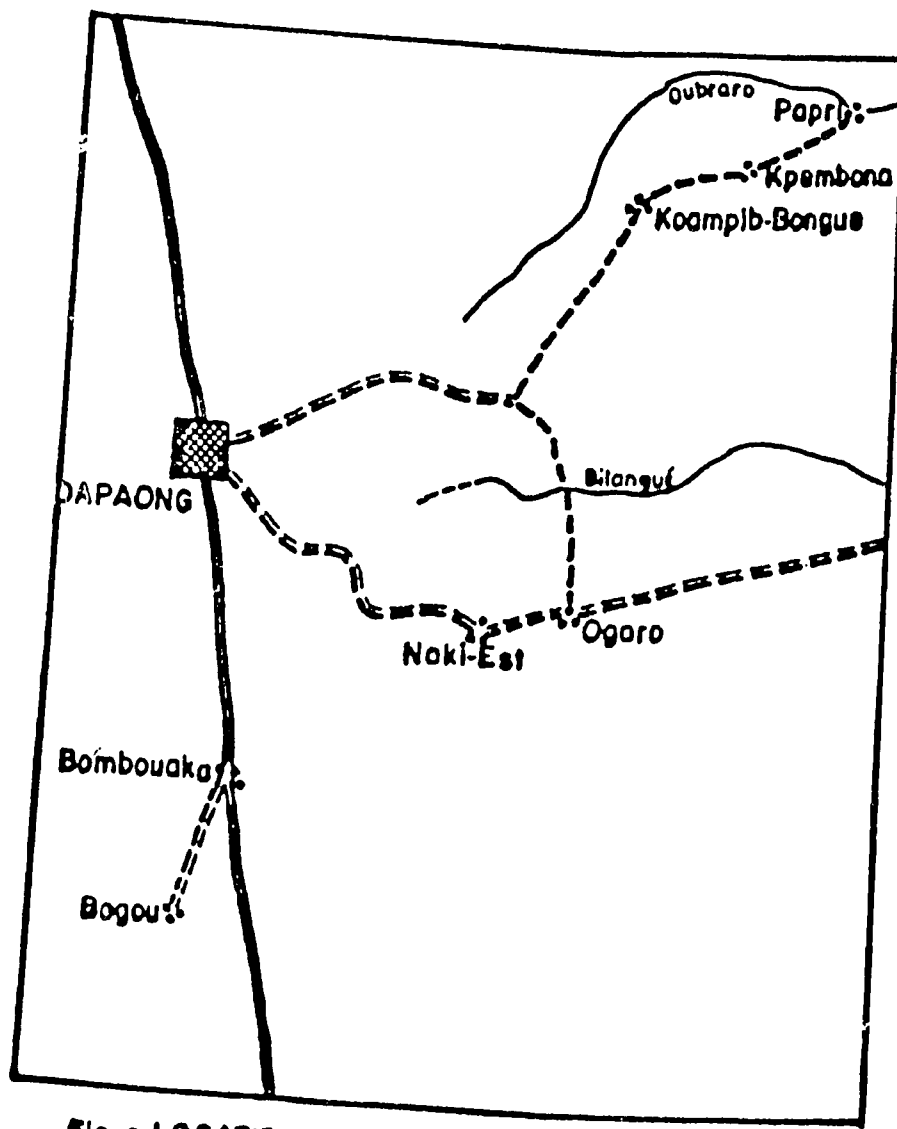


Fig. 4. LOCATION OF THE PILOT VILLAGES

Although there is relatively a good network of second and third class roads in the area, public means of transport appear to be in short supply. The most popular means of long distance travel is the bicycle. Table 1 provides a summary of highway distances between pilot villages and the location of some essential services.

Table 1

Active Population, Road Type and distances between Pilot villages and other essential services

Pilot Villages	Active * Population	Roads** type	----------) km (---------- Clinic	Post Primary School	Large*** Market	Agricultural Extension/ Fert. Depot
Bogou	994	2	0	0	29	0
Bombouaka	1061	1	0	0	21	0
Kowaspit-Bong	1782	3	0	9	25	0
Kpembona	828	3	3	15	36	0
Maki-Est	1665	2	0	0	35	0
Ogaro	869	2	9	9	40	0
Papri	1247	3	0	18	34	0

Source: DRDR
* Person 12 years or more
** 1: first class road
2: second class road
3: third class road
*** Large market refers to Dapaong

In general, incomes in all seven villages appear to be relatively low due, in part, to pressure on the land and declining agricultural productivity. Migration, among the youth is very apparent. Almost all the farmers interviewed have a relative or know of someone in the village who has recently migrated to one of the neighbouring countries.

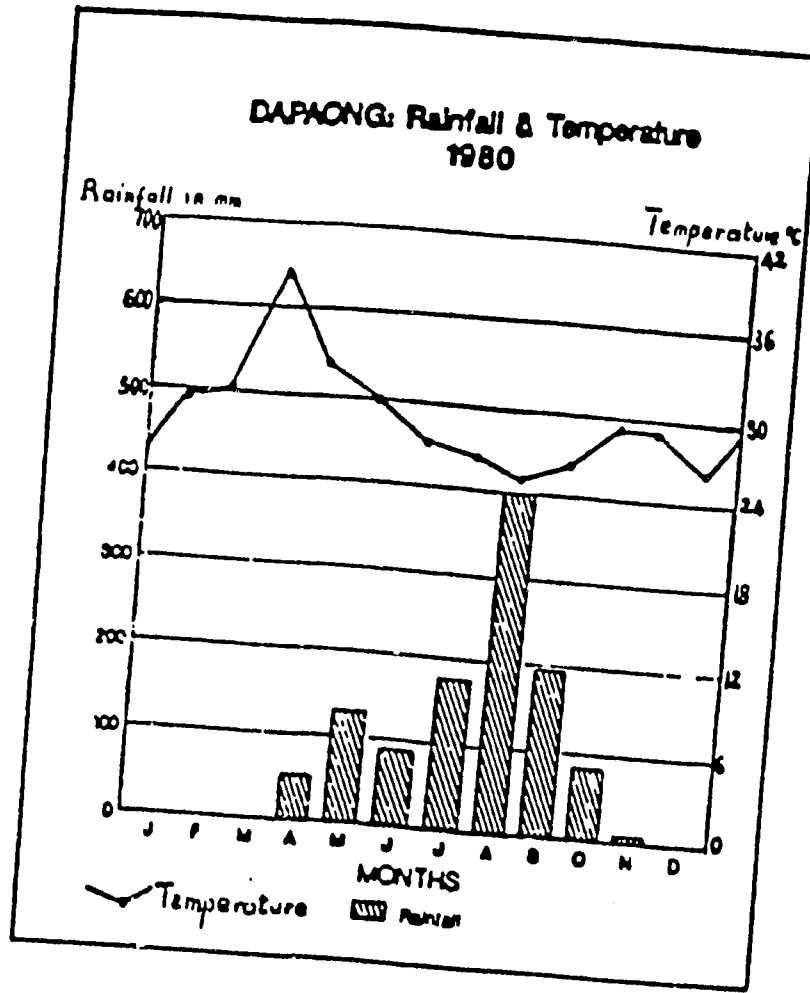
Undernutrition is very apparent among adults and children alike. Put against the estimated 2.9% annual population growth rate and the emergent continous cropping system, the SFRP can be seen as a timely intervention to forestall possible future widespread food shortages and environmental degradation.

Physical and Biological Environment

Climate

The climate of the pilot area is greatly influenced by the dry Harmattan or North-east Trade Winds that blow from the Sahara, usually, from October to March. Temperatures are generally high during the months of February, March and April.

Although no rainfall data could be obtained specifically for the individual pilot villages, data for nearby Dapaong provide some insight into the volume and pattern of distribution (fig 5 and appendix Table 2). As shown in fig.5, the wettest months are July and August. It is also clear that since 1983 annual rainfall totals have consistently fallen below the 8 year (1980-1987) average of 919.3 mm . The 1983 total of 775.9 mm, for example, was about 143.4 mm below the annual mean for the area. The problem of water however, is not very acute since the annual rainfall totals never fell below 600 mm considered critical for the two main staples, millet and sorghum (de Haan, 1987).



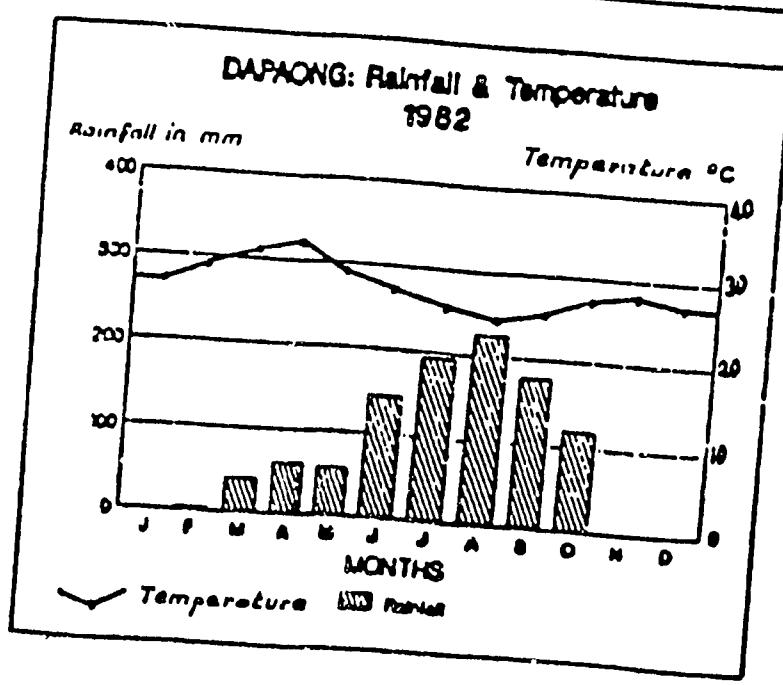
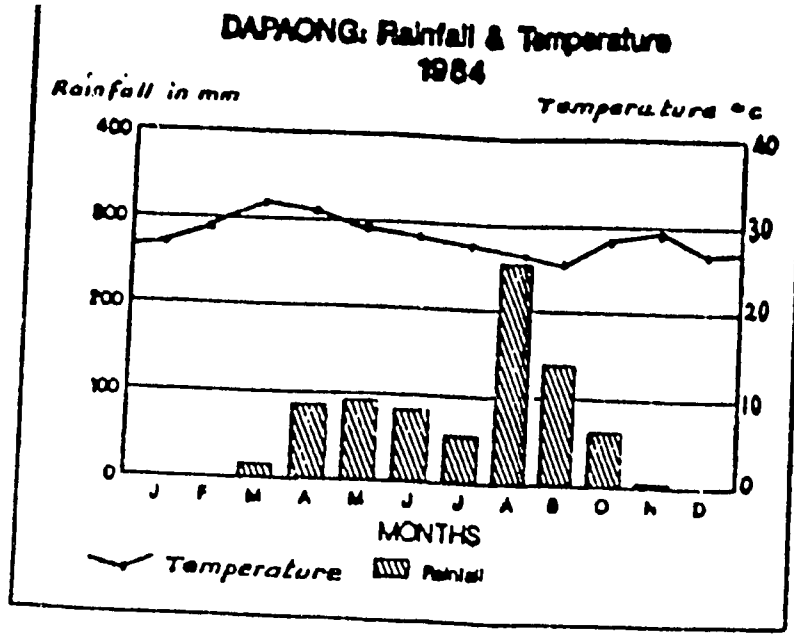
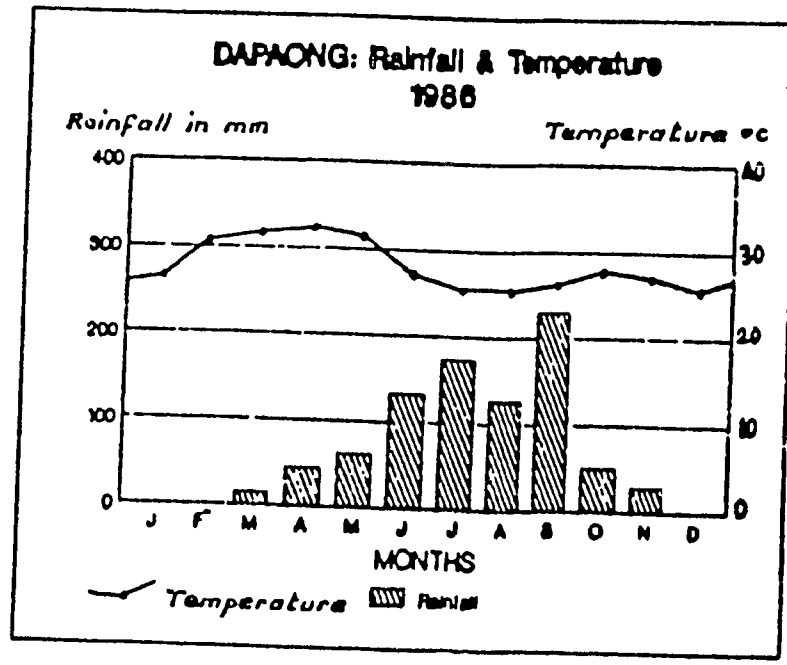


Fig. 5. Dapaong : Monthly Rainfall and Temperatures - Selected years.





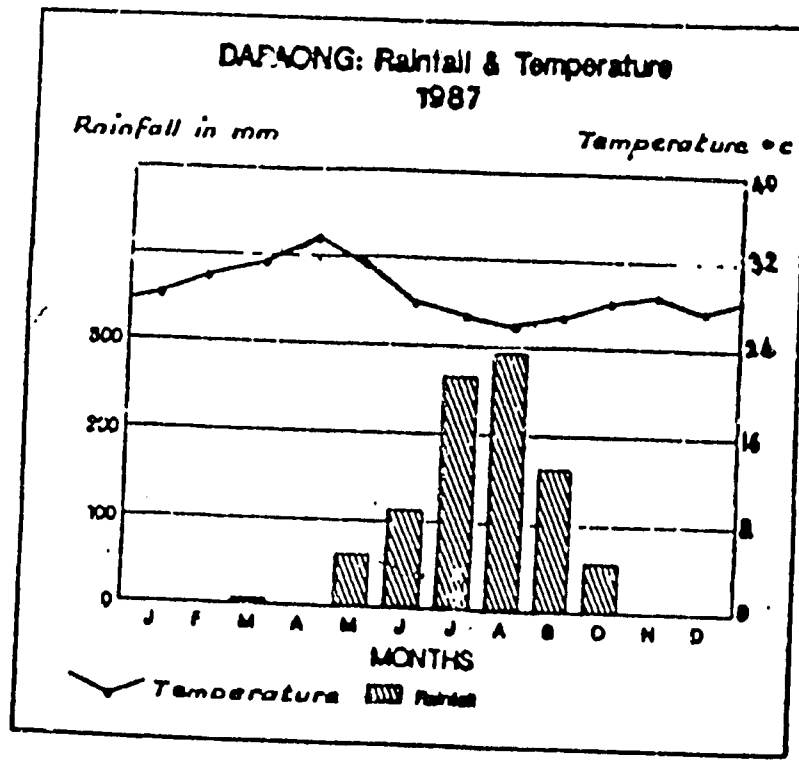


Fig. 5 : Continued

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One significant observation during the survey was the degree to which farmers have and continue to adapt to the changing weather patterns. As explained in detail under "Farming Systems", farmers survival strategies, in recent times, have included: elaborate patterns of crop rotation and planting sequence; selection of seeds that do best in poor years; and the use of different varieties of the same crop at the same time on the same plot.

Land, Soil and Water

Farmers' Perception of Site and Soil Conditions

Perceptions of farmers about site and soil conditions were as follows:

- Erosion and drought risk were rated as high by 70% of respondents.
- Moisture holding capacity was rated as low by 80% of respondents.
- Soil nutrient status was consistently rated as low by all respondents.

Topography and Soil Physical Properties

The area is made up of slopes, valleys and plains. Slopes ranged from 2 - 3%. The main streams which drain the area are Oubiaro, Bilagué and Koulougona.

Papri and Kpembona

Textures were sandy loam in the topsoil (0 - 20 cm) changing to sandy loam or loam in the subsoil (20 - 50 cm). Quartz gravel and ferruginous concretions occured throughout the profile. A loose soil layer of 50 -75 cm overlaid a compact clayey layer.

Naki-Est and Ogaro

Textures were sandy loam in both the topsoil and subsoil. Ferruginous concretions occured in the subsoil. A loose soil layer of 75 - 100cm overlaid a compact clayey layer.

Bombouaka, Bogou and Kowampit Bong

Textures were sandy loam or silt loam in the topsoil changing to loam or sandy loam in the subsoil. Topsoils were relatively free of gravels but gravels occured in the subsoil. There was a 50- 65 cm layer of loose topsoil above a compact layer.

Soil Reaction, Exchange Acidity, Base Saturation and Cation Exchange Capacity in the Topsoil

pH in water ranged from 5.7 (Bombouaka and Site 1a:Naki-Est) to 7.0 at Papri (Appendix Table 3). It averaged 6.3.

pH in KCl was always less than pH in water.

Exchange acidity was uniformly low and averaged 0.09 meq/100g soil.

Base saturation was moderate, it ranged from 37 % in site 1a (Naki- Est) to 70% in Kowampit Bong and averaged 55%.

Cation exchange capacity determined by NH_4 saturation at pH 7 and displacement ranged from 6.3 meq/100g in site 1b (Naki-Est) to 13.08 meq/100g in Bombouaka with an average of 8.29 meq/100g.

Plant Nutrients in the Topsoils

The level of essential nutrients in topsoil are described as adequate when they are above the critical level. Critical levels obtained from the literature on tropical African soils (IFDC 1979, Roche et al 1980, Munson 1982 and Lindsay & Cox 1985) are used when data on Togolese soils are unavailable.

Nitrogen

Levels of organic carbon and total N were very low and averaged 0.4 and 0.04 % respectively.

Phosphorus

Bray P1 ranged from 1.5 ppm (Bombouaka) to 9.44 ppm (Kowampit Bong). It averaged 3.8 ppm. Olsen-Dabin P ranged from 3.55 ppm (Kpembona) to 7.55 ppm at Kowampit Bong, with an average of 5.69 ppm. Both extractants consistently indicated very low levels of available soil P.

Potassium

Exchangeable potassium was low to adequate; it ranged from 0.09 meq/100g (Bogou and Kpembona) to 0.22 meq/100g in Papri. It averaged 0.14 meq/100g.

Calcium

Exchangeable calcium was generally adequate. It ranged from 2.11 meq/100g (Bogou) to 5.38 meq/100g (Papri). It averaged 3.15 meq/100g.

Magnesium

Exchangeable magnesium was generally adequate, it ranged from 0.60 meq/100g (Ogaro) to 2.28 meq/100g (Bombouaka). It averaged 1.03 meq/100g.

10

Sulphur

Levels of readily soluble + portions of absorbed sulphate were adequate in all sites. It ranged from 12.08 ppm in Kowampit Bong to 44.35 ppm in Naki-Est and averaged 21.20 ppm.

Micronutrients

Extractable manganese and iron were high in all sites and copper was moderate to adequate. Zn was generally low to moderate but was adequate in Bombouaka. Boron was very low in Naki Est but adequate in all other sites.

Soil Classification and Suitability

Figure 6 is a map of northern Togo showing the soil types in the pilot area (40 km radius of Dapaong) on a scale of 1: 500,000. Tropical ferruginous soils occur in the villages of Papri, Kpembona, Ogaro and Naki-Est. However, the parent materials at Papri and Kpembona were granite while the parent materials at Ogaro and Naki-Est were sandstone. Lithosols occur in Bombouaka, Bogou and Kowampit Bong. The soils in the pilot area have not been classified in the USDA system, however, based on available data on soils of the West African savanna, their approximate equivalents in the USDA system are shown in table 2.

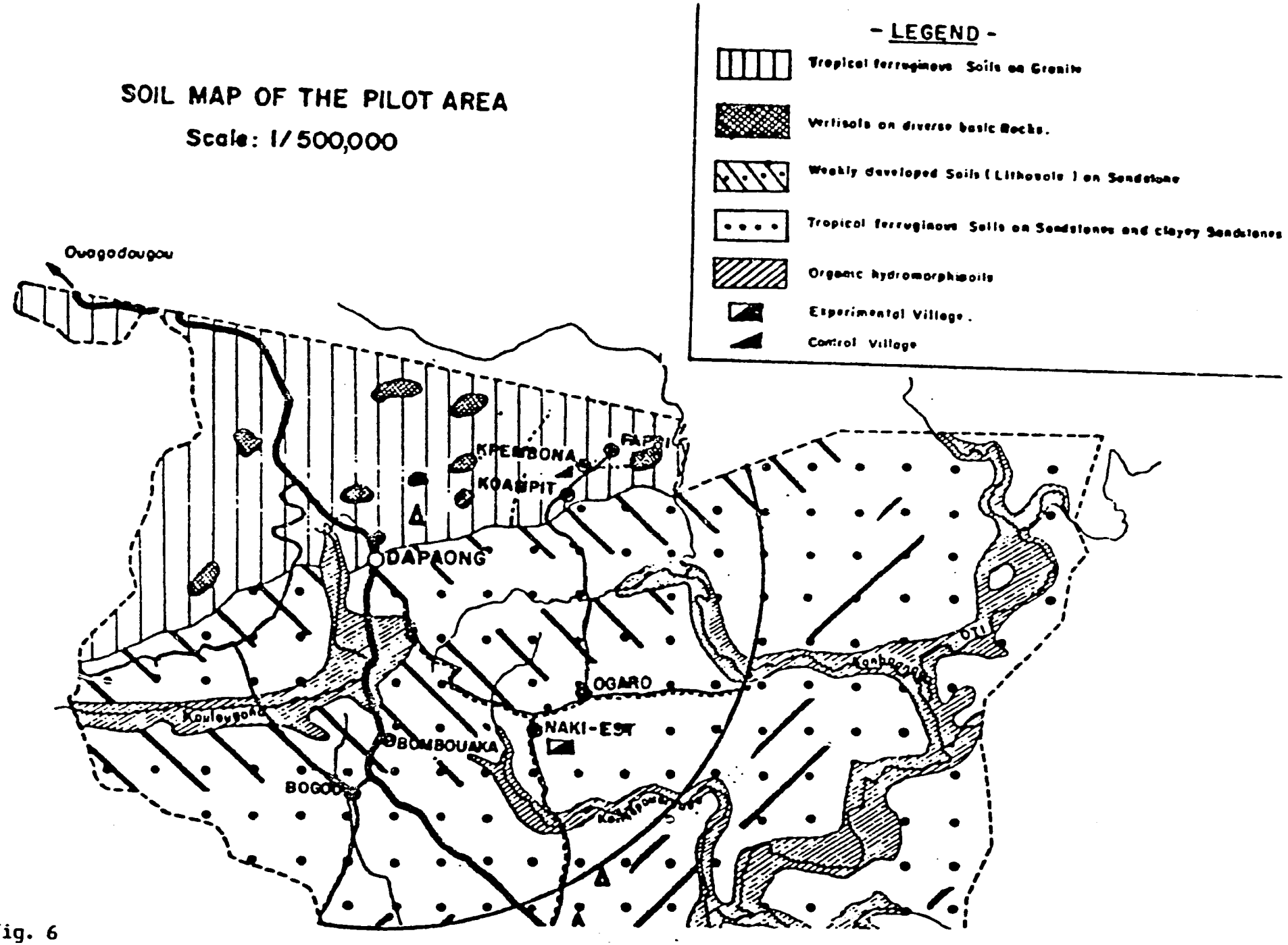
SOIL MAP OF THE PILOT AREA
Scale: 1/500,000
- LEGEND -
Tropical ferruginous Soils on Granite
Vertisols on diverse basic Rocks.
Weakly developed Soils (Lithosols) on Sandstone
Tropical ferruginous Soils on Sandstones and clayey Sandstones
Organic hydromorphic soils
Experimental Village.
Control Village
Ouagadougou
KPEMBONA
KOAMPIT
DAPAONG
OGARO
NAKI-EST
BOMBOUAKA
BOGOO
Kouloubona
Kanbogou
OTI

Fig. 6

Table 2

Classification of Soils of the Pilot Area*

Village	INRA/ORSTOM	USDA
Papri	Sols ferrugineux tropicaux sur granite	Alfisol
Kpembona	ditto	ditto
Naki-Est	Sols ferrugineux tropicaux sur grès	ditto
Ogaro	ditto	ditto
Bogou	Sols peu évolués	Entisols or inceptisols
Kowampit Bong	ditto	ditto
Bombouaka	ditto	ditto

Source : *Adapted from Lamouroux (1962), Jones & Wild (1975) Mutsaers et al (1986), Roche et al (1980)

The sites examined are generally prone to erosion but they are suitable for the cultivation of sorghum and millet (D.K. Missou-Assogba private communication).

The Human environment

Settlement patterns

Except in a few areas where the presence of a fairly large market or a stream might have led to the concentration of houses at a particular site or built-up area, dwellings are generally dispersed over wide areas. A typical farming village, therefore, is an agglomeration of several farmsteads/hamlets separated by tracts of farmlands.

A typical residence is a round structure with a conical roof; a number of these are arranged in a circle within an enclosing wall to form a compound household or Soukhala. A Soukhala may consist of a man, his wife(s) and children, sometimes his daughter(s)-in-law and grand children. In other words, a Soukhala is made up of one or several units

of production and/or consumption. A summary of constituent hamlets, the number of Soukhalas and corresponding number of production/consumption units in pilot villages is provided in Table 3.

Table 3

Constituent hamlets, number of soukhalas and Production units in pilot villages.

		------> Total Number of <------	
Pilot Village	Constituent Hamlets	Soukhalas	Production units/ Households
Bogou	4	210	233
Kpembona	3	220	308
Ogaro	3	142	339
Naki-Est	8	308	473
Bombouaka	8	388	712
Papri	8	241	466
Kowampit-Bong	5	160	182

Source: Direction Régionale du Développement Rural (Savanes).

Although the dispersed settlement pattern may pose some initial problems with regard to reaching individual farmers, it has the unique advantage of facilitating the spatial diffusion of innovations (neighborhood/contagion effect) once the diffusion centers have been established.

Social Organization

The Moba and Gourma are the two main ethnic groups in the pilot area. Both practice the patrilinial system of inheritance (i.e. property passes on from father to son). The basic unit of government or village authority is enshrined in the Bate (village chief). The Bate is usually an adult

male, presumably, a direct descendant of the first person to have settled in the village boundary. However, unlike village chiefs of the more nucleated villages in the forest zone, the Bates appear to have very limited influence over their subjects due, in part, to the dispersed nature of the settlement townships. Next in the power hierarchy are the heads of Soukhala. Aside from their religious and other ceremonial functions (e.g. overseeing birth, marriage and funeral ceremonies), heads of Soukhala serve as custodians of their groups' property, including farmlands; therefore, they exercise some degree of influence over the organization of agricultural production of their group members.

The Economic Environment

Land - Tenure and Access

The system of land tenure among the Gourma-Moba is fairly complex and therefore very difficult to generalize. One thing which is clear, however, is that, at the moment there is more than one kind of tenure in operation corresponding to different types of land-use. Permanently cultivated land within shorter distances from the village as well as manured compound land, for example, usually have permanent individual tenure while more distant lands, especially those in hilly areas are, for the most part, reserved for communal grazing.

Nevertheless, there seem to be a clear distinction between tenurial arrangements for descendants of early settlers (indegenes) and those of later arrivals. Property right on the former's land is sanctioned while the latter only have the usufruct of the inherited or acquired land even though the right is irrevocable. Thus, the size and quality of the land claim depend on the order of arrival of the individual's ancestors in the village - the largest and best lands to descendants of "first comers". In addition farmers borrow land from each other for use over varying period of time. Money does not change hands in such transactions since it is a local taboo to sell land. Instead "tenants"

make token payments in the form of kola nuts, a chicken or a basketful of grain at the end of the cropping season.

Thus, two main categories of land tenure preval in the pilot area, namely; freehold (inheritance) and short-term "lease". As shown in table 4, about 80 percent of the farmers interviewed till their own land ; the remaining 20 % who farm on borrowed land apparently do so for reasons other than landlessness.

TABLE 4

Land Tenure Categories by Pilot Village N = 10

VILLAGE	Tenure Category	
	FREEHOLD	SHORT-TERM LEASE
Kowampit-Bong	X	X
Bogou	XX	-
Bombouaka	X	X
Kpembona	X	-
Naki-Est	X	-
Ogaro	X	-
Papri	X	-

However, growing demand for farm land due to rapid population growth and scarcity of off-farm employment appear to have brought some pressure to bear on farmlands. All the farmers interviewed practice continuous cropping -- a reaffirmation of Harrison's (1987) estimate that nine-tenths of arable land in Togo is under cultivation. Farm sizes as etimated by farmers ranged from 0.5 ha to 13.5 ha with a mean of 3.3 ha.

Farm -level Labor :

Three main sources of farm labor are obtainable in the pilot area, namely family labor including that of return migrants, hired labor, and mutual assistance (pooled labor).

About 70 percent of farmers rely on return-migrant and resident family members to meet their farm labor requirements. But as a couple of farmers hinted, the former source is fast drying out because of the emergent pattern of migration[1]

A few farmers counteract the apparent labor shortage during the period of high labor demand by organising labor pools to give mutal assistance to one another. In a few cases farmers hire labor usually for short periods to perform specific tasks on the farm. Wages are usually paid for in kind. When wages are paid in cash they range between 200 CFA and 250 CFA. Farmers reported that colleagues who have ploughs rent them out for use by other farmers. But very few farmers can hire a set of plough and draft animals to plough their fields at the current fee of about 8.000 CFA per hectare because the seasonal cash flow tends to be inversely related to the level of agricultural activity, i.e. the time of peak agricultural activity - June to October - coincides with the time when farmers cash resources are at their lowest ebb.

The cash flow and labor situation have some implications for SFRP in the light of the planned mass application of fertilizers to whole village farmlands. Given the increased labor demand that come with fertilizer use, individual farmers should be encouraged to form labor pools to counteract possible labor bottlenecks during the period of peak agricultural activity.

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1. Recent migrants tend to stay longer and prefer making occasional cash remittances to returning home at the beginning of the cropping season to help family members with farm work.

Capital

Apart from livestock and a few bicycles, the capital owned by farmers consist largely of goods produced through a direct embodiment of labor. Examples include grain lofts, some hand tools and a few home-made ploughs. Consequently capital levels are relatively low in the pilot area.

However, under a government-sponsored agricultural credit scheme, the two agricultural development agencies (DRDR and SOTOCO) provide equipment and some inputs credit to individual farmers for the cultivation of cotton. The type of equipment and percentage of sampled farmers who received them for the 1987 cropping season are provided in Table 5.

Table 5

Percent of farmers receiving DRDR/SOTOCO equipment and input credit for cotton cultivation - 1987. (N= 10)

Item / Description	% Farmers
1. Animal Traction	
a) Oxen	20
b) Plough	30
2. Other Inputs	
a) Improved seeds	50
b) Fertilizers	40
c) Pesticides	50

Sources of cash for farm operations :

Eighty percent of farmers interviewed use their own cash resources for their farm operations. These are derived principally from the sale of farm produce and livestock and occasional remittances from migrant family members. For example, all cotton produced by the farmers in 1987 were sold to the accredited buying agency, SOTOCO; between 40 per cent and 50 per cent of groundnuts and cowpea were also sold for

cash. The amount of sorghum and millet that were sold was difficult to estimate. But, in general, a greater proportion of the two cereals are stored in grain lofts over extended periods for domestic use.

FARMING SYSTEMS AND AGRICULTURAL PRODUCTION

Land Use

Land in the pilot area is used mainly for food and cash crop production, and livestock breeding.

Land Clearing

Farms are cleared with hoes in March. It involves piling up weeds and stumps of millet and sorghum from the previous crop. After the first rains, the land is tilled and ridged usually with hoes but sometimes with animal traction.

Cropping Patterns

The major food crops are sorghum and millet followed by cowpea. A large number of farmers continuously grow various combinations of sorghum and/or millet on the same piece of land. Maize is less important and is usually cropped near dwellings. Rice may be cultivated in the lowlands. Cotton is the major cash crop, followed by groundnut. Table 6 shows acreages under major crops in the Savanes. The following arrangements of crops were reported by farmers:

- Three months millet/six months millet/cowpea
- Three months millet/six months sorghum/cowpea
- Three months millet/six months millet/six months sorghum/cowpea
- Three months millet/six months millet
- Three months millet/six months sorghum

Line sowing was usually practised and millet and sorghum may be sown in the same planting hill.

Table 6

Estimated Acreage, Yields and Production of Food Crops in the Savanes Region (1980 - 1985)

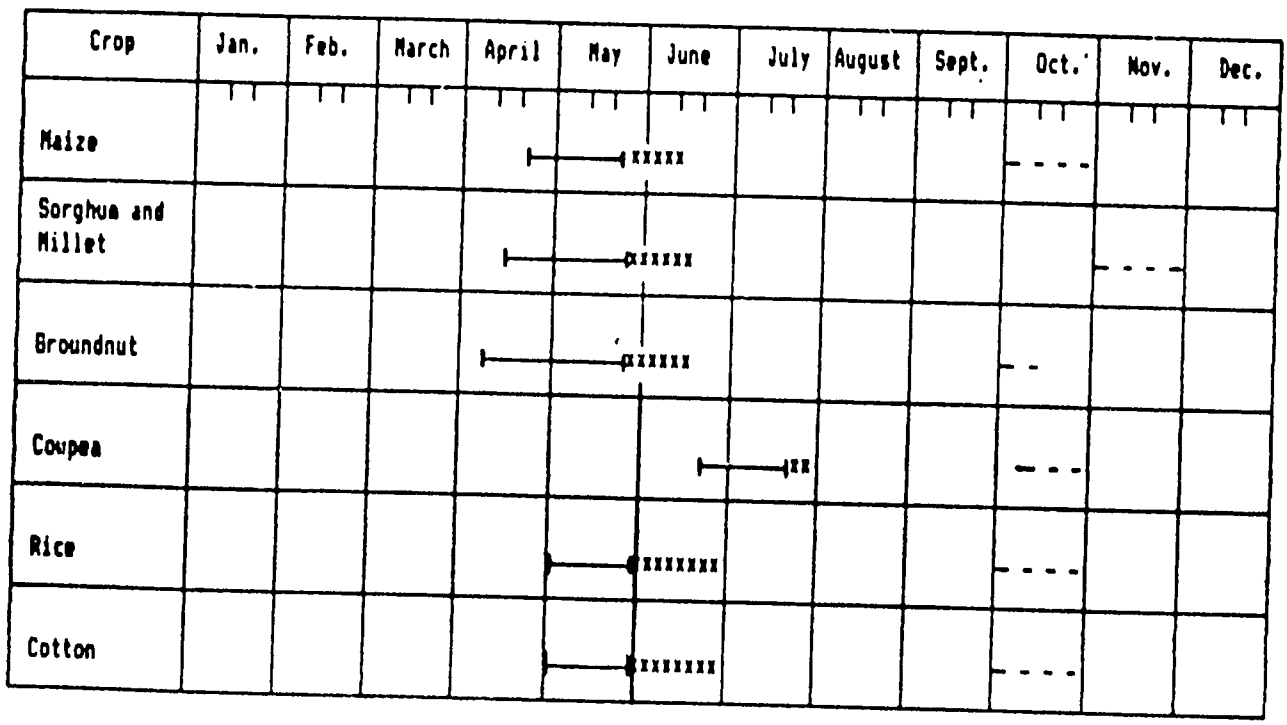
		1980 - 1981	1981 - 1982	1982 - 1983	1983 - 1984	1984 - 1985
SORGHUM	Area (ha)	42,100	39,900	35,400	26,900	39,900
	Production (t)	28,391	22,357	30,388	24,667	36,301
	Yield (t/ha)	0.602	0.494	0.639	0.508	0.624
MILLET	Area	84,700	81,100	40,600	51,800	50,000
	Production	34,304	30,575	33,705	44,771	67,279
	Yield	0.498	0.377	0.718	0.643	0.783
COWPEA	Area	45,400	45,400	39,100	56,600	75,600
	Production	5,155	7,111	7,491	7,907	18,481
	Yield	0.114	0.157	0.197	0.139	0.245
RICE	Area	3,600	5,500	5,500	4,700	5,100
	Production	2,941	5,340	5,208	3,257	3,800
	Yield	-	0.946	0.946	0.679	0.548
GROUNDNUT	Area	16,300	16,300	8,400	10,900	15,800
	Production	8,095	8,737	7,003	6,944	9,724
	Yield	0.444	0.377	0.709	0.550	0.615
BAMBARA NUT	Area	-	2,100	2,100	700	2,600
	Production	-	1,718	1,718	916	2,384
	Yield	-	0.684	0.684	0.565	0.613
YAM	Area	2,000	2,200	2,200	1,800	1,400
	Production	13,100	21,525	21,325	14,297	14,320
	Yield	-	7.600	7.919	7.942	10.229
MAIZE	Area	1,100	500	600	1,000	800
	Production	1,500	744	775	775	1,681
	Yield		0.407	0.461	0.461	0.615
TOTAL		195,200	193,000	133,900	154,400	191,200

Source : Enquêtes et Statistiques Agricoles.

Recommended spacing was 40 cm within rows and 80 cm between rows ; farmers however used wider spacings. Cowpea was usually planted across millet/sorghum rows. Cotton and groundnut were grown as sole crops.

Dates of Planting and Harvesting

Planting begins in May and extend to July depending upon the crop species (figure 7). Harvesting commences in October and ends in November again depending on the crop species.



Legend: ⊢—⊣ Land preparation
xxxxx Planting
— - Harvest

Fig. 7 Cropping Calendar for Food Crops and Cotton in the Savanes Region

Source : Société Togolaise de Coton

Crop Rotation

The basic rotation for cotton growing farmers is cotton-millet/sorghum - groundnut - cotton. Other variants reported were cotton-millet- groundnut - millet - cotton, and cotton - millet/sorghum - cotton.

Fallow Period

There is no fallow, pressure on the land being high.

Crop Protection

Weeds are controlled manually in 2 -4 weedings, with 3 weedings being the most frequent. Striga is a problem in sorghum cultivation. Farmers rotated crops to avoid the problem. Screw worms are important pests of sorghum and millet. Vertebrate pests reported included guinea fowls, wild ducks, and wild pigs. Crop protection advice and service were readily available from the Societé Togolaise de Coton (SOTOCO) for cotton. Forty per cent of respondents reported that they had used pesticides.

Inputs and Yields

All farmers reported the use of local millet and sorghum varieties. Improved varieties of sorghum e.g. variety 517 and E - 35 are however available.

Crop yield per unit area on farmers fields as estimated by the Extention Service is shown in Table 6. They are generally well below the yield potentials.

Ninety-nine per cent of lands in the Savanes that are cropped with cotton are fertilized (Table 7), while only 16.3% of lands cropped with millet and sorghum are fertilized. Seventy seven per cent of respondents said that they had used fertilizers at one time or the other. Rates of application were difficult to estimate, but were well below the Extension recommended rate of 150 kg/ha of 15:15:15 + 50 kg/ha Urea or 100kg/ha triple super phosphate + 50 kg/ha Urea. Farmers used any quantity of fertilizers they could afford. Plots close to the house received fertilization, those further away did not. In Togo all fertilizers are sold at 3.250 FCFA/50kg bag irrespective of the grade.

Table 7
Fertilizer Use in the Savanes (1987)

Crop	Ipendjal	Oti-Nord	FED	SOTOCO	Fertilized Acreage (ha)	Planted Acreage (ha)	Proportion fertilized (%)
Sorghum and Millet	2,485	546	1,280	6,937	11,248	69,150	16.3
Maize	78	112	-	332	522	3,827	13.6
Cowpea	1,115	8	-	584	1,707	15,515	11.0
Rice	73	110	13	19	215	1,728	12.4
Groundnut	778	348	342	2,614	4,082	16,907	24.1
Cotton	1,496	1,426	767	6,276	9,965	10,066	99.0

Source: Enquêtes et Statistiques Agricoles, Togo.

Although farmers recognize that fertilizer use would enhance the productivity of their depleted soils fertilizers are generally applied to cotton crops. Fertilizers and other input credit for the cultivation of food crops is not easily accessible to farmers. Such facilities are given only to farmers' cooperatives after the members have met several requirements. For example, the combined output of the group must have attained a level specified by the lending agency. Also, the group is required to invest a significant proportion of the credit on a collective farm as a demonstration of collective responsibility for repayment of the loan.

Farmers reported that generally the cooperatives have been a success, particularly in an area where other forms of associations have experienced costly failures. However, the conditions for credit acquisition need some review and improvement.

The issue of inequity, for example, needs to be addressed. At the moment it is nearly impossible for individuals who cannot ap-

propriate the use of more land to acquire fertilizers and other input credit to grow food crops. Thus SFRP's strategy whereby all farmers in the experimental village will receive fertilizers regardless of the scale of production should serve as a first step towards addressing the problem of inequity.

Livestock

Fifty per cent of respondents own cattle, nearly all respondents owned sheep, goats, chicken. A few owned pigs.

Manure is important for food production in the pilot area, all farmers reported its use, but the small quantities available is a major constraint. Only plots close to dwellings receive manure.

Post Harvest Activity and Harvest Utilization

Millet and sorghum stalks are used for domestic purposes - roofing, firewood. Some farmers reported that the straw from 3 months millet may be incorporated into the soil, but that of 6 months millet was usually used in the home.

Grains are stored within the Soukhala in traditional grain lofts built with mud. They may also be stored in sacks and pots. Grains were sometimes treated with ash before storage. Storage was usually for a period of 2 - 6 months, but there were few reports of treated millet and sorghum being stored for more than a year. Storage was for consumption, sale and seed.

Marketing of Farm Produce

Bicycles play a significant role in the Social and commercial activities of the people. Transportation of food crops and sometimes, livestock to the market is usually accomplished on foot or by bicycles. Consequently farmers hardly bring their produce to the large commercial center, Dapaong to sell. Instead, farmers' produce are sold in the nearest village market to middlemen for resale to consumers in the urban centers.

Seasonal variation in food prices is very high. These are largely determined by market forces, however. In 1987 for example, the market price of unshelled groundnuts increased threefold from a post-harvest low of 40 CFA/kg to 133 CFA/kg around the time of seeding (Table 8).

Table 8

Variation in Food Prices in the pilot area (1987)

Food crop	Prices (CFA/kg) Highest	Lowest
Sorghum	66	48
Millet (6 month variety)	67	44
Millet (3 month variety)	57	40
Groundnut (Unshelled)	133	40
Groundnut (Shelled)	173	70
Cowpeas	143	85
Rice	70	60

Source: Statistiques Agricoles (1988)

Despite the prospects for increased earnings if farmers can store some of their produce over an extended period of time and sell during the lean season, most farmers sell their produce soon after harvest. Aside from pressure to sell to meet their immediate cash needs, farmers reported that lack of long-term storage systems seem to be the over-riding factor for the early disposal of "excess" farm produce. Therefore, any investment made to improve current storage systems will enhance farmers' overall cash earnings in the long-run.

CONCLUSIONS OF SURVEY AND IMPLICATIONS FOR THE SOIL FERTILITY RESTORATION PROJECT

1. Farmers reported soil infertility as a major constraint to increasing food crop production. Laboratory analysis showed that soils in the pilot area depleted in nitrogen and phosphorus supply. Nitrogen and phosphorus fertilizers are crucial for restoring soil fertility. Potash fertilizers will also be required but the degree of need is less than that of N and P.

2. There is no fallow period in the pilot area because of pressure on the land and the soils are therefore under continous cropping. Phosphate fertilizer investment options should compare the application of single relatively large doses of P versus smaller annual applications.

3. There is potential for the use of animal manure, but since the amounts produced are insufficient they would need to be supplemented with commercial fertilizers.

4. Sorghum and millet are the major food crops in the area fertilization of entire villages should be based on sorghum/millet farms.

5. Extension fertilizer recommendations for sorghum and millet in the Savanes of Togo emphasize the use of 15:15:15 compound fertilizer. The benefits of compounds and single nutrients carriers should be compared as investment strategies.

6. There has been an increase in the use of TSP and DAP by West African countries because of savings in transportation costs (IFDC 1987). However, these materials have undergone limited testing by IFDC in West Africa. There is therefore need for economic and agronomic evaluation of high analysis P fertilizers like DAP and TSP in OFT in the pilot area.

7. There is need to maintain close contacts with the Direction Régionale du Développement Rural (DRDR).
Its extension workers are already familiar with the pilot area and farmers. Improved pratices such as use of good seed, correct plant population and weeding will improve crop response to the fertilizer investment treatments.

8. The villages of Naki-Est and Kpembona have similar soils and easy access to markets. Arrangement for land tenure are not a problem. Soil fertility is a major constraint to increased food crop production. These villages were therefore chosen for the detailed survey. Naki-Est will be the Experimental village and Kpembona, the control.

9. Farmers reported labor shortages during the period of peak agricultural activity. To help minimise the problem, the Project should work in collaboration with ther local leadership and extension to strengthen existing labor pools or encourage farmers to form new ones where they do not exist. Such groupings would also serve as nuclei for the development of viable farmers cooperatives or credit unions.

10. The current system of fertilizer distribution in the pilot area is biased against farmers who do not grow cotton or cannot appropriate the use of more land. The Project's strategy whereby all farmers in the experimental village will be supplied with fertilizers regardless of scale of production for sorghum/millet based cropping systems will not only help address the problem of inequity but will also serve as a "headstart" to those farmers who would otherwise have no access to fertilizers.

11. As a first step towards sustained fertilizer use in the experimental village, the project should work in collaboration with the local leadership, extension and farmers to explore the possibility of using part of the returns from the initial fertilizer delivery to create a village level Fertilizer Revolving Fund. The Fund so created would be used to make future bulk purchases of fertilizers for use by contributing farmers.

12. The wide fluctuation in food prices suggests that farmers may increase their earnings if they can hold stocks over extended period of time. Therefore, efforts should be made to appraise and improve current storage systems to enable farmers to hold their stocks and sell at peak prices.

13. Heads of Soukhala play a significant role in the social and economic life of their peoples. Indeed their role as custodians of their groups' property including farm lands puts them in a position to exert significant influence over the organization of agricultural production in the area. Therefore, their involvement in the project will enhance its success.

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Appendix Table I

Average temperature, rainfall and number of raindays
Dapaong 1980-1987

	J	F	M	A	M	J	J	A	S	O	N	D
T	26.9	29.7	32.4	31.8	29.9	27.4	26.0	25.9	25.9	28.2	28.5	26.8
R	0	3.3	17.3	40	79.3	116	183.3	260.5	168.5	51.4	14.4	0
N°	0	2	2	4	8	11	14	17	14	5	2	0

Source : Service de la Météorologie, Lomé - 1988

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Appendix Table 2

Temperature, Rainfall and Number of Rain Days - Dapaong

Year		J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1980	T	28.9	30.3	38.7	32.3	30	27.1	26.5	25.1	26.4	28.7	28.5	26.2	
	R	0	0	0	52.7	130.2	89.2	176	404	195.9	83.4	8.1	0	1139.5
	N°	0	0	0	4	5	9	9	23	12	10	3	0	75
1981	T	25.9	30	31.7	31.6	28.7	27.8	25.7	25.2	26.4	29.2	28.5	28.4	
	R	0	0	56.5	40.7	91	182.4	207.1	387.7	121.3	5.7	0	0	1092.4
	N°	0	0	2	6	6	8	18	18	11	2	0	0	71
1982	T	26.9	29.1	30.8	31.3	29.3	27.3	26	25.3	25.9	27	27.5	26.9	
	R	0	3.3	39.7	61.1	57.9	145.5	195	225.9	178.5	120.1	0	0	1027
	N°	0	2	2	5	7	13	15	15	15	10	0	0	84
1983	T	23.9	30.4	31.5	32.6	29.7	26.6	25.8	29.5	26	28.8	29	28.1	
	R	0	0	1.8	53	99.9	99.5	194.7	180.2	143	3.8	0	0	775.9
	N°	0	0	1	3	14	13	11	16	14	1	0	0	73
1984	T	26.7	28.8	31.6	30.8	29.3	27.7	26.8	26.3	25.8	28	29.4	26.4	
	R	0	0	16.6	85.8	92.7	83.3	54.7	254.6	138.8	62.5	5.6	0	794.8
	N°	0	0	3	4	10	11	13	15	17	3	2	0	78
1985	T	28.5	28.5	32.2	31.3	30.3	27.9	25.7	25.4	25.3	28.2	29.1	25.8	
	R	0	0	4.1	31.3	42.6	81.8	199.5	211.9	177.4	29.2	0	0	777.8
	N°	0	0	2	4	9	10	19	15	18	1	0	0	78
1986	T	26.5	30.7	31.6	31.9	30.6	27.6	25.1	25.2	25.5	27.8	27.3	25.7	
	R	0	0	14.3	44.5	61.9	133.7	174.4	127	231	50.7	29.5	0	867
	N°	0	0	1	4	7	10	15	15	14	4	2	0	72
1987	T	28.2	30.5	31.3	33.3	31.8	27.9	26.5	25.8	26.6	28.1	29.4	27.4	
	R	0	0	6.6	0	59.6	112.8	265.4	293.4	163.3	56.4	0	0	880.70
	N°	0	0	2	0	5	13	15	20	12	5	0	0	72

T = Temperature in 0°C°
N°= Number of raindays
r = Rainfall in mm
Source: Service de la Météorologie, Lomé - 1988

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Appendix Table 3

Soil Analytical Data of Sites in the Pilot Area

Village	Site No.	Depth (cm)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Organic Carbon (%)	Total N (%)	C/N	Available P (ppm) (BRAY I)	Available P (ppm) (OLSEN-DABIN)
Naki - Nat Centre	1a	0-20 20-50	7.82 16.90	30.11 28.15	59.13 54.36	9.93 20.41	0.63 0.45	0.05 0.04	12.60 11.25	3.11 2.97	5.55 7.57
	1b	0-20 20-50	9.07 12.84	38.68 40.47	50.10 44.47	3.54 1.64	0.36 0.27	0.03 0.02	12.00 13.50	5.36 2.40	4.03 5.54
Bogou	2	0-20 20-50	9.06 17.68	71.29 31.39	18.61 50.27	0.86 2.37	0.27 0.21	0.03 0.03	9.00 7.00	1.69 1.56	5.03 18.18
Ipembona	3	0-20 20-50	6.59 14.90	18.50 16.82	71.62 67.89	12.06 21.74	0.36 0.33	0.03 0.02	12.00 16.50	1.99 1.70	3.55 25.76
Kowanpit-Bong	4	0-20 20-50	5.79 10.08	22.46 14.24	68.46 74.61	15.45 21.76	0.31 0.17	0.04 0.02	7.75 8.50	9.44 6.21	7.55 9.07
Bombonaka	5	0-20 20-50	14.05 19.00	55.09 38.22	26.20 41.11	0 8.59	0.47 0.40	0.05 0.04	9.40 10.00	1.50 1.70	7.15 6.08
Papri	6	0-20 20-50	9.40 10.10	18.47 40.99	70.48 44.81	6.14 26.01	0.41 0.36	0.04 0.03	10.25 12.00	4.41 7.63	5.59 29.28
Ogaro	7	0-20 20-50	5.78 12.59	36.90 24.26	53.68 58.50	0.41 0.44	0.30 0.23	0.03 0.03	10.00 7.67	3.17 4.65	7.04 27.71

Appendix Table 3 : continued

Soil Analytical Data of Sites in the Pilot Area

Village	Site No.	Depth (cm)	NH_4 Oac pH7 Exch. K (meq/100g)	Exch. Ca (meq/100g)	Exch. Mg (meq/100g)	Exch. Na (meq/100g)	Sum of bases (meq/100g)	Cation Exchange Capacity (meq/100g)	Base Saturation (%)	Exchange Acidity (meq/100g)	pH (H_2O)	pH (KCl)	KH_2PO_4 Extractable S (ppm)
Naki -Est Centre	1a	0-20	0.18	2.52	0.79	0.12	3.62	9.89	36.60	0.10	5.7	4.8	24.22
		20-50	0.14	3.63	1.29	0.15	5.22	8.48	61.56	0.07	6.0	5.0	12.11
	1b	0-20	0.13	2.42	0.60	0.11	3.27	6.30	51.90	0.12	6.3	5.4	44.35
		20-50	0.10	2.72	0.79	0.13	3.73	7.30	51.10	0.10	6.0	5.1	24.16
Bogou	2	0-20	0.09	2.11	0.91	0.12	3.23	7.55	42.78	0.10	6.0	4.7	24.16
		20-50	0.08	2.63	1.80	0.17	4.68	6.31	74.17	0.12	6.3	4.8	17.17
Kpembona	3	0-20	0.09	2.43	0.90	0.15	3.56	6.79	52.43	0.10	6.4	5.3	16.22
		20-50	0.07	3.13	1.51	0.17	4.88	7.58	64.38	0.07	7.0	5.5	12.12
Kowampit-Bong	4	0-20	0.14	3.72	0.92	0.13	4.92	7.05	69.79	0.10	6.5	5.5	12.08
		20-50	0.14	3.43	0.89	0.14	4.60	6.50	70.77	0.10	6.6	5.4	12.09
Bombouaka	5	0-20	0.13	3.88	2.28	0.17	6.46	13.08	49.39	0.00	5.7	4.5	12.26
		20-50	0.13	3.75	2.82	0.18	6.88	7.09	97.04	0.07	6.0	4.3	12.16
Papri	6	0-20	0.22	5.38	1.20	0.12	6.93	10.41	66.57	0.07	7.0	6.0	12.19
		20-50	0.18	5.05	1.01	0.12	6.36	9.24	66.83	0.07	7.1	6.1	12.12
Ogaro	7	0-20	0.13	2.72	0.60	0.12	3.57	5.28	67.61	0.10	6.4	5.4	24.15
		20-50	0.10	2.62	0.64	0.18	3.54	6.75	52.44	0.10	6.1	5.1	12.09

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Appendix Table 3 : continued

Soil Analytical Data of Sites in the Pilot Area

Village	Site No.	Depth (cm)	0.1 N HCL Extractable Mn (ppm)	Extractable Zn (ppm)	Extractable Cu (ppm)	Extractable Fe (ppm)	Extractable B (Hot Water) (ppm)
Naki - Est Centre	1a	0-20 20-50	82.15 87.09	1.61 1.01	0.91 1.01	203.15 204.66	0 0.40
	1b	0-20 20-50	65.52 57.89	1.01 0.70	0.71 0.60	207.94 193.62	0 0
Bogou	2	0-20 20-50	61.01 41.11	1.71 1.62	1.01 1.52	284.43 205.86	2.42 Traces
Kpenbona	3	0-20 20-50	67.21 74.76	1.62 1.31	1.01 1.21	190.98 188.30	1.62 6.22
Kowampit-Bong	4	0-20 20-50	96.55 71.65	2.42 1.41	1.61 0.81	130.57 150.46	1.97 5.04
Bombouaka	5	0-20 20-50	118.82 76.52	4.50 4.36	3.17 2.94	264.10 214.35	2.00 2.80
Papri	6	0-20 20-50	173.91 129.23	3.05 1.41	1.52 1.51	197.99 174.27	2.44 2.79
Ogaro	7	0-20 20-50	107.77 77.18	1.01 1.01	0.50 0.71	65.00 89.17	0.80 0.81

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APPENDIX 9

A Report on the Baseline Survey of the SFRP in the Ashanti Region of Ghana

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A REPORT ON THE BASELINE FARM SURVEY OF THE SOIL FERTILITY RESTORATION PROJECT IN THE ASHANTI REGION OF GHANA

Summary

1. The 1988 SFRP baseline data for Ghana were collected in the Ashanti region in the villages of Adjamesu and Hwidiem. A total of 121 farmers were interviewed, 67 of whom are women. The survey generated data on gender; cultural groups; marital status; household location and composition; education; employment; land availability and tenure; the use of machinery; animals, equipment, and credit; sources of information about fertilizers; crop areas and management; the use and costs of fertilizers; organic manures; crop residues; the use and cost of labor; disposal and use of crop production; and finally, the perceptions of farmers about constraints to fertilizer use and agricultural production.
2. The sample households are mostly comprised of nuclear families with age and gender distributions that allow meaningful comparisons between men and women farmers in various age groups. The households headed by women are somewhat larger than those of men in Hwidiem but in Adjamesu the reverse is the case.
3. The salient feature of schooling in the Ashanti region of Ghana is that although men have attained more years of education than women, younger Ashanti women have more schooling than older ones. This is evidence of real and meaningful social change for women.
4. The households headed by women are closer to markets for agricultural products than those of men as is the distance to stores for household

goods and fertilizer. However, the distances from households to household and individual plots managed by women are uniformly greater than for men.

5. Among adult household members, women are more likely than men to be engaged in off-farm employment but the number of months per year of off-farm employment is greater among men than women. The annual off-farm earnings of men are greater than that of women.

6. Among farmers that are head of households, women are again more often engaged in off-farm employment with the exception of Adjamesu, where the frequency of off-farm employment among men exceeds that of women. The duration and earnings from off-farm employment are again greater among men than women farmers. The great majority of off-farm employment is within the village of residence of men and women. However, the proximity of Adjamesu to Kumasi provides greater urban off-farm employment than in Hwidiem.

7. Although men and women predominantly manage their own plots, each gender may manage plots of the other. There are differences between the sizes of crop areas managed by women and men, however, the differences are not significant.

8. The data on land tenure in the Ashanti region of Ghana show that among men and women about 80% of plots are family owned with secure tenure rights. Women farmers are more likely to rent plots in Hwidiem than in Adjamesu.

9. The ownership of agricultural equipment is limited to men in Hwidiem. Women are somewhat less likely than men to own handtools and no women reported owning agricultural equipment. Thus, women are more likely than men to borrow tools for agricultural work.

10. Animal ownership is greater among men and women in Adjamesu than in Hwidiem. The average sample figures indicate that men own 16 animals and women 8. But animal ownership in Hwidiem is greater among women than men.

11. In the control village of Hwidiem, maize and cassava as sole crops and as bases for intercrops account for 84% of the crops on 106 sampled plots and 66% of 129 sampled plots in Adjamesu. For the total sample these crops account for 75% of the cropping systems.

12. The average size of the 235 plots included in the sample in both villages is 0.6 acres. The average plot size for men is 0.76 acres and 0.55 acres for women.

13. The total sample figures show that disregarding gender, 32% of the sample plots are allocated for the intercrop of maize and cassava. The sole crop of cassava is second in importance for both men and women, 17% and 16% of all plots, respectively. A striking contrast in crop choices by gender in Adjamesu is evident in that men allocate 30% of the area under their management to various cassava intercrops and diverse other crops but only 9% of the women show this pattern.

14. Both villages rely heavily on household labor. Specifically, 77% of all workdays are performed by household labor in Hwidiem and 87% in Adjamesu.

15. Women hire more labor than men for the difficult task of land preparation and use more workdays of labor than men for the tasks of land preparation, planting, weeding, fertilizer application, and other activities.

16. Use of household and hired labor by men and women farmers varies between villages and among crops and activities. For instance, farmers in Adjamesu rely more on household labor for the production of maize, but

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use more hired labor for weeding cassava than those in Hwidiem. Farmers in Hwidiem are twice as likely as those in Adjamesu to hire labor for the maize-cassava intercrop. The use of hired labor for maize-cassava in Hwidiem (38 workdays/acre) exceeds that of Adjamesu (19 workdays/acre).

17. In Hwidiem 56% of all workdays for all activities were performed by men, 41% by women, and 3% by children. The corresponding figures for Adjamesu are 38%, 41%, and 21%, respectively. There is no evidence in this study that food production is the sole or exclusive responsibility of women or men. Although, men perform most of the land preparation activity, neither gender performs agricultural tasks without the assistance of the other.

18. The total sample figures show 14% of all farmers used fertilizer during the survey season and that men (21%) are more likely to use fertilizer than women (9%). Adjamesu showed more gender equality of fertilizer use than Hwidiem, but farmers in Hwidiem are somewhat more likely to use fertilizer than in Adjamesu.

19. Lack of knowledge is an important constraint to the adoption of fertilizers. Twenty-nine percent of the men in Hwidiem and 42% of the men in Adjamesu reported having no knowledge about the use of fertilizer. Among women farmers, 42% in Hwidiem and 35% in Adjamesu reported no knowledge about fertilizer use.

20. The perception about the lack of need for fertilizer is still present among some farmers. Men (29%) in Hwidiem are more likely than women (12%) to report that fertilizers are not needed. No men in Adjamesu reported that fertilizers are not needed but 13% of the women reported no need.

21. The cost of fertilizer is another important constraint to fertilizer use. Twenty-one percent of the farmers in Hwidiem and 14% of those in Adjamesu cited the expense of fertilizer as a reason for discontinuing use. Eighteen percent of the total sample cited this reason. Women are less likely than men to report that price is a constraint to fertilizer use.

22. Regardless of gender, Ashanti farmers are quite clear about their aversion to handling organic waste. The words the farmers used to describe organic manure were dirty, filthy, and unhealthy. Thus the use of organic manure in the Ashanti region of Ghana is minimal.

23. The use of agricultural credit in both sample villages is very limited. Only 26% of the farmers in the sample reported using some sort of agricultural credit during the survey year. Farmers in Adjamesu were somewhat more likely than in Hwidiem to use credit, 30% and 21%, respectively. It is noteworthy that 76% of the farmers in the sample that did not use credit made no attempt to obtain a loan for the 1988 cropping season.

24. Most crop output is produced for the dual purposes of household consumption and sale. Seventy-one percent of the farmers in Hwidiem and 50% of those in Adjamesu cultivated maize for the dual purposes of household consumption and sale. Eighty percent of the cassava in Adjamesu was used for these purposes. The data for all crops show that crops grown for these purposes are more frequent in Hwidiem (69%) than Adjamesu (53%).

25. Sales of crops take place mostly in the village of the farmers' residence. Sixty-seven percent of all farmers reported that all crops were sold in the village of residence and 23% made sales in Kumasi.

26. Farmers themselves are most often responsible for crop sales. This is the case for 73% of the total sample, 71% of the farmers in Hwidiem, and 75% of the farmers in Adjamesu.

27. A significant number of farmers are uncertain about the value of information from agricultural cooperatives. The total sample figures show that 56% of the farmers are uncertain about the value of information received from agricultural cooperatives and 17% perceive information from this source as not helpful.

28. There is an apparent lack of confidence among some farmers about the information that extension workers provide; 54% of the farmers view information from extension workers as not helpful, 34% view such information as very helpful, and 12% find such information somewhat helpful.

29. Thirty percent find information from other farmers very helpful and 18% find such information helpful to some degree.

30. Overall, farmers in the Ashanti region of Ghana find information from fertilizer dealers and cooperatives least helpful.

31. The problem of integrating women into agricultural cooperatives is evident in that 90% of the women farmers are uncertain about the value of information from this source. Seventy percent of the women in Hwidiem are uncertain about the value of information from extension workers. These figures almost certainly indicate the exclusion of women from extension and cooperative services. The value of information received by women in Adjamesu generally follows the same pattern.

32. The access of farmers to the extension service is rather limited in the survey region. Fifty-six percent of the farmers in the sample did not receive extension service visits during the survey year. The lack of

extension service visits is more frequent among women than men farmers. In Hwidiem, 52% of the men farmers and 87% of the women farmers received no extension visits. In Adjamesu, 30% of the men and 51% of the women did not receive extension service visits.

33. A small but significant proportion of farmers have had access to television programs concerned with agricultural. Twenty-four percent of the farmers in Hwidiem and 35% of those in Adjamesu reported having seen at least one television program concerned with agricultural products. In Hwidiem 38% of the men and 10% of the women reported seeing fertilizer information on television. The corresponding figures for Adjamesu are 43% and 30%, respectively.

34. The data clearly show that low soil fertility is perceived as the most important constraint to agricultural production in both villages, regardless of gender. This uniformly important constraint demonstrates that the goals of the SFRP clearly address the most important constraint to agricultural production as perceived by farmers in the Ashanti region of Ghana.

35. Regardless of gender, the lack of rain and a combination of pests and diseases are perceived as the second and third most important constraints to agricultural production.

36. The major constraint to fertilizer use cited by both men and women is lack of knowledge, followed by high prices, lack of available supplies, and lack of money. Some women think that fertilizer changes the taste and texture of cassava and cite this as a constraint to fertilizer use.

Estimates of production functions for maize-cassava intercropping indicate the following:

37. Overall productivity in Hwidiem was significantly higher than in Adjamesu. Thus, holding other factors constant, crop yields of the maize-cassava intercrop were significantly higher in Hwidiem than in Adjamesu.

38. The farmer's gender did not have a statistically significant effect on overall crop productivity. Although men farmers have a higher level of productivity the difference was not statistically significant. Therefore, the hypothesis that men and women farmers have the same level of overall productivity cannot be rejected.

39. The use of fertilizer had a positive effect on yields of maize/cassava; however, this effect was not statistically significant mainly because of very limited fertilizer use among farmers (less than 4% in the subsample).

40. The level of education of farmers, measured by the number of years of schooling, had a positive impact on crop yields and overall productivity, but the coefficients of this variable were not statistically significant. The lack of statistical significance may be due to the apparent correlation of this variable with the gender and labor use variables.

41. Coefficients of labor use variables in the linear models show that (a) although the average productivity of the labor of men (8.4 kg of maize per workday) is somewhat higher than the productivity of labor for women (5.9 kg of maize per workday), the difference is not statistically significant and (b) the average productivities of men, women, or children are not significantly different, but rather equal to about 7-8 kg of maize per day of work. It is interesting to note that, at the average price of maize (Cedis 45/kg) the value of this average (marginal) product is Cedis 360 per day, which is very close to the average wage rate paid

in the region. This is an indication that farmers in the region use labor at levels that are consistent with the price environment.

The estimated elasticity of crop yields with respect to labor, 0.49, indicates the percent change in crop yields associated with a 1% change in the use of labor, i.e., on the average 10% increase in labor use resulted in about 5% increase in crop yields. The use of fertilizers should bring about an increase in the average productivity of labor but not necessarily in the magnitude of its elasticity.

42. The negative sign of the coefficient for the variable area cultivated per farm, although statistically significant in only one model, indicates diseconomies of scale in crop production, i.e., that crop yields decrease as the area cultivated per farm increases. Such diseconomies may be associated with difficulties farmers have in managing several plots which are often located at considerable distances from each other.

Estimates of the functions of farmers' income indicate the following:

43. Gross crop and household incomes of farmers in Hwidiem were significantly higher than in Adjamesu. Coefficients of the dummy 0-1 variable for village were statistically significant at 0.05 level of significance in all models.

44. Men have significantly higher levels of income than women farmers. Coefficients of the dummy 0-1 variable for gender of the farmer were statistically significant at the 0.10 level of significance in all models.

45. The use of fertilizer has a positive impact on farmers income. The coefficients of the dummy 0-1 variables for fertilizer use were positive

but not statistically significant, probably as a result of the small number of farmers using fertilizer (about 4%).

46. The intensity of labor use (workdays/acre) of men, women, and children had a statistically significant impact on the levels of farmers' income. Parameter estimates show that on the average, a workday of a man, woman, and child per acre of cultivated land increased the annual income per farm by Cedis 912, 775, and 878, respectively. Differences among these estimates were not statistically significant.

47. Elasticity estimates of crop income and total household income with respect to intensity of labor use in crop production were 0.55 and 0.47, respectively. These estimates were statistically significant at 0.01 level of significance and show that on the average a 10% change in the intensity of labor use in crop production changed crop and total income by 5.5% and 4.7%, respectively.

48. Coefficients of the variable crop area per farm reflected the statistically significant impact of increased cultivated area on the levels of income per farm. The coefficients in the linear models show that, holding "constant" other variables included in the model about Cedis 50,000 of increment in annual income per farm was associated with an additional acre of cultivated land. The magnitude of these estimates should increase with the use of fertilizer.

Estimates of the labor use models for Hwidiem and Adjamesu indicate the following:

49. In both villages men farmers on the average use less labor per acre than women, however, differences were not statistically significant.

50. Fertilizer use had a positive impact on the use of labor per acre of cultivated land. This impact was statistically significant in Hwidiem but not in Adjamesu.

51. Off-farm employment by farmers had a positive effect on the intensity of labor use in crop production in Hwidiem but a negative one in Adjamesu. This is not surprising because off-farm employment as a source of income may increase the use of labor in crop production by providing financial means to hire farm labor (income effect), but also it may decrease the use of labor by diminishing the availability of family labor to work in the farm (substitution effect).

52. Education of farmers measured in terms of number of years of schooling had a positive and statistically significant effect on the intensity of labor use in Adjamesu. However, in Hwidiem the coefficients of this variable were very small and not significant and were deleted from the models.

53. Coefficients estimating the effect of the variable area cultivated per farm on the intensity of labor use were statistically significant in all models. These effects, however, were positive in Hwidiem but negative in Adjamesu. These results are probably due to the smaller areas of cultivated land per farm in Hwidiem (average of 1.24 acres) than in Adjamesu (average of 1.96 acres). There is an apparent positive relationship between intensity of labor use and area cultivated when farms are small and include no more than one plot. This relationship becomes negative when farms are larger and have more than one plot. In the case of large-scale farmers, negative relationships may be explained by the presence of constraints in family labor and by difficulties in the management of several plots of land.

The value of the information and results presented in this report will be substantially enhanced when they are compared with similar results that will be obtained on the basis of the 1989 farm survey to be conducted after fertilizers are extensively used by farmers in the experimental village.

A REPORT ON THE BASELINE FARM SURVEY OF THE SOIL FERTILITY RESTORATION PROJECT IN THE ASHANTI REGION OF GHANA

Introduction

The rapidly increasing populations of sub-Saharan Africa and declining per capita food production continue to focus international attention on the region. In particular, the regions of West and Central Africa have presented some of the most complex problems in agricultural development during the latter quarter of this century.

The soils of West Africa are generally low in fertility, readily exhausted through cropping, and prone to leaching of nutrients and erosion. Farmers have traditionally coped with these problems through shifting cultivation or "bush fallow rotations" where land is left fallow for perhaps 5 or 10 years to allow natural vegetation to restore soil fertility. In the past, these practices combined with complex cropping systems have permitted low but relatively stable food production.

In recent years the increasing need for additional food has compelled farmers to shorten fallow periods which threatens the stability and sustainability of the shifting cultivation systems. Marginal lands are being cultivated for food crop production, and there is increasing evidence that more frequent and continuous cropping of the fragile and highly weathered soils is causing serious depletion of soil organic matter, overall fertility levels, and environmental degradation. The ecological diversity of West Africa further compounds these problems and poses a complex scientific

challenge for agriculturalists, especially soil scientists, agronomists, sociologists, and economists.

International development agencies and donors are justifiably concerned about these problems and support initiatives to reverse or mitigate the problems of sub-Saharan African farmers and their natural environments. The need to manage and protect the natural resource base for agriculture in the region is imperative. Systems to improve crop production through soil amendments or new alternatives must be developed to increase the productive potential of the existing resource base for food production and contribute to a sustainable agricultural base.

Basic and applied agricultural research is needed to obtain an improved understanding of the physical, chemical, biological, and socioeconomic features of agricultural systems in the region. It is especially important to identify and analyze the determinants of stability and environmental degradation of the resource bases in West Africa.

In this regard, it is necessary to identify and test methods and systems of resource management for soil fertility and cropping practices. In particular, it is necessary to design and monitor soil management systems that can at least stabilize or, ideally, increase food production. One particularly important priority for such research is to collect detailed information on the role and use of fertilizers and associated soil amendments in stabilizing, increasing, and sustaining the productive potential of West African soils. Such research should be pursued within prevailing circumstances of agricultural policies, farming systems, and socioeconomic conditions.

Considering the problems of the availability and use of fertilizers in West Africa compared with other developing regions of the world and the

imperative for farmers to increase food production, the International Fertilizer Development Center (IFDC) is conducting a Soil Fertility Restoration Project (SFRP) to determine the agronomic, economic, and social benefits of fertilizer and associated soil amendments in countries and villages of West Africa. The project examines the contribution of fertilizer use in villages in Ghana, Togo, and Niger and assesses the potential of fertilizer to increase and sustain food crop production and farm incomes under contrasting agronomic, climatic, and socioeconomic conditions.

As an applied agronomic and socioeconomic research program, the SFRP evaluates various fertilizer investment options and assesses their benefits for the restoration of soil productivity, the sustainability of soil fertility, evolution of farming systems, the economies of local communities, and the implications for the reversal of environmental degradation.

Implementation of the SFRP over a 5-year period will center on pilot projects in selected villages in three agroclimatic regions in West Africa. These projects will provide baseline data on the agronomic, socioeconomic, and environmental benefits of fertilizers and associated amendments for the major soils and ecologies in the region.

Specifically, the pilot research areas are in the humid zone of Ghana, the savanna zone of Togo, and the Sahel zone in Niger. The elimination of specific soil fertility constraints in these potentially productive areas and the availability of markets for additional produce would make fertilizer use profitable and attractive for small-scale farmers.

The SFRP research first required the selection of pilot regions in contrasting agricultural and social environments where crop production and soil fertility may be increased and maintained through soil amendments and fertilizer use, the collection of base line ecological and socioeconomic data,

and the establishment of pilot projects in selected regions. This was accomplished with the collaboration of national programs to field test soil amendments and fertilizer use strategies. Emphasis was given to the use of indigenously available resources for the soil amendments and the use of fertilizer. The products obtained through low-cost processing of indigenous raw materials as well as conventional fertilizer products were considered in designing the research.

The training of national program personnel to implement and monitor the pilot projects and collect the necessary agronomic and socioeconomic data is an important aspect of the project. The determination of economically and socially effective strategies to restore soil fertility that could be recommended for adoption in selected regions through government-sponsored programs is also of great importance and is continuing. The sharing and dissemination of information from the project and strengthening the capability of various national agricultural research organizations to conduct similar soil fertility restoration research through scientific support and consultation, material support in the execution of the pilot projects, and an annual workshop are additional benefits of the SFRP. The long-term development objective of the project is to increase the availability of food, increase rural incomes, and promote agricultural and rural development in Africa through the reclamation and conservation of croplands whose fertility is depleted.

The purpose of this report is to describe the socioeconomic characteristics, farming practices, and the role of women in agriculture that existed in the SFRP research areas in 1988, the initial year of the project. The data and report will provide a basis for determining the social and economic consequences of fertilizer use interventions in subsequent years of

the project. The consequences of fertilizer use will be evaluated in terms of changes in the socioeconomic environment, farming practices, use of inputs, agricultural production and productivity, monetary income of farmers, employment, and the role of women in agricultural development.

The Data and the Sample Region

The Data

The 1988 baseline data for the SFRP were collected through the use of a questionnaire that contained open and closed ended items. The survey generated data on gender; cultural groups; marital status; household location, composition, education, and employment; land availability and tenure; the use of machinery, animals, equipment, and credit; sources of information about fertilizers; crop areas and management; the use and costs of fertilizers, organic manures, and crop residues; the use and cost of labor; disposal and use of crop production; and finally, the perceptions of farmers about constraints to fertilizer use and agricultural production. Extensive interviews were also conducted with village chiefs to provide an overview of agriculture in each village.

In the Ashanti region of Ghana, a random sample of farmers in two villages was stratified to include women. A total of 121 farmers were interviewed, 67 of whom were women. Thus, comparisons of gender differences in agriculture are significant contributions of the SFRP. The interviews were conducted by national collaborators in each country and supervised by IFDC staff from Headquarters and the West Africa Division.

The interviewers received tutorial instruction on field survey work and interviewing. Practice interviews were conducted and detailed discussions about the intent and nature of the questionnaire in general and the SFRP in particular were completed with the interviewers. The interviews were conducted in village centers, households, and in the fields of farmers. The cooperation and support of the farmers that was reported by the interviewers were attributable to the support of the project by each village chief. Household data are very difficult to obtain in West Africa and are found sparsely in the literature. The uniqueness and quality of the SFRP data are attributed to its richness, depth, and the design of the questionnaire.

The Sample Region

Located in the central part of Ghana, the Ashanti Region exhibits most of the physical, biological, and other environmental factors required of a project such as the SFRP (see Figure 1). About two-thirds of the 2.1 million people in the region live in rural areas and are directly engaged in agriculture or in agro-based industries. With fairly well-distributed 1,600 mm of annual rainfall, mean annual temperature of 27°C (see Figure 2), and potentially productive soil types, the region is considered potentially one of the most agriculturally productive in the nation.

Kumasi, the regional capital, is the second largest city in Ghana with about a quarter of the total regional population. Nearly all the important trading routes connecting the northern and southern parts of Ghana converge at Kumasi. Kumasi is also the meeting point of the railway lines from Accra, the national capital, in the southeast and from the twin harbor cities, Sekondi-Takoradi, in the southwest.

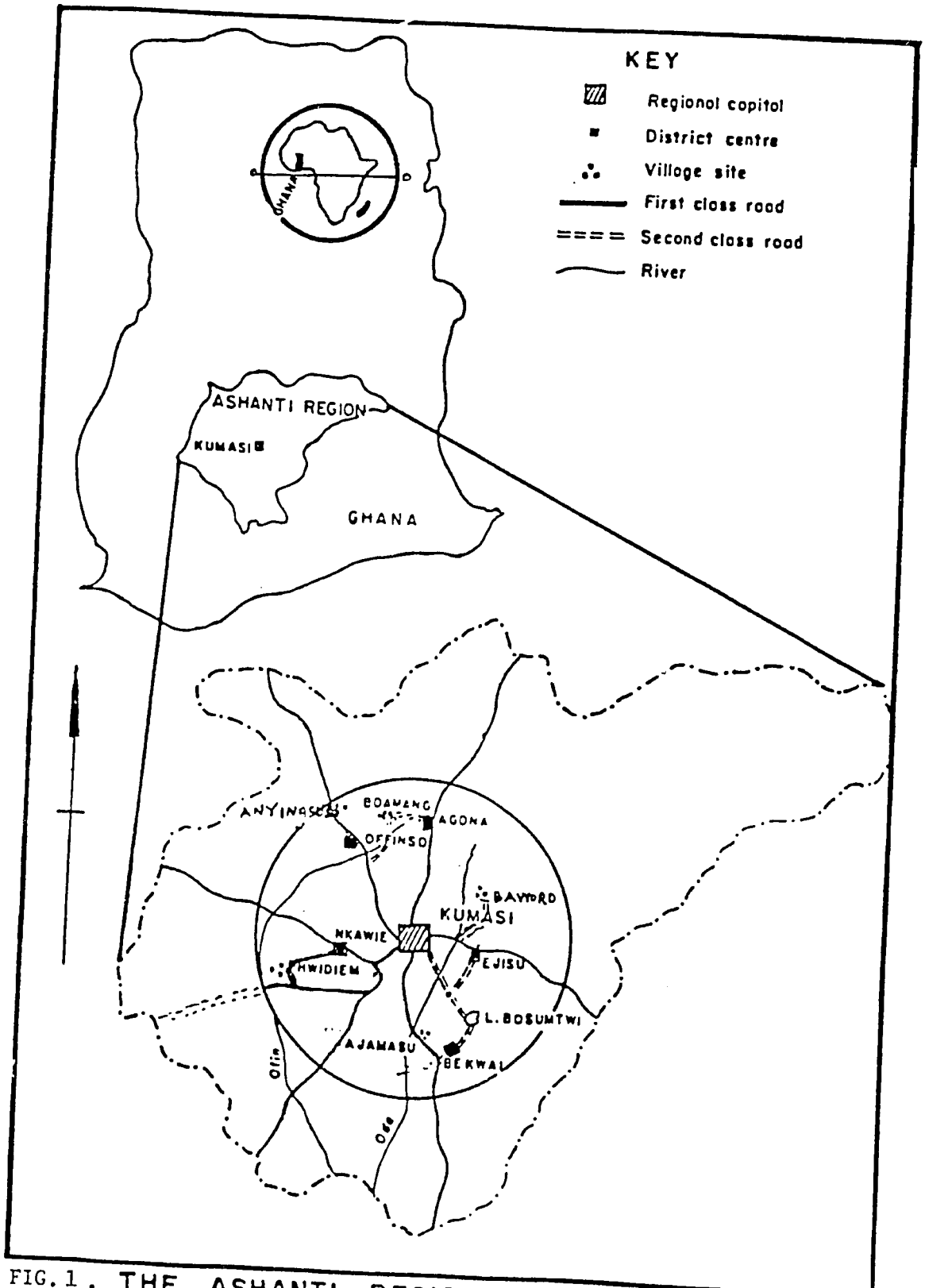

FIG. 1. THE ASHANTI REGION OF GHANA

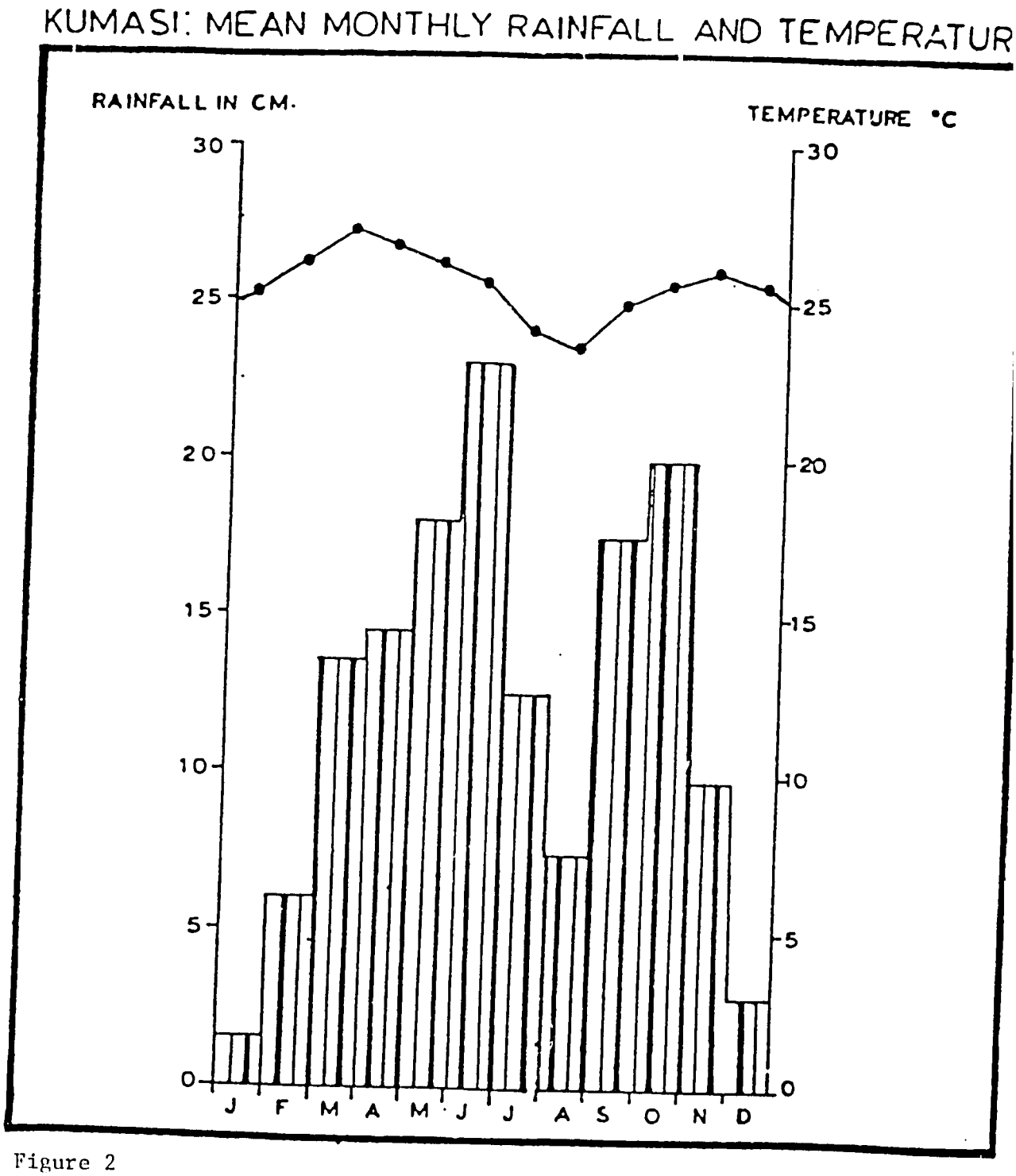

Figure 2

SOURCE: Meteorological Services Department, Kumasi

Within the Ashanti region, settlements are urban and semi-urban townships whose residents provide markets for a substantial proportion of the food crops grown in neighboring villages. Thus, the ecological, socioeconomic, infrastructural, and institutional arrangements in the region provide an ideal environment for the SFRP whose ultimate goal is to improve the well-being of small-scale farmers through increased agricultural productivity.

The Sample Villages

Based on exploratory surveys, an experimental and control village in the Ashanti region were chosen to be studied extensively. The experimental village will receive fertilizers, and the control village without fertilizer serves as a basis of comparison about changes that occur as a result of the SFRP intervention. The experimental village is Adjamesu, and the control village is Hwidiem.

Based on data from 15 villages within a 40 km radius of Kumasi, the experimental village was finally chosen by the following criteria: (1) the availability and access to large markets and fertilizer distribution centers for farmers, (2) experiences and viability of extension workers, (3) location of villages to enhance the diffusion of information about fertilizer and the SFRP, and (4) soil tests to determine fertility. As shown in Table 1.1 compared to Hwidiem, the control village, Adjamesu, the experimental village, is closer to the large market in Kumasi and has a larger population base. The interviews with the village chiefs of Adjamesu and Hwidiem are useful for understanding the character of agriculture in the Ashanti villages and are provided in the form of overviews.

Table 1.1. Population Estimates for Adjamesu and Hwidiem and Distances to Selected Services

Village	Total Population	Distances to Services				
		Hospital	Commercial Bank	Secondary School	Large[a] Market	Agricultural Extension/ Fertilizer Depot
		(km)				
Adjamesu	2,258[b]	16.0	16.0	16.0	16.0	16.0
Hwidiem	998[c]	25.0	4.5	3.2	25.0	25.0

a. The large market as used here refers to Kumasi where farmers make bulk sales of farm produce and procure agricultural inputs such as seeds, fertilizer, and tools.
b. 1987 projection based on 1970 Population Census data and a 2.5% growth rate.
c. 1984 Population Census of Ghana: Preliminary Report (unpublished), courtesy of the Statistical Service.

Village Overview: Adjamesu

The Chief of Adjamesu, Nana Fobi, provided an interview about the situation of agriculture in his village. Chief Fobi is a full-time farmer and a one-time recipient of the prestigious National Best Farmer Award.

The Chief estimated that more than half of the 2,300 people in his village are children; a significant proportion of the 350 households is headed by women, and about 85% of the adult population are farmers. He stated that the main objectives of most farmers in the village are to produce more food to feed the growing population, sell any surpluses for cash to meet their needs, and to reinvest in agriculture.

Concerning recent changes in the general structure of agriculture in the village, the Chief explained that several changes have occurred over the past decade. Recent changes include the introduction of "new" crops,

increases in the size of farm plots, and greater participation of the youth in agriculture. The cultivation of tomatoes and other vegetables, he said, is increasingly popular among younger farmers because the crops mature early and there is always a market for sales. He sees the proximity of Adjamesu to Kumasi, the regional capital (24 km), and Bekwai, the district capital (12 km), as well as the presence of a first class road as great assets in marketing farm produce.

Farmland

Land for food crops, he noted, is readily available for residents, but for cash tree crops such as cocoa and coffee, residents have to travel to other parts of the country, usually the Western Region of Ghana, to acquire land for new farms. He attributed the apparent shortage of good farmland to two factors: (1) the decline in the productive capacity of village farmlands and (2) the need to make larger farms to provide food for the growing population. He explained further that by custom, village farmlands cannot be sold. However, land can be leased to friends for shorter periods, usually for a year or two.

Farm Labor

According to the Chief, most of the farmers rely on family labor for farm operations. Children, particularly from age 10, play a very significant role in farming. They help in planting, harvesting, and sometimes the sale of farm produce. In some cases about three or four farmers create a group to provide reciprocal labor on their farms. This practice, locally referred to as "noboa," is very common among those who "specialize" in the cultivation of

tomatoes and other vegetables. Farmers also hire labor to accomplish specific tasks on their farms.

Women, for example, usually hire labor for the difficult task of land preparation, such as bush clearing and collection of debris. The average daily wage for about 5 hours of work for specific farm tasks was estimated as follows:

Table 1.2. Activity and Cost of Labor

Activity	Wage (¢)	US $
Land clearing	350	1.75
Tree felling and chopping	350	1.75
Debris collection	350	1.75
Weeding	300	1.50

200 cedis = US $1.

In all cases, an extra ¢50 is paid in lieu of free lunch for farm laborers. The Chief explained that farm labor is always in short supply because migrants who used to come from the neighboring countries to work on the village farms rarely come these days. Also most of the local young men prefer to work on their own farms rather than "selling" their labor to other farmers.

Use of Fertilizer and Other Soil Amendments

The use of fertilizer is fairly recent in the village and is mostly used to grow tomatoes and other vegetables. The main food crops of cassava, maize, plantain, and cocoyam hardly receive any fertilizers, he said. Farmers do not use animal manure for two reasons. First, it is not available because the few goats and chickens are raised on a "free-range" basis. Second, the

idea of using animal manure is alien to most farmers, as the Chief put it, "we are yet to learn that practice even if we had the manure."

Agricultural Extension

The Chief praised the SFRP for the significant improvement in the relationship between the resident extension officer and the local farmers. He hinted that prior to SFRP involvement in agriculture in the village, farmers rarely followed extension advice because some of the recommendations were too abstract. But since several farmers visited the SFRP test plots, the attitudes of most farmers have changed a great deal. "I see a lot of farmers talking to the extension officer; some even invite him to their farms, and the officer appears highly motivated," the Chief added.

In his estimation, an additional extension officer in the village will not only help ease the present workload of the officer but will be very beneficial to his people as well.

General Problems of Agriculture

The Chief mentioned lack of agricultural credit, declining productivity, rising costs of inputs and equipment, and inadequate storage systems as the main agricultural problems in Adjamesu. He explained that, although several farmers are aware of credit facilities at the commercial banks, most take loans from friends, relatives, and local money-lenders. He mentioned the volume of paper work involved, uncertainties, and delays as the main reasons why farmers shun the commercial banks.

Regarding storage systems, the chief emphasized that the current practice of "hanging corn cobs over the fire place" needs some improvement. He also stated that alternative methods suggested by extension personnel

entail additional costs that most farmers cannot afford. In response to a suggestion about the possibility of a community storage system involving all farmers in the village, he said, that may be too difficult to manage. He was of the opinion that as a first step, he would prefer the construction of smaller storage facilities involving between 10 and 20 families.

Concerning declining productivity, the Chief rated declining soil fertility second to changing weather patterns as basic problems. He did note, however, that the length of fallow has been reduced considerably over the last two decades, and that soils in the village need to be improved. Finally, Chief Fobi sees SFRP as a timely intervention and looks forward to significant improvements in agriculture in his village.

Village Overview: Hwidiem

The Chief of Hwidiem died in early February 1989. Pending the selection of a new Chief, Opanin Baffour Awuah, a long-time resident and Chairman of the Village Development Committee (VDC), acts as Chief for Hwidiem and agreed to an interview about the situation of agriculture in Hwidiem.

The VDC Chairman said that about 65% of the estimated 500 economically active population in the village are women, most of whom are engaged in the production of maize, cassava, and plantain. He attributed the preponderance of females over males to the "mass exodus" of young men from the village to Nigeria and other West African countries in the late 1970s and early 1980s. He explained that most of the migrants have returned to Ghana but have chosen to live in the regional capital, Kumasi, and engage in retail

business or take urban employment. This trend, he said, has had bad consequences for food production in the village.

Farm-Level Labor

The Chief explained that most farmers use family labor for agricultural work. Single women usually hire labor for the more difficult tasks such as land preparation, bush clearing, and debris collection. He estimated that about 26 workdays are required to prepare a hectare of land for seeding. At the wage of ¢400 or about US $2/day this amounts to about ¢10,400 or US $52/ha. He said farmers who cannot afford that cost at the beginning of the cropping season form labor pools to work on each other's farms. Like Adjamesu, children from about age 10 help in weeding and harvesting.

Changing Patterns of Agriculture and Land Use

Regarding changes in agriculture, the Chairman recalled that the village was once a major cocoa-producing center. But since the 1970s several farmers have converted their cocoa farmlands to food cropland, mainly plantain, maize, and cassava. Lately, ginger, tomatoes, and other vegetables are receiving greater attention. He attributed these changes to declining yields and falling cocoa prices since the 1970s. Thus, the farmers' response to the growing food demand has generally been to increase the size and number of farms under food crop production.

Consequently, the Chairman said, some farmers are experiencing a land shortage. A few farmers have moved to other regions of Ghana while those who cannot afford new cropland have pursued sharecropping. Lately, he continued, a few farmers have obtained land on a lease basis for a duration of about 3 years at a cost of between ¢5,000 and ¢6,000 (US $25 and US $30)/ha.

Use of Fertilizers and Other Soil Amendments

Chairman Awuah said that very few farmers in the village use fertilizers. Fertilizer use is confined mostly to the cultivation of vegetables and ginger--two crops that have markets in Kumasi. He attributed the low level of fertilizer use in the village to the cost and availability. He explained that, although several farmers recognize the importance of fertilizers, few farmers can afford the current retail price of ¢2,300 (US $11.50) and ¢1,600 (US $8.00)/bag of 50 kg for NPK and sulfate of ammonia, respectively.

Regarding the use of crop residue and animal manure, Chairman Awuah said, "it will take some time to convince most farmers in the village about the usefulness of residue and manure." He explained that at the moment most farmers burn or throw away the debris after weeding because it is generally believed that good farmers keep their farms clean of debris and weeds.

Agricultural Extension

Farmers generally receive extension advice about the use of fertilizer on cash crops such as cocoa, ginger, and tomatoes, but "very little is said about food crops such as maize and cassava". As he put it, "the only thing I remember having been advised about maize is the need to use improved seeds, but the seeds are not easy to come by." The chairman views the SFRP fertilizer trials on farmers' fields and the posting of an extension officer to the village as positive steps toward better communication between farmers and the extension service.

Crop Yields, Harvest, and Storage

Asked about crop yields, Chairman Awuah explained that yields have steadily declined since the 1970s. He recalled how as a young boy he could hardly carry the harvest from a single cassava plant. Nowadays, it takes more than 10 matured plants to fill an average-size basket. He also cited the period 1982-84 as the worst crop years in recent memory. Like the Chief of Adjamesu, he attributed low yields to drought and uncontrolled bush fires during the dry season. Accordingly, he views the recent increases in crop yields as a direct outcome of good rain.

The Chairman explained that most farmers harvest and sell maize when mature. He cited two reasons why farmers sell their crops soon after harvest. First is their desire to meet immediate cash needs. Second is the lack of storage facilities for maize over extended periods of time. The following prices of dry maize at different times of the year were provided by the Chief.

Table 1.3. Maize Prices by Time of Sale (in cedis/100 kg)

Time of Sale	Sale Price	
	Cedis	US $
At harvest	3,000	15.0
3-4 months after harvest	5,000	25.0
6 months after harvest	6,500	32.5

200 cedis = US $1.

The Chief mentioned that it is common for a few village residents, particularly women, to buy and store grain to wait for price increases. But in most cases they can buy only a few hundred kilograms. Above all, they cannot store the grain long enough to profit when prices peak.

General Problems of Agriculture

In describing the agricultural problems of farmers in Hwidiem, the Chairman mentioned lack of farm credit, high cost of farm labor, theft, and damage caused by rodents and other pests. He explained that the beginning of the cropping season is a time when farmers have very little money to invest in agriculture. Consequently, many farmers cannot hire extra labor to supplement family labor. This results in farms large enough to provide food for home consumption and virtually nothing for market sale.

Crop theft, he said, has become rampant in recent times. He cited the arrest and prosecution of two young men who had raided a farm the week before the interview. Regarding rodents, the Chairman mentioned that "grass-cutters" are causing severe damage to crops. The strategies of some farmers to repel the rodents include setting traps around the perimeter of their farms and spraying a few crops with a locally prepared solution believed to be highly toxic to the rodents.

Demographic Characteristics of Households

The Sample Households

The distributions of sample households by age and gender are presented in Table 2.1. Of the 121 farmers interviewed in both villages, 55% are women and 45% are men. Men and women in the control village of Hwidiem are generally younger than in the experimental village of Adjamesu. The social, economic, and agronomic consequences of fertilizer use will be monitored for a sample of farmers that includes young as well as older men and women farmers in Adjamesu. These distributions show that the sample of

farmers will clearly allow meaningful contrasts and comparisons between men and women to be made.

Table 2.1. Distribution of Sample Households by Gender and Age in Adjamesu and Hwidiem

	Adjamesu						Hwidiem					
	Men		Women		Total		Men		Women		Total	
Age	N	%	N	%	N	%	N	%	N	%	N	%
<24	-	-	2	5	2	3	10	32	2	7	12	19
25-29	3	13	4	11	7	12	9	29	2	7	11	18
30-34	5	22	5	14	10	17	4	13	2	7	6	10
35-39	2	9	3	8	5	8	1	3	11	36	12	19
40-44	1	4	6	16	7	12	-	-	4	13	4	7
45-49	2	9	7	19	9	15	3	10	3	10	6	10
50-54	1	4	3	8	4	7	1	3	2	7	3	5
55-59	3	13	2	5	5	8	1	3	-	-	1	2
>59	6	26	5	14	11	18	2	7	4	13	6	10
TOTAL	23	100	37	100	60	100	31	100	30	100	61	100
Percent	38		62		100		51		49		100	

Household Composition

Table 2.2 shows the percentage distributions of the household relatives of men and women farmers by village and the total sample. In the control village of Hwidiem, spouses, sons, and daughters comprise 77% of the households headed by men but about 90% of the households headed by women. Women farmers in Hwidiem are more likely than men to have their households comprised mainly of sons and daughters. Thus, women in Hwidiem have substantial family labor available. The traditional matrilocal and matrifocal features of Ashanti culture are evident in these figures.

Table 2.2. Family Structure of Sample Households

Village	Farmer Gender	Wives	Husbands	Sons	Daughters	Sisters	Parents	Grandchildren	Other[a]
		(%)							
Hwidiem	Men	38	-	31	8	7	8	-	8
	Women	-	25	46	18	1	3	4	3
	Total Sample	28	20	29	10	3	4	2	4
Adjamesu	Men	23	-	30	20	4	8	10	5
	Women	-	24	36	29	1	2	1	7
	Total Sample	23	16	26	20	2	4	4	5
All Sample	Men	30	-	30	14	6	8	5	7
	Women	-	24	41	24	1	3	3	4
	Total Sample	26	17	28	14	3	4	3	5

a. Other includes cousins, uncles, nieces, nephews, grandparents, and brothers.

In Adjamesu, wives, sons, and daughters comprise 73% of the households headed by men, unlike Hwidiem, where grandchildren comprise 10% of the household relatives. Husbands, sons, and daughters comprise nearly 90% of the households headed by women in Adjamesu. Regardless of gender, about one-quarter of the households are comprised of spouses. This figure is somewhat higher for men in Hwidiem (38%). The data in Table 2.2 clearly show the households in both villages are nuclear rather than extended.

Household Size

Table 2.3 describes further the sample households by the mean number of men, women, children, and mean household size. Although the mean number of men per household is equal regardless of gender in Hwidiem, households headed by men in Adjamesu have more men than those headed by women. The mean number of women in households headed by men as compared with women is about equal in Hwidiem, but the average number of women per household is somewhat higher in

households headed by men in Adjamesu. The total sample figures in Table 2.3 show further that households headed by women have on the average more children than households headed by men. Although the male-headed households compared with those of women are on the average larger, this difference is not statistically significant. The variation of household sizes among men is greater in both villages as evidenced in the total sample standard deviations.

Table 2.3. Size and Composition of Sample Households, Number of Men, Women, and Children in Households by Gender, Village, and Total Sample

		Men in Household		Women in Household		Children in Household		Size of Household	
Village	Farmer Gender	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Hwidiem	Men	2.1	1.5	1.8	1.4	1.8	1.9	5.5	4.1
	Women	2.1	1.3	1.7	.8	2.3	1.6	5.9	2.5
	Total Sample	2.1	1.4	1.7	1.1	2.1	1.7	5.7	3.4
Adjamesu	Men	2.7	1.5	2.2	1.5	2.6	2.0	7.5	3.4
	Women	1.5	1.0	1.8	.9	2.4	1.8	5.7	2.7
	Total Sample	2.0	1.3	1.9	1.2	2.5	1.9	6.4	3.1
Total Sample	Men	2.4	1.5	2.0	1.4	2.1	2.0	6.4	3.9
	Women	1.8	1.2	1.7	.8	2.4	1.7	5.8	2.6
	Total sample	2.1	1.4	1.8	1.1	2.3	1.8	6.0	3.3

Frequencies of household sizes are shown in Table 2.4 by village and gender. In Adjamesu, 70% of the households headed by men and 54% of those headed by women have six or more persons. Thus, there is a higher concentration of larger households among men than women. The total sample figures for Adjamesu show that 60% of the households surveyed have six or more residents.

Table 2.4. Frequency Distributions of Household Sizes in Adjamesu and Hwidiem by Gender of Farmer

Household Size	Adjamesu						Hwidiem					
	Men		Women		Total		Men		Women		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
1-3	4	17	8	22	12	20	10	32	5	17	15	25
4-5	3	13	9	24	12	20	9	29	9	31	18	30
6-7	4	17	12	32	16	27	4	13	7	23	11	18
8-9	6	27	3	8	9	15	3	10	7	23	10	16
10-11	3	13	5	14	8	13	2	6	1	3	3	5
12-17	3	13	-	-	3	5	3	10	1	3	4	6
TOTAL	23	100	37	100	60	100	31	100	30	100	61	100
Percent	38		62		100		51		49		100	

In Hwidiem 39% of the households headed by men have six or more residents, but in sharp contrast, 52% of the households headed by women have six or more residents, thus, indicating a higher concentration of larger households among women. The total sample figures for Hwidiem show that 45% of the households have six or more residents.

Schooling

As shown in Table 2.5, on the average men farmers in Hwidiem are younger than women farmers but have about twice as many years of schooling. In Adjamesu, the experimental village, the men farmers are older and again have about twice as many years of schooling on the average. In considering the total sample in Table 2.5, women farmers are only somewhat older than men, but again on the average men have about twice as many years of formal schooling. These results indicate that in the past Ashanti women have had limited opportunities for formal schooling.

Table 2.5. Age and Schooling of Farmers by Gender, Village, and Total Sample

Village	Gender	Age of Farmers (Years) N	Mean	Standard Deviation	Schooling of Farmers (Years) N	Mean	Standard Deviation
Hwidiem	Men	31	32.9	13.3	31	9.1	4.2
	Women	30	40.7	11.6	30	4.7	4.8
	Total Sample	61	36.8	13.0	61	7.0	5.0
Adjamesu	Men	23	47.2	15.9	23	5.8	5.4
	Women	37	42.7	12.3	37	3.5	4.2
	Total Sample	60	44.5	13.8	60	4.4	4.8
Total Sample	Men	54	39.0	16.0	54	7.7	5.0
	Women	67	41.8	12.0	67	4.1	4.5
	Total Sample	121	40.6	13.9	121	5.7	5.0

Table 2.6 shows the mean age of the farmers and all adult household members by gender, village, and the total sample of 425 persons. The data show that women are on the average older than men but uniformly have 3-4 years less schooling than men. More instructive data on the relationship between gender and education is shown in Table 2.7 where specific age intervals are used for analysis rather than average ages of farmers and all adult household members. The data show that men have more average years of schooling than women, regardless of age. However, among women it is interesting and instructive to note that years of schooling is inversely related to age. Succinctly stated, the younger the Ashanti woman the greater the average years of schooling. That younger women are receiving more years of schooling is evidence of real and meaningful social change for women in the Ashanti region of Ghana. This general relationship is also characteristic of men. These relationships hold when the data are analyzed for the experimental and control villages (Tables 2.8 and 2.9).

Table 2.6. Age and Schooling of Farmers and All Adult Household Members by Gender, Village, and Total Sample

Village	Gender	Age (Years) N	Age (Years) Mean	Age (Years) Standard Deviation	Schooling (Years) N	Schooling (Years) Mean	Schooling (Years) Standard Deviation
Hwidiem	Men	121	27.3	14.1	121	8.6	4.1
	Women	91	32.4	15.3	91	5.5	4.5
	Total Sample	212	29.5	14.9	212	7.3	4.5
Adjamesu	Men	110	32.6	19.9	108	7.8	4.1
	Women	106	33.3	16.3	105	5.0	4.5
	Total Sample	216	32.9	18.2	213	6.4	4.5
Total Sample	Men	231	29.8	17.3	229	8.2	4.1
	Women	197	32.9	15.8	196	5.2	4.5
	Total sample	428	31.2	16.7	425	6.9	4.5

Table 2.7. Schooling of Farmers and All Adult Household Members by Age, Gender, and Total Sample

	Gender								
	Men			Women			Total Sample		
	Schooling (Years)			Schooling (Years)			Schooling (Years)		
Age (Years)	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
<24	124	8.8	2.7	76	7.4	3.5	200	8.3	3.1
25-29	25	10.9	3.7	23	7.3	4.6	48	9.2	4.5
30-34	14	10.3	1.3	13	6.3	4.8	27	8.4	3.9
35-39	13	8.3	5.1	20	5.4	4.9	33	6.5	5.1
40-45	10	7.6	5.4	24	3.3	4.0	34	4.6	4.8
>45	43	4.4	4.9	40	0.7	2.0	83	2.6	4.2
Total Sample	229	8.2	4.1	196	5.2	4.5	425	6.9	4.5

Table 2.8. Schooling of Farmers and All Adult Household Members by Age and Gender in Hwidiem

	Gender								
	Men			Women			Total Sample		
	Schooling (Years)			Schooling (Years)			Schooling (Years)		
Age (Years)	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
<24	69	8.8	3.3	37	8.0	3.0	106	8.5	3.2
25-29	18	10.9	4.0	7	8.5	3.7	25	10.2	4.0
30-34	6	10.0	0	6	6.8	5.5	12	8.4	4.0
35-39	4	11.0	2.7	13	5.2	5.2	17	6.5	5.3
40-45	7	8.0	5.6	12	3.0	3.8	19	4.8	5.0
>45	17	4.6	4.8	16	0.1	0.5	33	2.4	4.1
Total Sample	121	8.6	4.1	91	5.5	4.5	212	7.3	4.5

Table 2.9. Schooling of Farmers and All Adult Household Members by Age and Gender in Adjamesu

	Gender								
	Men			Women			Total Sample		
	Schooling (Years)			Schooling (Years)			Schooling (Years)		
Age (Years)	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
<24	55	8.9	1.9	39	6.8	3.9	94	8.0	3.0
25-29	7	11.0	3.4	16	6.8	5.0	23	8.0	4.9
30-34	8	10.6	1.7	7	6.0	4.6	15	8.4	4.0
35-39	9	7.2	5.6	7	5.7	4.5	16	6.5	5.1
40-45	3	6.6	5.7	12	3.6	4.5	15	4.2	4.7
>45	26	4.3	5.1	24	1.0	2.5	50	2.7	4.4
Total Sample	108	7.8	4.1	105	5.0	4.5	213	6.4	4.5

Household Locations and Access to Markets

Table 2.10 describes the differences between men and women and between Hwidiem and Adjamesu about distances to markets where agricultural production may be sold and purchased. Women farmers in both villages reported being, on the average, closer to markets than men. The closer proximity of women to such markets shows their attraction to and participation in marketing agricultural products. This may also indicate conscious decisions by women to locate their households near markets. Ashanti men farmers rarely participate in the retail of food crops on the market. This is usually viewed as a responsibility of the wife or daughter, or other women family members, if the farmer is a bachelor. Men are considered poor bargainers especially in negotiating business matters with women. The participation of men in food crop sales is usually limited to whole farm sales or bulk sales of farm produce either to a middlewoman from the village or the market center. In this context it is important to note that all farmers, regardless of gender, reported the primary and most often used method of transportation is by foot. The near universal transportation by foot in this context refers exclusively to trips between villages and farm plots. The reliance on foot transportation is due to the fact that over 90% of farms can be reached only by footpaths as there are no access roads for motorized vehicles to most farms. However, trips to the market centers for the sale of produce and purchase of inputs are generally made with trucks and buses which are readily available as indicated by the respondents. The information in Table 2.11 further shows that on the average there are no significant differences by gender or village concerning the distance to stores to purchase household goods. The distances are substantial owing to the reliance on foot transportation. The same principles are evident in the distances to fertilizer stores as shown in Table 2.12,

although women in Hwidiem are closer to fertilizer stores than other women or men in the sample.

Table 2.10. Distances From Households to Markets for Agricultural Products by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
	Distance			Distance			Distance		
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
		- - - - (km)- - - -			- - - (km)- - - -			- - - (km)- - - -	
Hwidiem	28	8.6	11.8	27	3.9	8.6	55	6.3	10.6
Adjamesu	23	9.0	11.7	37	3.8	8.5	60	5.8	10.1
Total Sample	51	8.8	11.6	64	3.8	8.5	115	6.0	10.3

Table 2.11. Distances from Households to Stores for Household Goods by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
	Distance to Store			Distance to Store			Distance to Store		
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
		- - -(km)- - - -			- - - (km)- - - -			- - - -(km)- - - -	
Hwidiem	27	23.8	3.0	14	22.2	4.3	41	23.3	3.5
Adjamesu	12	23.1	2.3	14	22.0	3.3	26	22.5	2.9
Total Sample	39	23.6	2.8	28	22.1	3.7	67	23.0	3.3

Table 2.12. Distance From Households to Fertilizer Stores by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
	Distance			Distance			Distance		
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
		- - - - (km)- - - -			- - - (km)- - - -			- - - -(km)- - - -	
Hwidiem	28	20.2	7.9	28	17.5	9.2	56	18.9	8.7
Adjamesu	22	20.1	4.2	31	20.4	4.6	53	20.3	4.4
Total Sample	50	20.2	6.5	59	19.1	7.3	109	19.6	6.9

The final observations about markets and transportation are shown in Table 2.13. Regardless of village or gender the sample reported near universal access to regular and predictable commercial transportation. Thus the reliance on foot transportation is mainly a consequence of cost and farm location rather than availability.

Table 2.13. Farmers With Access to Commercial Transportation to Markets by Gender, Village, and Total Sample

	Gender					
	Men		Women		Total Sample	
Village	N	Percent of Farmers	N	Percent of Farmers	N	Percent of Farmers
Hwidiem	31	93.5	30	96.6	61	95.0
Adjamesu	23	91.3	37	91.8	60	91.6
Total Sample	54	92.5	67	94.0	121	93.3

Distances From Households to Farm Plots

Distances to Household Plots

As shown in Table 2.14 for the total sample, the average distance from the households to household plots is greater for women (3.7 km), than for men (2.2 km). These distances are more equal between men and women in Hwidiem, 1.3 km and 1.8 km, respectively. However, in Adjamesu the average distance to household plots for women (5.3 km) is about 3 km greater than for men (2.5 km). This disparity may be explained by the greater population density around Adjamesu. This, of course, means that women spend more time

walking to fields than men. It appears that soil fertility generally decreases as the distance from the household increases, thus the soil fertility of plots cultivated by women may be less than that of men. This observation is consistent with the general literature that women often cultivate the least fertile plots.

Table 2.14. Distances From Households to Household Plots by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
		- - - - (km)- - - -			- - - -(km) - - -			- - - -(km)- - - -	
Hwidiem	27	1.3	1.1	29	1.7	1.6	56	1.5	1.4
Adjamesu	23	3.3	2.4	34	5.3	3.2	57	4.5	3.1
Total Sample	50	2.2	2.1	63	3.7	3.1	113	3.0	2.8

Distances to Individual Plots

Owing to the greater population of Adjamesu and population dispersion compared to Hwidiem, the total sample figures in Table 2.15 indicate that the average distance to individual plots in Adjamesu is nearly three times greater than in Hwidiem.

Table 2.15. Distances From Households to Individual Plots by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
		- - - - (km)- - - -			- - - (km)- - - -			- - - -(km)- - - -	
Hwidiem	26	1.0	0.9	26	1.4	1.4	52	1.2	1.2
Adjamesu	19	2.5	2.3	34	3.6	3.6	53	3.2	3.2
Total Sample	45	1.6	1.8	60	2.7	3.1	105	2.2	2.6

The distance figures for Hwidiem show that the fields of men are on the average closer to the household (.98 km) than fields cultivated by women (1.38 km). Table 2.15 also shows clearly that the individual plots in Adjamesu, regardless of gender, are at a greater average distance from the household compared with Hwidiem. As in Hwidiem, the individual plots cultivated by women in Adjamesu are on the average further from the household than those of men, 3.64 km and 2.55 km, respectively.

Off-Farm Employment of Farmers and Adult Household Members

The percentages of adult household members including farmers (424 persons) with off-farm employment by village and gender are shown in Table 2.16. The total sample figures show that on the average women (19%) are somewhat more likely than men (16%) to be engaged in off-farm employment and that only 17% of household members are engaged in off-farm employment regardless of village or gender.

Table 2.16. Farmers and Adult Household Members With Off-Farm Employment by Gender, Village, and Total Sample

	Gender					
	Men		Women		Total Sample	
Village	N	Percent	N	Percent	N	Percent
Hwidiem	121	14.9	90	17.8	211	16.1
Adjamesu	107	16.8	106	19.8	213	18.3
Total Sample	228	15.8	196	18.9	424	17.2

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The descriptive data in Table 2.17 show that women in Adjamesu are more economically active in off-farm employment compared with their counterparts in Hwidiem and that men in both villages are employed off the farms more months per year than women.

The data on annual off-farm earnings per adult household member including farmers shown in Table 2.18 indicate that the greatest earnings are by men in Hwidiem followed by men in Adjamesu. Women in Hwidiem average more off-farm earnings than women in Adjamesu. The greatest contrast between off-farm earnings are between men in Hwidiem and women in Adjamesu. The average difference in this case is 18,611 cedis or about US $93. The average annual off-farm earnings by gender for the total sample shows men earning 41,826 cedis and women earning 28,065 cedis, a difference of 13,761 cedis or a difference of about US $69.

Table 2.17. Average Duration of Off-Farm Employment of Farmers and Adult Household Members in Months Per Year by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
		Months Per Year			Months Per Year			Months Per Year	
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Hwidiem	16	8.2	3.6	16	5.3	3.3	32	6.8	3.7
Adjamesu	12	8.3	2.3	18	6.4	3.3	30	7.2	3.0
Total Sample	28	8.2	3.0	34	5.9	3.3	62	7.0	3.4

Table 2.18. Annual Off-Farm Earnings of Farmers and Adult Household Members by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
		Earnings Per Year in Cedis[a]			Earnings Per Year in Cedis[a]			Earnings Per Year in Cedis[a]	
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Hwidiem	12	44,167	39,208	13	31,538	34,060	25	37,600	36,415
Adjamesu	11	39,273	26,841	18	25,556	20,127	29	30,759	23,433
Total Sample	23	41,826	33,201	31	28,065	26,507	54	33,926	30,041

a. 200 cedis = US $1.

A more detailed description of off-farm employment by gender and village is shown in Table 2.19. The higher off-farm earnings of men are associated with more average years of schooling and more average months per year of off-farm employment, although the percentage of women engaged in off-farm employment is somewhat greater than men, 18.9% and 15.8%, respectively. This is the case regardless of village.

Table 2.19. Average Age, Years of Schooling, and Characteristics of Off-Farm Employment of Farmers and Adult Household Members by Gender, Village, and Total Sample

						Off-Farm Employment	
Village	Gender	N	Age Mean (years)	Schooling of Farmer Mean (years)	Farmers With Off-Farm Employment (%)	Months Per Year Mean	Earnings Per Year in Cedis[a] Mean
Hwidiem	Men	121	27.3	8.6	14.9	8.2	44,166.7
	Women	91	32.5	5.5	17.8	5.3	31,538.5
Adjamesu	Men	110	32.7	7.9	16.8	8.3	39,272.7
	Women	106	33.3	5.0	19.8	6.4	25,555.6
Total Sample	Men	231	29.9	8.3	15.8	8.2	41,826.1
	Women	197	32.9	5.3	18.9	5.9	28,064.5

a. 200 cedis = US $1.

Off-Farm Employment of Farmers

In this section, the analysis of off-farm employment is restricted to farmers who are head of households. Although results show similar trends, sharper contrasts are often observed.

The gender differences in the percentages of farmers engaged in off-farm employment are shown in Table 2.20. Thirty percent of the total sample is engaged in off-farm work. Men in Adjamesu show the highest mean percentage of off-farm employment (39%) followed by women in Adjamesu (32%). Women farmers in Hwidiem are more likely to be employed off the farm (27%) than men (22%).

Table 2.20. Farmers With Off-Farm Employment by Gender, Village, and Total Sample

	Gender					
	Men		Women		Total Sample	
Village	N	Percent	N	Percent	N	Percent
Hwidiem	31	22.6	29	27.6	60	25.0
Adjamesu	23	39.1	37	32.4	60	35.0
Total Sample	54	29.6	66	30.3	120	30.0

Further instructive gender differences in off-farm employment are shown in Table 2.21. On the average women farme. are engaged in off-farm employment fewer months than men, 5 months and 7 months, respectively. Men farmers in Adjamesu, the experimental village, work an average of 7.5 months off the farm followed by men in Hwidiem, 6.8 months. Women farmers in Adjamesu work about twice as many months off-farm as their counterparts in

Hwidiem, 6.4 months and 3.4 months, respectively. The somewhat greater off-farm employment in Adjamesu is probably explained by the proximity of this village to the commercial center of Kumasi.

Table 2.21. Average Duration of Off-Farm Employment of Farmers in Months Per Year by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
		Months Per Year			Months Per Year			Months Per Year	
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Hwidiem	6	6.8	3.7	8	3.4	1.2	14	4.9	3.0
Adjamesu	6	7.5	2.7	12	6.4	3.4	18	6.8	3.1
Total Sample	12	7.2	3.1	20	5.2	3.1	32	5.9	3.2

The average earnings for the total sample by gender in Table 2.22 show that men farmers earn about 13,500 cedis (US $68) more than women per year from off-farm work. The greatest gender disparity in off-farm income is in Hwidiem where men farmers average about 45,000 cedis (US $225/year) and women about 18,000 cedis or about US $90/year, a difference of 27,000 cedis or US $135. Likewise women farmers earn less in Adjamesu from off-farm work (27,667 cedis) than men (31,222 cedis), a difference of 3,555 cedis or about (US $18.00). Based on these figures the propensity to realize off-farm income is greater for men in general but men farmers in Hwidiem and women farmers in Adjamesu show the highest average off-farm earnings.

Table 2.22. Annual Off-Farm Earnings of Farmers by Gender, Village, and Total Sample

	Gender								
	Men			Women			Total Sample		
		Earnings Per Year in Cedis[a]			Earnings Per Year in Cedis[a]			Earnings Per Year in Cedis[a]	
Village	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Hwidiem	7	45,143	37,110	8	18,125	24,678	15	30,733	33,005
Adjamesu	9	31,222	22,337	12	27,667	22,677	21	29,190	22,038
Total Sample	16	37,313	29,459	20	23,850	23,347	36	29,833	26,718

a. 200 cedis = US $1.

Table 2.23 summarizes age, years of schooling, and characteristics of off-farm employment by gender, village, and the total sample for farmers only. Again the men farmers in Hwidiem have the greatest off-farm earnings followed by men in Adjamesu. On the average men farmers in Adjamesu (47 years) are the oldest in the sample and the youngest average age is among men in Hwidiem (33 years). The women farmers in Adjamesu show an average age of about 43 years and the women in Hwidiem about 41 years.

Table 2.23. Average Age, Years of Schooling, and Characteristics of Off-Farm Employment of Farmers by Gender, Village, and Total Sample

						Off-Farm Employment	
Village	Gender	N	Age Mean (years)	Schooling of Farmer Mean (years)	Farmers With Off-Farm Employment (%)	Months Per Year Mean	Earnings Per Year in Cedis[a] Mean
Hwidiem	Men	31	33.0	9.2	22.6	6.8	45,142
	Women	30	40.8	4.7	27.6	3.4	18,125
Adjamesu	Men	23	47.3	5.8	39.1	7.5	31,222
	Women	37	42.8	3.6	32.4	6.4	27,666
Total Sample	Men	54	39.1	7.8	29.6	7.2	37,312
	Women	67	41.9	4.1	30.3	5.2	23,850

a. 200 cedis = US $1.

The highest average for years of schooling is for men in Hwidiem (9.2 years) followed by men in Adjamesu (5.8 years). Women farmers, regardless of village, have fewer years of schooling than men, but the average years of schooling for women in Hwidiem (4.7 years) exceeds that of women in Adjamesu (3.6 years). The higher levels of schooling in Hwidiem may be explained by a secondary school being located within 4 km from the village compared to Adjamesu where the nearest secondary school is 16 km from the village. The percentage of farmers with off-farm employment is greater in Adjamesu than in Hwidiem, regardless of gender. The average months per year of off-farm employment are greatest among men in Adjamesu (7.5 months), followed by men in Hwidiem (6.8 months), women in Adjamesu (6.4 months), and the least engaged in off-farm employment, women farmers in Hwidiem (3.4 months). Perhaps the most interesting gender comparison in Table 2.23 is among men in Hwidiem and women in Adjamesu. Specifically, although the average months per year in off-farm employment are about equal, men in Hwidiem average 45,142 cedis (US $226) in off-farm earnings and women average 27,666 cedis (US $138), a difference of 17,476 cedis or about US $87. Finally, it should be noted that men in Hwidiem work only slightly fewer months per year off-farm than men in Adjamesu, but the former earn substantially more on the average. This may be explained by higher numbers of years of schooling among farmers in Hwidiem.

Locations of Off-Farm Employment for Farmers and Adult Household Members

The descriptive data shown in Table 2.24 indicate that about two-thirds of the sample are engaged in off-farm employment in their respective villages. About equal percentages of women (65%) in Hwidiem and

men (68%) are engaged in off-farm employment in their village of residence, 19% in the regional center of Kumasi, and 17% in other villages in Ghana.

Table 2.24. Frequency Distributions of Locations of Off-Farm Employment for Farmers and Adult Household Members by Gender, Village, and Total Sample

	Village													
	Hwidiem						Adjamesu						Total Sample	
	Men		Women		Total		Men		Women		Total			
Location	N	%	N	%	N	%	N	%	N	%	N	%	N	%
In the village	13	68	11	65	24	66	7	39	17	80	24	61	48	64
In Kumasi	2	11	4	24	6	17	6	33	2	10	8	21	14	19
In other villages in Ghana	4	21	2	11	6	17	5	28	2	10	7	18	13	17
TOTAL	19	100	17	100	36	100	18	100	21	100	39	100	75	100
Percent	53		47		100		46		54		100			

In Hwidiem about two-thirds of adult men and women are employed in the village. Although women (24%) are more likely than men (11%) to seek off-farm earnings in Kumasi, men (21%) in Hwidiem are more likely than women (11%) to travel to villages other than Kumasi and seek off-farm earnings.

In Adjamesu, 61% of men and women are engaged in off-farm employment in the village, 21% are employed in Kumasi, and 18% in other villages in Ghana. Women (80%) from Adjamesu engaged in off-farm employment are about twice as likely as men (39%) to find employment in the village. Men, however, are about three times more likely than women to be employed in Kumasi or other villages in Ghana. This is an indication that, in general, women in the Ashanti region are "village bound" in finding opportunities for off-farm

employment that allow for the performance of domestic work such as caring for children, daily food preparation, and other household tasks.

Types of Employment of Farmers and Adult Household Members

The total sample figures in Table 2.25 show that about three-quarters of the farmers engaged in off-farm employment work in small trade and service occupations.

Table 2.25. Frequency Distributions of Types of Off-Farm Employment of Farmers and Adult Household Members by Gender, Village, and Total Sample

	Village													
	Hwidiem						Adjamesu							
	Men		Women		Total		Men		Women		Total		Total	
Type of Employment	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Government service	6	32	1	5	7	19	-	-	-	-	-	-	7	9
Agricultural labor	3	16	-	-	3	8	1	6	1	4	2	5	5	7
Small trade	2	11	12	71	14	39	4	24	18	86	22	58	36	49
Construction	2	11	-	-	2	6	2	12	-	-	2	5	4	5
Service occupations	5	25	4	24	9	25	9	52	2	10	11	29	20	27
Mining	1	5	-	-	1	3	1	6	-	-	1	3	2	3
TOTAL	19	100	17	100	36	100	17	100	21	100	38	100	74	100
Percent	53		47		100		45		55		100			

In Hwidiem, government service (19%), small trade (39%), and service occupations (25%) account for over 80% of off-farm employment. The most frequent type of work among men in Hwidiem is government service (32%), followed by service occupations (25%), and agricultural labor (16%). Ninety-five percent of the employment among women in Hwidiem is accounted for by small trade (71%) and service occupations (24%).

There is no government employment among men or women in Adjamesu. Small trade (24%), construction (12%), and service occupations (52%) account for about 90% of the off-farm employment among men in Adjamesu, and small trade and services account for 96% of the off-farm employment of women.

Characteristics of Farms

Number of Plots

The descriptive information presented in Table 3.1 shows the average number of plots managed by men and women farmers by village and for the total sample. The total sample figures show that the mean number of plots managed by men in the 52 households headed by men is 1.9 and that women manage an average of 1.7 plots among the 10 men farmers who head households and had women managing plots. Eight women farmers have an average of 1.4 plots managed by men and 64 women farmers show an average of 1.9 plots managed by women. Thus, men and women predominantly manage their own plots, but each gender may manage plots of the other, however this is not common.

Table 3.1. Number of Farm Plots Per Farmer by Gender, Village, and Total Sample

		Men Managed Plots (Number)			Women Managed Plots (Number)			Number of Plots Per Farm		
Village	Gender of Farmer	N[a]	Mean	Standard Deviation	N[b]	Mean	Standard Deviation	N[c]	Mean	Standard Deviation
Hwidiem	Men	30	1.7	0.7	4	1.5	0.6	31	1.8	0.9
	Women	3	1.7	1.2	28	1.8	0.9	29	1.9	0.9
	Total Sample	33	1.7	0.7	32	1.7	0.9	60	1.9	0.9
Adjamesu	Men	22	2.2	0.7	6	1.8	1.2	22	2.7	1.1
	Women	5	1.2	0.4	36	1.9	1.0	36	2.1	1.0
	Total Sample	27	2.0	0.8	42	1.9	1.0	58	2.3	1.1
Total Sample	Men	52	1.9	0.7	10	1.7	0.9	53	2.2	1.0
	Women	8	1.4	0.7	64	1.9	1.0	65	2.0	1.0
	Total Sample	60	1.8	0.7	74	1.8	1.0	118	2.1	1.0

a. N = number of farmers having plots managed by men.
b. N = number of farmers having plots managed by women.
c. N = total number of sample farmers.

The total sample figures also show that the mean number of plots on farms of women (2.0) and of men (2.2) is very similar. In the village of Hwidiem, 30 men farmers have an average of 1.7 plots managed by men and only 4 men farmers have an average of 1.5 plots managed by women. Among 3 women farmers in Hwidiem, men manage an average of 1.7 plots and 29 women farmers have an average of 1.1 plots managed by women. Finally in Hwidiem, the mean number of plots on farms of men (1.8) and of women (1.9) is about the same.

Among men farmers in Adjamesu, 22 have an average of 2.2 plots managed by men and 6 have an average of 1.8 plots managed by women. Among women farmers in Adjamesu, 5 have an average of 1.2 plots managed by men and 36 have an average of 1.9 plots managed by women. However, the mean number of plots on the farms of women (2.1) is less than on farms of men (2.7).

It is generally evident from Table 3.1 that men and women farmers tend to cultivate their own plots. It is, however, important to recall that, because of the pattern of matrilocal residence in the Ashanti region of Ghana, women farmers have greater access to the labor of sons than men, a point discussed in reference to household size and composition.

Area of Plots

The average crop areas per farm managed by men and women by village and gender of farmer are shown in Table 3.2.

Table 3.2. Crop Areas of Farms Managed by Men and Women by Gender of Farmer, Village, and Total Sample

Village	Gender of Farmer	Crop Area Managed by Men			Crop Area Managed by Women			Crop Area Per Farm		
		N[a]	Mean	Standard Deviation	N[b]	Mean	Standard Deviation	N[c]	Mean	Standard Deviation
		- -(acres per farm) -			- -(acres per farm)- -			- - - -(acres) - - - -		
Hwidiem	Men	30	1.2	0.8	4	1.0	0.7	31	1.3	0.9
	Women	3	1.7	2.0	29	1.1	1.2	30	1.2	1.3
	Total Sample	33	1.2	0.9	33	1.1	1.2	61	1.3	1.1
Adjamesu	Men	22	1.7	1.0	6	1.4	0.9	22	2.1	1.2
	Women	5	0.6	0.4	37	0.9	0.6	37	1.0	0.6
	Total Sample	27	1.5	1.0	43	0.9	0.6	59	1.4	1.0
Total Sample	Men	52	1.4	0.9	10	1.2	0.8	53	1.6	1.1
	Women	8	1.0	1.2	66	1.0	0.9	67	1.1	1.0
	Total Sample	60	1.3	0.9	76	1.0	0.9	120	1.3	1.1

a. N = number of farmers having plots managed by men.
b. N = number of farmers having plots managed by women.
c. N = total number of sample farmers.

The total sample figures show that among 52 households headed by men, an average of 1.4 acres is cropped by men and 1.2 acres by women. Among 8 households headed by women, men and women cropped an average of 1.0 acre. The total sample figures further show that the crop area on farms managed by men is on the average larger than on farms managed by women, 1.6 acres and 1.1 acres, respectively.

On a per farm basis, in the village of Hwidiem, men farmers reported averages of 1.2 acres cropped by men and 1.0 acre by women, and an average total crop area per farm of 1.3 acres. The total sample figures for Hwidiem further show that the average crop area per farm managed by men, 1.1 acres, and that of women, 1.2 acres, is about equal.

In Adjamesu, men farmers show per farm averages of 1.7 acres cropped by men, 1.4 acres cropped by women, and an average total crop area of

2.1 acres per farm. Women farmers in Adjamesu show per farm averages of 0.6 acre cropped by men, and 0.9 acre by women, and an average total crop area of 1.0 acre per farm.

The instructive and useful interpretation of the descriptive data in Table 3.2 is that, although there are differences between the crop areas of farms managed by men and women, the differences are not statistically significant. The largest average crop area per farm is among men farmers in Adjamesu (2.1 acres) and the smallest among women in Adjamesu (1.0 acre).

Land Tenure

The number and areas of farm plots by type of land tenure by gender for the total sample are shown in Table 3.3. These data clearly indicate that family-owned plots comprise 76% of the total area managed by men and women. Twelve percent of the total area managed by men and 10% of the total area managed by women are individually owned. This is an indication that familial and individually-owned plots are the dominant form of land tenure in the Ashanti region of Ghana.

Tables 3.4 and 3.5 show the number and areas of farm plots by type of land tenure, gender, and the total sample for Hwidiem and Adjamesu, respectively. With some exceptions, the data in these tables show trends very similar to the total sample figures in Table 3.3. Specifically, among men farmers 81% of the total sample area in Adjamesu and 71% of the total area in Hwidiem are represented by family-owned plots. In contrast 15% of the total sample area for men in Hwidiem and 9% of the sample area for men in Adjamesu are individually owned.

Table 3.3. Number and Areas of Farm Plots by Type of Land Tenure by Gender and Total Sample

Gender of Plot Manager	Land Tenure	Number of Plots: N	Number of Plots: Mean	Number of Plots: Standard Deviation	Number of Plots: Total in Sample	Area of Plots: Mean (acres)	Area of Plots: Standard Deviation (acres)	Area of Plots: Total in Sample (acres)
Men	Family owned	48	1.8	0.8	87.0	1.3	0.9	61.4 (76)
	Family borrowed	2	1.5	0.7	3.0	0.6	0.6	1.2 (2)
	Family rented	1	2.0	.	2.0	2.5	.	2.5 (3)
	Individual owned	8	1.6	0.5	13.0	1.2	0.7	9.6 (12)
	Individual borrowed	1	1.0	.	1.0	0.6	.	0.6 (1)
	Individual rented	3	1.3	0.6	4.0	1.8	1.3	5.4 (6)
	Total Sample	63	1.7	0.7	110.0	1.3	0.9	80.7 (100)
Women	Family owned	61	1.7	0.8	104.0	0.9	0.9	58.5 (76)
	Family borrowed	7	1.0	0.0	7.0	0.5	0.4	3.8 (5)
	Family rented	9	1.1	0.3	10.0	0.6	0.3	5.2 (6)
	Individual owned	8	1.4	0.5	11.0	0.9	0.6	7.5 (10)
	Individual borrowed	3	1.0	0.0	3.0	0.5	0.3	1.4 (2)
	Individual rented	1	1.0	.	1.0	0.2	.	0.2 (1)
	Total Sample	89	1.5	0.7	136.0	0.8	0.8	76.6 (100)
Total Sample	Family owned	109	1.8	0.8	191.0	1.1	0.9	120.0 (76)
	Family borrowed	9	1.1	0.3	10.0	0.5	0.4	5.0 (3)
	Family rented	10	1.2	0.4	12.0	0.8	0.7	7.7 (5)
	Individual owned	16	1.5	0.5	24.0	1.1	0.6	17.1 (11)
	Individual borrowed	4	1.0	0.0	4.0	0.5	0.3	2.0 (1)
	Individual rented	4	1.3	0.5	5.0	1.4	1.3	5.6 (4)
	Total Sample	152	1.6	0.7	246.0	1.0	0.9	157.3 (100)

Figures in parentheses are rounded percentages.

Table 3.4. Number and Areas of Farm Plots by Type of Land Tenure, Gender, and Total Sample in Hwidiem

Gender of Plot Manager	Land Tenure	Number of Plots				Area of Plots		
		N	Mean	Standard Deviation	Total in Sample	Mean	Standard Deviation	Total in Sample
						(acres)		
Men	Family owned	25	1.7	0.7	42	1.2	0.8	29.1 (71)
	Family rented	1	2.0	.	2	2.5	.	2.5 (6)
	Individual owned	6	1.5	0.5	9	1.0	0.7	6.2 (15)
	Individual borrowed	1	1.0	.	1	0.6	.	0.6 (2)
	Individual rented	2	1.0	0.0	2	1.2	1.1	2.4 (6)
	Total Sample	35	1.6	0.7	56	1.2	0.8	40.8 (100)
Women	Family owned	26	1.5	0.6	40	1.0	1.2	27.0 (75)
	Family borrowed	5	1.0	0.0	5	0.4	0.1	2.0 (6)
	Family rented	5	1.2	0.4	6	0.8	0.3	3.8 (11)
	Individual owned	2	1.5	0.7	3	1.2	1.1	2.4 (7)
	Individual borrowed	1	1.0	.	1	0.8	.	0.8 (2)
	Total Sample	39	1.4	0.5	55	0.9	1.0	35.9 (100)
Total Sample	Family owned	51	1.6	0.6	82	1.1	1.0	56.1 (73)
	Family borrowed	5	1.0	0.0	5	0.4	0.1	2.0 (3)
	Family rented	6	1.3	0.5	8	1.0	0.8	6.3 (8)
	Individual owned	8	1.5	0.5	12	1.1	0.7	8.6 (11)
	Individual borrowed	2	1.0	0.0	2	0.7	0.1	1.4 (2)
	Individual rented	2	1.0	0.0	2	1.2	1.1	2.4 (3)
	Total Sample	74	1.5	0.6	111	1.0	0.9	76.7 (100)

Figures in parentheses are rounded percentages.

Table 3.5. Number and Areas of Farm Plots by Type of Land Tenure, Gender, and Total Sample in Adjamesu

Gender of Plot Manager	Land Tenure	Number of Plots				Area of Plots		
		N	Mean	Standard Deviation	Total in Sample	Mean	Standard Deviation	Total in Sample
						(acres)		
Men	Family owned	23	2.0	0.9	45	1.4	1.0	32.3 (81)
	Family borrowed	2	1.5	0.7	3	0.6	0.6	1.2 (3)
	Individual owned	2	2.0	0.0	4	1.7	0.4	3.4 (9)
	Individual rented	1	2.0	.	2	3.0	.	3.0 (7)
	Total Sample	28	1.9	0.8	54	1.4	1.0	39.9 (100)
Women	Family owned	35	1.8	0.9	64	0.9	0.6	31.6 (78)
	Family borrowed	2	1.0	0.0	2	0.6	0.7	1.8 (4)
	Family rented	4	1.0	0.0	4	0.4	0.1	1.4 (3)
	Individual owned	6	1.3	0.5	8	0.9	0.5	5.1 (13)
	Individual borrowed	2	1.0	0.0	2	0.3	0.1	0.6 (1)
	Individual rented	1	1.0		1	0.2	.	0.2 (1)
	Total Sample	50	1.6	0.9	81	0.8	0.6	40.7 (100)
Total Sample	Family owned	58	1.9	0.9	109	1.1	0.8	63.9 (79)
	Family borrowed	4	1.3	0.5	5	0.6	0.6	3.0 (4)
	Family rented	4	1.0	0.0	4	0.4	0.1	1.4 (2)
	Individual owned	8	1.5	0.5	12	1.1	0.6	8.5 (10)
	Individual borrowed	2	1.0	0.0	2	0.3	0.1	0.6 (1)
	Individual rented	2	1.5	0.7	3	1.6	2.0	3.2 (4)
	Total Sample	78	1.7	0.8	135	1.0	0.8	80.6 (100)

Figures in parentheses are rounded percentages.

The descriptive data for women in Tables 3.4 and 3.5 show that the total family-owned sample area of women farmers in Adjamesu is slightly larger than in Hwidiem, 75% and 78%, respectively.

Another interesting contrast is that 11% of the total sample area of women in Hwidiem is rented by families as compared with 3% in Adjamesu. The data for women farmers also show that 7% of the total area in Hwidiem and 13% in Adjamesu are individually owned. Finally, it is apparent from these data

that the security of land ownership is conducive to capital investment among men and women in both villages.

Equipment, Tools, and Animals

The percentages of farmers who own equipment, hand tools, and animals are shown in Table 3.6 by gender, village, and total sample.

Table 3.6. Farmers' Ownership of Equipment, Hand Tools, and Animals by Gender, Village, and Total Sample

Village	Gender	Ownership of Equipment		Ownership of Hand Tools		Ownership of Animals	
		N	Percent	N	Percent	N	Percent
Hwidiem	Men	31	12.9	31	100.0	31	41.9
	Women	30	0.0	30	93.3	30	46.7
	Total Sample	61	6.6	61	96.7	61	44.3
Adjamasu	Men	23	0.0	23	100.0	23	60.9
	Women	37	0.0	37	94.6	37	51.4
	Total Sample	60	0.0	60	96.7	60	55.0
Total Sample	Men	54	7.4	54	100.0	54	50.0
	Women	67	0.0	67	94.0	67	49.3
	Total Sample	121	3.3	121	96.7	121	49.6

The total sample figures show that the percentage of farmers owning agriculture equipment such as seeders, sprayers, and tractors is minimal. Seven percent of the men farmers reported owning such equipment, no women reported owning such equipment, and only 3% of the total sample report equipment ownership. A gender comparison of equipment ownership within and between villages shows that only men in Hwidiem (13%) report owning equipment. Based on the descriptive data in Table 3.6, it is apparent that the ownership

of equipment is minimal and exclusively limited to men. The general absence of agricultural equipment suggests that an examination of the ownership of handtools is appropriate and useful.

The total sample figures for the percentages of farmers owning hand tools in Table 3.6 show near universal reliance on such tools and virtually no difference among men (100%) and women (94%) farmers, specifically 97% of the total sample reported owning handtools. This empirical generalization holds within and between genders and villages, although women are somewhat less likely than men to own handtools. Women may therefore be obliged to borrow handtools for farmwork which is a constraint on their agricultural production and potential.

Also shown in Table 3.6 are the percentages of farmers reporting ownership of animals. The total sample figures indicate that 50% of men and women farmers own animals, but these figures disguise greater variation in animal ownership within and between villages and genders.

The greatest percentage of farmers owning animals is among men in Adjamesu (61%), followed by women in Adjamesu (51%), women in Hwidiem (47%), and finally men in Hwidiem are least likely to own animals (42%).

The greater percentages of men and women in Adjamesu owning animals may be evidence of more prosperity than in Hwidiem that has a smaller population base. The proximity of Adjamesu to the major commercial center of Kumasi contributes to more commercial opportunity and thus to greater animal ownership.

Further insight into the ownership of handtools and animals is presented in Table 3.7 which shows the average numbers of handtools and animals owned by farmers by gender and village. The total sample figures show an average of 2.2 handtools owned and the average number of handtools owned

being somewhat less for women (2.1) than for men (2.4). The greatest average number of handtools owned by farmers is among men in Adjamesu (2.6), followed by women in Adjamesu (2.3), and men in Hwidiem (2.2); and the least average number of handtools owned is by women in Hwidiem (1.9). Thus the experimental village shows a greater average availability of handtools than the control village of Hwidiem.

Table 3.7. Number of Hand Tools and Animals Owned by Farmers, Gender, Village, and Total Sample

		Number of Hand Tools Owned			Number of Animals Owned		
Village	Gender	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Hwidiem	Men	31	2.2	0.9	13	9.8	6.8
	Women	30	1.9	0.8	14	11.5	9.5
	Total Sample	61	2.0	0.9	27	10.7	8.2
Adjamesu	Men	23	2.6	0.9	14	22.3	40.7
	Women	37	2.3	1.0	19	6.7	5.5
	Total Sample	60	2.4	0.9	33	13.3	27.4
Total Sample	Men	54	2.4	0.9	27	16.3	29.8
	Women	67	2.1	0.9	33	8.8	7.7
	Total Sample	121	2.2	0.9	60	12.1	20.9

On the average, as shown in Table 3.7, the sample of farmers owns 12 animals and men own about twice as many animals (16) as women in the sample (9). Men in Adjamesu own the greatest average number of animals (22), followed by women in Hwidiem (12), men in Hwidiem (10), and women in Adjamesu (7).

More detail about handtool ownership is shown in Table 3.8. This table shows that within and between village and genders, at least 90% of handtools are machetes, hoes, and axes. Further, women in Hwidiem are at no particular disadvantage in access to important handtools such as machetes,

hoes, and axes. However, women in Adjamesu are somewhat less likely than men to own hoes and axes and may be more obliged to borrow tools.

Table 3.8. Frequency Distributions of Types of Hand Tools Owned by Farmers, by Gender, Village, and Total Sample

	Village									
	Hwidiem				Adjamesu				Total Sample	
	Men		Women		Men		Women			
Type of Tool	N	%	N	%	N	%	N	%	N	%
Machete	31	40	30	41	23	36	37	36	121	38
Hoe	29	37	30	41	23	36	34	33	116	37
Axe	12	15	12	16	12	18	16	16	52	16
Post hole digger	3	4	1	1	1	2	10	10	15	5
Other	3	4	1	1	5	8	5	5	14	4
TOTAL	78	100	74	100	64	100	102	100	318	100

The descriptive data in Table 3.9 are a basis for discussing the relationships between off-farm employment, crop area per farm, and ownership and number of animals. The total sample figures show no great average differences between percentages of men and women engaged in off-farm employment, the crop area per farm, or the percentage of farmers owning animals. However, on the average men own about twice as many animals as women. Off-farm employment among both men and women in Adjamesu is higher than in Hwidiem which may explain the greater frequency of animal ownership in Adjamesu.

Table 3.9. Schooling, Employment, Area Cropped, and Ownership of Equipment, Tools, and Animals by Gender, Village, and Total Sample

Village	Gender	Farmer Schooling N	Farmer Schooling Mean (years)	Off-Farm Employment (%)	Crop Area Per Farm Mean (acres)	Ownership of Equipment (%)	Ownership of Hand Tools (%)	Number of Hand Tools Owned Mean	Ownership of Animals (%)	Numbe of Anima Owned Mean
Hwidiem	Men	31	9.2	22.6	1.3	12.9	100.0	2.2	41.9	9.
	Women	30	4.7	27.6	1.2	0.0	93.3	1.9	46.7	11.
	Total Sample	61	7.0	25.0	1.3	6.6	96.7	2.0	44.3	10.
Adjamesu	Men	23	5.8	39.1	2.1	0.0	100.0	2.6	60.9	22.
	Women	37	3.6	32.4	1.0	0.0	94.6	2.3	51.4	6.
	Total Sample	60	4.5	35.0	1.4	0.0	96.7	2.4	55.0	13.
Total Sample	Men	54	7.8	29.6	1.6	7.4	100.0	2.4	50.0	16.
	Women	67	4.1	30.3	1.1	0.0	94.0	2.1	49.3	8.
	Total Sample	121	5.7	30.0	1.3	3.3	96.7	2.2	49.6	12.

Within the village of Hwidiem, slightly more women (28%) than men (23%) are engaged in off-farm employment. This probably accounts for 47% of women owning animals compared with 42% of the men. The greater off-farm employment of women in Hwidiem may also explain the somewhat higher average number of animals owned by women (12) compared with men (10).

The relationship between off-farm employment, crop area per farm, and the percentage of farmers owning animals and the average number of animals owned in Adjamesu is different than in Hwidiem. Specifically men in Adjamesu (39%) are more often engaged in off-farm employment than women (32%) and crop an average of 2 acres compared with 1 acre by women. Again, crop area and off-farm employment earnings probably explain why 60% of the men compared to

51% of the women in Adjamesu report animal ownership. Furthermore, the average number of animals owned by men in Adjamesu (22) greatly exceeds that of women (7). Further changes in the ownership of hand tools and animals by farmers in the experimental village as a result of the use of fertilizers would be an indication of the economic impact of the SFRP.

Crops and Cropping Systems

The percentage distributions of plots with sole crops (235) and various intercrops are shown in Table 3.10. The total sample figures clearly indicate that maize and cassava as sole crops and bases for intercrops account for 75% of the cropping systems in the sample. The plantain-cocoyam intercrop (12%) is the most prominent among plantain-based intercrops. There is, however, considerable variation between villages and gender on crop and cropping systems.

In the control village of Hwidiem, maize and cassava as sole crops and bases for intercrops account for 84% of the crops on 106 sampled plots and 66% of 129 sampled plots in Adjamesu. Plantain-based systems account for 9% of the crops in Hwidiem but 29% in Adjamesu. This difference is mainly attributable to the popularity of the plantain-cocoyam intercrop that is cultivated on 14% of the plots managed by men and 22% of those cultivated by women. The proximity of Adjamesu to Kumasi and a first class road provide an opportunity for women to sell plantains and cocoyams that are a source of cash income for the women of Adjamesu. Conversely, in Hwidiem the minimal importance of plantain-based systems is evident in that men cultivate this intercrop on only 8% of their plots and women report it on only 10% of their plots.

Table 3.10. Percentage Distributions of Crops and Intercrops by Gender, Village, and Total Sample

Crop	Hwidiem						Adjamesu						Total Sample	
	Men		Women		Total		Men		Women		Total			
	N Plots	%	N Plots	%	N Plots	%	N Plots	%	N Plots	%	N Plots	%	N Plots	%
Maize-cassava	28	55	20	36	48	45	9	19	18	22	27	21	75	32
Cassava	6	12	8	14	14	13	11	23	13	16	24	18	38	16
Other cassava-based intercrops	-	-	4	7	4	4	7	14	6	8	13	10	17	7
Maize	6	12	3	5	9	8	5	10	6	8	11	9	20	9
Maize-plantain	3	5	2	4	5	5	1	2	5	6	6	5	11	5
Other maize-based intercrops	4	8	6	11	10	9	2	4	2	3	4	3	14	6
Plantain	2	4	1	2	3	3	2	4	5	6	7	5	10	4
Plantain-cocoyam	2	4	2	4	4	4	7	14	18	22	25	19	29	12
Plantain-cassava	-	-	2	4	2	2	1	2	5	6	6	5	8	3
Other crops[a]	-	-	7	13	7	7	4	8	2	3	6	5	13	6
TOTAL	51	100	55	100	106	100	49	100	80	100	129	100	235	100
Percent	22		23				21		34		100			

a. Other includes such crops as tomatoes, okra, beans, rice, peppers, and ginger that are sole crops or intercropped with maize or cassava.

Note: Analysis of data collected by plot.

Further insight into the cropping systems of the sample villages in regard to the size of plots and crop areas is shown in Table 3.11. The total sample figures show that the average size of 235 plots in both villages is 0.6 acre and that the total sample area is about 150 acres. The average plot area of the 106 plots in Hwidiem is 0.7 acre and a total sample area is about 74 acres. In Adjamesu the average plot area is about 0.6 acre for 129 plots with a total area of about 76 acres. More detail about the size of plots and crop areas by type of land tenure, gender, and village is shown in Table 3.12.

Table 3.11. Number and Size of Plots and Crop Area by Village, Gender of Manager, and Total Sample

	Gender								
	Men			Women			Total Sample		
Village	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area
		- - -(acres)- - -			- - -(acres)- - -			- - -(acres) - - -	
Hwidiem	51	0.77	39.10	55	0.64	35.10	106	0.70	74.20
Adjamesu	49	0.75	36.60	80	0.49	39.30	129	0.59	75.90
Total Sample	100	0.76	75.70	135	0.55	74.40	235	0.64	150.10

Note: Analysis of data collected by plot.

The figures in Table 3.12 show that the average family-owned plot area among men in Hwidiem is 0.7 acre and the total sample area in Hwidiem under this form of land tenure is about 27 acres. The average individual plot owned by managers who are men is 0.9 acre, but the total area under this system for men in Hwidiem is only 5 acres. The average size of family-owned plots managed by women in Hwidiem is also 0.7 acre, and the total area under

Table 3.12. Number and Size of Plots and Crop Area by Gender of Manager, Land Tenure, Village, and Total Sample

Gender of Manager	Land Tenure	Crop Area: Hwidiem Number of Plots	Hwidiem Average Plot Area (acres)	Hwidiem Total Sample Area (acres)	Adjamesu Number of Plots	Adjamesu Average Plot Area (acres)	Adjamesu Total Sample Area (acres)	Total Sample Number of Plots	Total Sample Average Plot Area (acres)	Total Sample Total Sample Area (acres)
Men	Individual owned	6	0.87	5.20	5	0.84	4.20	11	0.85	9.40
	Family borrowed	-	-	-	3	0.40	1.20	3	0.40	1.20
	Family rented	3	1.83	5.50	-	-	-	3	1.83	5.50
	Individual borrowed	1	0.60	0.60	-	-	-	1	0.60	0.60
	Individual rented in	1	0.40	0.40	2	1.50	3.00	3	1.13	3.40
	Family owned	40	0.69	27.40	39	0.72	28.20	79	0.70	55.60
Women	Individual owned	3	0.40	1.20	5	0.58	2.90	8	0.51	4.10
	Family borrowed	4	0.40	1.60	2	0.20	0.40	6	0.33	2.00
	Family rented	5	0.78	3.90	3	0.47	1.40	8	0.66	5.30
	Individual borrowed	1	0.80	0.80	2	0.30	0.60	3	0.47	1.40
	Individual rented in	-	-	-	2	0.30	0.60	2	0.30	0.60
	Family owned	42	0.66	27.60	66	0.51	33.40	108	0.56	61.00

Note: Analysis of data collected by plot.

this arrangement is about 28 acres. Thus in Hwidiem there seems to be no significant inequality in the size of family-owned plots managed by men and women.

Further descriptive data in Table 3.12 show that the average size of 39 family-owned plots managed by men in Adjamesu is 0.7 acre and 66 family-owned plots managed by women show an average area of 0.5 acre.

The gender differences in land allocation for particular crops for the total sample are shown in Table 3.13 for 235 plots. The total sample figures show that men and women allocate 75 of 235 (32%) plots for the intercrop of maize and cassava, with an average area of 0.7 acre, or 36% of the total sample area of about 150 acres.

Table 3.13. Crop Area and Size of Plots by Crops, Gender, and Total Sample

	Gender								
	Men			Women			Total Sample		
Crop	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area
		- - - (acres)- - -			- - - (acres)- - -			- - - -(acres)- - -	
Maize	11	0.78	8.60 (11)	9	0.44	4.00 (5)	20	0.63	12.60 (9)
Cassava	17	0.64	10.80 (14)	21	0.39	8.20 (11)	38	0.50	19.00 (13)
Plantain-cocoyam	9	0.66	5.90 (8)	20	0.52	10.50 (14)	29	0.57	16.40 (11)
Maize-cassava	37	0.70	26.00 (34)	38	0.75	28.50 (38)	75	0.73	54.50 (36)
Plantain	4	0.60	2.40 (3)	6	0.[illegible]	3.80 (5)	10	0.62	6.20 (4)
Maize-plantain	4	1.00	4.00 (6)	7	0.49	3.40 (5)	11	0.67	7.40 (5)
Plantain-cassava	1	1.20	1.20 (2)	7	0.31	2.20 (3)	8	0.43	3.40 (2)
Other cassava intercrops[a]	7	0.79	5.50 (7)	10	0.42	4.20 (6)	17	0.57	9.70 (6)
Other maize intercrops[a]	6	0.93	5.60 (7)	8	0.70	5.60 (8)	14	0.80	11.20 (8)
Other crops[a]	4	1.43	5.70 (8)	9	0.44	4.00 (5)	13	0.75	9.70 (6)
TOTAL	100	.76	75.7	135	.56	75.4	235	.64	150.1
Percent	43		50	57		50	100		100

a. Other includes such crops as tomatoes, okra, beans, rice, peppers, and ginger that are sole crops or intercrops with maize or cassava.

Note: Figures in parentheses are rounded percentages.

This is followed by 38 plots or 16% of all plots sole cropped with cassava, with an average plot area of 0.5 acre or 13% of the total sample area. Next in importance is the plantain-cocoyam intercrop that is found on 12% of all plots with an average area of 0.6 acre, and 11% of the total sample area. Continuing in a descending order, 20 plots or 9% of 235 plots are allotted for maize, with an average plot area of 0.6 acre, or 9% of the total sample area. Cassava intercrops are cultivated on 17 plots, or 7% of all plots with an average area of 0.6 acre, or 13% of the total sample area. Thus, about three-quarters of the 235 sample plots are cropped with maize-cassava, plantain-cocoyam, cassava, maize, and cassava intercrops.

The allocation of crops by gender shows remarkable similarity for the dominant maize-cassava intercrop. Men have 37 plots with this intercrop, with an average plot area of 0.7 acre or 34% of the 75.7 acres managed by men. Women reported 38 plots of maize-cassava again with an average plot area of about 0.7 acre, which comprises 38% of the 75.4 acres managed by women in the sample.

The sole crop of cassava is second in importance for both men and women who allocate 17 and 21 plots for this crop, respectively, or 17% of all plots managed by men and 16% of all plots managed by women. However, the average plot area with cassava among men is 0.6 acre and 0.4 acre among women. Sole cropped cassava represents 14% of the total area managed by men and 11% of that managed by women.

The sole crop of maize is the third most important for men and comprises 11% of area under their management. Maize represents an average plot area of about 0.8 acre. The figures for sole crop maize show that women have 9 plots or 7% of all plots managed by women with this crop with an

average plot area of about 0.4 acre or 5% of the total sample area managed by women.

Concerning the plantain-cocoyam intercrop, it is a crop especially attractive for women who have 14% of their total sample area with this crop and an average plot area of 0.5 acre. Men have an average plot area of 0.7 acre with this intercrop or 8% of the total sample area managed by men.

The total area managed by men shows that 34% is cropped with maize-cassava, 14% with cassava, 11% maize, 8% plantain-cocoyam, and other cassava intercrops comprise 7%. These crops account for about 75% of all crops managed by men. Of the total sample area managed by women, 38% is cropped with maize-cassava, 11% with cassava, 14% with plantain-cocoyam, 5% with maize, and 6% with other cassava intercrops. These crops account for 75% of all crops managed by women.

The descriptive data for crop areas, size of plots, and crops by gender in Hwidiem are shown in Table 3.14 and in Table 3.15 for Adjamesu. A comparison of the total sample figures in these tables clearly shows that the maize-cassava intercrop is important in both villages. Interestingly, farmers in Hwidiem allocate 50% of the total sample area for the maize-cassava intercrop and Adjamesu only 23%. The figures for the plantain-cocoyam intercrop are also contrasting in that Hwidiem allocates 5% of the total sample area for this intercrop and Adjamesu 17%. Of the 10 crop categories in Tables 3.14 and 3.15, Adjamesu allocates a greater total sample area to maize, cassava, plantain-cocoyam, plantain, plantain-cassava, other cassava intercrops, and diverse other crops than Hwidiem but the total sample areas are about equal, 76 acres for Adjamesu and 74 acres for Hwidiem. The crops and cropping systems of Adjamesu are more diverse than in Hwidiem which may be explained by Adjamesu being more market oriented.

Table 3.14. Crop Area and Size of Plots by Crop, Gender and Total Sample for Hwidiem

Crop	Gender: Men			Gender: Women			Total Sample		
	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area
		- - - (acres)- - -			- - - (acres)- - -			- - - -(acres)- - - -	
Maize	6	0.67	4.00 (10)	3	0.43	1.30 (4)	9	0.59	5.30 (7)
Cassava	6	0.60	3.60 (9)	8	0.41	3.30 (9)	14	0.49	6.90 (9)
Plantain-cocoyam	2	1.65	3.30 (8)	2	0.30	0.60 (2)	4	0.98	3.90 (5)
Maize-cassava	28	0.69	19.40 (50)	20	0.89	17.90 (51)	48	0.78	37.30 (50)
Plantain	2	0.50	1.00 (3)	1	0.60	0.60 (2)	3	0.53	1.60 (2)
Maize-plantain	3	1.13	3.40 (9)	2	0.40	0.80 (2)	5	0.84	4.20 (6)
Plantain-cassava	-	-	-	2	0.40	0.80 (2)	2	0.40	0.80 (1)
Other cassava intercrops[a]	-	-	-	4	0.50	2.00 (6)	4	0.50	2.00 (3)
Other maize intercrops[a]	4	1.10	4.40 (11)	6	0.83	5.00 (14)	10	0.94	9.40 (13)
Other crops[a]	-	-	-	7	0.40	2.80 (8)	7	0.40	2.80 (4)
TOTAL	51	0.77	39.1	55	0.64	35.1	106	0.70	74.2
Percent	48		53	52		47	100		100

a. Other includes such crops as tomatoes, okra, beans, rice, peppers, and ginger that are sole crops or intercrops with maize or cassava.

Note: Figures in parentheses are rounded percentages.

Table 3.15. Crop Area and Size of Plots by Crop, Gender and Total Sample for Adjamesu

Crop	Gender: Men			Gender: Women			Total Sample		
	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area	Number of Plots	Average Plot Area	Total Sample Area
		- - - (acres)- - -			- - - (acres)- - -			- - - -(acres)- - - -	
Maize	5	0.92	4.60 (13)	6	0.45	2.70 (7)	11	0.66	7.30 (10)
Cassava	11	0.65	7.20 (20)	13	0.38	4.90 (12)	24	0.50	12.10 (16)
Plantain-cocoyam	7	0.37	2.60 (7)	18	0.55	9.90 (25)	25	0.50	12.50 (17)
Maize-cassava	9	0.73	6.60 (18)	18	0.59	10.60 (27)	27	0.64	17.20 (23)
Plantain	2	0.70	1.40 (4)	5	0.64	3.20 (8)	7	0.66	4.60 (6)
Maize-plantain	1	0.60	0.60 (2)	5	0.52	2.60 (7)	6	0.53	3.20 (4)
Plantain-cassava	1	1.20	1.20 (3)	5	0.28	1.40 (4)	6	0.43	2.60 (3)
Other cassava intercrops[a]	7	0.79	5.50 (15)	6	0.37	2.20 (6)	13	0.59	7.70 (10)
Other maize intercrops[a]	2	0.60	1.20 (3)	2	0.30	0.60 (1)	4	0.45	1.80 (2)
Other crops[a]	4	1.43	5.70 (15)	2	0.60	1.20 (3)	6	1.15	6.90 (9)
TOTAL	49	0.75	36.6	80	0.50	39.3	129	0.59	75.9
Percent	38		48	62		52	100		100

a. Other includes such crops as tomatoes, okra, beans, rice, peppers, and ginger that are sole crops or intercrops with maize or cassava.

Note: Figures in parentheses are rounded percentages.

Concerning gender comparisons for crops in Hwidiem, the descriptive data in Table 3.14 show that with the exception of maize-cassava and plantain, the average plot area managed by women is consistently smaller for all other crops compared to men. Beyond the near equal allocation of the total sample area in Hwidiem among men (50%) and women (51%) for maize-cassava, women and men favor maize intercrops as a second preference, 14% and 11% of the total sample area, respectively. Beyond these comparisons men and women in Hwidiem are remarkably similar in their choices of crops.

The gender comparisons for the experimental village of Adjamesu in Table 3.15 indicate that men and women show greater diversity in crop choices than in Hwidiem. As in the case of the control village the average plot area managed by women, 0.5 acre, is smaller than that managed by men, 0.75 acre. The sample of men and women in Adjamesu allocate, respectively, 18% and 27% of their total area to the maize-cassava intercrop. The second most frequent intercrop for women in Adjamesu is plantain-cocoyam, 25% of the total area managed by women, but men allocate only 7% of their total area to this intercrop. Table 3.15 further indicates that in Adjamesu men allocate 20% of their total area to cassava and women allocate 12%.

A striking contrast in crop choices by gender in Adjamesu is evident in that men allocate 30% of the area under their management to other cassava intercrops and other crops, but women allocate only 9% of their total sample area to these crops. Furthermore, men allocate 13% of their area for maize and women only 7%.

Availability and Use of Variable Inputs

Use of Household and Hired Labor

Descriptive data showing the use of household and hired labor in workdays per acre by type of activity and village for all crops are presented in Table 4.1.

Table 4.1. Average Use of Household and Hired Labor by Activity and Village

	Village					
	Hwidiem			Adjamesu		
Activity	Household Labor	Hired Labor	Total Labor Used	Household Labor	Hired Labor	Total Labor Used
	(workdays/acre)					
Land preparation	29.9	23.6	53.5	36.5	19.8	56.3
	(56)	(44)	(100)	(65)	(35)	(100)
Planting	16.8	1.6	18.4	24.1	1.6	25.7
	(91)	(9)	(100)	(94)	(6)	(100)
Weeding	30.1	9.6	39.7	33.7	10.6	44.3
	(76)	(24)	(100)	(76)	(24)	(100)
Harvesting	18.1	2.7	20.8	25.2	0.3	25.5
	(87)	(13)	(100)	(99)	(1)	(100)
Marketing	7.0		7.0	8.0		8.0
	(100)		(100)	(100)		(100)
TOTAL[a]	101.9	37.5	139.4	127.5	32.3	159.8
	(73)	(27)	(100)	(80)	(20)	(100)
Fertilizer application	10.4		10.4	5.6	0.2	5.8
	(100)		(100)	(97)	(3)	(100)
Pest control				20.0		20.0
				(100)		(100)
Storage	10.0	1.3	11.3	45.0		45.0
	(88)	(12)	(100)	(100)		(100)
Other activities	8.3		8.3	10.8		10.8
	(100)		(100)	(100)		(100)
TOTAL[b]	130.6	38.8	169.4	208.9	32.5	241.4
	(77)	(23)	(100)	(87)	(13)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

The total use of household and hired labor per acre in Adjamesu, 241 workdays, is greater than that of Hwidiem, 169 workdays. This is mainly

because farmers in Adjamesu clearly use more household labor, 209 workdays, than Hwidiem, 131 workdays. The use of hired labor in Hwidiem, 39 days, is only marginally greater than in Adjamesu, 33 workdays. Both villages rely heavily on household labor for all agricultural activities. Specifically, 77% of all workdays for all activities are performed by household labor in Hwidiem and 87% in Adjamesu. Labor is hired mainly to supplement household labor in performing land preparation and weeding activities.

More instructive and descriptive data are shown in Table 4.2 about the use of household and hired labor by activity and gender for the village of Hwidiem.

Table 4.2. Average Use of Household and Hired Labor by Activity and Gender for Hwidiem

	Gender					
	Men			Women		
Activity	Household Labor	Hired Labor	Total Labor Used	Household Labor	Hired Labor	Total Labor Used
	(workdays/acre)					
Land preparation	25.7	18.0	43.7	33.7	28.7	62.4
	(59)	(41)	(100)	(54)	(46)	(100)
Planting	14.8	1.7	16.5	18.5	1.5	20.0
	(90)	(10)	(100)	(93)	(7)	(100)
Weeding	27.2	10.6	37.8	32.7	8.7	41.4
	(72)	(28)	(100)	(79)	(21)	(100)
Harvesting	17.8	3.6	21.4	19.1		19.1
	(83)	(17)	(100)	(100)		(100)
Marketing	8.8		8.8	4.6		4.6
	(100)		(100)	(100)		(100)
TOTAL[a]	94.3	33.9	128.2	108.6	38.9	147.5
	(74)	(26)	(100)	(74)	(26)	(100)
Fertilizer application	3.8		3.8	23.8		23.8
	(100)		(100)	(100)		(100)
Storage	10.0	1.7	11.7	10.0		10.0
	(85)	(15)	(100)	(100)		(100)
Other activities	7.5		7.5	10.0		10.0
	(100)		(100)	(100)		(100)
TOTAL[b]	115.6	35.6	151.2	152.4	38.9	191.3
	(76)	(24)	(100)	(80)	(20)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

The proportions of household and hired labor that are used by men and women farmers in Hwidiem to perform the major activities of land preparation, planting, weeding, harvesting, and marketing are equal, 74% and 26% of household and hired labor, respectively. However, among these activities women use more workdays of household labor for every activity except the marketing of produce. Women farmers in Hwidiem reported more use of hired labor than men for land preparation, which is the most difficult and demanding agricultural task. Table 4.2 clearly shows that women hire labor for the most physically demanding tasks. This observation is not well reflected in the literature on women and agriculture in sub-Saharan Africa.

Also instructive in Table 4.2 are the figures about the total workdays per acre of labor use reported by men and women farmers in Hwidiem. Specifically, women used 191 days of labor and men 151 days. Women used more total days of labor than men for the tasks of land preparation, planting, weeding, fertilizer application, and other various activities.

As shown in Table 4.3 the patterns of the use of household and hired labor in Adjamesu are similar to that of Hwidiem. Specifically, 86% of all workdays used by men in Adjamesu were performed by household labor and 14% of all workdays were performed by hired labor. Among women in Adjamesu those percentages are 84% and 16%, respectively. For the major work tasks women hire more labor than men for land preparation and weeding although the difference is not great. Women use more labor (household plus hired) than men for the activities of land preparation, planting, weeding, and marketing. In this regard it is interesting that women in Adjamesu hire no labor for marketing, harvesting, pest control, storage, or for other various activities. Men in Adjamesu hire no labor for the activities of marketing, fertilizer

application, pest control, storage, or for the residual category of other various activities.

Table 4.3. Average Use of Household and Hired Labor by Activity and Gender for Adjamesu

Activity	Gender: Men			Gender: Women		
	Household Labor	Hired Labor	Total Labor Used	Household Labor	Hired Labor	Total Labor Used
	(workdays/acre)					
Land preparation	33.7	15.6	49.3	38.3	22.6	60.9
	(68)	(32)	(100)	(63)	(37)	(100)
Planting	22.0	1.8	23.8	25.5	1.4	26.9
	(92)	(8)	(100)	(95)	(5)	(100)
Weeding	29.3	9.8	39.1	36.4	11.1	47.5
	(75)	(25)	(100)	(77)	(23)	(100)
Harvesting	32.4	0.8	33.2	20.4		20.4
	(98)	(2)	(100)	(100)		(100)
Marketing	3.5		3.5	11.0		11.0
	(100)		(100)	(100)		(100)
TOTAL[a]	120.9	28.0	148.9	131.6	35.1	166.7
	(81)	(19)	(100)	(79)	(21)	(100)
Fertilizer application	5.0		5.0	5.6	0.2	5.8
	(100)		(100)	(97)	(3)	(100)
Pest control	20.0		20.0			
	(100)		(100)			
Storage				45.0		45.0
				(100)		(100)
Other activities	20.0		20.0	1.7		1.7
	(100)		(100)	(100)		(100)
TOTAL[b]	165.9	28.0	193.9	183.9	35.3	219.2
	(86)	(14)	(100)	(84)	(16)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

The use of labor varies with the crops and intercrops grown by farmers. Thus, some aspects of the use of household and hired labor in the most important crops are presented below.

Maize--Table 4.4 shows the use of household and hired labor in workdays per acre of maize by activity and village. The village of Adjamesu relies more on household labor for the production of maize than Hwidiem, 78% and 67% of total labor days, respectively. Thus, for the production of maize both villages rely heavily on household labor, especially Adjamesu. Concerning the very important task of weeding, farmers in Hwidiem are more likely than those in Adjamesu to hire labor. Specifically, about 50% of the labor for this task is hired in Hwidiem but only 30% in Adjamesu.

Table 4.4. Average Use of Household and Hired Labor in Maize by Activity and Village

	Village					
	Hwidiem			Adjamesu		
Activity	Household Labor	Hired Labor	Total Labor Used	Household Labor	Hired Labor	Total Labor Used
	(workdays/acre)					
Land preparation	26.0	28.9	54.9	30.6	19.3	49.9
	(47)	(53)	(100)	(61)	(39)	(100)
Planting	9.8	1.7	11.5	17.1	3.9	21.0
	(85)	(15)	(100)	(81)	(19)	(100)
Weeding	17.1	16.4	33.5	25.8	11.1	36.9
	(51)	(49)	(100)	(70)	(30)	(100)
Harvesting	18.8		18.8	33.7		33.7
	(100)		(100)	(100)		(100)
Marketing	18.8		18.8	11.9		11.9
	(100)		(100)	(100)		(100)
TOTAL[a]	90.5	47.0	137.5	119.1	34.3	153.4
	(66)	(34)	(100)	(78)	(22)	(100)
Fertilizer application	6.3		6.3			
	(100)		(100)			
TOTAL[b]	96.8	47.0	143.8	119.1	34.3	153.4
	(67)	(33)	(100)	(78)	(22)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

Cassava--Table 4.5 shows the use of household and hired labor in workdays per acre of cassava by activity and village. In Hwidiem 84% of all workdays for cassava were performed by household members and 82% in Adjamesu. Land preparation and planting for cassava are the labor tasks for which farmers in both villages are most likely to hire labor. However, farmers in Adjamesu (28%) are more likely to hire labor for weeding cassava than those in Hwidiem (14%).

Table 4.5. Use of Household and Hired Labor in Cassava by Activity and Village

	Village					
	Hwidiem			Adjamesu		
Activity	Household Labor	Hired Labor	Total Labor Used	Household Labor	Hired Labor	Total Labor Used
	(workdays/acre)					
Land preparation	31.9	14.4	46.3	33.0	15.5	48.5
	(69)	(31)	(100)	(68)	(32)	(100)
Planting	19.7	0.9	20.6	21.2	1.2	22.4
	(96)	(4)	(100)	(95)	(5)	(100)
Weeding	29.5	5.0	34.5	26.3	10.0	36.3
	(86)	(14)	(100)	(72)	(28)	(100)
Harvesting	26.3		26.3	37.5		37.5
	(100)		(100)	(100)		(100)
Marketing				2.5		2.5
				(100)		(100)
TOTAL[a]	107.4	20.3	127.7	120.5	26.7	147.2
	(84)	(16)	(100)	(82)	(18)	(100)
Fertilizer application				5.0		5.0
				(100)		(100)
TOTAL[b]	107.4	20.3	127.7	125.5	26.7	152.2
	(84)	(16)	(100)	(82)	(18)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

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Maize-Cassava Intercrop--The use of household and hired labor in workdays per acre of intercropped maize-cassava is shown in Table 4.6.

Table 4.6. Use of Household and Hired Labor in Maize-Cassava Intercrop by Activity and Village

	Village					
	Hwidiem			Adjamesu		
Activity	Household Labor	Hired Labor	Total Labor Used	Household Labor	Hired Labor	Total Labor Used
	(workdays/acre)					
Land preparation	24.0	21.6	45.6	32.2	14.5	46.7
	(53)	(47)	(100)	(69)	(31)	(100)
Planting	16.2	2.1	18.3	16.0	0.4	16.4
	(89)	(11)	(100)	(98)	(2)	(100)
Weeding	32.3	12.4	44.7	34.4	4.2	38.6
	(72)	(28)	(100)	(89)	(11)	(100)
Harvesting	16.6	1.8	18.4	6.6		6.6
	(90)	(10)	(100)	(100)		(100)
Marketing	5.4		5.4	7.5		7.5
	(100)		(100)	(100)		(100)
TOTAL[a]	94.5	37.9	132.4	96.7	19.1	115.8
	(71)	(29)	(100)	(84)	(16)	(100)
Fertilizer application	12.5		12.5	7.5	0.4	7.9
	(100)		(100)	(95)	(5)	(100)
Storage	10.0		10.0	45.0		45.0
	(100)		(100)	(100)		(100)
Other activities	8.3		8.3			
	(100)		(100)			
TOTAL[b]	125.3	37.9	163.2	149.2	19.5	168.7
	(77)	(23)	(100)	(88)	(12)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

The labor of household members for the maize-cassava intercrop represents 77% of all the workdays for this crop in Hwidiem and 88% in Adjamesu. Farmers in Hwidiem (23%) are about twice as likely to hire labor for maize-cassava than those in Adjamesu (12%), although total labor used for this crop for both villages is about equal. Land preparation for maize-cassava in Hwidiem is almost equally performed by household and hired

labor, 53% and 47%, respectively. This is in contrast to Adjamesu where 69% of all land preparation days for maize-cassava were performed by household labor and 31% by hired labor. Apparently no labor was hired for harvesting cassava in Adjamesu, but 10% of all workdays for harvesting cassava in Hwidiem were performed by hired labor. The use of hired labor for maize-cassava in Hwidiem (38 workdays/acre) exceeds that of Adjamesu (19 workdays/acre).

Other Crops--Table 4.7 summarizes the total use of household and hired labor in workdays per acre by crop in Hwidiem and Adjamesu. These results show and allow comparisons of the intensity of labor use by crops/intercrops and the relative importance of household and hired labor in the production of these crops in both villages. The results discussed here pertain to crops other than maize, cassava, and maize-cassava intercrop.

Table 4.7. Average Use of Household and Hired Labor by Crop in Hwidiem and Adjamesu

	Village					
	Hwidiem			Adjamesu		
Crop	Household Labor	Hired Labor	Total Labor Used	Household Labor	Hired Labor	Total Labor Used
	(workdays/acre)					
Maize	90.5	47.0	137.5	119.1	34.3	153.4
	(66)	(34)	(100)	(78)	(22)	(100)
Cassava	107.4	20.3	127.7	120.5	26.7	147.2
	(84)	(16)	(100)	(82)	(18)	(100)
Plantain[a]	93.2		93.2	131.5	26.4	157.9
	(100)		(100)	(83)	(17)	(100)
Maize-cassava	94.5	37.9	132.4	96.7	19.1	115.8
	(71)	(29)	(100)	(84)	(16)	(100)
Maize-plantain	97.8	60.1	157.9	94.4	40.9	135.3
	(62)	(38)	(100)	(70)	(30)	(100)
Plantain-cocoyam[a]	79.9	17.1	97.0	129.0	34.7	163.7
	(82)	(18)	(100)	(79)	(21)	(100)
Plantain-cassava[a]	161.4	12.5	173.9	159.1	60.2	219.3
	(93)	(7)	(100)	(73)	(27)	(100)
Other maize intercrops	112.6	40.9	153.4	103.3	42.9	146.2
	(73)	(27)	(100)	(71)	(29)	(100)
Other cassava intercrops[a]	47.0	37.7	84.7	82.9	79.8	162.7
	(55)	(45)	(100)	(51)	(49)	(100)

a. Does not include harvesting and marketing of produce.

Note: Figures in parentheses are rounded percentages.

All workdays for plantain cultivation in Hwidiem were performed by household members and no labor was hired for work on this crop. In Adjamesu household labor accounts for 83% of all labor for plantain cultivation and hired labor 17%.

The plantain-cassava intercrop shows an interesting contrast in labor between Hwidiem and Adjamesu. In Hwidiem, 93% of all workdays for this intercrop are accounted for by household labor and only 7% by hired labor. However, in Adjamesu 27% of all workdays for plantain-cassava is accounted for by hired labor and 73% by household labor.

The remaining crops in Table 4.7, including maize-plantain, plantain-cocoyam, other maize intercrops, and other cassava intercrops, show no notable contrasts between villages.

Use of Labor of Men, Women, and Children

In Tables 4.8 through 4.14 the use of labor of men, women, and children by activity, village, gender of farmer, and crop is shown. In these tables the labor of children in workdays was calculated by assuming that 2 days of work of a child is equal to 1 day of work of a man or woman.

Table 4.8 shows the use of labor of men, women, and children in workdays per acre by activity and village. In Hwidiem 56% of workdays for all activities were performed by men, 41% by women, and 3% by children. The corresponding figures for Adjamesu are 38% for men, 41% for women, and a remarkable 21% for children whose labor appears useful for storage activities. These figures do not support the dictum that women dominate food production activity but do suggest that perhaps the role of children in sub-Saharan agriculture deserves more research attention. The figures in Table 4.8

Table 4.8. Average Use of Labor of Men, Women, and Children by Activity and Village

Activity	Village							
	Hwidiem				Adjamesu			
	Men	Women	Children	Total	Men	Women	Children	Total
	(workdays/acre)							
Land preparation	39.4	13.2	1.0	53.6	37.0	17.0	2.0	56.0
	(74)	(25)	(1)	(100)	(66)	(30)	(4)	(100)
Planting	7.4	9.2	1.7	18.3	8.3	15.1	2.2	25.6
	(40)	(50)	(10)	(100)	(32)	(59)	(9)	(100)
Weeding	20.7	18.1	1.0	39.8	17.7	23.9	2.8	44.4
	(52)	(45)	(3)	(100)	(40)	(54)	(6)	(100)
Harvesting	9.7	9.4	1.8	20.9	6.8	10.5	8.2	25.5
	(46)	(45)	(9)	(100)	(27)	(41)	(32)	(100)
Marketing	3.4	3.6		7.0	1.6	5.6	0.8	8.0
	(48)	(51)		(100)	(20)	(70)	(10)	(100)
TOTAL[a]	80.6	53.5	5.5	139.6	71.4	72.1	16.0	159.5
	(58)	(38)	(4)	(100)	(44)	(46)	(10)	(100)
Fertilizer application	6.3	4.2		10.5	2.6	2.3	0.8	5.7
	(60)	(40)		(100)	(46)	(40)	(14)	(100)
Pest control					12.5	7.5		20.0
					(63)	(37)		(100)
Storage	6.3	5.0		11.3		10.0	35.0	45.0
	(56)	(44)		(100)		(22)	(78)	(100)
Other activities	1.7	6.7		8.4	5.0	5.8		10.8
	(20)	(80)		(100)	(46)	(54)		(100)
TOTAL[b]	94.9	69.4	5.5	169.8	91.5	97.7	51.8	241.0
	(56)	(41)	(3)	(100)	(38)	(41)	(21)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

Table 4.9. Average Use of Labor of Men, Women, and Children by Activity and Gender for Hwidiem

Activity	Gender							
	Men				Women			
	Men	Women	Children	Total	Men	Women	Children	Total
	(workdays/acre)							
Land preparation	36.8	6.1	0.8	43.7	41.7	19.6	1.1	62.4
	(84)	(14)	(2)	(100)	(67)	(31)	(2)	(100)
Planting	10.2	4.6	1.7	16.5	5.1	13.2	1.8	20.1
	(62)	(28)	(10)	(100)	(25)	(66)	(9)	(100)
Weeding	27.4	10.1	0.4	37.9	14.8	25.1	1.6	41.5
	(72)	(27)	(1)	(100)	(36)	(60)	(4)	(100)
Harvesting	10.8	9.5	1.1	21.4	6.1	9.3	3.8	19.2
	(51)	(44)	(5)	(100)	(32)	(48)	(20)	(100)
Marketing	5.9	2.9		8.8		4.6		4.6
	(67)	(33)		(100)		(100)		(100)
TOTAL[a]	91.1	33.2	4.0	128.3	67.7	71.8	8.3	147.8
	(71)	(26)	(3)	(100)	(46)	(49)	(5)	(100)
Fertilizer application	3.8			3.8	11.3	12.5		23.8
	(100)			(100)	(47)	(53)		(100)
Pest control								
Storage	8.3	3.3		11.6		10.0		10.0
	(72)	(28)		(100)		(100)		(100)
Other activities	2.5	5.0		7.5		10.0		10.0
	(33)	(67)		(100)		(100)		(100)
TOTAL[b]	105.7	41.5	4.0	151.2	79.0	104.3	8.3	191.6
	(70)	(27)	(3)	(100)	(41)	(55)	(4)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

Table 4.10. Average Use of Labor of Men, Women, and Children in Workdays Per Acre by Activity and Gender for Adjamesu

Activity	Gender							
	Men				Women			
	Men	Women	Children	Total	Men	Women	Children	Total
	(workdays/acre)							
Land preparation	37.0	11.0	1.2	49.2	37.0	21.3	2.6	60.9
	(75)	(22)	(3)	(100)	(61)	(35)	(4)	(100)
Planting	11.6	10.1	2.2	23.9	6.2	18.5	2.2	26.9
	(49)	(42)	(9)	(100)	(23)	(69)	(8)	(100)
Weeding	20.7	16.4	2.0	39.1	15.8	28.4	3.3	47.5
	(53)	(42)	(5)	(100)	(33)	(60)	(7)	(100
Harvesting	10.8	7.1	15.4	33.3	4.2	12.8	3.5	20.5
	(33)	(21)	(46)	(100)	(21)	(62)	(17)	(100)
Marketing	2.8	0.7		3.5	0.8	8.9	1.3	11.0
	(80)	(20)		(100)	(7)	(81)	(12)	(100)
TOTAL[a]	82.9	45.3	20.8	149.0	64.0	89.9	12.9	166.8
	(56)	(30)	(14)	(100)	(38)	(54)	(8)	(100)
Fertilizer application	5.0			5.0	2.3	2.6	0.9	5.8
	(100)			(100)	(40)	(45)	(15)	(100)
Pest control	12.5	7.5		20.0				
	(63)	(37)		(100)				
Storage						10.0	35.0	45.0
						(22)	(78)	(100)
Other activities	10.0	10.0		20.0		1.7		1.7
	(50)	(50)		(100)		(100)		(100)
TOTAL[b]	110.4	62.8	20.8	194.0	66.3	104.2	48.8	219.3
	(57)	(32)	(11)	(100)	(30)	(48)	(22)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

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Table 4.11. Average Use of Labor of Men, Women, and Children in Maize by Activity and Village

Activity	Village							
	Hwidiem				Adjamesu			
	Men	Women	Children	Total	Men	Women	Children	Total
	(workdays/acre)							
Land preparation	40.9	14.0		54.9	39.8	9.9	0.2	49.9
	(80)	(20)		(100)	(75)	(24)	(1)	(100)
Planting	5.6	4.0	2.0	11.6	7.6	11.5	1.9	21.0
	(55)	(35)	(10)	(100)	(42)	(46)	(12)	(100)
Weeding	10.8	22.7		33.5	19.9	14.2	2.8	36.9
	(39)	(61)		(100)	(54)	(41)	(5)	(100)
Harvesting	18.8			18.8	7.6	14.3	11.8	33.7
	(100)			(100)	(24)	(52)	(24)	(100)
Marketing	18.8			18.8	2.9	8.3	0.6	11.8
	(100)			(100)	(35)	(60)	(5)	(100)
TOTAL[a]	94.9	40.7	2.0	137.6	77.8	58.2	17.3	153.3
	(69)	(30)	(1)	(100)	(51)	(38)	(11)	(100)
Fertilizer application	6.3			6.3				
	(100)			(100)				
TOTAL[b]	101.2	40.7	2.0	143.9	77.8	58.2	17.3	153.3
	(71)	(28)	(1)	(100)	(51)	(38)	(11)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

Table 4.12. Average Use of Labor of Men, Women, and Children in Maize-Cassava Intercrop by Activity and Village

Activity	Village							
	Hwidiem				Adjamesu			
	Men	Women	Children	Total	Men	Women	Children	Total
	(workdays/acre)							
Land preparation	37.1	8.0	0.5	45.6	30.2	13.4	3.1	46.7
	(81)	(18)	(1)	(100)	(68)	(27)	(5)	(100)
Planting	9.3	7.2	1.8	18.3	6.7	7.6	2.1	16.4
	(48)	(43)	(9)	(100)	(36)	(53)	(11)	(100)
Weeding	28.7	14.6	1.4	44.7	14.8	17.8	6.0	38.6
	(61)	(35)	(4)	(100)	(41)	(46)	(13)	(100)
Harvesting	9.0	7.4	2.0	18.4	2.5	2.5	1.6	6.6
	(53)	(38)	(9)	(100)	(38)	(39)	(23)	(100)
Marketing	1.3	4.2		5.5		5.0	2.5	7.5
	(13)	(87)		(100)		(67)	(33)	(100)
TOTAL[a]	85.4	41.4	5.7	132.5	54.2	46.3	15.3	115.8
	(65)	(31)	(4)	(100)	(47)	(40)	(13)	(100)
Fertilizer application	6.3	6.3		12.6	3.1	2.9	1.9	7.9
	(74)	(26)		(100)	(25)	(60)	(15)	(100)
Storage	2.5	7.5		10.0		10.0	35.0	45.0
	(25)	(75)		(100)		(22)	(78)	(100)
Other activities	1.7	6.7		8.4				
	(17)	(83)		(100)				
TOTAL[b]	95.9	61.9	5.7	163.5	57.3	59.2	52.2	168.7
	(58)	(38)	(4)	(100)	(34)	(35)	(31)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

Table 4.13. Average Use of Labor of Men, Women, and Children in Cassava by Activity and Village

Activity	Village							
	Hwidiem				Adjamesu			
	Men	Women	Children	Total	Men	Women	Children	Total
	(workdays/acre)							
Land preparation	33.3	12.1	0.8	46.2	30.2	15.9	2.3	48.4
	(71)	(27.0)	(2)	(100)	(63)	(33)	(4)	(100)
Planting	7.9	10.1	2.6	20.6	7.9	12.6	1.9	22.4
	(41)	(49)	(10)	(100)	(33)	(57)	(10)	(100)
Weeding	16.7	17.6	0.2	34.5	18.1	16.5	1.7	36.3
	(59)	(40)	(1)	(100)	(48)	(47)	(5)	(100)
Harvesting	7.5	15.0	3.8	26.3	7.5	7.5	22.5	37.5
	(29)	(57)	(14)	(100)	(20)	(20)	(60)	(100)
Marketing					1.3	1.3		2.6
					(50)	(50)		(100)
TOTAL[a]	65.4	54.8	7.4	127.6	65.0	53.8	28.4	147.2
	(51)	(43)	(6)	(100)	(44)	(37)	(19)	(100)
Fertilizer application						5.0		5.0
						(100)		(100)
TOTAL[b]	65.4	54.8	7.4	127.6	65.0	58.8	28.4	152.2
	(51)	(43)	(6)	(100)	(43)	(38)	(19)	(100)

a. Includes dominant labor activities (80%-90%) for the sampled plots.

b. Includes all activities present (10%-20%) for the sampled plots. Figures in parentheses are rounded percentages.

Table 4.14. Average Total Use of Labor of Men, Women, and Children by Crop and Village

Crop	Village							
	Hwidiem				Adjamesu			
	Men	Women	Children	Total	Men	Women	Children	Total
	(workdays/acre)							
Maize	94.9	40.7	2.0	137.6	77.8	58.2	17.3	153.3
	(69)	(30)	(1)	(100)	(51)	(38)	(11)	(100)
Cassava	65.4	54.8	7.4	127.6	65.0	53.8	28.4	147.2
	(51)	(43)	(6)	(100)	(44)	(37)	(19)	(100)
Plantain[a]	45.8	42.0	5.4	93.2	61.0	90.4	6.3	157.7
	(49)	(45)	(6)	(100)	(39)	(57)	(4)	(100)
Maize-cassava	85.4	41.4	5.7	132.5	54.2	46.3	15.3	115.8
	(65)	(31)	(4)	(100)	(47)	(40)	(13)	(100)
Maize-plantain	81.3	64.7	11.8	157.8	67.9	63.4	6.0	137.3
	(52)	(41)	(7)	(100)	(50)	(46)	(4)	(100)
Plantain-cocoyam[a]	38.8	57.4	0.9	97.1	67.8	90.3	5.7	163.8
	(40)	(59)	(1)	(100)	(41)	(55)	(4)	(100)
Plantain-cassava[a]	53.8	120.1		173.9	83.2	127.6	8.8	219.6
	(31)	(69)		(100)	(38)	(58)	(4)	(100)
Other maize intercrops	77.7	68.7	7.1	153.5	90.4	34.7	21.3	146.4
	(51)	(45)	(4)	(100)	(62)	(24)	(14)	(100)
Other cassava intercrops[a]	49.6	34.9		84.5	101.0	59.0	2.8	162.8
	(59)	(41)		(100)	(62)	(36)	(2)	(100)

a. Does not include harvesting and marketing of produce. Figures in parentheses are rounded percentages.

generally suggest that on the average the work of land preparation is largely the responsibility of men in both villages. Among the other major activities of planting, weeding, harvesting, and marketing in Hwidiem, the percentages of workdays among men and women are remarkably similar, although men devote more days to weeding than women; women work more in planting. It is a common belief in West Africa that seeds should be planted by the hands of a fertile woman. It is clear, however, that the physically demanding tasks of land preparation and weeding are more often the responsibility of men rather than women in Hwidiem.

The pattern of labor use for farmers in Adjamesu is somewhat different than in Hwidiem. Men and children account for 70% of the workdays allocated for land preparation and women 30%, somewhat higher than in Hwidiem (25%). Planting in Adjamesu is more the responsibility of women and children than in Hwidiem, as their combined labor for planting accounts for 68% of all workdays for this activity. Sixty percent of the weeding work is performed by women and children in Adjamesu in contrast to that activity being more equally shared in Hwidiem. Harvesting and marketing work are also dominated by women and children in Adjamesu. Their combined figures are 73% and 80%, respectively.

Table 4.9 describes labor data for men, women, and children in the control village of Hwidiem by gender of farmer. As an introductory and general observation it is quite clear that neither gender performs agricultural activities without the assistance of the other.

Men who manage farms in Hwidiem clearly use more labor by men. On these farms, 70% of all agricultural workdays were performed by men, 27% by women, and 3% by children. The activities of land preparation, planting, weeding, marketing, fertilizer application, and storage are most often the

responsibility of men on farms managed by men, although harvesting work is more equally shared between men and women.

The pattern of labor use on farms managed by women in Hwidiem clearly shows that women are not solely responsible for agricultural work on their farms and that much of the work on the farms managed by women is performed by men. The pattern of men performing the most physically demanding work of land preparation is again evident on the farms managed by women in Hwidiem. However, on farms managed by women the tasks of planting, weeding, harvesting, marketing, storage, and other activities are predominately performed by women, but clearly not exclusively by women. Overall the work on farms managed by women is remarkably shared with men as evident in that 41% of all workdays on farms managed by women were performed by men, 55% by women, and 4% by children.

Table 4.10 presents descriptive labor data for men, women, and children by gender for the village of Adjamesu. As in Hwidiem, there is no evidence that food production is the sole or exclusive responsibility of women, but rather the agricultural work on farms managed by women is supported by the labor of men and children.

On farms managed by men in this village, 57% of all workdays for all activities are accounted for by the labor of men, 32% by women, and 11% by children. The corresponding figures for farms managed by women in Adjamesu are 30%, 48%, and 22%, respectively.

Again, regardless of the gender of the farm manager the demanding task of land preparation is largely the responsibility of men but women contribute more to this activity on farms under their management.

Maize--The labor use data for the production of maize by village indicate in Table 4.11 that for all labor activities in Hwidiem 71% were performed by men, 28% by women, and 1% by children. The corresponding percentages for Adjamesu are 51%, 38%, and 11%, respectively. Unlike Hwidiem, the labor of children in maize production in Adjamesu is notable, 11% of all labor as compared to 1% in Hwidiem.

Labor for land preparation, planting, harvesting, marketing, and fertilizer application for maize in Hwidiem is mainly the responsibility of men, but women appear to have the major responsibility for weeding maize fields.

In Adjamesu, men are primarily responsible for land preparation and weeding of maize. The planting of maize is about equally shared by men and women in Adjamesu, 42% and 46% of all planting days, respectively. The harvesting and marketing of maize in Adjamesu is largely the responsibility of women, 52% and 60% of workdays for these activities, respectively. Children in Adjamesu contribute substantially to maize production as they perform 12% of all workdays for planting and 24% for harvesting.

Maize-Cassava Intercrop--The patterns of labor use for the maize-cassava intercrop shown in Table 4.12 indicate that in Hwidiem 58% of all workdays for this crop are performed by men, 38% by women, and 4% by children.

In contrast the workdays of men and women for the intercrop of maize-cassava in Adjamesu are rather equal, 34% of all days are accounted for by men and 35% by women. Unlike Hwidiem, however, 31% of the total labor use in this crop is accounted for by the labor of children in Adjamesu. Judging the labor of children in the two villages, it is apparent that child labor is

substantial in Adjamesu in general and for the maize-cassava intercrop in particular.

In Hwidiem the work of land preparation, planting, weeding, harvesting, and fertilizer application are predominantly performed by men. Women in Hwidiem are primarily involved in the marketing and storage of the maize-cassava production. Children in Hwidiem are responsible for 9% of the total workdays for planting and harvesting this intercrop.

In Adjamesu land preparation is again the responsibility of men and 68% of the total workdays in this activity are performed by men. Planting the maize-cassava intercrop is predominantly performed by women, who account for 53% of all workdays for this activity, and children whose labor accounts for about 11%.

Of the approximately 39 days allocated for weeding the maize-cassava intercrop in Adjamesu, 41% are workdays of men, 46% are of women, and 13% of children. The storage work for maize-cassava is exclusively performed by women and children who account for 22% and 78% of the 45 days allocated for this activity.

Cassava--Results on labor use for cassava are shown in Table 4.13. Of the 128 workdays for cassava in Hwidiem, 51% are accounted for by men, 43% by women, and 6% by children. Of the 152 total workdays for this crop in Adjamesu, 43% are accounted for by men, 38% by women, and 19% by children. Again, the importance of child labor in Adjamesu is evident.

Seventy-one percent of the 46 days of land preparation for cassava are accounted for by the labor of men in Hwidiem, 27% by women, and 2% by children. The corresponding figures for Adjamesu are 63%, 33%, and 4% of 48 total workdays, respectively.

The 22 workdays for planting cassava are rather equally distributed among men (41%) and women (49%) in Hwidiem, but in Adjamesu, 67% of the workdays for this activity are accounted for by the labor of women and children.

Concerning the weeding of cassava in Hwidiem, 59% of the average of 35 workdays used for this task were performed by men, 40% by women, and 1% by children. The gender distribution of this task in Adjamesu is remarkably well distributed between genders with men accounting for about 48% of the average of 36 workdays, women 47%, and children about 5%.

The harvesting of cassava in Hwidiem is largely the responsibility of women and children who account for 57% and 14% of the average 26 workdays used for this activity, respectively. Interestingly, the harvesting of cassava in Adjamesu is a task performed mainly by children, who account for 60% of the average of 38 workdays of this activity.

Other Crops--Table 4.14 summarizes the total use of labor of men, women, and children per acre by crops in Hwidiem and Adjamesu.

The figures show that the labor of men in Hwidiem dominates the production of sole cropped maize, 69% of all workdays for this crop, and the maize-cassava intercrop, 65% of all workdays. The labor of women is dominant for the production of the plantain-cocoyam intercrop as 59% of all workdays for this crop were attributed to women, but 40% of the workdays for this crop are performed by men. The plantain-cassava intercrop is also dominated by the labor of women who performed 69% of all the workdays for this crop. The labor of men and women for all other crops in Hwidiem is more equally shared. The labor of children in Hwidiem is small for all crops.

In Adjamesu 51% of the average use of labor for maize was provided by men who also dominate the labor used in other maize intercrops (62%) and other cassava intercrops (62%). In Adjamesu the labor of women is dominant for plantain (57%), plantain-cocoyam (55%), and plantain-cassava (58%) but not without a substantial labor contribution from men.

The labor of children in Adjamesu is primarily for cassava (19%), other maize intercrops (14%), maize-cassava (13%), and maize (11%). Again, the use of labor of children in Adjamesu is greater than in Hwidiem.

Use of Fertilizers

The present and past use of fertilizer by village and gender is shown in Table 4.15. The figures show that the use of fertilizer, regardless of gender or village, was minimal for the survey cropping season. Although men are more likely to use fertilizer than women, men in Hwidiem (26%) are most likely to use fertilizer and women in Hwidiem least likely (3%). There is far more equality in the use of fertilizer by gender in Adjamesu. Specifically, the percentages of men and women sampled in Adjamesu that have used fertilizer during the survey season are about equal, 14% and 13%, respectively. Overall the farmers in Hwidiem were slightly more likely than in Adjamesu to have used fertilizers during the survey season, 15% compared to 13%, respectively. The total sample figures show 14% of all farmers used fertilizer during the survey season and that men (21%) are more likely to use fertilizer than women (9%).

Table 4.15. Present and Past Use of Fertilizers by Gender, Village, and Total Sample

	Farmers Using Fertilizer This Season (%)	Prior Use of Fertilizer[a] (%)
Hwidiem		
Men	26	65
Women	3	17
TOTAL	15	38
Adjamesu		
Men	14	37
Women	13	27
TOTAL	13	31
Total Sample		
Men	21	52
Women	9	23
TOTAL	14	35

a. Farmers that have used fertilizer at least once.

The figures describing the use of fertilizer prior to the survey year show that 35% of the men and 83% of the women in Hwidiem have not used fertilizer in the past. The lower use of fertilizer in Adjamesu is evident in that 63% of the men and 73% of the women have not used fertilizer in the past. The total sample figures show that the percentage of men who have used and never used fertilizers are about equal, 52% and 48%, respectively. Regarding women 23% have used fertilizer in the past compared with only 9% during the survey season and 77% have never used fertilizer. Overall about two-thirds of the sample regardless of gender have never used fertilizer.

The descriptive data in Table 4.16 show the percentages of farmers giving particular reasons for not using fertilizer. Twenty-nine percent of the men in Hwidiem and 42% of the men in Adjamesu reported having no knowledge

about the use of fertilizer. Among women farmers, 42% in Hwidiem and 35% in Adjamesu reported no knowledge as a reason for not using fertilizer. Overall 38% of the total sample reported no knowledge as a reason for not using fertilizer. Lack of knowledge was the most important reason given by farmers for not using fertilizer.

Table 4.16. Percentage Distributions of Reasons Given by Farmers for Not Using Fertilizers by Gender, Village, and Total Sample

Reasons	Hwidiem			Adjamesu			Total Sample		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
	- - - -(%)- - - -			- - - -(%)- - - -			- - - -(%)- - - -		
No knowledge	29	42	39	42	35	37	37	38	38
Lack of money	0	17	13	33	39	37	21	28	26
Not needed	29	12	16	0	13	11	11	13	12
Causes problems	14	12	13	17	0	9	16	6	9
Too expensive	14	0	3	8	13	6	11	6	8
Other	14	17	16	0	0	0	4	9	7
TOTAL	100	100	100	100	100	100	100	100	100

Men in Hwidiem do not cite lack of money as a reason for not using fertilizer, but 17% of the women farmers cite this factor as a constraint. Thirty-three percent of the men and 39% of the women in Adjamesu cite lack of money as a constraint to fertilizer use. Thus, women are more likely to cite lack of money as a constraint (28%) than men (21%).

Men (29%) in Hwidiem are about two and one-half times more likely to indicate that fertilizer is not needed than women (12%). No men in Adjamesu suggested that fertilizer is not needed, but 13% of the women cited lack of need as a reason for not using fertilizer. Overall about 11% of men in both villages and 13% of the women suggested that fertilizer is not needed and therefore not used.

Perhaps because men are more familiar with fertilizer, 14% in Hwidiem and 17% in Adjamesu stated that fertilizer causes problems, such as changing the taste of cassava and excessive weeds. Twelve percent of the women in Hwidiem cite this problem, but it was not cited at all by women in Adjamesu.

Fourteen percent of the men in Hwidiem view fertilizer as too expensive to use, but women do not view price as a constraint in the control village. In Adjamesu 8% of the men and 13% of the women view the expense of fertilizer as a reason for not using it. The total sample figures show that limited knowledge and the view that fertilizer is not needed account for 50% of the reasons for not using it.

Among those farmers who have previously used fertilizer, the reasons for discontinuing use are shown in Table 4.17. Twenty-one percent of the farmers who have discontinued fertilizer use in Hwidiem and 43% in Adjamesu cited lack of money as the reason. Overall 31% of the total sample cited this reason. Twenty-one percent of the farmers in Hwidiem and 14% of those in Adjamesu cited the expense of fertilizer as a reason for discontinuing use. Eighteen percent of the total sample cited this reason.

Table 4.17. Percentage Distributions of Reasons Given by Farmers for Discontinuing the Use of Fertilizers by Village and Total Sample

Reason	Hwidiem	Adjamesu	Total Sample
	(%)		
Lack of money	21	43	31
Too expensive	21	15	18
Stopped growing vegetables	16	14	15
Not available	16	14	15
Not needed	16	0	9
Promotes weeds	5	7	6
Other	5	7	6
TOTAL	100	100	100

Ashanti farmers appear to hold widely the viewpoint that fertilizers are only best used for vegetable production. Thus, 16% of the farmers in Hwidiem and 14% of those in Adjamesu discontinue using fertilizers when they ceased growing vegetables.

Concerning the supply and availability of fertilizer, 16% of the farmers in Hwidiem and 9% of the total sample reported such problems as a reason for not using fertilizer. However, this problem was not cited by any farmers in the village of Adjamesu.

Finally among the reasons offered by Ashanti farmers for not using fertilizers is the problem of weeds. Specifically, 5% of the farmers in Hwidiem, 7% of those in Adjamesu, and 6% of the total sample reported that excessive weeds occur as a result of using fertilizer.

Use of Organic Manure

The use of organic manure in the sample villages is minimal. Three percent of the total sample, 2% of the farmers in Hwidiem, and 5% in Adjamesu reported using organic manure during the survey year. Four percent of the total sample, 7% of the farmers in Hwidiem, and 2% in Adjamesu reported having used organic manure in cropping seasons prior to the survey year.

The Ashanti farmers were quite clear about their aversion to handling organic waste. Fifty percent of the total sample offered reasons for not using organic manure that may be understood as handling problems. The words the farmers used to describe organic manure were dirty and unhealthy. Fifty percent of the total sample cited such problems as did 67% of the sample from Hwidiem. Among the very few who use organic manure, the sources were fowl, rabbits, sheep, and goats.

Use of Agricultural Credit

The use of agricultural credit in both the experimental and control village is very limited; 26% of the total sample reported the use of some sort of credit during the survey year. Farmers in Adjamesu were somewhat more likely than those in Hwidiem to use agricultural credit, 30% and 21%, respectively.

For the total sample, loans from family members and friends account for 71% of all loans, and loans from moneylenders account for 16%. In Hwidiem loans from family members and friends account for 77% of all loans and moneylenders account for 7%. The greatest reliance on moneylenders for agricultural loans is in Adjamesu where 22% of all loans were from this source and 56% of loans were made from family members. The greater reliance on moneylenders in Adjamesu may be explained by the proximity of this village to Kumasi, an urban and market-oriented city well populated with money lenders. This observation is also supported in that, unlike Hwidiem, 11% of loans in Adjamesu were obtained from rural banks.

In the general context of the use of credit, it is noteworthy that in the total sample 76% of the farmers made no attempt to obtain an agricultural loan. The corresponding figures for Hwidiem and Adjamesu are 75% and 76%, respectively.

In the total sample the major reasons for not seeking an agricultural loan were that a loan was not needed (50%), money was available from family members (25%), expected application to be disapproved (9%), fear of crop failure (7%), fear of debt (6%), high interest rates (2%), and no lender available (1%).

Among those farmers who sought agricultural loans but did not receive a favorable decision, 46% made a request from a rural bank, 23% from a money lender, 14% from a friend, 9% from a co-op bank, 4% from a family member, and 4% made requests from a commercial bank. In Hwidiem 83% of the farmers who applied for a loan did so from a rural, co-op, or commercial bank. Only 17% sought loans from family members or friends.

In Adjamesu 50% of those farmers who sought loans approached a moneylender, 30% a rural bank, and 20% sought but did not obtain a loan from a friend. In Adjamesu moneylenders and friends are the favored sources for farmers to request loans.

Sixty-two percent of those farmers who sought loans but ultimately failed to receive a favorable decision cited disapproval of the application or the source having no funds as reasons. Fourteen percent declined to accept an approved loan because of excessive interest rates and 5% of the farmers decided not to accept an approved loan. Nineteen percent cited various bureaucratic problems, late application, and similar reasons for not receiving a loan.

In Hwidiem 82% of the farmers who applied but failed to receive a loan cited outright disapproval of the application or no money being available as reasons, 18% cited bureaucratic problems, not accepting an approved loan because of excessive interests, or delays as reasons for not receiving a loan.

In Adjamesu farmers gave the following reasons for not receiving a loan: Loan not approved (20%), no money available from lender (20%), excessive interest rates (30%), 10% changed their mind and did not accept an approved loan, and 20% cited various other reasons.

Disposal and Use of Crop Output

The disposal and use of maize, cassava, and all other crop outputs are shown in Table 5.1. Data in this table indicate that 71% of the farmers in Hwidiem and 50% of the farmers in Adjamesu cultivated maize for the dual purposes of household consumption and sale. Eighty percent of the cassava in Adjamesu was used for these purposes. The figures for all crops grown for household consumption and sale indicate that these uses are more frequent in Hwidiem (69%) than in Adjamesu (53%).

Table 5.1. Percentage Distribution of Uses and Disposal of Crop Products by Village

Use	Hwidiem			Adjamesu		
	Maize	Cassava	All Crops	Maize	Cassava	All Crops
	(%)			(%)		
Consumption and sale	71	-	69	50	80	53
Sale	21	-	25	18	20	21
Household consumptions	4	-	3	29	-	23
Storage	4	-	3	-	-	-
Lost to pests	-	-	-	3	-	3
TOTAL	100	-	100	100	100	100

Table 5.1 further shows that farmers in both villages use between 18% and 25% of maize, cassava, and all other crops exclusively for sale. Thus, in both villages there are many farmers that use crop production for household consumption rather than exclusively for market sale. However, there are some differences between villages. Twenty-nine percent of the maize and 23% of all other crops are used for household consumption in Adjamesu as compared with 4% and 3% in Hwidiem. Unlike Adjamesu, 4% of the maize and 3%

of all crops are used for storage in Hwidiem. Finally, Table 5.1 suggests that pests, while minimal, are a greater problem in Adjamesu than in Hwidiem.

Place of Sale for All Crops

The descriptive statistics for the total sample in Table 5.2 show that 67% of all crops sold were sold in the village in which the farmer resides. This table also shows that farmers in Hwidiem (71%) are more likely to make sales for their crops in the village than farmers in Adjamesu (63%).

Table 5.2. Percentage Distribution of Places of Sale for All Crops by Village

Place of Sale	Hwidiem (%)	Adjamesu (%)	Total Sample (%)
In village	71	63	67
Kumasi	25	20	23
Nkawie	4	-	2
On-farm	-	17	8
TOTAL	100	100	100

Interestingly, farmers in Hwidiem sell 25% of their crops destined for market in Kumasi and for Adjamesu this figure is 20%. Overall 23% of the sample found markets for their agricultural products in Kumasi.

Farmers in Hwidiem sold 4% of their crops in the neighboring village of Nkawie. Farmers in Adjamesu reported that 17% of their crops were sold on the farm. Such sales are often made to Kumasi residents who travel to Adjamesu to purchase food and sometimes purchase a complete field of cassava or maize.

Household Responsibility for Crop Sales

Table 5.3 clearly shows that farmers themselves are most often responsible for the sale of crops. This is the case for 73% of the total sample, 71% of the farmers in Hwidiem, and 75% of the farmers in Adjamesu. The identical figures for Hwidiem and Adjamesu of 21% indicate that wives of farmers share sales work equally in both villages and that only minor sales are made by the sisters and daughters of farmers.

Table 5.3. Percentage Distribution of Persons Responsible for Crop Sales

Person Making Sales	Hwidiem (%)	Adjamesu (%)	Total Sample (%)
Farmer	71	75	73
Farmer's wife	21	21	21
Farmer's sister	4	4	4
Farmer's daughter	4	-	2
TOTAL	100	100	100

Characteristics of Maize Sales

The units of measure for maize sales in the Ashanti region of Ghana are diverse and lack uniformity. Maize, the most important crop, is sold in units of cobs, baskets of varying sizes, kilograms, minibags, maxibags, and headloads. However, cobs, baskets, and kilogram units are most common and are used to describe maize sales by gender, village, and the total sample in Table 5.4.

Table 5.4. Mean Quantity, Percent, and Price of Maize Sold by Gender, Village, and Total Sample

		Gender								
		Men			Women			Total Sample		
		Mean								
Village	Unit of Measure	Quantity Sold	Percent Sold	Price (Cedis/Unit)	Quantity Sold	Percent Sold	Price (Cedis/Unit)	Quantity Sold	Percent Sold	Price (Cedis/Unit)
Hwidiem	10 cobs	131.8	76.7	116.8	48.0	60.0	-	119.9	74.3	116.8
	Basket	8.0	80.0	-	8.0	44.5	500.0	8.0	56.3	500.0
	10 kg unit	45.8	70.1	344.4	21.3	71.8	353.0	33.6	70.8	348.0
Adjamesu	10 cobs	75.0	65.0	116.7	60.0	50.0	128.3	66.0	57.5	122.5
	Basket	44.3	76.3	700.0	14.8	64.3	990.0	26.6	68.3	881.3

Women are somewhat less likely than men to sell maize which indicates an interest in meeting the needs for household consumption. In contrast, men have a somewhat greater interest in generating cash to provide for household needs other than food. Table 5.4 shows further that the prices received by men and women are approximately the same but that prices vary probably because of diverse sizes of baskets and units of measurement.

Sources of Agricultural Information

Table 6.1 provides descriptive data on the perceptions of farmers about the value of agricultural information received from various sources by village and the total sample.

The total sample figures indicate that 56% of the farmers are uncertain about the value of information received from agricultural cooperatives and 17% perceive information from this source as not helpful. Thus, nearly three-fourths (73%) of the sample does not view information from agricultural cooperatives as helpful and only 27% find cooperatives very helpful (23%) or somewhat helpful (4%).

Regarding the value of information received from extension workers, 54% of the total sample perceive the value of such information as not helpful or are uncertain about the value of such information. About one-third of the farmers (34%) view information from extension workers as very helpful, and 12% find such information somewhat helpful. Thus, the total sample is nearly equally divided about the value of advice and information from extension workers.

Table 6.1. Perceptions About the Value of Agricultural Information From Various Sources by Village and Gender

Source of Information / Gender	Perceptions About Value of Information							
	Very Helpful		Somewhat Helpful		Not Helpful		Uncertain	
	Hwidiem	Adjamesu	Hwidiem	Adjamesu	Hwidiem	Adjamesu	Hwidiem	Adjamesu
	(%)							
Men								
Cooperatives	30	50	10	-	5	17	55	33
Extension workers	41	48	7	8	11	22	41	22
Other farmers	31	35	15	25	19	15	35	25
Fertilizer dealers	27	25	27	10	9	15	37	50
Women								
Cooperatives	5	15	5	-	32	15	58	70
Extension workers	19	30	11	20	37	27	33	23
Other farmers	28	27	18	16	11	30	43	27
Fertilizer dealers	18	22	4	4	26	22	52	52

The total sample of farmers is rather equally divided as to the value of information received from other farmers. Fifty-two percent of the sample view information from other farmers as not helpful and the value of such information uncertain. Thirty percent find information from other farmers very helpful and 18% find such information somewhat helpful. Thus, 48% find information from other farmers helpful to some degree. Sixty-six percent of the farmers find information from fertilizer dealers not helpful and are uncertain about the value of information from this source, 23% find information from this source very helpful, and 11% find information from fertilizer dealers somewhat helpful.

Overall, it appears that farmers in the Ashanti region find information from fertilizer dealers and cooperatives least helpful. The sample is rather evenly divided about the value of information obtained from extension workers and other farmers but tend to value information from other farmers above that from extension workers.

Hwidiem

As shown in Table 6.2, 5% of the men in Hwidiem perceive information from agricultural cooperatives as not helpful and 55% are uncertain about the value of information from this source. Thirty percent of the men find information from cooperatives very helpful and 10% report such information as somewhat helpful. The problem of integrating women into agricultural cooperatives is very evident in Hwidiem in that 90% of the women are uncertain about the value of information from cooperatives and characterize such information as not helpful. This figure almost certainly results from the exclusion of women from cooperative activity.

Table 6.2. Perceptions About the Value of Agricultural Information From Various Sources in Hwidiem by Gender

Sources of Information / Gender	Perceptions of Farmers: Very Helpful	Somewhat Helpful	Not Helpful	Uncertain
	(%)			
Men				
Cooperatives	30	10	5	55
Extension workers	41	7	11	41
Other farmers	31	15	19	35
Fertilizer dealers	27	27	9	37
Women				
Cooperatives	5	5	32	58
Extension workers	19	11	37	33
Other farmers	28	18	11	43
Fertilizer dealers	18	4	26	52

The perceived value of information from extension workers for men farmers in Hwidiem is such that 41% characterize it as very helpful and 7% as somewhat helpful. But if the percentages of farmers who view extension information as not helpful and uncertain are combined, 52% of the farmers are probably influenced minimally by extension advice. Among women in Hwidiem 19% report the value of information from extension services as very helpful, 11% as somewhat helpful, 37% as not helpful, and 33% are uncertain about the value of information provided by extension workers. These figures indicate that extension services have not reached Ashanti women to the extent that is possible and desirable. This point is clear when the not helpful category is combined with the uncertain category for women which shows that 70% of the

women in Hwidiem do not perceive much value in agricultural information offered by extension workers.

Thirty-one percent of the men and 28% of the women in Hwidiem find information from other farmers very helpful or somewhat helpful, 15% of the men and 18% of the women find information from other farmers somewhat helpful. Men in Hwidiem are somewhat more likely than women to perceive information from other farmers as not helpful, 19% and 11%, respectively. Women (26%) are about three times as likely as men (9%) to view the value of information from fertilizer dealers as not helpful. Thus, 52% of the women in Hwidiem but only 32% of the men farmers view the value of information from fertilizer dealers as uncertain. Finally, the data in Table 6.2 suggest that information from other farmers is most useful for women in Hwidiem and that information from fertilizer dealers is most useful for men.

Adjamesu

Table 6.3 shows that men in Adjamesu are equally divided about the value of information received from agricultural cooperatives. Specifically, 50% find such information very helpful and 50% view such information as not helpful and are uncertain about the value of agricultural information obtained from cooperatives. The general exclusion of women from participation in cooperatives in Adjamesu is again evident in that 85% are uncertain about the value of such information and characterize it as not helpful. Only a small minority of women in Adjamesu (15%) view agriculture information from cooperatives as very helpful.

Table 6.3. Perceptions About the Value of Agricultural Information From Various Sources in Adjamesu by Gender

Sources of Information Gender	Perceptions of Farmers			
	Very Helpful	Somewhat Helpful	Not Helpful	Uncertain
	(%)			
Men				
Cooperatives	50	-	17	33
Extension workers	48	8	22	22
Other farmers	35	25	15	25
Fertilizer dealers	25	10	15	50
Women				
Cooperatives	15	-	15	70
Extension workers	30	20	27	23
Other farmers	27	16	30	27
Fertilizer dealers	22	4	22	52

The men farmers characterize information received from extension workers in Adjamesu as very helpful (48%), somewhat helpful (8%), not helpful (22%), or of uncertain value (22%). Women farmers in Adjamesu are more likely to view information from extension workers as very helpful (30%) or somewhat helpful (20%) than in Hwidiem where the corresponding are 19% and 11%, respectively. But a substantial 50% of the women in Adjamesu are uncertain about the information received from extension workers and characterize it as not helpful. This is compared with 70% of the women in Hwidiem who are uncertain about the value of extension information and characterize it as not helpful.

Men in Adjamesu generally characterize agricultural information received from other farmers as more helpful than do women. Specifically, 35% of the men and 27% of the women in Adjamesu find information from other farmers very helpful. Twenty-five percent of the men but only 16% of the women characterize information from other farmers as somewhat helpful.

Interestingly, twice as many women (30%) as men (15%) perceive information from other farmers as not helpful. Men and women farmers in Adjamesu are about equally uncertain about the value of agricultural information received from others, 25% and 27%, respectively.

Nearly equal percentages of men (25%) and women (22%) perceive information from fertilizer dealers as very helpful in Adjamesu. But 22% of the women compared with 15% of the men characterize information from fertilizer dealers as not helpful. Finally, 50% of the men and 52% of the women in Adjamesu are uncertain about the value of information offered by fertilizer dealers.

In summary, 54% of the men in Hwidiem find information from fertilizer dealers very helpful and somewhat helpful and 45% of the women find other farmers very helpful and somewhat helpful. In Adjamesu 60% of the men cite other farmers as very helpful and somewhat helpful but fully 50% of the women characterize extension workers as very helpful or somewhat helpful. The consequences of the work of extension services in Adjamesu compared with Hwidiem are evident in these figures.

Extension Service Visits

The number of extension service visits per year received by farmers by village, gender, and total sample is shown in Table 6.4.

Fifty-six percent of the farmers in the total sample reported receiving no extension service visits during the survey year. Ten percent received one visit, 16% received between two and four visits, 5% received between five and ten visits, and 13% of the total sample reported receiving more than 10 extension service visits during the survey year.

Table 6.4. Percentage Distributions of Farmers by Number of Extension Service Visits Per Year, by Village, Gender, and Total Sample

Number of Visits Per Year	Village												Total Sample	
	Hwidiem						Adjamesu							
	Men		Women		Total		Men		Women		Total			
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
0	15	52	26	87	41	70	7	30	19	51	26	43	67	56
1	2	7	4	13	6	10	1	4	5	14	6	10	12	10
2-4	4	13			4	7	8	35	7	19	15	25	19	16
5-10	2	7			2	3	2	9	2	5	4	7	6	5
More than 10	6	21			6	10	5	22	4	11	9	15	15	13
TOTAL	29	100	30	100	59	100	23	100	37	100	60	100	119	100

Seventy percent of the farmers in Hwidiem and 43% of the farmers in Adjamesu received no extension visits during the survey year. Further evidence that Adjamesu is better served by extension visits is evident in that 25% of the farmers received between two and four visits in Adjamesu during the survey year, but only 7% of the farmers in Hwidiem received between two and four visits. No women farmers in Hwidiem received more than one visit by extension workers during the survey year and 67% received but one visit.

The visits of extension workers to Adjamesu were more evenly distributed among men and women farmers than in Hwidiem. Among those farmers receiving no extension visits in Adjamesu, 27% were men and 73% were women. Among those receiving one visit 83% were women and 17% were men. About equal percentages of men and women in Adjamesu received between two and four visits, 53% and 47%, respectively. Among those farmers receiving between five and ten extension visits, 50% were men and 50% were women. Finally, and in stark contrast to Hwidiem, among those receiving between five and ten visits in Adjamesu, 56% were men and 44% were women.

Agricultural Information From Radio and Television

In Hwidiem 27% of the farmers reported owning a radio and for Adjamesu this figure is 25%. The ownership of radios by gender is such that 41% of the men in Hwidiem but only 13% of the women have access to agricultural information from this medium.

Radio ownership among men is somewhat greater in Adjamesu (52%) than in Hwidiem (41%). However, only 8% of the women farmers in Adjamesu report owning a radio, somewhat less than in Hwidiem.

Regarding agricultural information from television programs, 24% of the farmers in Hwidiem and 35% of those in Adjamesu reported having seen at

least one television program that concerned fertilizer products. In Hwidiem 38% of the men but only 10% of the women farmers reported seeing fertilizer information on television. In contrast, 43% of the men in Adjamesu and 30% of the women report having seen fertilizer information presented on television.

Perceptions of Farmers About Constraints to Agricultural Production and Fertilizer Use

Assumptions for Calculating Scores for Constraints

In calculating the scores and ranks for perceived constraints to agricultural production and fertilizer use, it is assumed that the relative importance of the first constraint is equal to three times the importance of the third most important constraint. Thus, a constraint that is mentioned three times in the third order of importance is as important as a constraint mentioned once in the first order of importance.

It is further assumed that the importance of the second constraint is equal to 1.5 times the importance of the third most important constraint. Thus, a constraint that is mentioned two times in the second order is as important as a constraint mentioned once in the first order of importance.

These assumptions serve as a basis for calculating the scores for the relative importance of constraints (SRI) to agricultural production and fertilizer use where:

$$SRI_i = \sum_{j=1}^{3} (W_j f_j)_i$$

where w_j = weights and f_j = frequencies for a given i constraint and j orders or ranking.

Constraints to Agricultural Production

The scores and ranks for perceived constraints to agricultural production by village and gender are shown in Table 7.1. This table clearly shows that low soil fertility is perceived as the most important constraint to agricultural production in both villages regardless of gender. This uniformly important constraint demonstrates that the goals of the SFRP clearly address the most important constraint to agricultural production as perceived by farmers in the Ashanti region of Ghana.

The lack of rain is perceived as the second most important constraint to crop production in Adjamesu among both men and women farmers. However, in the control village of Hwidiem men rank pests and diseases as the second most important constraint and women view the lack of rain as second in importance as a constraint to crop production.

Men and women farmers in Adjamesu uniformly agree that pests and diseases are the third most important constraint to crop production as do women in the control village of Hwidiem. However, men in Hwidiem rank the lack of rain rather than pests and diseases as the third most important constraint to crop production.

Men and women in Adjamesu cite other factors such as thieves, lack of improved varieties, and poor land preparation as the fourth most important constraint to crop production. As the fourth most important constraint in Hwidiem, men cite lack of land fallow and women cite weeds as the fourth most important constraint hindering crop production. Men and women farmers in Adjamesu agree that the lack of fallow ranks fifth in importance as a constraint to agricultural production as do women in Hwidiem. But men in Hwidiem cite weeds as the fifth most important constraint.

Table 7.1. Ranked Scores of the Relative Importance of Constraints to Agricultural Production as Perceived by Farmers by Village and Gender

	Village											
	Hwidiem						Adjamesu					
	Men		Women		Total Village		Men		Women		Total Village	
Constraint	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Low soil fertility	57	1	50	1	107	1	49	1	61	1	110	1
Pests and diseases	36	2	27	3	63	2	13	3	19	3	32	3
Lack of rain	26.5	3	33	2	59.5	3	22	2	33	2	55	2
Lack of fallow	15	4	6	5	21	4	3	5	7.5	5	10.5	6
Weed growth	8	5	7.5	4	15.5	5	2.5	6	2.5	7	5	7
Other[a]	3	6	6	5	9	6	6	4	17	4	23	4
No money for inputs	1	7	6	5	7	7	3	5	19	3	22	5
Lack of fertilizer	-	-	-	-	-	-	6	4	4.5	6	10.5	6

a. Other includes thieves, lack of improved varieties, and poor land preparation.

As the sixth most important constraint to agricultural production, men in Hwidiem cite various other problems such as thieves, lack of improved varieties, and poor land preparation. Women in Hwidiem rank these problems as fifth in importance. In Adjamesu men cite weeds and women cite the lack of fertilizer as the sixth most important constraint to agricultural production.

The least important constraints for crop production among men in Hwidiem are money for inputs and lack of fertilizer. Among women in Hwidiem the lack of fallow, money, and the residual category of other are the least important constraints to crop production. In Adjamesu men and women agree that the problem of weeds is among the least important constraints to crop production. Women are most likely to view the lack of fertilizer as the least important constraint to crop production.

It is important to note that although all farmers in the sample view low soil fertility as the major constraint to crop production, the lack of fertilizer to correct this problem is not ranked highly in importance. The SFRP is designed to demonstrate to farmers the benefit and contribution of fertilizer in increasing soil fertility.

Constraints to Fertilizer Use

Table 7.2 shows the ranked scores for the SRI of constraints to fertilizer use by village and gender.

Men and women in Hwidiem cite the most important constraint to fertilizer use as having "no knowledge" about the use of fertilizer products. In Adjamesu both men and women farmers view their limited financial resources as the most important constraint to fertilizer use.

Men in Hwidiem rank high prices for fertilizer as the second most important constraint and women cite excessive weed growth as a problem with

Table 7.2. Ranked Scores of the Relative Importance of Constraints to Fertilizer Use as Perceived by Farmers by Village and Gender

Constraint	Village											
	Hwidiem						Adjamesu					
	Men		Women		Total Village		Men		Women		Total Village	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
No knowledge	21	1	33	1	54	1	9	4	19.5	2	28.5	2
No money	12	4	21	3	33	2	25.5	1	60	1	85.5	1
High prices	19.5	2	13.5	4	33	2	6	6	6	6	12	6
Excessive weed growth	10	6	22.5	2	32.5	3	15	2	7.5	4	22.5	3
Not available	18	3	1.5	7	19.5	4	7	5	9	3	16	5
Other	11.5	5	-	-	11.5	6	12	3	7	5	19	4
Difficult to apply	7.5	7	-	-	7.5	7	1	8	3	8	4	9
Rots cassava	-	-	3	6	3	8	4.5	7	3	8	7.5	8
Changes taste of food	2	8	12.5	5	14.5	5	6	6	3.5	7	9.5	7

fertilizer use that usually increases labor costs for weeding work. Men in Adjamesu agree with women in Hwidiem about the relative importance of excessive weed growth as a constraint to fertilizer use. However, women in Adjamesu perceive their lack of knowledge as the second most important constraint to fertilizer use.

Women in Adjamesu and men in Hwidiem rank the unavailability of fertilizer as the third most important constraint to fertilizer use. Women in Hwidiem rank lack of money as the third most important constraint to fertilizer use and men in Adjamesu cite other constraints such as transportation as ranking third in importance as a constraint to fertilizer use.

Men in Hwidiem cite "no money" as the fourth most important constraint to fertilizer use and women cite high prices as fourth in relative importance. Men in Adjamesu cite lack of knowledge and women cite excessive weed growth as the fourth most important constraint to fertilizer use.

The fifth most important constraint to fertilizer use to men in Hwidiem is the residual category of other that includes such problems as transportation. In contrast, women in Hwidiem view as rather important their perception that fertilizer changes the taste and texture of food, especially cassava, and rank this factor fifth in relative importance. Men in Hwidiem rank this factor as eighth and of the least relative importance.

Men and women in Adjamesu rank the food taste and texture problem as sixth and seventh in relative importance, respectively.

There also appears to be a perception in Hwidiem that fertilizer rots cassava and women cite this problem as sixth in relative importance. Men

and women in Adjamesu rank this problem as seventh and eighth in relative importance, respectively.

Econometric Analyses

In the previous sections of this report, descriptive statistics of variables that characterize agricultural production and the socioeconomic environment in the SFRP area of the Ashanti region have been presented and discussed. Frequency distributions and means of variables are useful for descriptive purposes and for comparisons but inadequate to study relationships among variables. In the following sections statistical procedures are used to estimate and evaluate relationships that can help explain crop production, farmers' income, and the demand for farm labor.

Production economics theory is used as a basis to specify models of functions for crop production, farmers' income, and the demand for farm labor. Ordinary least square procedures were then used to estimate these functions using cross-sectional data from a subsample of farmers. Observations include in the estimations were those having information on the variables included in the models.

In the context of this baseline survey report of the SFRP in the Ashanti region of Ghana, estimates of functions of production, farmers' income, and farm labor demand that are presented here should be viewed as representative of relationships that characterize agricultural production in the project area before fertilizers are extensively introduced in the experimental village. These functions will be useful for comparisons with similar relationships that will be estimated using survey data to be collected

in subsequent years after fertilizers are more extensively used by farmers. This should allow the identification and assessment of changes in levels of production, productivity, income, and labor demand, among others.

Crop Production Functions

Crop production occurs as a result of the combination and management of a set of variable inputs, such as seeds, labor, water, fertilizer, and pesticides under given agroclimatic and soil conditions. Concepts of production economics theory are used to establish the relationships among crop production and a set of variable inputs and agroclimatic and soil factors in the form of a production function. Estimates of properly specified production function models provide valuable information about the input-output relationships that characterize crop production in diverse agroclimatic and socioeconomic environments.

In this study, cross-sectional data from a subsample of farmers in the Ashanti region of Ghana were used to estimate production function models for maize/cassava intercropping which is the dominant cropping system in the region. Given the objectives of the study and the data collected in the survey, the following linear and logarithmic models were estimated:

Linear Models:

Model 1. $Y = \alpha + \gamma_1 V + \gamma_2 G + \gamma_3 F + \beta_1 E + \beta_2 ML + \beta_3 WL + \beta_4 CL + \theta A$

Model 2. $Y = \alpha + \gamma_1 V + \gamma_2 G + \gamma_3 F + \beta_1 E + \beta_2 TL + \theta A$

Logarithmic Models:

Model 1. $\ln Y = \alpha + \gamma_1 V + \gamma_2 G + \gamma_3 F + \beta_1 \ln E + \beta_2 \ln ML + \beta_3 \ln WL + \beta_4 \ln CL + \theta \ln A$

Model 2. $\ln Y = \alpha + \gamma_1 V + \gamma_2 G + \gamma_3 F + \beta_1 \ln E + \beta_4 \ln TL + \theta \ln A$

where: Y = yield of maize and cassava in kilograms of maize per acre, average prices of maize and cassava were used to measure cassava yields in kilograms of maize equivalent;

V = dummy 0-1 variable for village, 1 for Hwidiem, and 0 for Adjamesu;

G = dummy 0-1 variable about the gender of the farmer, 1 for a man, and 0 for a woman;

F = dummy 0-1 variable about the use of fertilizer by the farmer, 1 for user, and 0 for nonuser;

E = farmers' schooling in number of years;

ML = labor of men in workdays per acre;

WL = labor of women in workdays per acre;

CL = labor of children in workdays per acre, calculated by assuming that 2 days of work of a child are equal to 1 day of work of a man or woman;

TL = total labor used in workdays per acre;

A = total area cultivated per farm in acres; and α, γ's, β's, and θ are parameters of the production functions.

Natural logarithms of the continuous variables described above are included in the specification of the logarithmic models.

Estimates of these production function models are presented in Table 8.1. For the SFRP these estimates are important to (a) determine the most important input-output relationships that characterize crop production in the pilot area before fertilizers are extensively introduced, and (b) to test hypothesis about the impact of various factors on crop production.

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Table 8.1. Parameter Estimates of Production Functions for Maize/Cassava Intercropping in Ghana

Independent Variables	Linear Models[a]		Logarithmic Models[b]	
	Model 1	Model 2	Model 1	Model 2
Intercept	137.7	114.7	6.39**	4.57**
	(226.4)	(222.7)	(0.29)	(0.57)
Dummy 0-1 variables:				
Village (VG)	803.2**	701.4**	0.64**	0.60**
	(182.4)	(146.8)	(0.13)	(0.11)
Gender of farmer (G)	189.2	166.1	0.07	0.13
	(172.3)	(148.4)	(0.14)	(0.11)
Fertilizer Use (F)	199.9	253.1	0.33	0.23
	(320.2)	(314.6)	(0.25)	(0.23)
Continuous variables:[c]				
Farmer schooling (years) (E)	3.2	11.0	0.04	0.04
	(18.1)	(17.1)	(0.06)	(0.05)
Men labor (workdays/acre) (ML)	8.4**	-	0.08**	-
	(2.4)		(0.05)	
Women labor (workdays/acre) (WL)	5.9*	-	0.04	-
	(3.8)		(0.06)	
Children labor (workdays/acre) (GL)	15.0**	-	0.09**	-
	(5.6)		(0.05)	
Total labor (workdays/acre) (TL)	-	8.2**	-	0.49**
		(2.0)		(0.13)
Crop area per farm (acres) (A)	-22.9	-14.8	-0.37**	-0.15
	(75.6)	(74.4)	(0.18)	(0.16)
F value	12.15	12.15	8.90	15.48
R square	0.55	0.55	0.55	0.61
Number of observations	67	67	67	67

a. Dependent variables in the linear models are the total yields of maize and cassava in kilograms of maize per acre. Average prices of maize and cassava are used to measure cassava yields in maize equivalents.
b. Dependent variables in the logarithmic models are the logarithm of the total yields of maize and cassava in kilograms of maize per acre.
c. In the form of logarithms in the logarithmic models.

Standard errors of parameter estimates are in parentheses.

*Significant at 0.10 level of significance.
**Significant at 0.05 level of significance.

The parameter estimates of production functions shown in Table 9.1 indicate the following:

1. Coefficients of the dummy 0-1 variable for village show that overall productivity in Hwidiem was significantly higher than in Adjamesu. Thus, holding other factors constant, crop yields of the maize-cassava inter rop were significantly higher in Hwidiem than in Adjamesu.
2. Gender did not have a statistically significant effect on overall crop productivity. Although the positive coefficients of the dummy 0-1 variable for gender indicate a higher level of productivity for men farmers but these coefficients were not statistically significant. Therefore, the hypothesis that men and women farmers have the same level of overall productivity cannot be rejected.
3. The use of fertilizer had a positive effect on yields of maize/cassava; however, the coefficients of the dummy 0-1 variable for fertilizer use were not statistically significant mainly because of very limited fertilizer use among farmers (less than 4% in the subsample).
4. The level of education of farmers, measured by the number of years of schooling, had a positive impact on crop yields and overall productivity, but the coefficients of this variable were not statistically significant. The lack of statistical significance may be due to the apparent correlation of this variable with the gender and labor use variables.
5. Coefficients of labor use variables in the linear models are estimates of the average productivity of labor and estimates of the elasticities of crop yields with respect to labor use in the logarithmic models. These estimates show that, although the average productivity of the labor of men (8.4 kg of maize per workday) is somewhat higher than the productivity of labor for women (5.9 kg of maize per workday), the

difference is not statistically significant. Therefore, the hypothesis of equality of coefficients could not be rejected at acceptable levels of significance. The much higher coefficient estimating the average productivity of child labor (15 kg of maize per workday) is based on the a priori assumption that 2 days of work of a child are equal to 1 workday of a man or woman. If this assumption is ignored, then the average productivities of men, women, or children are not significantly different, but rather equal to about 7-8 kg of maize per day of work. It is interesting to note that, at the average price of maize (Cedis 45/kg) the value of this average (marginal) product is Cedis 360 per day, which is very close to the average wage rate paid in the region. This is an indication that farmers in the region use labor at levels that are consistent with the price environment.

The estimated elasticity of crop yields with respect to labor, 0.49, indicates the percent change in crop yields associated with a 1% change in the use of labor, i.e., on the average 10% increase in labor use resulted in about 5% increase in crop yields. The use of fertilizers should bring about an increase in the average productivity of labor but not necessarily in the magnitude of its elasticity.

6. The negative sign of the coefficient for the variable area cultivated per farm, although statistically significant in only one model, indicates diseconomies of scale in crop production, i.e., that crop yields decrease as the area cultivated per farm increases. Such diseconomies may be associated with difficulties farmers have in managing several plots which are often located at considerable distances from one another.

Farmers' Income

Estimates of present levels of farmers' income are important to determine the impact of fertilizer use interventions of the SFRP on the income of farmers in subsequent years. The main sources of income for farmers in the Ashanti region are off-farm employment and crop production. Data on income from off-farm employment were collected in the survey. However, income from crop production can be estimated only on the basis of reliable data on the revenues and costs associated with all the crops grown by farmers.

Because of the diversity in crops and intercropping practices of farmers in the area, it is very difficult to obtain accurate estimates of the farmers' income from crop production. To overcome this problem, estimates of total revenue associated with the production of maize/cassava intercropping, the dominant cropping system in the area, were used as estimates of gross income from crop production.

Average annual incomes of farmers by village and gender of farmers are presented in Table 8.2. Results for both villages clearly show that income from crop production comes mostly from cassava (82%) rather than maize (18%), and that income from off-farm employment represents on the average only 6% of the annual income per household, with 94% of this income coming from crop production.

Although the proportions of income from different sources are very similar for men and women, average levels of income are 50%-70% higher among men than women. This is due mainly to the larger areas of cultivated land per farm among men compared to women. Crop incomes per acre among men are only 10%-20% higher than among women. Differences in levels of income between men and women are higher in Hwidiem (71%) than in Adjamesu (54%).

Table 8.2. Average Annual Household Income by Village and Gender

Village	Gender	Annual Income Per Acre: Cassava Income Mean	Annual Income Per Acre: Maize Income Mean	Annual Income Per Acre: Crops Income Mean	Annual Income Per Farm: Crops Income Mean	Annual Income Per Farm: Off-Farm Earnings Mean	Annual Income Per Farm: Total Household Income N	Annual Income Per Farm: Total Household Income Mean
		- - - - (Cedis/acre) - - - -			- - - - - (Cedis/farm) - - - - -			
Hwidiem	Men	65,019 (86)	10,277 (14)	75,296 (100)	112,023 (95)	6,167 (5)	36	118,189 (100)
	Women	57,266 (84)	10,536 (16)	67,802 (100)	67,854 (97)	2,080 (3)	25	69,934 (100)
	Total Village	61,842 (86)	10,383 (14)	72,225 (100)	93,921 (96)	4,492 (4)	61	98,413 (100)
Adjamesu	Men	23,606 (61)	15,000 (39)	38,606 (100)	90,011 (95)	4,412 (5)	17	94,422 (100)
	Women	26,206 (79)	7,066 (21)	33,272 (100)	54,048 (88)	7,316 (12)	19	61,364 (100)
	Total Village	24,979 (70)	10,813 (30)	35,791 (100)	71,030 (92)	5,944 (8)	36	76,975 (100)
Total sample by gender of farmer								
Men		51,736 (81)	11,792 (19)	63,528 (100)	104,962 (95)	5,604 (5)	53	110,566 (100)
Women		43,854 (83)	9,038 (17)	52,892 (100)	61,892 (93)	4,341 (7)	44	66,233 (100)
Total sample both villages		48,161 (82)	10,543 (18)	58,703 (100)	85,425 (94)	5,031 (6)	97	90,456 (100)

Figures in parentheses are percentages.

Estimates of Farmers' Income Functions

Linear and logarithmic models of functions of farmers' income were estimated to determine the influence of inputs and factors of production on the gross income of farmers. Estimating equation models were similar to those used previously for the estimation of production functions. In these models the dependent variables were alternatively the gross income from crops and the total household income as measured in Cedis per farm.

Estimates of the functions of farmers' income shown in Table 8.3 indicate the following:

1. Gross crop and household incomes of farmers in Hwidiem were significantly higher than in Adjamesu. Coefficients of the dummy 0-1 variable for village were statistically significant at 0.05 level of significance in all models.
2. Men have significantly higher levels of income than women farmers. Coefficients of the dummy 0-1 variable for gender of the farmer were statistically significant at the 0.10 level of significance in all models.
3. The use of fertilizer has a positive impact on farmers income, but the Coefficients of the dummy 0-1 variables for fertilizer use were not statistically significant, probably as a result of the small number of farmers using fertilizer (about 4%).
4. The intensity of labor use (workdays/acre) of men, women, and children had a statistically significant impact on the levels of farmers' income. Parameter estimates show that on the average, a workday of a man, woman, and child per acre of cultivated land increased the annual income per farm by Cedis 912, 775, and 878, respectively. Differences among these estimates were not statistically significant.

Table 8.3. Parameter Estimates of Gross Income Functions Based on Maize/Cassava Intercropping in the Ashanti Region

Independent Variables	Gross Crop Income Models[a]			Gross Household Income Models[b]		
	Linear Models		Logarithmic Model	Linear Models		Logarithmic Model
	Model 1	Model 2	Model 1	Model 1	Model 2	Model 1
Intercept	-101,126**	-99,547**	6.88**	-103,856**	-101,761**	7.33**
	(15,330)	(15,472)	(0.57)	(17,269)	(17,337)	(0.65)
Dummy 0-1 variables:						
Village (V)	52,917**	45,323**	0.57**	54,855**	48,032**	0.58**
	(12,202)	(10,276)	(0.10)	(13,746)	(11,514)	(0.12)
Gender of farmer (G)	18,171*	17,021*	0.22**	20,432*	18,181*	0.23**
	(11,069)	(9,641)	(0.10)	(12,469)	(10,803)	(0.12)
Fertilizer use (F)	19,588	27,118	0.24	22,732	30,984	0.26
	(22,641)	(22,808)	(0.23)	(25,505)	(25,557)	(0.26)
Continuous variables[c]						
Men labor (workdays/acre) (ML)	920**	-	-	912**	-	-
	(172)			(194)		
Women labor (workdays/acre) (WL)	736**	-	-	775**	-	-
	(265)			(299)		
Children labor (workdays/acre) (CL)	1,712**	-	-	1,756**	-	-
	(383)			(431)		
Total labor (workdays/acre) (TL)	-	924**	0.55**	-	933**	0.47**
		(148)	(0.13)		(166)	(0.15)
Crop area per farm (acres) (A)	48,015**	49,350**	1.62**	51,555**	53,031**	1.56**
	(5,347)	(5,398)	(0.16)	(6,023)	(6,048)	(0.18)
F value	25.41	33.00	36.22	22.30	29.28	25.46
R square	0.75	0.73	0.75	0.73	0.71	0.68
Number of observations	67	67	67	67	67	67

a. Dependent variables in the linear models are the total gross income of crops in Cedis per farm and in the logarithmic models the logarithmic of this income.
b. Dependent variables in the linear models are the total household gross income in Cedis per farm and in the logarithmic models the logarithm of this income.
c. In the form of logarithms in the logarithmic models.
Standard errors of parameter estimates are in parentheses.
*Significant at 0.10 level of significance.
**Significant at 0.05 level of significance.

5. Elasticity estimates of crop income and total household income with respect to intensity of labor use in crop production were 0.55 and 0.47, respectively. These estimates were statistically significant at 0.01 level of significance and show that on the average a 10% change in intensity of labor use in crop production changed crop and total income by 5.5% and 4.7%, respectively.
6. Coefficients of the variable crop area per farm reflect the statistically significant impact of increased cultivated area on the levels of income per farm. These coefficients in the linear models provide an estimate of the average increment in income per farm (Cedis) that is associated with an additional acre of cultivated land, holding "constant" other variables included in the model. Thus, about Cedis 50,000 of increment in annual income per farm was associated with an additional acre of cultivated land. The magnitude of these estimates should increase with the use of fertilizer. Coefficients of this variable in the log models are estimates of elasticities of income with respect to area cultivated per farm.

Labor Use Functions

Labor productivity and demand are important aspects of agricultural development. In general, the use of fertilizers brings about increases in labor productivity and demand. Estimates of labor demand functions are useful to determine the influence of fertilizer and other factors on the demand for farm labor. Data on wage rates of farm labor are required to estimate properly specified models of labor demand. However, in this study functions of intensity of labor use in crop production (workdays/acre), rather than

labor demand functions, were estimated because of the lack of adequate data on wage rates.

The following models of labor use functions were estimated by village because of important differences between villages in the influence of some variables on labor use.

Model 1: $TL = \alpha + \gamma_1 G + \gamma_2 F + \gamma_3 EM + \beta_1 E + \theta A$

Model 2: $\ln TL = \alpha + \gamma_1 G + \gamma_2 F + \gamma_3 EM + \beta_1 \ln E + \theta \ln A$

where EM is a dummy 0-1 variable for off-farm employment, 1 for yes and 0 for no; and all other variables are as previously defined. Estimates of these models for Hwidiem and Adjamesu are shown in Table 8.4 and indicate the following:

1. In both villages men farmers on the average use less labor per acre than women, however, these differences were not statistically significant.
2. Fertilizer use had a positive impact on the use of labor per acre of cultivated land. This impact was statistically significant in Hwidiem but not in Adjamesu.
3. Off-farm employment by farmers had a positive effect on the intensity of labor use in crop production in Hwidiem but a negative one in Adjamesu. This is not surprising because off-farm employment as a source of income may increase the use of labor in crop production by providing financial means to hire farm labor (income effect), but also it may decrease the use of labor by diminishing the availability of family labor to work in the farm (substitution effect).

Table 8.4. Parameter Estimates of Labor Use Functions for Maize/Cassava Intercropping in Hwidiem and Adjamesu

Independent Variables	Hwidiem		Adjamesu	
	Linear Model	Logarithmic Model	Linear Model	Logarithmic Model
Intercept	68.27**	4.66**	90.98*	4.86**
	(9.55)	(0.14)	(8.35)	(0.18)
Dummy 0-1 Variables				
Gender of farmer	-12.50	-0.25**	-15.86	-0.23
	(11.05)	(0.12)	(11.19)	(0.17)
Fertilizer use	61.68**	0.55**	12.43	0.18
	(32.89)	(0.35)	(14.19)	(0.21)
Off-farm employment	34.95**	0.34**	-16.60*	-0.25*
	(12.14)	(0.13)	(9.88)	(0.16)
Continuous Variables (1)				
Farmers' schooling (years)	–	–	2.60**	0.16**
			(1.09)	(0.07)
Crop area per farm (acres)	11.31*	0.33*	-14.31**	-0.78**
	(6.95)	(0.18)	(3.86)	(0.20)
F value	4.67	30.12	4.68	5.37
R square	0.34	0.29	0.54	0.57
Number of observations	41	41	26	26

Dependent variables in the linear models are the total labor used in workdays per acre and in the logarithmic models the logarithm of quantity.
(1) In the form of logarithms in the logarithmic models.
Standard errors of parameter estimates are in parenthesis.
*Significant at 0.10 level of significance.
**Significant at 0.05 level of significance.

4. Education of farmers measured in terms of number of years of schooling had a positive and statistically significant effect on the intensity of labor use in Adjamesu. However, in Hwidiem the coefficients of this variable were very small and not significant and therefore deleted from the models.

5. Coefficients estimating the effect of the variable area cultivated per farm on the intensity of labor use were statistically significant in all models. These effects, however, were positive in Hwidiem but negative in Adjamesu. These results are probably due to the smaller areas of cultivated land per farm in Hwidiem (average of 1.24 acres) than in Adjamesu (average of 1.96 acres). There is an apparent positive relationship between intensity of labor use and area cultivated when farms are small and include no more than one plot. This relationship becomes negative when farms are larger and have more than one plot. In the case of large-scale farmers, negative relationships may be explained by the presence of constraints in family labor and by difficulties in the management of several plots of land.

DRAFT

Appendix 10 (a)

NOTE ABOUT FARM BUDGET IN GHANA

1. SAMPLE

11. Farmers will be selected among those included in the sample for agronomic manitoring.

12. In the experimental village (Adjamasu), two farmers, 1 man and 1 woman, will be selected from each fertilizer treatment option. Since there are three fertilizer treatments a total of 6 farmers will be selected in this village.

13. In the control village (Hiwidiem) 4 farmers, 2 men and 2 women will be selected.

14. Definitive selection will be made by national coordinator depending on collaboration possibility of the farmers.

2. EXECUTION

Two visits per month with intervals of 15 days during the first 4 month of the survey will be conducted (planting to harvesting maize).

Average of one visit per month after maize harvesting, for cassava data collection.

3. MARKET PRICE

Obtain from local publications about every week both official and private selling prices in Kumasi for maize grain, green cobs of maize, dry cobs of maize, maize flour, fresh root of cassava and gari.

FARM BUDGET IN GHANA

June 6th, 1989

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CROP AND FARM BUDGETS DATA

1. IDENTIFICATION :

- Farmer : _____ Sex : MALE / FEMALE
- Ethnic group : _____
- Fertilizer option : _____

2. LOCATION :

- Country : _____
- Village : _____

3. AVAILABILITY OF RESSOURCES :

31. Availability of Land :

Plot N°	Distance in km	Crop	Area in acres	Use in previous season	Type of * Management
1					1 2 3 4
2					1 2 3 4
3					1 2 3 4
4					1 2 3 4
5					1 2 3 4
6					1 2 3 4
7					1 2 3 4
8					1 2 3 4
9					1 2 3 4
10					1 2 3 4

1 = Individual plot managed by man.
2 = Individual plot managed by woman.
3 = Household plot managed by man
4 = Household plot managed by woman

32. Availability of Labor (Family labor working in the Farm) :

	Full time	Part time
Number of men		
Number of women		
Number of children		

4. CROP BUDGETS FOR MAIZE and MAIZE + CASSAVA :

- Crop : MAIZE / MAIZE+CASSAVA - Plot area : _____ Acres

- Plot number : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10

Land preparation	DATE		Use of labor in number of days (*)					
			Family labor			Hired labor		
	MM	DD	Men	Women	Child.	Men	Women	Child.
Bush clearing								
Tree felling/chopping								
Burning								
Debris collection								
1st fertilizer broad--cast								
Hoeing after fertilizer								
Other (indicate)								

* Average hours of work per day (See table below)

Average number hours per day for land preparation

Activity	Men	Women	Child.	Activity	Men	Women	Child.
Bush clearing				1 fertilizer broadcast			
Tree felling/ chopping				Hoeing after fertilizer			
Burning				Other			
Debris col--lection							

Maize (with or without cassava)	DATE		Use of labor in number of days (*)					
			Family labor			Hired labor		
	MM	DD	Men	Women	Child.	Men	Women	Child.
1st Fertilizer broad.								
1st Fertilizer hoeing								
Planting								
1st weeding								
2nd weeding								
2nd Fertilizer broad.								
2nd Fertilizer hoeing								
Harvest green ears								
Transport to village								
Transport to market								
Selling/threshing								
Harvest in dry								
Transport to village								
Shelling/threshing								
Storage								
Transport to market								
Selling/threshing								
Other (What ?)								

Observations about quality of labor and constraints :

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* Average number hours per day for maize

Activity	Men	Women	Child.	Activity	Men	Women	Child.
Fert.broadc.				Harvest dry ears			
Hoeing				Schel/tresh.			
Planting				Other			
Harvest green ears							

Cassava	DATE		Use of labor in number of days (*)					
			Family labor			Hired labor		
	MM	DD	Men	Women	Child.	Men	Women	Child.
Stem cutting								
Stakes cutting								
Planting								
1st weeding								
2nd weeding								
3rd weeding								
4th weeding								
1st harvest								
Transport to village								
1st transport to market								
2nd harvest								
Transport to village								
2nd transport to market								

Observations about quality of labor and constraints :

Cassava	DATE		Use of labor in number of days (*)					
			Family labor			Hired labor		
	MM	DD	Men	Women	Child.	Men	Women	Child.
3rd harvest								
Transport to village								
3rd transport to market								
4th harvest								
Transport to village								
4th transport to market								
Other (What ?)								

Observations about quality of labor and constraints :

* <u>Average number hours per day for cassava</u>

Activity	Men	Women	Child.	Activity	Men	Women	Child.
Stem cutting				Transport			
Stakes cut.				Other			
Weeding							
Harvest							

5. USE OF OTHER INPUTS : (for the whole farm, all plots and production)

INPUT (Manure, fertilizer, pesticides, equipments....)	DATE		QUANTITY	UNITS	COST/UNIT
	MM	DD			

6. PRODUCTION :

61. Of the plot sampled

- Variety (ies) of maize: _____

- Variety (ies) of cassava : _____

A Yield estimation by sub-plots

On two sub-plots of 100 m² (10 m X 10 m) into the plot sample at a representative place, get the following information :

Crop	Data to collect	Sub-plot N° 1	Sub-plot N° 2
MAIZE	Number planting holes after 2nd weeding		
	Total number of stems after flowering		
	Total number of ears at harvest time		
	Total numb. fertil ears at harvest time		
	Total weight of dry ears in kg		
	Total weight of dry grains in kg		
	Total weight of dry straw in kg		
CASSAVA	Number of plants at maize harvest		
	Weight of commercial roots at 12 months		
	Number of commercial roots at 12 months		

Observations (pests, deseases...) :

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B Direct yield estimation for the plot sample

B1 Maize

- Quantity of green ears harvested :_____ Unit :_____
- Quantity of dry ears harvested :_____ Unit :_____
- Storage quantity :_____ Unit :_____ Time :_____

If production of maize sold on field :

- For green ears : Area :_____ Unit :_____ Price :_____
- For dry ears : Area :_____ Unit :_____ Price :_____

If production of maize managed by farmer :

- Sale of green ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of dry ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of maize grain harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

B2. Cassava

- Harvest for household consumption:

Date	Quantity	Unit	Date	Quantity	Unit

If production of cassava sold on field :

- Area :_____ Unit :_____ Price :_____

If production of cassava harvested and sold by farmer :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

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62. Other plots with maize and cassava

- Crop : MAIZE / MAIZE+CASSAVA - Plot area : _____ Acres
- Plot number : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10
  - Variety (ies) of maize : _____
  - Variety (ies) of cassava : _____

A Yield estimation by sub-plots

On one sub-plot of 100 m² (10 m X 10 m) into the plot at a representative place, get the following information :

Crop	Data to collect	Sub-plot
MAIZE	Number planting holes after 2nd weeding	
	Total number of stems after flowering	
	Total number of ears at harvest time	
	Total numb. fertil ears at harvest time	
	Total weight of dry ears in kg	
	Total weight of dry grains in kg	
	Total weight of dry straw in kg	
CASSAVA	Number of plants at maize harvest	
	Weight of commercial roots at 12 months	
	Number of commercial roots at 12 months	

Observations (pests, deseases...) :

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B Direct yield estimation

B1 Maize

- Quantity of green ears harvested :_____ Unit :_____
- Quantity of dry ears harvested :_____ Unit :_____
- Storage quantity :_____ Unit :_____ Time :_____

If production of maize sold on field :

- For green ears : Area :_____ Unit :_____ Price :_____
- For dry ears : Area :_____ Unit :_____ Price :_____

If production of maize managed by farmer :

- Sale of green ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of dry ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of maize grain harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

B2. Cassava

- Harvest for household consumption:

Date	Quantity	Unit	Date	Quantity	Unit

If production of cassava sold on field :

- Area :_____ Unit :_____ Price :_____

If production of cassava harvested and sold by farmer :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm in village, in Kumasi, other (indicate).

63. Other plots with maize and cassava

- Crop : MAIZE / MAIZE+CASSAVA - Plot area :_____ Acres
- Plot number : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10
  - Variety (ies) of maize :_____
  - Variety (ies) of cassava :_____

A Yield estimation by sub-plots

On one sub-plot of 100 m² (10 m X 10 m) into the plot at a representative place, get the following information :

Crop	Data to collect	Sub-plot
MAIZE	Number planting holes after 2nd weeding	
	Total number of stems after flowering	
	Total number of ears at harvest time	
	Total numb. fertil ears at harvest time	
	Total weight of dry ears in kg	
	Total weight of dry grains in kg	
	Total weight of dry straw in kg	
CASSAVA	Number of plants at maize harvest	
	Weight of commercial roots at 12 months	
	Number of commercial roots at 12 months	

Observations (pests, deseases...) :

B Direct yield estimation

B1 Maize

- Quantity of green ears harvested :_____ Unit :_____
- Quantity of dry ears harvested :_____ Unit :_____
- Storage quantity :_____ Unit :_____ Time :_____

If production of maize sold on field :

- For green ears : Area :_____ Unit :_____ Price :_____
- For dry ears : Area :_____ Unit :_____ Price :_____

If production of maize managed by farmer :

- Sale of green ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of dry ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

At farm, in village, in Kumasi, other (indicate).

Sale of maize grain harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

B2. Cassava

- Harvest for household consumption:

Date	Quantity	Unit	Date	Quantity	Unit

If production of cassava sold on field :

Area : _____ Unit : _____ Price : _____

If production of cassava harvested and sold by farmer :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm in village, in Kumasi, other (indicate).

64. Other plots with maize and cassava

- Crop : MAIZE / MAIZE+CASSAVA - Plot area : _____ Acres
- Plot number : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10
  - Variety (ies) of maize : _____
  - Variety (ies) of cassava : _____

A Yield estimation by sub-plots

On one sub-plot of 100 m² (10 m X 10 m) into the plot at a representative place, get the following information :

Crop	Data to collect	Sub-plot
MAIZE	Number planting holes after 2nd weeding	
	Total number of stems after flowering	
	Total number of ears at harvest time	
	Total numb. fertil ears at harvest time	
	Total weight of dry ears in kg	
	Total weight of dry grains in kg	
	Total weight of dry straw in kg	
CASSAVA	Number of plants at maize harvest	
	Weight of commercial roots at 12 months	
	Number of commercial roots at 12 months	

Observations (pests, deseases...) :

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B Direct yield estimation

B1 Maize

- Quantity of green ears harvested :_____ Unit :_____
- Quantity of dry ears harvested :_____ Unit :_____
- Storage quantity :_____ Unit :_____ Time :_____

If production of maize sold on field :

- For green ears : Area :_____ Unit :_____ Price :_____
- For dry ears : Area :_____ Unit :_____ Price :_____

If production of maize managed by farmer :

- Sale of green ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of dry ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of maize grain harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

B2. Cassava

- Harvest for household consumption:

Date	Quantity	Unit	Date	Quantity	Unit

If production of cassava sold on field :

- Area :_____ Unit :_____ Price :_____

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<u>If production of cassava harvested and sold by farmer :</u>

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm in village, in Kumasi, other (indicate).

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65. Other plots with maize and cassava

- Crop : MAIZE / MAIZE+CASSAVA - Plot area :_____ Acres
- Plot number : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10
  - Variety (ies) of maize :_____
  - Variety (ies) of cassava :_____

A Yield estimation by sub-plots

On one sub-plot of 100 m² (10 m X 10 m) into the plot at a representative place, get the following information :

Crop	Data to collect	Sub-plot
MAIZE	Number planting holes after 2nd weeding	
	Total number of stems after flowering	
	Total number of ears at harvest time	
	Total numb. fertil ears at harvest time	
	Total weight of dry ears in kg	
	Total weight of dry grains in kg	
	Total weight of dry straw in kg	
CASSAVA	Number of plants at maize harvest	
	Weight of commercial roots at 12 months	
	Number of commercial roots at 12 months	

Observations (pests, deseases...) :

B Direct yield estimation

B1 Maize

- Quantity of green ears harvested :_____ Unit :_____
- Quantity of dry ears harvested :_____ Unit :_____
- Storage quantity :_____ Unit :_____ Time :_____

If production of maize sold on field :

- For green ears : Area :_____ Unit :_____ Price :_____
- For dry ears : Area :_____ Unit :_____ Price :_____

If production of maize managed by farmer :

- Sale of green ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of dry ears harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

- Sale of maize grain harvested :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm, in village, in Kumasi, other (indicate).

B2. Cassava

- Harvest for household consumption:

Date	Quantity	Unit	Date	Quantity	Unit

If production of cassava sold on field :

Area :_____ Unit :_____ Price :_____

If production of cassava harvested and sold by farmer :

Place of sale *	Date		Quantity	Unit	Price (C/unit)
	MM	DD			

* At farm in village, in Kumasi, other (indicate)

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7 POST HARVEST DATA

If it is not possible to collect some post harvest data on the plot sampled (several plots production mixed), collect it on the following table by doing 3 repetitions for each measurement and each farmer.

Data	1	2	3
Gross quantity in kg (ears)			
Net quantity in kg (without husk)			
Time of labor in hours for shelling			
Net quantity in kg grain			
Time of labor in hour for threshing			
Date of collect	/ /89	/ /89	/ /89

Repetition	Operation	Use of labor in number of hours					
		Family labor			Hired labor		
		Men	Women	Child.	Men	Women	Child.
1	Shelling						
	Threshing						
2	Shelling						
	Threshing						
3	Shelling						
	Threshing						

Observations :o

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Appendix 10(b)

NOTE SUR L'ENQUETE BUDGET AU TOGO

1. L'ECHANTILLONNAGE

11. Les paysans seront choisis parmi ceux qui ont été sélectionnés dans l'échantillon du suivi agronomique.

12. Dans le village expérimental (Naki-est), deux paysans, un homme et une femme seront choisis pour chaque option. Puisqu'il y a 5 options, un total de 10 paysans (5 hommes et 5 femmes) sera sélectionné dans ce village pour l'enquête budget.

13. Dans le village témoin (Kpembona) 4 paysans, 2 hommes et 2 femmes seront sélectionnés pour l'enquête budget.

14. Le choix définitif des 10 + 4 paysans (7 hommes et 7 femmes) sera effectué par le coordonnateur national, en tenant compte des capacités de collaboration de chacun.

2. FREQUENCE DE COLLECTE DES DONNEES

Deux visites par mois, à intervalle de 15 jours seront effectuées pendant la période de culture (de la préparation du sol à la phase finale de récolte.

Les visites seront ensuite mensuelles (collecte des données sur la commercialisation et la transformation).

3. LES PRIX DU MARCHE

Obtenir des publications locales avec une fréquence hebdomadaire les prix officiels et réels du marché principal pour le sorgho grain, la bière de sorgho, le mil précoce grain et le mil tardif grain.
Collecter directement les données au marché en cas d'absence de statistiques.

DONNEES SUR LES CULTURES ET BUDGETS D'EXPLOITATION AU TOGO

1. IDENTIFICATION :

- Paysan : _____ Sexe : MASCULIN / FEMININ
- Croupe ethnique : _____

2. LOCALISATION :

- Pays : _____ - Village : _____

3. RESSOURCES DISPONIBLES :

31. Disponibilité en terre :

Par. N°	Distance en km	Culture	Surface en ha	Utilisation précédente	Type de gestion *
1					1 2 3 4
2					1 2 3 4
3					1 2 3 4
4					1 2 3 4
5					1 2 3 4
6					1 2 3 4
7					1 2 3 4
8					1 2 3 4
9					1 2 3 4
10					1 2 3 4

* 1 = Parcelle individuelle sous conduite d'un homme
2 = Parcelle individuelle sous conduite d'une femme
3 = Parcelle familiale sous conduite d'un homme
4 = Parcelle familiale sous conduite d'une femme

32. Disponibilité en main d'oeuvre FAMILIALE :

	Temps plein	Temps partiel
Nombre d'homme		
Nombre de femmes		
Nombre d'enfants		

4. BUDGET PARTIEL POUR LE SORGHO ET LE MIL :

41. PARCELLE DE CASE

Les renseignements suivants concernent la principale parcelle de case (une seule parcelle) cultivée en sorgho associé ou non avec du mil de 3 mois et du mil de 6 mois.

- Culture SORGHO/PETIT MIL/MIL 6 MOIS - Surface parcellaire :_____ Ha

- Parcelle N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10

A TRAVAUX CULTURAUX

TRAVAUX CULTURAUX SUR LA PARCELLE DE CASE (SORGHO+MIL 3 & 6 MOIS)	DATE		Main d'oeuvre utilisée en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Défrichement (collecte des debris + brûlis)								
Ouverture du sol pour le billonnage								
Epandage d'engrais								
Fermeture des billons								
Semis (sorgho + mils)								
Premier sarclage								
Démariage (sorgho+mils)								
1 er apport d'azote								
1 er buttage								
Second sarclage								
2nd apport d'azote								
2nd buttage								
3ième sarclage								
Autre (préciser)								

Nombre moyen d'heures de travail par jour pour la préparation du sol

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Défrichement				Buttage			
ouverture bil -lons				Autre			
Epandage des engrais							
Apport azote							
Sarclage							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

B TRAVAUX DE RECOLTE DE LA PARCELLE DE CASE

LE SORGHO

RECOLTE DU SORGHO	DATE		Utilisation de la main d'oeuvre en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Récolte des épis								
Transport des épis								
Stockage								
Coupe des tiges								
Transport des tiges								
Stockage des tiges								
Autre								

Nombre moyen d'heures de travail par jour pour le sorgho

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Récolte épis				Transport tiges			
Transport des épis				Stockage tiges			
Stockage épis				Autre			
Récolte des tiges							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

LE MIL DE TROIS MOIS

RECOLTE DU MIL 3 MOIS	DATE		Utilisation de la main d'oeuvre en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Récolte des épis								
Transport des épis								
Stockage								
Coupe des tiges								
Transport des tiges								
Stockage des tiges								
Autre								

Nombre moyen d'heures de travail par jour pour le sorgho

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Récolte épis				Transport tiges			
Transport des épis				Stockage tiges			
Stockage épis				Autre			
Récolte des tiges							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

LE MIL DE 6 MOIS

RECOLTE DU MIL 6 MOIS	DATE		Utilisation de la main d'oeuvre en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Récolte des épis								
Transport des épis								
Stockage								
Coupe des tiges								
Transport des tiges								
Stockage des tiges								
Autre								

Nombre moyen d'heures de travail par jour pour le sorgho

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Récolte épis				Transport tiges			
Transport des épis				Stockage tiges			
Stockage épis				Autre			
Récolte des tiges							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

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42. PARCELLE DE BROUSSE

Les renseignements suivants concernent la principale parcelle de brousse (une seule parcelle) cultivée en sorgho associé ou non avec du mil de 3 mois et du mil de 6 mois.

- Culture SORGHO/PETIT MIL/MIL 6 MOIS - Surface parcellaire :_____ H

- Parcelle N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10

A TRAVAUX CULTURAUX

TRAVAUX CULTURAUX SUR LA PARCELLE DE CASE (SORGHO+MIL 3 & 6 MOIS)	DATE		Main d'oeuvre utilisée en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Défrichement (collecte des debris + brûlis)								
Ouverture du sol pour le billonnage								
Epandage d'engrais								
Fermeture des billons								
Semis (sorgho + mils)								
Premier sarclage								
Démariage (sorgho+mils)								
1 er apport d'azote								
1 er buttage								
Second sarclage								
2nd apport d'azote								
2nd buttage								
3ième sarclage								
Autre (préciser)								

Nombre moyen d'heures de travail par jour pour la préparation du sol

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Défrichement				Buttage			
ouverture bil-lons				Autre			
Epandage des engrais							
Apport azote							
Sarclage							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

B TRAVAUX DE RECOLTE DE LA PARCELLE DE BROUSSE

LE SORGHO

RECOLTE DU SORGHO	DATE		Utilisation de la main d'oeuvre en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Récolte des épis								
Transport des épis								
Stockage								
Coupe des tiges								
Transport des tiges								
Stockage des tiges								
Autre								

Nombre moyen d'heures de travail par jour pour le sorgho

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Récolte épis				Transport tiges			
Transport des épis				Stockage tiges			
Stockage épis				Autre			
Récolte des tiges							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

LE MIL DE TROIS MOIS

RECOLTE DU MIL 3 MOIS	DATE		Utilisation de la main d'oeuvre en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Récolte des épis								
Transport des épis								
Stockage								
Coupe des tiges								
Transport des tiges								
Stockage des tiges								
Autre								

Nombre moyen d'heures de travail par jour pour le sorgho

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Récolte épis				Transport tiges			
Transport des épis				Stockage tiges			
Stockage épis				Autre			
Récolte des tiges							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

LE MIL DE 6 MOIS

RECOLTE DU MIL 6 MOIS	DATE		Utilisation de la main d'oeuvre en jours					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Récolte des épis								
Transport des épis								
Stockage								
Coupe des tiges								
Transport des tiges								
Stockage des tiges								
Autre								

Nombre moyen d'heures de travail par jour pour le sorgho

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Récolte épis				Transport tiges			
Transport des épis				Stockage tiges			
Stockage épis				Autre			
Récolte des tiges							

Souligner les données vérifiées pour les distinguer des données indiquées par le paysan.

Observations sur la qualité du travail et les contraintes :

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C LES TRAVAUX POST-RECOLTE

Ce chapitre concerne le sorgho et les mils quelque soit la parcelle de provenance du grain.
Les temps de battage de transport au marché et de vente doivent être indiqués en heure avec référence exacte pour chaque répétition à la quantité battue exprimée en kg de grain.
Faire 3 mesures pour chaque activité (3 répétitions).

LE SORGHO

TRAVAUX	Quantité traitée en kg de grain	DATE		Utilisation de la main d'oeuvre en heure					
				Familiale			Salariée		
		jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Battage									
Battage									
Battage									
Transport au marché									
Transport au marché									
Transport au marché									
Vente									
Vente									
Vente									

Observations :

LE MIL DE 3 MOIS

TRAVAUX	Quantité traitée en kg de grain	DATE		Utilisation de la main d'oeuvre en heure					
				Familiale			Salariée		
		jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Battage									
Battage									
Battage									
Transport au marché									
Transport au marché									
Transport au marché									
Vente									
Vente									
Vente									

Observations :

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LE MIL DE 6 MOIS

TRAVAUX	Quantité traitée en kg de grain	DATE		Utilisation de la main d'oeuvre en heure					
				Familiale			Salariée		
		jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Battage									
Battage									
Battage									
Transport au marché									
Transport au marché									
Transport au marché									
Vente									
Vente									
Vente									

Observations :

5. UTILISATION D'AUTRES INTRANTS (Toute culture)

Ce tableau concerne l'ensemble de l'exploitation (toute culture et toute parcelle).

INTRANTS (fumier, engrais, pesticides, matériel.....)	DATE		QUANTITE	UNITES	COUT PAR UNITE
	jour	mois			

Observations :

6. LA PRODUCTION :

61. DE LA PRINCIPALE PARCELLE DE CASE

- Variété(s) de sorgho : _____
- Variété(s) de mil 3 mois : _____
- Variété(s) de mil 6 mois : _____.

Sur 2 carrés piquetés de 25 m² (5 m X 5 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Carré de rendement N° 2

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Evaluation du rendement de l **ensemble de la parcelle de case** :

SORGHO :

- Quantité d'épis récoltés:_____ Unité :_____ Kg/unité :_____
- Quantité d'épis stockés :_____ Unité :_____ Temps :_____

(unités selon le mode de transport : botte, bassine, charette...)

Observations :

MIL DE 3 MOIS :

- Quantité d'épis récoltés:_____ Unité :_____ Kg/unité :_____
- Quantité d'épis stockés :_____ Unité :_____ Temps :_____

(unités selon le mode de transport : botte, bassine, charette...)

Observations :

MIL DE 6 MOIS :

- Quantité d'épis récoltés:_____ Unité :_____ Kg/unité :_____
- Quantité d'épis stockés :_____ Unité :_____ Temps :_____

(unités selon le mode de transport : botte, bassine, charette...)

Observations :

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62. DE LA PRINCIPALE PARCELLE DE BROUSSE

- Variété(s) de sorgho : _____
- Variété(s) de mil 3 mois : _____
- Variété(s) de mil 6 mois : _____

Sur 2 carrés piquetés de 25 m² (5 m X 5 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle

Carré de rendement N° 1

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Carré de rendement N° 2

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Evaluation du rendement de l'ensemble de la parcelle de brousse

SORGHO :

- Quantité d'épis récoltés:_____ Unité :_____ Kg/unité :_____
- Quantité d'épis stockés :_____ Unité :_____ Temps :_____

(unités selon le mode de transport : botte, bassine, charette...)

Observations :

MIL DE 3 MOIS :

- Quantité d'épis récoltés:_____ Unité :_____ Kg/unité :_____
- Quantité d'épis stockés :_____ Unité :_____ Temps :_____

(unités selon le mode de transport : botte, bassine, charette...)

Observations :

MIL DE 6 MOIS :

- Quantité d'épis récoltés:_____ Unité :_____ Kg/unité :_____
- Quantité d'épis stockés :_____ Unité :_____ Temps :_____

(unités selon le mode de transport : botte, bassine, charette...)

Observations :

63. DES AUTRES PARCELLES (CASE OU BROUSSE) CULTIVEES EN SORGHO & MILS

- Culture SORGHO/PETIT MIL/MIL 6 MOIS - Surface parcellaire _____ Ha

- Parcelle N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10

Sur 2 carrés piquetés de 25 m² (5 m X 5 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Carré de rendement N° 2

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Observations :

- Culture SORGHO/PETIT MIL/MIL 6 MOIS - Surface parcellaire :_____ H

- Parcelle N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10

Sur 2 carrés piquetés de 25 m² (5 m X 5 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Carré de rendement N° 2

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

<u>Observations :</u>

- Culture SORGHO/PETIT MIL/MIL 6 MOIS - Surface parcellaire :_____ H

- Parcelle N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10

Sur 2 carrés piquetés de 25 m² (5 m X 5 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Carré de rendement N° 2

Mesures	Sorgho	Mil 3 mois	Mil 6 mois
Nombre de poquets après démariage			
Nombre de plantes après démariage			
Nombre d'épis à la récolte			
Poids total épis en kg			
Poids total de grain en kg			

Observations :

7 VENTE DU GRAIN

71 SORGHO

Lieu de vente *	Date		Quantité	Unité	Prix (fcfa/unité
	jour	mois			

* Au village, au marché (préciser quel marché...).

Observations :

72 MIL DE 3 MOIS

Lieu de vente *	Date		Quantité	Unité	Prix (fcfa/unité
	jour	mois			

* Au village, au marché (préciser quel marché...).

Observations :

73 MIL DE 6 MOIS

Lieu de vente *	Date		Quantité	Unité	Prix (fcfa/unité
	jour	mois			

* Au village, au marché (préciser quel marché...).

Observations :

8 TRANSFORMATION ET VENTE SOUS FORME DE BOISSON

Lieu de vente *	Date		Quantité fabriqué		Travail en heure			Vente	
	jour	mois	kg grain	l bière	Homme	femme	enfant	Litres	fcfa

* Au village, au marché (préciser quel marché...).
° Prix obtenu pour la quantité totale vendue.

Remarque : La différence entre la quantité de boisson fabriquée et vendue correspond à l'autoconsommation du ménage.

Observations :

Appendix 10(c)

NOTE SUR L'ENQUETE BUDGET AU NIGER

1. L'ECHANTILLONNAGE

11. Les paysans seront choisis parmi ceux qui ont été sélectionnés dans l'échantillon du suivi agronomique.

12. Dans le village expérimental (Tchizon), deux paysans, un homme et une femme seront choisis pour chaque option. Puisqu'il y a 4 options, un total de 8 paysans (4 hommes et 4 femmes) sera sélectionné dans ce village pour l'enquête budget.

13. Dans le village témoin (Maiguero) 4 paysans, 2 hommes et 2 femmes seront sélectionnés pour l'enquête budget.

14. Le choix définitif des 8 + 4 paysans (6 hommes et 6 femmes) sera effectué par le coordonnateur national, en tenant compte des capacités de collaboration de chacun.

15. Pour le budget partiel par culture (temps de travaux) , on retiendra pour chaque paysan ses 2 parcelles collectives principales cultivées en 1989 en mil/niébé. L'une sera choisie dans un "champ de case" (le principal champ situé près du village) et l'autre dans un "champ de brousse" (le principal champ éloigné du village).

2. FREQUENCE DE COLLECTE DES DONNEES

Deux visites par mois, à intervalle de 15 jours seront effectuées pendant la période de culture (de la préparation du sol à la phase finale de récolte).

Les visites seront ensuite mensuelles (collecte des données sur la commercialisation de la production).

3. LES PRIX DU MARCHE

Obtenir des publications locales avec une frequence hebdomadaire les prix officiels et réels du marché principal de chaque village pour le mil et le niébé.
Des données couvrant toute l'année sont nécessaires. Faire éventuellement une enquête.

DONNEES SUR LES CULTURES ET BUDGETS D'EXPLOITATION AU NIGER

OPTION DE FERTILISATION : 1 2 3 4

1. IDENTIFICATION :

- Paysan : _____ Sexe : MASCULIN / FEMININ
- Groupe ethnique : _____

2. LOCALISATION :

- Pays : _____
- Village : _____

3. RESSOURCES DISPONIBLES :

31. Disponibilité en main d'oeuvre FAMILIALE :

Nombre	à Plein temps	à Temps partiel	
		Pendant campagne	% du temps
Hommes			
Femmes			
Enfants			

Observations sur les activités rémunérées des membres de la famille travaillant à temps partiel et leur apport (argent, mil...) avec la valeur estimée au moment de l'apport :

_____

32. Equipement en traction animale :

OUI/NON. Si oui, fournir les informations suivantes :

Type de traction	Bovine	Asine
Nombre d'animaux dressés	0 / 1 / 2 / Plus	0 / 1 / 2 / Plus

Equipement : CHARRETTE / CHARRUE / POLYCULTEUR / AUTRE (Préciser)

Autre équipement : _____

Observations : Préciser en cas d'équipement en commun le nom des autres propriétaires pour chaque type d'équipement et la part de propriété

33. Disponibilité en terre :

Champ N°	Distance en km	Surface en ha	Gestion /* acquisiti.	Parcelle N°	Surface en ha	Culture semée en 1989	Culture semée en 1988
1			1 2 3 4	1			
			A B C D	2			
				3			
2			1 2 3 4	1			
			A B C D	2			
				3			
3			1 2 3 4	1			
			A B C D	2			
				3			
4			1 2 3 4	1			
			A B C D	2			
				3			
5			1 2 3 4	1			
			A B C D	2			
				3			
6			1 2 3 4	1			
			A B C D	2			
				3			
7			1 2 3 4	1			
			A B C D	2			
				3			

* 1 = Champ individuel sous conduite d'un homme
2 = Champ individuel sous conduite d'une femme
3 = Champ collectif sous conduite d'un homme
4 = Champ collectif sous conduite d'une femme

A = Hérité
B = Acheté
C = Loué
D = Prêté

33. Disponibilité en terre (suite)

Champ N°	Distance en km	Surface en ha	Type de gestion *	Parcelle N°	Surface en ha	Culture semée en 1989	Culture semée en 1988
8			1 2 3 4	1			
			A B C D	2			
				3			
9			1 2 3 4	1			
			A B C D	2			
				3			
10			1 2 3 4	1			
			A B C D	2			
				3			

* 1 = Champ individuel sous conduite d'un homme
2 = Champ individuel sous conduite d'une femme
3 = Champ collectif sous conduite d'un homme
4 = Champ collectif sous conduite d'une femme

A = Hérité
B = Acheté
C = Loué
D = Prêt

Observations : _____

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4. BUDGET PARTIEL POUR LE MIL ET LE NIEBE :

41. CHAMP DE CASE (le principal champ à proximité du village)

- Culture MIL/MIL+NIEBE - Surface occupée :_____ Ha

- Champ N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 - Parcelle N° 1 / 2 / 3

TRAVAUX CULTURAUX COMMUNS AUX mil et niébé CHAMP DE CASE

PREPARATION DU SOL ET SOINS CULTURAUX	DATE		Main d'oeuvre utilisée en jours (*)					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Nettoyage (désouchage, ramassage, brûlis)								
Transport engrais								
Labour								
1 er épandage engrais								
Enfouissement engrais								
1er sarclage								
Transport azote								
1er apport d'azote								
Transport azote								
2nd apport d'azote								
Second sarclage								
Autre (spécifier)								

* Nombre moyen d'heures de travail par jour (Voir tableau ci-dessous

Observations : _____

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TRAVAUX CULTURAUX COMMUNS AUX mil et niébé CHAMP DE CASE (Suite)

Nombre moyen d'heures de travail par jour :

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Nettoyage				Transport azote			
Labour				Epandage azote			
Transport engrais				Sarclage			
Epandage				Autre			
Enfouissement engrais							

Observations :

TRAVAUX CULTURAUX COMMUNS AUX mil et niébé CHAMP DE CASE (suite)

Utilisation de la traction animale pour la préparation du sol et l'entretien :

Opérations	Temps mis	Unité (jour/ heures)	Mode de paiement			
			Total payé en fcfa	Paiement en nature		
				Nature*	Quantité et unité	Prix par unité
Nettoyage						
Labour						
Transport des engrais						
Enfouissement						
1er transport d'azote						
2nd transport d'azote						
1er sarclage						
2nd sarclage						
Autre (préciser)						

* Préciser la nature du bien donné : Mil, sorgho, travail...

Observations : _____

TRAVAUX SPECIFIQUES AU MIL CHAMP DE CASE

MIL (avec ou sans niébé)	DATE		Utilisation de la main d'oeuvre en jours*					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Semis								
Resemis								
Remplacement des manquants								
Démariage								
Récolte des épis								
Transport des épis								
Coupe des tiges								
Transport tiges								
Autre (préciser)								

Observations : _____

TRAVAUX SPECIFIQUES AU MIL CHAMP DE CASE (suite)

* Nombre moyen d'heures de travail par jour pour le mil

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfant
Semis				Récolte tige			
Remplacement				Transport tige			
Démariage				Autre			
Récolte épis							
Transport épis							

Utilisation de la traction animale pour la culture du mil (avec ou sans niébé

Opérations	Temps mis	Unité (jour/ heures)	Mode de paiement			
			Total payé en fcfa	Paiement en nature		
				Nature*	Quantité et unité	Prix par unit
Transport des épis						
Transport tiges						
Autre (préciser)						

* Préciser la nature du bien donné : Mil, sorgho, travail..

Observations : _____

TRAVAUX SPECIFIQUES AU NIEBE CHAMP DE CASE

NIEBE (travaux spécifiques)	DATE		Utilisation de la main d'oeuvre en jours*					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Semis								
Resemis								
Remplacement manquants								
Traitement 1								
Traitement 2								
Traitement 3								
1er récolte gousses								
1er Transport gousses								
1er battage								
1er Transport marché et vente								
2nd récolte gousses								
2nd Transport gousses								
2nd battage								
2nd Transport marché et vente								
3ème récolte gousses								
3ème Transport gousses								
3ème battage								
3ème Transport marché et vente								
Récolte fanes								
Transport fanes								
Autre (préciser)								

Observations : _____

Observations (suite) :

TRAVAUX SPECIFIQUES AU NIEBE CHAMP DE CASE (Suite)

* Nombre moyen d'heures de travail par jour pour le niébé

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Semis				Récolte fane			
Traitement (1 2 ou 3)				Transport fane			
Récolte gous.				Autre			
Transport gousses							

Observations :

TRAVAUX SPECIFIQUES AU NIEBE CHAMP DE CASE (Suite)

Utilisation de la traction animale pour la culture du niébé :

Opérations	Temps mis	Unité (jour/ heures)	Mode de paiement			
			Total payé en fcfa	Paiement en nature		
				Nature*	Quantité et unité	Prix par unité
Transport gousses 1						
Transport gousses 2						
Transport fanes						
Autre (préciser)						

* Préciser la nature du bien donné : Mil, sorgho, travail.

Observations : _____

4. BUDGET PARTIEL POUR LE MIL ET LE NIEBE (SUITE) :

42. CHAMP DE BROUSSE(le principal champ éloigné du village)

- Culture MIL/MIL+NIEBE - Surface occupée :_____ Ha

- Champ N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 - Parcelle N° 1 / 2 / 3

TRAVAUX CULTURAUX COMMUNS AUX mil et niébé CHAMP DE BROUSSE

PREPARATION DU SOL ET SOINS CULTURAUX	DATE		Main d'oeuvre utilisée en jours (*)					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Nettoyage (désouchage, collecte, brûlis)								
Transport engrais								
Labour								
1 er épandage engrais								
Enfouissement engrais								
1er sarclage								
Transport azote								
1er apport d'azote								
Transport azote								
2nd apport d'azote								
Second sarclage								
Autre (spécifier)								

* Nombre moyen d'heures de travail par jour (Voir tableau ci-dessous)

Observations : _____

TRAVAUX CULTURAUX COMMUNS AUX mil et niébé CHAMP DE BROUSSE (Suite)

Nombre moyen d'heures de travail par jour :

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Nettoyage				Transport azote			
Labour				Epandage azote			
Transport engrais				Sarclage			
Epandage				Autre			
Enfouissement engrais							

Observations :

TRAVAUX CULTURAUX COMMUNS AUX mil et niébé CHAMP DE BROUSSE (suite)

Utilisation de la traction animale pour la préparation du sol et l'entretien :

Opérations	Temps mis	Unité (jour/ heures)	Mode de paiement			
			Total payé en fcfa	Paiement en nature		
				Nature*	Quantité et unité	Prix par unité
Nettoyage						
Labour						
Transport des engrais						
Enfouissement						
1er transport d'azote						
2nd transport d'azote						
1er sarclage						
2nd sarclage						
Autre (préciser)						

* Préciser la nature du bien donné : Mil, sorgho, travail.

Observations : _____

TRAVAUX SPECIFIQUES AU MIL CHAMP DE BROUSSE

MIL (avec ou sans niébé)	DATE		Utilisation de la main d'oeuvre en jours*					
			Familiale			Salariée		
	Jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Semis								
Resemis								
Remplacement des manquants								
Démariage								
Récolte des épis								
Transport des épis								
Coupe des tiges								
Transport tiges								
Autre (préciser)								

Observations : _____

TRAVAUX SPECIFIQUES AU MIL CHAMP DE BROUSSE (suite)

* Nombre moyen d'heures de travail par jour pour le mil

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Semis				Récolte tige			
Remplacement				Transport tige			
Démariage				Autre			
Récolte épis							
Transport épis							

Utilisation de la traction animale pour la culture du mil (avec ou sans niébé)

Opérations	Temps mis	Unité (jour/ heures)	Mode de paiement			
			Total payé en fcfa	Paiement en nature		
				Nature*	Quantité et unité	Prix par unité
Transport des épis						
Transport tiges						
Autre (préciser)						

* Préciser la nature du bien donné : Mil, sorgho, travail...

Observations : _____

TRAVAUX SPECIFIQUES AU NIEBE CHAMP DE BROUSSE

NIEBE (travaux spécifiques)	DATE		Utilisation de la main d'oeuvre en jours*					
			Familiale			Salariée		
	jour	mois	Hommes	Femmes	Enfant	Hommes	Femmes	Enfant
Semis								
Resemis								
Remplacement manquants								
Traitement 1								
Traitement 2								
Traitement 3								
1er récolte gousses								
1er Transport gousses								
1er battage								
1er Transport marché et vente								
2nd récolte gousses								
2nd Transport gousses								
2nd battage								
2nd Transport marché et vente								
3ème récolte gousses								
3ème Transport gousses								
3ème battage								
3ème Transport marché et vente								
Récolte fanes								
Transport fanes								
Autre (préciser)								

Observations : _____

Observations (suite) :

TRAVAUX SPECIFIQUES AU NIEBE CHAMP DE BROUSSE (Suite)

* Nombre moyen d'heures de travail par jour pour le niébé

Opérations	Hommes	Femmes	Enfants	Opérations	Hommes	Femmes	Enfants
Semis				Récolte fane			
Traitement (1 2 ou 3)				Transport fane			
Récolte gous.				Autre			
Transport gousses							

Observations :

TRAVAUX SPECIFIQUES AU NIEBE CHAMP DE BROUSSE (Suite)

Utilisation de la traction animale pour la culture du niébé :

Opérations	Temps mis	Unité (jour/ heures)	Mode de paiement			
			Total payé en fcfa	Paiement en nature		
				Nature*	Quantité et unité	Prix par unité
Transport eau trait--ments						
Transport gousses 1						
Transport gousses 2						
Transport fanes						
Autre (préciser)						

* Préciser la nature du bien donné : Mil, sorgho, travail...

Observations : _____

5. UTILISATION D'AUTRES INTRANTS POUR TOUTE L'EXPLOITATION

INTRANTS (fumier, engrais, pesticides, matériel.....)	DATE		QUANTITE	UNITES	COUT PAR UNITE
	jour	mois			

Observations :(préciser lorsqu'il s'agit d'un intrant destiné à une par-celle individuelle)

6. LA PRODUCTION :

61. CHAMP DE CASE (le principal champ à proximité du village)

- Variété(s) de mil : _____

- Variété(s) de niébé : _____

A EVALUATION DE LA PRODUCTION PAR SONDAGE

Sur 2 carrés piquetés de 100 m² (10 m X 10 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Carré de rendement N° 2

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grain en kg		
Poids total de paille ou fanes en kg		

Observations : _____

_____

_____

B EVALUATION DU RENDEMENT DE LA PARCELLE DE CASE PAR ENQUETE ET PESEE

LE MIL :

Récolte en vert pour la soudure :

Date	Nombre de bottes	Nombre d'épis/botte	Date	Nombre de bottes	Nombre d'épis/botte

Recolte en sec (période normale de récolte) :

- Quantité de bottes récoltées sur toute la parcelle: _____
- Poids moyen d'un échantillon de botte

Botte N°	Nombre d'épis	Poids en kg	
		Botte entière	grain
1			
2			
3			
4			

Observations : _____

B EVALUATION DU RENDEMENT DE LA PARCELLE DE CASE PAR ENQUETE ET PESEE (suit

LE NIEBE :

Récolte en vert pour la soudure (et la vente):

Date	Nombre d'unités	Estimation kg / unité	Estimation fcfa/unité	Prix total en fcfa

Recolte en sec (période normale de récolte) :

Récolte N°	Nombre total de sacs gousse	Echantillon de Sac de gousses N°	Poids en kg	
			du sac	grains du sac
1		1		
		2		
2		1		
		2		
3		1		
		2		

Observations : _____

6. LA PRODUCTION (SUITE):

62. CHAMP DE BROUSSE (le principal champ éloigné du village)

- Variété(s) de mil : _____

- Variété(s) de niébé : _____

A EVALUATION DE LA PRODUCTION PAR SONDAGE

Sur 2 carrés piquetés de 100 m² (10 m X 10 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Carré de rendement N° 2

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grain en kg		
Poids total de paille ou fanes en kg		

Observations : _____

B EVALUATION DU RENDEMENT DE LA PARCELLE DE BROUSSE PAR ENQUETE ET PESEE

LE MIL :

Récolte en vert pour la soudure :

Date	Nombre de bottes	Nombre d'épis/botte	Date	Nombre de bottes	Nombre d'épis/botte

Recolte en sec (période normale de récolte) :

- Quantité de bottes récoltées sur toute la parcelle: _____
- Poids moyen d'un échantillon de botte

Botte N°	Nombre d'épis	Poids en kg	
		Botte entière	grain
1			
2			
3			
4			

Observations : _____

63. AUTRE CHAMP DE CASE OU BROUSSES CULTIVEES EN MIL/NIEBE

- Culture MIL/MIL+NIEBE - Surface occupée :_____ Ha
- Champ N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 - Parcelle N° 1 / 2 / 3
- Variété(s) de mil :_____
- Variété(s) de niébé :_____

Sur 2 carrés piquetés de 100 m² (10 m X 10 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Carré de rendement N° 2

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Observations :_____

63. DES AUTRES PARCELLES CASE OU BROUSSES CULTIVEES EN MIL/NIEBE

- Culture MIL/MIL+NIEBE - Surface occupée :_____ Ha
- Champ N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 - Parcelle N° 1 / 2 / 3
- Variété(s) de mil :_____
- Variété(s) de niébé :_____

Sur 2 carrés piquetés de 100 m² (10 m X 10 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Carré de rendement N° 2

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Observations :_____

63. DES AUTRES PARCELLES CASE OU BROUSSES CULTIVEES EN MIL/NIEBE

- Culture MIL/MIL+NIEBE - Surface occupée : _____ . Ha
- Champ N° : 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 - Parcelle N° 1 / 2 /
- Variété(s) de mil : _____
- Variété(s) de niébé : _____

Sur 2 carrés piquetés de 100 m² (10 m X 10 m) implantés dans la parcelle avec l'aide du coordonnateur, réaliser les mesures suivantes au cours du cycle :

Carré de rendement N° 1

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Carré de rendement N° 2

Mesures	MIL	NIEBE
Nombre de poquets 1 mois après semis		
Nombre d'épis à la récolte		
Poids total d'épis ou de gousses en kg		
Poids total de grains en kg		
Poids total de paille ou fanes en kg		

Observations : _____

7 LA VENTE (Concerne toute la production de l'exploitation en mil et niébé)

71 LE MIL

Si la production de mil est vendue au champ :

- Surface vendue :_____ Unité :_____ Prix de vente :_____

Si la production de mil est gérée par le paysan :

- Vente de grain :

Lieu de vente *	Date		Quantité	Unité	Prix (fcfa/unité
	jour	mois			

* Au village, au marché (préciser quel marché...).
(préciser le poids moyen de l'unité utilisée)

- Vente de paille :

Lieu de vente *	Date		Quantité	Unité	Prix (fcfa/unité
	jour	mois			

* Au village, au marché (préciser quel marché...).
Eventuellement nature et quantification du service rendu en échange de la paille de mil :

Observations :

72 LE NIEBE

Si la production de mil est vendue au champ :

- Surface vendue :_____ Unité :_____ Prix de vente :_____

Si la production de mil est gérée par le paysan :

- Vente de grain :

Lieu de vente *	Date		Quantité	Unité	Prix (fcfa/unité
	jour	mois			

* Au village, au marché (préciser quel marché...).
(préciser le poids moyen de l'unité utilisée)

- Vente de fanes :

Lieu de vente *	Date		Quantité	Unité	Prix (fcfa/unité
	jour	mois			

* Au village, au marché (préciser quel marché...).
Eventuellement nature et quantification du service rendu en échange des fanes de niébé

Observations :

APPENDIX 11

DRAFT

SOIL FERTILITY RESTORATION PROJECT

AGRONOMIC EVALUATION OF THE 1988 ON FARM TRIALS IN THE KUMASI AND MARADI PILOT AREAS

by

E. Rhodes, M. Gaoh & S. Opoku

JUNE 1989

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EFFECTS OF FERTILIZER COMBINATIONS ON MAIZE SEED YIELDS AND MILLET SEED AND STALK YIELDS ON FARMERS FIELDS

ABSTRACT

In 1988, On Farm Trials (OFT) were conducted in 5 villages in the Kumasi pilot area of Ghana and in 4 villages in the Maradi pilot area of Niger. A total of 40 households participated in these trials. In Kumasi, all fertilizer combinations were superior to the check and differences between combinations involving SSP were not significant. The 100 N 40 P_2O_5 30 K_2O kg/ha combination as Urea + KCl + SSP was the most promising in terms of physical response. It gave average maize yield of 3271 kg/ha as compared to the check of 2057 kg/ha. In Maradi all fertilizer combinations were also superior to the check, but ground Tahoua phosphate rock + Urea was inferior to all combinations involving SSP.
The most promising combination in terms of grain and stalk yield was 45N 20 P_2O_5 kg/ha as Urea + SSP. It gave an average grain yield of 1172 kg/ha and stalk yield of 2394 kg/ha. The check gave a grain yield of 588 kg/ha and stalk yield of 1383 Kg/ha.

The trials were a powerful demonstration to farmers in the pilot area of the potential for fertilizer use. The results used in conjunction with previous knowledge of crop response to fertilizers would be useful in formulating the initial fertilizer options at the village level. Future OFT will evaluate higher analysis phosphate materials.

1. INTRODUCTION

The soils of West Africa are generally low in fertility and fragile. Small farmers have traditionally coped with these problems by resorting to a bush fallow rotation, which has allowed low but stable levels of crop production. However the bush fallow system is breaking down in the humid zone and has been re-

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placed by continuous cropping of lands depleted in fertility in many areas of the savanna and sahel zones. There is an urgent need to develop and test systems of soil management that will increase crop production substantially at the village level and at the same time protect the natural resource base for agriculture in the region.

The SFRP seeks to identify, characterize and promote fertilizer adoption in pilot areas where fertilizers have a strong potential of being used on a sustainable basis. The project is presently based in 4-5 villages in each pilot area in the humid, savanna and sahel zones of West Africa, where specific soil fertility constraints exist and can be corrected by appropriate fertilizer use.

1988 was the start-up year of the SFRP. It was decided to make effective use of the growing season by conducting simple trials/demonstrations on farmers fields, on relatively large plots and involving farmer-participation. The objectives were to:

1. Compare various fertilizer combinations that could form the basis for formulating the initial village level fertilizer options for maize-based cropping systems in Ghana and millet-based cropping systems in Niger, and:

2. Demonstrate to farmers in the pilot areas the potential of fertilizer use in anticipation of the application of fertilizers on hundreds of hectares of farm lands.

2.0 MATERIALS AND METHODS

The trials were farmer/researcher managed -- field technicians pegged out the plots and supervised the fertilizer application ; the rest of the management operations-sowing plant population, weeding were the responsibility of the farmer. Field assistants were always available for advice .

2.1 Ghana

Average annual rainfall in the Kumasi pilot area is 1400-1600 mm. The soils have been classified as Luvisols and Acrisols and are probably Alfisols and Ultisols in the USDA system. Table 1 shows selected physical and chemical properties of the soils on which the trials were conducted.

Two phosphate sources single superphosphate (SSP) and sulphuric acid based 50% partially acidulated Togo phosphate rock in combination with various rates of nitrogen and potassium fertilizer were evaluated. The P sources were broadcast at planting of maize. Urea was side dressed in 2 splits at 2 weeks after plant-

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ing and 6 weeks after planting. Potassium chloride (KCl) was broadcast at planting.
The treatment combinations tested are shown in Table 3.

The design was randomized complete block with each site considered as a single replicate. There were 4 sites in each of 5 villages.

At harvest two 5x4m subplots from each of the 500 m^2 plots were sampled and grain weight recorded at 14% moisture content.

2.2 Niger

Average annual rainfall in the Maradi pilot area is 400-500 mm.

The soils have been classified as Tropical ferruginous on sands.

Table 2 shows selected physical and chemical properties of the soils.

The phosphate sources evaluated were SSP, ground Tahoua phosphate rock (TPR) and a mixture of SSP/TPR, at a constant N (Urea) rate. The P sources were broadcast at planting of millet. Urea was point-placed in 2 splits at 1st weeding and just before flowering. A few of the sites were intercropped with cowpea, but the cowpea crop were more or less failures. The treatment combinations tested are shown in Table 5. The design was randomized complete block with each site as a single replicate . There were 5 sites in each of 4 villages.

At harvest a 10x10 m subplot from each of the 1000 m^2 plots was sampled, and grain yield and stalk yield recorded.

3.0 RESULTS AND DISCUSSION

3.1 Ghana

Duncans multiple range test on the physical response of maize to Fertilizer combinations over 5 villages showed (Table 3) that Fertilizer combinations were superior to the check and differences between combinations involving SSP were not significant. The 100N - $40P_2O_5$ - $30K_2O$ kg/ha combinations as Urea + KCl + SSP appeared to be most promising. Table 4 shows mean maize seed yields for each treatment in each village and the corresponding standard deviations.

Mean grain yield response to fertilizers was greatest in Adjamesu followed by Baworo. Lower but good responses were obtained in Boamang, Anyinasuso and Hwidiem (Table 6). Before fertilization all sites tested low in phosphorus with minor differences between sites. All sites were adequate in K especially Adjamesu. Organic C was generally low in all sites. Hwidiem with relatively

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low response tested relatively high only in exchangeable Ca.

The Adjamesu and Baworo sites were the most acidic, but pH was above 5.4. The difference in yield response between sites cannot be fully explained by difference in soil analysis.

Differences in crop management between P sites may explain some of the differences in response. It should be recalled that farmers made their own decisions of plant population, weeding etc.

With an average increase in yield of 60 % over the check (Table 3) on relatively large plots, the trial served as a powerful demonstration of the potential of fertilizer use. Low analysis sulphate of ammonia and 15:15:15 are still the dominant fertilizers used by farmers in the pilot area. The trial thus exposed them to the use of higher analysis Urea, and partially acidulated Togo phosphate rock.

The results obtained used in conjunction with previous knowledge of crop response to fertilizers in Ghana would be useful in formulating the fertilizer options for village level fertilization in the 1989 field program.

3.2 Niger

The effects of fertilizer combinations on millet grain yields are shown in Table 5. All combinations were superior to the check, but ground Taboua phosphate rock + Urea was inferior to all combinations involving SSP. The best fertilizer combination seemed to be 45N - 20P_2O_5 kg/ha as Urea + SSP.
Means of millet grain yields for each treatment in each village and their corresponding standard deviations are shown in table 6.

There were large responses of millet grain yield to fertilizers in all villages. The biggest response was in Maiguero, followed by Zaboua, Tchizon and Nwalla. Table 3 shows that there were some variability in level of nutrients between villages and sites but that all sites were very low in organic carbon, available phosphorus and total nitrogen. Zaboua which tested lowest in available phosphorus but highest in exchangeable bases recorded the biggest response to the fertilizer combinations. As pointed out for Ghana, differences in crop management between sites may explain some of the differences in response between sites.

The very large average grain yield increases, of 115% over the check (Table 6) on large plots demonstrated the potential of fertilizer use in the pilot area.

Table 7 shows the effects of fertilizer combinations on millet stalk yields.

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Table 8 shows means of millet stalk yield for each treatment in each village and the corresponding standard deviations.

All combinations were again superior to the check, but TPR + Urea was inferior to all combinations involving SSP. There was no difference between combinations involving SSP.

The best combination seemed to be 40N - $20P_2O_5$ kg/ha. The Base Line Exploratory survey had indicated that farmers in the pilot area used millet straws for a variety of domestic purposes. The significant straw yield increases resulting from fertilizer use may make feasible the return of a part of the crop residue to the soil thereby improving the soil organic matter.

Indigenous TPR on its own performed poorly. However a lower rate of application in combination with SSP should be worth evaluation over more than 1 year. The results obtained from the On farm trials would be useful in formulating the village level fertilizer options for 1989.

4.0 CONCLUSION

The trials were powerful demontrations to farmers in the pilot area of the potential for fertilizer use.
The results used in conjunction with previous knowledge of crop responses to fertilizers in West Africa would be useful in formulating the initial fertilizer options at the village level.

5.0 FUTURE WORK

Soil analysis, foliar symptoms observed in the pilot area in 1988 and previous work indicate that phosphorus is a key element limiting crop yields in West Africa. Phosphate materials are of special importance in the investment strategies of the Soil Fertility Restoration Project. There has been little or no evaluation on farmers fields in the pilot areas of high analysis P materials. These materials may decrease transportation costs and make fertilizers more affordable. In 1989 the On Farm Trials will evaluate direct and residual effetcs of high analysis P materials such as TSP, DAP, Togo - PAPR 50.
Information obtained from these trials will aid in up grading the fertilizer investment options at the village level.

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Table 1. Physical & Chemical Properties of Topsoils (0-20cm) in the Kumasi Pilot Area, Ghana.

Analysis	Site No.	Amansie (Adjamasu)	Site No.	Ejisu-Juaben-Bosumtwi (Baworo)	Site No.	Kwabre-Sekyere (Boamang)	Site No.	Offinso (Anyinasuso)	Site No.	Atwima (Hwidiem)
Clay %	1	28.82	3	16.51	5	16.20	7	18.97	9	9.12
	2	42.07	4	18.94	6	19.55	8	45.48	10	11.71
Silt %	1	29.43	3	8.82	5	6.74	7	12.49	9	15.61
	2	33.25	4	11.58	6	7.49	8	9.25	10	12.18
Sand %	1	41.22	3	72.33	5	75.67	7	67.71	9	72.41
	2	21.75	4	68.15	6	71.90	8	45.61	10	74.01
Organic Carbon %	1	2.06	3	1.47	5	1.45	7	1.41	9	1.88
	2	2.74	4	0.93	6	1.70	8	0.76	10	1.76
Total N %	1	0.17	3	0.12	5	0.12	7	0.13	9	0.11
	2	0.23	4	0.10	6	0.13	8	0.06	10	0.15
C/N	1	12.21	3	12.21	5	12.17	7	11.42	9	16.36
	2	11.39	4	9.13	6	13.32	8	12.38	10	11.25
Available P (mg kg-1) (BRAY 1)	1	5.41	3	4.84	5	7.95	7	4.22	9	6.16
	2	2.75	4	5.11	6	4.16	8	2.02	10	7.73

Table 1. (Continued)

Analysis	Site No.	Amansie (Adjamasu)	Site No.	Ejisu-Juaben-Bosumtwi (Bamoro)	Site No.	Kwabre-Sekyere (Boamang)	Site No.	Offinso (Anyinasuso)	Site No.	Atwima (Hwidiem)
NH4OAc pH7 Exch. K (C mol kg-1)	1	0.42	3	0.25	5	0.26	7	0.24	9	0.24
	2	0.31	4	0.15	6	0.17	8	0.05	10	0.27
Ca (C mol kg-1)	1	5.80	3	7.53	5	9.33	7	5.61	9	6.03
	2	7.56	4	2.54	6	4.00	8	1.55	10	11.86
Mg (C mol kg-1)	1	1.76	3	2.10	5	1.77	7	1.12	9	1.57
	2	2.74	4	1.01	6	1.33	8	0.93	10	1.50
Na (C mol kg-1)	1	0.10	3	0.09	5	0.06	7	0.06	9	0.05
	2	0.08	4	0.05	6	0.05	8	0.05	10	0.08
Cation Exchange Capacity (C mol kg-1)	1	11.70	3	11.19	5	11.66	7	9.35	9	11.25
	2	18.12	4	9.38	6	7.99	8	8.00	10	12.53
pH (H2O)	1	5.5	3	6.2	5	6.5	7	5.6	9	6.1
	2	5.3	4	5.0	6	5.6	8	5.5	10	6.8

Table 2. Physical & Chemical Properties of Topsoils in the Pilot Area of Niger.

Analysis		Site No.	Tchizon-Kouregue	Site No.	Maiguero	Site No.	N'Wala Dan-Sofoua	Site No.	Zaboua
Clay	%	1	3.5	6	4.4	11	1.7	16	4.2
		2	3.3	7	3.6	12	1.6	17	3.1
		3	2.8	8	2.9	13	2.0	18	3.2
		4	2.3	9	2.6	14	1.9	19	1.6
		5	3.7	10	2.8	15	3.8	20	2.7
Silt	%	1	3.8	6	4.6	11	2.8	16	2.8
		2	2.5	7	4.7	12	2.9	17	2.2
		3	4.6	8	3.7	13	2.3	18	1.3
		4	3.9	9	3.6	14	1.6	19	3.0
		5	2.5	10	5.8	15	0	20	2.6
Sand	%	1	92.7	6	91.0	11	95.6	16	93.0
		2	94.3	7	91.6	12	95.5	17	94.8
		3	92.7	8	93.5	13	95.7	18	95.5
		4	93.9	9	93.8	14	96.5	19	95.5
		5	93.9	10	91.5	15	96.2	20	94.6

Table 2. (Continued)

Analysis	Site No.	Tchizon-Kouregue	Site No.	Maiguero	Site No.	N'Wala Dan-Sofoua	Site No.	Zaboua
Organic Carbon %	1	0.06	6	0.08	11	0.06	16	0.07
	2	0.05	7	0.09	12	0.08	17	0.06
	3	0.06	8	0.10	13	0.10	18	0.08
	4	0.06	9	0.06	14	0.06	19	0.06
	5	0.05	10	0.10	15	0.05	20	0.08
Total N %	1	0.007	6	0.014	11	0.004	16	0.009
	2	0.009	7	0.017	12	0.008	17	0.008
	3	0.008	8	0.010	13	0.013	18	0.011
	4	0.009	9	0.008	14	0.004	19	0.004
	5	0.004	10	0.015	15	0.006	20	0.008
C/N	1	8.6	6	5.7	11	15.0	16	7.8
	2	5.6	7	5.3	12	10.0	17	7.5
	3	7.5	8	10.0	13	7.7	18	7.3
	4	6.7	9	7.5	14	15.0	19	15.0
	5	12.5	10	6.7	15	8.3	20	10.0
Available P (mg kg-1) (BRAY I)	1	1.4	6	2.1	11	2.1	16	1.1
	2	1.1	7	2.5	12	2.8	17	0.4
	3	1.8	8	6.0	13	4.9	18	0.4
	4	0.7	9	1.8	14	4.6	19	0.4
	5	3.5	10	3.5	15	2.8	20	1.8

Table 2. (Continued)

Analysis	Site No.	Tchizon-Kouregue	Site No.	Maiguero	Site No.	N'Wala Dan-Sofoua	Site No.	Zaboua
NH4OAc pH7 Exch. K (C mol kg-1)	1	0.04	6	0.06	11	0.05	16	0.14
	2	0.04	7	0.12	12	0.10	17	0.10
	3	0.04	8	0.07	13	0.08	18	0.14
	4	0.04	9	0.07	14	0.06	19	0.07
	5	0.04	10	0.17	15	0.06	20	0.13
Exch. Ca (C mol kg-1)	1	0.25	6	0.30	11	0.40	16	1.09
	2	0.30	7	0.13	12	0.58	17	1.01
	3	0.61	8	0.85	13	0.70	18	1.08
	4	0.53	9	0.31	14	0.38	19	0.60
	5	0.49	10	0.86	15	0.45	20	1.06
Exch. Mg (C mol kg-1)	1	0.12	6	0.12	11	0.15	16	0.38
	2	0.13	7	0.08	12	0.20	17	0.37
	3	0.16	8	0.27	13	0.28	18	0.27
	4	0.17	9	0.11	14	0.14	19	0.19
	5	0.15	10	0.36	15	0.17	20	0.34
Exch. Na (C mol kg-1)	1	0.03	6	0.03	11	0.05	16	0.03
	2	0.03	7	0.03	12	0.03	17	0.02
	3	0.02	8	0.05	13	0.03	18	0.03
	4	0.02	9	0.03	14	0.03	19	0.04
	5	0.02	10	0.03	15	0.03	20	0.03

Table 2. (Continued)

Analysis	Site No.	Tchizon-Kouregue	Site No.	Maiguero	Site No.	N'Wala Dan-Sofoua	Site No.	Zaboua
Cation Exchange Capacity (C mol kg-1)	1	0.54	6	0.63	11	0.67	16	1.67
	2	0.59	7	0.35	12	0.94	17	1.54
	3	0.93	8	1.27	13	1.12	18	1.55
	4	0.84	9	0.55	14	0.64	19	0.94
	5	0.84	10	1.47	15	0.74	20	1.60
Exchange Acidity (C mol kg-1)	1	0.10	6	0.12	11	0.02	16	0.03
	2	0.09	7	0.02	12	0.03	17	0.04
	3	0.10	8	0.03	13	0.03	18	0.03
	4	0.08	9	0.03	14	0.03	19	0.04
	5	0.14	10	0.05	15	0.03	20	0.04
pH (H2O)	1	6.2	6	6.1	11	6.5	16	6.8
	2	5.9	7	6.1	12	6.5	17	6.3
	3	5.7	8	6.2	13	6.5	18	6.5
	4	6.0	9	6.3	14	6.5	19	6.4
	5	5.4	10	6.5	15	6.6	20	6.5

Table 3. Effect of Fertilizer Combinations on Maize Grain Yields in the Kumasi Pilot Area, Ghana.

DUNCAN GROUPING	MEAN SEED YIELD (kg/ha)	SOURCE N	P_2O_5	K_2O	kg/ha
A	3295.4	100	80	30	(SSP)
A	3270.8	100	40	30	(SSP)
BA	3094.9	100	60	0	(SSP)
BA	3022.8	100	60	30	(SSP)
B	2836.5	100	60	0	(TPAPR)
C	2056.5	0	0	0	CHECK

N Source = Urea (46% N)
P Sources = SAB Togo PAPR 50 (26% P_2O_5)
SSP (18% P_2O_5)
K Source = KCl (60% K_2O)

Table 4. Maize Grain Yields at Various Fertilizer Combinations and Villages in the Kumasi Pilot Area, Ghana.

SOURCE N	P_2O_5	K_2O kg/ha		VILLAGE	MEAN SEED YIELD (kg/ha)	STANDARD DEVIATION
100	40	30	(SSP)	ADJAMESU	3924.875	948.42
100	40	30	(SSP)	ANYINASUSO	3436.125	955.16
100	40	30	(SSP)	BAWORO	2182.000	1067.26
100	40	30	(SSP)	BOAMANG	2701.125	969.84
100	40	30	(SSP)	HWIDIEM	3837.500	540.88
100	60	0	(SSP)	ADJAMESU	3544.875	799.65
100	60	0	(SSP)	ANYINASUSO	3515.000	696.93
100	60	0	(SSP)	BAWORO	1393.500	560.91
100	60	0	(SSP)	BOAMANG	2475.142	875.30
100	60	0	(SSP)	HWIDIEM	3617.875	922.29
100	60	0	(TPAPR)	ADJAMESU	3364.000	413.60
100	60	0	(TPAPR)	ANYINASUSO	3153.875	1025.40
100	60	0	(TPAPR)	BAWORO	1751.833	719.09
100	60	0	(TPAPR)	BOAMANG	2449.000	545.21
100	60	0	(TPAPR)	HWIDIEM	3192.625	587.58
100	60	30	(SSP)	ADJAMESU	3423.625	844.11
100	60	30	(SSP)	ANYINASUSO	3287.375	820.47
100	60	30	(SSP)	BAWORO	1747.333	968.54
100	60	30	(SSP)	BOAMANG	2564.428	650.02
100	60	30	(SSP)	HWIDIEM	3715.125	820.28
100	80	30	(SSP)	ADJAMESU	3743.500	876.01
100	80	30	(SSP)	ANYINASUSO	3309.375	1183.94
100	80	30	(SSP)	BAWORO	1777.000	1136.17
100	80	30	(SSP)	BOAMANG	3053.142	1080.01
100	80	30	(SSP)	HWIDIEM	3804.625	674.21
0	0	0	CHECK	ADJAMESU	1923.875	773.81
0	0	0	CHECK	ANYINASUSO	2533.750	1050.15
0	0	0	CHECK	BAWORO	632.500	286.74
0	0	0	CHECK	BOAMANG	1758.571	765.48
0	0	0	CHECK	HWIDIEM	3040.625	704.73

Table 5. Effect of Fertilizer Combinations on Millet Grain Yields in the Maradi Pilot Area, Niger.

DUNCAN GROUPING	MEAN SEED YIELD (kg/ha)	SOURCE N	SOURCE P_2O_5 kg/ha
A	1268.85	45	30 (SSP)
BA	1171.55	45	20 (SSP)
B	1130.15	45	15,60 (SSP,TPR)
C	851.20	45	30 (TPR)
D	587.95	0	0 CHECK

N Source = Urea (46% N)
P Sources = SSP (18% P_2O_5)
TPR : Tahoua Phosphate Rock (28% P_2O_5)

Table 6. Millet Grain Yields at Various Fertilizer Combinations and Villages in the Maradi Pilot Area, Niger.

SOURCE N	SOURCE P_2O_5	SOURCE (kg/ha)	VILLAGE	MEAN SEED YIELD (kg/ha)	STANDARD DEVIATION
45	15,60	(SSP,TPR)	MAIGUERO	1204.000	704.90
45	15,60	(SSP,TPR)	N'WALA	1032.200	241.22
45	15,60	(SSP,TPR)	TCHIZON	1001.000	314.52
45	15,60	(SSP,TPR)	ZABOUA	1283.400	126.73
45	20	(SSP)	MAIGUERO	1400.800	871.75
45	20	(SSP)	N'WALA	963.400	249.08
45	20	(SSP)	TCHIZON	1133.200	523.25
45	20	(SSP)	ZABOUA	1188.800	116.18
45	30	(SSP)	MAIGUERO	1307.400	610.18
45	30	(SSP)	N'WALA	997.000	177.86
45	30	(SSP)	TCHIZON	1501.400	539.67
45	30	(SSP)	ZABOUA	1269.600	210.06
45	30	(TPR)	MAIGUERO	852.200	658.59
45	30	(TPR)	N'WALA	743.200	227.42
45	30	(TPR)	TCHIZON	840.000	482.10
45	30	(TPR)	ZABOUA	969.400	269.83
0	0	CHECK	MAIGUERO	570.800	553.58
0	0	CHECK	N'WALA	480.800	102.92
0	0	CHECK	TCHIZON	648.000	456.39
0	0	CHECK	ZABOUA	652.200	132.05

Table 7. Effect of Fertilizer Combinations on Millet Stalk Yields in the Maradi Pilot Area, Niger.

DUNCAN GROUPING	MEAN STALK YIELD (kg/ha)	SOURCE N	SOURCE P_2O_5 kg/ha
A	2543.9	45	30 (SSP)
A	2394.2	45	20 (SSP)
A	2345.8	45	15,60 (SSP,TPR)
B	1843.5	45	30 (TPR)
C	1382.7	0	0 CHECK

N Source = Urea (46% N)
P Sources = SSP (18% P_2O_5)
TPR : Tahoua Phosphate Rock (28% P_2O_5)

Table 8. Millet Stalk Yields at Various Fertilizer Combinations and Villages in the Maradi Pilot Area, Niger.

SOURCE N	SOURCE P_2O_5 (kg/ha)		VILLAGE	MEAN STALK YIELD (kg/ha)	STANDARD DEVIATION
45	15,60	(SSP,TPR)	MAIGUERO	2511.200	650.38
45	15,60	(SSP,TPR)	N'WALA	1510.000	390.64
45	15,60	(SSP,TPR)	TCHIZON	2328.000	770.92
45	15,60	(SSP,TPR)	ZABOUA	3034.000	561.21
45	20	(SSP)	MAIGUERO	2552.200	781.42
45	20	(SSP)	N'WALA	1539.000	389.60
45	20	(SSP)	TCHIZON	2531.400	1060.16
45	20	(SSP)	ZABOUA	2954.000	624.41
45	30	(SSP)	MAIGUERO	2734.400	487.83
45	30	(SSP)	N'WALA	1456.000	267.40
45	30	(SSP)	TCHIZON	2872.200	1038.34
45	30	(SSP)	ZABOUA	3113.000	541.31
45	30	(TPR)	MAIGUERO	2127.200	812.31
45	30	(TPR)	N'WALA	1125.000	313.28
45	30	(TPR)	TCHIZON	1787.600	1034.60
45	30	(TPR)	ZABOUA	2334.000	1074.62
0	0	CHECK	MAIGUERO	1247.800	621.76
0	0	CHECK	N'WALA	854.000	169.94
0	0	CHECK	TCHIZON	1774.200	1375.89
0	0	CHECK	ZABOUA	1655.000	348.56

Appendix 12(a)

PARTICIPANTS
SFRP Pre-planting Training 9-11th March, Kumasi, Ghana

Name	Institution	Position
E. R. Rhodes	IFDC-A	Teamleader/Agronomist
E. A. Dennis	Soil Research Inst.	Sen. Soil Scientist
D. Pouzet	IFDC-A	Agro-Economist
K. Acheampong	IFDC-A	Rural Sociologist
P. Agyili	Soil Research Inst.	Sen. Pedologist
E. Asiedu	Nkeme Dist.	District Officer
Dankwa Boateng K.	Min. of Agric.	Research Assistant
Baffour Asare M.	Min. of Agric.	Technical Officer
P. K. Gyapong	Min. of Agric.	Technical Officer
A. M. Hyamekye	Min. of Agric.	Senior Tech. Officer
Eric Appiagyei Danka	Min. of Agric.	Technical Officer
Peter K. Amoako	Min. of Agric.	Technical Officer
Kingsley Nkrumah	Min. of Agric.	Technical Officer
Agyenim Boateng	Min. of Agric.	Technical Officer
Asamoah Agyapong K.	Min. of Agric.	Technical Officer
James Doku	Min. of Agric.	Technical Officer
Gyamfi Mensah	Min. of Agric.	Technical Officer
Kwakwa Sarpong	Min. of Agric.	Regional director of Agriculture
Sam Opoku	Min. of Agric.	Coordinator
*Asibi Nahyi	Min. of Agric.	Deputy Sec. (Ashanti Region)

* Mr. Nahyi joined us for a few minutes on 10/3/89 and gave a short address.

Appendix 12(b)

PARTICIPANTS
SFRP Pre-planting Training Program
Dapaong, Togo - April 11-14, 1989

1.	Dr. E. R. Rhodes	Agronomist (SFRP Team Leader) IFDC, Lomé
2.	Mr. D. Pouzet	Agro-Economist SFRP, IFDC, Lomé
3.	Dr. K. Acheampong	Sociologist SFRP, IFDC, Lomé
4.	Mr. E. Melebou	Coordinator INS, Lomé
5.	Mr. P. Abo	Chef sect. vulg. secteur Kpendjal, DRDR-Savanes
6.	Mr. Missou Assogba	Chef service INS de la Kara, Kara
7.	Mr. Bondidjel Naldjoum	Technicien de recherche, IFDC, Dapaong
8.	Mr. Lengue Lorimpo	Technicien de recherche, IFDC, Dapaong
9.	Mr. Soumani Moussa	Encadreur zone Kpembona
10.	Mr. Konfino Wone	Encadreur zone Naki-Est
11.	Mr. Odanou Migoula	Encadreur zone Kwoampit-Bong
12.	Mr. Djakouri Djardja	Encadreur zone Ogaro
13.	Mr. K. M. Alognikou	Research Assistant, IFDC, Lomé
14.	Melle. N'Danou Amoui	Research Assistant, IFDC, Lomé
15.	Melle. Detouc N.	Technicienne de recherche, IFDC, Dapaong
16.	Mr. Bassi Tchalim	Technicien de recherche, IFDC, Dapaong
17.	Mr. Idrissou Ibrahima	Technicien de recherche, IFDC, Dapaong
18.	Mr. Kanwore Maatieyidou	Technicien de recherche, IFDC, Dapaong
19.	Mr. Apelete K. Alognon	Technicien de recherche, IFDC, Dapaong
20.	Mr. Koussa Dissirama	Agro-economiste, IFDC, Dapaong
21.	Mr. Sakiti Anani	Research Assistant, IFDC, Lomé
22.	Mr. Abalo Komlan	Chef service INS Savanes à Dapaong
23.	Mr. Tampene Damoye	Technicien agricole INS, Dapaong
24.	Mr. Dissani N'Koubaka	Technicien agricole INS, Dapaong
25.	Mr. Attiogbe Anani C.	Adj. d'Agriculture INS, Dapaong.

SFRP/am

Appendix 12(c)

PARTICIPANTS

SFRP Pre-Planting Training for Counterpart Field Personnel
Maradi, Niger May 2-4, 1989

1.	E. R. Rhodes	SFRP, Team Leader, IFDC-Africa, Lomé
2.	K. Acheampong	SFRP, Sociologue, IFDC-Africa, Lomé
3.	D. Pouzet	SFRP, Agro-Economist IFDC-Africa, Lomé
4.	M. Goube	Directeur, TANARA, INRAN, Maradi
5.	Hounhouenou G.	Observateur, B.P. 14 Maradi
6.	Mahamane Ousmane	Observateur, INRAN, Maradi
7.	Babba Adamou Garba	Observateur, INRAN, Maradi
8.	Aboubacar Amadou	Observateur, s/c Sani Abdou BIAO, Maradi, BP. 2
9.	Abdou Salifou	Observateur, INRAN, Maradi
10.	Rabiou Adamou	Observateur, INRAN, Maradi
11.	Moussa Bakoye	Observateur, INRAN, Maradi
12.	Laouli Issa	Observateur, INRAN, Maradi
13.	Ari Abdourahamane	Observateur, INRAN, Maradi
14.	Harouna Sanda	s/c Mme Issa Harouna/DDA, Maradi
15.	Harouna Sidolo	Observateur, INRAN, Maradi
16.	Souley Dan Maïguia T.	s/c El Hadji Zagui Bakoye, Autogare, Maradi
17.	Laouli Dakaou	Observateur, INRAN, Maradi
18.	Boubacar Yahaya	Observateur, INRAN, Maradi
19.	Marou Assane Rarafi	DECOR/CNRA, Maradi
20.	Mme Zarafi Adiza	DECOR/CNRA, Maradi
21.	Berrada Abdel	Pédologie, TANARA, Maradi
22.	Sirifi Seyni	Agronome
23.	Maïdjirgui Abdoulayi A.	
24.	Chipkao Idrissa	Directeur Départemental de l'Agric. (DDA) Maradi
25.	Natilia Cazalica	DDA

SFRP/am

APPENDIX 13 LIST OF FIELD TRIPS AND CONSULTANCIES

DATE	DESTINATION/PURPOSE	PERSONNEL
1-3 Aug.	- Kumasi, Ghana. To participate in field day and visit the Dahwenya irrigation Project.	E. Rhodes
1-13 Aug	- Kumasi, Ghana. To participate in field day and supervise the verification survey.	K. Acheampong
25 Aug-3 Sep	- Niamey, Niger. To make arrangements for, and participate in Steering Committee Meeting.	E. Rhodes
28 - 3 Sept.	- Niamey, Niger to participate in Steering Committee Meeting	A. U. Mokwunye and K. Acheampong
28 - 1 Sept.	- Niamey, Niger to participate in Steering Committee Meeting	P. L. G. Vlek
8 - 15 Sept.	- Dapaong, Togo. To train, determine sampling frame and supervise the conduct of the verification survey	K. Acheampong
12 Sept. - 4 Oct.	- Dapaong, Togo. To assist in conduct of the verification survey.	K. Alognikou and A. Sakiti
Aug. 12 - 21 Sept.	- Lome, Togo ; Niamey, Niger ; Maradi, Niger. To supervise the conduct of the verification survey	T. Thompson
4 - 18 Nov.	- Lome, Togo. To supervise the coding of the data obtained from the verification surveys.	C. Baanante and T. Thompson
13 Nov. - 10 Dec.	- To assist in designing of OFT for 1989 and do the statistical analysis of OFT for Ghana.	J. Henao
21-22 Dec 88	- Zio Prefecture. To evaluate CARE/APP Irrigation Project.	D. Pouzet and K. Acheampong

DATE	DESTINATION/PURPOSE	PERSONNEL
16-18 Feb 89	- Accra/Kumasi (Ghana). To evaluate Dahwenya irrigation project and collect background information for the design of the farm budget studies.	K. Acheampong D. Pouzet and C. Baanante
07-11 Mar 89	- Accra/Kumasi (Ghana). To evaluate Dahwenya irrigation project, to train field staff and launch 1989 field programs.	E. Rhodes D. Pouzet K. Acheampong
31 March	- Deve/Lokossa (Benin). To evaluate irrigation project site in Mono region.	E. Rhodes D. Pouzet K. Acheampong
11-15 April	- Dapaong/Naki-Est (Togo). To train field staff, to launch 1989 field programs.	E. Rhodes K. Acheampong, D. Pouzet
30 April to 6 May	- Niamey/Maradi (Niger). To train field staff, to launch 1989 field programs.	E. Rhodes K. Acheampong, D. Pouzet
17 May to 2 June	- Dapaong/Naki-Est (Togo). To collect soil samples, delineate parcels of lands, distribute fertilizer options.	K. Alognikou and A. Sakiti
23-27 May	- Dapaong/Naki-Est (Togo). To monitor progress in implementation of field programs and supervise distribution of fertilizer options.	K. Acheampong D. Pouzet A. N'Danou
23 May to 2 June	- Dapaong/Naki-Est (Togo). To monitor progress in implementation of field programs and supervise distribution of fertilizer options.	K. Acheampong A. N'Danou
24-26 May	- Accra/Kumasi (Ghana). To assist in planning of film on SFRP and to inspect field work.	E. Rhodes M. Connolly
1st June	- Accra (Ghana). To discuss problems in the implementation of the SFRP with Director Crops Services, Ministry of Agriculture.	E. Rhodes

7 - 9 June	- Accra/Kumasi (Ghana). To monitor fer - tilizer distribution and make a few changes on the instruments for the collection of data for the farm budget studies.	K. Acheampong & D. Pouzet
10 - 20 June	- Dapaong /Naki Est (Togo). To assist in planting/fertilizing of researcher managed trials and to oversee fertilizer application at the village scale.	A. Alognikou and A. Sakiti.
18 - 24 June	- Niamey/Maradi (Niger) to monitor field activities.	D. Pouzet
10-13 July	- Dapaong/Naki Est (Togo) to check the farm budget survey, prepare subplots for yield evaluation, organize collection of data on food prices and utilization of crop residues.	D. Pouzet

Appendix 14 - FERTILIZER DISTRIBUTION BY OPTION AND SETTLEMENT IN NAKI-EST (The experimental village), TOGO.

SETTLEMENTS	OPTIONS					TOTAL
	1	2	3	4	5	
Batébogou	15	14	15	15	6	59
Sawaga	15	14	14	14	6	57
Djembengou	7	7	9	7	6	30
Naki-Centre	7	5	7	6	2	25
Mamite-Bagou	5	5	7	5	0	22
Tamandjoaré	4	4	5	6	1	19
Djamonbagou	4	4	3	4	0	15
Napa-Bagou	4	4	2	2	1	12
Socioeconomic farmers*	16	14	16	14	5	60
TOTAL (farmers)	77	71	78	73	27	299

* These are the sample of farmers to be used for agro- socio- economic monitoring and evaluation.