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Profile of Farm Units in Two Villages of Central Upper Volta

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PROFILE OF FARM UNITS IN TWO VILLAGES OF CENTRAL UPPER VOLTA

*Peter J. Matlon**

This is the first in a series of periodic reports presenting preliminary results from ongoing ICRISAT village studies in West Africa. The objective of these reports is to make available on a timely basis highlights of results emerging from ICRISAT socioeconomic village research, thereby stimulating discussion and early feedback from potential users of the information.

The general purpose of the village study program is to help guide technical on-station research toward the development of improved production technologies that are well-adapted to farmers' conditions. In reaching this goal, ICRISAT's village research will be executed in two phases:

1. A baseline analysis of traditional farming systems identifying priority areas for technology development and potential limitations to technology adoption;
2. An evaluation of improved technologies on farmers' fields under farmers' management.

During 1980, the village study program will be limited to research in two Mossi villages. The villages, Nakomtenga and Nabitenga, are located 35 km northeast of Ouagadougou. During the 1981 cropping season, the program will be expanded to include six additional villages, selected to represent

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three agroclimatic zones in Upper Volta and Niger. These will be followed by the second phase of farmer trials of promising technologies in 1982. Continuous monitoring of traditional systems will be done throughout this second phase in each village to provide a control in the technology evaluation process. The program is expected to continue in each location for an indefinite period.

BACKGROUND OF THE NAKOMTENGA/ NABITENGA STUDY

The current study is being conducted in close cooperation with ICRISAT programs in Sorghum Improvement and Agronomy, and follows work begun by the agronomy program in Nakomtenga during 1979. The goals of the 1980 study are:

1. to analyze production systems of the most common crops and crop associations cultivated under local technology in the central region of Upper Volta;
2. to evaluate the performance of an improved short-duration sorghum variety (E35-1) in combination with improved technicultural practices under farmers' management;
3. to develop and test survey methodologies for later use in the expanded program of village studies.

Forty-four farmers in the two study villages are participating in this year's survey. Participants were selected from among those members of the village groupement who expressed a willingness to cooperate. Since it is possible that the selection procedure may have biased the sample toward somewhat larger or more progressive farm units, a later survey of randomly sampled farmers in both villages will be conducted to place participants in a broader population perspective.

Each participating farmer is cultivating a 500 m^2 plot of E35-1 located adjacent to a similarly sized control plot sown to a local white sorghum. Farmers have been given sufficient chemical fertilizer (14-23-15) to treat both plots at a rate of 100 kg/ha and have been advised to plow each plot before planting and to perform identical thinning and weeding operations. The only difference in cultural practice between test plots regards the date of planting. The partially photosensitive E35-1 is recommended for planting soon after 14 June, whereas the full-season photosensitive local variety is to be planted immediately after the initiation of the rains as per traditional practice. It is emphasized that all operations are being carried out by farmers under their own management.

SURVEY METHODOLOGY

A census of participating farm families was conducted during the third week of May, 1980 and produced the following data:

- basic demographic information on all household members.
- a listing of all fields farmed by household members in 1979.
- 1980 cropping plans of all members, including the location of each field and crops to be planted.
- an inventory of all animal traction equipment.
- operations for which animal traction equipment were employed in 1979 and foreseen for 1980.

The census revealed that 44 sample households farmed a total of approximately 730 fields, on which 39 distinct cropping enterprieses (sole crops or unique crop mixtures) were identified. To reduce the number of fields to a manageable level for subsequent data collection and analysis, enterprise frequencies were calculated and the 11 most common sole crops and mixtures were selected for more intensive follow-up study.

In late May weekly interviews were begun with each head of household. The majority of information is being collected by two field assistants permanently stationed in Nakomtenga. In these interviews detailed input-output flow information is being obtained on each field under the direct control of the head of household that contains a selected enterprise. These enterprises and the number of observations for each included in the intensive survey are as follows:

CROP	OBSERVATIONS
Sorghum, E35-1, improved management ..	44
Sorghum, white local, improved management	44
Sorghum, white local, traditional management	3
Sorghum, white local/cowpea ..	30
Sorghum, red local ..	7
Sorghum, red local/cowpea and/or sorrel	29
Millet, local ..	10
Millet, local/cowpea and/or sorrel ..	40
Maize, local ..	2
Groundnut, local ..	40
Bambara nut ..	22
Cowpea ..	4
Total ..	300

Data being collected on each field include:

- labor time (in hours) by operation and age/sex category of worker;
- amount of organic and chemical fertilizer applied;
- approximate seed rates;
- harvest off-take;
- field area.

Additional supplementary agronomic information is being obtained through interviews and field visits on all E35-1 plots, on local control plots with improved cultural practices, and on sorghum or millet control plots with traditional cultural practices. Sample yield plots are also being installed on this sub-set of survey fields as a check of harvest recall information. These data will be used later in combination with the flow data described above to explain production differentials among and between treatments.

PROFILE OF SAMPLE HOUSEHOLDS

The information already obtained in the first census questionaire provides a profile of the size and composition of sample households, as well as a preliminary picture of the dominant cropping patterns in the central region of Upper Volta. Since the sample contains an approximately equal number of handtool and animal traction (A.T.) farmers, the data also permit comparisons of farm unit characteristics across these two technologies.

Utilization of Animal Traction Equipment

Among the sample of 44 farm units, 23 units currently possess A.T. equipment. This rate is believed to be substantially higher than the population in the two study villages. The types of equipment owned by sample farmers and the operations performed are shown in Table 1. The majority of equipment is donkey-drawn, with only two farmers in possession of an oxen-powered plow. Two farmers own only donkey carts without field cultivation equipment. Among the 21 farmers with either an oxen plow or houe manga capable of preplanting soil preparation, 18 planned to plow at least one of their fields. Farmers reported they most frequently plow their groundnut, white sorghum, and millet fields, in that order.

Table 1. Animal traction ownership and usage among 44 sample households.

Number of Households Owning Animal Traction Equipment, by Type				Number of Households Planning to Use Animal Traction Equipment, by Operation				
Plow	Houe Manga	Weeder	Cart	Plowing	Ridging	Scarifi-cation	Weeding	Transport
2	19	17	15	18	1	13	11	13

It is important to note that only half of the A.T. farmers intended to weed with animal-drawn equipment, and a somewhat larger number planned a preplanting scarification. Until field areas are measured it is not possible to calculate the area of fields on which these operations are performed. However, the impression is that scarification is the most important operation in terms of field area.

Demographic Structure

Sampling units in the survey are farm families or menages. These have been defined as those members of a family who work together and who prepare their meals together drawing from a common food source. Table 2 summarizes the size and composition of sampled households, divided into handtool and A.T. units. The data show that A.T. families are approximately 20% larger on average than handtool units, and have a slightly less favorable dependency ratio (i.e. the ratio of nonactives to total family size as determined by age). The latter is explained primarily by the greater number of children under the age of 10 in A.T. families. The differences in dependency ratio imply a slightly greater consumption requirement per A.T. active, which may contribute in part to the adoption of labor augmenting A.T. equipment.

The data also indicate that household heads in A.T. families are older on average than those in handtool units and have more wives. These results suggest that households more advanced in their life-cycles and which have retained a larger work force, are more likely to have accumulated sufficient capital to invest in A.T. equipment. Thus, among the ten households in the sample with aged heads (50 years plus) and greater than the average number of members (11 or more), eight have adopted A.T. equipment.

Table 2. Demographic structure of handtool and animal traction households

Type of Household	Average No. of household members[a]	Composition of Family: % less than 10 years	Composition of Family: % 60 years or more	Composition of Family: Total % young and old	Age of Household Head: Average[a]	Age of Household Head: % less than 40 years	Age of Household Head: % 60 years or more	Number of Wives of Head: Average[a]	Number of Wives of Head: % of households with 1 wife	Number of Wives of Head: % of households with 2 wives	Number of Wives of Head: % of households with 3 or more
Handtool	9/28[b] (3/52)	37/9	6/7	44/6	46/04[c] (11/39)	23/8	9/5	1/66[c] (1/06)	42/9	23/8	23/8[d]
Animal Traction	11/04[b] (4/20)	40/9	6/3	47/2	49/73[c] (10/32)	17/4	17/4	2/08[c] (1/12)	43/5	17/4	39/1
Total	10/20 (3/95)	39/6	6/5	46/1	47/97 (10/88)	20/5	13/6	1/88 (1/10)	43/2	20/5	21/8

[a]Standard deviation is in parentheses

[b]Not significantly different at 15% level using two-tailed student's t-test, D.F. = 42

[c]Significantly different at 15% level using two-tailed student's t-test, D.F. = 42

[d]Percentages do not sum to 100 due to 2 bachelor heads of household.

While those preliminary results suggest several hypotheses relating family structure, investment capacity, and A.T. adoption, further in-depth interviews will be conducted to determine more precisely the circumstances of past adoption. A survey of wealth indicators will also be conducted to determine variation between A.T. and handtool units which could further indicate wealth-biased adoption patterns.

Cropping Patterns

Table 3 presents the distribution of fields to be planted to each of the major crops and crop associations (those with at least five observations) segregated by A.T. and handtool households. Because the results are based on numbers of fields and not field area, the conclusions to be drawn should be considered tentative and must await area measurements for verification.

The largest numbers of fields identified are, in order of magnitude, groundnut, bambara nut, gombo, and the mixture millet/cowpea. Although 71% of the fields are planted in pure stands, this statistic is dominated by groundnut, bambara, gombo, and sorrel--crops that are typically planted in very small parcels. When these fields are excluded, only 29% of the fields are planted sole. It should be noted that the majority of sorghum and millet fields (more than 80%) are sown to mixtures, most commonly with cowpea as the principal intercrop. In contrast groundnut is nearly always planted in pure stands.

The data also reflect substantial field fragmentation, with the average farm unit clutivating more than 16 distinct fields. The degree of fragmentation and number of fields can be explained by several factors:

Table 3. Distribution of fields planted to major crops among handtool and animal traction households

CROPS	HANDTOOL HOUSEHOLDS		ANIMAL TRACTION HOUSEHOLDS		TOTAL	
	Ave. no.of fields per household	Households planting at least one field	Ave. no.of fields per household	Households planting at least one field	Ave. no.of fields per household	Households planting at least one field
SOLE CROPPED						
Millet	0/24	4	0/39	5	0/32	9
Red Sorghum	0/24	5	0/26	6	0/25	11
White Sorghum	0/19	4	0/26	3	0/22	7
Maize	0/66	14	0/65	13	0/66	27
Groundnut	4/42	21	3/96	23	4/18	44
Bambara Nuts	2/29	21	2/52	23	2/41	44
Cowpea	0/14	2	0/13	3	0/14	5
Okra	1/76	20	2/57	22	2/18	42
Sorrel	1/14	12	0/87	11	1/00	23
Others[a]	0/19	3	0/52	8	0/36	11
INTERCROPPED						
Millet/Cowpea	1/52	13	1/35	14	1/43	27
Millet/Cowpea/Sorrel	0/81	8	0/87	11	0/84	19
Red Sorghum/Cowpea	0/76	11	0/65	13	0/70	24
R.Sorghum/Cowpea/Sorrel	-	-	0/22	5	0/11	5
White Sorghum/Cowpea	0/43	8	0/70	11	0/57	19
Others[b]	0/86	21	1/14	23	1/01	44
Total number of fields per household	15/66		17/04		16/39	
% Fields sole cropped	71/8		71/3		71/5	
% Fields sole cereals	8/5		12/2		10/4	
% Fields sole legumes	44/0		38/6		41/2	
% Fields intercropped with cereal base	25/0		27/7		26/4	
Number of households	21		23		44	

[a] Handtool households: Rice(2), Sesame(2), Number of fields is in parenthesis.
Animal traction households: Soybean(4), Sesame (2), Eggplant (2), Rice (4).

[b] Handtool households: Maize/R.Sorghum/W.Sorghum(1), Millet/Sorrel(2), R.Sorghum/Sorrel(2), Groundnut/Bambara nut(1), Maize/Okra(1), Maize/R.Sorghum(3), W.Sorghum/Cowpea/Sorrel (3), Okra/Sorrel(1), Okra/Cowpea(2), Sesame/Cowpea(1), Tobacco/Sweet potatoes/Tomatoes(1).
Animal traction households: Millet/Sorrel(2), R.Sorghum/Sorrel(1), Groundnut/Bambara nut/Maize/Okra(3), Maize/R.Sorghum(1), Maize/W.Sorghum(3), Maize/Leaves for Sauce(3), Maize/R.Sorghum/Leaves for sauce(2) Bambara/Sorrel(1), R.Sorghum/Cowpea/Rice(1), Maize/R.Sorghum/Tobacco(1), Groundnut/Sorrel(1), Sesame/Cowpea(1).

1. the wide variety of crops produced (a diversification strategy based on consumption objectives and risk avoidance);
2. substantial micro-variations in soil quality;
3. internal fragmentation of decision-making between family fields farmed in common and private fields farmed by individual household members.

While A.T. families farm nearly two more fields than handtool farmers, the difference is not significant.[1] That is, there is no evidence in these results to suggest an area expansion effect attributable to A.T. Rather, the slightly larger number of fields can be explained by the greater number of active members in A.T. families; for example, the average number of fields per active member (all between 10 and 60 years of age) is 2.9 for A.T. families compared with 3.0 for handtool families.

Similarly, the number of fields planted to the major crops reflect no important differences in cropping patterns across technologies, either with respect to the specific crops sown or with respect to the relative importance of sole cropped and mix cropped fields. The close similarity of cropping patterns suggests either that use of animal traction at observed levels does not significantly change factor requirements for the major crops examined and/or that consumption/production objectives are sufficiently homogeneous and inflexible to preclude major changes in crop mix. It must be reemphasized, however, that one can not draw final conclusions on cropping patterns on the basis of the available field counts alone.

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[1] At the 15% level of significance using a two-tailed student's t-test.

Crop Emphasis by Sex

The distribution of fields by sex of the principal cultivator presented in Table 4, underlines the substantial sexual specialization characteristic of the Mossi farm households. Males cultivate the dominant proportion of cereal fields, whereas women emphasize the condiments and cash crops, cultivating more than 60% of the fields planted to groundnut, bambara nuts, okra, and sorrel. The importance of considering sexual differences in the design of extension programs, particularly with regard to groundnut, is clear. Moreover, how the differential investment capability of males and females, their labor availability, and their access to manure affect crop productivity and capacity for technical change in specific crops are subjects for closer examination in the village studies.

Distribution of Fields by Location

The location of fields with respect to the farmhouse can affect crop management in several ways. Fields immediately adjacent to the concession would be expected to receive the largest quantity of organic manures and, due to lower travel time, a greater degree of management attention. Thus one could tentatively hypothesize that more intensive crops would be disproportionately located nearer the house. Fields located at some distance from the village would be expected to receive less labor input and management attention but may, on the other hand, be characterized by a higher level of inherent fertility due to more recent fallowing. Finally, fields located near the village might be expected to receive an intermediate level of labor and manure inputs, but the soils would be expected to be of low fertility due to continuous cultivation.

Table 4. Fields planted to each major crop by sex of principal culti

Crops	Sex of Principal Cultivator		Number of fields
	Men	Women	
	%	%	
Sole Cropped			
Millet	86	14	14
Red Sorghum	100	-	11
White Sorghum	69	31	10
Maize	100	-	29
Groundnut	40	60	184
Bambara Nuts	19	81	106
Cowpea	84	16	6
Okra	2	98	96
Sorrel	2	98	44
Others[a]	100	-	16
INTERCROPPED			
Millet/Cowpea	76	24	63
Millet/Cowpea/Sorrel	68	32	37
Red Sorghum/Cowpea	87	13	31
Red Sorghum/Cowpea/Sorrel	79	21	5
White Sorghum/Cowpea	100	-	25
Others[a]	58	42	44
Total	47	53	721

[a]See footnote to Table 3 for list of crops.

Table 5 presents a breakdown of fields by location among A.T. and handtool farms. The results indicate that A.T. farmers control a substantially greater proportion of fields (68% compared with 48%) hypothesized to have higher fertility - i.e., those adjacent to the concession and outside the village. It is clear that this factor must be considered in making productivity comparisons between A.T. and handtool farmers.

Among crops, the only consistent locational pattern concerns maize, a crop highly responsive to fertile soils, which is concentrated almost exclusively adjacent to the concession. The data do not show a consistent relation between field location and whether crops are planted sole or in mixtures. Among handtool farmers, sole fields are more frequently located in the bush, with the opposite pattern evident for A.T. farmers. Reasons for this difference are not clear.

Finally it is significant that the majority of fields farmers intend to plant but for which land is not yet located involve groundnut, bambara, and okra. This suggests that first priority in field selection is given to the food grains with area expansion occuring, as resources permit, primarily for the cash crops and condiments.

Summary

Although the results presented in this report are preliminary and based solely on census information, they contain important suggestions for research. These will help focus the more in-depth analysis as the intensive flow data become available.

Table 5. Percentage of fields planted to each major crop by location of field.

CROPS	HANDTOOL HOUSEHOLDS				ANIMAL TRACTION HOUSEHOLDS				TOTAL			
	Next to house	In village	In bush	Not identified[a]	Next to house	In village	In bush	Not identified[a]	Next to house	In village	In bush	Not identified[a]
SOLE CROPPED												
Millet	50	25	25	-	50	30	20	-	50	29	21	-
Red Sorghum	50	50	-	-	25	50	25	-	38	50	12	-
White Sorghum	33	-	33	33	67	-	33	-	50	-	33	17
Maize	85	8	-	7	92	8	-	-	88	8	-	4
Groundnut	15	29	26	30	25	13	27	35	20	21	27	32
Bambara Nuts	13	35	23	29	19	26	28	26	16	30	26	27
Cowpea	-	67	23	-	-	50	50	-	-	60	40	-
Okra	32	50	18	-	35	24	32	9	34	34	26	5
Sorrel	20	56	24	-	46	18	18	18	32	38	21	9
Others[b]	17	50	17	17	13	73	14	0	14	67	14	5
INTERCROPPED												
Millet/Cowpea	30	52	18	-	25	36	39	-	28	44	28	-
Millet/Cowpea/Sorrel	29	65	6	-	32	18	50	-	31	38	31	-
Red Sorghum/Cowpea	40	40	20	-	33	20	47	-	37	30	33	-
R.Sorghum/Cowpea/Sorrel	100	-	-	-	57	-	43	-	63	-	37	-
White Sorghim/Cowpea	40	40	20	-	33	20	47	-	43	28	29	-
Others[b]	60	35	5	-	58	11	31	-	63	22	15	-
Total (%)	28	39	20	13	39	21	29	11	34	29	24	12
% Planted sole	58	64	80	100	68	75	62	100	63	68	66	100
% Planted in Mixtures	42	36	20	-	32	25	38	-	37	32	34	-
Average number fields per household	4/38	6/14	3/04	2/04	6/56	3/60	4/26	1/86	5/52	4/81	4	1/95

[a]Location of field not yet identified.

[b]See footnote to Table 3 for list of crops.

1. The reasons for and results of the high degree of fragmentation in cereal crop production require closer examination. It is necessary to determine how soil type variation is incorporated into farmers' planting strategies and whether local varietal distinctions play a role in the observed fragmentation. The implications for improved varietal development are clear. Inheritance, land tenure, and the cost of travel time as limits to the application of animal traction also require investigation.

2. The dominance of intercrops in traditional cereal production once again emphasizes the need to better understand both agronomic and economic relations in intercrop systems. It also underscores the necessity of explicitly considering how varieties perform with leguminous intercrops in the selection and development of improved sorghums and millets. Observed practices suggest that intercropping with legumes may be a more adaptable means of maintaining soil fertility than, for example, systems of cereal-legume rotation.

3. The results regarding crop specialization by sex appears to justify the current emphasis on males in cereal extension programs, but suggests the need for distinct approaches for groundnut. It seems clear that technological advances in specific crops would lead to a redistribution of income, and possibly labor, between men and women. This redistribution warrants some consideration in further studies.

4. The determinants of animal traction adoption are not well understood. This subject takes on additional priority if improved varieties being developed by ICRISAT crop improvement programs are found to be highly responsive to soil preparation adequately achieved only with animal traction.

5. The effects of animal traction with respect to productivity, labor use, and area expansion under farmers' conditions is not clear. The preliminary evidence in this report suggests that if existing equipment is used primarily for scarification and shallow plowing, operations not normally performed by handtool farmers, animal traction would not be labor saving and thus little or no area expansion would be expected. The stability of cropping patterns between animal traction and handtool farmers supports this interpretation. Whether this level of tillage has important yield effects on farmers' fields also has yet to be determined. Finally, evidence suggesting that animal traction farmers may be farming soils of higher quality makes it imperative to take explicit account of soil quality variation in the productivity analysis and to explore reasons for the differences in access to fields by location.

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