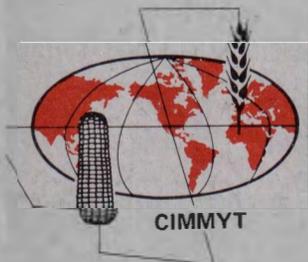


MAIZE PRODUCTION PATTERNS  
IN SOUTHERN ZAIRE

Mbuki Mwamufiya  
&  
James B. Fitch



CENTRO INTERNACIONAL DE MEJORAMIENTO DE MAIZ Y TRIGO

INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER

México

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For more than a decade, Zaire's maize production has not increased fast enough to supply rapidly increasing domestic demand. The result has been a sharp increase in maize imports, 1/ and this in turn has pinched already limited sources of foreign exchange.

In an effort to increase understanding of Zaire's maize production system, this paper focuses on describing certain maize production practices in the south-central part of the country. Observations and data presented here are based on field research undertaken by Mwamufiya in 1974 and 1975, in conjunction with Zaire's national maize program. 2/ This research included a survey of 299 producers from four adjacent districts. Three of these districts, Mwene-Ditu, Gandajika, and Tshilenge, are in the region of Kasai Oriental, while Kaniama, the fourth, is in the region of Shaba (Map. 1).

The first part of this paper focuses on describing overall cropping patterns of farms in the survey area and shows how maize production fits into this scheme. Maize planting practices are then described, together with a description of seed origin, seed protection, and fertilization procedures. Related aspects of labor use and

1/ For details on production and imports since 1950, see Mwamufiya and Fitch 2/.

2/ Mwamufiya's Ph.D. dissertation 1/ provides a more complete description of the study and resultant findings.

maize marketing and distribution have been treated in previous reports [2,3].

### Cropping Patterns

The study area lies between six and seven degrees south of the equator. The soils are primarily red, ocre-red, and yellow latosols. Shifting cultivation is practiced. Plots are used for periods of four or five years, according to farmers and village officials in the area. Then they are abandoned to fallow for four or more years. In the more densely populated regions the length of time under cultivation is increasing and the duration of fallow is decreasing. 3/

Agriculture in the area depends almost entirely on natural rainfall, which averages between 1200 and 1600 mm per year. There are two distinct rainy seasons and two dry seasons. Heavy rains last from late August through January, followed by a short dry period of about 15 days. A second period of rains sets in and lasts until early May, when a longer dry period begins.

Total area cropped averages only 1.59 hectares per farm family for the entire crop year, over all districts surveyed. Farm size and percentage of land area devoted to each of the seasonal crops in each district are shown in Table 1. The predominant crops are maize and cassava, with the latter dominating. Over the entire survey area, farmers were found to devote about two-thirds more land to cassava sown alone than to maize alone. However, some of the cassava reported under pure cassava stands during the survey period was actually cassava which had been interplanted with other crops during the preceding crop year. On a weight basis, the difference between maize and cassava production is more substantial than indicated by acreage. Government statistics for the three Kasai Oriental Districts estimate maize production to have been 28,000 tons during the 1971-72 and 1972-73 crop years, compared to some 600,000 tons of cassava. Other crops grown in the area include beans, ground nuts, cotton, and tobacco.

Table 1 shows that inter-cropping is very important in the survey area. On average, just over 20 percent of the land area is devoted to inter-crop combinations, and maize is a component of each of these. Maize sown alone accounts for some 22 percent. Inter-planting of maize with other crops

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3/ Just under 70 percent of the lands cropped in the survey area are common lands owned by the extended village family or clan. 22 percent are under government ownership, with the remainder falling under various categories of private property.

Table 1. Percent of land devoted to each crop, total area cropped\* in 1974-75, and sample size, by district.

Crop	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
	Percent of total area in crop			
Maize	23.0	20.8	26.1	16.2
Maize-cassava	10.5	6.1	14.8	15.4
Maize-bean	5.5	4.7	1.9	4.8
Maize-cassava-bean	1.7	0.2	0.5	2.3
Maize-cassava-ground nut	1.0	9.5	2.3	1.0
Cassava	42.5	35.9	32.0	31.2
Cotton	1.8	14.5	13.3	14.4
Tobacco	5.9	0.0	0.0	0.0
Ground nuts	0.4	0.5	6.0	5.7
Beans	0.2	1.4	1.0	3.1
Other crops	7.4	6.4	2.3	6.0
Average total area cropped (ha)	1.82	1.58	1.64	1.45
Sample size	108	67	68	56

\* Includes area cropped during the entire crop year 1974-75, and often includes acreage from two crops, especially in the case of maize. In many cases, land devoted to cassava was planted during the previous crop year.

is common in most parts of Zaire. While a government study in 1970 indicated that from 80 to 90 percent of the land planted to maize in the survey area was inter-cropped, <sup>4/</sup> the figures from Table 1 indicate that less than 50 percent of the area planted to maize was inter-cropped in 1974 and 1975. This suggests that, for the survey area at least, maize inter-cropping is less important than was previously thought.

<sup>4/</sup> The Department of Agriculture study <sup>5/</sup> showed that 81 percent of the maize land in the Kabinda sub-region of Kasai Oriental was inter-cropped in 1970, with the corresponding figure being 92 percent for the Haut-Lomami sub-region of Shaba. Since the 1974-75 study described here did not cover these two regions in their entirety, however, the figures may not be directly comparable to results of the present survey.

Two government-sponsored production programs affect cropping patterns in the survey area. In Kaniama, 29 percent of the farmers surveyed were enrolled in the TABAZAIRE program, designed to stimulate the production of tobacco, whereas 23 percent of the farmers in the three Kasai Oriental districts were enrolled in CAKO, a cotton production program. These affiliations serve to explain some of the differences in district cropping patterns shown in Table 1. Participants in these programs receive advice from extension agents, access to tractor plowing services for land devoted to the specialty crop itself, and they can purchase certain specialized inputs through the administrative agencies. Association with these programs is known to influence maize production patterns. Regression analysis described in a previous report /3/ showed that affiliation with TABAZAIRE had a significantly negative impact on the amount of land which farmers in Kaniama planted to maize.

#### Cropping Intensity and Rotation Patterns

Ecological conditions permit the planting of two crops of maize each year throughout the survey region. The first crop is planted with the onset of the first rainy period, during August, September, or October, depending upon the particular weather pattern of the district; the second crop is planted in January or February, to coincide with the second rainy period.

While 98 percent of the farmers interviewed planted first-crop maize during 1974-75, only 57 percent reported that they typically plant a second crop. Planting and harvesting other crops can interfere with getting a second crop of maize planted. In Kasai Oriental, there are government regulations which make the planting of certain acreages of cotton mandatory. These regulations are rigorously enforced by officials in Gandajika and Mwene-Ditu, and less than 45 percent of the farmers in these two districts reported that they plant second crops of maize. The corresponding figures for Kaniama and Tshilenge --where such regulations did not exist or were not enforced-- were both above 65 percent.

Table 2 shows that maize is consistently rotated more with maize itself and cassava than with any other crop. For farmers under TABAZAIRE program, maize is frequently planted following a tobacco crop. In the three Kasai Oriental districts, where CAKO operates and where mandatory cotton acreages are imposed, maize frequently follows cotton. Only 12 percent of all farmers surveyed reported planting maize on plots which had not been cropped the previous season.

Table 2. Percentage distribution of crops that preceded maize a/ on plots planted in 1974-75, by district.

Crop	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Maize	16.2	12.2	11.7	15.2
Cassava	12.0	13.4	12.6	18.2
Tobacco	16.2 <sup>b/</sup>	0	0	0
Beans	4.2	2.4	1.9	6.1
Cotton	5.4	17.1 <sup>c/</sup>	27.2 <sup>c/</sup>	13.6 <sup>c/</sup>
Maize & beans	12.6	3.7	8.7	4.5
Maize & cassava	9.6	15.9	11.7	7.6
Maize, cassava & ground nuts	1.8	4.9	2.9	4.5
Maize, cassava & beans	1.8	1.2	3.9	6.1
Other crops <u>d/</u>	6.4	10.9	12.6	21.8
No crop on land	13.8	18.3	6.8	3.0

a/ Includes plots interplanted with other crops.

b/ Figure strongly influenced by tobacco growers under TABAZAIRE program

c/ Figure heavily influenced by cotton growers under the CAKO program.

d/ Made up of a variety of minor crops and crop groupings, no one of which accounted for more than 4 percent of the cases reported.

### Planting Maize

The timing of planting maize and the way it is planted in association with other crops can be expected to affect yields. As noted above, the timing of maize planting is geared to rainfall patterns. The survey clearly established that the great majority of farmers plant maize during the period immediately following the onset of the rainy season (Table 3).

Table 3. Relationship of maize planting time to the first rainfall, percent of farmers reporting, by district.

Period of planting	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Before first rains	8.5	4.5	8.1	5.5
Immediately after first rains	76.4	79.1	58.1	74.6
Long after the first rains	15.1	16.4	31.1	20.0

As Table 1 demonstrated, maize is interplanted with other crops about as frequently as it is planted alone. However, it is not always planted at the same time as the other crops. Table 4 indicates when maize is planted in a maize-cassava association. An interdistrict comparison of the responses shows a contrast between Kaniama on one hand, and Tshilenge, Gandajika, and Mwene-Ditu, on the other hand. In Kaniama, 53 percent of the farmers plant maize and cassava simultaneously, but some 48 percent of the farmers in the other three districts (Kasai Oriental) plant maize more than two weeks before planting cassava.

Table 4. Timing of maize planting when intercropped with cassava, percent of respondents reporting by district.

Maize planting time relative to that of cassava	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
More than 2 weeks before	6	41	56	45
During 1st and 2nd week before	22	18	6	13
Simultaneously	53	9	0	0
During 1st & 2nd week after	4	20	15	21
More than 2 weeks after	3	9	10	17
Don't know /don't plant both together	12	3	13	4

Similarly, the timing for the insertion of maize in a maize-bean association (Table 5) shows a contrast between Kaniama and the Kasai Oriental districts, with 90 percent of the farmers in Kaniama planting maize and beans simultaneously. There appears to be no strong pattern in the Kasai Oriental, although slightly more farmers plant maize after beans than before.

Table 5. Timing of maize planting where intercropped with beans, percent of respondents reporting by district.

Maize planting time relative to that of beans	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
More than 2 weeks before	1	8	25	8
During 1st & 2nd week before	0	18	20	26
Simultaneously	90	36	12	21
During 1st & 2nd week after	3	24	22	28
More than 2 weeks after	0	6	9	13
Don't know/don't plant both together	6	8	12	4

The reasons for the differences between Kaniama and the other three districts are not fully known. Differences in the ethnic backgrounds of the inhabitants may provide some explanation. <sup>5/</sup> The larger areas cropped per farm in Kaniama apparently place heavier burdens on available labor <sup>[3]</sup>. Thus, Kaniama farmers may opt to plant corn simultaneously with other crops when interplanting, in order to save labor.

Large time lags between initiation and completion of maize planting, and planting too long after the rains have started, may have negative effects on yields, due to associated pest and plant disease problems. Table 6 shows that 80 percent of the farmers in the three Kasai Oriental districts start and complete planting within a week's time. On the other hand, 68 percent of the Kaniama farmers take more than a week. The greater length of time required in Kaniama may also be associated with the labor constraint cited above.

<sup>5/</sup> The three southern Kasai Oriental districts are occupied mainly by Baluba-Kasai and Bena Kanioka people. Kaniama is inhabited by a greater mixture of groups, including Baluba-Kasai, Baluba-Shaba, Kalundwa, Tshokwe, and Karund peoples.

Table 6. Length of maize planting period, percent of farmers reporting by district.

Number of days between the first and last day of planting	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
1 - 3	7	36	44	34
4 - 7	19	38	35	55
8 - 14	32	14	9	7
15 - 22	15	2	3	0
23 - 30	21	4	5	2
Don't know	6	6	4	2

A separate comparison was made between those farmers operating under the government-sponsored programs for producing cotton or tobacco and farmers not associated with these programs. Even where there were no significant differences in area devoted to maize, farmers under the government programs were found to finish planting within a shorter time period. This may have been due to technical advice about the importance of timeliness in planting which farmers in the government programs receive. Even though government tractor services are not provided for maize in these programs, previous plowing for the specialty crops also may make the ground quicker and easier to work.

The predominant technique for preparing seedbeds and tilling soils in maize cultivation entails the use of the manually-operated hoe. Of the farmers interviewed, 93 percent reported total reliance on hoe cultivation, whereas 5 percent reported the use of a tractor or tractor-hoe combination. There was no reported use of animal traction for maize cultivation in the survey area.

Seventeen measurements were taken at random throughout the survey area, to determine the density of planting. Where maize is planted alone, seed hills are set an average of 100 cm apart, with 100 cm spacing between rows. For intercropping, seed holes were typically set at about 160 cm apart, with row spacing remaining unchanged. Assuming an average of three plants per hill --which is optimistic, in view of the quality of most seed-- this would indicate 30,000 plants per ha for maize planted alone, and 18,750 plants per ha for maize which is interplanted. These figures compare with the 50,000 plant per ha density recommended by Programme Nationale Mais [4, p. 317].

## Seed Varieties and Seed Protection

Farmers of the study area use a number of seed varieties which are generally called "local varieties". For the 1974-1975 season, about 90 percent of the farmers interviewed planted local varieties of maize and the remaining 10 percent planted the GPS3 (Gandajika Population Synthetic), GPS4, and the Salongo variety (Mexican Tuxpeño 1) provided by the Institut National des Recherches Agronomiques (INERA) and Programme Nationale Mais (PNM).

Many current local varieties used in the study area have evolved from improved varieties which were introduced by the Institut National pour l'Etude Agronomique du Congo Belge (INEAC) between 1933 and 1960. The supply of improved seeds, which declined gradually in the 1960's, has resumed on a smaller scale through the efforts of INERA and Programme Nationale Mais. Some farmers of the study area indicated that they preferred local varieties of maize to the new varieties provided by INERA and PNM which, according to these farmers, are less insect resistant in post harvest storage than local varieties.

Given the heavy reliance on locally grown seed, the selection, storage, and protection of seed are of great importance. Just under 80 percent of the farmers interviewed indicated that they do not select seeds until after harvest. The common practice is to draw good-looking and apparently well preserved ears from the family granary. Only rarely are special provisions made for storing seed maize.

The most typical storage location was reported to be in the attic of the house; 45 percent of the respondents reported this practice. Only 17 percent reported storage by hanging maize in the warmth and smoke above the fireplace, whereas 35 percent reported the use of separate granaries which are usually made of mud.

Over 60 percent of the farmers surveyed acknowledged "heavy" insect damage in storage. Damage results from excessive moisture in the grain, and from rats and weevils. Thirty percent of those interviewed reported taking no action against rats and insects, whereas 35 percent indicated use of rat traps. Less than two percent reported the use of DDT or fumigants.

## Use of Modern Inputs

The survey disclosed relatively little use of modern chemical inputs in maize production. As shown in Table 7, only about 2 percent of the farmers interviewed reported use of insecticides on maize. An equally low percentage use chemical fertilizer on their maize.

Table 7. Use of insecticides, chemical fertilizers, and green manure, percent of farmers reporting by district.

Practice	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Use insecticides on maize	3	0	2	2
Use chemical fertilizer on maize	1	2	6	0
Have experience using fertilizer on crops other than maize	38	34	48	29
Bury ashes and grass for green manure on maize	54	15	35	15

Fertilizer and insecticides are generally not available except for the production of cotton and tobacco under the government programmes. And, even for these crops, the supply of fertilizer is often irregular and unreliable. The survey indicated that 38 percent of the farmers had used fertilizer at one time or another on crops other than maize. This included 77 percent of those participating in the government-sponsored cotton and tobacco programs, compared to only 24 percent among non-participants. Many farmers do adhere to the established practice of burying ashes and green grass or weeds in maize plots as a means of fertilization. Over all districts, 34 percent of the farmers surveyed followed that practice.

#### Extension Information

More than half of the farmers interviewed had been visited by an extension agent (moniteur agricole) in 1973-1974 (Table 8). As would be expected, farmers enrolled in one of the special government production programs experienced a much higher incidence of visitation than those not enrolled. Extension advice is an integral part of these programs.

Table 8 indicates that relatively few farmers received extension agent advice on maize production. Again, however, affiliates of the government programs received more advice, even though these programs emphasize the production of crops other than maize.

Table 8. Percentage of farmers receiving extension agent visitations and advice on maize production, 1973-1974, by district and program affiliation.

	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Received extension agent visit:				
Affiliate of government program <u>a/</u>	77	100	95	85
Non-affiliate	34	38	63	56
Received advice from agent of maize production:				
Affiliate of government program	13	0	26	39
Non-affiliate	8	4	22	7

a/ Enrolled in CAKO or TABAZAIRE.

### Summary

Farmers in the south-central area of Zaire, surveyed for this study, practice shifting cultivation. Maize is second in importance to cassava production, not only in terms of the total weight of the crop, but also in terms of area planted. Maize interplanted with other crops --cassava, beans, and ground nuts-- occupies just about as much land as does maize planted alone. Nevertheless, this degree of intercropping appears to be much lower than a previous study had reported for the area. Over half of the farmers surveyed reported planting two crops of maize per year.

A large majority of the farmers interviewed reported total reliance on hoe cultivation, whereas only a few reported the use of tractor services, and no use of draft animals was encountered.

Very few farmers reported the use of new or improved maize seed varieties. Rather, the vast majority still secure seed from their own household stocks of maize, saved from the previous harvest. Relatively few farmers take special precautions to protect their seed from moisture, insects, or other hazards.

Very few farmers reported using chemical fertilizer or insecticide for their maize crop. The supply of these inputs in the survey area is quite unreliable.

Many of the farmers surveyed are affiliated with special government programs to produce tobacco (the TABAZAIRE program) and cotton (CAKO). On the one hand, these affiliations appear to reduce farmers' maize production efforts due to the added labor requirements for the specialty crop. On the other hand, affiliates do report receiving more extension agent advice on maize production than non-affiliates, and they also were found to be more timely in completing the planting of maize.

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