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Title: MAIZE PRODUCTION AND MARKETING IN FOUR DISTRICTS OF ZAIRE: AN INTRODUCTORY ECONOMIC ANALYSIS

Abstract approved: James Fitch

In recent years Zaire has changed from a net exporter to a net importer of maize. Four districts of South Central Zaire were selected to investigate factors which limit the production and the supply of marketed maize grain in Zaire.

Farmers in this area were interviewed to collect data on the number of crops planted, the peak periods for agricultural operation, the division of labor within the household and the labor force available for agricultural work. Survey procedures were also used to determine when and where farmers sell maize and who buys marketed maize. The effects on maize production of the policies of the central and regional governments were also investigated.

During the sixties and early seventies, national investment policy has heavily favored the urban based manufacturing and mining sectors, undoubtedly contributing to the fact that many Zairians

migrated from rural to urban areas. In the absence of a compensating increase in labor productivity, these migrations reduced agricultural output and the quantities of food crops sold, particularly, the quantity of maize delivered to urban markets.

At the producer's level, this study indicates that low maize production is a consequence of inadequate storage for seed and consumption maize. The use of seeds of low quality for germination combined with production practices that result in untimely planting, weeding and harvesting contribute to low maize yields.

This study also indicates that one of the factors which has contributed to limit the quantity of maize produced is a shortage of labor during peak periods of agricultural operations. Labor shortages exist because of the limited number of household members involved in agricultural work, and because of the division of labor in the household which assigns some agricultural tasks almost exclusively to women.

The study also indicates that the effectiveness of the marketing system in providing incentives for maize production has been limited by weak transportation and communication links between production and consumption centers and by efforts of some traders to gain oligopsonistic power in their relations with maize producers in the more isolated areas. This study also indicates that national price policies have negatively affected maize production. Other regional and local policies have served to restrict interregional trade.

The policy implications of this study suggest that a number of government programs may be helpful in increasing maize production and the supply of marketable surplus. These may include: (1) government information programs designed to improve maize storage, seed quality and the efficiency of the marketing system; (2) diffusion of information on the appropriate times for planting, weeding and harvesting maize; (3) further promotion of the technological package developed by Programme National Mais and the provision of inputs and incentives favorable to the adoption of this technology; (4) providing incentives for the promotion of a greater participation of all household members in agricultural production; and (5) some mechanical assistance for plowing such as is now provided by two government supervised production organizations, CAKO and TABAZAIRE. Indications from this study also suggest that a successful implementation of such programs would necissitate some reorganization of the extension service and diverting a larger share of government current and investment expenditures to agriculture.

Maize Production and Marketing in Four Districts of Zaire: An Introductory Economic Analysis

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Dean of Graduate School

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I. INTRODUCTION

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Economic development is a process by which a population increases the efficiency with which it provides desired goods and services, thereby increasing the per capita standard of living and general well being (53, p. 3). In this process of economic transformation, the role of agriculture is to provide food for rapidly growing urban populations, create a market for manufactured goods, generate foreign exchange earnings from export of crops and provide capital and labor for the growth of the non-agricultural sector. Thus, the overall goal of agricultural development is the increase of the well being of the society and, in particular, the improvement of the well being of the rural people and their greater integration in the decision making process of the nation.

In 1959, the population of Zaire was evaluated at about 14.0 million people, and it was increasing at a global rate of about 2.6% per year. Of the 1959 population, 78% lived in the rural area and derived their livelihood directly from agriculture. In 1970, the population of Zaire had risen to over 21.6 million people, growing at a global rate of 4.2% per year (10, pp. 29-38). Optimistic estimates of the 1970 Zairian population evaluated the rural population at 70% of the total (38). But pessimistic estimates, based on preliminary results of the 1970 census, evaluated the urban and semi-urban population at 46% of the Zairian population, and the strictly rural population at 54% (10, p. 40).

The process of transformation of dual economies such as described by Lewis (50) and Fei and Ranis (20) assumes that rural urban migrations adapt to the rate of growth of non-agricultural employment. On the basis of this assumption and given a country with an initial high proportion of its labor force in agriculture and a small growth rate of the non-agricultural sector these models often predict a long process of adaptation before the absolute share of agriculture in the total population reaches a maximum decline. In recent years countries such as Zaire have come to realize that other factors can accelerate immigration to urban areas and that the effect of such migrations can have a tremendous impact on agricultural production and economic development.

Agriculture, which accounted for 31.1% of the Gross Domestic Product (GDP) in 1960 (51), declined in relative importance to represent 17.3% of the GDP in 1973 (Table 1.1). In 1959, export revenues from agricultural products represented 39.2% of the

Table 1.1. Value added and gross domestic product.

	% of Gross Domestic Product						
Sector of Activity	1966	1967	1968	1969	1970	1971	1972
Production of Goods	36.0	36.7	45.8	44.7	42.3	36.1	35.0
Commercialized Agriculture	9.0	9.8	12.3	10.3	8.2	8.0	10.0
Mining and Metallurgy	17.7	18.1	25.3	26.3	15.8	14.7	14.3
Manufacturing	6.3	6.0	4.9	4.7	8.0	8.6	8.9
Construction	2.1	2.2	2.2	2.5	3.1	3.8	2.9
Energy	0.8	0.7	1.0	0.9	0.9	0.9	0.8
Services	43.9	45.2	35.9	37.4	42.6	48.4	50.5
Transportation and telecommunication	5.3	5.7	5.3	5.3	7.9	8.4	8.5
Commerce	13.4	12.8	11.3	11.9	12.0	13.8	14.8
Services	25.1	26.7	19.3	20.2	22.6	26.3	27.2
Goods and Services	80.0	81.9	81.7	82.1	84.8	84.5	85.5
Import Taxes	9.3	8.2	7.6	8.4	5.3	5.8	6.9
GDP at Market Price	89.2	90.2	89.3	90.5	90.2	90.3	91.4
Subsistence Agriculture	9.5	9.8	9.8	8.5	8.3	7.8	7.3
Subsistence Construction	1.3	--	0.9	1.0	1.6	1.9	1.5
GDP (10^6 Zaires)	304.8	460.1	728.5	902.4	962.8	1032.4	1140.8
Population (1000 people)	18290	19060	19860	20700	21690	22300	22910

Sources: (3, 4, 2, 96)

export earnings; in 1973 the agricultural share in export earnings had dropped to 15.1% (Table 1.2). An analysis of the Zairian situation indicates that the relative decline of agriculture in the economy can be partially attributed to: 1) the civil wars and the post independence political turmoils which accelerated the destruction of the production and marketing infrastructures for agricultural products, set up by the colonial administration; 2) the greater emphasis placed on the development of the mining, manufacturing and industrial sectors in the mid 1960's; and 3) a rapid rate of rural to urban migration over the 1960's period.

An economic survey of Zaire, in 1968, indicated that the economic activity in Zaire was largely concentrated in mining, manufacturing and commerce. Using 57% of the labor force, mining, metallurgy, manufacturing and transportation accounted for 79.5% of the value added, and distributed 61.2% of the salaries paid by the surveyed firms. With 30.4% of the labor force, agriculture accounted only for 4.58% of the value added and distributed 10.6% of the salaries. In terms of the regional distribution of the economic activity, the 1968 survey indicated that 59.96% of the 1134 firms surveyed were located in Kinshasa and Lubumbashi and accounted for 90.31% of the value added; these firms distributed 81.49% of the salaries to 56.84% of the sample labor force (78). The sectoral distribution of capital and investment promoted by such initiatives as

Table 1.2. Contribution of major crops to export revenue (%).

	Year											
Commodities	1958	1959	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Total exports	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Minerals	38.5	42.3	46.5	51.3	58.4	55.9	79.5	81.6	81.5	80.3	81.0	84.0
Agriculture	41.2	39.2	27.8	18.1	16.4	18.3	15.7	14.1	15.4	18.3	16.5	15.1
Palm Products	--	--	10.5	7.9	6.0	7.6	7.4	4.4	4.9	5.5	5.1	0.3
Coffee	--	--	6.3	9.6	3.7	5.9	4.1	3.7	5.9	7.0	8.1	7.2
Cocoa	--	--	0.7	0.3	0.7	0.6	0.5	0.4	0.4	0.4	0.3	0.3
Tea	--	--	0.5	0.5	0.6	0.3	0.4	0.3	0.4	0.5	0.7	0.4
Rubber	--	--	4.3	2.8	2.7	2.7	2.3	2.1	1.8	1.7	1.6	1.5
Timber Products	--	--	1.5	1.4	0.8	0.7	0.8	0.7	0.4	0.6	0.8	0.8

Source: (85, 86)

the creation of a new code of investment (77), the creation of the Societe de Financement du Development' (SOFIDE) (92), and a greater participation of public investment in the overall investment does not seem to have modified the trends set forth by the pre-1968 development. By 1973, of the investment generated by the 1969 Code des Investissements(77), only 0.3% was invested in agriculture (4, p. 91) and 66.2% of the accumulated private capital generated by the Code des Investissements was invested in Kinshasa and the southern part of the Shaba Region (4, p. 55). From 1968 to 1972 the share of agriculture in investment budget expenditures averaged only about 4.0% and the share of agriculture in current government budget expenditures averaged less than 1.0% of the total current expenditures (4, p. 141).

In response to political and socioeconomic changes, many Zairians migrated to the urban area where security was greater and the chance of obtaining a remunerated job was thought to be brighter (10, 47, 79). An analysis of the group of people who migrated to Kinshasa between 1960 and 1967 shows that 40% of the migrants were younger than 15 years of age, 20% between 15 and 20 and 40% over 20 years of age when they came to Kinshasa (79, pp. 1-80). Extended to other Zairian non-rural communities, the 1967 findings indicate that the seven years prior to 1967 changed drastically not only the composition of the non-rural areas, but also that of the rural areas from which migrants came. Between 1959 and 1970, large urban areas became larger (Table 1.3) and small communities such as Gandajika, in Kasai Oriental which had only 5000 in 1958 increased nearly to 60,000 people in 1970 (51, p. 6).

As a result of political and socio-economic changes in Zaire, salaried employment in agriculture declined from 1,008.1 thousands, in 1960 to 346.3 thousands in 1966 (38, 63, 64). The effects of these transformations on agriculture were two fold: on one hand the exodus of some traditional farmers and most plantation workers reduced agricultural output because withdrawal of labor from agriculture has taken place without a compensating increase in labor productivity, and, on the other hand, a large exodus of farmers and plantation workers increased the demand for staple food for the non-farming population. Between 1960 and 1966 agricultural production declined at an average annual rate of 3.6% (88). It is only in the late 1960's and early 1970's that agricultural production started rising to the 1959-1960 level of production (2, 3, 4, 38, 60, 39). Although subsistence agriculture which provides staple food to urban areas declined at a smaller rate than the plantation economy, between 1960 and 1966 (38), its recovery at a rate of about 1.23% per year between 1966 and 1971 (3, 38) could hardly keep pace with the

Table 1.3. Population and rate of growth by region and administrative unit.

			Average Annual Rate of Growth	
Regions and Administrative Units	1958	1970	Natural (expected)	Global (estimated)
Region of Shaba	1,654,176	2,753,714	3.1	4.5
City of Lubumbashi	168,775	318,000	4.6	5.7
City of Likasi	69,814	146,394	4.4	6.7
District of Tanganyika	442,716	696,363	3.5	4.0
District of Haut Lomami	363,446	602,368	2.5	4.5
District of Haut Shaba	268,944	394,316	3.5	3.4
District of Lualaba	340,481	596,273	1.8	5.0
Region of Kasai Occidental	1,246,455	2,433,861	1.7	6.0
City of Kannanga	107,346	428,960	3.4	12.7
District of Kasai	497,098	833,468	1.8	4.6
District of Lulua	642,011	1,171,433	1.4	5.4
Region of Kasai Oriental	912,178	1,872,231	2.3	6.3
City of Mbuji Mayi		256,154		
District of Kabinda	504,139	1,118,725	2.4	7.2
District of Sankuru	408,039	497,352	2.1	1.7
Kasai and Shaba	3,812,809	7,059,806	2.3	5.0
Zaire	13,540,182	20,705,834	2.3	4.2

Source: (3)

4.2% rate of population growth and the increasing phenomenon of urbanization.

The production of maize followed the pattern of declines and rises parallel to that of the entire agricultural sector. Table 1.4 indicates that it was not before 1969 that the quantity of maize produced in Zaire returned to the 1959 level of production. In Zaire, maize is produced for human consumption and for industrial uses in the production of beer and the manufacturing of food for livestock. Maize is the major cereal produced in Zaire in terms of the total area devoted to its production, relative to the area devoted to the production of other cereals (Table 1.5). A geographic distribution of maize production and consumption indicates that maize plays a greater relative importance in consumption patterns of the population of the Regions of Kasai Occidental, Kasai Oreintal and Shaba (Figure 1.1).

1.2. Identification of the Maize Problem

Behind the so called maize problem lies a general problem of basic food supply, particularly the supply of foodstuffs to urban areas. Under the present technological conditions of the rural areas and the pricing system of basic food products, the quantity of locally produced staple food is insufficient to meet the demand. Thus, several agricultural products exported before 1960 have been

Table 1.4. Maize production, import and export in Zaire, 1950-1974.

	Tons				
Year	Produced	Traded	Export	Import	Urban Demand
1950	336,635	68,000	17,748		50,252
1951	313,289	69,000	23,938		45,062
1952	305,640	55,000	207		54,793
1953	327,100	76,000	4,577		71,423
1954	321,670	80,000	20,443		59,557
1955	325,419	81,000	8,443		72,557
1956	315,245	103,000	2,984		100,015
1957	330,350	119,357	14,204		105,153
1958	320,222	115,751	15,119	718	101,350
1959	332,690	97,961	8,863	8,002	97,100
1960	--	--	--		
1961	250,000[a]	--	--		
1962	226,000[a]	--		38,837	--
1963	252,000[a]	--		81,888	--
1964	237,000[a]	--		73,356	--
1965	232,000[a]	--		45,144	--
1966	270,000[a]	--		74,355	--
1967	297,000[a]	--		68,632	--
1968	250,000[a]	103,000		57,677	160,677
1969	350,000[a]	100,000		69,600	169,600
1970	375,000[a]	90,000		87,500	177,500
1971	306,000[a]	130,000		106,962	236,962
1972	433,000[a]	135,000		108,450	243,450
1973	477,000[a]	114,480[b]		146,378	260,858
1974	524,000[a]	125,760[b]		170,000	295,760

Sources: (86, p. 55; 42, p. 58; 21-25; 16)

-: Information not available

[a] FAO estimate

[b] Our estimate

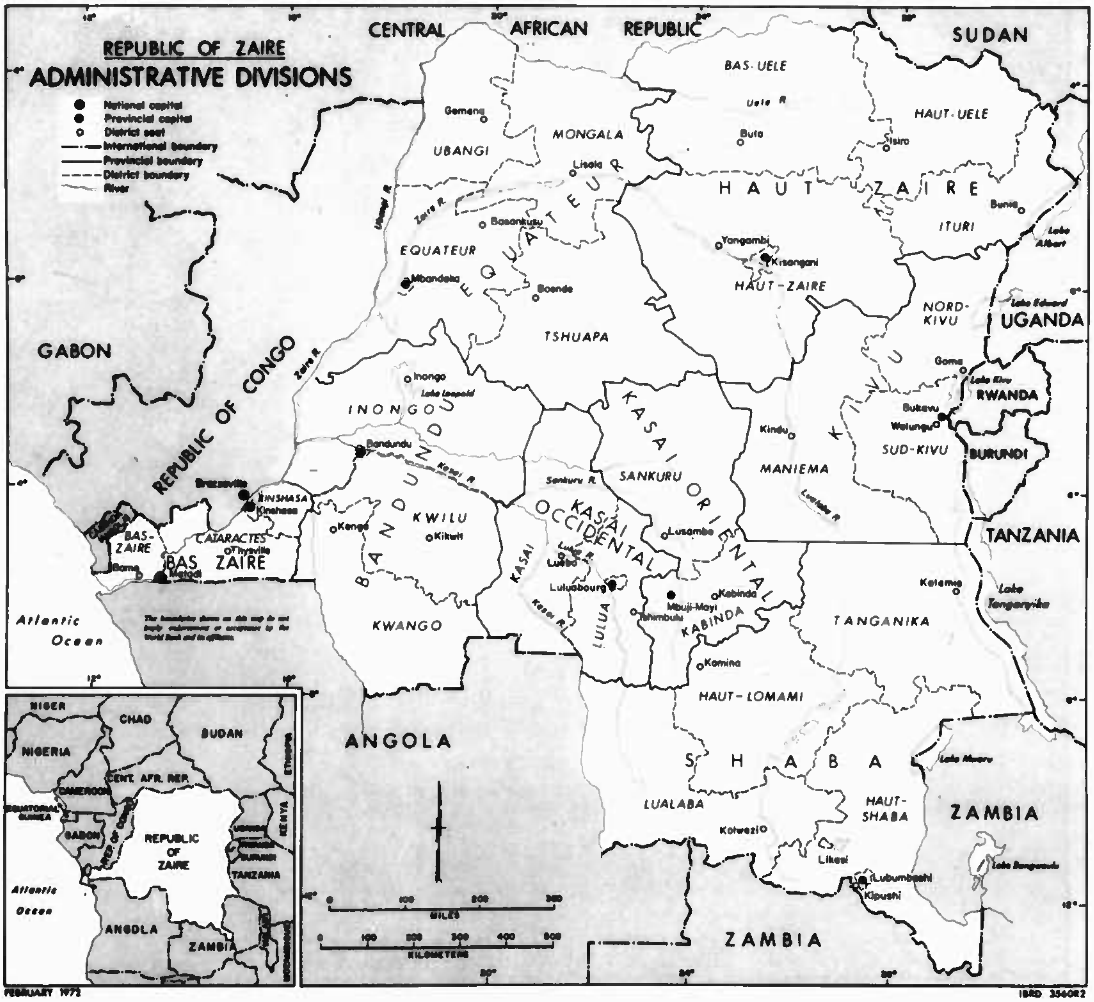
Table 1.5. Major crops produced in Zaire.

Crop	1948-52		1961-65		1970	
	Area (1000 ha.)	% of total cereal area	Area (1000 ha.)	% of total cereal area	Area (1000 ha.)	% of total cereal area
Cassava	655		668		800[a]	
Maize	337	57.9	266[a]	62.7	330[a]	64.9
Millet and Sorghum	90	15.5	53[a]	12.5	40[a]	7.8
Rice	151	25.9	102	24.1	135[a]	26.6
Groundnuts	250		222[a]		270[a]	
Cotton	333		97[b]		100[a]	
Wheat	4	0.69	3[a]	0.70	3[a]	0.60

Source: United Nations Food and Agriculture Organization. Production Yearbook, Vol. 25, Rome, 1971, cited by Linsenmeyer (51, p. 4).

[a] FAO estimate.

[b] Unofficial figures.



Source (38)

Figure 1.1. Republic of Zaire: Administrative divisions.

imported in recent years to meet the local demand (60, 85, 86). The exportation of Zairian maize which started in 1933, increased to a peak of 31 thousand tons in 1947 (51). But in 1959, with production increasing at a slow rate, the country had already started importing foreign maize to meet urban demands. By 1974, 170 thousand tons of maize were being imported from Zambia, Rhodesia, South Africa or Angola (54) and more than 57% of the maize supply to urban consumption centers was being imported from outside countries (Table 1.4).

Many reasons can be evoked to explain the shortage of the domestic staple food supply. First, the demand for food has increased as a result of a natural population growth. The demographic transformation of the 1960's, the concentration of investment and employment in urban areas (4, 63, 78), and the increase in per capita income for some segments of the society (64) increased the demand for higher quality staple foods. Higher wages for mining, manufacturing and industrial workers and employees induced changes in tastes and increased the demand for maize, rice and wheat products (Table 1.4; 38), particularly in urban areas.

A second reason for the development of food shortage in Zaire is the unbalanced policy for the development of the agricultural and non-agricultural sectors, before and after the 1960's. Before 1960 the emphasis put on the development of export crops and mining and manufacturing discriminated against the production of staple food (90); after 1960, the emphasis on the development of mining, metallurgy, manufacturing and the commercial sector discriminated against both the production of staple foods and of commercial crops. Partially in response to these changing economic forces and to the lack of profitable opportunities in the rural area, thousands of people, particularly the young with some elementary education, migrated to towns (10, 32, 79) at a rate higher than the rate of growth of employment of the non-agricultural sector. With staple food production being basically labor intensive under the traditional technology, the rural to urban migration (with no increase in the productivity of the traditional sector) reduced the total output of staple food and the capacity of the traditional agriculture, which produced most of the staple food, to feed growing urban areas.

A third cause of food shortages in Zaire is the deterioration of the production and marketing organizations set up by the colonial administration of the Belgian Congo. Seed degeneration, the deterioration of soil fertility and cultural practices reduced yield and the productivity of agriculture. The deterioration of the transportation and marketing networks reduced market transactions and forced some farmers to revert to subsistence production.

For some time, Zaire has relied on imports from world markets to meet its urban demand for basic food items. In recent years, the cost of imports of basic food and agricultural products has rapidly increased as a result of the energy crisis and the overall shortage of supply of food products for the world as a whole. The consequences of this price change have been to increase the foreign exchange expenditures for food products. In 1972, imports of cereals, fish and meat accounted for about 7.5% of the declared imports of goods and services (85, p. 82). In 1973, the same products accounted for 9.3% of the total value of imports (86, pp. 83-87). The average price of imported maize rose from U.S. $76.0 per ton in 1967 to U. S. $157.1 per ton in early 1975 (Table 1.6). In a country such as Zaire, with limited export revenues, the increase in the import of basic food products has restricted the capacity of growth of those essential projects which, in their initial phase of development, rely heavily on the availability of foreign exchange earnings. Thus, for the future development of Zaire, a reliable domestic source of food supply has become an issue of national priority.

Table 1.6. Import price per ton for maize delivered to the Kakontwe Mill in Likasi.

Price	Year							
(Zaire)	1967	1968	1969	1970	1971	1972	1973	Jan 1975
	76	76	84	84	84	80	137.6	157.1

Source: 54
(For 1967-1975, 1 Z = 100 K = U. S. $2).

1.3. National Maize Policy

1.3.1. Historical Background

Portuguese explorers introduced maize and cassava at the mouth of the Congo River in 1482. From there maize expanded inland in response to a growing demand from Arab and British slave merchants. After 1885, the development of maize became closely associated with the effort of the administration of the Congo Free State to generate a substantial exportable surplus. After the Congo Free State became the Belgian Congo, in 1908, the role of maize in the coercive colonial economy was to provide adequate food for urban workers and workers engaged in the production of minerals, palm products and rubber (55, pp. 237-239). In 1933, the 'Institut National pour l'Etude Agronomique du Congo Belge et du Ruanda Urundi' (INEAC) was created to develop a better technology and better agricultural practices directed at improving the production of maize, cassava, ground nuts and plantation crops, such as palm nuts, cocoa, tea, coffee, rubber, etc. (90). In 1971, INEAC was changed to 'Institut National pour l'Etude et la Recherche Agronomique' (INERA). The volume, scope and quality of the research conducted by INEAC was of great significance, particularly in the area of export crops (19, 91). INEAC developed, adapted and distributed improved varieties of seeds (Table 1.7) and provided technical advice for the production of most major crops planted in today's Zaire.

By 1952, INEAC efforts had raised potential yields under peasant conditions to an estimated 87% for beans, 125% for cotton, 150% for ground nuts and oil palm, 233% for rice, and 380% for manioc (56, p. 243). In order to make the most efficient use, in rural areas, of the technologies developed by INEAC, and to increase acreage and output levels per farming unit, the colonial administration of the Belgian Congo decided to resettle some natives in production units. The settlements were called 'paysannats'. The first trial in 'paysannat' was made of five settlers established around the Gandajika research station, in 1936 (33, p. 789; 3, p. 52). But the 'paysannat' scheme became operational in 1943 in the Sankuru Sub-Region (101, p. 53) and by the late 1950's, the 'paysannat' membership had risen to 120,000 (55, p. 244). Cooperative systems were organized on each 'paysannat' to provide inputs and manufactured goods. According to Van den Abeele, by the time of the general introduction of the 'paysannat', membership was free in order to avoid putting restrictions on natives and to attract into agriculture those individuals who were inclined to farm and to learn farming (101, p. 53).

The outbreak of political unrest in the new independent State of Congo destroyed a great part of the research structure and research

Table 1.7. Quantity of improved seeds provided by INEAC.

Crop	Year 1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Maize (tons)	31.1	71.4	12.5	46.3	21.6	25.0	68.9	131.2	66.0	2.7
Rice (tons)	286.1	1208.4	12.2	14.0	1.9	22.8	3.2	13.8	4.9	0.1
Ground nuts (tons)	9.5	2.2	2.3	5.1	12.2	11.0	14.6	10.9	6.9	3.8
Cotton (tons)	1.0	3.0	11.7	--	20.6	6.2	0.7	10.8	6.3	14.7
Coffee Arabica (tons)	(1)	5.1	9.5	11.2	13.8	15.9	5.4	6.5	7.4	3.0
Tea (tons)	15.5	3.8	5.5	3.2	11.0	11.1	14.6	11.0	11.1	0
Rubber (thousand seeds)	65.0	13539.9	8644.0	5627.8	553.2	578.7	1115.7	2198.0	910.0	240.0
Cassava (thousand meters)	164.5	54.2	29.0	268.8	621.0	233.2	34.2	82.6	49.7	48.0
Palm (thousand seeds)	3016.2	8106.3	6242.7	4322.3	7018.6	5552.0	5788.0	3994.8	3966.4	94.8

Source: Compiled from publications by INEAC, particularly INEAC: Bulletin d'Information, 1951 to 1961 (34).

(1) negligible

material created by INEAC. A government project financed by Zaire and the European Development Fund to revive the'paysannat' in Gandajika has made a slow start. INERA (formerly INEAC), which lost a great part of its research capability in the post-independence political turmoils, has been unable to surface as a leader and a coordinator of agricultural research. In recent years, some research duties formerly assigned to INEAC have been reassigned to specialized agencies that could provide better research management to speed up agricultural production. In 1972, the government of Zaire asked CIMMYT (International Maize and Wheat Improvement Center) to cooperate in reshaping maize improvement and production. Researchers of the CIMMYT team in Zaire actually organize and conduct the research work of Programme National Mais (PNM), a government agency whose objectives are to develop and to adapt maize varieties which are insect resistent, produce high yields under Zairian ecologic conditions and which meet consumer's taste. Other objectives of Programme National Mais are to train Zairians for the continuation of the research work in maize agronomy, protection and breeding and to develop technological packages for the introduction of new maize varieties to farmers.

1.3.2. Maize Pricing

The concept of using prices as devices to increase farmers' production was introduced with the setting of regional prices for various commodities sold by producers. Up to 1967, provincial governments set floor prices for commodities sold by producers in their respective areas. The role of the central government in establishing floor prices developed after the 1967 devaluation of the national currency (42, 60).

The price of maize in Zaire is subject to government legislation on the price of maize grain and maize flour. The legislation on floor prices fixes the minimum price to be received by farmers selling maize. In practice, these floor prices are interpreted more as a maximum than as a minimum (60, pp. 235-237). Government intervention in maize pricing extends to the establishment of ceiling prices and margins for maize flour from the wholesalers (mills) to the retailers. This system was intended to prevent drastic price increases for the consumers. In order to achieve this objective, the government has periodically been establishing the ceiling price at which traders can deliver maize grain to flour mills; the government has also established a system of ceiling prices at which each distribution channel is supposed to sell maize flour (82). Ceiling prices are revised periodically. Another consequence of low priced maize flour is that producer's floor prices have often been set low and adjusted only irregularly to provide cheap maize grain to traders who buy from producers. When floor prices have been adjusted, the coefficient of adjustment has not always taken into account the changes in market conditions for supply and demand (60).

Maize grain is collected and carried from production to final consumption centers. In some regions of Zaire, a system of gradient pricing was established to offset the cost of collecting and transporting maize in areas beyond the reach of main communication networks (42). In 1974, new regulations replaced gradient pricing with a single floor price for maize in each Region (87). In order to promote interregional transfers of maize and other foodstuffs, major river and railroad transport companies (which in Zaire are government agencies) have established transport tariffs favorable to the shipment of maize between district and regions (provinces) (15). Maize from remote production centers which reaches urban consumption centers is collected by licensed traders whose major activity is concentrated on the selling of manufactured products. On occasion, particularly shortly after harvest, these traders include maize in their line of business. Generally speaking, there are no traders specialized in the collection, storage and protection of maize.

Maize deficits are supplied by import. Early in 1975, the import price for maize grain reaching the Kakontwe mill in Likasi was Z 78.55 per ton FOB at the Zambian border. The delivery price for the imported maize to the Kakontwe Mill was Z 84.93 (54); the delivery price of local maize to the mill was set by the government at Z 63.00 per ton and the minimum farm gate price was fixed by the government at Z 40.00 per ton[1]. The Z 21.93 per ton difference between the delivery price of imported maize and the delivery price of local maize in Shaba and Kasai Regions suggests that substantial savings in exchange might be gained merely by allowing the domestic mill delivery price to rise, stimulating local production and supply. But up to May of 1975 the government did not allow increases in the delivery price for maize, perhaps because of its commitment to keep the wholesale price of maize flour out of the mill at Z 50.00 per ton (54) and its desire to keep retail prices and marketing margins low. In May of 1975, when the importation of the Kakontwe Mill alone was expected to rise to 168 thousand tons, the gate price of maize grain to farmers was still Z 40.00, the same price which existed in 1973 when the import price of maize was Z 68.80 per ton FOB at the border, and the total quantity imported by the Kakontwe Mill was 82 thousand tons.[2]

1.3.3. Input Supply Policy

Land, family labor, and local seeds are the inputs most used in

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[1] The price of Z 40 per ton was set as a floor price; but as we will show, misinterpretation by local officials has made of this floor a ceiling and a key policy variable.

[2] In 1973 the total Zairian import of maize was 146,376 tons.

agricultural production. Most Zairian land is communally owned by all members of the community group or clan. The July 20, 1973 legislation on land ownership stipulates that land is an exclusive, unalienable and imprescriptible property of the state. A presidential address of November 1973, suggested that there is no legal limit to the amount of land a farmer can devote to agricultural purposes, although special legislation may be needed for some agricultural uses such as plantation activities and timber production (57).

In practice, farmers use their rights on communal land or make arrangements with other ethnic groups to get use rights for agricultural purposes. In general, the amount of land a farmer plants is limited by the total available land, the labor force available at the farm, and the density of occupancy on the communal land. As the density of occupancy increases, some farmers must walk longer distances to get to spots of good land for agriculture.

About 20 thousand tons of fertilizer are imported annually and used in specific projects. Some farmers organized in production schemes such as the paysannat use subsidized fertilizer, insecticide and mechanical clearing for the production of cotton and tobacco. In this case, inputs are financed by credit channelled through supervising agencies such as 'Commission Agricole du Kasai Oriental' (CAKO) and TABAZAIRE (16, 48, 80, 81). Chemical inputs are not generally used in the production of traditional crops such as cassava, maize, ground nuts, etc. But for the 1973-74 season, Programme National Mais (PNM) organized a small supervised credit program to support planting for 27 farmers involved in maize production (73, p. 12). For the 1974-1975 years, PNM extended supervised credit to 146 farmers, indicating that PNM may eventually expand this effort to significant size. The limited availability and the rising price of imported fertilizer (Table 1.8) as well as the low price of maize grain restricts the expansion of the use of fertilizer in the production of maize (16).

1.4. Scope and Justification of the Study

Zaire can provide an increased maize supply by importing larger quantities of maize grain or by investing in the local production of maize. Whether or not Zaire should import or produce maize depends on alternative costs of importing versus production and on political decisions. On the economic side, the decision to produce or import maize weighs the foreign exchange cost of imports against the cost of developing an adequate technology, the cost of importing the fertilizer and insecticides that are needed to increase the quantity of maize produced, and the opportunity cost of labor and other imputs diverted from the production of other crops to increase the production of maize. At the farmer's level, whether or not to produce more maize will depend on the capacity of

Table 1.8. Delivery price of fertilizer (Zaires per 100 kg) at each production center, in Kabinda sub-region (Prices free of import taxes).

	Production Centers														
	Baluba Lubelanji			Dilunga Bena Tshimanga Bena Kayembe			Bakwa Mukendi			Bena Mpunga Bena Kakona Gandajika			Baluba Mbuji Mayi		
Fertilizer	1973	1974	1975	1973	1974	1975	1973	1974	1975	1973	1974	1975	1973	1974	1975
Amonium sulfate (21% N)	8.13	12.48	15.58	8.30	12.80	15.90	8.22	12.64	15.74	8.46	13.12	14.46	8.82	12.44	16.54
Urea (45% N)	11.85	18.41	21.01	12.02	18.73	22.47	11.94	18.57	22.29	12.18	19.05	21.07	12.34	19.37	23.09
P_2O_5 (40%)	10.92	16.94	20.49	11.09	17.26	20.81	11.77	17.10	20.65	12.07	17.58	19.37	11.41	17.30	21.45
P_2O_5 (45%)	13.38	20.96	24.80	13.55	21.28	25.12	13.47	21.12	24.96	13.71	21.60	23.68	13.87	21.12	25.76
Potassium sulfate K_2SO_4 (50%)	10.91	15.32	19.46	11.08	15.64	19.78	11.00	15.48	19.62	11.24	15.96	18.34	11.40	16.28	20.42
20-20-0	12.95	19.35	--	13.12	19.66	--	13.04	19.50	--	13.78	20.00	--	13.44	20.29	--
12-12-17	--	18.66	--	--	18.38	--	--	18.22	--	--	18.70	--	--	19.02	--

Source: Compiled by C. J. Coursier, FAO technician for fertilizer trials in Kasai (17)
-- information not available.

income generated by increased maize production to compensate for the cost of acquiring inputs and the opportunity cost of labor and other inputs diverted from other crops to increase the quantity of maize produced. With the rising cost of importing maize, the government of Zaire has selected to pursue objectives of self sufficiency in basic foods production (57) and develop the production of maize (72). In the light of this decision there has appeared a need for microeconomic studies at the village level to improve government understanding of the peasant decision making process and to guide government policies in the planning and implementation of programs aimed at expanding the domestic production of maize.

1.5. Objectives of the Study

The objectives of this research study are:

(1) to describe the maize production system in four districts of the Regions of southern Kasai Oriental and northern Shaba. This description will be achieved through the analysis of agricultural practices prevailing in maize production and through the identification and the analysis of market practices and the mechanisms of price formation;

(2) to identify constraints which limit the capability of farmers to grow more maize;

(3) to analyze national marketing and pricing policies which affect maize production; and

(4) to evaluate alternative strategies for the improvement of maize production and marketing.

1.6. Methodology for Data Collection

Two hundred and ninety-nine respondents from 77 villages in the districts of Tshilenge, Gandajika and Mwene-Ditu, in the Kasai Oriental Region, and from the district of Kaniama in the Shaba Region constituted the master sample for the data used in this study. A modified version of the two stage sampling technique described by Monroe and Finkner (58) was used for the selection of villages and respondents included in the sample. In Kasai Oriental, a map of the survey area (scale 1:50, 000) was divided into squares of approximately equal size, each square was assigned a random number and 50 squares were chosen by drawing with replacement and taking into account the density of population and the problem of travel for field personnel. In each square one village was picked taking into account problems of accessibility. In the district of Kaniama 27 villages were drawn with replacement out of a list of villages provided by the local administration. The selection was done in such a way that most of the Kaniama district was covered taking into account constraints due to transportation problems.

In each village four respondents were selected after arriving in the village. Selection was made from the persons gathered by the chief in the village. Because of the social structure in the villages women were not called upon to attend the gathering. This social structure made it difficult to include many women in the sample.

The information used in this study was gathered in 1974-1975. A questionnaire in Tshiluba was submitted to farmers in Tshilenge Gandajika and Mwene-Ditu, in December 1974-January 1975. A Swahili version of the same questionnaire was used in Kaniama in March 1975. Market information gathered in the Gandajika-Mbuji Mayi area lasted from October 1974 through December 1975.

Originally we had planned to interview 308 household units, 200 in Kasai and 108 in Kaniama. The refusal to answer in some villages of Kasai Oriental reduced the number of interviews to 303; in addition, four questionnaires were rejected as incomplete. The final sample thus contains 299 completed questionnaires.

For each interview, the household unit was asked to provide information about the following:

a) The level of education of the head of the household, his age, his ethnic group.

b) The size of the household.

c) Land tenure and decision making procedures within the household or the village unit.

d) The total area currently planted, the area planted with maize.

e) Agricultural practices, the timing for sowing, the instruments used for agricultural practices and the distribution of the agricultural work within the family unit.

f) The protection of maize after harvest.

g) The marketing of maize, i. e., who, when and why maize is sold and the channels most commonly used for maize selling.

h) How much of the produced maize was currently sold.

i) An estimate of the household wealth by listing the number of radios, bicycles, stone houses and domestic animals in the household.

j) The size of the village, the distance to a principal road and the distance to a market.

k) Whether or not the farmer was a participant in either the Tabazaire or CAKO supervised scheme.

l) In Kaniama, the planting time for each crop, and the constraints on maize production.

Our approach to data collection contrasts with small sample analysis such as conducted by Norman (66) and many others. In this approach, a smaller number of villages, is selected and the household units in each village are observed over a twelve to eighteen month period in order to establish input output coefficients and investigate the efficiency of operation at each farm level; the observations from the sample are thereafter extended to a larger population. To the extent that the population to be dealt with is homogeneous, or for a study whose results are to be extended to a small universe, the small sample technique is quite an accurate estimate of household performance. However, when a study is devised for the introduction of a new technology, a small sample technique runs the risk of generalizing to a large population the properties of a sample that may not be representative. Recent studies on adoption of the Green Revolution tend to show that small locational differences may play a very important role in the adoption or rejection of an innovation by many households. The importance of these local differences can be diminished by increasing the sample in order to include a greater number of characteristics; this is what a study like ours has tried to do.

In addition to information provided by individual farmers, market information was gathered through direct observation of two urban markets in the cities of Mbuji Mayi and Gandajika, and of three rural markets in the villages of Kamanda, Kaseki and Nsona. Each market was visited at least twice a month during the first and last fifteen days of the month. Twice a month maize was bought and weighed and the retail price calculated for each market; the monthly average price was recorded as the maize retail price for the month. Price information was complemented by short interviews with female and male traders, producers and local officials.

1.7. Methods of Analysis and Organization of the Study

Most of this study will be descriptive using survey data from the districts of Tshilenge, Gandajika, Mwene-Ditu and Kaniama. In chapters where additional techniques are pertinent to an understanding of the problem,regression, principal component, discriminant and budgeting analysis will be introduced to complement the descriptive analysis.

The second chapter introduces a multiple product production and consumption model with labor limitations in production, to explain the behavior of the household which produces and sells maize. The model is also used to try to explain how the household would react to innovation and market incentives in a semi-subsistence environment. Chapter three presents the geographic situation of the survey area and describes the socio-economic profile of farmers.

Chapter four analyzes factors directly associated with the production of maize. These factors include land tenure, agricultural practices, labor availability and labor use.

Chapter five describes the agents, channels and operations involved in the marketing of maize. Marketing structure is analyzed by describing what people do, why they do it and how what they do contributes or does not contribute to an overall rapid growth of the sector. Chapter five looks at business practices, price and price formation in the marketing of maize and tries to evaluate how business practices and price formation explain the actual development of the maize business.

2. A THEORETICAL FRAMEWORK FOR THE ANALYSIS OF THE BEHAVIOR OF FARMERS IN THE STUDY AREA

2. 1. The Model

We start this analysis with three basic assumptions. The first assumption states that farmers in the study area sell part or all of some crops that they produce, but that overall, a large proportion of the farm output is used for domestic consumption. The second assumption is that for all practical purposes, the typical farming unit neither sells a significant part of its family labor force outside the farm nor purchases significant amounts of labor from outside. The third assumption is that there is no limitation to the amount of land that can be devoted to agricultural production.

The utility function of the typical producing unit (hereafter called household) is of the form depicted in relation (2. 1).

Assumptions regarding the utility function of the producing unit are as follows:

$$U = U(q_1^o, \ldots q_k^o, Q_1 \ldots Q_s, L, S) \qquad (2.1)$$

where q_i^o ($i = 1, \ldots k$) is the quantity consumed of a commodity q_i produced, Q_j ($j = 1, \ldots s$) the quantity consumed of a commodity provided by the market, I stands for (precautionary) cash income and S is the quantity of labor, measured in standard units, which is used in leisure. Further, it is assumed that:

$$U_{q_i^o}, U_{Q_j}, U_I > 0; U_S \geq 0, \qquad (2.2)$$

where $U_{q_i^o}$, U_{Q_j}, U_I and U_S are partial derivatives which represent the marginal utilities of the various items contributing to utility.

The farming unit of the study area allocates its labor force between work and leisure so as to produce the output of the crops that it needs for its subsistence and also to acquire the cash income needed to purchase from the market commodities and services that the household does not produce at all, or commodities and services that the family farm does not produce in sufficient quantity. The family farm produces cassava, maize, ground nuts, beans, bananas, legumes, cotton or tobacco and other minor crops. Since there is no legal limit to the amount of land that a family farm can devote to agricultural production, the amount of land planted is determined by the quantity and the quality of the labor force available in the household. In its Hicksian form, the family farm production function for a commodity i takes on the form

$$F_i (q_i, x_i, y, a; R_i) = 0, \; i = 1, 2, \ldots k \qquad (2.3)$$

where (2. 3) is assumed to possess continuous first and second order derivatives which are different from zero for all the non-trivial solutions. In (2. 2), q_i represents the level of output of a commodity i (i = 1, 2, . . . k); x_i represents the amount of household labor, in standard units, which is allocated to the production of a commodity i; y and z represent the quantity of fertilizer and the number of plowing hours used in the production of a commodity i. R_i stands for the technology used in the production of a commodity i. It includes, among other things, the quality of seed-bed preparation, the appropriate time for planting, weeding, harvesting, and the quality and the density of seeds. For purposes of this analysis, R_i is assumed to be fixed.

In the study area only a small number of farmers use tractor plowing and fertilizer in the production of cotton or tobacco. Fertilizer is not generally applied directly to the production of crops other than cotton and tobacco. For farmers not directly supervised by the CAKO or TABAZAIRE porgrams for the production of cotton or tobacco, the levels of use of fertilizer and tractor plowing hours are zero.

For farmers using fertilizer and tractor plowing the effects of these inputs on cotton or tobacco is positive; for limited subsequent production seasons, the residual effects of fertilizer and tractor plowing on crops which rotate with cotton or tobacco may be expected to be positive, because fertilizer residual effects and tractor plowing (which improve the quality of future seedbed preparation) can improve yield. (In the following analysis, the residual effects of fertilizer and plowing hours on other crops are not investigated.) Let us assume that the farmer being investigated is one of the few using fertilizer and tractor plowing for the production of cotton or tobacco.

The quantity of the labor allocated to the production of all crops is smaller or equal to the difference between the total household labor availability (H) and the amount spent in leisure (S), i.e.

$$H - S = X \geq \Sigma xi \qquad (2.4)$$

When the time arrives to plant, weed or harvest, H is a determined quantity that the household allocates between leisure and production activities.

It is assumed that the family farm derives its income from selling the commercial crops and part of its subsistence crops. We also assume that the family farm allocates its income between the purchase of market provided commodities Q_j ($j = 1, \ldots s$), a precautionary cash income I and payment for the purchased inputs. Then the household budget constraint can be written as

$$\Sigma P_i(q_i - q_i^o) - \Sigma P_jQ_j - r_1y - r_2z - I = 0 \qquad (2.5)$$

where P_i is the price of commodity i, produced at the farm; $(q_i-q_i^o)$ is the quantity sold of a commodity i produced at the farm; P_j is the price of a commodity j provided by the market; r_1 and r_2 are prices for fertilizer and plowing hours.

The household maximizes its utility function (2. 1) under the constraints defined by relations (2. 3) through (2. 5). It can be shown from the equilibrium conditions for constrained utility maximization that the quantities of a commodity produced (q_i), consumed (q_i^o) and marketed $(q_i-q_i^o)$ depend on the price of the commodity and the labor force allocated to the production of that commodity. It can also be shown from equilibrium conditions for utility maximization that the quantity of labor allocated to the production of a commodity is a function of the price of the commodity under consideration.

The assumptions underlying (2. 1) through (2. 5) are that a typical household is a utility maximizer under the constrait of its production process and labor availability. As presented in (2. 1) through (2. 5) production and consumption take place simultaneously. In practice, however, the household faces a multiple period production and consumption system which involves risks of non-convergence of production decisions and consumption needs. For the rest of this study we assume that the typical semi-subsistence household is a risk averter unit which, in time 't', allocates its limited labor assets to achieve an expected level of consumption in time 't + p' (p = 1, 2, . . . m). We also assume that the typical household allocates its resources in such a way that the variance of its consumptions from one period to another is minimized.

2.2. Labor Utilization

Models analyzing the behavior of subsistence farmers often investigate the behavior of farmers with limited land, and a surplus of labor available over the production year (61, pp. 165-185). The dual models of economic development in Lewis (50) and Fei and Ranis (20) emphasize the absorption in the industrial sector of agricultural labor surplus made up of existing farmers, casual workers and domestic retainers. Since it is assumed that the land is limited, a surplus of labor overcrowds the land and takes the production process into the phase of declining marginal product of labor which would in turn, result in a declining rate of increase of agricultural output. Failure of agriculture to keep pace with urban and industrial growth would increase the prices of agricultural products in urban markets. This, in turn, would induce labor and union demands for wage hikes, which would reduce employment in the industrial sector, thus creating surplus labor in urban centers. Models of dual economies with land shortage and labor surplus emphasize the idea that economic development takes place through a transfer of the labor surplus from the agricultural to the non-agricultural sector of the economy. For the system to proceed theories of transformation of dual economies sustain the idea that structural transformations must also take place in agriculture to prevent a slow down of the transfer of labor from agriculture to the non-agricultural sector (31, p. 313). In this line of thought, the development of the non-agricultural sector is assigned a leading role in the process of economic transformation, and the development of the agricultural sector is seen merely as a means for developing a surplus of labor which can be transferred to the non-agricultural sector at low cost. The development of agriculture is seen as having a marginal claim on labor and playing a minor role in economic development. However, the experience of today's more advanced economies indicates that the rate at which an economy becomes transformed is dependent on: (a) the proportion of the labor force initially in the agricultural sector; (b) the rate of growth of the total labor force; and (c) the rate of growth of the non-farm job opportunities which, in turn,is a function of capital accumulation in the industrial sector (53, p. 22).

When one considers production patterns such as the one we have surveyed for Zaire, one notices that production practices take place within a limited period of time and that there is no limit to the amount of land a household can use. The question then arises whether or not the labor surplus hypothesis is still reasonable, if indeed it is ever reasonable. In order to explain the shortage of food crop products, the concept of labor supply over a one year period has to be replaced by that of labor available at the period of crucial operations. With a production system based exclusively on labor and in an environment with no agricultural labor market, the labor supply to the household is a fixed quantity.

In a given period, labor available at each household is both a quantitative and qualitative concept. The quantity of labor available, measured in standard efficiency units, may be viewed as a function of a variety of attributes A_j:

$$H = H(A_1, \ldots A_9) \qquad (2.6)$$

with

$$H_{A_j} \geq 0; \; H_{A_j A_j} < 0 \qquad (2.7)$$

where

A_1 = the age of the head of the household

A_2 = the average age of the wife

A_3 = the number of wives

A_4 = the number of other male and female adults in the household

A_5 = the number of boys and girls seven to fourteen years of age

A_6 = the number of years of formal education

A_7 = index of the health status of the household

A_8 = the length of the participation in a supervised production scheme

A_9 = the number of children below seven years of age

H_{A_j} = first partial derivative of H with respect to A_j

$H_{A_jA_j}$ = second partial derivative of H with respect to A_j

After allocation of H between leisure and work, the quantity of the labor force measured in standard units that is available for work can be expressed in terms of the A_j's as in 2.8.

$$X = X(A_j) \quad (j = 1, \ldots 9) \tag{2.8}$$

with

$$\begin{aligned} &X_{A_j} \geq 0; \text{ for } j = 1, 2, \ldots 8 \\ &X_{A_jA_j} < 0 \text{ for } j = 1, 2, \ldots 5 \end{aligned} \tag{2.9}$$

$$X_{A_9} < 0 \tag{2.10}$$

In (2. 8), (2. 9) and (2. 10) we assume that all male and female adults are eligible for work and that all children seven to 14 years of age are healthy enough to help for some domestic tasks in the household.

Over time, the A_j's are variable and so are H, S and X. But in the short run, when production decisions are made and when agricultural operations take place, the A_j's take on determined values and H is a fixed quantity. The effects of a change in the A_j's on the quantity produced of a commodity 'i' can be traced through the change of the attributes A_j's on the labor force available in the household and the change of the fraction of the labor force allocated to each crop which is due to the change in the available labor force. Specifically,

$$\frac{dq_i}{dA_j} = \frac{dq_i}{dx_i} * \frac{dx_i}{dX} * X_{A_j} \qquad (2.11)$$

Let us assume that the phase of negative marginal product has not been reached yet and that

$$\frac{dq_i}{dx_i}$$

is positive. If X_{A_j} is positive, then the effect on q_i of an increase of A_j will depend on dx_i/dX, i.e. the allocation of the change in the labor force available between the i crops. Only if dx_i/dX is positive will dq_i/dA_j be positive. Otherwise dq_i/dA_j can be zero or even negative, depending on the household valuation of q_i, its initial production level or the market return on the selling of q_i. For instance, it is quite possible that an increase in the total household labor force results in no change or a reduction of the proportion of labor allocated to a commercial crop whose net return is lower than the opportunity cost of labor for other commercial and subsistence crops. In a study on the use of rural agricultural labor, Okai indicates that where food crops and commercial crops were competing for the scarce labor force, food crops were accorded a relatively high priority (67, p. 112).

Another aspect of the labor problem as viewed in relations (2.8) through (2.10) is the relative weight of the changes in q_i accounted for by changes in the A_j's. A study by Clark on the work done by rural women in Malawi indicates that for all crops planted, field work done by women exceeded the work done by males. Clark also showed that her conclusion still held at the level of individual crops such as cotton, tobacco and maize (13, pp. 81-91). Investigating alternative techniques in developing smallholder agriculture in a land abundant area, Vail indicates that, although adult males worked slightly longer hours than women during peak months, women worked more days per month in agricultural work (100, pp. 1-18). However, in a study on agricultural labor use in Uganda, Okai indicates that men generally worked a greater number of hours on the farm than women (67, p. 113). The controversy about whether the male or the female adults does most of the agricultural work remains open. It seems though that the number of hours worked should be related to the complexity of the tasks performed in order to serve as a basis for comparison between the work done by men and women.

In (2.3) we assume that q_i' s are independent products. Let us assume, now, that although q_j and q_k can be produced separately there exists a way of associating the production of q_j and q_k so that under the labor constraint the sum of q_j and q_k produced in associations exceeds the sum of q_j and q_k produced independently. This can happen in the extreme case where, within the time period opened for planting, the allocation of work time to producing q_j leaves little time for the planting of q_k on a separate plot of land. If such an association exists, then, given the utility function and the labor constraint, it may be advantageous to interplant q_j with q_k. Other elements such as positive external effects of one crop on another, if planted simultaneously on the same plot may make it attractive to associate crops with or without the limitations of a labor shortage. The technique of interplanting might even result in saving some labor force which, under a labor constraint, could be allocated to operations on other crops. In describing associations and pseudo associations of crops in shifting agriculture, Jurion explains that when it comes to deciding what to grow, African farmers choose the combination best able to meet the needs of a family over a period rather than one providing the greatest overall production (41, p. 47). Although he indicates that women are short of time to take care of all of the agricultural work, Jurion does not seem to associate labor shortage with crop mixture. In a system with minimum market transaction, the household has to provide directly for almost all of its needs and thus produce most of the needed crops at the farm. Thus, crop associations may be a farmer's response to a labor shortage at the planting time. They may also be a farmer's response to expected labor shortage at weeding and, perhaps, at the harvest time, particularly when non-similar tasks such as planting one crop, weeding a second and/or harvesting another one take place at the same time, in an environment where a social division of labor assigns specific tasks to specific members of the household.

2.3. Adaption and Response to Market Incentives

Two of the goals of economic development are to provide developing urban centers with adequate food supplies and develop large markets for industrial products in the rural area. It is assumed that as farmers gradually increase the set and the quantity of off farm commodities that they consume, they modify their consumption of commodities produced on the farm and reallocate their labor force between leisure and work so as to increase the purchasing power needed to acquire industrial and other market-provided commodities. One of the issues involved in investigating the behavior of a semi-subsistence farmer is how the farmer reacts to the introduction of a new crop and how he reacts to inventives intended to increase the production of traditional and new crops.

Since we assume that the farmer is a constrained utility maximizer, his reaction to the introduction of a new crop will finally depend on how the technology associated with the new crop affects the set of constraints already facing the farmer and the level of consumption of traditional and non-traditional commodities. For example, the introduction of tobacco in the set of crops produced by a farmer takes hours of labor which were previously devoted to the production of other crops or, perhaps, to leisure. But the production of tobacco can also generate income for the household. Thus it is the combined effects of the production of tobacco on other food crops and the money income derived from producing tobacco which is likely to determine the rate of adoption of a new crop or a new technology.

Similarly, how a semi-subsistence farmer adjusts the supply of commodities he produces and sells, in response to price changes depends on how well off the producer is likely to be after he reallocates his labor and other inputs so as to increase the production of the promoted commodities. In other words, a producer's response to price changes will depend on how the income generated by the increase in the production of the promoted commodities compensates for the reduction of leisure time and/or for the reduction in the production of other commodities induced by the increase in the production of the promoted products.

The introduction of the production of tobacco, for example, requires hours of labor which have to be taken from other crops previously produced. But the tobacco can also generate a new source of income which can improve the net income of the semi-subsistence farmer. Thus, it is the effects of the production of tobacco on money and all other crops which, in large, determine the rate of adoption of a new crop or a new technology. In particular, a semi-subsistence household which consumes market provided goods is likely to react not only to changes in the price of the commodities it sells but also to how these price changes reflect changes in the prices of commodities it acquires through market transactions.

An understanding of how a semi-subsistence farmer reacts or would react to innovation or price incentives thus requires an understanding that the farmer has an objective function and allocates his limited resources in order to optimize his objective function in a world of uncertainties. Thus, policies and strategies designed to transform the semi-subsistence sector would benefit from observation of the micro-processes through which the decisions of the subsistence farmer take place (28, pp. 23-25).

Adoption and responsiveness to incentives and innovations by subsistence and semi-subsistence farmers have prompted many research studies and sometimes generated controversies. Cultural determinists such as Boeke and the early administration of the Belgian Congo suggested that traditional farmers were unresponsive to incentives either because of their limited needs, or because of their indolence. Policies derived from these assumptions were either non-interventionist or involved imposition of the innovation (9, p. 40; 73, pp. 242-243). Continuous imposition has seldom survived the imposing hand, and often produced only marginal results while in effect. The case of the Belgian Congo shows that gradually the imposing hand came to the conclusion that voluntary participation was necessary to the success of agricultural transformation. The introduction of the paysannat system in the late 1940's indicates a switch of colonial policies from imposition to participation. As we concluded in the review of agricultural development in the Belgian Congo, at the end of the colonial era, the native agriculture made the greatest progress in the perennial and annual crops planted under freely accepted membership. Given the international situation and the understanding of the market that natives could get from the cropping patterns of European plantation owners or settlers, Congolese farmers planted proportionately more commercial crops than foodstuffs.(91).

The responsiveness of subsistence farmers to price incentives has been investigated by economists through the analysis of supply

responses of an individual or of a set of crops. Krishna (46), Jones (40) and Mellor (53) have all concluded that in their respective environment, traditional farmers adapt their supply to real incentives and price changes. In a study of the Bas-Congo Province in the Republic of the Congo, Ndongala showed that with the high prices for foodstuffs on the Kinshasa market, in medium size cities of the Bas-Congo Province, between 1959 and 1963 traditional farmers increased the total area planted 90.6%.. From 1958 to 1964, farmers increased the quantity of foodstuffs supplied to the market of Kinshasa 166.4%.. Ndongala also reported that the profit generated by agricultural products attracted more males to agricultural work, even to the point of undertaking jobs that in the traditional society had been generally considered as tasks performed by females. Crops that traditionally have a small demand in the area, such as potatoes, and new crops such as maize and rice were rapidly growing to meet the market demand. Ndongala reported, in addition, that price incentives introduced a division of tasks in the household, with males devoting more work to high return crops (coffee and rubber) and females working more in the production of food crops (62).
In two studies on farmers' supply responses with changes in market prices in Thailand, Behrman indicated that Thai farmers responded significantly to the changes in the price of rice. In the first study, Behrman showed that Thai farmers responded significantly to long

and short run price changes for rice, but that the short run supply was lower than the long run supply response (7).. In a second study, in 1969, Behrman showed that not only were farmers' short and long run price elasticities positive, but that with positive price changes in local and international markets, farmers extended the production of rice on land that was considered to be non-productive under lower commodity prices (8).. In a study on the supply function of cocoa and coffee Bateman also concluded that in the long run producers were responsive to price changes (5). The studies by Warton (102), Krishna (46), Bateman (5) and Behrman also suggest that in investigating the supply responses of farmers who produce more than one crop, it would be dangerous to generalize from the supply response on one crop only. Such a generalization is even more dangerous where the farmer uses more than one of the crops he produces for his own consumption.

One of the factors which induce adoption or responsiveness to market incentives is the 'marketing' of the innovation or the commodity which is being promoted. The emphasis on marketing as an essential factor in agricultural development has grown along with studies on producers supply responses. Commodities produced at scattered production centers are sold and consumed and the role of marketing is that of bridging the gap between production and consumption decisions (1). Detailed market knowledge and research on where, when, what and how much can be sold puts producers in a position to take advantage of the opportunities which are offered at different markets. Thus, market information and marketing institutions are channels which are intended to increase producers' responsiveness to market incentives and open the way for the adoption of innovations. Their efficiency is a function of : 1) the speed with which information flows from central markets to the producers; 2) the accuracy and the speed with which price variation reflects the change in supply and demand over the cropping season, and between geographically distributed regions; 3) the cost of allocating and distributing commodities; 4) cultural and structural factors relative to the length of the marketing chain; and 5) the seasonality of supply, i. e. factors which determine the rate at which goods enter the market. The role of market incentives and innovations can be seen as that of generating that price change which would induce a multiplier effect on the quantities of either all or of some crops produced, consumed or sold.

The reference to the utility function of the semi-subsistence farmer in equation (2. 1) indicates that adoption and responsiveness to market incentives are a matter of choice. This implies a recognition that farmers have preferences and can order, rank and select the alternatives that best improve their well being. The ranking of the policy maker is a sort of social ranking which does not necessarily coincide with the ranking of the individual producers (28, pp. 105-116). This does not mean that the ranking of individual farmers cannot be modified in favor of the innovation or the expected response. It is up to the policy maker to build into the innovation or the incentive mechanisms which increase the likelihood of changes favoring adoption and supply response.

Under free non-imposed transformation, an innovation can be introduced first, and then checked later for how well it had been adopted. In some areas of the world, the green revolution may have been introduced in this way. Demonstration plots or mass introduction of varieties of wheat, maize or rice, and the complementary package were introduced following this procedure. The cost of such a procedure may end up unnecessarily high. The experience of the green revolution has shown that given the wide variety of local conditions, some farmers selected only part of the package. A prior analysis of the package requirements and a better knowledge of farmers' behavior would have helped avoid a loss of resources, capital and time. This study should be understood in this perspective. The maize problem in Zaire is a serious one; the government is helping develop a technological package that could alleviate the production deficit. To achieve this goal, the package still needs to be adopted by farmers. The study in progress is aimed at providing information that could be used in building the technological package for maize production in the Districts of Kaniama, Mwene-Ditu, Gandajika and Tshilenge.

2. 4. Price and Market Organization

The increase in farm prices has often been used as incentive for a greater production. The underlying assumptions of such policies is that, in equilibrium, the quantities of an agricultural product produced, retained for consumption and sold are functions of the market prices of these commodities and the quantity of the labor force available for their production. In particular, the quantity of a commodity sold by a household can be expressed in terms of the price of the commodity at the farm (P_{if}), as in the following relations:

$$q_i^* = (q_i - q_i^o) = M\ (P_{if}) \qquad (2.12)$$

with

$$dq_i^*/dP_{if} > 0$$

For households scattered in the production area, at various distances from consumption and delivery points, the price finally received by a household for each commodity sold depends on the market price and the cost of delivering the commodity to consumption or delivery points. Let P_{im} be the market price of commodity i. The cost of delivering the commodity, or transfer cost, is a function of the distance from the market. The site price of a commodity, i, is thus a function of the market price and the distance to market. Expressed in terms of these prices and transfer costs, the household's supply relation of a commodity i can be written

$$q_i^* = M(P_{if}) \tag{2.14}$$

$$P_{if} = G(P_{im}, D) \tag{2.15}$$

$$G_{P_{im}} > 0 \tag{2.16}$$

$$G_D < 0 \tag{2.17}$$

where P_{im} is the market price for commodity i, D the distance which separates the production site from the market and $G_{P_{im}}$ and G_D, the partial derivatives of G with respect to P_{im} and D. Relations 2.14 and 2.15 are summarized in the following relations:

$$q_i^* = M(G(P_{im}, D)) \tag{2.18}$$

The change in the quantity supplied of a commodity i is a function of the change in the market price of the commodity and the change in the transfer cost of the commodity from the production center to the consumption or delivery point. This relationship is depicted in equation 2.19.

$$dq_i^* = \frac{dM}{dP_{if}} \quad (G_{P_{im}} \cdot dP_{im} + G_D \cdot dD) \qquad (2.19)$$

Under competitive forces price changes at the market level are rapidly communicated to producers through various information channels and the corresponding site prices received by each producing household adapt to on going market prices and changes in the transportation cost of the commodity sold. Thus, under perfect competition in the market for the product and perfect knowledge and information at the farm, positive changes of the quantity sold of a commodity 'i' are induced by positive changes of the price of the marketed commodity and/or by negative changes of the transfer cost of the commodity. Positive changes of the market price of a commodity can be brought about by promoting the demand for the commodity. Changes in the transfer cost aimed at increasing the supply of a commodity include, among other things: 1) the improvement of the transportation network; 2) the promotion of a greater competition among transporters; and 3) a greater number of market centers completely connected among themselves so that price changes in one market generate a mechanism of arbitrage between markets, which finally establishes new equilibrium prices for all markets.

However, where farmers are isolated from consumption or transformationcenters, market knowledge and market information at the farm are incomplete and increase in market prices often are not reflected in the price received by the producer selling at the farm. In such a case, policies aimed at increasing the quantity of a commodity sold may include, in addition to those mentioned above: 1) the promotion of a greater degree of competition among buyers at the farm; 2) the promotion of cooperatives for the marketing of agricultural products; 3) education campaigns to increase the information available to producers and, thus, increase their bargaining power; and 4) the establishment of floor prices. To be effective, floor price policies must be accompanied by campaigns of information and education to make producers aware of the existence and the meaning of these policies.

Often, policy makers set ceiling prices on some commodities to avoid social disturbances and inflationary effects that could result from a market characterized by continuing shortages of a commodity. The ceiling of market prices or the ceiling of the rate at which the price of a commodity can grow also limits the rate at which the quantity of the commodity supplied can grow. From relation (2. 19) a ceiling on the change of the market price of a commodity must be accompanied by a greater change in the cost of transportation to achieve a target increase in the quantity of a commodity supplied. But combined effects of price ceilings and a deterioration of the transportation network can only result in a smaller increase in the quantity of a commodity supplied. Also for a product which is sold in different forms, a chain of ceiling prices at the wholesale and retail levels for the finished and non-transformed products limit the increase in the quantity of a commodity that farmers can provide.

2. 5. Application of the Model

The utility and the production functions of the semi-subsistence household are not known. However some of the analytical tools developed in this chapter may be useful in understanding the problem of food production and supply.

In the third chapter which follows, we present a profile of the survey area which, to some extent, provides a background to the understanding of the economics of production and marketing of maize and other commercial and semi-subsistence crops. In the fourth chapter, we first discuss problems related to land tenure. Then we give a description of the cultural practices used in the production of maize in four districts of south-central Zaire. The fourth chapter also analyzes impact of labor availability and utilization on the production of maize and other crops planted in the survey area. Using the total area planted and the area planted in maize as an approximation of the total production and the production of maize of a household, linear regression is used to estimate which of the labor (see section 2. 2) and non-labor factors account for the variation in the total and maize areas planted.

No data was available to investigate the relationship between market price and farm prices and the quantity of commodities produced and sold. In the fifth chapter we try to discuss how marketing affects the quantities of maize produced and sold. In particular we try to indicate how market organization, marketing behavior, and price formation may have affected the production of maize in the survey area. For this purpose, the fifth chapter proposes to analyze the organization of the marketing of maize and the market behavior of the producers and sellers of maize. The organization of the marketing of maize and the behavior of marketing agents affect the price received by producers, and this price, in turn, affects the extent to which producers can adapt their supply to market demand.

3. DESCRIPTION OF THE STUDY AREA

The general area covering parts of the Districts[3/] of Tshilenge, Gandajika and Mwene-Ditu, in the Region of Kasai Oriental, and the District of Kaniama, in the Region of Shaba, was selected for this study (Figure 3. 1). Programme National Mais (PNM) and the CIMMYT team in Zaire have recognized this area as having great potential for maize production and marketing.

The study area is crossed by the copper railroad which runs from Lubumbashi to Ilebo (Figure 3. 1). It is also well located with respect to the town of Mbuji Mayi, a growing supply deficit center, in maize, and contains two research centers at Gandajika and Kaniama.

According to official estimation, maize and cassava are the major crops planted in the study area (43, 44, 88). Table 3. 1 indicates the reported production of maize and cassava for the 1971/1972 and 1972/1973 seasons. These official estimates of production are based on mandatory minimum acreages imposed by district governments and on the hypothesis that every able adult in the rural area is farming at least the minimum acreage imposed

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[3/] A District, as used in this study, is a second order subdivision of a Region (formerly, Province); it is equivalent to the administrative division actually known as a Zone.

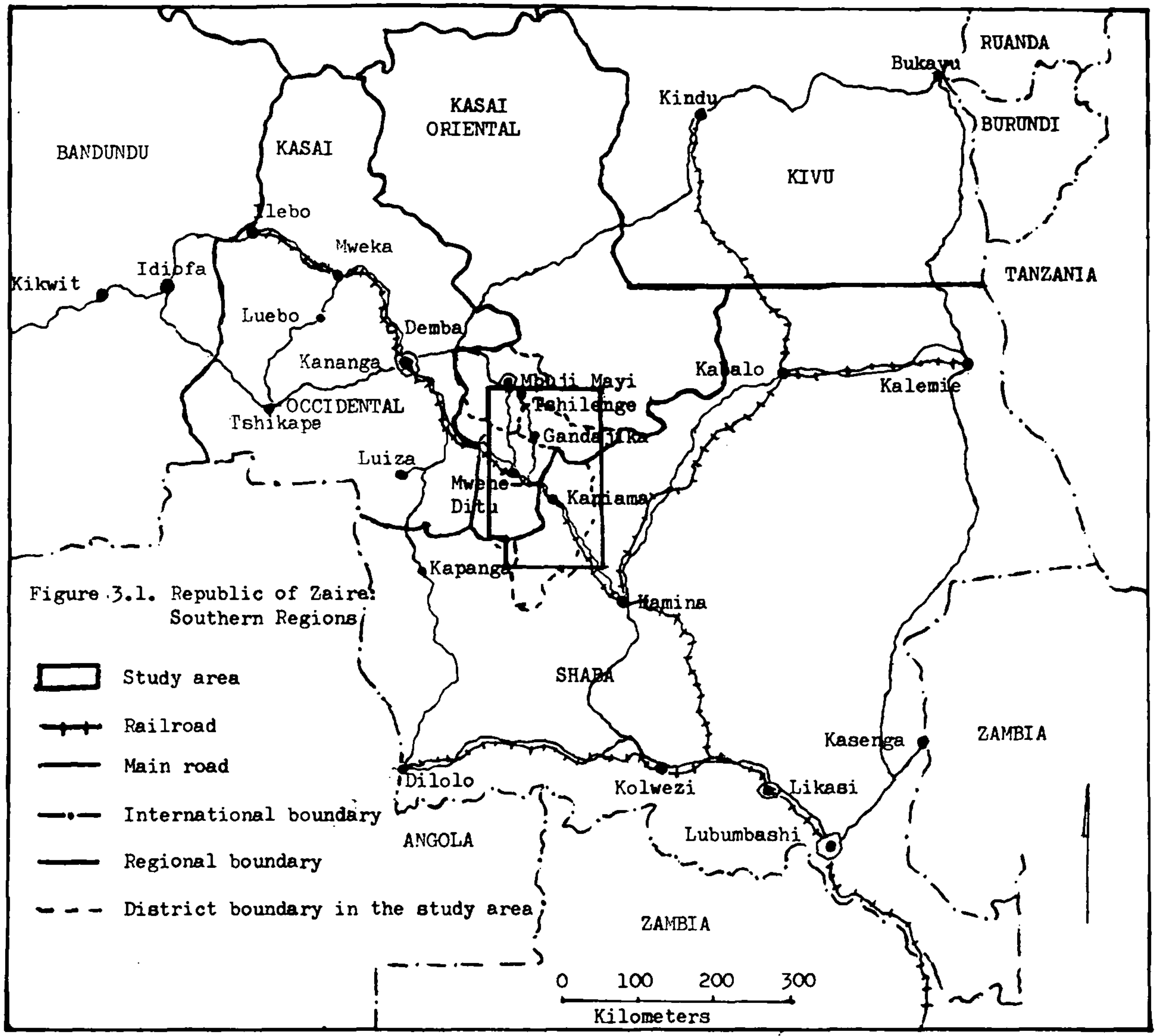

Figure 3.1. Republic of Zaire: Southern Regions

Table 3.1. Production of maize and cassava in Kabinda sub-region (tons).

Zone	Maize		Cassava	
	1971/1972	1972/1973	1971/1972	1972/1973
Gandajika	7,965	4,642	178,461	92,663
Mwene-Ditu	8,631	11,212	221,619	254,490
Tshilenge	20,964	2,695	351,015	100,631

Source: (43, 44)

for his district of origin (43, 44, 88). Figures in Table 3.1 should be taken with caution because mandatory acreages are seldom enforced. Furthermore, many able adults counted as living in the rural area often have moved to small or big towns and do not farm any longer.

The production of maize is affected by many factors. Among these, geologic, topographic, climatic, ethnographic and socio-economic factors are major determinants.

3.1. Geologic and Climatic Factors

Three kinds of soils dominate in this section of Kasai Oriental and Northern Shaba. They are: 1) red latosoils derived from the Bushmayi seltstone; 2) red latosoils derived from calcarious rock and Karoo sandstone; and 3) ocre-red and yellow latosoils derived from crystalline rocks (14).

Vegetation is riverine forest and scattered areas of humid evergreen, semi-deciduous and Guinean and periguinean sub-equatorial forests. Guinean wooded savannah in which some Sudano-zambezian species occur sparsely intermixed with small patches of deciduous open woodland are also encountered (41, p. 397).

Precipitation in the survey area averages between 1600 mm and 1200 mm a year. The area displays two rainy seasons and two dry seasons. The heavy sub-tropical rains last from late August to late January or early February; then there is a short dry season that lasts ten to fifteen days. A second rainy season lasts up to early May when a longer dry season starts. The average annual daily temperature is 23°C with average annual daily maximum of 29.0°C and an average annual daily minimum of about 17.0°C (41, p. 425).

3.2. Ethnographic and Socioeconomic Factors

3.2.1. Ethnic Groups and Village Size

In southern Kasai Oriental, the study area is occupied mainly by the Baluba-Kasai and the Bena Kanioka people. Kaniama has a greater mixing of ethnic groups; Baluba-Kasai, Baluba-Shaba, Kalundwa, Tshokwe and Karund live in the District of Kaniama. Most Kalundwa and Bena Kanioka are natives of this district. The groups of Tshokwe and Karund constitute minorities which moved to Kaniama because of changing economic conditions during the colonial and post-colonial periods. In the last 17 years some Baluba-Kasai have moved across the border to establish residence in Kaniama.

The density of population in the study area varies from a high of 73 inhabitants per square kilometer in Tshilenge, to a low of eight inhabitants per square kilometer in Kaniama (Table 3. 2). In the study area, farmers live in village units of varying size (Table 3. 3). In Tshilenge and Gandajika where the density of population is estimated at 25 inhabitants per square kilometer or more, the villages are stretched along main and secondary roads. Thus, a single village can extend over 2500 m on each side of the road that goes through the village.

Table 3. 2. Population and population density, 1972.

District	Population	Density/sq km
Gandajika	145, 320	25
Tshilenge	543, 050	73
Mwene-Ditu	200, 380	17
Total Kabinda Sub-Region	1, 161, 707	18
Kaniama	50, 120	8e

Source: (51, p. 13; 88)

e: estimation

Table 3.3. Average size of villages (number of people).

	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Average size	433	635	987	2676
Largest	2163	2760	2000	4909
Smallest	38	30	85	226

Source: Basic data were obtained from records of the village chiefs and local administrations.

In Kaniama and Mwene-Ditu the structure of large villages also exists along roads connecting district and local administration headquarters and Christian mission centers. Big villages also exist along railroad tracks at or near train stations. However, the average size of these big villages is smaller in Kaniama and Mwene-Ditu than in Gandajika and Tshilenge. Also of importance in Kaniama and Mwene-Ditu are small villages of 30 to slightly more than 200 people, established according to family ties.

Historically, the concentration of people in large villages in Tshilenge, Gandajika and Mwene-Ditu was favored by the paysannat system of the 1950's in order to centralize and to decrease the cost of distribution of water, medical care, technical advice and elementary education. Many large villages survived the destruction of the paysannat system in the late 1950's and early 1960's, and today they are the headquarters of the weekly rural markets.

The density of population and the size of the village may affect the total production in some parts of the study area. Given the need for new land and long fallows in order to maintain productivity in shifting agriculture, the increase in the population density and/or the size of the villages in a given area may reduce the possibility for village residents to find good new agricultural lands within a walkable distance from the village and, thus, force them either to walk farther from the village or to reduce the period of fallow on previously used plots of land. Long distances between villages and cultivated plots may reduce the quantity of land planted by farmers and, thus, reduce the output per unit of labor; and short fallows may adversely affect yields and, thus, reduce the output per unit of land.

In each village, farmers live in family units of approximately seven persons (Table A-1). In the sample that we selected, the average head of the household was 45 years of age, with about three years of elementary school education (Tables A-2, A-3). Of the respondents in various districts, 70 to 81% were single, widowed, divorced or married in a monogamic system; 19 to 30% were married in a non-monogamic system (Table A-4). About 80% of the respondents had been living in the village for more than five years when interviewed (Table A-5). For 60 to 70% of the respondents in each district, the decision to live in a particular village was made according to family ties that linked the respondent to the village (Table A-6). In each district, 49.3 to 70.4% of the sample population spent their childhood and adolescence in a village-type of life, while 28.3 to 49.3% of the respondents were raised in small towns, suburbs of small towns or in Christian missions (Table A-7).

Although many respondents selected their village of residency on purely ethnic or social grounds, 14.3 to 37.7% of the farmers in the survey area also listed the quality of land as a major determinant in their decision to live on a particular site (Table A-6). Thus, some economic reasons also lay behind the selection of a village for residence, particularly for the non-native that had moved to Kaniama. Over the five-year period prior to the survey, the number of farmers settling in villages was greater in Gandajika, Mwene-Ditu and Kaniama than in Tshilenge, the closest district to the town of Mbuji Mayi (Table A-5). A classification of the respondents with respect to age and the time of arrival shows that most of the new village residents were less than 50 years old (Table 3.4). A classification of the respondents with respect to the number of years in residence and the level of school training shows that over 50% of the respondents who settled in the study area more than 5 years prior to the interview, had spent less than four years in elementary school. The data also indicate that more than 50% of the new residents had completed four or more years of elementary school

(Table 3. 5). Information obtained from local authorities and the survey data suggest that the influx of farmers in villages was due not only to exchanges between villages, but that a small exchange between villages and small towns had taken place.

An interdistrict comparison of village residents indicates that 23% to about 28% of the village residents interviewed in Kaniama, Mwene-Ditu and Gandajika established residence in the village within five years prior to the time the interview was taken (Table 3. 6). The data also indicate that over 50% of the new residents (one to five years of residence) are under 40 years of age (Table 3. 4), and that most of the new residents have a higher number of years of school formation (Table 3. 5). A classification of the new village residents by age and by number of years of formal education indicates that over 50% of the new residents are under 40 years of age and have more than three years of formal school education (Table 3. 7). Thus in the five years prior to the time of the interview, some settlement of new farmers in the village took place which involved younger and more educated (formal education) people.

Many reasons may explain the mobility of farmers in and out of the village life. It seems that the reorganization of the paysannat system by CAKO in Gandajika, Tshilenge and Mwene-Ditu since 1968, and the supervision provided by TABAZAIRE, in

Table 3.4. Classification of residents by age and number of years of residence for each study district (%).

	Number of years of residence							
	Gandajika		Mwene-Ditu		Tshilenge		Kaniama	
Age	1-5	over 5	1-5	over 5	1-5	over 5	1-5	over 5
15-29	42.1	18.4	29.4	18.0	60.0	13.7	32.0	22.9
30-39	31.6	20.4	29.4	22.0	20.0	11.8	20.0	14.4
40-49	21.0	22.4	23.5	22.0	0.0	15.7	24.0	13.3
over 49	5.3	38.8	17.6	38.0	20.0	58.8	24.0	49.4
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.5. Classification of residents by level of education and years of residence for each district (%).

	Number of years of residence							
Years of	Gandajika		Mwene-Ditu		Tshilenge		Kaniama	
education	1-5	over 5	1-5	over 5	1-5	over 5	1-5	over 5
0	21.1	42.9	17.6	40.0	20.0	33.3	20.0	37.4
1-3	21.0	26.5	29.4	26.0	20.0	31.4	28.0	25.3
4-6	31.6	18.4	41.2	24.0	0.0	23.5	28.0	31.3
7-10	26.3	12.2	11.8	10.0	60.0	11.8	24.0	6.0
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.6. Classification of village residents by district and by number of years of residence (%).

Number of years of residence	District			
	Gandajika	Mwene-Ditu	Tshilenge	Kaniama
1-5	27.9	25.4	8.9	23.1
>5	72.1	74.6	91.1	76.9
Total	100.0	100.0	100.0	100.0

Table 3.7. Classification of the new village residents by age and by years of formal school education (in %).

	District and number of years of school education							
	Gandajika		Mwene-Ditu		Tshilenge		Kaniama	
Age	0-3	4-10	0-3	4-10	0-3	4-10	0-3	4-10
15-39	26.3	47.4	23.5	35.3	20.0	60.0	12.0	40.0
40-49	15.8	0.0	11.8	11.8	0.0	0.0	16.0	8.0
Over 49	5.3	5.3	11.8	5.9	20.0	0.0	20.0	4.0
Totals	100.0		100.1		100.0		100.0	

Kaniama, have had a lot to do with the change in attitudes about establishing in the village. Where producing cotton or tobacco was profitable to the producer, there was a tendency for younger people to settle in the village. According to the head of the CAKO operation in Gandajika City, when the paysannat system was revived, most farmers were in their fifties. The success of the first years attracted people in their thirties to join the production of cotton. But in recent years, producers indicated that low real prices for cotton, irregular and expensive supplies of fertilizer, and delays in the purchasing of produced cotton have slowed down the participation of farmers, particularly in Tshilenge. In Kaniama, a more vigorous price policy for tobacco and better organization of the supply of inputs encouraged more tobacco producers to remain on the land, in spite of the high cost of inputs provided by TABAZAIRE and the loss that the production of tobacco imposes on the production of maize.

Interdistrict comparison of village residents that we interviewed also suggests that villages in Tshilenge received fewer new resident farmers than the villages we visited in the other three districts (Table 3. 4). The limited settlement of new farmers may partially be due to the existence of more rewarding activities in the part of Tshilenge where we conducted the interviews; diamond smuggling in the neighborhood of the town of Mbüji Mayi and along the Mbùji Mayi River has historically attracted many young potential farmers. The attraction of the town of Mbùji Mayi itself and the hope of finding a paying job that the town may generate among potential farmers, particularly among the young ones, may also explain the small proportion of new resident farmers in the District of Tshilenge.

3. 2. 2. Farmer's Income and Wealth

In the survey area, a farmer's cash income comes from the selling of cotton, tobacco, maize, cassava and other minor crops that he produces. While maize and cassava are sold in an open market, respondents sell their cotton or tobacco to marketing boards which enjoy a legal monopsony on each crop.

Income from the selling of agricultural products added to previously accumulated assets, constitute a farmer's total wealth. This wealth is made up of the unharvested crops, the house or houses and the ownership of a radio, bicycle and livestock. Only a limited number of respondents have concrete houses; most houses are mud or stick and twig houses with thatched roofs (Table A-8). The average house has one or two rooms, but many respondents had additional houses used by a second or a third wife or purposely designed to be used as the kitchen (Table A-9).

In various districts, 13 to 28% of the respondents had a radio, and in all districts, but Gandajika, more participants in supervised production schemes had radio than did non-participants (Table A-10). About 50% of the respondents listened to agricultural programs regularly broadcasted on the local radio.

Bicycles are another of a producer's assets. Farmers use bicycles as a means of transportation between the village and the town and/or to the sites where crops are planted. Of the respondents in various districts, 27 to 67% owned a bicycle. A greater proportion of producers in the supervised production schemes (CAKO and TABAZAIRE) owned bicycles than did non-supervised farmers, except in Gandajika district (Table A- 11). The savings from selling cotton or tobacco were often invested in buying radios and bicycles. A comparison between districts shows that more producers in Kaniama own radios and bicycles than producers in Gandajika, Tshilenge and Mwene-Ditu (Tables A- 10 , A-11). The inter-district comparison of supervised respondents also reveals that proportionately more TABAZAIRE farmers owned radios and bicycles than farmers supervised by CAKO. The difference between Kaniama and the other districts can be attributed either to differences in consumption behavior or to more income generated by agriculture in Kaniama than in Tshilenge, Gandajika and Mwene-Ditu. For supervised farmers, field investigation suggests that tobacco production in Kaniama paid more than cotton production in Tshilenge, Gandajika and Mwene-Ditu.

Livestock is another important element of a producer's assets. None of the respondents raised cattle, but many farmers raised one, two,three or more goats, sheep or chickens (Tables A-12 to A-15). Often, respondents did not include very young animals in their list, perhaps because of a higher risk of mortality among younger animals than among old ones. Goats, sheep, chickens and pigs are commonly sold in market places, and inthe districts of Gandajika, Mwene-Ditu and Tshilenge, livestock may constitute an important part of a producer's annual income. In the survey area about 13.4% of the farmers had herds of livestock of ten or more animals (Table 3.8).

Table 3.8. Number of respondents with ten or more sheep, goats, pigs or chickens.

Number of animals	Number of people			
	Sheep	Goats	Pigs	Chickens
10-15	2	5	2	16
16-20	3	2	3	6
> 20	0	0	1	1

Livestock, bicycles, radios and the income from the selling of agricultural products do not include the total wealth of a farmer, but they are the major items that can serve as guarantees for loans or bank credit. The wealth of most farmers in the survey area, as described above, indicates that most of these producers do not have very many assets which can be used as guarantees for credit to small scale farms.

4. MAIZE PRODUCTION

Factors most likely to affect the production of maize are land tenure, labor availability and the technology used in the production of maize. By technology is meant, here, the agricultural practices and all the inputs complementary to land and to labor which are used in the production of maize. In this chapter we analyze the availability and the effects of these factors on the production of maize. We will discuss successively the system of land tenure, the production practices used in producing maize, and the availability and the use of labor in maize production. Since the farming units being investigated produce a variety of other crops, the analysis of factors which affect the production of maize will include references to other crops which compete with the production of maize in the use of factors such as labor.

4.1. Land Tenure and Land Use

Maize is grown by village farmers on land that belongs to the extended village family or clan; non-clan members acquire use rights on clan land through marriage, special arrangements with the clan or village chief, or through special arrangements made by local or regional administrations. In Gandajika, Tshilenge and Mwene-Ditu, about 70% of the farmers plow land that belongs to their own clan; 12 to 20% use community land allocated by extension agents (Table A-16) and less than 10% plow land that does not belong to their clan or tribe, according to previously established use rights. Kaniama, in contrast, presents a slightly higher proportion of people benefitting from use rights and government allocation of land (Table A-16). Often farmers list as state land, tribal and non-tribal land selected by extension agents under the framework of mandatory educational agricultural work for maize, cassava, ground nuts, cotton, tobacco and beans.

In general the clan does not put a limitation on the maximum amount of land a household can plow. Family work force, population density and the distance from the village to good land, among other factors, influence the area held by individual households. Before the beginning of the cropping season, in September or December-January, individual households, extension agents, supervised scheme authorities, or village chiefs select the sites for future crops. The survey data suggest that this selection is basically an individual decision where supervised scheme authorities or extension agents do not operate (Tables A-17, A-18) Once a site has been selected, it is plowed several successive crop seasons until it is left to fallow; in Gandajika, Tshilenge, and Mwene-Ditu, a sizable proportion of farmers suggest that they can keep a selected site only up to harvest (Table A-19); this answer may reflect translation bias rather than real fact. In practice there is no legal or tribal limit on how long a site can be used; in pure traditional agriculture successive plantings of one or several crops take place on the same site until declining returns for most kind of crops is reached, then the site is abandoned to fallow. On supervised schemes, crop rotation and fallow periods are determined by scheme authorities.

Few farmers suggest that land availability limits their production of maize (A- 20). In Tshilenge, Gandajika and Mwene-Ditu, land limitation is due either to rocky soil which is hard to hoe and/or to dense population which necessitates long distances between cultivated plots and the village. In Kaniama, a scarcity of land exists.the same as in Gandajika, Tshilenge and Mwene-Ditu, but the causes are not always the same. In the District of Kaniama, special legislation has continued the system of granting large land concessions of 200 to 3600 hectares to wealthy or influential Zairois. The introduction of large concessions has deprived some farmers of their rights to communal land and gradually relegated them to marginal agricultural land. The financial support provided by TABAZAIRE to concession owners for the production of tobacco has allowed many to hire workers and has induced many natives to work for a more or less regularly paid salary rather than to establish as farmers (89).

Thus, although land does not presently constitute an obstacle to the expansion of maize and other agricultural production, the increase of the density of population, the rise in the rate of occupancy of the land and special land concessions in the District of Kaniama may, in the future, restrict the quantity of land available for the production of staple foods by village farmers.

4. 2. Production Practices

In the general survey area, there are two regular crops of maize; in Gandajika, Tshilenge and Mwene-Ditu, the first crop is planted in September-October and the second in January. In Kaniama the first maize crop is planted in October-November, and the second in late January and February. In recent years a third crop has developed in the light of the high price of maize in October-December, and also because of the impossibility for the January and May harvests to cover the household's need for maize over the January-December consumption period. The third maize crop is often referred to by farmers as "swamp maize". This is not a new variety of maize, as the name may suggest, rather swamp maize refers to the same varieties of maize but planted in semi-dry swamp land, along water streams. In mid or late August, soil moisture along water streams, improved by small rains, is apparently sufficient to sustain germination and the growth of maize.

All but six of the farmers interviewed planted first season maize in 1974-1975. The second crop of maize although technically feasible over most of the study area is often hindered by other crops, mandatory or not, which are planted or harvested during the January-February period. In districts such as Gandajika and Mwene-Ditu where mandatory cotton was enforced in 1974-1975, less than 50% of the farmers planted a second crop of maize, but over 60% of the farmers in Tshilenge and Kaniama planted a second crop of maize (Table A-21)

In Tshilenge many farmers admitted they had deserted the production of cotton, however, because of lack of incentives, and they had decided to plant maize, instead. In Kaniama cotton was produced only by three of the farmers we interviewed. Besides, for those farmers involved in tobacco production, the tobacco season is over when the second crop of maize is planted. These interdistrict differences with respect to the production of cotton may explain the differences in the proportion of farmers planting a second crop of maize in the surveyed districts. Survey data thus suggest that the planting of cotton limit the possibility of planting a second crop of maize in Tshilenge, Gandajika, and Mwene-Ditu.

For the first crop of the 1974-1975 season, 63.5% of the farmers planted one maize plot and another 34.5% planted more than one plot (Table A-22). Many reasons may explain the planting of more than one plot of maize. Most polygamists tend to have one plot of maize for each wife, and a risk averter who expects yield to vary with the soil differences and the many microclimatic conditions in the production area may turn to planting more than one plot of maize to minimize the risk of low yields on some of the plots of maize. However, if the increased number of plots implies that maize is planted at sites far from each other, the over-all effect of holding more than one plot of maize may reduce the total area planted per unit of labor and thus affect the output of maize.

4.2.1. Seed Bed Preparation and Crop Rotation

The technique most used for seed bed preparation is hoe plowing; animal or tractor power is seldom used in maize production (Table A-23). In some plots previously planted with cotton or tobacco, maize may benefit from secondary effects of tractor plowing. But even in these few cases, hoe clearing and plowing always precede maize planting because plots previously planted with cotton or tobacco are invaded by weeds between the period of cotton or tobacco harvest and maize planting.

Because of the hardness of the soil, following the dry season, farmers wait for the first rains to soften the ground before they start plowing. Given the tool used for soil breaking and the number of crops to be planted within the same time period, this practice tends to limit the amount of land that can be plowed by a farmer for each separate crop per unit of time. . However, if a plot has been plowed once it becomes easier to handle for subsequent crops. This may explain the system of rotation used in village farming methods which consist in planting successive crops on one plot once it has been opened to agriculture.

In the four districts studied, maize is not often planted on plots newly opened to agriculture; instead one crop of maize replaces cassava, cotton, tobacco or a crop association involving maize and/or cassava and other crops. An interdistrict comparison of the rotations used in maize production indicates, proportionately, that more farmers in Kaniama and Mwene-Ditu plant maize on newly opened strips of land than do farmers in Gandajika and Tshilenge. The reasons for this interdistrict difference are not known. But Kaniama and Mwene-Ditu have the first and second lowest population densities for the four districts under consideration (Chapter 3). We speculate that in these low density districts, farmers are more able to find new agricultural land within walkable distances from the village than are farmers in more densely populated Tshilenge and Gandajika.

The production patterns used by farmers not supervised under the TABAZAIRE (tobacco) and CAKO (cotton) programs[5/] indicate that over 45% of the plots planted with maize for the 1974-1975 season had been occupied by cassava, maize or an association of maize and cassava or maize and beans. In contrast, 29.4 to 64.7% of the plots planted with maize by supervised farmers in the study districts, in 1974-1975 had been planted with cotton or tobacco in the previous year and 17.7 to 35.3% had been planted with maize, cassava or an association involving maize and cassava or maize and beans (Table A-24).

The cotton-maize and tobacco-maize rotations are built in rotations which are established by the authorities supervising the production of cotton or tobacco. The planting patterns of non-supervised farmers indicate definitely that maize rotates with maize, cassava and beans. The impact of these rotations on maize yield in traditional agriculture still remains to be investigated. But in an area with little or no application of fertilizer on most plots, successive planting of maize in the same field or continuous rotations of maize and cassava seem likely to reduce yields.

About 20% of maize plots in Tshilenge and 27% in Kaniama

[5/] In the remaining of this thesis, farmers supervised by CAKO or TABAZAIRE programs will be referred to as 'supervised farmers' or as 'participants'; in short, they will be designated by 'P'. Farmers not supervised will be referred to as 'non-participant' or as 'non-supervised farmers', in short, they will be designated by 'NP'.

were planted on strips of land previously planted to beans or an association involving maize and beans (Table A-24). We were unable to determine whether farmers use this rotation to benefit from the fertilizing effect of the varieties of beans used or whether maize is just used to serve as support for growing beans. In many cases we observed that a maize-bean association followed another crop of maize and beans. Thus, the argument of maize supporting beans seems to prevail. More in-depth analysis seems to be needed, however, to determine why the maize-bean rotation occurs in these two districts.

4. 2. 2. Maize Planting Time

About 60 to 80% of farmers in study districts plant the first maize crop after the first rains (Table A- 25) in late August, in September or in October. About 15 to 31. 0% of the farmers plant maize late after the rain has begun.

Generally farmers turn burned ashes and weeds in decomposition under continuous or discontinuous serpentine lines and plant maize seeds in hills on the top of the ridge. Farmers sow maize as plowing proceeds, i. e. farmers do not plow the entire plot first and then come back to proceed with seeding. Rather as one or few ridges are formed, they are planted, then the farmer goes on to forming new ridges. This implies that there may be a substantial time lag between the first and the last seeds sown.

Long time-lags between the first and the last planting may have unexpected negative effects on harvest and yield. In experiment, at the Gandajika PNM station, date of planting trials that we were able to follow showed that where viruses, grasshoppers and other insects are abundant, they attack the first seeds as these emerge from the ground. The insects and virus develop as moisture and fresh grass become abundant and get ready to attack the next emerging seeds. In the end, an entire crop can be completely ruined by insects and virus. Our observation of farmers' maize plots in Gandajika and Tshilenge suggest that a sizable proportion of farmers were victims of post-sowing insect damages due probably to the extent of time lag between the first and the last sowing operation.

Late planting, on the other hand, has other serious negative effects on maize production. As moisture content increases with increased rains, fungi and bacteria of all kinds develop above the ground ready to attack growing seeds before or after germination. In 1973-1974, PNM's weekly date of planting trials at the Gandajika station showed severe infestations of downey mildew on all planting made after October 8 (73, p. 50). In experimental trial, maize planted in late October or thereafter returned zero yield. The effects of downey mildew on late plantings are a real problem, particularly if a program should be designed to promote a second crop of maize in January and February.

About 90% of the farmers surveyed in Tshilenge, Gandajika and Mwene-Ditu finish planting within a two week period. In Kaniama where some maize producers have to wrestle with a forest vegetation over 15% of the farmers take about two weeks to finish planting, and 20.8% need even more than three weeks to finish planting (Table A-26). A comparison of supervised and non-supervised farmers indicates that supervised farmers in all districts tend to finish planting in shorter periods of time than non-supervised farmers. Perhaps many supervised farmers have taken lessons from the production of cotton or tobacco where they are told to finish planting within a limited time period.

When planting an association of maize and cassava or maize and beans, some farmers plant maize first and insert cassava or beans in the association at a later date; some plant maize and cassava or maize and beans simultaneously; others first plant cassava or beans, and then insert maize later. Whichever procedure is used, the time of the insertion of maize affects the yield on maize.

Farmers of the study districts were asked to indicate which procedure they used to insert maize in a maize-cassava or maize-bean association. The results are presented in Table A-27. An interdistrict comparison indicates that 55% or more farmers in Tshilenge, Gandajika and Mwene-Ditu would plant maize first and then insert cassava in the association a few days to a few weeks later. In Kaniama 52.8% of the maize producers, particularly among the non-supervised ones, plant maize and cassava simultaneously. The reasons for the interdistrict difference between farmers in Kaniama and those in the other three districts are not well known. We speculate that these reasons have to do with differences in ethnic groups and past agricultural experience of farmers in Kaniama and those in the other three study districts.

In Mwene-Ditu, Tshilenge and Gandajika, 40.9 to 55.9% of the farmers we interviewed plant maize first and insert cassava in the association more than two weeks later (Table A-27). Field data indicate that some of these farmers wait up to 30 days after maize has been planted before they plant cassava. It is not known how this practice affects maize yields; and no information on past studies were available on maize yield changes due to the time of insertion of maize in a maize-cassava association.

In a maize-bean association the available information also indicates a difference between Kaniama and the other three district studied, with over 80% of the farmers in Kaniama planting maize simultaneously and 53.9 to 62.2% of the farmers in the other districts planting maize and beans either simultaneously or with maize preceding beans (Table A-28). As we indicated in the preceding paragraph, the reason for the difference between Kaniama and the other districts is not clear and the effects on maize yields of these planting practices have not yet been investigated.

4.2.3. Maize Varieties and Seed Density

Farmers of the study area use a wide set of seed varieties generally called 'local varieties' and at various seed density. About 90% of the farmers investigated in Tshilenge, Gandajika, Mwene-Ditu and Kaniama generally planted local varieties of maize and the remaining 10% used seed varieties provided by the Institut National des Recherches Agronomiques (INERA) and by Programme National Mais (PNM) (Table A-29).

In the study area, the designation 'local varieties' used by farmers should be taken cautiously. Since 1933, the Institut National pour l'Etude Agronomique du Congo Belge (INEAC) conducted research studies directed to developing varieties of maize that can adapt local conditions and meet consumers' taste. INEAC (which changed to Institut National de Recherches Agronomiques (INERA), in 1974) created or adapted varieties of maize which were passed on to farmers. By 1954, INEAC had distributed 2,836 tons of maize seeds (35, pp. 18-19) and by 1960 the research service had provided 3,090 tons. Today's local varieties are thus the result of intercrossings between local varieties and varieties introduced by INEAC, INERA and PNM.

Since the INEAC maize research programme started at the Gandajika research station, five synthetics (GPS = Gandajika population synthetic) and one double cross hybrid have been produced; INEAC also introduced the Hickory King maize variety in production in the study area. Actually only GPS_3, GPS_4, GPS_5 and the double hybrid are used in production. Programme National Mais has introduced composite varieties developed in Zaire (PNM1, Shaba-Safi) or adapted from CIMMYT varieties (Mexican Tuxpenol). In 1974-1975, Tuxpeno 1), known in Zaire as Salongo, was used in demonstration plots organized by Programme National Mais in Tshilenge, Gandajika, Mwene-Ditu and Kaniama.

Under experimental conditions the varieties created or adapted by INERA or PNM can yield over 6 tons per hectare (73, pp. Appendix Table 1 through 5). But the average yield obtained by farmers on a variety such as Shaba Safi are lower and present a large variability between farms (73, pp. 9-10).

The yield on local varieties is generally estimated at 700 to 1000 kg of shelled maize per hectare with traditional production methods. But even using traditional seeds and densities of planting it has been shown that yields can be increased 1500 to 2000 kg per hectare if farmers take better care to implement complementary inputs in maize production such as good seedbed preparation, planting, weeding and harvesting maize at the right time (42, p. 29).

The density of plants per hectare used in traditional sowing methods is generally low and conducive to low yield per unit of land. Seventeen measurements were taken in Kaniama and southern Kasai Oriental to estimate the density of seeds of maize in traditional methods of planting.

Where maize is planted alone, seed holes are set an average of 100 cm apart and rows are set an average of 100 cm from each other. In maize association, seed holes are 160 cm apart and rows are 100 m from each other.[6/] Farmers often plant two, four, six or more seeds per hill. Let us assume that after germination and thinning, three plants are let to grow in each hill. Under these conditions the maize density in traditional planting methods would vary between 18,750 plants on plots where maize is associated with crops such as cassava, and 30,000 plants in plots where maize is planted alone.

Ex-post, the density of plants on a given plot depends on the density of seeds planted and the proportion of seeds which germinate. The rate of plant germination depends on the quality of the seeds

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[6/] In one village south of Gandajika City (Fig. 3, 1) a farmer who may have visited a PNM demonstration plot was consistently using 25 cm between seed holes and 110 cm between rows.

planted. Given the practice by many farmers not to select maize seeds ahead of time (Table 4. 1) but just to draw from their granary good looking and apparently well preserved cobs, and given the low quality of protection against insects for maize in most village granaries (Table A- 30), and because of the insect damage declared by farmers for maize in their granaries (Tables A-31, A-32), the quality of seeds for germination can be expected to be low. Thus a substantial number of the seed grains taken form the granary may not be of good quality for germination. Farmers of the study area often plant more seeds per hill in an effort to increase the rate of germination and the density of plants per unit of land. The effects on plant germination and seed density of the multiple seed planting technique using maize seed not specially selected and protected in an environment where the rate of insect damage is high, still remain to be tested. But a first approximation based on field observation would suggest that plant population in the traditional planting methods is even lower than the seed densities estimated above. This low density of seed is another source of the low yields per unit of land observed in the study area.

Table 4.1. Proportion of farmers who select maize seeds before, during or after harvest.

Farmer type	Before harvest	At harvest time	After harvest	Other answers
NP	7.3	8.7	78.7	5.9
P	2.6	9.1	84.4	3.9
T	6.1	8.8	79.7	5.4

Programme National Mais (PNM) considers 50,000 plants per hectare as the desired population density. In 1972-1973 PNM used a completely randomized design to test village farming methods against the program's own method. Three hill spacings were used:

One plant per hill, hills 25 cm apart (PNM's method)

Two plants per hill, hills 50 cm apart (common village practice)

Four plants per hill, hills 100 cm apart (common village practice).

The PNM study noted that the difference in seed density between the program's method and the village method was greatly influenced by inter-row spacing differences between its methods and the ones used by traditional farmers. The study indicated that while village farmers often planted two seeds every 50 cm or four seeds every 100 cm, their inter-row spacings were not the 75 cm used by PNM, but varied from 100 to 300 cm. The study went on to conclude that traditional planting methods used by farmers in Shaba were conducive to a population density lower than 50, 000 plants per hectare. The study noted, however, that density of 50, 000 plants per hectare would be high on plots not fertilized by chemicals or the use of legumes (72, p. 31). But the study also indicated that by using well selected and protected local seeds and planting techniques yield could increase to about 1500 kg per hectare if the producer uses what we have called complementary inputs in maize production; i. e. good seedbed preparation and planting, weeding and harvesting at the right time. PNM also showed that these yields could be increased to 2600 kg per hectare, using local varieties of maize, if complementary inputs are combined with a greater seed density (72, p. 7).

Many farmers often explained that they needed a larger space between hills and between rows to make space for other crops which are associated with maize and/or to have enough space between plants and between rows for easy movement at the weeding and/or harvesting time. More investigation thus is needed to evaluate the over all effects of village planting methods. A system of evaluation of seed density and yield in the traditional farming methods must take into account the density of population and the yield in one crop as well as the density of population and the yield on all crops which are associated on the same plot.

4. 2. 4. Use of Chemical Inputs and Green Manure, and Post Planting Protection of Maize Plant

Most farmers of the study area use neither fertilizer nor insecticides directly on maize (Tables A-33, A- 34), although many of them have heard of these chemicals before and some 30% have applied fertilizer to other crops than maize (Table A-35). On demonstration plots organized by PNM farmers are being introduced to the application of fertilizer and insecticides on maize. On plots supervised by the Commission Agricole du Kasai Oriental (CAKO) and TABAZAIRE, maize benefits from the secondary effects of fertilizer used on cotton or tobacco. But given the time lags between the cotton or tobacco harvest and the planting time for maize, these secondary effects often do not result in big yield gains.

Farmers often bury burned ashes and/or partially decomposed weeds under the ridges that they prepare for planting and call these ashes and weeds 'green manure' (Table A- 36). But field observation suggests that there is no extensive use of green manure for the production of maize or any other crop.

About 34 to 60% of the farmers interviewed in Kaniama, Gandajika, Mwene-Ditu and Tshilenge said they visited their maize plots at least once a month after they had finished planting. About 26 to 64% of the farmers in the same districts said they visited their maize plots practically every day (Table A-37). It is not known how well these visits are related to weeding, thinning or replanting. Although many producers weed their maize, field observation raises the suspicion that a sizable proportion does it late because there appears not to be an established calendar for the time when weeding has to take place. A single weeding of a maize plot or the practice of late weeding, as it appears to be the case of some farmers in the study area, may result in low maize yields.

4. 2. 5. Crop Associations and the Area Planted to Maize

The term crop association refers to a combination of crops planted on a given plot in a given season. When crops are not planted more or less simultaneously, the association is called, here, a succession of crops. Miracle (56), Jurion (41), Van den Abeele and Vandenput and the 1970 Zaire/FAO survey of agricultural production in Zaire (84) indicate that Zairian farmers use a variety of crop associations which are adapted to ecologic conditions and specific to each social group or set of social groups.

The most common maize associations in the survey area are maize-cassava, maize-beans, maize-cassava-beans, maize-cassava-ground nuts (Table 4. 2). Of lesser importance are maize-ground nuts, maize-cotton, maize-cassava-ground nuts-beans, maize-ground nuts-beans, maize-banana.

Many farmers plant two or three separate plots of maize and in about 55% of these plots maize is associated with other crops; however, if the area devoted to each maize association is taken as the basis for comparison, one notices that in the survey area maize is planted more alone than associated with other crops (Table 4. 3).

Table 4.2. Percentage of plots planted with each of the major maize associations (%).

	Maize Association							
Farmer type	Maize alone	Maize beans	Maize cassava	Maize ground nuts	Maize cassava ground nuts	Maize cotton	Maize cassava beans	Sample size
NP	43.3	10.5	28.9	3.9	4.9	1.3	7.2	305
P	52.2	8.7	27.8	4.3	7.0	0.0	0.0	115
T	45.0	10.0	28.6	4.0	5.5	0.9	5.2	420

NP = Non-supervised farmer
P = Supervised farmer
T = Total

Cropping patterns in the survey area also show a predominance of cassava all over the four districts; cassava is planted alone, or, more often associated with maize, ground nuts and beans. Thus, although farmers show strong preference for maize, in current consumption, strategic reasons bring them to plant cassava whenever possible in order to guarantee a steady supply of food for the household. In the survey area, cassava has a growing period of about 18 months, which is a longer period than maize, but it presents various advantages that reduce the risks of growing it. Cassava can be harvested continually for about six months after the

Table 4.3. Farm size and proportion of land devoted to each crop by district and affiliation. (%)

Crop Association	District											
	Gandajika			Mwene-Ditu			Tshilenge			Kaniama		
	NP*	P	T	NP	P	T	NP	P	T	NP	P	T
Maize	26.2	25.9	26.1	22.0	18.1	20.8	18.7	9.7	16.2	22.1	25.5	23.0
Maize-cassava	14.8	14.7	14.8	5.2	8.4	6.1	11.0	26.7	15.4	12.5	5.5	10.7
Maize-bean	2.1	1.5	1.9	5.2	3.6	4.7	4.8	4.9	4.8	6.9	1.5	5.5
Maize-cassava-bean	0.7	0.0	0.5	0.2	0.0	0.2	3.2	0.0	2.3	2.3	0.0	1.7
Maize-cassava-ground nut	3.3	0.0	2.3	10.5	7.2	9.5	1.4	0.0	1.0	0.5	2.7	1.0
Cotton	5.6	30.2	13.3	6.4	33.4	14.5	8.1	30.6	14.4	2.0	1.0	1.8
Tobacco	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	20.9	5.9
Cassava	34.5	26.3	32.0	39.8	26.8	35.9	35.2	21.0	31.2	47.8	27.2	42.5
Ground nuts	8.1	1.5	6.0	0.1	1.4	0.5	5.1	7.3	5.7	0.0	1.4	0.4
Beans	1.4	0.0	1.0	1.5	1.1	1.4	4.4	0.0	3.1	0.3	0.1	0.2
Other	3.3	0.0	2.3	9.1	0.0	6.4	8.3	0.0	6.0	5.0	14.3	7.4
Average farm size in hectares	1.59	1.75	1.64	1.45	2.00	1.58	1.40	1.59	1.45	1.93	1.57	1.82

* NP = Nonparticipant in supervised agriculture   P = participant in supervised agriculture   T = Total

first 18 have been reached; roots that are not needed immediately are kept (stored) underground, in the field, with no major risks of deterioration (34, p. 104). Thus, cassava constitutes a food reserve for most farmers, a precautionary reserve against poor maize harvests and a basic source of food during the last months that precede a new harvest of maize. This means that any commercial crop or any crop which increases the variance of cassava on hand must substantially compensate for the loss from reducing the size of cassava holdings. This is a necessary condition for the new crop to be adopted or to stand a chance for long run success.

In terms of the total area planted to all crops, a comparison between supervised and non-supervised producers indicates that except in Kaniama, the average supervised farmer holds a larger total area than an average non-supervised agricultural producer (Table 4.3). The difference between supervised farmers in Kaniama and supervised farmers in the other districts is probably due to the fact that production of tobacco, a very labor intensive crop, takes place in September through February, the period during which most of the traditional crops are planted. The data in Table 4.3 also indicate that the average farmer in Kaniama holds a larger total area planted to all crops than farmers in the other districts. The reasons for this difference between Kaniama and other districts are not known. But in some areas of Kaniama the presence of a forest vegetation made of big trees may account for some of the difference. In this area, farmers have to clear a large portion of land to compensate for the space which cannot be used for planting because it is occupied by big logs and standing trees. In other areas factors such as the rate of participation of household members in agricultural work, and a larger proportion of farmers with previous experience on a large commercial farm (Table A-38) may account for the larger total area planted in Kaniama.

If we compare supervised and non-supervised farmers in the four districts under study, the data shows that except for Tshilenge, supervised farmers allocate proportionately less of the land they plant to maize than do non-supervised farmers (Table 4. 4). This is a direct consequence of the proportion of the supervised farmer's total area taken by the production of cotton or tobacco and the requirement by the supervising authority that these commercial crops be planted as single crops.

In relative terms, a comparison of the area planted to maize indicates that producers in Gandajika allocate proportionately more of the land they plant to the production of maize than farmers in the other three districts. The greater relative importance of maize in the production patterns of farmers in Gandajika may be explained by the importance taken by this district as the major local supplier of maize for the town of Mbuyi Mayi.

An analysis of the production patterns of supervised farmers indicates that in Gandajika and Mwene-Ditu these farmers plant maize proportionately more as a single crop than in association with other crops (Table 4. 4). But the data for all farmers suggest that where specialization in maize occurs, producers tend to plant maize more as a single crop than in association with other crops (Table 4. 5). This non-cropping trend is apparent in the cropping patterns of supervised farmers .(Table 4. 4).

Although crop associations take less than 50% of the land planted by farmers of the study area, one may want to try to explain why farmers practice crop association at all. In the multiple period production and consumption system that faces a farmer, crop association may be an effective way of allocating the scarce labor resource, over time. The maize and cassava, and ground nut and cassava associations are examples of such an effective allocation of labor over time. Maize and ground nuts are seasonal crops; if they were planted as single crops, plots on which these crops would be planted would remain idle between the harvest time and the beginning of the new planting season because, in the between period, ecological conditions are not favorable for planting. During the idle period weeds would invade the plots and thus force the farmer to provide for extra effort when the plot is cleared and opened again. Since the cassava growing period of 18 months extends beyond the three to four months required for growing maize, a labor saving

Table 4.4. Maize production patterns of farmers grouped by affiliation.

	District							
	Gandajika		Mwene-Ditu		Tshilenge		Kaniama	
Production pattern	P	NP	P	NP	P	NP	P	NP
Percentage of the total area planted to all maize associations	42.1	47.1	37.3	43.1	41.3	39.1	35.2	44.3
Percentage of the total area planted to maize only	25.9	26.2	18.1	20.8	9.7	18.7	25.5	22.1
Maize alone as a percentage of the total maize area	61.8	55.6	48.5	48.0	23.5	47.8	72.4	49.8

Table 4.5. Maize production patterns of all farmers.

	District			
Production pattern	Gandajika	Mwene-Ditu	Tshilenge	Kaniama
Percentage of the total area planted to maize	45.6	41.3	39.9	41.9
Percentage of the total area planted to maize only	26.1	20.8	16.3	23.1
Percentage of all maize area planted in maize only	57.2	50.4	40.8	54.9

technology may favor the association of short growing period crops with long growing period crops particularly where the planting period for the associated crops coincides and the interaction between crops may result in minimum losses on associated crops. Though more is needed to evaluate yield gains or losses in crop association, for crops such as cassava which can adapt to very poor soil (101), association with other crops may appear to reflect an effective way of allocating scarce labor.

4. 3. Maize Harvest and Protection

4. 3. 1. Maize Harvest and Disposal of the Harvest

Farmers harvest maize three to four months after planting (Table A-39); depending on the variety and the district, the growing period may be longer. Most farmers let maize husks dry in the field before harvesting it in late January or early February. According to the former INEAC standard (82), 33 man hours are needed to harvest one Ha of maize planted according to modern technology, and Van den Abeele insists that maize should be well dried for successful conservation (101, p. 150). The short length of the January dry season and the social distribution of agricultural work among males and females in a household do not facilitate a fast harvest and a successful maize conservation.

In the study area, maize harvesting is mostly a females' job (Table A-40), although some males are helping their wives get maize in the granary. Farmers often let maize dry in the field. But as they increase the length of maize exposure to sunlight they run the risk of labor shortage when rains return. And when this misfortune happens, as it often does, some maize has already started deteriorating when it is finally harvested. In an effort to overcome labor shortage at harvest time, farmers' wives often enter into work sharing agreements with each other in order to speed up harvesting on each plot. A modified version of the work sharing agreement between village women includes maize payment to helping harvesters. This practice is becoming popular in villages neighboring commercial and administrative centers; there women traders and some city women move to the countryside at harvest time, offering their services to one producer after another in return for one to two baskets of maize. Similarly, urban women often visit their village at harvest time and help their parents for some maize baskets that they bring back to town. In the neighborhood of the town of Gandajika, labor shortages often bring some farmers to selling whole plots of maize; the buyer then hires workers who harvest maize at the buyer's expense.

Maize harvest belongs to the household. Before granaries are "sealed off" to other members of the household, the family head allocates a portion of the crop to each member of the household who participated in the production; an additional amount is given to the housewife for the family's immediate consumption needs. The individual allocation is a property of the receiver who can sell or use it for any purpose of his or her choice. The head of the household allocates maize in the granary between consumption, seed and sales when he so judges convenient; under normal conditions access to the granary is under his unique authority, although ethnic and sociological differences vary the rigidity with which this authority is applied.

4.3.2. Maize Protection

Most farmers store maize in the husk (Table A-41) and use smoke and heat from the kitchen fire in an attempt to speed up the drying process and keep bugs away. Chemical insecticides and raticides are not commonly used in post harvest maize protection (Tables A-30, A-42).

Generally, once maize is harvested it is stored in the house or in an outside granary (Tables A-43, A-44). Over 80% of farmers in Gandajika store their maize in the house; in Tshilenge and Kaniama about 60% of the farmers store consumption and seed maize in their house, and the remaining 40% store in outside granaries. In Mwene-Ditu over 50% of the farmers, particularly the Bena

Kanioka people, store seed and consumption maize in outside granaries. In the house, maize husks are laid down in the attic (Tshisasa), stores in big baskets (mitenga) capable of containing six to seven women's standard baskets (a woman's standard basket can carry 200 to 250 husked maize ears), or hung in a bunch of cobs, 100 to 150 cm above the fireplace.

Many farmers use big baskets as temporary storage facilities for maize to be eaten or sold in the near future; big baskets are generally laid on the ground in one of the house corners. In the house maize is protected by the smoke and the heat from the kitchen fire. Granaries which are separated from the house are mud or stick and twig huts with thatched roofs, just like the farmers' homes, but smaller in size. They may also be rectangular frames off the ground with an attic protected by a thatched roof.

A large crop of maize often forces farmers to lay maize husks on the ground, inside the granary. But even above the ground, high degrees of humidity in outside granaries, which are seldom heated, often increases mold and indoor germination.

In the village, granaries are built within 10 m of the main house (Table A-45); off the village, granaries are built in the field or in its neighborhood. The latter practice was encountered in the Bena Kanioka area of Mwene-Ditu and Gandajika. In Kaniama most village granaries are separated from the maize field by 200 to 1000 m; in Mwene-Ditu and particularly in Gandajika and Tshilenge most village granaries are within 100 m of the nearest maize field (Table A-46) because most farmers maintain a plot of maize around the house. Neighboring village granaries are not very distant from each other either; less than 100 m generally separate adjacent granaries (Table A-47). Just before the new maize is brought in, most farmers clean their granary and get the attic ready (Table A-48). Most farmers do not think that granaries are the origin of insects, instead they find in maize fields themselves the main source of weevils and rats which attack maize (Tables A-49, A-50).

Maize has to be protected against weevils and rats, but the greatest danger to harvested maize comes mainly from insect damage (Tables A-31, A-32). Weevils attack maize before it is harvested and thereafter develop in the granary as time elapses after harvest.

Ten Kg of apparently clean shelled maize were stored in a plastic bag for observation in the cement house we were living in. After one month the bag was full of weevils and the grain was completely infested. The experiment was intended to show that even apparently clean grain were not completely free of larvae or weevils, and that a cement storage was not necessarily a complete protection against bugs. Farmers are aware of the sources of weevils; 71.6% in Kaniama, 57.7% in Mwene-Ditu, 50.6% of the producers in Tshilenge directly pointed at their fields as the origin of the bugs; but it seems that many farmers have not derived direct conclusions on when to harvest or how far their maize plot should be from their house for best protection. Up to 90% of the farmers in Gandajika, Tshilenge and Mwene-Ditu plant maize all around their house and increase the risk of transfer of bugs from the field to the house and/or the granary and from the granary to the field.

Of the surveyed farmers, only 14.9% selected and separated seed grain before or at harvest time (Table 4.1) and only 7.4% to 19.2% of the respondents in various districts applied different treatment to future seed grain to protect it against insect damage (Tables A-30, A-42).

Maize storage in the study area is inadequate and farmers often lose a substantial proportion of their harvest as a result of late harvest and/or poor post harvest protection. Over 60% of the surveyed farmers acknowledged heavy insect damage in stored maize (Tables A-31, A-32). Often insects attack part of the maize before it is harvested, and the system of granaries adjacent to growing maize plots increases the ease with which insects can transfer from the fields to the granaries and from the granaries to the fields. In storage, losses are due to poor ventilation and high temperature and humidity in the granary, particularly in non-heated mud granaries used for maize, and to a lack of insecticidal and raticidal treatments. Tests run at the Gandajika Research Station in January and February 1975 indicated that the moisture content of maize freshly harvested by farmers exceeded 20%. Field observation indicated that some maize had molded and was germinating before it was harvested. Excess moisture content in stored maize grain increases heating, caking, molding and sprouting (71, p. 56). As the moisture content and the temperature increase, temperature and humidity are gradually achieved at which insects that attack maize can breed and spread to the whole of the stored maize grain (71, pp. 56-57; 18, pp. 376-378). Given the system of storage of maize and seed grain in the survey area, inadequate storage results in high losses and seed grain of low quality for germination.

4. 4. Organization of Maize Production and Knowledge of the New Maize Technologies

4. 4. 1. Organization of Maize Production

In the study area, the production of maize and other food crops is left under the control of peasant farmers. Theoretically district representatives of the Regional Department of Agriculture carry on the execution of agricultural plans of the Department of

Agriculture. District agricultural authorities use the services of extension agents, the 'moniteur agricole', to reach farmers scattered over the production area under their authority. About half of the farmers we surveyed acknowledged having been visited by a 'moniteur agricole' during the 1973-1974 production season, but only 12.0% acknowledged they received advice on how to grow maize. An interdistrict comparison of the surveyed districts indicates that the action of the extension agent is more spread out in Gandajika and Tshilenge than in Kaniama and Mwene-Ditu (Tables A-51 , A- 52). The survey data also indicate that more supervised farmers were visited by extensionagents thannon-supervised ones (Table A- 51). The more widely spread presence of the extension agent in Gandajika and Tshilenge is due to the fact that the first effort to revive agricultural production started in these districts before reaching Mwene-Ditu and Kaniama. Supervised farmers are more in contact with extension agents because, in addition to the visits of district extention agents, the supervised farmer receives special extension advice for the production of cotton or tobacco.

In many parts of the study area the extension agents are accepted by farmers as the regular channel for the provision of information. Of the surveyed farmers, 38.9% to 73.5% indicated they would consult with the extension agent if they had questions about hybrid and composite maize. But the training and material facility of the extension agent do not always make it possible for him to help the producer. The average 'moniteur agricole' has about three years of secondary school training with emphasis on general agriculture. According to two 'moniteurs agricoles' who were temporarily released by the District of Kaniama to be part of our survey team, lack of transportation equipment often limits the logistic support that they can provide to producers.

4.4.2. Agricultural Experience and Knowledge of New Technologies to Improve Maize Production

The agricultural experience of a farmer and his knowledge of other ways to increase his production affect his predispositions to try new ideas such as the planting of new varieties of maize, the adoption of a new agricultural calendar and changes in cultivation practices.

When we interviewed them, 61.2 to 73.2% of the farmers in Tshilenge, Gandajika, Mwene-Ditu and Kaniama had been farming for more than ten years (Table A-53); 38.2 to 62.7% had held a paid job in the past (Table A-54) and for 4.5 to 8.8% of the farmers in Mwene-Ditu, Tshilenge and Gandajika, and 22.2% in Kaniama, the paid job had been located on a large commercial farm or a plantation (Table A-38). The difference between Kaniama and the other districts arises probably from the fact that Kaniama was a settlement for Belgian colonists who farmed extensively some of the land of this district before independence, and used natives as workers on their farms and concessions.

Of the farmers interviewed in the study districts 23.9 to 58.3% were aware of the existence of new technologies to improve maize production (Table A-55), and 17.9 to 59.3% were aware of the existence of hybrid and/or composite varieties such as Salongo, PNM 1, Shaba Safi, GPS 3 or GPS 4 (Table A-56). For most farmers, this awareness developed between 1970 and 1974 (Table A-57), perhaps with the development of the action of Programme National Mais (PNM) since 1973, in collaboration with CAKO and TABAZAIRE. For most respondents aware of the new maize varieties, the information was obtained from the local extension agent (the 'moniteur agricole') or from neighbors (Table A-58).

By 1975, 30% of the respondents in Mwene-Ditu, 10.2% in Kaniama and 10.3% in Gandajika had planted hybrid or composite maize. Most respondents who had planted new varieties of maize had done so within five years prior to the survey, particularly in 1974-1975 (Tables A-59, A-60), following an increase in demonstration plots by PNM. Because of the collaboration of PNM with CAKO or with TABAZAIRE, proportionately more supervised respondents were aware of and had planted new varieties of maize than had non-supervised farmers (Table A-56, 59).

Insecticides and fertilizer are used in the survey area for the production of cotton, tobacco and to a small extent, maize. A small fraction of the respondents, mostly supervised ones, had applied fertilizer and insecticides to maize (Table A-61). A greater proportion of the respondents had applied fertilizer to other crops, mostly cotton or tobacco (Table A-62, A-63). Historically, many respondents who had applied fertilizer or insecticide to maize, cotton or tobacco had done so for the first time either during the paysannat period of the 1950's, or within the five years prior to our interview (Tables A-64, A-65).

Farmers of the study area seem eager to learn about new methods of producing maize. After Programme National Mais increased its demonstration plots planted with the Salongo variety in southern Kasai Oriental, many farmers came to see for themselves the new maize that neighbors or extension agents had told them about. In the village of Nkwadia, about 40 km southeast of Mbuji Mayi, on the road to Gandajika, two respondents told us they had ridden about 30 km to the village of Nsona to look at the new maize. Six producers were planting maize at Nsona, using credit for seeds, fertilizer, insecticide and technical assistance provided by PNM with some collaboration from CAKO. In Kaniama, respondents in and out of TABAZAIRE production schemes told us they had visited PNM's demonstration plots where some of their colleagues had planted a new variety of maize. Some had ridden to the 'Domaine de Kasese' where a full scale completely mechanized production scheme supervised by Belgian and Zairian technicians was producing maize using hybrid and composite varieties such as GPS 3, GPS 4, Salongo, Shaba Safi, PNM 1 and the Rhodesian SR 52. In southern Kasai Oriental as well as in Kaniama, we came across respondents who acknowledged having bought the new variety seeds from neighbors or friends who had held demonstration plots.

Farmers seem even willing to try new production methods. Few growers acknowledged using for maize some of the fertilizer which was initially provided for cotton or tobacco. However, in spite of this willingness the production of maize is limited by such factors as the lack of credit for inputs and the lack of a widely spread system of information on production practices.

4. 5. Labor Availability and Agricultural Production

4. 5. 1. Family Size and Labor Utilization

In previous pages we have already mentioned labor constraint, particularly at peak times, as the major constraint to agricultural production under the actual traditional technology. Over the growing season farmers have to make sure that all their maize, cassava, beans, ground nuts, vegetables, cotton, tobacco, etc., are planted within a given period to secure good yields. Thus, following the first rains the family labor force is needed in planting up to four or five different crops so that agricultural work puts heavy demands on the household labor force.

In the theoretical model, the labor force available in each household was associated with factors such as the age, the level of education and the agricultural experience of the head of the household, the average age of the wife, the number of wives and the number of males and females in the household divided by age groups. In the survey area, the average size of the household was seven persons with a maximum of 21 and a minimum of one person for singles, widows without children, and those whose children were self supporting. If we discount children under 15 years of age, the average number of persons per household capable of performing direct agricultural tasks was three for Kaniama, Tshilenge and Mwene-Ditu, and four for Gandajika. However, in Kasai Oriental, where the secondary school system is wide spread, many young males and females were attending weekday school and thus were not available for agricultural work. Because of a late start, many young males and females were still attending high school at age 21 or 24 and had to be supported by the family. For all practical purposes, the head of the household, his wife or wives and sometimes their aging parents living in the household, were the only labor force available for agricultural work required to sustain the household.

The agricultural work performed by a household can be expected to be affected by the age of the head of the household and that of his wife (or wives), their level of education, (Chapter 2), their past experience in agriculture and the division of tasks between males and females in the household. The age and the agricultural experience of a farmer--which are closely related for most village farmers--and his level of education can be expected to enhance the organizational capability of a household to perform agricultural tasks.

Of the interviewed farmers, the average head of a household was 45 years old (Table A-3) with three years of formal school education (Table A-2) and more than 10 years of agricultural experience (Table A-53). He was married to one wife (Table A-4).

Tasks performed by the household in maize production include clearing, plowing, sowing, weeding, harvesting and pre-storing work. Within the working group in the household, a division of labor assigns activities to men and women jointly or alone. According to interviewed farmers, cutting trees is generally done by men (Table A-66), although women cut small trees. Clearing, plowing, sowing and weeding are done jointly by men and women but occasionally children seven to 14 years of age help their parents weed maize

(Tables A-66, A-67). Of the respondent farmers, most of whom were men, 33.8% said that harvesting is generally handled by women alone and 44.7% said that men and women participate jointly in harvesting maize. Field experience suggests that women are more involved in harvesting than men. Harvesting also involves outside workers (both men and women) who, at harvest time, offer their services for payment in kind (Table A-40). Carrying maize to the market is done mostly by women and by female children (Table A-68).

Hiring outside labor for agricultural purposes is not a common practice among village farmers. About 4.0% of the farmers interviewed indicated that they often hired outside labor force at the harvest time (Table A-40). But for the 1973-1974 growing season, a proportionately larger number of farmers hired outside labor for planting, weeding and harvesting. An interdistrict comparison with respect to hiring outside labor indicated that in Tshilenge--the most densely populated district of the study area (Chapter 3)--more farmers tended to hire outside labor than in the other districts studied. The data also suggest, in Tshilenge, Gandajika and Mwene-Ditu, that farmers hired outside labor slightly more for weeding and harvesting--two tasks performed largely by women--than for planting maize (Table A-69). This observation already gives some indication on operations for which labor availability may be a limiting factor for maize production. We will return to the problem later.

Let us now indicate that over 10% of the respondent farmers in Tshilenge, Gandajika and Mwene-Ditu indicated that they had worked or they were working periodically off the farm during the twelve month period prior to the time of the interview (Table A-70). It was not clear from responses provided by farmers if the differences between districts, in taking off farm jobs are associated with the proximity of medium and large size commercial towns such as Gandajika, Tshilenge, Mwene-Ditu and Mbuji Mayi, or if the off farm jobs are associated with operations such as the collection and the processing of cotton or tobacco. But of the farmers who acknowledged having held an off farm job in the twelve months prior to the interview time, none mentioned having worked for another farm in return for cash.

Field observation and farmers' responses suggest that not many farmers hire outside labor for planting, weeding and harvesting. Only a few village chiefs, schoolmasters and local administrators can get outside labor to do the job. In many of these cases one can seldom talk of hired workers. A school teacher who gets his students to work for him, or an administrator who gets some villagers to help his wife without paying them is not really hiring anybody. A common practice is a job sharing system whereby people from the same village (often young couples and/or single males of the same age group) agree to join in clearing, plowing or harvesting so as to speed up the finishing of each individual task on each participant's plot. For harvesting, this practice often turns into real hiring of outside workers; at the end of the task each worker is paid in kind. In areas surrounding urban communities such as Gandajika and Mbuji Mayi, many urban ladies offer this kind of work force to farmers around the town. The return from these in-kind payments is used for consumption or for sales in urban markets. But as figures in Table A-69 indicate, even in the case of hired labor for harvesting maize, only a limited number of farmers turned to this practice.

Respondents of the study area listed labor shortage, lack of tractor for plowing, lack of good seed and fertilizer as factors most limiting for the production of maize. Of all the major limiting factors suggested, 26.0% to 61.1% of the farmers in various districts cited labor shortage and the lack of tractors for plowing as the most limiting factors for maize production (Table A-71). Yet only a limited number of farmers were using hired labor for agricultural operations. A limited use of hired labor in the study area is due to a combination of reasons, some of which are economic and/or cultural. In a system with a communal ownership of land every member has access to the land and traditionally there is a pride for the head of a household to be able to sustain his family out of the production of his own hands. Under these conditions there is little supply of outside labor in the village for other farmers to use. Thus, in order to expand the use of outside labor, farmers would have to rely on workers from distant towns who accept to work seasonally for immediate cash or in-kind payment. We indicated in the third chapter that most farmers had very limited resources which could be transformed into cash for direct payment. Thus the capability of most villagers to attract outside labor was limited. For harvesting, however in-kind payment is commonly accepted by workers . At harvest, maize is immediately available when the task is accomplished. This may explain why there were slightly more farmers using outside labor for harvesting than for planting maize. This may be explained by noticing that if the outcome of a crop was certain at the harvest time and could be relied upon for cash or in-kind payment, it was completely uncertain at the planting time. From the above discussion we conclude that if the supply of labor force available for use by other village farmers was very limited for most villages of the study area, the capability of a farmer to hire outside labor for agricultural operations was limited by the limited assets and the poor financial situation of many farmers in the study area.

Most farmers rightly indicated that under the present village technology, increasing maize production implies planting larger plots of land with maize (Table A- 74). This is to say that under the present technology maize can be increased by devoting increasing proportions of the available labor force to maize production. But for the multiple product farmer who is already suffering a labor shortage, an increase in the proportion of labor devoted to maize production implies the reduction in the production of other crops which must be produced at the farm. Similarly the introduction of a new crop, mandatory or not, whose production period coincides with that of maize may reduce the quantity of maize produced. The problem of labor availability and labor use is thus of a major importance in the development of agricultural production in the study area.

In order to understand the nature and the effects of the labor problem it is important to refer to the division of tasks in the household and the time periods during which labor shortages for agricultural operations occur. A sample of 108 male respondents from the District of Kaniama and 95 female producers operating in the rural and urban markets of southern Kasai Oriental were asked to indicate during which month of the growing season they planted maize, cassava, ground nuts and beans. These farmers were also asked to indicate which of the agricultural tasks were the most labor demanding and during which month of the growing season they felt labor shortages. Answers provided by the respondents are summarized in Tables 4.6 through 4.9.

Respondents' answers indicate that most farmers plant cassava, maize, ground nuts and beans over the same time period: August to October, and January and February, for farmers in southern Kasai Oriental (Table 4.6); and September, October, January, February and March, for farmers in Kaniama (Table 4.7). In September-October, farmers in the TABAZAIRE System plant tobacco which is a labor intensive crop; and in December-January, farmers in Gandajika, Tshilenge and Mwene-Ditu plant the mandatory cotton.

Once planted, crops need to be weeded and harvested simultaneously, or one crop needs weeding at the same time that another has to be planted or harvested. Thus, over the same time period, the household's limited labor force has to be allocated among clearing, plowing and sowing, and/or weeding and harvesting many crops. Since clearing, seedbed preparation and sowing are, according to farmers, the set of agricultural operations most time consuming (Table 4.8), the simultaneous execution of these operations on all crops that need to be planted cause a labor shortage (Table 4.9) and limit the size of the land which is cultivated in a growing season.

Interviewed farmers suggest that there is a labor shortage in

Table 4.6. Months during which farmers in southern Kasai Oriental plant designated crops.

Crops	Proportion of respondents planting in each month (%)						
	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Cassava	25.6	41.6	10.4	6.4	3.2	6.4	6.4
Maize	37.8	30.0	2.2	0.0	0.0	19.7	9.8
Ground nuts	29.5	35.2	13.9	0.0	2.4	13.1	5.7
Beans	2.5	19.3	52.1	0.8	2.5	15.1	7.6

Table 4.7. Months during which farmers in Kaniama plant designated crops.

Crops	Proportion of farmers planting in each month (%)							
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
Cassava	31.6	16.0	5.8	2.2	12.0	17.3	14.7	0.4
Maize	40.2	14.3	1.4	0.4	19.1	19.1	5.3	0.0
Ground nuts	36.4	17.0	1.9	0.5	19.4	17.5	6.8	0.5
Beans	35.5	18.0	2.5	1.0	19.5	16.5	7.0	0.0

Table 4.8. Agricultural tasks considered most difficult and most time consuming (%).

Task	Area Kaniama	 Kasai Oriental
Clearing, plowing and planting	74.8	39.9
Weeding	21.3	29.4
Harvesting	1.9	19.4
Plowing and weeding	1.9	0.0
Harvesting maize and planting another crop	0.0	6.5
Other answers	0.0	4.8

Table 4.9. Month of labor shortage for agricultural work (%).

Area	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August
Kasai Oriental	1.6	3.9	13.4	8.7	7.9	4.7	3.9	18.9	25.2	11.8	0.0	0.0
Kaniama	18.0	23.0	21.6	9.3	3.6	6.5	9.3	5.8	0.7	0.7	0.7	0.7

Kaniama at the planting time, and a labor shortage in Tshilenge, Gandajika and Mwene-Ditu, during the months of April, May, June and November (Table 4.9). These answers must be interpreted in the light of the division of tasks among household members and the period of the growing season during which these tasks are performed.

Males and females who participate together in clearing, seedbed preparation and sowing indicate that these tasks are difficult and labor demanding; males and females also react the same way in assessing the difficulty related to weeding. Males and females participate together in the weeding of food crops with the females, perhaps, taking a larger share of the task. With an increased use of commercial crops, males have become deeply involved in weeding cotton or tobacco. But males and females diverge completely in assessing the labor demand of harvesting, a task performed mostly by females. Male respondents suggest that harvesting is not very labor demanding (Table 4.8), although a sample of mostly male farmers indicated that harvesting is the one operation for which they hire slightly more outside labor (Table A-69). Thus, the difference in the appreciation of the labor requirement of some tasks which are performed mostly by females may explain the difference between males and females in the assessment of the period over which labor shortage occurs.

A study by Okai on major crops of Uganda indicates that weeding and harvesting were the most time consuming tasks for operations involving cotton, finger millet, ground nuts and cassava (67, p. 110). In addition, investigations by INEAC indicate that in terms of the man day per hectare required for its production, weeding and harvesting are very labor demanding tasks in the set of operations which precede the post harvest treatment of cotton, maize, ground nuts and cassava (Table 4. 10).

Table 4. 10. Man day requirement for operations involved in the production of specified crops.

Operation	Cotton (savannah)	Maize	Ground nuts	Cassava
		Man-days		
Clearing	18.00	111.5	112.50	112.50
Seedbed Preparation	24.00	16.75	35.00	24.50
Sowing	25.00	10.90		17.00
Weeding	64.00	18.00	16.00	100.00
Harvesting	67.00	33.00	130.00	50.00
Post harvest treatment		57.00	32.00	427.50
Total	198.00	247.15	415.50	731.50

Source: (36)

The answers provided by women respondents in Kasai are somewhat puzzling. These women who indicated that clearing, plowing and planting, weeding and harvesting were difficult and labor demanding did not list August through October, and January and February as the critical months of labor shortage. Instead, they said that they were short of labor in November and April through June, a period during which they weeded and/or harvested cotton and the second crop of maize. However, the period of December through March, over which cotton was planted and during which maize, cassava, ground nuts and beans were planted, harvested and/or sold was said by 25.2% of the respondents to be a period of labor shortage. The observation of the participation in agricultural work and the answers provided by women in Kasai Oriental, may suggest that although some tasks are labor consuming, women did not consider them to cause a labor shortage if the work was done jointly by males and females. But when one of the labor consuming jobs was done exclusively or mainly by the females in the household, then the women suffered an acute labor shortage.

The observation of agricultural practices in the study area and the analysis of the system of job sharing and the use of outside labor for harvesting suggest that farmers suffer a labor shortage during periods of peak operations. Labor shortage originates from the small number of household members who are actually involved in agricultural production. Labor shortage during some peak months may also be due to the social distribution of agricultural operations between men and women, and to the limited financial capability for most farmers to hire outside labor.

The effects of labor shortage during peak months are twofold. Labor shortage limits the total area planted and the yield per unit of land. At the planting time, labor shortage limits the area that can be cleared, plowed and planted. In the rush to get crops planted once the first rains have arrived, seedbeds are not prepared with the maximum care and the seeds themselves are not scrutinized to eliminate most of the seeds already destroyed by insects. Because of the many crops that have to be planted simultaneously, some crops end up being planted late. Moreover, as weeds develop simultaneously on most plots, it becomes impossible for farmers to provide thorough weeding for all crops at the right time. Thus, labor shortage during months of peak operations decreases yields. When the time for harvest comes, labor shortage necessitates partial or late harvesting of some crops so that the overall effects of labor shortage result in a low level of total output. Because most crops produced on farms of the survey area are consumption oriented, a low level of output implies a lower level of marketable surplus that can be shipped to the non-rural area.

In the following section we use regression analysis to investigate the effects of some attributes of the labor supply on the total area and the area planted with maize. Additional explanatory variables such as the distance to market, and the average distance to cultivated plots are added to the attributes of the labor force discussed in the second section of the second chapter.

4.6. The Analysis of the Area in Production of Individual Households

Peasant production function has been used by economists to test hypotheses based on accepted economic theories in order to assess the efficiency of farm operation as compared to theoretical standards with the objective of finding alternative ways of bringing farmers to perform better. B. F. Massell and R. W. M. Johnson for example, used the production function of peasant farmers to estimate the interfarm and intrafarm coefficients for Rhodesian farmers (52). This section is not directly interested in estimating a production function; this study did not generate the necessary data to estimate a production function. Rather, here the area in production by individual households is taken as an approximation or as an indication of production potentials. The assumption underlying this approach is that given the technology used in production and the level of yield achieved in traditional agriculture, the greater the total area planted, the greater the production.

The regression technique is used in this section in an attempt to analyze the parameters which explain the variation in area of planted maize and in total area planted. Variables and the sign of their expected effects on maize area and total areas are summarized in Figure 4. 1. In the following, a short explanation is given for each of the variables in the model.

4. 6. 1. The Variables in the Model

Total Area. The total area planted by a household includes the sum of the areas planted with all crops. The planted area includes plots planted during the 1974-1975 growing season and plots of cassava or banana planted in earlier seasons, but not yet harvested. The variable total area planted is used as a measure of total agricultural production.

Maize Area. The maize area includes the area planted with maize alone and the area planted in maize associations. It is used, here, as a measure of maize production.

Family Size. In the second chapter, we introduced the components of the size of the family as a measure of the labor force which contributes to agricultural production. For our purpose, the family is composed of units of children younger than seven years of age, children who are between seven and fourteen years of age and whom we arbitrarily call 'adolescents', male and female adults (15-24 years) and older people (55 years and over). Children younger than seven years do not contribute to agricultural production. Adults and people over 54 are responsible for agricultural

All variables	Dependent variables	
	Total area	Total maize area
Total area (1/100 Ha)		
Total maize area (1/100 Ha)		
Age of the head of the household (years)	+	+
Average age of the wife (years)	+	+
Family size (Number of persons)	+	+
Ownership of radio and/or bicycle	+	+
Education (years of formal education)	+	?
Years spent under supervision	+	+
Distance to market (km)	-	?
Average distance to the plots (km)	-	?
Number of wives	+	+
Participant in TABAZAIRE	-	-
Participant in CAKO	+	+
Number of wives weighted by their age	?	?
Size of the village	+	+
Tshilenge	?	?
Mwene-Ditu	?	?
Gandajika	?	?

+ Positive effect expected
- Negative effect expected
? Uncertainty of sign of the expected effect

Figure 4. 1. Dependent and independent variables in the model and expected sign of the effect of the independent variables on the dependent variables.

production. In many households, heads of households and/or housewives are the most responsible for agricultural production.

Number of Years Under Intensive Supervision. The number of years a farmer has been under intensive supervision provides an occasion for learning about production techniques and new opportunities open to agricultural producers. In addition, under CAKO supervised scheme,,as the number of years spent under supervision increases, the number of plots plowed with tractors increases for some producers and further plowing on the same is made easier. Thus, we expect the number of years spent under extension to affect positively the total area and the area planted with maize.

Participation in CAKO and TABAZAIRE. Production of cotton or tobacco under either CAKO or TABAZAIRE production programs requires the producer to conform to instructions set by the supervising agency. This limits the time that participants can devote to food crops. For instance, tobacco is planted in September and October, a period over which maize, and cassava are planted. Cotton is planted in December and January, when a second crop of maize and more cassava and ground nuts can be planted. In addition, TABAZAIRE forbids growing cassava plots near tobacco plots to avoid damage that the mosaic of cassava can cause to tobacco. Thus, tobacco growers are forced to have their plots in separate geographic areas. This inconvenience does not exist under CAKO supervision, where maize, cassava and cotton can grow side by side on the long strip of land assigned to the participant. At the time cotton is planted in December-January, most farmers have planted their maize and cassava in September and October. Thus, the participation in CAKO may have some negative effects on the area planted, but as the number of years of participation increases, the negative effect of participation should be offset by the advantages associated with growing cotton.

Distance to Market and Plots. The variable "distance to market" refers to the distance between the village of the respondent and the market in which the respondent sold his agricultural products, or to the market place closest to the village. The "distance to plots" refers to an average distance between the village and the plots. Distance to market and distance to plots were expected to negatively affect the area planted. A farmer located far from his plots has to walk longer before reaching them, thus losing in the amount of time he can spend plowing, planting, and weeding. A producer located far from market places lacks the information on price and marketing practices that can serve as incentives for greater production.

Village Size. In the survey area, large villages were located along main and secondary roads accessible by motor vehicle. Many large villages also held weekly market operations. Because of the information on prices, and market supply and demand made available through market places, we expect the size of the village to be positively related to area held by producers.

Education. The level of formal education can be estimated by the number of years spent in school. Although formal school training attended by most respondents did not deal with agricultural problems, school education opens new horizons and is expected to have enhanced the capability of school trained respondents to organize the allocation of their resources to production. School education is expected to influence positively the total area planted.

Ownership of Bicycle or Radio. Whether or not a respondent owns a bicycle or a radio is a sign of past performance. However the ownership of a bicycle or a radio can also be considered as an indication of modern orientation and a status that a household is likely to try to maintain by plowing more land to provide commodities for exchange.

District Effect. The district effects are represented by the dummy variables for Gandajika, Tshilenge and Mwene-Ditu; Kaniama is taken as the district of reference. District effects are introduced in an attempt to explain regional, ecological and sociological differences that exist between the surveyed districts and which are not explained by the other variables in the model.

Age. Age is taken as a parameter for physical strength and thus the ability to perform agricultural operations. We expect both the age of the head of the household and that of his wife to be positively related to the total area planted by the household.

4.6.2 Empirical Results

A linear relation was used to relate the total area or the area planted with maize to a set of explanatory variables. The model used is the form

$$Y_j = a_{oj} + \sum_{i=1}^{3} a_{ij} + \sum_{t=1}^{2} c_{tj} + \sum_{k} b_{kj} x_{kj} + v_j \qquad (4.1)$$

where Y_j is the area planted with crops j, a_{oj} is the intercept, a_{ij} denotes the district effect, c_{tj} is the effect of participation in the CAKO or TABAZAIRE extension scheme; x_{kj}'s are the scores on the original variables introduced in 4.6.1 and specified in Table 4.11; v_j is the random error.

Results of the linear relations are listed in Table 4.11 and Table 4.12. Table 4.11 presents interdistrict regression results and Table 4.12 presents intradistrict results. The proportion of the variance in the total and the maize area planted explained by the observed independent variables is small. The coefficients of multiple correlation in the interdistrict regression model are 0.5365 for the total area planted and 0.4037 for total maize area (Table 4.11); and for the intradistrict regression model, the coefficients of multiple correlation range from 0.5476 for Tshilenge to about

Table 4.11. Estimated interdistrict regression coefficients.

	Dependent Variables			
	Total area		Maize area	
Variations	B$^{(i)}$	s$^{(ii)}$	B	s
Constant	51.08	26.5314	41.18	14.2189
Age of the head of the household	0.53	0.4762	- 0.03	0.2609
Size of the village	0.01*	0.0062	----	------
Number of years under CAKO or TABAZAIRE supervised production	8.55*	5.030	- 1.14	2.7453
Size of the family	8.17*	1.7544	1.96*	1.0607
Distance to market	- 0.72+	0.5146	- 0.12	0.2795
Level of education of the head of the household	3.84*	2.3038	0.68	1.2686
Number of wives weighted by age	- 0.43*	0.1902	--	--
Average age of the wife	1.96*	0.5962	0.71*	0.2974
Ownership of a bicycle or radio	27.04*	11.8500	11.89*	6.6985
Number of wives	--	--	2.43	5.5331
Participation in CAKO scheme	21.74	17.5165	12.40	9.7631
Participation in TABAZAIRE Scheme	-52.25*	25.4257	-27.30*	14.0290
Mwene-Ditu	-53.21*	17.2451	-21.66*	9.4732
Tshilenge	-99.43*	19.6636	-30.71*	10.7433
Gandajika	-44.32*	23.6016	- 5.91	10.6735
Coefficient of multiple correlation (R)	0.53658		0.41151	

(i) Regression coefficient

(ii) Standard error

-- Variable not used in a regression

* Significant at the 5% level

+ Significant at the 10% level

Table 4.12. Estimated intradistrict regression coefficients for total area planted.

Variable	District							
	Kaniama		Mwene-Ditu		Gandajika		Tshilenge	
	B(i)	s(ii)	B	s	B	s	B	s
Constant	-63.98	51.22	- 4.01	39.3738	- 7.13	33.9737	65.07	32.9531
Family size	15.38*	3.7297	4.86*	2.8562	12.02*	2.5539	4.23	3.3388
Age of the wife	5.90*	1.3135	1.67*	0.9078	1.51*	0.8267	2.54*	0.9175
Number of wives weighted by age	- 1.25*	0.3428	--	--	--	--	- 0.79*	0.4803
Age of head of household weighted by level of education	0.11	0.1296	--	--	--	--	--	--
Age of head of household	--	--	0.12	0.8708	- 0.16	0.6929	--	--
Education	--	--	4.18	4.3730	--	--	--	--
Size of the village	0.022*	0.0133	0.031*	0.0167	0.021+	0.0138	- 0.55	0.8123
Ownership of bicycle or radio	38.07+	23.4346	25.26	25.2633	9.60	18.7178	44.92*	24.7559
Distance to market	- 0.93+	0.7079	--	--	2.53+	1.8997	- 2.18	2.6541
Years under supervised production	--	--	13.33	10.5392	15.41*	5.8267	-14.91	9.7983
Participation in TABAZAIRE	-17.69	25.9378	--	--	--	--	--	--
Participation in CAKO	--	--	57.67*	31.6956	- 6.38	20.1031	31.22	29.4363
Multiple correlation coefficient	0.5959		0.7005		0.70055		0.5476	

(i) Regression coefficient
(ii) Standard error
-- Variables not used in a regression
* Significant at the 5% level
\+ Significant at the 10% level

0.7006 for Gandajika (Table 4.12). Using an F value (for the null hypothesis of no correlation between the dependent and the independent variables), the overall F ratios indicate that all the regressions are significant at the five percent level. However, for all the regressions in Tables 4.11 and 4.12 less than 50% of the variation in the dependent variables is explained by the independent variables. The small proportion of the variances of the total and the maize can be attributed to many reasons. Variables such as the nature of land (rocky, forest, savannah) and health condition, on which no data were collected, may account for the unaccounted for variance in the total area and the area planted with maize. Besides, as we will discuss later, the assumption of a linear relation between the dependent and all the independent variables for the case under study may be questionable.

We tested the hypothesis of significant district and managerial effects ($a_{ij} \neq 0 \neq c_{tj}$ for all i and t). Interdistrict regression results indicate that the beta coefficients related to the dummy variables for district effects are significantly different from zero at the five percent level of significance, for the total area planted; for the total maize area, district effects are significantly different from zero, at the five percent level, for Tshilenge and Mwene-Ditu only. Interdistrict regression results also indicate that managerial effects of participating in CAKO or TABAZAIRE production scheme are significantly different from zero for the total area planted; for the total maize area, only the effect of participating in TABAZAIRE is significant at the five percent level. In the intradistrict regression results, managerial effects are significant only for the district of Mwene-Ditu (Table 4. 12).

When participation in CAKO or TABAZAIRE is included in the interdistrict function with total area planted as the dependent variable, using dummy variables for participation in CAKO or TABAZAIRE production scheme, the coefficients of correlation (R) are increased only slightly. The value of R changes from 0. 4794 to 0. 4844, for the total area planted and from 0. 3440 to 0. 36251 for the maize area. The contribution of the managerial factors is small and not significant. However, when the district effect is included, after the inclusion of the management effects, the coefficients of correlation changes from 0. 4844 to 0. 5366 for the interdistrict regression model with total area as the dependent variable; for the interdistrict with maize area as the dependent variable, the inclusion of the district effects increased the coefficient of correlation from 0. 36251 to 0. 41151. An F test for the significance of the additional contribution of the management and district effects indicates the managerial effects did not contribute significantly in explaining the variance of the area planted in all crops but significantly affected the variance of the area planted in maize (F = 4.04). The data also indicate that the district effects affect significantly the variation of the total and the maize area held by households (F = 19.79 , for the regression model with total area as the dependent variable; F = 12.09, for the regression with maize area as the dependent variable).

Although significant, in some instances, the net contribution to the explanation of interhousehold variation in total and maize areas made by the management (CAKO or TABAZAIRE) and district dummy variable is relatively small. This could be due, in part, to multicollinearity arising from the inclusion of management and district as explanatory variables.

Some variables included in the interdistrict and intradistrict models were not significant at the five percent level in either the interdistrict or the intradistrict regression results; therefore the contribution of these variables in explaining the area planted in all crops or in maize should be interpreted with caution. Other variables were statistically significant in one or more regression results and not significant in others, perhaps as a result of multicollinearity (interdistrict results), or the size of the sample used (intradistrict results).

Let us now consider the factors which are the most important (as estimated by t-ratios) in explaining the differences in the total and maize areas held by households. The results of the interdistrict and intradistrict models (Tables 4.11 and 4.12) indicate that the size of the family and the age of the wife were significant in the interdistrict and intradistrict regression results, except for the size of the family in the district of Tshilenge.

The ownership of a bicycle or radio, the number of wives (weighted by their age), the level of education of the head of the household and the number of years spent in CAKO or TABAZAIRE production scheme were statistically significant in the total area planted by households in all districts; or the area planted with maize, the size of the family, the age of the wife and the distance to market were the only factors which were statistically significant in explaining the difference between households (Table 4.11). In the intradistrict regression model of Table 4.12 the number of wives (weighted by their age) was significant in Kaniama and Tshilenge; the size of the village was significant in Kaniama and Mwene-Ditu; and the number of years in supervised production scheme was significant only for the district of Gandajika.

Not surprisingly, the size of the family was statistically significant in the interdistrict and intradistrict regression models. As the size of the family increases, more food is needed to meet the nutritional needs of the household and, eventually, more labor is made available for agricultural operations.

The predominance of the size of the family in explaining the variation in the area planted was explored by splitting household members into age groups. The group of members younger than seven years was dropped as not contributing to production. Adolescents (7-14 years), male and female adults (15-54 years) and members above 54 were used as substitute variables for the size of the household. Regression coefficients using these new variables showed at the 5% level that although all the coefficients associated with the variables were positively related to the total area planted, only the number of adolescents was significantly associated with the total area planted. This does not mean that this group of members participate more in agricultural work than older males and females. Rather, the effect of this age group should be interpreted as supportive of the production efforts of the housewife. Participation of members of this age group in taking care of younger brothers and sisters, carrying water jars, and firewood, and, perhaps, in harvesting, allows the housewife to spend more time and effort in field work.

Regression results and the additional contribution of the age of the wife in explaining the variation in the total and maize areas planted by household indicate that the age of the wife contributed significantly in separating household to the extent of overshadowing the age of the head of the household. The age of the head of the household was significant in neither of the regression results.

However, this lack of statistical significance should not be taken as an indication that the husband is unimportant in agricultural work. Other attributes such as the level of education of the head of the household indicate, in some instances, that there is a significant effect between the total and the maize areas planted and some qualitative or quantitative attributes associated with the head of the household.

In order to check on the association between the age of the head of the household and the total area planted, principal component analysis (65, 94, 27) was conducted on a set of 31 variables including all of the variables represented in Table 4.11. The first component which accounted for 38.33% of the variation in the total area planted by 275 of the respondents also accounted for 51.48% of the variation in the ages of the wives and 39.25% of the variation in the ages of the heads of the household. We then considered components with eigen values greater or equal to unity which accounted for at least 1% of the variation in the total area planted. Together, these components accounted for 83.44% of the variation in the total area planted, 79.99% of the variation in the age of the head of the households and 85.46% of the variation in the age of the wives. This result indicates that although the association between the total area planted and the age of the wife is stronger than the association between the area planted and the age of the husband, the latter association is undeniable. However, because of the relationship between the age of the head of the household and the age of the wife and other variables in Table 4. 11, the effect of the age of the head of the household is overshadowed.

In the beginning it was thought that the various explanatory variables were linearly associated to explain the variation in the total and the maize area planted. Relation 4. 1 was based on this linear assumption. However, the emergence of the age of the wife as the major factor in explaining the variation in the area planted and the small proportion of the variance of the area planted accounted for by the explanatory variables suggested that an examination of polynomial trends would be warranted in trying to explain more of the variance in the area planted in maize and all crops. According to the theoretical model of the second chapter, the contribution of the wife to the work force for agricultural operations increases with age at a decreasing rate (chapter 2, relation (2.8) and (2.9). Thus the incorporation of a model with a second degree polynomial trend in the age of the wife would be warranted to explain the differences in the total and the maize area planted by households.

The model selected is of the form depicted in relation (4. 2).

$$Y_j = a_{ij} + \sum_{i=1}^{3} (a_{ij} + \sum_{t=1}^{2} c_{tj} + dX_{1j}^{2} + \sum b_{kj}X_{kj} + v_j \qquad (4.2)$$

where X_{1j}^2 is the square of the age of the wife; a_{ij} the district effect for a household 'j' of belonging to a district 'i'; c_{tj} the management effect of belonging to a supervised scheme 't'; and X_{kj} are the dependent variables defined in Table 4.13; v_j is the residual factor and 'd' is the beta coefficient associated with the age of the wife. We expect 'd' to be negative.

In Table 4.13, regression results for the interdistrict model are displayed with total and maize areas as the dependent variables. Because of the multicollinearity that may arise from adding multiplicative terms to a multiple regression equation some explanatory variables in Table 4.11 were dropped in order to avoid singularity in the matrix of the explanatory variables.

The estimates of the multiple regression equation with a second order polynomial trend in the age of the wife indicates that 96.61% of the variation in the total area and 61.47% of the maize area planted are accounted for by the independent variables (Table 4.13). Besides the district and management effects which we discussed in the linear model, factors most important in explaining the area planted (on the basis of their t-ratios) are the age of the wife, the size of the family, the level of education, for both the total and the maize areas. The number of years spent in a supervised production scheme, the distance to market and the distance to cultivated plots were significant only for the total area planted. The size of the

Table 4.13. Estimated interdistrict coefficient for the non-linear model.

	Dependent variable			
	Total area		Maize area	
Independent Variable	B(i)	s(ii)	B(i)	s(ii)
Constant	-226.30	0.6174	-129.07	12.4337
Average age of the wife	25.14*	0.3254	12.52*	0.6958
(Average age of the wife)^2	- 0.14*	0.0019	- 0.08*	0.0046
Number of wives weighted by their age	--	--	1.26*	0.1028
Family size	- 7.05*	0.3320	- 11.66*	1.0402
Level of education	8.67*	0.4720	4.38*	0.8280
Number of years of participation in a supervised production scheme	2.93*	1.0808	- 2.25	1.8824
Size of the village	--	--	0.004*	0.0022
(Distance to market)^2	- 0.02*	0.0019	- 0.01	0.0344
(Average distance to planted plots)^2	- 7.34*	0.6944	--	--
Participation in CAKO production scheme	25.48*	3.8018	24.95*	6.6225
Participation in TABAZAIRE production scheme	-110.91*	5.6174	- 54.45*	9.7103
Mwene-Ditu	-125.01*	3.7750	- 55.60*	6.5460
Tshilenge	-154.59*	4.0832	- 75.34*	8.6148
Gandajika	- 70.96*	4.0016	- 21.92*	7.0243
Coefficient of multiple correlation	0.98293		0.78405	

(i) Beta regression coefficients

(ii) Standard error

* Significant at the 5% level

-- Variable not used in a regression.

family is still significantly associated with the total and the maize areas planted, but in the non-linear regression results of Table 4.13, the beta coefficients associated with the size of the family are negative. We had expected a positive sign for the effects of the size of the family on the total and the maize area planted. The sign of the beta coefficient associated with the size of the family thus suggest either that we have a bad regression or that there is a specification error in the way the size of the family enters the regression model as a measure of the labor force. Another approach of introducing the size of the family as a measure of the labor supply, consists in assigning coefficients to each member according to his contribution to agricultural work and thus creating a composite variable for labor supply. One way of achieving this is to assign a coefficient of unity to, say, female adults, lower positive coefficient to the other family members, and a negative coefficient smaller than unity, in absolute value, to children under seven years of age. The negative sign for this group of members being the reflection of the assumption that the time spent in caring for them is taken from labor which would have been used in production. This procedure was not used here because of the difficulty involved in estimating the necessary coefficients.

The distance to market and the average distance to cultivated plots were significant in the interdistrict model with the total area planted as the dependent variable. Although many respondents reported to have only one to two kilometers to walk to get to their fields, some farmers in areas of greater population density, such as around Kaniama City and along the road from Mbuji Mayi to Gandajika City reported to have ten or more kilometers to walk to get to their plots. Regression results suggest that the average distance to cultivated plots affects significantly the total area planted. Thus, as the population and the rate of occupancy increase in the survey area, or as more large concessions are granted forcing farmers to walk farther to get to good land, the area planted by households grouped in village units will be adversely affected.

The regression results with the maize area as the dependent variable indicate that the coefficients of the variable "the number of years in a supervised scheme" has an opposite sign to one expected (Figure 4. 1). However, this coefficient is not significant at the five or ten percent level. Over all, except for the unexpected sign for the beta coefficient associated with the size of the family, the regression results in Table 4. 13 conform with our expectation for variables in Table 4. 13 whose signs are predicted in Figure 4. 1. Specifically that the total area planted in all crops positively related to the age of the wife, the level of education of the head of the household, the number of years under the CAKO or the TABAZAIRE advisory system and whether or not a farmer is under the CAKO system. For the total area planted, the second order polynomial regression result also indicates that as the wife gets older she contributes less to the family work force and that the distance to market, the average distance to cultivated plots and participation in the TABAZAIRE system affect negatively the total area planted in all crops. Except for the case of distance to market and the number of years spent under the CAKO or TABAZAIRE system, the above conclusions can be extended to the maize area as well.

4.7. Conclusions and Implication for Maize Production

In village production methods, the quantity of maize produced depends on the area planted to maize and the use of yield improving techniques such as good seeds, appropriate seed density and planting, weeding and harvesting at the right time. The area planted with maize and the timely execution of planting, weeding and harvesting depends on the labor force available in the household at peak periods for these operations, and on the degree of participation of household members in agricultural operations.

Regression results indicate that the age of the wife and the size of the household are the factors which account for a large proportion of the variation in the total area and in the area planted with maize. Field observation suggests that the quantity of maize and other crops produced is limited by the quantity of labor available during peak periods for agricultural operations. In many households, agricultural labor is short at peak time because of the small number of members who are actually involved in agricultural production, and, to some extent, because of the division of tasks between males and females which assign the execution of some tasks more or less exclusively to females. Given the number of traditional, mandatory and non-mandatory commercial crops which must be planted, weeded and/or harvested at the same time, labor shortages during periods of peak operations limit the area which can be properly planted and the timely execution of weeding and/or harvesting of maize. Furthermore, because of the financial situation of most farmers and given the socio-cultural environment of the village society, most village farmers are not able to hire outside labor force.

Field observation also indicates that many farmers do not make a thorough selection and protection of maize which is to be used as future seeds. Because of the inadequate storage system, maize seeds which are planted are not of good quality to secure good germination and adequate seed density. Low seed density, and late planting, weeding and harvesting tend to decrease maize yields; and low yields on small plots of land planted with maize tend to keep the quantity of maize produced by each household at a low level.

In maize production, plant breeding research conducted by

PNM can contribute to a higher productivity of labor per unit of land. This means that more maize can be produced on the same plot of land and perhaps that food needs in maize can be met by plowing less land, thus saving in the labor input required for the pre-harvest operations. This labor can be used for the production of commercial and food crops. Research already in progress should be continued in the direction of genetic improvement such as the development of shorter maize stalks, of genotypes which are more tolerant of weed growth and of varieties with a shorter maturation period. All these improvements will have direct and/or indirect effects to improve yield and/or to reduce the labor requirement by easing or altering the peak labor demand for maize operations as compared to peak labor demand for other crops which also need to be produced. However, these genetic improvements would not be considered as substitutes for research on methods to increase and save the labor force involved in agricultural production at each household level. In fact, the observation of demonstration plots organized by Programme National Mais in southern Kasai Oriental and in Kaniama suggests that the planting of maize according to norms recommended by this agency may increase the labor demand of maize, particularly at harvest time.

The conclusions of this study are that maize production can be improved by the promotion of yield increasing and labor saving production practices. Factors which are likely to increase yields are: 1) better selection of seed; 2) the use of adequate storage and post harvest protection practices; 3) good seedbed preparation; 4) adherance to an agricultural calendar for a timely execution of planting, weeding and harvesting; 5) the increase in the density of plants for each maize plots.

In order to carry out an agricultural calendar, the role of an extension agent may become crucial for explaining the instructions at the local level. Because of the vast production area that an extension agent would have to cover to reach farmers, specific radio programs with reference to maize production may be organized at the provincial level to simplify the task of the extension agent. The effectiveness of the extension service may require a reorganization of the actual system with major emphasis on the training, logistic support for the extension agents and an active participation of farmers.

Where maize is planted alone, plant density can be increased by reducing between rows and between hills spacings; but where maize is planted in association with other crops, additional study may be needed. To determine the effects of the association and the consequences of shifting from association to single crops of maize.

Measures directed at increasing the labor involved in maize production are of the social and technical nature. Social changes which may increase available agricultural labor force including a greater participation of adult household members in operations involved in maize production, particularly a greater participation of the husband and children in the harvesting of maize. Eventually the school calendar in various districts could be set in such a way that one of the school breaks coincides with the harvest season. Such a school calendar would allow household members still in school to go back to their village and help their parents harvest maize.

A potential source of agricultural labor is constituted of the unemployed and marginally employed men and women who besiege urban and semi-urban communities. Most of today's farmers are too poor to hire outside labor force and, perhaps, communications are generally too bad to permit rapid access to farmers who need help. Policies to get these urban unemployed men and women to join their villages and become farmers have failed because of the deteriorating of the conditions of life in the village, and a biased investment policy which, apparently favored urban development. A reversal of these policies and a modification of the distribution of income seem to be a prerequisite for the reduction of the rate of migration of potential farmers and the change of attitudes toward returning to the rural area.

Labor saving techniques that might be used in the survey area include:

1) oxen or mules for plowing
2) tractor plowing
3) chemical herbicides.

To develop the use of oxen for plowing, farmers must own oxen or be able to buy or rent them. In the survey area, no farmer owned a single head of cattle and no cattle raising operation was able to provide enough oxen for farmers to buy or rent. Given the poor economic status of the farmers and the absence of bank credit to small scale farm operations, oxen plowing is not a likely alternative to increase maize production. CAKO and TABAZAIRE have been using tractor plowing as a labor saving technique in the production of cotton or tobacco. However, given the foreign exchange requirement for the importation of tractors and parts, only a few tractors can be available in each of the CAKO or TABAZAIRE production areas. Because of the transportion problems only a limited number of farmers can benefit from their services.

Similar to the CAKO or TABAZAIRE system, a scheme can be organized for the production of maize, with a pool of tractors to ease soil breaking and seedbed preparation. Since the production of cotton does not conflict with the production of the major crops of maize, the activities of CAKO can be extended to include the production of maize. However, given the additional demand for labor by the production of maize for weeding and harvesting, it may finally appear that the production of maize on semi-mechanized schemes has greater negative effects on the production of other crops which must be planted more or less simultaneously. Data from the study area suggest, for example, that a tobacco grower can devote only a limited area to maize production, over the first maize season because tobacco, a very labor extensive crop is planted over the same period as maize. In spite of this immediate effect which may be negative, the experiences in CAKO and TABAZAIRE supervised production schemes suggest that even if only 0.30 to 0.50 Ha of land per household are opened every year, in the long run, the residual effects of tractor plowing on one plot can be large enough to generate savings on labor, when the same plot is hoed in the future.

The use of herbicides as a labor saving technique in maize production has not yet been tried in villages of the survey area. As in the case of the tractor, chemicals and hand tools needed for this technique would be imported. This means that the capacity of Zaire to import and the demand on foreign exchange for greater priority projects could limit the quantity of herbicides available at the critical time. Additional studies are needed to determine the feasibility of an extensive use of herbicides in agricultural production at the small scale level.

In addition to the capital investments just mentioned, better hand tools of the local type and hand tools used in other parts of the world can be introduced in small farm production. Field studies are needed to test how tools such as rakes, light cultivating hoes and wheeled hoes for row weeding can be adapted and/or introduced in small farm production.

Yield increasing and labor saving techniques can bring improvement in maize production; but in order to achieve this objective as rapidly as possible, agricultural production must be organized and superior inputs must be introduced in traditional productions. Field trials and demonstration plots supervised by Programme National Mais (PNM) (72, 73) as well as research work undertaken by the former 'Institut National pour l'Etude Agronomique de Congo' (INEAC) (91, 101) suggest that, in a short run, the greatest increase in maize production in the study area can come from increasing the production of maize per unit of land through the use of improved seeds and chemical inputs. The increase of maize production thus requires investments in research for the creation of the varieties which fit local conditions and the supply of inputs which can secure the best yields.

At the present time the private sector has apparently shown no major interest in the organization of the production of basic foods.

This would indicate that if maize production is to supply the quantities of maize which is required to meet the domestic demand, then a larger share of the public expenditure is to be devoted to support of the production of this crop than has been done in the past.

Another problem which may affect the production of maize is that of land availability. Land availability is not per se a limitation to increasing agricultural production in the study area. Field observation indicates that there are still large areas that could be opened to agriculture. However, since agricultural production is mainly centered around the village organization and owned communal land, and given the requirements of a shifting agriculture, farmers in densely populated areas such as in some parts of Tshilenge and Gandajika Districts are finding it more difficult to get good agricultural land within a walkable distance from the village. And regression results indicate that longer distances to cultivated plots affect significantly the total area held by households (Table 4.13). Thus, for some villages of the study area, a relocation of some village members on land that belongs to other clans, in the same district or across district boundaries may be a way to increase the production of maize and other crops. Additional investigation would be needed, however, to determine conditions under which such relocations could be stimulated and the socio-economic problems to overcome to make relocation programs work.

The problem of concessions in Kaniama also needs to be explored. As we said earlier, in the district of Kaniama, a special legislation has continued the system of large concessions ranging from 200 to over 3600 hectares. The introduction of large concessions has deprived some farmers of their rights to their communal land and/or relegated them to marginal agricultural lands. Because of this, some farmers have been drawn into becoming workers in large concessions whose owners reside most of the year in the towns of Lubumbashi, Kamina or Kinshasa, i.e., far from the Kaniama area. Perhaps many of the natives who are now workers on concessions have chosen to do so because of the more or less regular flow of income that is guaranteed by TABAZAIRE which finances the production of tobacco by providing funds to most concession owners. But one wonders if the granting of concessions should continue, and if concessions should be of the large size as was observed in Kaniama. The experience of countries with land problems where natives have gradually become deprived of their land would suggest that the problem of concessions should be approached with caution. The comparative advantages of big versus small concessions need to be examined as well as the advantages of concessions over improved small scale farms with guaranteed use right on land, but with no claim to individual land ownership. Since TABAZAIRE, a public agency, provides a great part of the financing of many concession operations, we would suggest that TABAZAIRE increase the emphasis on helping more natives to establish as independent farmers instead of contributing to relegating them to marginal land or causing them to be transformed into concession workers.

5. MAIZE MARKETING

Understanding how maize is used in the survey area provides a basis for understanding maize marketing. In this chapter we first discuss the various uses to which households allocate their maize. Then the organization and the performance of the marketing of maize are examined.

5.1. Uses of Harvested Maize

After harvest maize is allocated among consumption needs, seed for subsequent plantings, and sales. Except in a purely reflexive relationship, or as occasional gifts, farmers do not use maize to pay tribute to the chief in the village. Maize harvested is the property of the production unit which produces it. Bartering seems also to be a common practice; depending on the district of origin, 47 to 87% of the farmers interviewed acknowledged using maize for direct payment of debts (Table A-73).

In consumption, maize and cassava flours are mixed with boiling water in the cooking of a thick paste called 'fufu', 'bidia' or 'nshima', which serves as the basic food in this area. Tender maize is often fried or boiled and used as a vegetable. Maize is also used in the preparation of 'tshibuku', 'tchorst' and 'cinq cent' (which are three alcoholic beverages produced by villagers). It is not known how much maize villagers devote to the production of these beverages, but on each market day of the period we stayed in Kasai Oriental, market places at Gandajika City, and in the villages of Nsana, Kamanda and Kaseki sold tshibuku. Furthermore, in Kaniama and Mwene-Ditu where respondents were explicitly asked whether or not they regularly drank tshibuku, respectively 72.2% and 67.2% said they did. In Gandajika and Tshilenge respectively, 48.5% and 33.9% of the respondents volunteered the information that they regularly drank tshibuku.

All farmers in the sample used maize in the preparation of fufu; about 87% used maize in fufu throughout the year and 80.9% of the respondents ate fufu twice a day (Tables A-74 and A-75). Most households of the study area mix maize and cassava flours in the preparation of the fufu mix. However, the proportion of maize flour actually used in the mix is a function of maize availability and cultural and/or regional differences in the preference for maize flour. Responses provided by the respondents suggest that where the average area planted with maize is large, such as in Gandajika (0.75 Ha/household) and Kaniama (0.76 Ha/household), farmers actually used more maize flour in the fufu mix than in Tshilenge (0.58 Ha/household) and Mwene-Ditu (0.64 Ha/household), where the average area planted with maize was smaller (Table A-76). However, given the area planted in maize in Mwene-Ditu, the large proportion of the respondents (50%) who actually used little maize flour in the fufu mix can hardly be explained in terms of maize availability alone. Other factors such as cultural differences in the preference for maize flour seem to play a role in the determination of the quantity of maize flour which is actually used.

Ninety-three women producers of maize selling in rural and urban markets of predominantly Baluba-Kasai homeland (Southern Kasai Oriental) and 107 respondents in Kaniama were asked the hypothetical question about which fufu mix they would prefer to eat if they had to choose only one of the following four fufu mixes: the first of cassava only; the second of maize only; the third of maize and cassava with maize flour dominating; and the fourth of maize and cassava with cassava dominating. Table 5.1 shows the results.

Table 5.1. Preference for different proportions of maize and cassava in cooking fufu.

	Percent of respondents	
Composition of fufu	Kaniama	Southern Kasai Oriental
Maize flour only	26.2	30.1
Maize and cassava flour with maize dominating	30.8	46.2
Maize and cassava flours with cassava flour dominating	28.0	18.3
Cassava flour only	15.0	18.3
Total	100.0	100.0
Sample size	107	93

Over 50% of the farmers in Kasai Oriental and Kaniama chose the mix with a high content of maize flour. Interdistrict comparison indicates however, that 57% of the farmers in Kaniama preferred a fufu mix with a high content of maize flour, against 76.3% in Southern Kasai Oriental. The average areas planted in maize in both areas suggest that there are other factors than maize availability alone which account for the district differences. One of these other factors is the cultural differences between ethnic groups living in the various districts. Apparently the Baluba-Kasai people prefer a higher content of maize four in their fufu than the Kalundwa from Kaniama district.

The quantity of maize consumed at the farm determines how much can be shipped to the market and the preference for maize is an indication of how much of the actual or the potential production will be devoted to domestic consumption. A comparison between farmers in Kaniama and those in Southern Kasai Oriental suggests that for equal increase in the average production of maize, the proportion of the increase devoted to domestic consumption would be larger in Baluba-Kasai homeland than in Kaniama.

The proportion of the maize harvest which is not used for domestic consumption, future seed, gifts or bartering operations is sold. In the study area 66.6% of the maize producers sold some maize. An interdistrict comparison suggests that in districts with a relatively larger maize area per household, such as in Gandajika and Kaniama proportionately more farmers were selling maize (Table A-73) than in districts such as Tshilenge and Mwene-Ditu where the average maize area per household was smaller. Maize sellers shipped to market about 29.3% of their production.

This percentage is based on a hypothetical question. In a short pre-survey investigation 35 farmers reported an average production of nine bags of shelled maize for the 1973-1974 season. We estimated this production at 324 Kg. Each subsequent farmer was then asked the hypothetical question about how many bags of maize he would sell if he had produced nine bags. During the main survey, it appeared that many farmers produced more than nine bags. When the main survey was over, we decided to reassess our estimation of the proportion of maize sold. Eighty-five farmers were asked to indicate how much maize they had produced for the first crop of 1974-1975, how much they had already sold, and how much they thought they would sell of that harvest. The average sale per farmer based on this new data was 30.1% of the production. We concluded that the estimation from the hypothetical question was a fairly acceptable estimation of the proportion of maize sold. Figures in Table 5.2 are based on the hypothetical question. An interdistrict comparison of the four districts under study also suggest that in Gandajika and Kaniama, where the total and maize areas were relatively higher, farmers were willing to sell proportionately more of their maize (Table 5. 2) than in Tshilenge and Mwene-Ditu where the average total and maize areas were relatively smaller (see above and Chapter 4). From the above discussion we conclude that in a ceteri paribus condition, as the total quantity of maize produced increases, one can expect more farmers to get involved in selling maize and these sellers can also be expected to sell proportionately more of their production of maize.

Table 5. 2. Estimated share of maize sold as a percent of total quantity harvested.

District	Producers selling maize	All producers of maize
Kaniama	32. 0	23. 0
Mwene-Ditu	24. 8	16. 5
Gandajika	32. 4	23. 4
Tshilenge	23. 1	11. 3

5. 2. The Decision to Sell Maize

5. 2. 1. Characteristics of Maize Sellers

The division of the respondents between sellers and non-sellers of maize generates an interest in investigating factors which best differentiate between these groups. If such factors exist then they can be used to predict group membership. Factors which most account for the distinction between sellers and non-sellers of maize would be a valuable source of information which would allow policy makers to design and implement policies which stimulate key factors having positive effects on the decision to sell and discourage or reduce the effect of those factors having a negative impact on the propensity to sell maize.

In the second chapter we indicated that the quantity of maize sold was directly affected by the price received by the producer for each standard unit of maize sold (Chapter 2, section 2.4). Many other factors, beside price, may also account for whether or not a farmer sells maize. These factors can be cultural, such as in the preference for maize, the level of education, the exposure to a modern life which relies on market provided goods to satisfy some needs. There may also be economic reasons such as the expected future availability of maize, and food crops which substitute for maize, past economic performance, market information, the size of the family to be fed and many other factors which affect the decision whether or not to sell maize.

Farmers of the study area did not have records of the prices received for the maize that they sold; thus it was impossible to use the price factor in trying to distinguish between sellers and non-sellers. Based on a "step-down" elimination provided by discriminant analysis (65, p. 451), the following factors were retained from the available information for their potential to account for the distinction between sellers and non-sellers of maize:

- the total area planted in all crops
- the area planted with maize
- the proportion of maize actually used in the fufu mix
- the age of the head of the household
- the number of years of school education for the head of the household
- the number of years of experience in supervised production scheme
- the size of the household (measured in 'consumption units')[7]
- whether or not a household owns a bicycle or a radio
- the distance separating the village from the market.

Testing for the significance of the difference between maize sellers and non-sellers on the basis of these factors is equivalent to testing for the significance of the difference of group means over these factors. In this study we are interested not only in testing for the significance of the variables in separating between sellers and non-sellers of maize, we are also interested in discovering which

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[7] An adult 15 years old or over is considered as one consumption unit; a household member who is seven to fourteen years of age is considered as half of a consumption unit; and any member below seven years of age is considered as two-tenths of one consumption unit.

of these factors contribute most in operating this separation. We want to rank the factors in terms of their contribution to discriminating between maize sellers and non-sellers.

In order to rank the variables that we have just listed, we first need to determine whether or not they have any separating power which permits a distinction between sellers and non-sellers of maize. Let us assume that the populations of the p variables (p = 10) are multivariate normal with a common covariance matrix but that the mean responses of sellers and non-maize-sellers on these p variables are different. Testing for the power of the selected variables to distinguish between sellers and non-sellers of maize is equivalent to testing the hypothesis that the differences of means on the p variables for sellers and non-sellers of maize are not all equal to zero. A single ratio for testing for the difference in means for the p variables in the test of significance of the linear compound.

$$y_i = \sum_{i=1}^{k} b_j x_{ij} \qquad (5.1)$$

where the b_j's are selected so as to maximize the square of the critical t ratio computed on the combined variable y_i and x_{ij}'s are subject i's scores on the j variables. The set of optimal weights b_j are optimal in the sense that they maximally discriminate between the groups (here sellers and non-sellers of maize). Equation 5.1 is called the discriminant function (27, pp. 13-14). Under the assumption of equal covariance matrix for the populations on which the original variables are drawn, the b_j's give the relative importance of the contribution of each variable to the discriminant function (65, pp. 217-221).

If $b_1 \ldots b_k$ are the weights which provide maximum discrimination between defined groups, then the discriminant function score for an individual i is defined just as in relation (5. 1) above, and the mean discriminant functions for each of any defined two groups are

$$\bar{y}^1 = \sum_{j=1}^{k} b_j \bar{x}_j^1 \qquad (5.2)$$

$$\bar{y}^2 = \sum_{j=1}^{k} b_j \bar{x}_j^2 \qquad (5.3)$$

If V(y) is the variance of the composite score y, then for each individual evaluated on the same original k variables, the deviation of the individual discriminant function score from each group means can be regarded as a unit normal z score, i. e.

$$z_y = \frac{y - \bar{y}^{(i)}}{(V(y))^{1/2}} \quad (i = 1, 2) \qquad (5.4)$$

With any z score a table of unit normal distribution can be used to get the estimate of the probability of a deviation from each group mean of the magnitude of the calculated z.

The discriminant function score, the mean discriminant score for each group, and the within groups variance of the discriminant function scores can be used to classify individuals for whom only scores on original variables are known. For each case, a standardized z_y scores (5.4) are computed for each group 'i'. To each standardized score corresponds a probability density value which is the ordinate of the normal curve. The simple or weighted ratios of these ordinate values can be used as the estimates of the probability that an individual belongs to each group. Then the individual is assigned to the more probable group (69, p. 256).

All of the above operations can be conducted if the discriminant function score has been evaluated. Thus the preliminary problem in discriminant analysis is to determine optimal values of the b_j coefficients such that the difference between mean scores for the groups will be maximized, relative to the variation between groups (69, p. 244).

5.2.2 Empirical Results

Ten variables were thought to explain whether or not a farmer in the survey area would sell maize. These variables are presented in Table 5.3 which lists the means for each original variable. The weights of the discriminant function were obtained in a stepwise derivation with the variable displaying the greatest overall multivariate F ratio for the test of difference among the group means being selected first (65, p. 447).

The group means for each discriminating variable indicate that maize sellers live in families of smaller size. They are older, have less formal education and have a relatively longer experience in a supervised production scheme. The group means also indicate that farmers who own a bicycle or a radio show a greater propensity to sell maize than farmers who do not. This can be interpreted to suggest that as a farmer becomes involved in buying market provided goods he tends to show a greater propensity to sell part of his output in order to obtain the income he needs to buy from the market.

Table 5. 3. Means for the discriminating variables and number of cases in each group.

Variables/Size	Group 1 (sell)	Group 2 (not sell)	Total
Family size (members)	. 4. 71	9. 38	6. 34
Age of the respondents	45. 91	42. 84	44. 84
Ownership of bicycle or radio	0. 52	0. 38	0. 47
Number of years in extension	1. 14	0. 85	1. 04
Years of formal education	2. 52	3. 06	2. 71
Total area planted (1/100 Ha)	170. 41	131. 27	156. 79
Size of the village (people)	931. 83	1295. 78	1058. 53
Distance to market (km)	9. 71	10. 21	9. 88
Area planted with maize (1/100 Ha)	75. 60	28. 03	33. 37
Proportion of maize in fufu	1. 88	2. 08	1. 95
Number of observations	191	102	293

The group means also indicate that, on the average, maize sellers hold a larger total area planted; they live closer to market places and use a smaller proportion of maize flour in the preparation of fufu. Maize sellers also live in villages of smaller size. We had expected that respondents in large villages would be more inclined to sell maize than farmers in smaller villages because of a greater possibility of a market place and market information in large villages. The data suggest the opposite. Apparently, although producers in large villages plant a greater total maize area than farmers in small villages (Chapter 4, Table 4. 13), many producers in large villages prefer to retain their own maize. Large villages are found principally in the districts of Tshilenge and Gandajika, and in these districts maize prices rise very high in October through early December. But at these prices most farmers cannot afford buying from the market. Thus, we speculate that farmers are reluctant to sell their maize in areas where severe seasonal shortages can be later expected to arise. Thus, it may be this factor, rather than village size, which is appearing here.

A 'step down' analysis was used to determine the importance of each variable in the discriminant function (Table 5. 4). At 10% level of significance, the partial F statistics for variables entering in the discriminant function indicate that, in the order of importance, variables which account most for the separation between sellers and non-sellers of maize are the total area planted, the size of the village, the proportion of maize in fufu, the size of the family (in consumption units), the number of years of formal education, the ownership of a bicycle or a radio and the distance to market. Other variables were not significant by this criterion. The sign of the standardized and non-standardized discriminant function coefficients (Table 5.5) indicates whether these variables contribute positively or negatively to the discriminant function. In other words the sign of the discriminant function coefficients indicate whether or not a factor affects positively or negatively the propensity to sell maize.

Table 5.4. Stepdown selection of the original variables on the basis of their univariate F ratio.

Variables entered on each step	F to enter	Wilks Lambda
Total area planted	10.59284	0.96488
Size of the village	5.53485	0.94681
Maize in fufu	4.00932	0.93385
Family size	2.88214	0.92479
Years of formal education	2.20072	0.91775
Ownership of a bicycle or radio	2.62979	0.97939
Distance to market	2.82369	0.90047
Number of years in a supervised scheme	1.18450	0.89673
Area planted in maize	0.96826	0.89367
Age of the head of the household	0.26228	0.89284

Thus, factors which have positive and significant effects on the decision to sell are the total area planted, the number of years spent in a supervised production scheme and the ownership of a bicycle or a radio. Factors which have negative and significant effects on the decision to sell are the size of the family, the proportion of maize flour in the cooking of fufu, the distance to market, the size of the village and the level of education. Note that the closer to a market a farmer is the more he is inclined to sell maize; also note that it is not maize area planted which discriminates best between sellers and non-sellers, of maize but the total area planted in all crops. The high degree of correlation between total area planted and area planted to maize may mask the significance of area planted to maize. We had expected the level of education to affect positively the decision to sell. The data suggest the opposite. The mean values of the variables used in this analysis suggest that farmers who have more formal education showed a negative willingness to sell maize. This may be a reflection of the younger age and larger family size of more educated farmers and may not stem from education per se.

The contribution of the original variables to the discriminating function is presented in Table 5.5.. Both standardized and unstandardized discriminant coefficient functions are listed in Table 5. 5. Unstandardized discriminant coefficients can be applied to raw values of the associated variables to arrive at a discriminant score. The interpretation of standardized coefficients is analagous to the interpretation of the beta coefficients in multiple regression. The sign of each coefficient indicates whether the variable makes a positive or negative contribution to the discriminant function. The standardized coefficients which indicate the relative importance of the original variables shows that the distinction between sellers and non-sellers of maize depends on the contrast or difference between the total area, the area planted with maize, the 'modern' orientation and the number of years in extension, on the one hand, and on the other hand, on the size of the village, the proportion of maize in fufu, the distance to market, the level of education and the size of the household.

Table 5.5. Standardized and unstandardized function coefficients.

Variable	Coefficient	
	Standardized	Unstandardized
Family size	-0.34395	-0.0157160
Age of the respondent	+0.10558	+0.0063709
Ownership of a bicycle or a radio	+0.32628	+0.652549
Number of years in a supervised scheme	+0.23595	+0.156874
Years of formal education	-0.28795	-0.107879
Total area planted	+0.29621	+0.0029723
Size of the village	-0.53308	-0.0004371
Distance to market	-0.31141	-0.0246679
Area planted in maize	+0.24701	+0.0046197
Proportion of maize in fufu mix	-0.32211	-0.358799
Constant		+0.257107

The importance of the power of the discriminant function to separate between sellers and non-sellers of maize can be tested using various statistics (65, p. 441-444; 95, pp. 218-223). Table 5.6 lists the statistics used to test the discriminating power of the discriminant function. The cannonical correlation is a measure of association between the discriminant function and the dummy variable which defines the two group memberships; it indicates how closely the function and the group classification variable (SELL or NOT SELL) are related. It is also a measure of the function's ability to discriminate among groups. The square of the cannonical correlation can be interpreted as the proportion of the variance in the discriminant function explained by the groups (65, p. 442). Thus, in the case of selling versus not selling maize, about 10.2% of the variation in the discriminating function is accounted for by the groups. The lambda statistic is an inverse measure of the discriminating power in the original variables which has not yet been removed by the discriminant function, i.e., the larger the lambda, the less information in the set of discriminators (65, p. 443). In the case of SELL vs. NOT SELL the final lambda of 0.89835 indicates that variables in Table 5.3 have a weak power in discriminating between sellers and non-sellers of maize.

The lambda statistic can be transformed into a chi-square to test whether or not the power of the discriminating variables is different from zero (65, p. 442). The final chi-square statistic in Table 5.6 indicates that the set of variables used in this analysis significantly influences the decision to sell.

Table 5.6. Summary of statistics on the discriminant function.

Statistics	Value
Cannonical correlation	0.32735
Wilks Lambda	0.89284
Chi Square	32.53013
Degree of freedom	10

A classification of the respondents was undertaken using the 'z' scores defined in relation (5.4). Prior probabilities were set at 35% for non-sellers of maize and 65% for maize sellers. Out of the 102 respondents not selling maize, 72 would have been classified as sellers, on the basis of the discriminant function and the respondents' scores on original variables. Of the respondents selling maize, 173 out of 191 were correctly classified. Of the known cases, 69.3% were correctly classified (Table 5.7).

Table 5.7. Predicted group membership.

Observed		Predicted	
	Number of cases	Group 1	Group 2
Group 1 (sellers)	191	173	18
Group 2 (non-sellers)	102	72	30

% of known cases correctly classified = 69.3

The high proportion of non-sellers not correctly classified suggests that additional information is needed to fully explain the decision to sell maize. The lambda score discussed above also indicates a generally low ability to explain what distinguishes sellers from non-sellers, given the variables available here. Nevertheless it was indicated that high total area planted to crops, smaller village size (possibly an indicator of reasonably stable year around maize availability for the areas surveyed here), a lower preference for maize in fufu, and a shorter distance separating the village from the market all account significantly to explain the decision to sell maize.

At the beginning of this section we have indicated that the decision to sell is influenced by the price of the commodity and in the second chapter we argued that quantity of a commodity sold by a farmer depends on the price the producer receives. But in all of this section we have been unable to include the price factor in our analysis because no price data was available at the farms we visited. The next three sections (section 5. 3 through 5. 5) discuss factors which influence the price received by producers who sell maize.

5.3. Market Organization

5.3.1. Markets and the Marketing of Maize

Market organization for maize and other agricultural crops is location specific; it is largely a function of population density and the level of cash income. In Kaniama, where population density is low and most villages are of small size, transactions in maize take place in the producer's village. In the other three districts, a good proportion of maize is sold through weekly rural markets. Once or twice a week women carry head loads of either maize, cassava or other items to one of the market places operating along main or secondary roads. Just after harvest women literally invade the market places trying to sell or buy maize.

In some cases, maize is sold in the husk to truckers and itinerant traders who go from door to door of the various houses in the village. Around Gandajika City, entire maize plots are sometimes sold to truckers or traders who finance the cost of harvesting and husking. Sometimes the producers take maize to the market; in other cases, maize is husked directly at the market place, while the seller is waiting for buyers or, most commonly, women husk maize ears prior to going to the market place. There, maize cobs are sold in bulk in small loads; buyers mix loads, break the loads into different assortments, sell it nearby on the same market, or store it for future sales either on the same market or on more central locations. Except during the shortage of the end of the year, rural markets serve as shipping points for other outlets, and direct purchases by village consumers make up a small part of transactions. In the vicinity of urban and semi-urban communities, direct buys by consumers share significantly in the total volume of transactions on maize.

About half of the producer-sellers in the sample sold their maize in the village; of the remaining half, some sold maize by establishing stands along main roads, 21.0% sold in rural markets and 19% of the farmers selling maize took their product directly to urban markets (Table A-77).

Rural markets exist where the density of population and the level of income are high and the transportation network good enough to attract buyers and sellers. Kaniama which presents a smaller density of population (Chapter 3) presented only two rural and one urban market. In this district, where many villages were far from main roads, 64.9% of the producers selling maize sold maize in the village and 36.1% in organized markets. This contrasted with Gandajika, for example, where 69% of the producers sold directly in organized market places. In Mwene-Ditu some portions of the districts which were selected for investigation were served by bad transportation networks. In Tshilenge some farmers we visited lived in villages which held a weekly market day. These observations may explain that a large proportion of sellers in these districts sold maize in their village (Table A-77).

5.3.2. Marketing Agents

The marketing of maize involves the sale of maize grain by producers to consumers, directly or through various middlemen who act as intermediaries between producers and consumers. The marketing of maize depends on the structure of production. After harvest, some farmers sell their maize in the village, others send their wives and daughters to carry head loads of maize to rural and urban markets. These small quantities are then assembled by middlemen and shipped to transformation and consumption centers.

Middlemen involved in the marketing of maize include local (or village) assemblers, rural assemblers, urban assemblers and truck owner licensed traders. Local or village assemblers are male and female traders who collect maize from villages for sales in rural markets. This category includes women and some male bicycle riders who are very active between isolated villages or rural markets (here also called closed market) and non-isolated (or open) markets. Rural assemblers are traders who operate between villages and rural markets in a non-isolated rural environment; these middlemen are also very active in the rural urban link. Rural assemblers are mostly women producers and non-producers who take advantage of their locational position to gather maize for sale in rural and urban markets. Urban assemblers are males and females who gather maize from the urban markets for sales in regional and non-regional urban markets. Urban assemblers are also very active in open rural markets located along main roads connecting separated urban areas. Urbanassemblers also include more females than males. In local terminology rural based female assemblers are called 'basumbishiludi', approximately 'resalers'.

All the assemblers we have mentioned up to this point have in common that they require no special license to do business. In contrast, licensed traders, are traders who have been granted a legal status to do business. In this study, licensed traders who buy maize occasionally but own neither a store nor a truck are aggregated with rural or urban assemblers. Truck-owner-licensed-traders are truck and/or store owners who buy and sell manufactured and non-manufactured goods. They are urban based in most cases, and at harvest they add maize to their regular line of business. Truck owner licensed traders who generally possess more capital than most of the other middlemen buying maize from producers can conduct operations in areas beyond the reach of the other assemblers. Truck-owner-licensed-traders operate in all markets but enjoy a special buying position in remote and isolated villages and markets.

In the rest of this chapter, truck-owner-licensed-traders will simply be called licensed traders.

Women traders and bicycle riders often walk or ride up to 70 km to gather maize and ship it to more centrally located markets or shipping points where maize is loaded on trucks moving to urban areas. Assemblers and traders buy maize directly or commission agents to carry out the primary gathering of maize. Urban based women traders often commission rural based assemblers, and more centrally located rural assemblers commission villagers and local assemblers in remote and isolated areas to buy maize for them. In this kind of agreement, the commission agent receives a sum of money to buy a determined number of sacks of shelled maize within a limited time. In due time, the agent delivers the sacks of maize at a determined shipping point. Under this kind of agreement, the assembler who is financing the operation (oftenanurbanassembler) pays the full cost of shipping maize to the reception point; the assembler also pays a commission for each sack received. Another kind of agreement has the commission agent use his or her own money to collect a determined number of sacks of maize to be delivered at a determined point in time and at a given shipping point. Under this agreement two different kind of arrangements are used to fix the price of maize. The first arrangement has the receiver pay a price agreed upon the day of the initial agreement. The second arrangement has the receiver pay a price per sack equal to the price currently used in the town or at the point of delivery. These last two arrangements were not as commonly used in the survey area as the agreement consisting in having an assembler provide the capital for the purchase of maize.

In remote areas, licensed traders hire itinerant agents to collect maize. The agent delivers empty sacks to farmers who fill them with shelled maize; on a later day the agent comes back to pay and take possession of the maize. The agent can also set market dates in remote areas where market places are rare and road communication between villages too difficult for trucks to travel. Farmers of the surrounding area are then invited to these seasonal market places. Trucks or train wagons then take the purchased grain to urban markets or to flour mills.

Most non-licensed traders buy maize and resell it within a few days to few weeks. But some of these assemblers buy maize in villages, just at harvest time; maize is stored in rented houses, in the village, until urban prices start rising. The grain is then taken to shipping points and loaded on trucks moving to town. Licensed traders or their agents store their maize in provisional granaries built for this purpose.

Traders sell their maize in bulk or retail in rural or urban markets. Non-licensed traders sell to consumers and other middlemen; no special regulation determines who the assemblers can sell their maize to. Licensed traders theoretically operate under government regulations which will be discussed in section 5. 4. 3.

Survey data indicate that 48. 8% of the respondents in the district of Kaniama sold their maize to consumers and local assemblers in the village; 20. 0% sold to rural assemblers, and 18. 8% sold directly to licensed traders. In Mwene-Ditu, Gandajika and Tshilenge, where more rural and urban markets exist, a higher proportion of the respondents sold to rural and urban assemblers. In Gandajika, 63. 6% of the producers interviewed sold maize to women traders, rural and urban assemblers (Table 5. 8). Where women traders were very active the role of licensed traders appeared to decline. In practice, many women start as local assemblers, but as their capital increases they rise to the status of rural assemblers and perhaps urban assemblers.

Producers were also asked through which of the existing channels they introduced the largest proportion of their maize into the market. In Tshilenge and Mwene-Ditu more than half the producers sold in their village to assemblers and licensed traders. In Gandajika, about one-third sold most of their maize in the village; in Gandajika 43. 1% of the producers carried or rode with most of

Table 5.8. Proportion of producers selling maize to different categories of buyers (%).

Buyer	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Consumers and local assemblers	50.1	37.2	29.1	35.6
Bicycle riders	1.3	18.6	12.7	3.5
Rural and urban assemblers	20.0	44.1	63.6	39.3
Licensed traders	18.8	11.9	7.3	21.2

Table 5.9. Proportion of producers selling most of their maize in designated locations (%).

Location or market	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Village (at home)	67.4	63.6	32.7	57.1
To TABAZAIRE, CAKO or Kasese	32.5	2.2	1.7	0.0
Along main roads	1.2	4.5	5.2	0.0
Rural markets	26.7	11.4	17.2	14.3
Urban markets	0.0	20.5	43.1	28.6
Other answers	4.7	0.0	1.7	0.0

their maize to the urban market in Gandajika City or in Mbuji Mayi (Table 5.9).

Gandajika demonstrates an entirely different marketing system from any of the other three districts studied. There, 60.3% of the farmers sell directly in rural and urban areas. The reason for this difference may be found, in part, in the efforts of the Office National des Fibres Textiles (ONAFITEX) which contributed in repairing some ferries and small bridges to allow a rapid collection of cotton. This modest improvement in the transportation network has made some villages more accessible to truckers, lorry transporters and assemblers; and this improved access to towns has also made it possible for farmers to convey maize directly to the urban market instead of selling in the village or in the rural market.

In Tshilenge where many villages hold weekly market, some of the farmers who say they sell in the village can be interpreted as saying that they sell in a rural market which happens to be in their village.

5.3.3. Marketing Channels for Maize

Marketing channels for maize are characterized by their diversity. Figure 5.1 provides a general overview of channels used in the marketing of maize in Kasai Oriental, Kasai Occidental

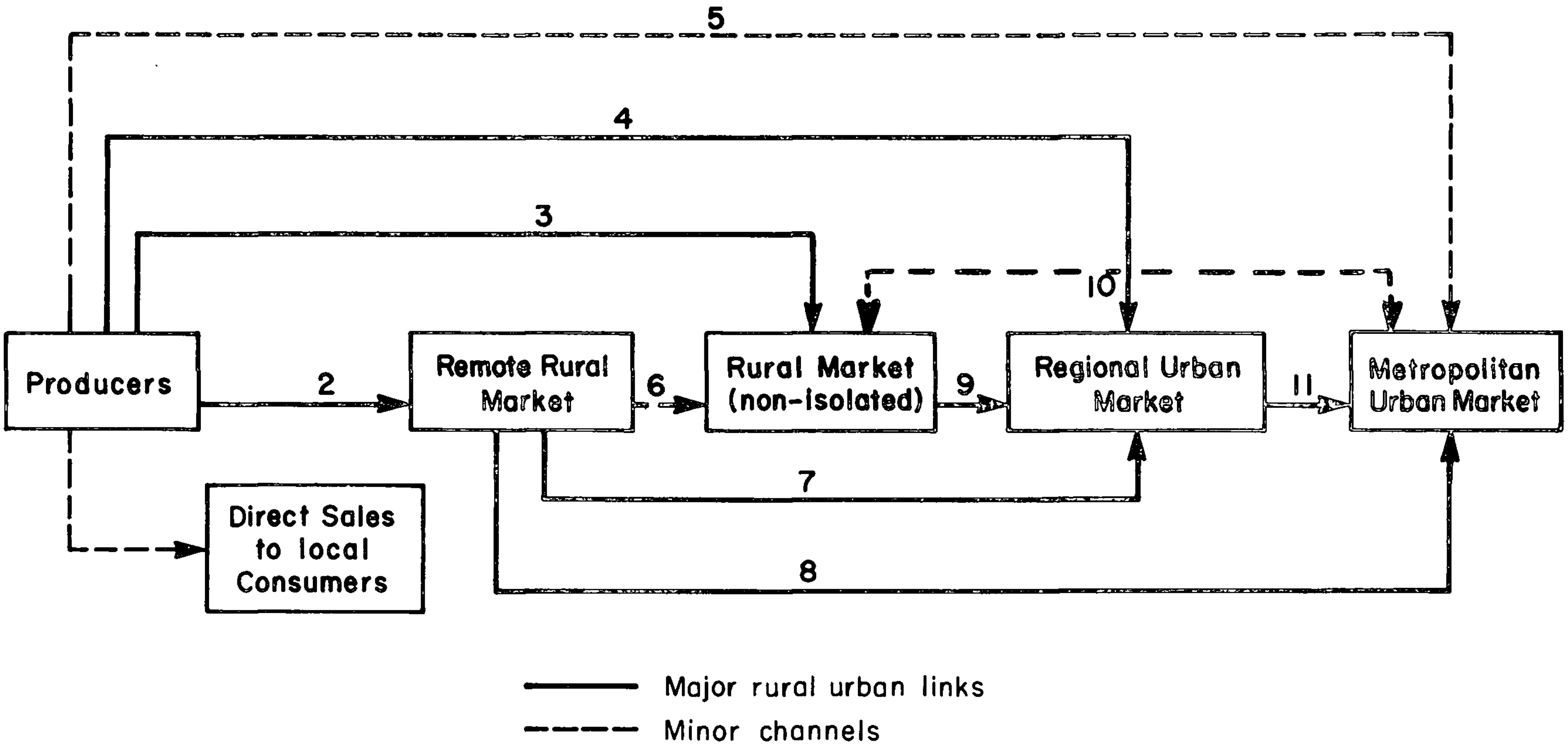

Figure 5.1. Distribution channels for maize in Kasai and Kaniama.

and Shaba Regions. Figure 5. 2 is a more detailed outline of the same process for a subsystem of the marketing operations in the study area, with a specific indication of the type of agent involved.

Some links, such as preliminary movement through remote rural markets, have been eliminated in Figure 5. 2 to simplify the exposition.

If we consider the domestic supply reaching metropolitan areas such as Kinshasa, Kananga, the mining towns of Shaba and, to some extent, Mbuji Mayi, the major links in maize marketing involve the movement of grain from the producer to some 'closed' (remote, isolated) rural markets or to one of the remote rural markets established on a seasonal basis by maize buyers (channel 2). Some of this grain goes through regional markets (such as Lwiza, Demba, Mweka, Ilebo, Luebo, in Kasai Occidental; or Nyunza, Kabalo, Kongolo, Kalemie, Kaniama, Sandoa, or Dilolo in Shaba) to metropolican areas (channels 2, 7, 11), but the major bulk is transferred directly to metropolitan areas by trucks, train, wagons or ships (channel 2-8). (Figure 3. 1).

In southern Kasai Oriental where most of our marketing study took place and in the surroundings of most urban areas in Kasai Occidental, the major links in maize marketing involve the movement of grain from producers to 'open' (non-isolated) rural markets (channel 3) and to regional urban markets directly (channel 4) or

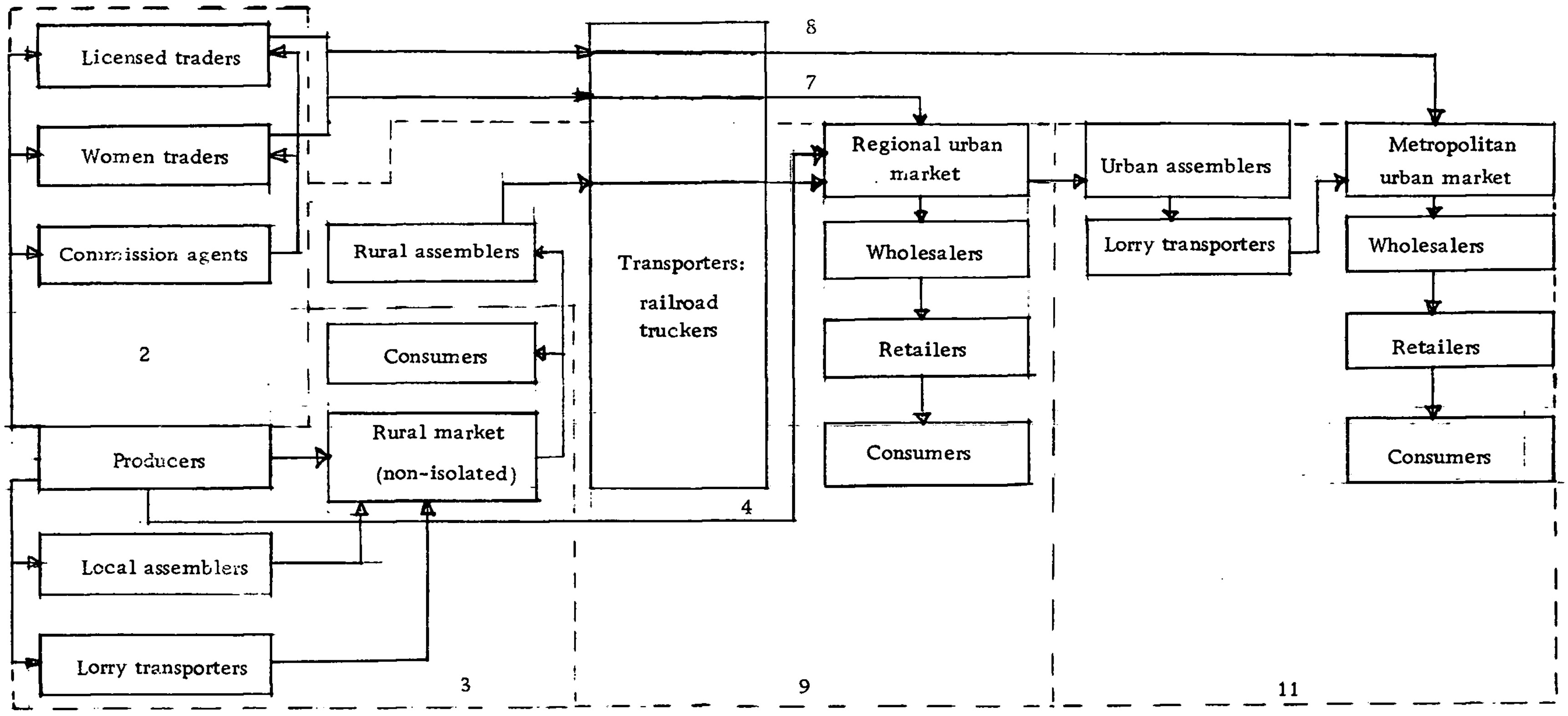

Figure 5.2. Major producer to consumer distribution links in the rural-urban marketing system for maize in Gandajika, Tshilenge, Mwene-Ditu and Mbuji Mayi. Numbered lines are major distribution channels outlined in Figure 5.1. Numbered dotted contours indicate marketing agents involved in some major distribution channels outlined in Figure 5.1.

through the open rural markets (channels 3-9). From late January to the end of March, thousands of women producers take their maize directly to the metropolitan market of Mbuji Mayi (channel 5), and at the end of the year, when maize has become scarce on urban and open rural markets, women traders assemble maize from closed markets and ship it to open rural markets and/or to regional urban markets (channel 6). Where population is dense and road transportation fair, a predominance of open rural market transactions over closed rural market operations has been noticed.

A producer may harvest his maize and then sell it, or as observed in the neighborhood of urban areas, in Kasai Oriental, he may sell unharvested plots directly to assemblers. Farmers sell some maize to neighbors in short supply, but more often he sells to commissioned or independent assemblers in the village or in rural and urban markets; or he pays for his maize to be conveyed to a regional or a metropolitan urban market. An independent local or village assembler sells his or her maize in rural markets and occasionally in urban markets. A commissioned assembler gathers maize at a shipping point from which the grain is loaded on trucks or train wagon moving to the urban area.

In the rural market, the producer takes his maize and sells it in bulk or breaks it up into smaller loads that are displayed for sales. In rural markets of Gandajika, Tshilenge and Mwene-Ditu, the unit of measurement was a number of husked ears per unit or for a multiple of a unit of money. A wholesale buyer gets a wholesale price by accumulating additional ears that are given as gifts ('nsakidilu') as more money is spent to buy from the same seller. A small load buyer gets a retail price. As described earlier in this section, the transfer of maize to regional or non-regional urban markets involves producers, rural assemblers and licensed traders. In the survey area housewives carried their maize in head loads to Gandajika, Tshilenge, Mwene-Ditu or Kaniama; there maize was sold to consumers, wholesalers or retailers, in bulk or on a per load basis. Rural assemblers act exactly like producers once they have purchased maize although the time span of their transactions extend over a longer period. Occasionally producers and/or rural assemblers pay for lorry transportation for themselves and their maize to be carried to an urban market. The transporter charges a fee on a per sack and per accompanying individual basis. Urban assemblers operate mostly in urban and between markets. They often use rural market places as shipping points to regional urban markets where maize is either stored for future shipments to metropolitan markets or sold to consumers and retailers.

In Shaba, licensed traders provided flour mills with part of the maize they needed to feed mining workers; as we indicated in the introductory chapter this local supply was insufficient to cover the needs. In Kasai Oriental and Kasai Occidental, rural and urban assemblers supplied urban markets with shelled maize which was transformed by small flour mills distributed in great number in cities such as Mbuji Mayi and Kananga. Licensed traders in Kasai Occidental also sold maize to flour mills, but certain numbers of them joined licensed traders in Kasai Oriental who distributed shelled maize through urban markets. In these cases, traders and urban assemblers did not sell maize themselves, particularly when licensed traders were male. Instead the trader or the assembler contracted with women retailers who agreed to sell a portion of the grain on a commission basis. Under this kind of agreement, the retailer agreed to pay a fixed sum per sack. This sum was negotiated so as to include the retailer's fees. In many cases, retailers broke up the sack into basins of 30 kg or smaller which were sold to other middlemen and/or consumers. Consumers took their grain to one of the small flour mills around the market place, or to similar mills in town and got the flour they needed for the cooking of fufu.

The link between metropolitan areas such as Lubumbashi, Kananga and Mbuji Mayi is established through seasonal shipment of maize flour from Lubumbashi, Likasi and Kananga to Mbuji Mayi or through the shipment of grain beyond the geographic boundaries of a metropolitan area. Hence, Mweka, Demba, Luebo and Lwiza, in Kasai Occidental, sell maize to Mbuji Mayi or Lubumbashi, and Nyunzu, Kabalo, Kongolo and Kaniama, in Shaba, sell grain to Mbuji Mayi.

5. 4. An Examination of Five Markets

In order to assess the structure of the market system three rural and two urban markets were selected and analyzed in terms of price formation, marketing information and the conduct of the intermediaries. The two urban markets discussed are those at Gandajika City and at Mbuji Mayi. The three rural markets at Nsona (10 km west of Gandajika City), Kamanda (21 km south of Gandajika) and Kaseki (18 km east of Gandajika) surround Gandajika City, a town of about 60, 000 people. Mbuji Mayi is located 85 km northwest of Gandajika City; the population of Mbuji and Mayi and its surburbs was estimated at 342, 000 people..

Over a thirteen month period from December 1974 to December 1975, these markets were visited at least twice a month. On each visit information was taken on estimated market attendance, major items sold and observations were made about the behavior of marketing agents. Twice a month maize was bought from three, four or five retailers selected among sellers in the market place. The purchases were made so as to include producers selling their own maize and traders who were selling maize previously bought from producers. The purchased loads were weighed and the average price of all purchases was recorded as the average retail price of maize for the month.

The data collected up to the 15 of December 1975 is the basis of the analysis which is conducted in this section and in section 5.4.4 and in section 5.5. In section 5.6 price data is used to investigate the performance of the urban-rural link.

5.4.1. Rural Markets

Kamanda market is located on the main road to Luputa and Mwene-Ditu City, south and southwest of Gandajika City. On an average opening day, each Saturday, five lorries stopped regularly at the market place bringing buyers or sellers to or from the market. Truckers served as transporters. They generally took no part in transactions in maize between sellers and buyers. Transporters charged a fee for each person and each load of commodity transported. The average daily attendance at Kamanda market was about 250 people throughout the year with a peak of 1500 during the period immediately following the maize harvest. As in the other two rural markets, manufactured and agricultural goods were sold in Kamanda but manufactured goods constituted a small portion of the commodities exchanged. Salt, soap, sardines, cigarettes and clothing were the basic manufactured goods sold. Agricultural and forestry products sold in Kamanda market were cassava, maize, cassava leaves (used as vegetable), groundnuts, charcoal, firewood and tshibuku, one of the local beverages we referred to earlier. Maize was abundant from mid-December to early March, then was eclipsed in volume of sales by cassava, charcoal and firewood. As in the other rural markets, at its peak period, maize dominated all other agricultural products in the market.

Local microclimates determined the timing for the abundance of maize in the market but the size of the supply and the location of the market with respect to potential buyers determined the duration of the peak flow. In the area surrounding Kamanda market, located on the main road between Gandajika City and the urban communities of Luputa and Mwene-Ditu, maize was ready for marketing in the second half of December, and rural assemblers and licensed traders from neighboring towns bought a great part of the supply directly from the village. The supply reaching the market was thus reduced by the direct purchases of these traders and assemblers.

The market in Kaseki met each Wednesday; on an average market day about 1000 people met to buy or sell maize, cassava, ground nuts, smoked fish, cassava leaves, salt, soap, sugar, clothing items, and minor agricultural and non-agricultural products. From time to time this market carried tools such as hoes and machetes. The peak attendance during the post-harvest season of maize often reached 3000 to 4000 people. On a regular market day of the maize season, four trucks from Gandajika and Mbuji Mayi carried assemblers and/or producers to and from the market. In Kaseki market, maize dominated other agricultural products from late December to mid-May, then cassava took over for the rest of the year.

The greater length of the maize sales period at Kaseki was due to this market being the exchange and the shipping point for maize from the Kaseki production area and also for maize from the Kalundwe and Kalambayi production areas. The Kalundwe and Kalambayi production areas are two large maize producing groups of villages trapped by bad roads, broken bridges and irregularly operated ferries on the Lubilansh River. Located 25, 30 or 40 km from the Gandajika market, producers from Kalundwe and Kalambayi who at times organized their own 'isolated' markets, had to walk to Kaseki which could be reached by more consumers, rural assemblers, and those truckers who could afford driving over the badly damaged road that separated Kaseki from Gandajika City.

The Nsona market met every Wednesday; in contrast with the first two rural markets. There were no trucks bringing buyers from Gandajika. Buyers or sellers walked the 10 km separating the rural market from the regional urban market in Gandajika. Maize was abundant in this market from December to March with peaks in February and March. Cassava again dominated the market the rest of the year. The attendance at the Nsona market averaged some two hundred buyers, with a peak of 400 to 500 involved in transactions at peak periods. Farmers in the Nsona production area had a choice between their own market, two other rural markets, and the urban market in Gandajika. The number of surrounding markets explains the smaller attendance in Nsona market.

Producers participation patterns were similar in all three rural markets. Maize is brought to market by females who carry it as head loads. No organized cooperative effort for grouped sale of maize by producers from the same village was observed. Each seller approached the potential buyer as an individual. Many of the female producer-sellers reported that before they left their house their husband fixed a minimum return for the load being carried to market.

In rural markets, producers sold maize in bulk or in small loads to rural assemblers, licensed traders and consumers. From late December to early April, maize sellers in rural markets were producers selling from their own harvest. After April, sellers were local and rural assemblers, mostly women assemblers established and living in the rural area, and producers who spent their post harvest time gathering maize from remote and isolated rural markets (Table 5.10).

Table 5.10. Number of producers and assemblers selling maize in the market.[a]

	Market							
	Gandajika		Kaseki		Kamanda		Nsona	
Month	P[b]	A[c]	P	A	P	A	P	A
December	64	192	126	73	40	20	27	0
January	384	95	176	0	70	0	38	0
February	720	104	159	0	-	-	-	-
March	189	260	55	5	-	-	83	18
April	14	260	44	74	18	2	-	-
May	3	231	72	74	4	31	0	20
June	2	295	0	287	0	63	-	-

[a] The numbers listed are monthly averages of estimates taken twice a month at 11:00 A.M., when a large portion of the sellers had already reached the market place. These numbers are listed as an indication of the lower bound of the number of sellers in the market (December 1974 to June 1975).

[b] P = Producers.

[c] A = Assemblers.

\- information not available.

Depending on the conditions of the markets, independent village and rural assemblers sold their maize in rural markets or directly in urban markets. Rural markets are held in the open and are deserted after market transactions are over; no storage buildings exist at the market place. Items not sold before the market ended were sold at reduced price or carried back to the village. Some producers in the market (particularly when selling in the urban market in Gandajika) indicated that they felt ashamed to take maize back to the village while other sellers returned with empty baskets. Hence at about 3:00 P. M., when the market closing time approached, many producer-sellers dropped the price of their maize in an attempt to sell as much as possible, In contrast, when left with unsold maize at the end of a market day, rural and urban assemblers contracted with villagers to store maize or built storage facilities of their own in the village.

5. 4. 2. Urban Markets

5. 4. 2. 1. Gandajika Market. The Gandajika regional urban market met every Friday and Sunday. Unlike rural markets, Gandajika market offered a larger selection of manufactured and agricultural goods. On a regular market day over 6000 people met to buy, sell or just look around. Eleven licensed traders own stores in the neighborhood of the market place; four of these were full time wholesalers for shelled maize and maize flour, four others sold rice on a more or less regular basis. For 1974, maize wholesalers said they sold about 260 tons of shelled maize and nine tons of maize flour, all imported from Kasai Occidental and northern

Shaba. The market place was also surrounded by 26 storage houses, three of which were being used as living and storage houses by women traders (urban assemblers) operating in the urban market. Most storage houses were owned by licensed traders from Gandajika and Mbuji Mayi. After the harvest time, when producers literally invaded the market, urban assemblers (licensed and non-licensed traders) bought maize on the cob, then shelled and sacked it, stored it or shipped it directly to Mbuji Mayi. Maize directly bought in villages and rural markets was also brought and stored in these urban storage houses. On a regular buying day, a licensed trader would hire women to do the buying for him and youths (males and females) to shell the maize just brought in. Women traders operating in the urban market performed similar operations, but on a smaller scale; ordinarily a female urban assembler would buy maize on the cob on Friday and Sunday and spend part of the following week shelling her maize before taking it to Mbuji Mayi. Licensed traders showed a greater tendency to retain maize for a longer period; female traders tended to store for sales in April, while most licensed traders cited August or September as the time for their maize to enter the market.

In Gandajika, as in Mbuji Mayi, neither the licensed trader nor the urban assembler directly involved in the purchase of maize would provide information on his or her operation. Licensed traders would use the services of women in the market to buy maize. The procedure was used to escape regulations that required a licensed trader to use weighing equipment and to register the quantity of maize bought and the price paid. Since non-licensed traders were not subject to these procedures, the government representatives who from time to time toured the market could not accuse the trader of violating the law.

In Gandajika, maize was sold on the cob from December to July, then shelled maize imported by licensed traders was introduced into the market. From late December to the end of May, maize dominated cassava in the market; after May cassava took over and many assemblers who had been selling maize converted to selling cassava. Producers dominated the sellers in the market for two months, in January and February; then the market was supplied entirely by rural assemblers and some urban assemblers who had been waiting for price rises (Table 5. 10).

The market place in Gandajika City also provided some services to buyers and sellers. Consumers and producers who did not have easy access to a flour mill in their village had access to seven small flour mills which could be used to transform maize into flour for private consumption. When maize grain became scarce, as we observed in October through December on 1974, rural and urban assemblers would mill their maize and sell flour.

5.4.2.2. Mbuji Mayi. The town of Mbuji Mayi, 85 km west of Gandajika City had three market places: Zaire, Bakwadianga and Simis. All three markets opened daily. Mbuji Mayi is supplied with maize by producers, rural assemblers and traders. Over the study period, producers and rural assemblers were the major suppliers in January through March. Beginning in April, regional urban assemblers from Gandajika City, the towns of Mwene-Ditu, Tshilenge and Kabinda and regional traders from other minor towns such as Luputa (Figure 3.1, Chapter 3) replaced producers and licensed traders as the major suppliers of maize for the Mbuji Mayi market. Licensed traders entered the market in July-August, when assemblers' supplies had run out.

When producers and rural assemblers were the major suppliers of maize grain to the Mbuji Mayi markets, most producers and rural assemblers took their maize to the Badwadianga market and the few regional urban assemblers in the market took their grain to the Zaire market. Although this behavior does not seem to have affected the retail price paid by consumers in Mbuji Mayi, so we will see later, the wholesale price of maize grain in these markets was affected by the presence of producers and rural assemblers. Data collected for the months of January through March 1975 indicate that producers and rural assemblers charged lower wholesale prices than regional urban assemblers operating in the Zaire market (Table 5.11).

Often urban retailers and assemblers from the town of Mbuji Mayi would buy maize grain from Bakwadianga for sales in Zaire market.

Table 5.11. Weighted average of the price of a basin of 30 kg of shelled maize in the Zaire and Bakwadianga markets of Mbuji Mayi. (makuta per basin)

Market	Month		
	January	February	March
Zaire	413	250	270
Bakwadianga	-	215	230
Assembler	367	230	250
Producers	-	180	200

It is not clear why producers would sell their product at lower prices than assemblers. Some producers that we asked to explain the difference between their price and the assemblers' price said they did not know that there was a significant difference in price within and between markets in Mbuji Mayi. It appears that the cost involved in acquiring and shipping maize to Mbuji Mayi has something to do with the difference in price noticed in the market. An assembler has to buy and ship their product to the market. Thus she sets her price so as to cover her expenses and achieve an expected level of profit. A producer who brings her own maize may have a differing view on the cost of acquiring the maize that she sells. Also, a regular assembler may have a better knowledge of the market which may explain the observed price differential.

Producers and rural assemblers who took their maize grain to Mbuji Mayi did not generally sell all of their maize immediately. Some maize was sold in wholesale units (sacks of 60, 90 or 120 kg), some in semi-retail units (basins of 30 kg) and some maize was also sold in retail units using small basins of a few hundred grams as units of measurement.

Ordinarily, producers and assemblers not native to Mbuji Mayi would pay a flat fee (ten makuta in December 1974 through August 1975, 30 makuta after August 1975) per sack which would cover the storage cost and the right for the producer or assembler to stay over night in the storage house until the sack was sold. The average producer or rural assembler brought three sacks of shelled maize, and it took her an average of seven days to sell the product. The owner of a storage house arranged to have as many producers and assemblers as possible in each 'motel-storage house'. In general, regional urban assemblers who sold in the same market were faster because they had better connections. Many producers explained their long stay in the market by saying that visiting Mbuji Mayi was also an objective of their trip to town, so they did not feel rushed to finish selling.

Forty-four storage houses in Bakwandianga market, and twenty-six in Zaire market were being used as storage facilities and/or 'motel-storage-houses' for rent to visiting assemblers and producers. Twenty-three small mills, in Bakwandianga market, and sixteen, in Zaire, were being used by sellers and buyers to transform maize grain into maize flour. As we will indicate in section 5. 5, these local mills will contribute to explain the small difference between the price of maize flour and the price of maize grain.

Maize suppliers which reach the Mbuji Mayi market are not provided by Kasai Oriental alone. Some maize grain is provided by Kabalo,Kongolo and Kalemie, in northern Shaba, and some is provided by the Kasai Occidental Region (Chapter 3, Figure 3. 1). Maize flour imported from other regions is provided by the Kakontwe Mill, in Likasi, and the flour mills of Kanange, in Kasai Occidental. For most of the year, maize flour appeared to dominate maize grain in the market place. Maize grain dominated only in the few months following harvest.

In concluding this section we would note that it is difficult to associate the volume of maize handled in the Mbuji Mayi market with a particular group of sellers. Similarly it is difficult to estimate the volume of maize which goes through each of the markets we investigated. But the number and the nature of suppliers of maize in the marketing subsystem centered around Mbuji Mayi suggest that free entry and the absence of artificially maintained prices have increased competition and the quantity of maize supplied to

Mbuji Mayi. The increased competition in Mbuji Mayi has, in turn, induced competition among small scale assemblers who buy from non-isolated rural markets. And, in spite of a difficult transportation network, increased competition in non-isolated rural markets has induced more and more assemblers to walk to remote villages. The overall results have been to generate some kind of integration between Mbuji Mayi and its food supplying area. Though this integration appears to be weakened by a transportation bottleneck, and the behavior of some marketing agents, as we will indicate, the beginning of this phenomena of integration is worth noticing.

5.4.3. Condition of Entry

In Zaire there are no government regulations on the selling of maize by producers, rural and urban assemblers and retailers. Thus any producers or assemblers can enter the market to buy and sell maize. Within the more or less defined boundaries of urban market places a fee is sometimes required for using a stand. But when observing the marketing system in 1974-1975, this fee did not appear to limit the entry in the maize market.

The purchase and sale of maize by licensed traders is regulated by regional and local ordinances. During the study period, licensed traders buying maize in Kasai Occidental, Kasai Oriental and Shaba Regions were required to get a special license from regional (provincial) or local authorities before engaging in buying maize from producers. The regulations also required licensed traders not to start buying maize before the opening day fixed by the regional or local authority. In 1975, in Shaba and Kasai Occidental, the delivery of a license was contingent on the agreement of the buyer to indicate which districts maize would be bought from and to sell to a designated flour mill at the fixed price of Z 63 per ton. In 1974, in Kasai Oriental, traders with licenses were also required to indicate in advance how much maize they planned to buy. For each purchase they were required to register the weight of each load and the price paid. The trader was required to pass this information on to the regional representative of the department of economy (87). In Shaba a regional ordinance had banned the export of maize beyond the provincial boundary. In retaliation, the government of Kasai Occidental, in 1975, was contemplating the establishment of a similar edict for maize produced within its boundaries.

In practice, it did not appear that many traders abided by government regulations. Our observation of the behavior of licensed traders in villages and rural markets of the study area indicates that many traders started buying maize earlier than dictated by local or regional government; many did not have weighing equipment; and some did not deliver maize to flour mills, preferring to sell it in smaller lots but at higher prices in the open market. Regional regulations and ordinances often made it difficult for traders to operate in the marketing of maize, but they did not appear to limit the number of traders dealing in maize within or between regions. Instead they made the collection of maize more expensive, in that traders who bought maize ahead of time, without licenses or outside their region of origin had to act secretely, and thus, perhaps, incure higher transaction costs. When passed on to the middleman in the marketing channel, these higher transaction costs finally increased the price to the final consumer.

The 'raison d'etre' of most regulations seems to have been to fight monopsony or secure supply within each regional boundary. But with production centers sparsely located in a vast production area, and only a small number of traders capable of covering such a wide area, limited competition for the purchase of maize is inescapable. Monopsonistic tendencies are reinforced by an inefficient transportation network and by an inadequate information network which failed to provide producers with sufficient market information.

Long distances and inadequate transportation constitute the greatest barrier to entry into the maize market. Remote villages or villages isolated by broken bridges, bad roads and irregularly operated ferries could not reach rural and/or urban markets to sell their maize. Because of the poor roads and the long distances required to travel most truck owners did not venture far from main roads.

For the size of most operations conducted by non-licensed traders, the size of the critical capital was not a barrier to entry. A sample of 134 local, rural and urban assemblers and commission agents were asked about the size and the origin of their initial capital at the time they started buying and selling maize for the 1974-1975 season. On the average a local assembler operating in the Gandajika and Mbuji Mayi area started buying maize with three zaïre; commissioned local assemblers started with about thirty zaïre. Independent rural assemblers invested seven zaïres on the average. Urban assemblers operating in the Gandajika market started buying maize with twenty zaïres. Non-licensed wholesale traders operating in Mbuji Mayi and Gandajika market often invested Z 7.0. 00 at the beginning of the buying season. Urban retailers in Mbuji Mayi had invested Z. 6. 46: in many cases the retailer started business by acting as a commissioned seller for a licensed trader or an urban assembler. In this case not much personal capital was required: one zaire or less could be enough. After paying the price agreed upon for each sack or basin, the commissioned retailer retained the retail suprlus and progressively accumulated capital for her own future business. Thus, even with a very small investment one could get involved in the marketing of maize.

Of the 134 non-licensed local, rural and urban assemblers interviewed, 71% responded that they had started their business from family savings; 28% by having borrowed from relatives in the extended family, and about 1% had gotten credit from licensed traders. Ten rural assemblers of the village of Mpiana who had received ten to twenty zaires in credit from licensed traders reported that credits from licensed traders were to be paid at a 100% rate of interest, after about a year. There was no private or public institution of credit open to the small assembler or to the producer of maize.

In contrast with non-licensed assemblers, licensed traders could afford to devote greater amounts of money to the seasonal purchase of maize. The average expenditures for maize in the case of four licensed-trader-wholesalers of maize, with headquarters in Gandajika City, amounted to 3, 120 zaires in 1974.

Traders need cash funds to repair or replace their trucks. They also need cash to pay for the collection, storage and the shipment of maize to flour mills and urban markets. However, since traders are essentially store owners or shop keepers, and occasionally maize buyers and sellers, their capital is often already committed when the time comes to buy maize. This situation limits the sum of money that can be devoted to purchasing maize.

In Kasai Occidental few licensed traders reported that because of their funds being committed when the time arrives to buy maize, they were very limited in the number of villages they could cover and the quantity of maize they could buy.

Under the order of the Central government, the National Bank of Zaire initiated special regulations to transfer short and long run funds to the agricultural sector (3) to meet the needs of such economic agents as the licensed traders. In particular the National Bank abrogated all ceilings on short run credit to agriculture and set a ceiling of six percent interest rate on loans to the agricultural sector (4). In spite of these regulations, however, short run credits to agriculture declined, in relative terms, between 1969 and 1972. For local banks in Kananga, Mbuji Mayi and Lubumbashi, credit declined because many credit applications for agricultural operations were unfounded, badly designed, incomplete or covered demands for operations unrelated to agriculture.

5.4.4. Product Differentiation

Sellers of maize grain and maize flour try to modify conditions surrounding their products in order to make them look different from competitor's products. In maize marketing, elements used by sellers to differentiate their products are the color of the maize grain, the size of the cobs, the size of the unit of measurement and the heaping techniques.

With volume as the unit of measurement, one of the devices for product differentiation was the different techniques of heaping used by retailers in selling maize. One basin was seldom filled the same as another and they were not filled the same way for different buyers. An experiment run at the Gandajika market showed that for most products, sellers would give less to well-dressed people and to foreign buyers. The latter being recognized by their inability to speak Tshiluba correctly or to speak it at all.

For sellers of maize and maize flour in the market places, product differentiation practices tended to induce elements of monopolistic or oligopolistic competition in the market at different times during the marketing period. Each seller tried as much as she or he could to induce a downward sloping demand curve for her or his product. But given the number of sellers and the close substitutability of the differentiated products, it is not likely that sellers were making excess profit (92, p. 69; 30, pp. 235-239; 6, pp. 320-322).

In the process of group behavior, producers and assemblers changed the number of cobs of maize offered per likuta or per 10 makuta more or less at the same time within a market and between the rural markets surveyed in the Gandajika production area. In this regard the regional urban market in Gandajika City served as a price indicator for operations conducted in surrounding rural markets. Retail measurement units used in selling maize were not similar or comparable, as we showed earlier for markets in Mbuji Mayi, but when changes in these units were introduced to respond to changes in supply, they occurred more or less at the same time, i.e. all markets in Mbuji Mayi would more or less simultaneously start using a bigger or a smaller unit of measure as supply conditions improved or worsened.

Observation of producers, assemblers and retailers at all levels indicates that sellers did try to differentiate their products from that of their competitors using a variety of techniques. To measure the effects of product differentiation on final price, all our monthly price estimates were based on disguised purchases made at least twice a month from different retailers in the market place and outside the market place. Maize from each 10 makuta purchase was weighed and the weights from different purchases in different markets are the basis for the following comparisons: within the same market 1) there tended to be a greater variation between sellers for maize sold on the cob than for shelled maize; 2) there was also a greater variation between sellers for shelled maize than for maize flour; also, within the same market (rural or regional or urban), 3) there was a greater variation in quantity sold by producers than there was for maize sold by rural or urban assemblers. If we compare sales made by producers in their villages and those made by producers in the market, 4) there was a greater variation between producer-sellers selling in their village than between producers selling in the market. Selling in an organized market place thus tended to increase the information about marketing practices available to the producer. Between markets, 5) the variation between sellers in maize sold for 10 makuta was greater in rural markets than it was in urban markets. In each market, 6) the magnitude of the variation of quantity sold by the various sellers declined as the time after harvest lengthened, with the smallest variations appearing in October-November. In December, in anticipation of the forthcoming harvest, producers and assemblers tended to offer a bit of their unsold stock, if any, and the variation in the quantity sold by different sellers in different markets started climbing again.

How much sellers gained in getting involved in a monopolistic competition process is difficult to assess because of the inadequacies of a volume measurement system. With this system it was difficult even for a seller to deliver the same quantity of maize or maize flour to successive buyers. However, observation of the situation prevailing in southern Kasai Oriental suggests that sellers differentiating their products secured profit that they would not have enjoyed otherwise, but this profit tended to be not significantly different for a comparable group of sellers.

5.5. Marketing Intermediaries, Marketing Behavior and Price Formation

Market structure in southern Kasai Oriental indicates that within the reach of rural and urban assemblers an increased competition has developed in buying and selling maize. The process of price formation within a market shows that individual sellers are not capable of greatly modifying the price to their own advantage.

In rural and regional urban markets, the seller might or might not have had any previous information on market prices. Upon arrival at the market she would usually take a quick tour of the market place to evaluate the supply and particularly the price at which other sellers were offering their product, and then establish her own price taking into account the size of the cobs of maize she had brought.

5.5.1. The Source of Market Information

One hundred and thirty-four assemblers and producers selling in rural and urban markets were asked to indicate how they got market information and which basis they used in fixing the price of their maize. Of the producers selling maize occasionally after harvest (66 in the sample), 10% said they had not used any prior basis for fixing the price, 28.4% of the women asked for information from other women in the market, 24.0% of the sellers gathered price information from the previous market day, 36.0% of the sellers walked through the market before establishing their own price, and 2.0% sent their children on a previous market day to check on the trend in the price of maize. Similarly, of the producers-traders, 2.0% used no prior basis for fixing their price, 20.4% asked other traders in the market, 34.7% gathered information from the previous market day, 38.8% walked through the market before setting their own price, and 4.1% sent their children to the previous market to gather market information (Table 5.12).

Table 5.12. Basis of information for fixing the price of maize in the market.

Source of information	Seller %	
	Occasional	Regular
No prior basis	10.0	2.0
Ask other women in the market	28.0	20.4
Price of previous market day	24.0	34.7
Walk through the market to check other sellers before setting price	36.0	38.8
Send children to check price on previous market day	2.0	4.1

As to the basis for fixing their prices, 7.6% of the 134 respondents said they fixed their price in relation to the quantity of maize on the market place, 21.2% used the price of other commodities sold in the market and in stores as the reference for establishing their price, 24.6% used the price of clothing as the basis for reference, 13.6% based their price on that of salt, 11.9% on that of palm oil, and another 11.9% used the price of detergent and/or soap as the basis for establishing prices for agricultural products (Table 5.13). If we compared occasional traders to regular producer-traders, we noticed that producers who were occasional traders put more emphasis on salt (16.1%) than producer-traders (7.1%).

Table 5.13. Products of reference used by sellers to fix their price for maize (% of respondents).

Quantity of maize in the market	7.6
Price of other commodities sold in market	21.2
Price of clothing items	24.6
Price of salt	13.6
Price of palm oil	11.9
Price of soap and detergent	11.9
Other answers	9.2

From the above discussion it appears that many producer-sellers, and village and rural assemblers went to market with no clear idea on what the price might be. The observation that many sellers needed to get to the market to find out about prices could be and was used by buyers to take advantage of the sellers' imperfect information. Since sellers had to reach the market to fix their prices, a buyer who could complete a transaction before the seller reached the market would have some degree of monopsonistic power. Buyers in Gandajika City, Kaseki, Kamanda and Nsona often waited for sellers at the entrance of the town or the village, up to two kilometers from the market place to buy maize at a cheaper price than in the market place. Buyers often told sellers that they wanted to relieve them from the burden of walking with the heavy load to the market, where the price would be the same anyway. But the price was not the same, and some sellers who had walked up to 30 km lost the opportunity of making some extra money. Disguised purchases made following the practice indicated that in Gandajika as well as in rural markets, at harvest time, the price outside the market place was 16 to 21% lower than in the market itself. On regular market days we estimated at 40% the quantity of maize sold by producers and village assemblers to rural or urban assemblers outside the market place.

Of the services rendered by a buyer operating at the village entrance, one can include the probability of selling the total quantity carried and, consequently, the relief from having to wait in the market for buyers to show up or from having to carry back the unsold maize. Although selling outside the market place may reduce some uncertainties, we still believe that sellers would do better walking the extra kilometer to reach the market place.

5.5.2. Market Behavior and Competition in the Maize Market

The final price at which maize was sold depended on the ability of sellers and buyers to negotiate the number and size of cobs to be transferred per unit of money. In general, the seller would not let the buyer do the counting, unless he or she wanted to buy the whole load. Instead, the seller would count and mix cobs of different sizes. It was up to the buyer to contest the mixing. The final price was reached often only after a confrontation of the bargaining powers of the buyer and the seller. If a seller made a selection which was not favorable to the negotiating buyer, the buyer would move to one of the tens or hundreds of other sellers in the market place and try to negotiate a better deal. Given this situation it was generally difficult for a seller to successfully modify the market price to her exclusive advantage. Informal collaboration among sellers did influence price however, as we witnessed in the village of Nsona, in February 1975. On that particular Wednesday, we noticed a producer about 45 years old, enter the market. She started selling her maize at 30 cobs for 10 makuta. Other sellers were selling 20 cobs of the same size for 10 makuta. We went and bought 30 cobs and the seller gave us two additional husked maize for the gift that most buyers ask from sellers. As soon as our transaction was concluded, a young seller, rushed up to tell our seller that she was disturbing the market. The latter immediately adjusted her offer to 20 cobs for ten makuta.

In urban markets, when rural and urban assemblers sold directly to consumers and retailers, the forces that operated in rural markets to converge prices also were at work. But here, because of different market knowledge for the different groups of sellers, this force operated to equalize prices only among similar sellers. During some periods of the year the presence of producers and assemblers with different market information often led to different equilibrium prices for different categories of sellers. During February and March of 1975, in Bakwadianga market in Mbuji Mayi, producers and assemblers were selling a basin of about 30 kg for different prices (Table 5. 11). However, as the time after harvest lengthened and the urban markets were dominated by assemblers, these discrepancies vanished. In August through early December, when urban markets were supplied almost entirely by licensed traders, additional forces tended to reduce the competitive mechanism. Only a few licensed traders had stored maize, and because of the shortage, retailers and semi-wholesalers had to take the supply price established by wholesalers. In some cases, wholesalers hired members of their own extended family and controlled the selling of their own maize down to the retail level.

Transactions on maize were not always based on impersonal competitive factors; kinship and personal relationships also played some role in the marketing chain. In many villages of the Gandajika, Tshilenge and Mwene-Ditu districts we often came across the expressions, " 'our son' who is a licensed trader in Mbuji Mayi buys most of the maize", or "such a 'women trader' located at such a place buys here". The expression 'our son' referred to a native of the village and a named trader was a trader well known by the village or by the farmer. In some villages, transactions were thus very personalized. Two women traders told us that after traveling for tens of kilometers some villages would not allow them to buy their maize because some other trader in Gandajika City or Mbuji Mayi was the regular buyer and he was expected to come.

On a larger scale, in 1975, ONACER technicians were given a demonstration of this personalization of trading in maize. ONACER/PNM, in collaboration with CAKO, had provided fertilizer insecticides and seed for the introduction of the Salongo variety (Tuxpeno 1) in the rural area. After harvest ONACER/PNM decided to buy all the maize in order to provide seeds for the 1975/1976 campaign. We went from village to village, buying maize from farmers whose production level was known. According to production data and at six makuta per kilogram of maize, only nine out of 48 farmers sold one-third or more of their production to ONACER/PNM. All the others sold one-fourth, one-fifth or even less. ONACER/PNM even proposed exchanging the Salongo variety for another variety, but farmers did not like the idea. This would have been without consequences if producers kept the maize they claimed they did not have for their own consumption. Instead, after we left, producers sold their maize nightly to licensed traders from Mbuji Mayi. In the village of Nsona, the nightly trade was monitored and it showed that farmers were selling the Salongo variety to traders, a fact that could be checked at the Mbuji Mayi retail market.

The price offered by ONACER/PNM (six makuta per kg) was greater than the average rural market price, at that time (five makuta per kg). It was also greater than the average price paid in a house to house purchase made in the village (about three to four makuta, which was also the average price paid by licensed traders). Although ONACER/PNM eventually changed the price to eight makuta per kg, farmers still would not sell the Salongo variety. It seems that producers who had established relationships with traders counted on these traders for such services as transportation to Mbuji Mayi, special treatment for a member of the family visiting the town, and financial assistance in terms of loans. The producers felt they had to sell some maize to these traders to guarantee the security of these services. It would be false to explain the observed behavior only in terms of guarantees for future services, but these services were taken into account and producers often recognized their importance. It is not known how much a farmer benefits from getting involved in personalized transactions, but the observation of some cases makes one wonder whether a producer would not be better off favoring a greater degree of competition among buyers.

Another practice which served to distort competition was observed in the non-regional urban market of Mbuji Mayi. There, urban assemblers and retailers operating in the Bakwadianga market organized in an association to prevent producers, village, rural and regional urban assemblers from selling as retailers in this market, after maize had become scarce. From late March through early May 1975, the association of women traders from Mbuji Mayi operating in the Bakwadianga market tried to force producers and assemblers from villages and district towns to sell to urban traders. The associated urban assemblers had decided that each member would take turns buying a number of sacks of maize from producers and assemblers coming from the countryside. To enforce their position, the associated women decided not to rent storage facilities to producers and district assemblers who tried to establish as retailers. It was reported that the influence of the association on the market was strong enough to allow the associated women to temporarily achieve their objective of establishing an oligopsony while trying to protect a loose oligopoly on the selling side. The oligopolistic behavior in the Bakwadianga market was denounced by women traders from the Gandajika regional urban market from where a large share of maize sold in Bakwadianga between January and July originated. It reportedly took the intervention of the regional charge of the economic problems in Kasai Oriental to get the associated women to give up putting pressure on other traders.

5. 5. 3. The Price of Maize

Market information, the behavior of the marketing agents and market supply and demand of maize determined the price at which maize was exchanged between market intermediaries. Table 5. 14 provides the price of maize grain and maize flour for the markets studied in the Mbuji Mayi and Gandajika areas. These prices were obtained following the procedures described at the beginning of section 5. 4.

Table 5.14. Retail price of maize in six markets of southern Kasai Oriental.[a]

	Urban			Rural			
	Zaire		Bakwadianga	Gandajika	Kaseki	Kamanda	Nsona
Month	Maize flour	Maize	Maize	Maize	Maize	Maize	Maize
1974 December	-	-	-	6.7	7.5	6.5	5.9
1975 January	13.3	13.8	12.2	5.3	4.4	4.8	3.9
February	12.6	8.5	8.1	4.7	3.6	2.9	3.0
March	14.8	8.7	7.8	5.5	5.3	4.8	5.1
April	14.7	11.0	11.8	8.8	7.3	8.1	6.7
May	11.7	7.3	7.2	7.5	7.2	4.9	7.9
June	14.8	8.9	8.6	7.2	6.7	5.9	6.7
July	14.4	10.7	9.9	9.4	9.2	8.5	7.7
August	24.6	24.5	19.3	18.5	14.6	13.3	9.4
September	-	-	-	20.1	16.1	16.7	11.1
October	38.4	26.1	28.4	29.8	27.6	31.7	26.2
November	34.6	29.3	31.6	28.4	29.8	29.9	31.1
December	30.0	28.6	27.0	20.1	20.3	26.1	-

[a] Makuta per kg.

The price figures in Table 5. 14 indicate that the price of maize grain rose or declined more or less at the same time, in all markets studied. This simultaneity of price changes in the six markets suggest a relatively good flow of information on supply and demand between markets. The jump in maize retail price, starting in August, is due to many reasons. A severe shortage of supply in the last five months of 1975 is the main reason for the size of the price increase. Other reasons such as general inflationary trends and the control of the market by few licensed traders may have contributed to the rise of the maize price.

The price data from the Zaire market in Mbuji Mayi indicate a relatively small difference between the price of maize grain and the price of maize flour for each of the ten months for which price information was available. The observation of the market of maize in Mbuji Mayi suggests that this development is primarily the result of the fact that a buyer has an alternative to direct buys of maize flour; similarly an assembler, licensed trader or retailer has an alternative to direct sales of maize grain. When the price of maize flour rises, a consumer can buy maize grain and have it milled by one of the small flour mills near the market place or not far away from home. Similarly when the price of maize flour increases, some licensed traders, urban assemblers or retailers can mill some of the maize grain that they still have in storage. A rise in the demand for maize grain tends to increase the price of maize grain. On the other hand, an increase in the number of licensed traders, urban assemblers and retailers milling their grain tends to increase the supply of maize flour and thus decrease its price. It is the interaction of these forces for maize flour and maize grain, which are substitutes, inconsumption, which explain a large part of the small difference between the price of maize flour and that of maize grain. The presence of small flour mills thus contributes to decreasing the size of the rise of the price of maize flour imported from Mwene-Ditu, Kananga and Kakontwe., in Likasi.

The share of the producer in the price rise over the year is not known. But information about when, after harvest, farmers sell most of their maize (Table A-78) suggest that 60% or more farmers in Tshilenge, Mwene-Ditu and Kaniama do not capture a large share of the August-December rise. These producers have already sold most of their maize when the major price rises occur.

Observation from the 77 villages we covered in the first phase of the collection of data, as well as post survey observation of villages surrounding the towns of Tshilenge, Gandajika and Mwene-Ditu indicate that it is the local, rural, urban assembler and the licensed trader who collect and store maize for future sales in the months of shortages. We asked producers to explain why they would not keep their grain until the period of high prices, since, as most of them seem to indicate (Table A-79), they knew of the periods of high prices. Most farmers selling maize answered that they had to sell early in order to pay for personal taxes, school fees and previous debts. Farmers not selling maize perhaps threw more light on the problem; they often said that their production was just too small.

5.6. Performance of the Rural Urban Link

We showed earlier that producers sell their maize to assemblers or directly to final consumers in the village and/or in rural or urban markets. In the process, producers or assemblers eventually husk maize, then carry or pay to have maize carried to the market. The difference between the price paid to the producer and the price paid by the consumer, or the marketing margin, indicates how well intermediaries are compensated for their services. The price changes over time in the rural markets relative to those in urban markets gives an indication of how well the changes in consumer prices are reflected back to the producer.

Under perfect competition and perfect information in spatially located markets commodity prices would move toward equilibrium and equilibrium prices for any two markets would differ only by the transfer cost of the commodity between these markets (11, pp. 89-91). A price differential above the transfer cost would induce shipments of the commodity from the low price to the high price market. In this section price spreads are used to analyze price relationship between the market of Gandajika and the rural markets of Kaseki, Kamanda and Nsona.

5. 6. 1. Parity Price and the Shipments of Maize to the Gandajika Urban Market

The concepts of parity price and price spreads have been used by Lele (45) and by Hays and McCoy (90) to investigate price relationship between spatially separated markets and the possibility of trade between these markets. Following their approach price parity will be computed in the following way:

$$P_{ik} = P_i - T_{ki} \tag{5.5}$$

where

P_{ik} = the price parity of one kg of maize in the i^{th} market (Gandajika) in relation to the k^{th} rural market (Nsona, Kaseki and Kamanda)

P_i = the actual retail price of one kg of maize in the Gandajika market

T_{ki} = the shipping costs involved in moving one kg of maize from the k^{th} rural market to the Gandajika market.

The actual price spread between the i^{th} and the k^{th} markets is then computed as:

$$PS_{ik} = P_{ik} - P_k \qquad (5.6)$$

Under spatial perfect competition the P_{ik} for grain moving from the k^{th} to the i^{th} market would be equal to P_k and the price spread would be zero. A positive price spread would provide a potential opportunity for assemblers or producers to make more than normal profits while a negative spread would reduce the volume of trade between the k^{th} and the i^{th} markets.

The price figures used in this analysis are those in Table 5. 14 for Gandajika, Kaseki, Kamanda and Nsona. Transportation costs were based on information provided by lorry transporters operating between Kaseki and Gandajika, and between Kamanda and Gandajika, For Nsona, where no lorry transporter's were operating, transfer cost was estimated taking into account the time required to walk from Nsona to Gandajika.

Figures 5. 3 through 5. 5 present retail prices of maize for the rural markets in Kaseki, Nsona and Kamanda and the parity price (P_{ik}) between these markets and Gandajika. By definition, parity prices below retail prices indicate a negative price spread and parity prices above the retail price indicate a positive price spread.

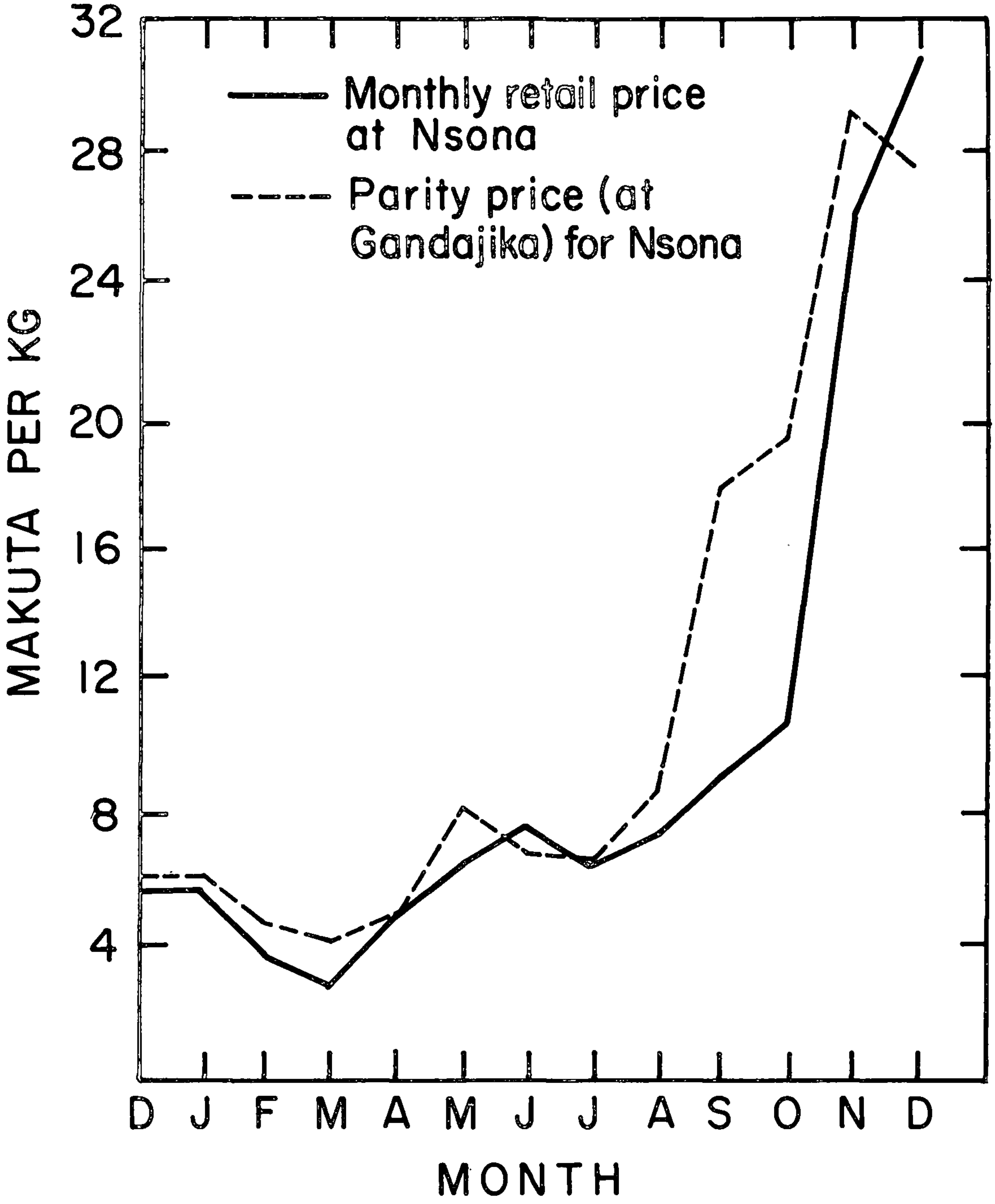

Figure 5. 3. Price spread for maize between Nsona and Gandajika markets, December 1974-December 1975.

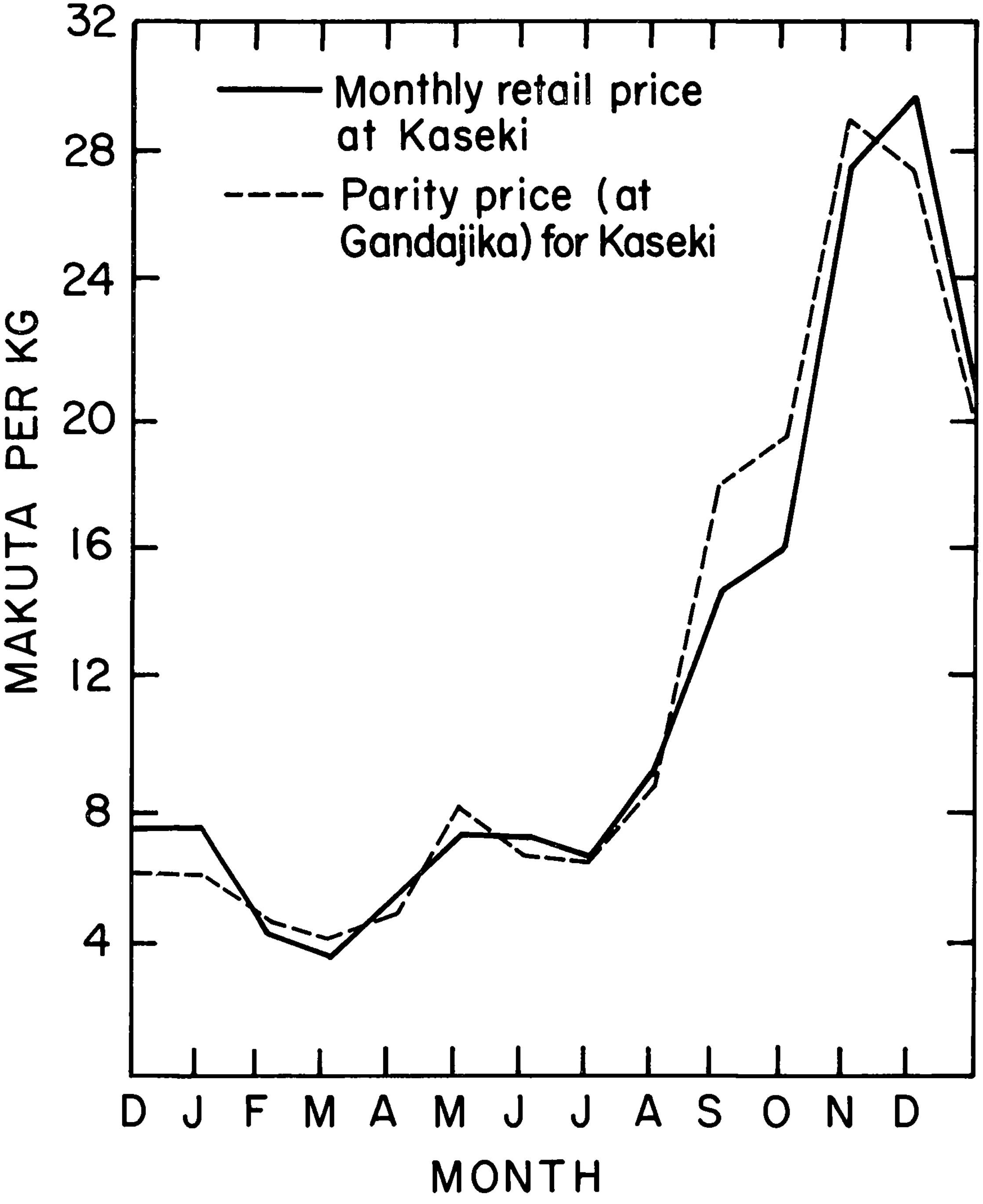

Figure 5. 4. Price spread for maize between Kaseki and Gandajika markets, December 1974-December 1975.

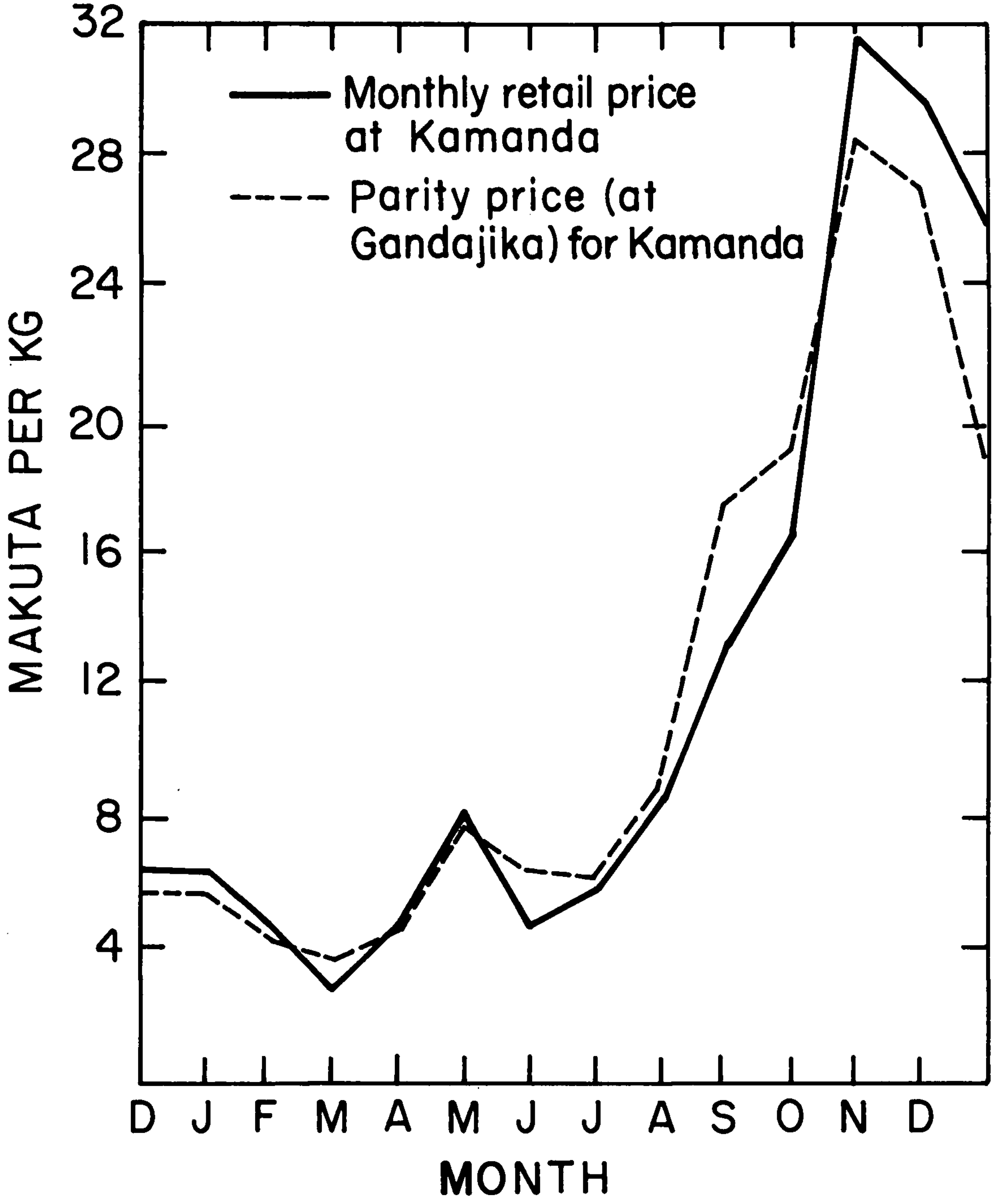

Figure 5. 5. Price spread for maize between Kamanda and Gandajika markets, December 1974-December 1975.

Before July 1975, most positive price spreads occurred in Nsona market; price spreads in Kamanda and Kaseki moved more erratically than in Nsona. The situation that occurred after July 1975 seemed unusual compared to previous price data compiled by the local branch of the Institut National des Statistiques, in Mbuji Mayi (Appendix Table B).

The predominance of positive price spreads indicated that it was possible to benefit from trade between Gandajika and the rural markets considered. In this model, price spreads were often positive because we included in the shipment cost only the cost involved in transporting and handling maize. If we had used a shipment cost to include the cost of transporting maize, handling charges and the cost of transporting the owner of the maize who often rode with his maize, price spreads for Kaseki and Kamanda would have been more negative than positive. However, since most of the maize shipped to Gandajika from the Kaseki, Kamanda and Nsona production areas were carried as head loads and because the cost of carrying a head load of maize was likely to be lower than the cost of shipping maize by lorry transportation, price spreads were probably more positive than indicated in Figures 5. 3 through 5. 5. On the other hand, if the opportunity cost of carrying maize is used instead of a simple estimate of the transportation cost, then, when selling maize competed with other agricultural operations, price spreads may well have been more negative than positive, for producers in the Kamanda, Kaseki and Nsona production areas who carried their maize to Gandajika instead of selling it in their rural markets.

The positive spreads first appear with the coming of the new harvest in January, February and March (Figures 5. 3 through 5. 5). The positive price spreads in December and January, for the market of Nsona seem to have been associated with the harvest from the third crop of maize that we described in Chapter 4. In the Nsona market, positive price spreads dominate most of the year, thus indicating a possibility of gains for moving maize from the Nsona production area to the Gandajika market. In Kamanda the most positive price spreads occurred after the month of April and lasted until mid-October. In Kaseki, positive spreads occurred more erratically than in Kamanda and Nsona, perhaps making it more difficult for sellers to decide on whether or not to take maize to the Gandajika market instead of selling it in the local market.

The nature of the production of maize and the period within which most farmers sold their maize were the main reasons for positive price spreads in February and March. As many producers sold in their markets the price in these markets declined. Simultaneously many urban assemblers from Mbuji Mayi, Gandajika and Tshlinge were buying in the Gandajika market.

This had the effect of keeping the price differential between Gandajika and rural markets above the transfer costs. These positive price spreads, in turn, attracted many sellers from the rural markets to sell directly in Gandajika market. The increased post harvest supplies in Gandajika reduced the positive spreads and with the rising price of maize grain in rural markets it was becoming less profitable for some sellers to take maize directly to the urban market.

The positive price spreads of the June through October period were partially due to supply shortages in the rural and the urban markets as well. Supply shortages caused prices to rise in rural and urban markets, because of the size of the demand in the Gandajika market, price spreads between this market and the surrounding rural markets became positive. In spite of these positive price spreads, however, the flow of maize between the rural and the Gandajika markets was small because there was little supply in the rural area. The observation of the rural markets of Kamanda, Nsona and Kaseki indicates that during this period, many women who were selling maize in January through June turned to selling cassava because maize had become difficult to find. The change to negative price spreads for the Kamanda market, in October is due to a change in transportation cost between Kamanda and the town of Gandajika. The negative price spreads in November and December can be partially attributed to the appearance of the early maize (third crop) in the Gandajika market. It can also be explained by some producers selling maize out of their reserve in the expectation of the new crop of maize.

The observation of market operations in the Gandajika production area indicates that when price spreads were positive, many sellers responded by taking their available supply of maize directly to more centrally located markets. This was particularly the case of producers and assemblers selling directly in Gandajika and Mbuji Mayi in February and March. This selling pattern indicates that producers and assemblers were responsive to price changes. In October through mid-December most maize coming from the neighboring countryside was brought to the Gandajika markets by assemblers who had walked long distances to gather some maize from remote villages; but this supply was generally small. The largest supply of maize sold in the Gandajika market was provided by licensed traders who started selling from their stocks. From time to time some maize was shipped from the Mbuji Mayi to the Gandajika market.

As we already indicated, the small supply, the reduction of the number of maize sellers, and non-competitive behavior on the part of licensed traders may explain why maize prices rocketed in the last five months of 1975.

5.6.2. Marketing Margins and Producers' Share

The analysis of price spreads provides a picture of spatial adjustments between markets, but it does not show how each of the intermediaries benefits from transactions involved in getting a product from production to consumption centers. In this section an attempt is made to determine the magnitude of the marketing margins in the rural urban link connecting the rural market of Kamanda to the urban market of Gandajika.

A study of the marketing margins generally includes market prices at the farm and wholesale and retail levels in rural markets. Such a study also needs an evaluation of the cost involved in transferring the commodity from one market to another. Because of the refusal of licensed traders to cooperate in this study, the following analysis is based on data provided by producers and small scale traders, mostly women. At the time this information was collected, producers were actively operating in the rural markets, so the price received by producers in the market of Kamanda was eventually representative of the price received by producers in the production areas surrounding the Kamanda market place. However, it was noticed that even in the rural markets producers tended to sell at a lower price than assemblers. Therefore, it was decided to break the rural market price into the proportion that went to the assemblers and what went to the producer. Because of the problem involved in collecting such information, the investigation was limited to February and March, the period over which most producers in the neighborhood of non-isolated rural markets sold the maize they intended to sell.

Table 5.15, which summarizes the margins, shows that in the first months that followed harvest, producers who sold maize in their village received 47.5% of the retail price in Gandajika and marketing margins shared for 52.5% of the retail price. Transportation alone accounted for 27.3% of the retail price and this single item affected heavily the producer's share. The high share of transportation in the retail price in the Kamanda area contrasted with findings made by Hays and McCoy in Northern Nigeria. In a study on the marketing of sorghum and millet in Nothern Nigeria, they found that transportation accounted only for 5.4% of the retail price of sorghum, and 6.5% of the retail price of millet. Hays and McCoy's study also indicated that the producer's share accounted for 69.8% of the retail price of sorghum and 68.2% of the retail price of millet (29, p. 17).

Table 5.15. The share (%) of the retail price each marketing agent received per 60 kg sack of maize shipped from the Kamanda producing area to the Gandajika urban market, February-March, 1975.

Marketing Agent	%
Retailer	14.8
Urban Assembler	2.2
Transporter	27.3
Rural Assembler	3.3
Village Assembler	4.9
Producer	47.5

Transportation cost in the survey area seemed to dictate the producer's share in the retail price of maize over the February-March period. Over this period, for a producer or assembler using lorry transportation to organize profitable operations in maize between the rural market in Kamanda and the urban market in Gandajika City, the producer or the assembler needed to ship at least two sacks of maize of 60 kg for a wholesale operation to be profitable. Producers and assemblers who had very little capital and/or were shipping one sack of shelled maize weighing 60 kg or less would not benefit from using lorry transportation between the Kamanda rural market and the Gandajika urban market, even if maize were sold in the retail market in Gandajika.

At 231 makuta per sack of 60 kg in Kamanda and 306 makuta per sack in Gandajika, the 150 makuta needed to transport the sack and the owner who often travelled with hir or her product would apparently favor sales in the rural market for most producers and small scale assemblers. However, many producers and assemblers avoided the cost of lorry transportation by carrying the equivalent of 25 to 30 kg of shelled maize in husked maize; they covered the 20 to 30 km between their village and the urban market where maize was finally sold at the retail or semi-retail price. By selling directly in the Gandajika market, producers were able to regain part of the margin that would have been taken by the transporter and the retailer.

However, only a few farmers located in the neighborhood of urban markets could walk to these markets. For the majority of producers located far from the urban area and/or in isolated villages, the transfer cost reduced the share of the producer in the urban retail price and perhaps limited the number of producers who could enter the maize market or the quantity of maize they sold.

Even those who walked to market to avoid the high transfer cost finally suffered from this cost in terms of the opportunity cost of the time spent in going to the urban market. For the production of cotton and the second crop of maize whose planting periods coincided with the time of harvest and marketing for maize, two to three weekly trips to rural and urban markets might have worsened the labor constraint which already restricts agricultural production. In addition, having the owner ride with his product to the urban market was a costly practice, particularly if the quantity transported was small. Instead a system of collection and convoy to town with only one conveyor would have saved producers' time. Unfortunately since no price was known before one reached the market, and given the lack of a comparable unit of measurement used in marketing maize, a single conveyor system would provide a source of endless discussion and irregular operations. Because of the amount of capital available, the transportation problem, together with imperfect information increased the risk of marketing operations.

Transportation costs and the lack of a collective organization to sell maize have also led producers and assemblers to take their maize directly to the town of Mbuji Mayi. Traders often argued that rural assemblers and producers lost when they took maize to Mbuji Mayi. Is it really so?

In order to increase understanding of the shipment operation, this study undertook an investigation of the budgeted costs and income for producers, assemblers and retailers operating in the Mbuji Mayi market for the February-March period. For the analysis, the emphasis was put on buyers and sellers involved in the Gandajika-Mbuji Mayi interurban link. Budgeted costs and returns for intermediaries presented in Table 5.16 are based on information provided by producers and assemblers who were traveling from Gandajika to Mbuji Mayi to sell maize.

The first and second columns in Table 5.16 refer to cost and returns of representative producers, local assemblers or rural assemblers who ship maize from the Gandajika production area to Mbuji Mayi. The third column refers to the cost and returns of a representative retailer who buys maize in the Mbuji Mayi market for sales in the same market. The fourth column also refers to costs and returns of a representative retailer who buys maize grain in the Mbuji Mayi market, gets it milled and sells maize flour. Most producers and rural assemblers who went to Mbuji Mayi to sell maize did it as a "one shot" operation. Regional urban assemblers and urban retailers inMbuji Mayi operated on a monthly basis. Many retailers bought one big basin for sale in the same day. For simplicity we made the assumption that there was no carry over for retailers from one day to the next. Therefore they were supposed not to incur any significant storage and transportation costs. The urban retailer considered here is a resident of Mbuji Mayi, thus he does not have to rent a room at the market place to wait for transactions to resume the next day.

Since the cost elements of a producer conveying her or his maize to Mbuji Mayi include the market value of maize, at the

Table 5.16. Budget and costs of marketing intermediaries in the Gandajika-Mbuji Mayi interurban link.

	Origin of Intermediary			
	Gandajika		Mbuji Mayi	
			Retailer	
Elements of the Budget	Producer or rural assembler*	Urban assembler	Shelled maize	Maize flour
Initial average working capital (makuta = K)	300-800	2000	646	646
Average number of sacks of 90 kg sold in one month	3	4		
Average number of 30 kg basins of maize sold in one day			1	1
Average quantity of maize handled in kg	270	1080	600	600
Flour equivalent for the total quantity of maize bought				562
Number of days needed to sell the average quantity of maize handled	7	2		
Total cost (K)	1837	6480	4500	5700
(1) Purchase cost of maize (K)	1170	4680	4300	4300
(2) Shipment cost for sacks of maize and owner (K)	350	1260		
(3) Maintenance cost for the owner and storage (K)	317	540	200	200
Storage (K)	30	120		
Food (K)**	287	420	200	200
(4) Milling cost of maize (K)				1200
Sales				
Wholesale				
Bakwadianga market (K)	2002.5			
Zaire market (K)	2146.5	8586		
Retail				
Bakwadianga market (K)	2146.5			
Zaire market (K)	2322	9288	5160	7699.4
Gross margin on sales				
Wholesale				
Bakwadianga market (K)	832.5			
Zaire market (K)	976.5	3906		
Retail				
Bakwadianga market (K)	976.5			
Zaire market (K)	1152	4608	860	3399.4
Return to management and capital				
Wholesale				
Bakwadianga market (K)	165.5			
Zaire market (K)	309.5	2106		
Retail				
Bakwadianga market (K)	309.5			
Zaire market (K)	485	2808	660	1999.4

* Producers and rural assemblers product was evaluated at Gandajika's price.

** Food taken by the seller while he's operating at the market place.

Gandajika price, the cost of shipping the product and the conveyor from Gandajika to Mbuji Mayi and the living expenses in Mbuji Mayi (Table 5. 16), the positive return to capital and management (Tables 5. 16, 5. 17) seem to support the claim by producers and assemblers that they benefitted from direct sales in Mbuji Mayi. We indicated that these sales took place at a time when producer-sellers were supposed to be involved in planting or weeding cotton and other crops. Thus, seven days spent in Mbuji Mayi may have carried a high opportunity cost of time which could reduce the returns obtained by a farmer conveying his product to Mbuji Mayi. We also indicated that producer-sellers said to come to town not only to sell maize but also to rest after working through the first maize season. The real opportunity cost of time for selling maize would then be reduced because of the pleasure derived from going to town. Thus, in spite of the opportunity cost of time, the positive returns to capital seem to support the claim by farmers and assemblers that they benefitted from selling their maize in Mbuji Mayi, over the February-March period.

Data from the February-March 1975 period indicate that while marketing margins varied between 41. 6% and 45. 5% of the wholesale price, they fluctuated between 45. 5% and 49. 6% of the retail price, depending on whether a producer or rural assembler sold his maize grain in the Bakwadianga or Zaire market of Mbuji Mayi

Table 5.17. The share of the retail price received by a producer or rural assembler for taking his maize to Mbuji Mayi and selling it as a retailer.

	Retail		Wholesale	
Cost items and return to capital	Bakwadianga	Zaire	Zaire	Bakwadianga
		percent		
Cost of maize	54.50	50.4	54.5	58.4
Transporter	16.30	15.1	16.3	17.5
Storage	1.4	1.3	1.4	1.5
Food	13.4	12.4	13.4	14.3
Return to management and capital	14.4	20.9	14.4	8.3
Total	100.0	100.1	100.1	100.0

(Table 5. 17). For the regional urban assembler taking his or her maize from Gandajika to Mbuji Mayi margins accounted for 45. 5% of the wholesale price. The margins were the lowest for the retailer buying maize grain for resale in the same market in Mbuji.Mayi.

Table 5. 18. The share of a regional urban assembler or a retailer from selling maize grain or for selling maize flour from previously purchased maize grain.

Cost items and return to capital	Regional Urban assembler	Urban retailer	
		Commodity sold	
		maize grain	maize flour
		Percent	
Cost of obtaining maize	54. 5	83. 3	55. 8
Transporter	14. 7		
Cost of milling maize	0. 0		15. 6
Storage	1. 4		
Food	4. 9	3. 9	2. 6
Return to capital and management	12. 5	12. 8	26. 0
Total	100. 0	100. 0	100. 0

Figures in Tables 5. 17 and 5. 18 indicate that returns to capital and management were lower than 10% of the market price only in the case of a producer or rural assembler selling his or her maize in the Bakwadianga wholesale market. The higher return to capital and management occurred for the producer or rural assembler selling as a retailer in Zaire market and for the Mbuji Mayi urban retailer selling maize flour from maize grain previously purchased from the market. However the returns to capital and management for the retailer selling maize flour seem excessive.

Although producers and rural assemblers would have much higher returns to capital and management by selling as retailers in the Zaire market, most producers and rural assemblers going to Mbuji Mayi took their maize to the Bakwadianga market. The few producers and rural assemblers we asked to explain why they stayed in Bakwadianga while they could get more for their maize in Zaire market indicated that they were unaware of the price difference between the two markets. Many other factors known to producers and assemblers may explain the producers and rural assemblers choice to stay in Bakwadianga, but the data from the markets in Mbuji Mayi suggest that limited information on market conditions may be responsible for lower margins received by producers and rural assemblers in some markets.

High returns may explain why many urban residents leave the town at harvest time to buy maize from the rural areas for sales in urban markets. They may also explain why other urban residents offer their labor for maize harvest, in areas surrounding the town, in exchange for baskets of maize which can be shipped and sold in Mbuji Mayi. High returns on maize may also explain why regular producers become assemblers in January, February and March, and gather maize for sales in Mbuji Mayi. The attempt by these assemblers to gather maize in Gandajika and Mbuji Mayi area has helped increase competition among sellers of maize and the price of maize received by producers in this area. The demand for transport services generated by the movements of assemblers and maize and other agricultural products between Gandajika and Mbuji Mayi, and between Mwene-Ditu and Mbuji Mayi, has generated a well structured system of lorry transportation which is unique in the area. The trade in agricultural products between Mbuji Mayi and its supply centers has generated seasonal or semi-permanent work for many assemblers and transporters involved in the marketing of maize.

Let us observe that this development has occurred in a limited area. If we consider districts such as Kaniama and the southern part of Mwene-Ditu where market places are rare and the road system is in bad condition, limited market information and transportation bottlenecks reduce the extent to which changes in central markets can affect the action of many maize producers.

5.7. Interregional Trade and Transfer of Maize

On many occasions in this paper we have indicated that maize consumed in Shaba, Mbuji Mayi and Kananga was often shipped from other regions in Zaire. We have also mentioned efforts by local administrations to prevent the exodus of local maize in order to supply local mills.

Except for the Kakontwe flour mill in Likasi most mills transforming maize into flour in Lubumbashi and Kananga were working under capacity when we visited them early in 1975; because the supply of maize grain was scarce.

In 1974, southern Shaba obtained maize from the northern part of the country, through Kinshasa, and also received maize from Kikwit, Mweka and northern Shaba. Kananga relied on Kikwit, Mweka and Lwiza as major sources for local supply, and Mbuji Mayi received maize from Kananga, Mweka, Lwiza and northern Shaba (Figure 3. 1 for site location). The action of traders from Mbuji Mayi in getting maize from everywhere, including part of the maize that traders from Shaba had imported from Zambia had not always been well received by authorities in the other regions, and most of the barriers that local administrations were trying to establish for the export of maize were primarily directed at traders from Kasai Oriental. Why is it that maize should go to Mbuji Mayi rather than to Lubumbashi or Kananga? In the case of these metropolitan areas, the problem that faces research is one of three markets competing for the same product, maize, which is produced at spatially dispersed production centers.

Let us consider the supply centers at Mweka, Kaniama, Nyunzu, Kabalo and Kalemie, from which maize can be shipped by railroad to consumption centers in Lubumbashi, Likasi, Mbuji Mayi and Kananga. If consumer prices were equal in all consumption centers, and if we assume transfer costs to be a linear function of distance, which is true for rail freight rates in Zaire, then the boundaries between competing markets would be the locus of points where the distances between markets would be equal. Table 5.19 shows the cost of transportation by railroad of one ton of maize from shipping points to consumption centers. Accordingly Kalemie, Kabalo, Nyunzu, Kongolo and Kaniama would be on the boundary of Mbuji Mayi, if we accept the assumption that shipping to Mwene-Ditu is equivalent to shipping to Mbuji Mayi. Mbuji Mayi and Mwene-Ditu are separated by 134 km of paved road. Kananga would have in its boundary the production area of Mweka, and Lubumbashi and Likasi would have to rely on external sources of supply or produce their own maize. If there were surpluses in some producing areas, boundaries could overlap, but in the shortage situation of Zaire a competitive marketing system would definitely favor Mbuji Mayi.

Up to this point we have assumed equality of prices in all three markets. In practice the situation is quite different. Around

Table 5. 19. Shipping costs for one ton of shelled maize from major producing centers to major consumption centers of Shaba and the two Kasai (makuta per ton).[a]

Shipping centers	Consumption centers			
	Mwene-Ditu Mbuji Mayi	Kananga	Lubumbashi	Likasi
Mweka	258	200	443	418
Kaniama	155	232	322	296
Kabalo	315	360	373	347
Nyunzu	334	386	392	366
Kongolo	347	504	405	379
Kalemie	443	494	501	494

[a] Costs used here were partially calculated by technicians working with the KINSHASA-DILOLO-LUBUMBASHI (KDL) railroad system. Other figures were calculated using KDL basic charts and prices. All prices were then multiplied by the coefficient 1. 6 to conform with the moving index used in the calculation of tariffs by the KDL authority (15).

Lubumbashi and Likasi a price policy introduced to prevent social disturbances that could affect the production of minerals has kept the price of maize flour below its cost of production. In 1973, the cost of production of one sack of 60 kg of maize flour at the Kakontwe mill, in Likasi, was about Z 6.75 (54). According to a prior arrangement between the Kakontwe Mill (which had been nationalized) and the government, a large proportion of the maize flour produced was to be used for providing food to mining workers, particularly in Shaba. In 1975, one sack of 60 kg of maize flour was sold to mining workers for Z 3.00, in Shaba, and each worker was allowed to buy a limited number of sacks of maize flour every month (2 sacks in 1975). The difference between the cost of production and the sale price to mining workers was paid for by GECAMINES, a government owned mining company. Maize flour not sold to mining workers was sold in the open market.

In Kananga and Mbuji Mayi the situation was quite different in spite of the existence of the diamond company in Mbuji Mayi which also distributed some maize flour to its workers. Hundreds of small flour mills as well as some larger mills were processing maize produced around the town or shipped from deep in the countryside. Under the pressure of local demands and a more or less open market, prices for maize flour and maize grain have risen more rapidly in Kasai Oriental than in most towns in Shaba and Kasai

Occidental. Under these conditions and assuming that transfer costs still remain a linear function of distance, then for any two competing markets, such as Lubumbashi and Mbuji Mayi, the boundary adjusted for price differentials for maize grain is the locus of constant difference in distances to the two markets, and the market boundary is a hyperbola (82, p. 129). This would suggest that because of the generally higher price of shelled maize and maize flour in Mbuji Mayi, this market would tend to invade the zone of influence of Kananga, such as Mweka and Lwiza (outside the railroad track). The assumption of linear transfer costs may hold as long as shipments of maize use the railroad system. But very often traders took their own trucks to buy maize in producing centers to avoid long delays due to railroad transportation. Given the situation of the roads in Zaire, one would expect that changing to truck transportation would induce a curvilinear transfer cost function throughout the entire range separating production and consumption centers. Where production centers extend over long distances such as is the case for Mbuji Mayi and southern Shaba, which compete for maize in northeastern Shaba, then the economic hyperbolas forming the boundary eventually completely enclose the market with the lower price (11); i. e. the high price market in Mbuji Mayi could eventually extend beyond the outer margin of the supply area for the low price market, Lubumbashi or Likasi, in this case. This explains why from August to December, maize from Zambia imported to feed southern Shaba appears regularly in the market in Mbuji Mayi and Gandajika City. This may also explain why a large part of the maize shipped from northern Shaba (Nyunza, Kabalo, Kongolo, Kalemie) is diverted to Mbuji Mayi.

Policies on the marketing of maize in areas such as the southern part of the Shaba Region do not seem to have been very helpful in promoting substantial increases in local maize production. In this respect, it can be noted that southern Shaba farmers do not seem to take advantage of the railroad and the paved road between Kolwezi and Lubumbashi to increase their supply of foodstuff to urban areas, as did farmers in the Bas Zaire Region (62). As a public servant in the regional department of agriculture in Lubumbashi noticed, since a large proportion of the urban workers can count on large mills to supply subsidized maize flour, the small mills that existed in Shaba and transformed locally produced maize have been disappearing. The decrease of assemblers collecting local maize has reduced the demand facing scattered producers and, perhaps, reduced the supply of maize marketed by each producing unit. The shortage of maize flour in urban market has also led to operations on subsidized maize flour which may conflict with government goals. In January 1975, the retail price of maize flour in five markets in Lubumbashi ranged from Z. 9.60 to Z 19.80

per sack of 60 kg i.e. largely higher than the Z. 3.50 paid by mining workers. The price differential between the subsidized and the non-subsidized markets for maize flour was conducive to speculative behavior and to operations which conflicted with government objective to maintain low prices for maize flour.

5.8. Government Price Policies and Maize Production and Marketing

As the marketing of maize is organized, the structure of the supply and demand in rural and urban markets indicates the existence of a system in which many producers, assemblers, retailers and few wholesalers sell maize and maize products. In some cases financial, technological and organizational constraints limit the level of competition in maize marketing so that producers are not able to adjust their supply to consumers' demand; in other cases, limiting factors to maize marketing are such that the available supply is not always able to react to market changes.

The analysis of the rural urban link in the Gandajika area and the observation of the interurban link between the Gandajika and Mbuji Mayi urban markets indicate that many producers, traders and consumers in these defined areas developed a good understanding of the market mechanism. The alignment of price changes in non-isolated rural markets on the price changes in the urban markets indicates that modifications in central markets were rapidly transmitted to local markets so that prices in these local markets tended to reflect the overall situation of production and demand in the area. By using such devices as checking the price charged by other sellers already in the market, asking other sellers in the market, or asking about previous market prices before going to market, farmers demonstrated that they are price searchers. By using the fluctuating prices of such items as clothing, palm oil, salt and soap to fix the price of maize grain and by carrying their grain directly to town, farmers demonstrated that they readily dealt in real terms. However, even in this limited area the observation of market operations also indicates that non-competitive behavior and technological and organizational constraints limit the effectiveness of maize marketing and the rate at which production and supply can adjust to the rising urban demand for maize. Government agencies have been aware of this problem for many years. But public intervention in the pricing of maize have scarcely helped to establish a direct relationship between the consumer price and the price received by farmers scattered over the production area.

Government intervention in maize pricing reaches two levels, the market of maize grain and the market of maize flour. In the market of maize grain, the government has established floor prices for maize grain bought from farmers and a ceiling price at which licensed traders can deliver maize grain to flour mills (38, 42, 60). In the market of maize flour, the government has established ceiling prices at the wholesale and retail levels (82). But floor prices have been given various interpretations which, in fact, have reduced their power to generate greater incentives for producers.

In the Kasai Oriental, Kasai Occidental and Shaba Regions that we visited we noted that most officials referred to the maize floor price as "the official price", "the government price". And most licensed traders we met in these Regions referred to the maize floor price as "the official maximum price". In Kasai Oriental, the 1974 Provincial Ordinance on the price of maize grain is revealing of the understanding of the concept of floor prices, even at the very high level of the provincial administration. After referring to the central government's ordinance on the minimum price, the governor of Kasai Oriental decreed "The maximum purchase price of shelled maize from farmers is fixed at four makuta per kilogram" (87). And this price was exactly what the Central Government had fixed as the minimum for the Kasai Oriental Region. Thus, a great confusion exists on the concept and the application of floor prices. If some top officials know what floor prices are supposed to be and what they are supposed to do, this understanding does not seem to be shared by the many local and regional government representatives who must enforce them.

In addition to some possible misinterpretation of the concept of floor price among government officials farmers are generally not aware of the existence of floor price policies. Of the 299 farmers in our master sample only 6. 1% knew of the existence of a government floor price policy and only 1. 5% knew the minimum price for the 1974 period. Thus, it seems that government efforts to increase market incentives by establishing a floor price for maize were largely handicapped by the failure of many local and regional authorities to comprehend and apply this policy and by a similar lack of comprehension by producers.

Agricultural price policies for foodstuffs in Zaire have been designed to provide cheap food items for urban workers and to maximize industrial surpluses that can be generated by low salaries induced by cheap food. In this, Zaire is just one of many countries using indirect taxation of agriculture to generate the development of other sectors of the economy (46). Such government price policies, as they existed in 1974-1975, appeared to create negative incentives for increased maize production.

In the following discussion we elaborate on this argument. The maize market consists of two parts, the market of maize grain and the market of maize flour. In the copper belt area of

Shaba, where most maize is imported from outside and milled by large scale flour mills, the market for grain is separated from the market for flour for most consumers. In Kasai Oriental and Occidental, where maize flour from large commercial mills competes with flour produced by small scale mills, the markets for maize flour and maize grain interpenetrate and cannot be completely separated. In one market place a consumer can get maize flour from small or large flour mills. She can also buy maize grain and have it milled at one of the small scale flour mills located either near the market place or a few blocks from her house. For a large scale flour mill, which buys maize grain, transforms it, and sells maize flour, the changes of the market conditions in market for grain directly affect its supply of maize flour.

Let us for the moment assume that everyone who buys a large quantity of maize is a trader who buys to deliver to large scale mills. The sources of maize supply for industrial transformation are both local production and imports. In early 1975, the average import price of maize from Zambia and Rhodesia delivered to the Kakontwe Mill in Likasi-Shaba was Z 85.62 per ton (54). The delivery price of the Zambian and Rhodesian maize to mills in the town of Kananga, in Kasai Occidental, was about Z 90.00 per ton. The price paid to the local producer was based on a floor price of Z 40.00 per ton, a price fixed by government authorities. Traders were required to sell their maize to mills for no more than Z 63.00 per ton. But traders argued that because of the cost of gasoline, capital, and because of the cost of buying, assembling, storing and protecting maize, the price of buying and marketing one ton of maize within 50 km of a good road or a railroad track could be no less than Z 73 per ton. In order to penetrate the countryside deeper than 50 km, some traders in Kananga argued that the delivery price to the mill of one ton of maize needed to be raised from Z 63.00 to about 85.00 per ton. The short local supply of maize grain forced flour mills to import foreign maize to meet the demand, but because of a foreign exchange constraint, the quantity of maize an importer could buy from outside was limited. Under these conditions, let us examine what effect on the local supply one can expect from the set of ceiling and floor prices fixed by the government.

Let S_P be the aggregate producers' supply schedule of maize grain, S_T the traders supply schedule, which includes all of a traders marketing charges and margins (Figure 5.6) and let S_I be the supply of imported maize. Let us also assume that the delivery price of imported maize is no less than Z 90 per ton for the whole of Zaire. The aggregate wholesale supply, MWFIYA is obtained by adding horizontally S_T and S_I (Figure 5.6). Assume that importers (who can be flour mill owners) can rely on Zambia and Rhodesia to supply maize, but that given the limited production of

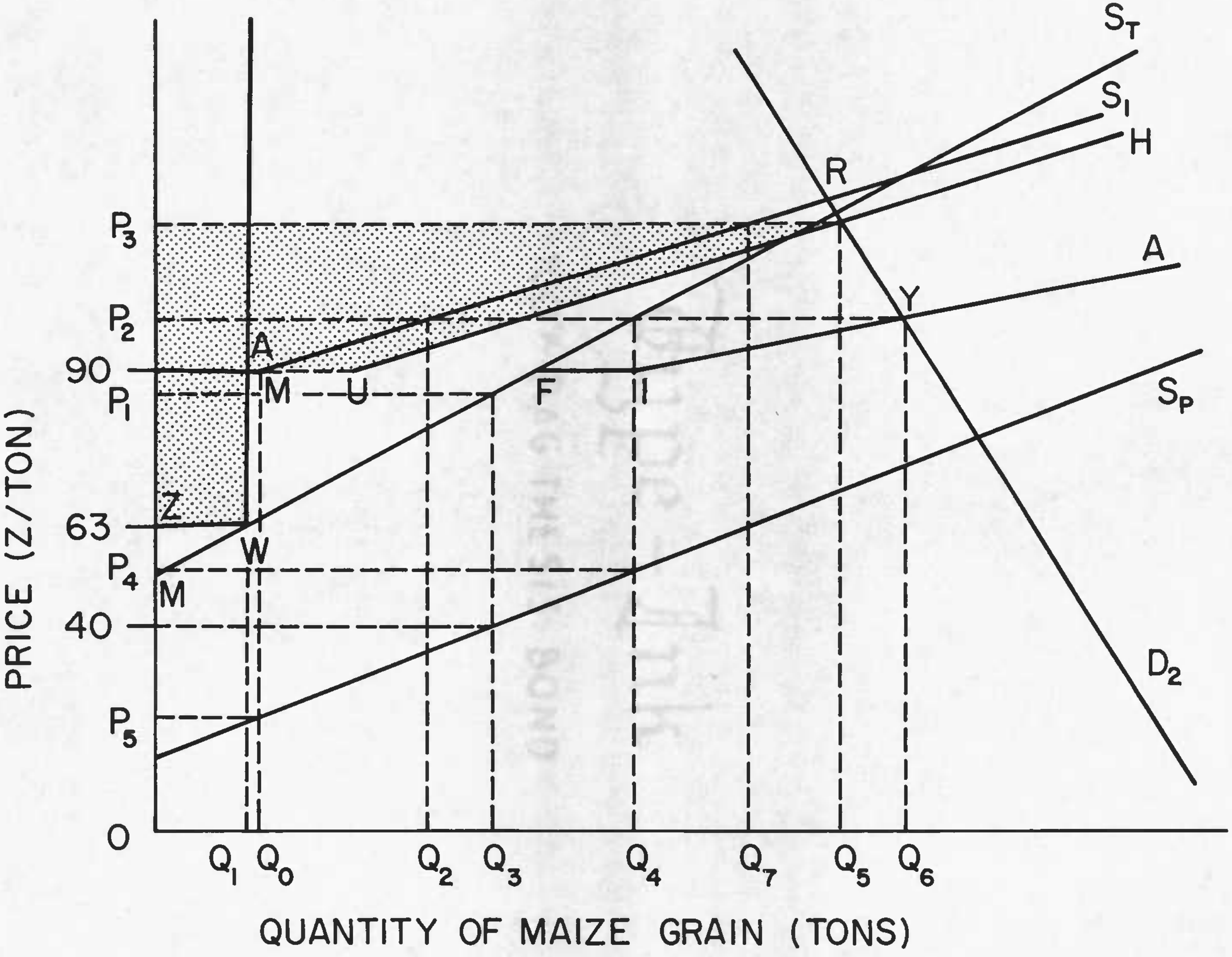

Figure 5.6. Equilibrium of the maize grain market.

these countries, increasing imports implies additional and more expensive sources of supply. Thus, as imported quantities of maize increase, the supply price of imports can be expected to rise. Let OQ_o be the quantity of maize grain that can be bought from Zambia and Rhodesia at an average price of Z 90 per ton, but beyond which the supply price of imports starts rising. At Z 40 per ton, a trader can buy OQ_3 of the local maize that he is willing to sell for no less than Z 73 ton. Let the wholesale demand of flour mills take the form D_2. Then, in equilibrium, traders would combine OQ_2 of imported maize and Q_2Q_6 (equal to OQ_4) of local maize, at a price of OP_2 per ton, and a price of OP_4 should be paid to local producers.

Floor prices are often introduced either because differences in the bargaining power of the marketing agents do not make it possible for the producer to get a 'fair share' of the surplus generated by the market system, or because of an option by the policy maker to improve income distribution. In Zaire, floor prices for maize and other locally produced agricultural products were introduced as an attempt by the government to correct market imperfection. But, as we noticed earlier, these prices are often unknown to the farmer, and lend themselves to purposeful misrepresentation. However, in spite of the imperfections that prevail in the market for maize grain, particularly in remote areas, the experience of the districts surrounding the town of Mbuji Mayi indicates that as the demand for maize and maize flour increased in consumption centers, more traders and assemblers went to the countryside to buy maize grain. As competition increased among traders and assemblers, these buyers penetrated deeper in the countryside and reached more producers. The penetration of the production area by more buyers increased the flow of information available to the producer. Price data indicate that under these circumstances, price changes in consumption centers were rapidly transmitted to rural markets.

Consider traders in Kasai Occidental and southern Shaba who deliver all or some of the maize they buy to flour mills. At the government ceiling price of Z 63 per ton, and in the absence of imports, the supply of maize grain to flour mills would become ZWAP. With the possibility of import open, the aggregate wholesale supply would become ZWAUH. Given the wholesale demand D_2, the market would clear at a price equal to OP_3 and quantity OQ_5. OQ_7 would be imported and Q_7Q_5 (= OQ_1) produced locally. For OQ_1 bought,traders are likely to pay less than Z 40 to farmers away from main roads. Thus surplus $ZWAMURP_3$ generated by the selling of OQ_5 will go to flour mills (which also operate as importers).

The ceiling delivery price of maize calls for the following observations.

(1) The smaller the fixed delivery price, the smaller the quantity produced locally and the greater the quantity imported.

(2) Ceiling prices also reduce the incentive for more traders to travel to villages located beyond 30 to 40 km from the main roads or the railroad track. Consequently, the ceiling price decreases the flow of information available to the producer, and also decreases the producers bargaining power with periodic traders. This does not mean that price ceilings cannot be used as a policy instrument. Rather, this indicates that when the price floor and ceiling are set irrespective of market conditions, the market becomes unpredictable.

From the analysis of price ceilings in the market of maize grain, we concluded that the surplus $ZWAURP_3$ was received by the millers. Under unconstrained market conditions for maize flour and other maize products, flour mills would collect the seller surplus generated in the market for maize grain. However, the market of maize flour in Zaire is also regulated from the mill to the retail level. For example, wholesale and retail prices established by an ordinance in April 1974, were theoretically the basis for the pricing of maize flour in early 1975. The 1974 ordinance fixed the wholesale price of maize flour at Z 80.80 per ton at the mill and 91.60 per ton elsewhere. The retail price was set at Z 108 per ton (82). In the copperbelt area of Shaba, a regional ordinance fixed at Z 50 the maximum wholesale price of maize flour at the mill. The Kakontwe flour mill in Likasi and its subsidiaries, which supply workers affiliated with the mining companies, were the only flour mills to get compensation for the difference between the cost of production (Z 107.53 per ton for Kakontwe (54)) and the sale price. If maize flour is sold according to policies stated by national and regional ordinances, the absence of compensation for the reduced price of maize flour has the effect of eliminating or shrinking any surplus that flour mills may have gained in the market for maize grain. In the absence of enforcement of the ceilings, regional and national price policies induced irregular operations in the maize market which resulted in higher prices for maize flour.

In the absence of compensation, ceiling prices on maize flour decrease the demand of flour mills for shelled maize, which, in turn, induces a reduction in the demand of traders for maize grain from local producers. Thus, either because of a ceiling on the delivery price of maize grain to flour mills or because of a ceiling price on maize flour, the overall effects of the ceilings are to restrict or reduce maize produced locally.

The demand for maize flour is a joint demand for the services of the producers, the traders, the importer and the flour mill. In a short period, these services can be considered to be combined in fixed proportion and the decisions for future production taken instantaneously. Under a fixed proportion assumption, the supply prices of the services needed to produce maize flour can be added vertically on appropriately scaled coordinates to form the supply price for maize flour (26). The intersection of the demand and the supply curves for maize flour gives the equilibrium price of maize flour and the supply price for the corresponding services of the producers, the traders, the importers and the flour mills. Under this presentation, the demand for the services of the producer, the traders, the importer and the flour mill can be derived directly from the demand for maize flour.

Under the assumption of fixed proportions, Friedman has indicated that the manipulation of derived demand and supply curves yields the proposition that an increase in the supply of one of a pair of jointly demanded items will tend to raise the price of the other item, and that an increase in the demand for one of a pair of jointly supplied items will tend to reduce the price of the other (26, pp. 151-153). Extending these conclusions to maize grain and maize flour which, somehow, are jointly supplied and demanded we can conclude that in a competitive situation an increase in the supply of maize flour will tend to raise the price of maize grain and an increase in the demand of maize flour will tend to reduce the price of maize grain. The reciprocal of the above statement implies that for the services of the producers, traders and flour mills which are jointly demanded by the users of maize flour, a reduction in the price of the services of the flour mill or those of a trader induced by ceiling prices on maize flour or the delivery price of shelled maize will tend to reduce the demand for maize grain. In turn, this reduction will tend to induce the decrease in the supply of maize grain by producers. Similarly, an increase in the price of the services of the producer through price support will tend to increase the supply of maize grain by producers. This increase, in turn, will tend to reduce the supply price of maize flour. Thus, with jointly demanded services of the producers, traders, flour mills and, eventually, of the importers, a change in the demand or the supply price of one kind of service induced by a policy generated a chain reaction for the supply or the demand of the other services. The apparent inability of government price policies to generate a greater supply of local maize seems to be linked to an insufficient attention paid to the impact of the chain of reactions in the formulation and the application of price policies.

5.9. Conclusion and Implication

The marketing of maize in Kasai Oriental, Kasai Occidental and Shaba Regions involves many participants who perform various marketing functions. In the study area about 65% of the maize producers sell some maize. Farmers who tend to sell more maize are those who live in family and villages of small size; they also live closer to organized market places and associate proportionally less maize flour to cassava flour in the preparation of the fufu mix.

Farmers selling maize hold a greater total area planted in all crops, they also have less formal education.

Our examination of two sub-systems of the marketing chain, the rural-urban link in the Gandajika production area and the interurban link between Gandajika and Mbuji Mayi indicates that in non-isolated markets the rural urban and the interurban links function with some degree of efficiency, in that price changes in the Mbuji Mayi market are rapidly transmitted to the Gandajika market on to rural markets. In this process the equilibrium price in each market seems to reflect the general situation of supply and demand in the Gandajika-Mbuji Mayi area. In non-isolated markets the conduct of intermediaries is evolving to greater competition although attempts have been made by some intermediaries to take control of one subsystem of the marketing system at some period of the year.

An analysis of the marketing shares indicates that in most cases the margin received by non-licensed traders are accounted for by the cost of providing services. However, further study on the cost of providing some of the services is needed in order to determine whether or not some intermediaries are able to exploit market information to increase their share of the retail price. In this study we were not able to assess the margins of operations involving licensed traders because most licensed traders refused to provide information.

In the rural urban link, positive and negative price spreads exist because of the small size and the erratic character of supply which increases the risks of intermarket arbitrage. Temporal price relationship and positive price spreads suggest that there is an opportunity for those who store maize to make more than normal profit. In the non-isolated area referred to here as well as over most of the Kasai Oriental, Kasai Occidental and Shaba Regions, most farmers do not involve themselves in storage operations; they sell most of the maize they planned to sell immediately after harvest or thereafter. Thus, most producers do not benefit from temporal price rises. Rural and urban assemblers and particularly licensed traders are the agents most involved in storage operations. The observation of storage houses and storage techniques used by most traders suggest that besides putting grain in a storage house, no special treatment is applied to protect maize. Thus no special cost prevented producers from storing maize for sales. But it seems that given the size of the harvest, most farmers do not have very much to store for sales, unless they become assemblers.

In remote villages and isolated rural markets, where most producers live, inadequate information on price and supply, and limited transportation services reduce the number of transactions conducted by maize producers. Bad roads also limit competition among intermediaries buying maize; and this limited competition reduces the share of the retail price received by producers.

Previous government policies aimed at increasing the effectiveness of maize marketing have apparently not succeeded in promoting the production of more maize. Some regional ordinances regulating trade on maize tend to reduce competition among traders and thus reduce the price received by maize producers. Furthermore, the formulation and the application of floor and ceiling prices for maize grain and flour seem to have introduced confusion and ineffectiveness in the use of a floor price as an instrument to promote the production and the marketing of greater quantities of maize.

In recent years the government has assigned the Office National des Cereales (ONACER) to help plan and implement policies intended to improve the effectiveness of maize marketing and increase the production of this cereal. The analysis of market operations in the study area suggests that in the marketing of maize, the action of ONACER can be helpful in the following areas:

a) expansion and improvement of market information available to producers;

b) measures to increase the bargaining power of producers (these may include a greater legal support for farmers to integrate in cooperatives and control their economic interest in market places);

c) the promotion and expansion of the use of standards of measurement for the commodities bought or sold, in particular the encouragement of the use of scales for measurement and the selling of shelled maize rather than maize on the cob;

d) the promotion of enterprises specialized in the supply of sacks and other materials for storage and the supply of insecticides for the post-harvest protection of maize;

e) the promotion and implementation of pricing policies which are sensitive to changing economic conditions, in particular the investigation of conditions under which price support programs and forward prices can be introduced to promote maize production;

f) cooperation with and promotion of cooperation between regional administrations to break inter-regional barriers which reduce the effectiveness of maize marketing; and

g) direct intervention in the buying and selling of maize, where necessary, to promot competition, increase incentives to producers, or implement price support policies.

The apparent inability of traders buying maize to provide incentives for increasing maize production has led some of ONACER's technicians to suggest that the agency be made into a marketing board with a monopsonistic power for the purchase of maize from farmers. This would require that the agency invest large sums of money in trucks, buildings and personnel. In order to cover the vast production area, ONACER would at least face the same transportation bottlenecks which have led many traders to reduce their areas of maize purchase to stretches along main roads and the railroad track. It does not now appear that funds can be found to finance the functioning of a large purchasing agency for maize.

It seems that in the process of improving maize production and market supply, a distinction must be made between the role of a public agency in the production and its role in the marketing of a product. In the production of maize, the role of a technology development agency cannot be readily filled by traders. In marketing, some services such as the buying of maize can be provided by ONACER as well as by interested traders. Thus, ONACER can take advantage of the presence of traders scattered in the production area to increase the collection of maize. The role of ONACER in such situations can be limited to setting standards and providing information to producers so that the overall marketing operation results in more incentives to produce maize. Involvement in direct maize buying is an option that should remain open to ONACER as a tool to achieve general or particular goals. The direct buying option does not mean, however, that ONACER has to become the only buyer of maize from producers. The costs of collecting maize over a production area as large as that of Zaire would be burdensome for ONACER.

6. GENERAL CONCLUSIONS

The production and marketing of maize involves various agents who perform diversified functions in providing maize to consumers. Maize is produced by many small scale farmers scattered over a large production area. At the primary level maize is sold in small quantities; these small quantities are collected by traders and assemblers and shipped directly to towns where maize is processed by large or small size flour mills which provide maize flour to consumers.

On the production side our examination of four districts of south central Zaire indicates that technological factors and limited availability of labor during peak periods of agricultural operations limit the quantity of maize produced by small scale farmers. Technological factors which seem to limit the production of maize are the lack of or the low level of use of yield improving techniques such as good seeds, good seedbed preparation, application of fertilizer, and planting, weeding and harvesting at the right time.

Under the present system which relies on techniques that yield low output per unit of land, the production of maize depends largely on the total area planted with maize which, in turn, is a function of the proportion of the available labor force devoted to the production of maize. Evidence from this study suggests that the amount of labor which is available during peak periods is limited and that many farmers suffer labor shortages during these periods because the available labor is not sufficient to meet the demands for adequate planting, weeding and harvesting for all of the crops produced.

Labor shortages occur because the labor which is available in the household is limited and because most farmers are financially unable to hire outside labor for farm work. Seasonal shortages of labor may also occur because of a limited participation of household members in the execution of some agricultural tasks which are socially considered as assigned to one group or sex among the household members.

On the marketing side, results from this study suggest that although some more or less efficient marketing operations are taking place in integrated and non-isolated markets, the degree of market information and competition is low in remote villages and markets where most producers live. Technical factors such as a bad transportation network, a low level of market information and competition tend to limit the producer's share of the retail price. And these information and technical barriers between the producer and the consumer limit the capacity of many farmers to adapt their production to price changes in consumer markets.

Even in non-isolated markets surrounding urban areas, an analysis of a marketing subsystem centered around the town of Gandajika suggest that in spite of some high level of integration between the urban and the rural markets, in terms of temporal price changes, the price received by producers is still low compared to the over all price changes over the years. The limited producer in temporal price changes seems to be low for three major reasons: 1) the imperfections inherent in the marketing system (bad roads, low level of market information); 2) the tendency for farmers to sell most of their maize within a few months after harvest; 3) a lack of cooperation among producers in the marketing of their maize grain.

Present floor and ceiling prices on maize and various regulations governing regional and interregional transactions on maize have not succeeded in promoting greater production. On the contrary the various interpretations to which the floor prices lend themselves, and some limitation to competition which seems to be generated by local regulation, have probably tended to decrease the share of the consumer retail price received by the producer.

An analysis of past policies aimed at increasing maize production suggests that policy makers emphasized price changes more than organizational and technological changes in maize production. A comparison of maize producers and sellers suggests that the average total area planted in maize in the non-isolated environment surrounding Gandajika and Mbuji Mayi where rural market prices are high, is not significantly higher than the average maize area planted by farmers in isolated market and villages. The data from the study area indicates that if the price of maize such as it is perceived through the market can determine whether or not a farmer sells maize and how much he sells, it is more the technological factors which determine how much maize a farmer produces over a growing season. Thus, policies aimed at improving maize production and marketing should consider both the improvement of the production system and that of marketing.

The conclusions of this study are that technological improvement most needed to improve maize production are of the yield increasing and peak period labor-saving types. Yield increasing practices which can improve maize production are: 1) the familiarization of farmers with an agricultural calendar whereby they learn about the right time for planting, weeding and harvesting; 2) the use of biochemical inputs. The research work conducted by Programme National Mais (PNM) has shown that substantial increases in yields can be obtained by combining all or some of the yield increasing techniques. Farmers also have to be introduced to better storage of maize grain and future seeds. Labor saving techniques which can improve maize production include the use of herbicides and tractors. But the actual limited capacity of Zaire to import will restrict the use of tractors to a few individuals or collective production units of the paysannat type.

In the near future, the source of labor for the development of agricultural production must be found in a greater participation of household members in farm operations. Another source of potential agricultural labor is constituted by the many unemployed and marginally employed men and women who, today, 'besiege' urban and semi-urban areas. Until now, attempts made by officials to have these men and women return to their village and produce food have been unsuccessful. Since early 1960 most of these migrants have been moving to town because the conditions of life in the village were deteriorating. For the last ten years these conditions have continued to worsen while the distribution of new investment and and economic action has increasingly biased in favor of the urban centers. If public action is to convince some portion of the urban population to return to agriculture or to supply a pool of labor for agriculture, a drastic shift in the geographic distribution of investment and income is imperative.

One of the reasons which precipitated the decline in traditional agricultural production and caused massive rural to urban migrations is the lack of organization of the system of traditional production and the apparent belief that the traditional sector can expand with no major investment in research, infrastructure.

and extension services to support the development of the traditional sector. In order to reverse today's trends of low production in traditional agriculture and decrease the exodus of potential farmers out of the rural area large investments are needed in agriculture. This means that the trends of investment priorities that the government of Zaire has followed in the past ten years have to be modified in favor of the agricultural sector. Given the present apparent lack of interest of the private sector in basic food production, a larger share of the public investment expenditure would be needed to promote the production of maize and other traditional crops.

A better organization of the extension service, the provision of production and marketing information through radio programs and the promotion of collective actions by farmers in the purchasing of inputs and the selling of maize and other agricultural products will tend to enable farmers to do a better job of defending their interests. Furthermore, an improved production system and a better communication network will tend to increase competition among intermediaries buying maize and speed up the rate of market integration. And the improvement of market integration will tend to increase producers responsiveness to price changes initiated by central markets and, thus, increase the effectiveness of the marketing system. This development will make superfluous and ineffective some local and regional regulations which, apparently limit the effectiveness of maize marketing. It will also improve the understanding that farmers have of governmental interventions in the marketing of maize and the interaction between producers, traders, government agencies and consumers and perhaps help correct some inconsistencies and confusion that seem to exist in today's floor and ceiling price policies.

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APPENDICES

APPENDIX A

Summary tables on the production environment and the practices used in the production and the marketing of maize in the Districts of Kaniama, Mwene-Ditu, Gandajika and Tshilenge.*

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*In this Appendix table data are classified by district affiliation. Some tables distinguish between farmers under intensive supervision by CAKO or TABAZAIRE for the production of cotton or tobacco and farmers who are not supervised. Farmers under intensive supervision are referred to as participants (P); those non-supervised by neither of these agencies are called non-participants (NP). The capital T used in some tables stands for Total.

Table 1. Classification of the households by district and by the number of persons in the household (%).

Number of Persons	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
1-2	11.1	20.9	11.8	14.3
3-6	44.4	38.8	50.0	35.7
7-10	31.5	25.4	27.9	37.5
11-14	8.3	7.5	8.8	8.9
15-20	4.6	7.5	0.0	3.6
21-30	0.0	0.0	1.5	0.0
Sample size	108	67	68	56

Table 2. Classification of the heads of the households by district and by number of years of formal education (%).

Number of years	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
0	33.3	34.3	35.3	32.1
1-3	25.9	26.9	26.5	30.4
4-6	30.6	28.4	22.1	21.4
7-9	8.3	10.4	14.7	8.9
10	1.9	0	1.5	7.1
Sample size	108	67	68	56

Table 3. Classification of the heads of households by district and by age (%).

Age	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
15-19	0	1.5	0	1.8
20-29	25.0	19.4	23.9	16.1
30-39	15.7	23.9	23.9	16.1
40-49	15.7	22.4	22.4	14.3
50-59	16.7	16.4	10.4	25.0
60-69	25.0	9.0	11.9	23.2
70-79	1.9	4.5	3.0	3.6
80-89	0	1.5	4.5	1.8
90-99	0	1.5	0	1.8

Table 4. Marital status of the head of the household (%).

Number of wives	District Kaniama NP	P	T	Mwene-Ditu NP	P	T	Gandajika NP	P	T	Tshilenge NP	P	T
0 (single, divorced, widowed)	0.0	0.0	0.0	18.9	14.3	17.9	16.3	5.3	13.2	16.3	7.7	14.3
1	68.8	74.2	70.4	60.4	57.1	59.7	53.1	94.7	64.7	62.8	76.9	66.1
2	22.1	19.4	21.3	13.2	28.6	16.4	26.5	0.0	19.1	16.3	7.7	14.3
3	9.1	6.5	8.3	3.8	0.0	3.0	2.0	0.0	1.5	0.0	7.7	1.8
4	0.0	0.0	0.0	3.8	0.0	3.0	0.0	0.0	0.0	4.6	0.0	3.6
6	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	1.5	0.0	0.0	0.0

Table 5. Classification of the heads of the households by district and by the number of years of residency in the village (%).

Number of years	District Kaniama NP	P	T	Mwene-Ditu NP	P	T	Gandajika NP	P	T	Tshilenge NP	P	T
Less than 1	1.3	6.5	2.8	5.8	14.3	7.5	8.3	5.3	7.5	2.4	0.0	1.8
1-3	11.7	12.9	12.0	13.5	14.3	13.6	12.5	5.3	10.4	7.9	7.7	7.1
4-5	10.4	3.2	8.3	3.8	7.1	4.5	10.4	10.5	10.4	0.0	0.0	0.0
More than 5	76.6	77.4	76.9	76.9	64.3	74.2	68.8	78.9	71.6	90.7	92.3	91.1

Table 6. Reasons for settling in a particular village (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Reasons	NP	P	T	NP	P	T	NP	P	T	NP	P	T
My village	67.5	67.7	67.5	65.0	41.2	59.7	64.9	68.2	65.8	70.6	70.6	69.6
Good land for agriculture	20.8	29.1	23.2	31.7	58.8	37.7	29.8	31.8	30.4	9.8	29.4	14.7
Closer to a main road	0.0	0.0	0.0	3.3	0.0	2.6	5.3	0.0	3.8	2.0	0.0	1.5
Closer to a city	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.5
Closer to a market	2.6	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	15.7	0.0	11.8
Other answer	9.1	3.2	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7. Classification of the heads of the households by district and by the place of residency during childhood and adolescence (%).

Place of residency	District Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Small town or suburb	29.6	33.3	49.3	28.3
Village only	70.4	62.1	49.3	66.0
Other answers	0.0	4.5	1.5	5.7

Table 8. Proportion of farmers with concrete houses (%).

	District			
Response	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Yes	3.7	6.0	4.4	3.6
No	96.3	94.0	95.6	96.4

Table 9. Number of rooms in the home (in addition to the kitchen) (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Number of extra rooms	NP	P	T	NP	P	T	NP	P	T	NP	P	T
0	3.9	3.2	3.7	35.8	14.3	31.3	20.4	26.3	22.1	7.0	0.0	5.4
1	9.1	9.7	9.3	18.9	7.1	16.4	20.4	15.8	19.1	16.3	7.7	14.3
2	51.9	54.8	52.8	26.4	57.1	32.8	34.7	26.3	32.4	58.1	61.5	58.9
3	16.9	19.4	17.6	11.3	14.3	11.9	20.4	26.3	22.1	4.7	23.1	8.9
4	18.2	12.9	16.7	5.7	7.1	6.0	4.1	5.3	4.3	14.0	7.7	12.5
5	0.0	0.0	0.0	1.9	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0

Table 10. Proportion of farmers who own a radio (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	9.1	29.0	14.8	13.2	14.3	13.4	16.3	10.5	14.7	25.6	38.5	28.6
No	90.9	71.0	85.2	86.8	85.7	86.6	83.7	89.5	85.3	74.4	61.5	71.4

Table 11. Ownership of a bicycle (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	63.6	74.2	66.7	32.1	14.3	26.9	34.7	15.8	29.4	23.3	69.2	33.9
No	39.4	25.8	33.3	67.9	85.7	73.1	65.3	84.2	70.6	76.7	30.8	66.1

Table 12. Number of farmers owning sheep.

Number of Sheep	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
0	96	45	52	39
1	1	7	5	4
2	4	6	4	7
3	1	5	1	0
≥4	6	4	6	9
Total no. sheep	73	63	70	59

Number 13. Number of farmers owning goats.

Number of Goats	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
0	73	34	37	25
1	8	11	5	9
2	8	8	7	3
3	4	6	5	3
4	4	3	3	9
5	3	1	3	4
≥6	8	4	8	2
Total no. goats	120	91	135	108

Table 14. Number of farmers owning pigs.

Number of Pigs	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
0	107	66	58	45
1	1	1	1	5
≥2	0	0	9	6
Total no. pigs	1	1	73	61

Table 15. Number of farmers owning chickens.

Number of Chickens	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
0	52	33	26	22
1	15	8	7	6
2	9	5	9	5
3	9	5	6	3
4	11	4	8	3
5	3	4	1	3
≥6	13	8	11	10
Total no. chickens	149	150	204	265

Table 16. Status of the land used for agricultural purposes (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Status	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Government settlement (Paysannat)	15.4	43.2	24.5	13.8	44.4	21.1	22.6	40.9	28.0	6.6	23.5	12.3
Communal land	72.4	40.5	60.8	77.6	40.0	71.0	71.7	59.1	68.0	88.9	76.5	85.5
Personal gift	7.7	16.2	10.8	8.6	5.6	7.9	3.8	0.0	2.7	4.5	0.0	3.2
Use rights through marriage	1.5	0.0	1.0	0.0	0.0	0.0	1.9	0.0	1.3	0.0	0.0	0.0
Other answers	3.1	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 17. Agents who selected the site of actual plots (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Agent	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Husband or head of household	94.8	77.4	89.8	88.7	78.6	86.6	83.7	47.4	73.5	90.7	92.3	91.1
Village chief	1.3	6.5	2.8	5.7	0.0	4.5	8.2	5.3	7.4	4.7	7.7	5.4
Extension agent	2.6	16.1	6.5	5.7	21.4	9.0	8.2	42.1	17.6	2.3	0.0	1.8
Other answers	1.3	0.0	0.9	0.0	0.0	0.0	0.0	5.3	1.5	2.3	0.0	1.8

Table 18. Agents who select crops for each plot.

Number of Years	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Husband	44.9	74.6	82.1	75.0
Wife	1.9	6.0	1.5	5.4
Husband and wife	47.7	13.0	11.9	16.1
Village chief	4.7	3.0	1.5	3.6
Extension agent	0.0	3.0	3.0	0.0
Other answers	0.9	0.0	0.0	0.0

Table 19. Length of time a plot can be used (%).

Length of Time	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Up to harvest	37.4	33.8	39.7	32.7
Every Year	21.5	63.1	60.3	63.6
No time limit	20.6	3.1	0.0	3.6
Other answers	20.6	0.0	0.0	0.0

Table 20. Willingness to produce more maize (%).

	District			
Response	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Yes	94.4	87.7	91.2	91.1
No	5.6	12.3	8.8	8.9

Table 21. Proportion of farmers who generally plant a second crop of maize (%).

Plant a second crop of maize	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	64.9	77.4	68.5	50.9	21.4	44.8	42.9	36.8	41.2	62.8	76.9	66.1
No	35.1	22.6	31.5	49.1	78.6	55.2	57.1	63.2	58.8	37.2	23.1	33.9

Table 22. Proportion of farmers holding a designated number of maize fields (%).

Number of maize fields	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
0	2.6	0.0	1.9	1.9	0.0	1.5	0.0	0.0	0.0	7.0	0.0	5.4
1	59.7	41.9	54.6	71.7	85.7	74.6	57.1	57.9	57.4	74.4	76.9	75.0
2	22.1	45.2	28.7	26.4	7.1	22.4	32.7	36.8	33.8	16.3	23.9	17.9
3	7.8	9.7	8.3	0.0	7.1	1.5	10.2	5.3	8.8	2.3	0.0	1.8
4	7.8	3.2	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 23. Instruments and techniques used for plowing maize plots.

Instruments and Techniques	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Hoes	96.2	88.6	93.8	98.1	100.0	98.5	87.8	84.2	86.8	90.7	100.0	92.9
Tractor and Hoe	1.3	11.4	4.4	0.0	0.0	0.0	10.2	15.8	11.8	2.3	0.0	1.8
Animal traction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other answer	2.6	0.0	1.8	1.9	0.0	1.5	2.0	0.0	1.5	7.0	0.0	5.4

Table 24. Crops that preceded maize on 1974-1975 maize plots (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Crop association	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Cassava	12.3	11.3	12.0	15.4	5.9	13.4	16.0	3.6	12.6	16.3	23.5	18.2
Ground nuts	2.6	0.0	1.8	3.1	0.0	2.4	4.0	0.0	2.9	2.0	5.9	3.0
Tobacco	0.9	49.1	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Beans	4.4	3.8	4.2	3.1	0.0	2.4	1.3	3.6	1.9	8.2	0.0	6.1
Cotton	6.1	3.8	5.4	4.6	64.7	17.1	21.3	42.9	27.2	8.3	29.4	13.6
Maize	18.4	11.3	16.2	15.4	0.0	12.2	13.3	7.1	11.7	20.4	0.0	15.2
Maize and beans	18.4	0.0	12.6	3.1	5.9	3.7	6.7	14.3	8.7	4.1	5.9	4.5
Maize and cassava	13.2	1.9	9.6	18.5	5.9	15.9	12.0	10.7	11.7	8.2	5.9	7.6
Maize and ground nuts	2.6	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maize, cassava and ground nuts	1.8	1.9	1.8	6.2	0.0	4.9	4.0	0.0	2.9	4.1	5.9	4.5
Maize and cotton	0.0	0.0	0.0	0.0	5.9	1.2	4.0	0.0	2.9	4.1	0.0	3.9
Maize, cassava and beans	2.6	0.0	1.8	1.5	0.0	1.2	2.7	7.1	3.9	2.0	17.6	6.1
Cotton and beans	0.0	0.0	0.0	1.5	0.0	1.2	1.3	3.6	1.9	0.0	0.0	0.0
Cassava and ground nuts	0.0	0.0	0.0	3.1	0.0	2.4	0.0	3.6	1.0	0.0	0.0	0.0
Cassava and beans	0.0	3.8	1.2	0.0	0.0	0.0	0.0	3.6	1.0	6.1	0.0	4.5
Cassava and cotton	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	2.9	0.0	0.0	0.0
Other crops	2.6	0.0	1.8	4.6	0.0	3.7	0.0	0.0	0.0	12.2	5.9	10.6
None	13.2	11.3	12.6	20.0	11.8	18.3	9.3	0.0	6.8	4.1	0.0	3.0
Do not remember	0.9	1.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 25. Period (before or after the first rains) when farmers plant maize (%).

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 rain had begun	15.1	16.4	31.1	20.0
Do not know	0.0	0.0	0.0	0.0

Table 26. Proportion of farmers who finish planting within a given time period (%).

Number of days between the first and the last day	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
1-3	9.3	0.0	6.6	34.6	42.9	36.4	40.8	52.6	44.1	25.0	61.5	34.0
4-7	10.7	31.7	18.9	38.5	35.7	37.9	36.7	31.6	35.3	67.5	15.4	54.7
8-14	32.0	32.3	32.1	15.4	7.1	13.6	6.1	15.8	8.8	5.0	15.4	7.5
15-22	16.0	12.5	15.1	0.0	7.1	1.5	4.1	0.0	2.9	0.0	0.0	0.0
23-30	25.3	9.7	20.8	5.8	0.0	4.6	6.1	0.0	4.4	0.0	7.7	1.8
Do not know	6.7	6.5	6.6	5.8	7.1	6.1	6.1	0.0	4.4	2.5	0.0	1.8

Table 27. Timing for the insertion of maize in a maize-cassava association.

Maize planting (weeks before and after cassava)	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
More than 2 weeks before	5.3	10.7	6.6	36.5	57.1	40.9	51.0	68.4	55.9	45.0	46.2	45.3
1-2 weeks before	10.7	21.4	13.2	17.3	0.0	13.6	2.0	5.3	2.9	10.0	23.1	13.2
Less than 1 week before	6.7	14.3	8.5	5.8	0.0	4.5	2.0	5.3	2.9	0.0	0.0	0.0
Simultaneously	61.3	32.1	52.8	14.3	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Less than 1 week after	1.3	7.1	2.8	7.7	14.3	9.1	10.2	0.0	7.4	17.5	7.7	15.1
1-2 weeks after	1.3	3.6	1.9	11.5	7.1	10.6	8.2	5.3	7.4	7.5	0.0	5.7
More than 2 weeks after	1.3	7.1	2.8	9.6	7.1	9.1	12.2	5.3	10.3	15.0	23.1	17.0
Do not know/ do not associate maize and cassava	12.0	12.9	12.3	3.8	0.0	3.0	14.3	10.5	13.2	5.0	0.0	3.8

Table 28. Timing for the insertion of maize in a maize-bean association (%).

Maize planting (weeks before or after beans)	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
More than 2 weeks before	1.3	0.0	0.9	7.7	7.1	7.6	26.5	21.1	25.0	5.0	15.4	7.5
1-2 weeks before	0.0	0.0	0.0	9.6	14.3	10.6	12.2	21.1	14.7	10.0	38.5	17.0
Less than 1 week before	0.0	0.0	0.0	5.8	14.3	7.6	2.0	15.8	5.9	12.5	0.0	9.4
Simultaneously	92.0	83.9	89.6	36.5	35.7	36.4	12.2	10.5	11.8	20.0	23.1	20.8
Less than 1 week after	0.0	10.0	2.8	21.2	7.1	18.2	18.4	21.1	19.1	25.0	7.7	20.8
1-2 weeks after	0.0	0.0	0.0	5.8	7.1	6.1	4.1	0.0	2.9	10.0	0.0	7.5
More than 2 weeks after	0.0	0.0	0.0	5.8	7.1	6.1	8.2	10.2	8.8	12.5	15.4	13.2
Do not know/ do not associate maize and beans	6.7	6.5	6.6	7.7	7.1	7.6	16.3	0.0	11.8	5.0	0.0	3.8

Table 29. Proportion of farmers planting designated varieties of maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Maize varieties	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Local varieties	98.7	65.6	88.9	98.1	71.4	92.4	85.7	89.5	86.8	95.5	92.3	94.3
PNM's varieties	0.0	0.0	0.0	0.0	0.0	0.0	4.1	10.5	5.9	2.5	0.0	1.9
INERA's varieties	1.3	12.5	4.6	0.0	21.4	4.6	6.1	0.0	4.4	0.0	7.7	1.9
Other answers	0.0	21.9	6.5	1.9	7.1	3.0	4.1	0.0	2.9	0.0	0.0	0.0
Do not know	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	1.9

Table 30. Preservation devices used to protect stored consumption maize against rats and weevils (%).

	District			
Device	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
None	33.0	29.4	30.1	26.3
Smoke	9.8	4.4	12.3	0.0
Salt	0.0	2.9	2.7	1.7
DDT	0.0	1.5	1.4	1.7
Fumigant	0.9	1.5	1.4	0.0
Rat traps	25.9	44.1	43.8	54.4
Other means	3.6	2.9	6.8	10.5
No answer/do not know	26.8	13.2	1.4	1.7

Table 31. Estimated insect damage to stored consumption maize (%).

	District			
Damage	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
None	2.8	7.6	10.3	5.7
Not much	14.2	21.2	23.5	22.6
A lot	83.0	66.7	61.8	67.9
No answer/do not know	0.0	4.5	4.4	3.8

Table 32. Estimated insect damage to stored seed maize (%).

	District			
Damage	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
None	2.8	9.1	13.2	9.4
Not much	14.2	21.2	22.1	24.5
A lot	83.0	65.2	60.3	62.3
No answer/do not know	0.0	4.5	4.4	3.8

Table 33. Proportion of producers applying insecticide on maize (%).

Use insecticide on maize	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Yes	2.8	0.0	1.5	1.9
No	97.2	100.0	98.5	98.1

Table 34. Proportion of producers applying fertilizer on maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Use fertilizer	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	0.0	3.2	0.9	1.9	0.0	1.5	2.0	15.8	5.9	0.0	0.0	0.0
No	100	96.2	99.1	98.1	100	98.5	98.0	84.2	94.1	100	100	100

Table 35. Proportion of farmers who have applied fertilizer to maize production or another crop (%).

Proportion of farmers	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Maize												
Yes	1.3	3.2	1.9	2.0	0.0	1.5	8.2	15.8	10.3	0.0	7.7	1.8
No	98.7	96.8	98.1	98.0	100	98.5	91.8	84.2	89.7	100	92.3	98.2
Other groups												
Yes	19.5	83.9	38.0	19.6	85.7	33.8	41.7	63.2	47.8	16.3	69.2	28.6
No	80.5	16.1	62.0	80.4	14.3	66.2	58.3	36.8	52.2	83.7	30.8	71.4

Table 36. Proportion of farmers who bury ashes and grass to serve as green manure for maize (%).

Use green manure	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Yes	53.8	15.2	35.3	15.1
No	46.2	84.8	67.3	84.9

Table 37. Frequencies of visits to maize plots after planting (%).

Frequency of visits	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Almost every day	64.1	33.3	39.7	26.4
Once a week	19.8	37.9	30.9	50.9
Once a month	9.4	9.1	5.9	5.7
Four times a month	4.7	1.5	4.0	3.8
Once or twice only	0.9	18.2	13.2	13.2
Few days before harvest only	0.0	0.0	1.5	0.0

Table 38. Previous experience on a large commercial farm (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	20.8	25.8	22.2	3.8	7.1	4.5	8.2	10.5	8.8	9.3	0.0	7.1
No	79.2	74.2	77.8	96.2	92.9	95.5	91.8	89.5	91.2	90.7	100	92.9

Table 39. Proportion of farmers who select maize seeds before, during or after harvest (%).

	District								
	Mwene-Ditu			Gandajika			Tshilenge		
Time	NP	P	T	NP	P	T	NP	P	T
Before harvest	7.4	0.0	5.9	4.1	5.3	4.4	9.3	7.7	8.9
At harvest time	5.6	0.0	5.4	4.1	0.0	2.9	6.9	0.0	5.4
After harvest	87.0	100.0	89.7	89.8	94.7	91.2	81.4	92.3	83.9
Other answer	0.0	0.0	0.0	2.0	0.0	1.5	2.3	0.0	1.8

Table 40. Persons involved in harvesting maize for the household (%).

	District			
Persons involved	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Children	4.3	1.5	7.9	3.5
Male adults	5.2	11.8	9.2	14.0
Female adults	19.1	54.4	32.9	40.4
Male and female adults	65.2	25.0	42.1	29.8
Children and male adults	0.9	0.0	0.0	1.8
Children and female adults	0.0	2.9	6.6	3.5
Hired male adults	0.0	2.9	0.0	5.3
Hired female adults	3.5	1.5	1.3	1.8

Table 41. Form in which seed maize is stored (%).

Form	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
In husk	87.7	95.5	88.2	88.7
Husked	12.3	3.0	10.3	11.3
Other answer	0.0	0.5	1.5	0.0

Table 42. Preservation devices used to protect stored seed maize against rats and weevils (%).

Devices	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
None	33.0	29.4	28.8	26.8
Smoke	11.6	7.4	19.2	16.1
Salt	0.0	2.9	1.4	1.8
DDT	0.0	1.5	1.4	1.8
Fumigant	0.9	0.5	1.4	0.0
Rat traps	24.1	41.2	39.2	42.9
Other means	2.7	2.9	6.8	8.9
No answer/do not know	26.8	13.2	1.4	1.8

Table 43. Storage facilities most used to store consumption maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Storage facilities	NP	P	T	NP	P	T	NP	P	T	NP	P	T
In the house in the attic	46.7	53.1	46.7	34.5	21.4	31.9	60.4	42.1	55.6	53.2	14.3	43.6
Hanging above fireplace	16.0	9.4	14.6	16.4	7.1	14.5	24.5	26.3	25.0	12.2	28.6	16.4
In big baskets (mitenga)	0.0	0.0	0.0	1.8	0.0	1.4	3.8	0.0	2.8	0.0	0.0	0.0
In a granary	36.0	34.4	35.5	47.3	71.4	52.2	11.3	31.6	15.3	34.1	5.2	40.0
Other answer	0.0	3.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No answer/do not know	1.3	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 44. Storage facilities used to store seed maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Storage facilities	NP	P	T	NP	P	T	NP	P	T	NP	P	T
In the house in the attic	46.7	54.8	49.1	34.5	21.4	31.9	54.7	36.8	50.0	45.0	14.3	37.0
Hanging above fireplace	16.0	9.3	14.2	18.2	0.0	14.5	32.1	31.6	31.9	20.0	14.3	18.5
In big baskets (mitenga)	1.3	0.0	0.9	1.8	0.0	1.4	3.8	0.0	2.8	0.0	0.0	0.0
Put on the ground	0.0	0.0	0.0	0.0	7.1	1.4	0.0	0.0	0.0	0.0	14.3	3.7
In a granary	34.7	35.5	34.9	45.5	71.4	50.7	9.4	31.6	15.3	35.0	57.1	40.7
No answer/do not know	1.3	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 45. Distance between the granary for maize and the closest house (%).

Distance	District Kaniama	Mwene-Ditu	Gandajika	Tshilenge
0 (in the house)	46.2	13.6	38.2	28.3
< 10 m	40.6	47.0	38.2	60.4
10-50 m	2.8	1.5	2.9	5.7
50-100 m	3.8	0.0	0.0	0.0
100-200 m	0.9	1.5	0.0	0.0
200-500 m	0.9	1.5	0.0	0.0
500-1000 m	1.9	4.5	0.0	5.7
> 1000 m	2.8	22.7	1.5	0.0
No answer/do not know	0.0	7.6	4.4	0.0

Table 46. Distance between the granary and the closest maize field (%).

Distance	District Kaniama	Mwene-Ditu	Gandajika	Tshilenge
<100 m	24.5	48.5	70.6	88.7
100-200 m	16.0	7.6	5.9	1.9
200-500 m	23.6	0.0	1.5	0.0
500-1000 m	21.7	3.0	5.9	5.7
> 1000 m	13.2	7.6	10.3	3.8
No answer/do not know	0.9	33.3	5.9	0.0

Table 47. Distance between a farmer's granary and that of the closest neighbor (%).

Distance	District Kaniama	Mwene-Ditu	Gandajika	Tshilenge
<100 m	90.6	74.2	71.6	96.2
100-200 m	3.8	4.5	6.0	0.0
200-500 m	0.9	1.5	1.5	0.0
500-1000 m	0.9	0.0	6.0	1.9
> 1000 m	1.9	15.2	10.4	1.9
No answer/do not know	1.9	4.5	4.5	0.0

Table 48. Cleaning of granary before storage of new maize (%).

	District			
Response	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Yes	95.3	80.3	63.2	83.1
No	2.3	15.2	33.8	13.2
No answer/do not know	1.9	4.5	2.9	3.8

Table 49. The origin of rats which attack stored maize (%).

	District			
Origin	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Field	71.6	57.5	50.6	44.8
Granary	3.7	8.5	18.0	17.2
Own house	9.2	7.0	11.2	10.3
Neighbor's granaries	0.0	2.8	5.6	3.4
Neighbor's houses	1.8	2.8	2.2	6.9
Neighbor's fields	0.0	0.0	4.5	0.0
Other answer	2.8	4.2	0.0	3.4
No answer/do not know	11.0	16.9	7.9	15.5

Table 50. The origin of weevils which attack stored maize (%).

	District			
Origin	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Field	70.9	58.6	43.5	49.1
Granary	8.2	8.6	19.6	21.0
Own house	8.2	7.1	14.1	10.5
Neighbor's granaries	0.0	1.4	5.4	1.8
Neighbor's houses	1.8	1.4	2.2	0.0
Neighbor's fields	0.9	0.0	5.4	0.0
Other answer	0.9	4.3	0.0	1.8
No answer/do not know	9.1	18.6	9.8	15.8

Table 51. Proportion of producers visited by the extension agent (moniteur agricole) in 1973-4 (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	33.8	77.4	46.3	37.7	100.0	50.7	63.3	94.7	72.1	55.8	84.6	62.5
No	66.2	22.6	53.7	62.3	0.0	49.3	36.7	5.3	27.9	44.2	15.4	37.5

Table 52. Proportion of producers who have been advised by the extension agent about growing maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	7.8	12.9	9.3	3.8	0.0	3.0	22.4	26.3	23.5	7.0	38.5	14.3
No	92.2	87.1	90.7	96.2	100.0	97.0	77.6	73.7	76.5	93.0	61.5	85.7

Table 53. Number of years of agricultural experience (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Number of years	NP	P	T	NP	P	T	NP	P	T	NP	P	T
1-5	13.0	29.0	17.6	26.4	28.6	26.9	26.5	15.8	19.1	16.3	15.4	16.1
6-10	11.7	19.4	13.9	1.3	14.3	11.9	8.3	10.5	8.8	14.0	0.0	10.7
11-15	6.5	9.7	7.4	13.2	7.1	11.9	6.1	10.5	7.3	9.3	23.1	12.5
16-20	7.8	3.2	6.5	11.3	14.3	11.9	10.2	21.0	13.2	9.3	15.4	10.7
21-30	18.2	9.7	15.7	15.1	0.0	11.9	20.4	21.0	20.6	16.3	23.1	17.9
31-40	13.0	9.7	12.0	11.3	21.4	13.4	4.1	0.0	2.9	9.3	15.4	10.7
41-50	2.6	3.2	2.8	5.7	0.0	4.5	6.1	10.5	7.3	14.0	0.0	10.7
51-65	0.0	0.0	0.0	0.0	0.0	0.0	6.1	10.5	7.3	2.3	7.7	3.6
No answer/do not know	27.3	16.1	24.1	5.7	14.3	7.5	12.2	0.0	8.8	9.3	0.0	7.1

Table 54. Previous experience in off-farm job (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	55.8	48.4	53.7	64.2	57.1	62.7	34.7	47.4	38.2	60.5	30.8	53.6
No	44.2	51.6	46.3	35.8	42.9	37.3	65.3	52.6	61.8	39.5	69.2	46.4

Table 55. Knowledge of methods to improve maize yield (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	61.0	51.6	58.3	17.0	50.0	23.9	40.8	47.4	42.6	32.6	38.5	33.9
No	39.0	48.4	41.7	83.0	50.0	76.1	59.2	52.6	57.4	67.4	61.5	66.1

Table 56. Awareness of the existence of hybrid and/or composite varieties of maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Awareness	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	59.7	58.1	59.3	11.3	42.9	17.9	36.7	52.6	41.2	27.9	30.8	28.6
No	40.3	41.9	40.7	88.7	57.1	82.1	63.3	47.4	58.8	72.1	69.2	71.4

Table 57. Period of beginning of the awareness (%).

Period	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
1940-1969	1.9	3.0	2.9	0.0
1970	0.9	0.0	2.9	0.0
1971	1.9	1.5	1.5	1.8
1972	7.0	0.0	7.4	0.0
1973	6.5	4.5	14.7	8.9
1974-1975	38.9	9.0	8.8	17.9
Don't know/"no" Table 56	40.7	82.1	61.8	71.4

Table 58. Source of the information about hybrid or composite varieties (%).

Source	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Extension agent	24.7	25.8	25.0	0.0	28.6	5.9	27.5	42.1	31.4	16.3	23.1	17.9
Traders	3.9	0.0	2.8	5.6	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0
Friend, relative neighbor	18.2	16.1	17.6	3.7	0.0	2.9	7.8	10.5	8.6	4.7	7.7	5.4
Former or present employer	2.6	3.2	2.8	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	1.8
Agricultural demonstration	0.0	0.0	0.0	1.9	7.1	2.9	0.0	0.0	0.0	0.0	0.0	0.0
Radio program	0.0	3.2	0.9	0.0	0.0	0.0	2.0	0.0	1.4	0.0	0.0	0.0
Newspaper	2.6	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other answer	6.5	6.5	6.5	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	1.8
No answer/"no" in Table 56/ do not know	41.6	45.2	42.6	88.9	64.3	83.8	62.7	47.4	58.6	72.1	69.2	71.4

Table 59. Proportion of farmers who have planted hybrid or composite maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Proportion of farmers	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	5.8	22.6	10.2	3.8	0.0	3.0	4.1	26.5	10.3	0.0	0.0	0.0
No	95.2	87.4	89.8	97.2	100.0	97.0	95.9	93.5	89.7	100.0	100.0	100.0

Table 60. Period in which hybrid or composite maize was planted for the first time (%).

	District			
Period	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
1940-1969	0.9	0.0	1.5	0.0
1971	0.9	0.0	1.5	0.0
1972	0.0	0.0	2.9	0.0
1974-1975	7.4	1.5	2.9	0.0
No answer/do not know/ "no" in Table 59.	89.3	98.5	91.2	100

Table 61. Proportion of farmers who have applied insecticide on maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Proportion of farmers	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	1.3	9.7	3.7	1.9	0.0	1.5	0.2	15.8	5.9	0.0	0.0	0.0
No	98.7	90.3	96.3	98.1	100.0	98.5	97.9	84.2	94.1	100.0	100.0	100.0

Table 62. Source of capital used to buy fertilizer (%)

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Source	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Own funds	11.7	77.4	30.6	17.0	78.6	29.9	38.8	68.4	47.1	16.3	61.5	26.8
Financing by seller	0.0	0.0	0.0	1.9	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Other answer	5.2	6.4	5.7	1.9	7.1	3.0	2.0	5.3	3.0	2.3	0.0	1.8
No answer/"no" in Table 35	83.1	16.1	63.9	79.2	14.3	65.7	59.2	26.3	50.0	81.4	38.5	71.4

Table 63. Period over which fertilizer was first applied (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Period	NP	P	T	NP	P	T	NP	P	T	NP	P	T
1940-1969	3.9	12.9	6.5	1.9	0.0	1.5	4.1	15.8	7.4	2.3	7.7	3.6
1970	3.0	19.4	8.3	0.0	7.1	1.5	12.2	15.8	13.2	4.7	7.7	5.4
1971	0.0	6.5	1.9	3.8	0.0	3.0	2.0	0.0	1.5	2.3	7.7	3.6
1972	2.6	19.4	7.4	3.8	28.6	9.0	2.0	10.5	4.4	4.7	7.7	5.4
1973	2.6	6.5	3.7	0.0	21.4	4.5	12.2	21.1	14.7	0.0	15.4	3.6
1974-1975	3.9	16.1	7.4	9.4	21.4	11.9	8.2	10.5	8.8	2.3	23.1	7.1
"no" in Table 35	83.1	19.4	64.8	81.1	21.4	68.7	59.2	26.3	50.0	83.7	30.8	71.4

Table 64. Period over which insecticide was first applied on maize (%).

	District			
Period	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
1940-1969	1.9	0.0	1.5	0.0
1970-1973	1.8	0.0	3.0	0.0
1974-1975	0.0	1.5	1.5	0.0
Don't remember/"no" in Table 61	96.3	98.5	94.1	100.0

Table 65. Persons involved in clearing maize plots for the household (%).

	District			
Persons involved	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Children	1.8	1.5	9.9	1.9
Male adults	33.3	72.7	45.1	48.1
Female adults	0.9	4.5	12.7	11.1
Male and female adults	62.0	21.2	31.0	38.9
Children and female adults	0.0	0.0	1.4	0.0

Table 66. Persons involved in sowing maize for the household.

	District			
Persons involved	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Children	6.2	3.0	5.8	1.9
Male adults	2.7	22.7	26.1	16.7
Female adults	7.1	9.1	5.8	9.3
Male and female adults	83.2	68.2	62.3	68.5
Children and female adults	0.9	0.0	0.0	0.0

Table 67. Persons involved in weeding maize for the household.

	District			
Persons involved	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Children	8.5	1.5	9.7	3.6
Male adults	4.3	19.7	20.8	10.9
Female adults	0.9	7.6	5.6	10.9
Male and female adults	85.5	72.7	63.9	72.7
Children and female adults	0.9	0.0	0.0	0.0

Table 68. How maize is carried to market (%).

Head loads carried by	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Children (7-14 yrs)	13.9	22.4	22.6	10.3
Wife	58.2	57.1	54.8	72.3
Husband	1.3	10.2	11.3	3.4
Bike to market	1.3	6.1	6.5	0.0
Ride with maize in traders' truck	2.5	0.0	4.8	13.7
Other answers	22.8	4.1	1.3	0.0

Table 69. Use of hired labor for planting, weeding or harvesting maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Planting												
Yes	5.2	6.5	5.6	3.8	7.1	4.5	6.1	0.0	4.4	11.6	7.7	10.7
No	94.8	93.5	94.4	96.2	92.9	95.5	93.9	100.0	95.6	89.4	92.3	89.3
Weeding												
Yes	5.2	6.5	5.6	7.5	7.1	7.5	12.2	5.3	10.3	11.6	7.7	10.7
No	94.8	93.5	94.4	92.5	92.9	92.5	87.8	94.7	89.7	88.4	92.3	89.3
Harvesting												
Yes	6.5	6.5	6.6	9.4	7.1	9.0	12.2	10.5	11.8	14.0	7.7	12.5
No	93.5	93.5	93.4	91.6	92.9	91.0	87.8	89.5	88.2	86.0	92.3	87.5

Table 70. Outside sources of income in 1973-1974 (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Response	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Yes	9.1	6.5	8.3	17.0	7.1	14.9	26.5	10.5	22.1	18.6	7.7	16.1
No	90.9	93.5	91.7	83.0	92.9	85.1	73.5	89.5	77.9	81.4	92.3	83.9

Table 71. Constraints limiting maize production (%).

	District			
Reasons	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Limited land	1.7	19.3	19.1	13.2
Other crops more profitable	0.9	0.0	4.3	2.6
Limited labor	11.5	8.3	4.3	14.5
No tractor	49.6	21.6	21.7	23.7
Lack of good seed and fertilizer	3.5	19.3	18.3	22.4
Limited storage	0.9	3.4	2.6	1.3
Lack of credit	0.9	3.4	7.0	2.6
Lack of buyers	0.9	1.1	4.3	2.6
Low price	0.0	4.5	3.5	1.3
Other	30.0	19.3	14.8	15.8

Table 72. Possible means of increasing maize production as seen by the farmer (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Planned increases	NP	P	T	NP	P	T	NP	P	T	NP	P	T
No plan	1.0	2.7	1.5	3.7	0.0	2.8	5.0	0.0	3.7	2.9	0.0	2.2
Number of fields	55.1	70.3	59.3	42.0	42.3	42.1	28.8	42.9	32.4	48.5	48.0	48.4
Size of fields	20.4	16.2	19.3	31.0	30.8	30.8	27.5	32.1	28.7	23.5	24.0	23.7
Use of fertilizer	7.1	2.7	5.9	12.3	26.9	15.9	26.3	7.1	21.3	14.7	24.0	17.2
Use of insecticide	1.0	0.0	0.7	3.7	0.0	2.8	5.0	7.1	5.6	4.4	4.0	4.3
Other	9.2	8.1	8.9	2.5	0.0	1.9	3.8	0.0	2.8	2.9	0.0	2.2
No answer/do not know	6.1	0.0	4.4	4.9	0.0	3.7	3.8	10.7	5.6	2.9	0.0	2.2

Table 73. Uses of the maize harvest (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Uses	NP	P	T	NP	P	T	NP	P	T	NP	P	T
Consumption												
Yes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feed Animal												
Yes	9.3	9.7	9.4	0.0	0.0	0.0	8.2	5.3	7.4	12.5	0.0	9.4
No	90.7	90.3	90.6	100.0	100.0	100.0	91.8	94.7	92.6	87.5	100.0	90.6
Pay hired harvester												
Yes	18.7	12.9	17.0	3.8	21.4	7.6	16.3	0.0	11.8	10.0	30.8	15.1
No	81.3	87.1	83.0	96.2	78.6	92.4	83.7	100.0	88.2	90.2	69.2	84.9
Gift to village chief												
Yes	24.0	12.9	20.8	3.8	7.1	4.5	6.3	0.0	4.5	0.0	7.7	1.9
No	76.0	87.1	79.2	96.2	92.9	95.5	93.8	100.0	95.5	100.0	92.3	98.1
Sell												
Yes	70.7	71.0	70.8	71.2	50.0	66.7	73.5	68.4	72.1	45.0	69.2	50.9
No	29.3	29.0	29.2	28.8	50.0	33.3	26.5	31.6	27.9	55.0	30.8	49.1
Bartering												
Yes	44.0	54.8	47.2	84.6	78.6	83.3	75.5	89.5	79.4	72.5	92.3	77.4
No	66.0	45.2	52.8	15.4	21.4	16.7	24.5	10.5	20.6	27.5	7.7	22.6
Seed												
Yes	100.0	96.8	99.1	100.0	100.0	100.0	95.9	100.0	97.1	95.0	100.0	96.2
No	0.0	3.2	0.9	0.0	0.0	0.0	4.1	0.0	2.9	5.0	0.0	3.8

Table 74. Regularity of use of maize in fufu mix (%).

Period	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
Throughout the year	97.2	79.1	86.8	75.0
Seasonally	1.9	20.9	11.8	25.0
No answer/do not know	0.9	0.0	1.5	0.0

Table 75. Daily frequency of use of fufu made with maize (%).

Times per week	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
1	0.9	0.0	0.0	0.0
2	0.9	7.5	11.8	16.1
3	0.9	1.5	2.9	3.6
7	0.9	4.5	10.3	7.1
14	91.7	80.6	72.1	71.4
Other answers	4.6	6.0	2.9	1.8

Table 76. Proportion of maize flour in fufu (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Amount of maize	NP	P	T	NP	P	T	NP	P	T	NP	P	T
A little	35.1	29.0	33.3	54.7	35.7	50.1	36.7	15.8	30.9	37.2	53.8	41.1
About 50%	29.9	29.0	29.6	28.3	7.1	23.9	28.6	31.6	29.4	34.9	23.1	32.1
Over 50%	32.5	38.7	34.3	13.2	50.0	20.9	26.5	36.8	29.4	25.6	23.1	25.0
100%	0.0	3.2	0.9	1.9	0.0	1.5	6.1	15.8	8.8	2.3	0.0	1.8
No answer/do not know	2.6	0.0	0.9	1.9	7.1	3.0	2.0	0.0	1.5	0.0	0.0	0.0

Table 77. Location where producers sold most of their maize (%).

	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
Location	NP	P	T	NP	P	T	NP	P	T	NP	P	T
The village (at home)	68.3	57.1	64.7	60.0	48.9	57.4	30.0	27.8	29.3	38.1	60.0	45.2
Along main roads	0.0	0.0	0.0	5.0	0.0	4.3	7.5	5.6	6.9	4.8	0.0	3.2
Rural markets	18.3	25.0	20.5	17.5	48.9	21.3	25.0	16.7	22.4	19.0	10.0	16.1
Urban markets	13.3	10.7	12.5	17.5	14.3	17.2	37.5	44.4	39.7	33.3	30.0	32.3
Other sites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.7	4.7	0.0	3.2
No answer/do not know	0.0	7.1	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 78. Number of months after harvest within which producers sell their maize (%).

Number of months after harvest	District											
	Kaniama			Mwene-Ditu			Gandajika			Tshilenge		
	NP	P	T	NP	P	T	NP	P	T	NP	P	T
<1	27.8	22.7	26.3	16.2	28.6	19.2	36.1	7.7	28.6	47.1	33.3	42.3
1-3	24.1	22.7	23.7	29.7	28.6	29.5	5.6	0.0	4.1	17.6	44.4	26.9
3-6	9.3	13.6	10.5	21.6	0.0	19.2	8.3	23.1	12.2	11.8	0.0	7.7
6-9	11.1	9.1	10.5	13.5	14.3	13.6	25.0	23.1	24.5	11.8	22.2	15.4
all year	27.8	27.3	27.6	16.2	14.3	15.9	19.4	38.5	24.5	5.9	0.0	3.8
Other answer	0.0	4.5	1.3	2.7	14.3	4.5	2.8	0.0	2.0	0.0	0.0	0.0
Do not know	0.0	0.0	0.0	0.0	0.0	0.0	2.8	7.7	4.1	5.9	0.0	3.9

Table 79. Months thought by farmers to bring the highest price for maize (%).

Months	District			
	Kaniama	Mwene-Ditu	Gandajika	Tshilenge
February-March	4.0	0.0	1.3	0.0
April-May	1.3	1.6	0.0	4.5
June-July	2.7	8.1	1.3	6.8
August-September	74.7	56.4	48.7	47.7
October-November	17.3	33.9	48.7	40.9

Appendix Table B

Monthly retail price of maize flour in Mbuji Mayi (1970-1974).
Unit: Kg. Price in makuta per kg.

Month	Year 1970	1971	1972	1973	1974
January	12.89	15.93	13.33	25.00	20.00
February	11.45	15.92	09.71	25.00	14.29
March	11.45	16.32	15.21	10.50	14.11
April	11.45	17.71	11.80	25.00	14.44
May	10.69	18.21	13.32	11.15	15.00
June	15.43	18.21	14.49	10.00	16.20
July	08.94	13.94	18.63	12.50	16.67
August	11.39	18.03	18.18	14.49	15.30
September	12.37	12.78	20.56	14.70	15.50
October	12.59	20.00	16.49	13.34	12.01
November	13.33	18.18	17.50	13.40	19.56
December	14.87	10.00	17.85	16.68	13.28

Source (68).