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WORKING PAPER

AN ECONOMIC ANALYSIS OF MAIZE PRODUCTION
IN THE KASAI ORIENTAL REGION OF ZAIRE:
A RESEARCH PROPOSAL

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PREFACE

This Working Paper is being distributed to researchers and donor agencies interested in research on small farmers in the Republic of Zaire. The author, Dean Linsenmeyer, is a native of Nebraska. He spent two years in the Kasaii region of Zaire as a volunteer between his junior and senior years at the University of Nebraska. Excited by his experience in Zaire, Mr. Linsenmeyer decided to pursue graduate study at Michigan State University and to concentrate on agricultural development in French speaking countries in Africa. Mr. Linsenmeyer has been granted a Foreign Area Fellowship to finance his dissertation research in Zaire for an eighteen-month period in 1974-75.

Mr. Linsenmeyer's research is designed to generate micro data on small farmers who are producing maize in the Kasaii region of Zaire. He proposes to test a number of specific hypotheses about small farmer decision-making under conditions of risk and uncertainty. His results are expected to be of value to the national maize program in Zaire which is being assisted by a team from CIMMYT. The results of Mr. Linsenmeyer's research should also be of interest to researchers throughout Africa who are trying to better understand the constraints on small farmer production under conditions of risk and uncertainty.

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AN ECONOMIC ANALYSIS OF MAIZE PRODUCTION IN THE KASAI ORIENTAL REGION OF ZAIRE: A RESEARCH PROPOSAL

I. Introduction

Education, it is philosophically assumed by this study, finds it primary purpose in enabling man through a better understanding of himself and his environment, to more fully attain the potential of his being. The purpose of this educational endeavor is to examine the smallholder agricultural environment in order to better understand the factors which restrict the attainment of goals defined by the smallholders themselves.

A. Importance of Agriculture in the Economy

The importance of the agricultural sector in most developing economies of Africa is underscored by numerous economic indicators. Agriculture is a source of food for rapidly expanding urban populations, a potential market for industrial products, a source of foreign exchange earnings from export crops, and a source of capital and labor for expanding industrial, transportation and service sectors.

The Republic of Zaire is no exception. Approximately 80 percent of its population in 1960 derived its livelihood directly from Agriculture. [Area Handbook 1971]. By 1970 this proportion decreased only slightly to 78 percent. [FAO 1971 table 4] Southworth and Johnson [1967, p. 6] point out that most African countries will be heavily dependent on agriculture for several decades in the future. Using a hypothetical country with 80 percent of its labor force engaged in agriculture and assuming an annual increase in the total labor force and in nonagricultural employment of 2 and 3 percent respectively, they calculate that the proportion in agriculture would have declined to only 67 percent over a 50 year period and it would take nearly 125 years before the absolute number in agriculture will reach a maximum and decline.

Although available statistical data on most facets of the economy and population in Zaire are quite unreliable for post-independence periods they may be cautiously regarded as general indicators of the economy. Agriculture's share of the Gross Domestic Product at factor costs was 31.1 percent in 1960, 21.9 percent in 1966 and 20.5 percent in 1969 [U.N. 1971, table 5]. This relative decline can be partially attributed to (1) the greater emphasis placed on the modern manufacturing and industrial sectors in the early post independence years, (2) the wide-spread breakdown of market infrastructure during the post independence political turmoil, and (3) the rapid rate of rural to urban migration in the 1960's. During the 1960-1966 period the growth rate of real GDP at constant 1960 factor costs originating from agriculture declined by 4.6 percent per year. However, this trend was gradually reversed and from 1966-1969 agriculture's contribution to the average annual growth rate in real GDP was a 2.2 percent. [U.N. 1971 table 7] Given the population growth rate of approximately 3.9 percent, the real GDP per capita originating from agriculture declined at a rate of 1.7 percent annually over the 1966-69 period.[1/]

Using an index of total agricultural production with the 1961-65 average being 100, the index rose steadily in the later 1960's to an index value of 135 in 1970 and 140 in 1972. [FAO, 1973, table 8 pg. 29]. However Table 1 shows that it was not until the late 1960's and early 70's that cereal production regained the pre-independence levels. Maize is the dominant cereal in the diet. Table 2 reveals that maize has constituted approximately 60 percent of all land allocated to cereals by percentage of surface area over the last two decades. Having established the importance of maize in cereal production, the study proceeds to examine some of the problems facing the maize industry.

[1/] Current estimates of population growth rates vary from 2.4 percent [Tollens, November ,1973] to official 1970 estimates of 3.9 percent [IBRD 1972] to 4.28 percent [Salongo,[January 1973].

TABLE 1: ANNUAL PRODUCTION OF MAJOR CEREALS (1959-71)

('000 Metric Tons)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Maize	320	333	250	226	252	237	232	270	297	250	350	375	306
Paddy Rice	173	165	71	74	60*	55*	49	91	100	130	130	188	195
Wheat	3	2	2	3	3	3	3	3	4	3	3	3	2
Millet and Sorghum	57	50	47	42*	43*	44*	24	25	26	18	30	38[F]	38[F]

NOTE: * - unofficial figures

F - FAO estimate

Sources: Year 1959-60: United Nations Food and Agriculture Organization. Production Yearbook, Vol. 15, Rome: 1962.

Years 1960-71: United Nations Food and Agriculture Organization. Production Yearbook, Vol. 26, Rome: 1973.

TABLE 2: MAJOR CROPS PRODUCED IN ZAIRE

Crop	1948-52 Area*	1948-52 % of total cereal area	1961-65 Area*	1961-65 % of total cereal area	1970 Area *	1970 % of total cereal area
Cassava	655		668		800 A	
Maize	337	57.9	266 A	62.7	330 A	64.9
Millet & 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	.69	3 A	.70	3 A	.60

NOTE: A = FAO estimate

B = unofficial figures

= area in 1,000 hectares

source: United Nations Food and Agriculture Organization. Production Yearbook, Vol. 25, Rome, 1971.

B. Identification of the Problems

The study will focus on four primary issues:

(1) Inadequate food Supply. The current supply of basic food items is inadequate for the following reasons:

(a) There is an insufficient quantity and quality of domestic staple food production to satisfy effective demand at current government-established farm gate and retail prices. Several commodities previously exported are now being imported in significant quantities. Maize exports began in 1933 and increased to a peak year in 1947 with 31 thousand tons exported [Brussel, 1959]. Although domestic effective demand for maize increased, production lagged and imports began in 1959. Imports increased to an estimated 107,000 metric tons in 1971. It is alleged that the imports originated in Angola, Rhodesia and South Africa. In 1970 Zaire imported 20 thousand tons of rice, 83 thousand tons of wheat flour, 37 thousand tons of malt, 16 thousand tons of sugar and 12 thousand tons of meat and meat products by Zaire.[Tollens, July 1973]

There are numerous reasons why domestic staple food production is lagging. Some are common to other developing countries and some unique to Zaire. First, demand for higher quality staple foods has increased as a result of natural population growth rate and an increase in per capita disposable income for particular segments of society. Tastes changed, particularly in the urban centers where those enjoying higher wages in modern mining, manufacturing or service industries demanded higher quality staple foods. Thus preferences shifted from cassava to higher quality cereals such as rice, maize, and wheat.

Secondly, staple food production is lagging as a consequence of unbalanced development policies over the pre- and post-independence periods. High priority was given to the modern industrial-urban sector in the pre- and early post-independence years.[1/] As a result, urban centers experienced a dramatic growth

[1/] Internal civil strife from 1960-65 exerted additional pressure for widely dispersed ethnic groups to relocate in more exclusive areas for security reasons, not necessarily where individual skills were most in demand nor most productive.

in population due to natural population growth rate and substantial rural-urban migration. For example, Kinshasa experienced an annual growth rate of 11 percent and Kananga quadrupled in size over the 1958-70 period. The population of Mbuji-Mayi increased tenfold and Gandajika grew from a small territorial capital of 5,000 to a city of 60,000 in the 1958-1970 period.

In addition to rapid urbanization and the subsequent problems of maintaining urban food supplies, and the natural growth in the demand for staple foods, food grain deficits increased further because of declining productivity due to seed degeneration, deteriorating soil fertility and cultural practices, and a general deterioration of the transportation network forcing farmers to revert to subsistence production. [IBRD, 1972]

(b) The real and monetary cost of feed grain imports has risen significantly at a time when the price of feed grains on the world market was increasing. This resulted in a drastic increase in foreign exchange expenditures on basic food and agricultural imports. By 1968 imports of cereals, fish, meat, fruits, vegetables and tobacco accounted for approximately 11 percent of the total value of imports, despite the fact that this was declared the "year of agriculture" and food and fiber production were given the "priority of priorities." The cost of imported maize was about $4 million in 1969.

(c) A reliable domestic food supply is an issue of national priority. The reliance of commercial food imports has been politically discredited because of the drain on scarce foreign exchange earnings, and the unreliability of such supplies. Also, food aid is drying up.[1/] The present and future reliability of such sources are indeed questionable. It is also questionable whether new buyers of feed grains on the world market do actually have access to tight supplies already committed to more traditional buyers in Japan, West Europe, etc.

[1/] For example, in the early 1960s maize and maize flour accounted for 16.4 percent of all economic aid received as agricultural products from all foreign donors.[Appendix I]

(2) Lack of Productive Employment in Rural Areas.

Although by no means unique to Zaire, the trend of rural to urban migration and the large disinvestment in human capital in the rural areas is only the symptom of a major problem. The lack of jobs in the rural areas which provide meaningful renumerations to the laborer may play a significant role in the social-political instability of much of post-independence Africa. The magnitude of underemployment in the rural areas of Zaire is unknown but the mushrooming shanty towns around Kinshasa, Lubumbashi, Kananga, Mbuji-Maji, indicate it is probably significant.

With an increasing demand for maize as a staple food and underemployed labor, the challenge is to increase the production of maize using that combination of practices and inputs which increase the returns to labor as well.

(3) Inadequacy of Micro-Economic Theory of Smallholder Decision Making Under Conditions of Risk and Uncertainty

Numerous economists have recognized the inadequacy of current micro-economic theory of smallholder agriculture. Lipton (1968) and Mikesell (1968) point out the inconsistency of economists who formulate abstract models based on hypothesized variables and assumptions of economic behavior towards monetary goals, while admitting that nonmonetary factors may be major determinants of growth in LDCs. Mikesell concludes by noting that: "The usefulness of growth models, even as partial approaches to reality, will require advances in our knowledge of incentives and the agents of change and the formulation of theories of motivation capable of empirical testing." [Mikesell 1968, pg. 37]

Two leading agricultural economists have recently urged a redirection of academic talent from macro to micro level theory development and empirical investigation. Hayami and Ruttan state that: "In our judgment, the major advances in the understanding of economic development processes and in design of development policies must be more solidly based on an understanding of micro economic processes and behavior." [Hayami and Ruttan, 1971, pg. 25]

This study will formulate alternative motivational models and from these derive hypotheses concerning incentives and economic behavior of smallholder maize farmers in Kasai Oriental Region. Micro level socio-economic data will then be collected over a 12 month period and analyzed to test these hypotheses in an attempt to contribute to the micro-level understanding of the development process.[1/]

(4) Inadequate Micro-Level Research to Guide Maize Policy and Planning In the Kasai Oriental Region and in the Country

Agricultural development plans have been outlined by the Government of Zaire and concrete policies and programmes to expand maize production are now being introduced in the Kasai Oriental and Shaba Regions with the assistance of a CIMMYT team.[2/] The CIMMYT team has a field headquarters in Kisonga Station, Shaba Region and is developing improved maize varieties and cultural practices adapted to the climate of the Kasai Oriental and Shaba Regions. As in many other developing countries, an adequate understanding of the grass roots, micro-functioning of the agricultural economy of Zaire is lacking. Eleven years after independence there were only two Zairois agricultural economists in Zaire with post-graduate training. In addition there are no definitive micro economic studies on maize production to guide national policy makers.

II. Justification of the Research

In light of the above problems there is an urgent need for (a) micro-economic village level studies in order to guide national policy on how to expand domestic food grain production and (b) an improved understanding of the theory of peasant decision making.

[1/] For further consideration of socio-economic factors affecting traditional agriculture in Zaire, see Verhaegen (1967) and (1969).

[2/] CIMMYT is the acronym for Centro Internacional de Mejoramiento de Maiz Y Trigo, a multinational research network centered in Londres, Mexico.

III. Description of the Maize Producing Area

(A) General Description of Production in Zaire

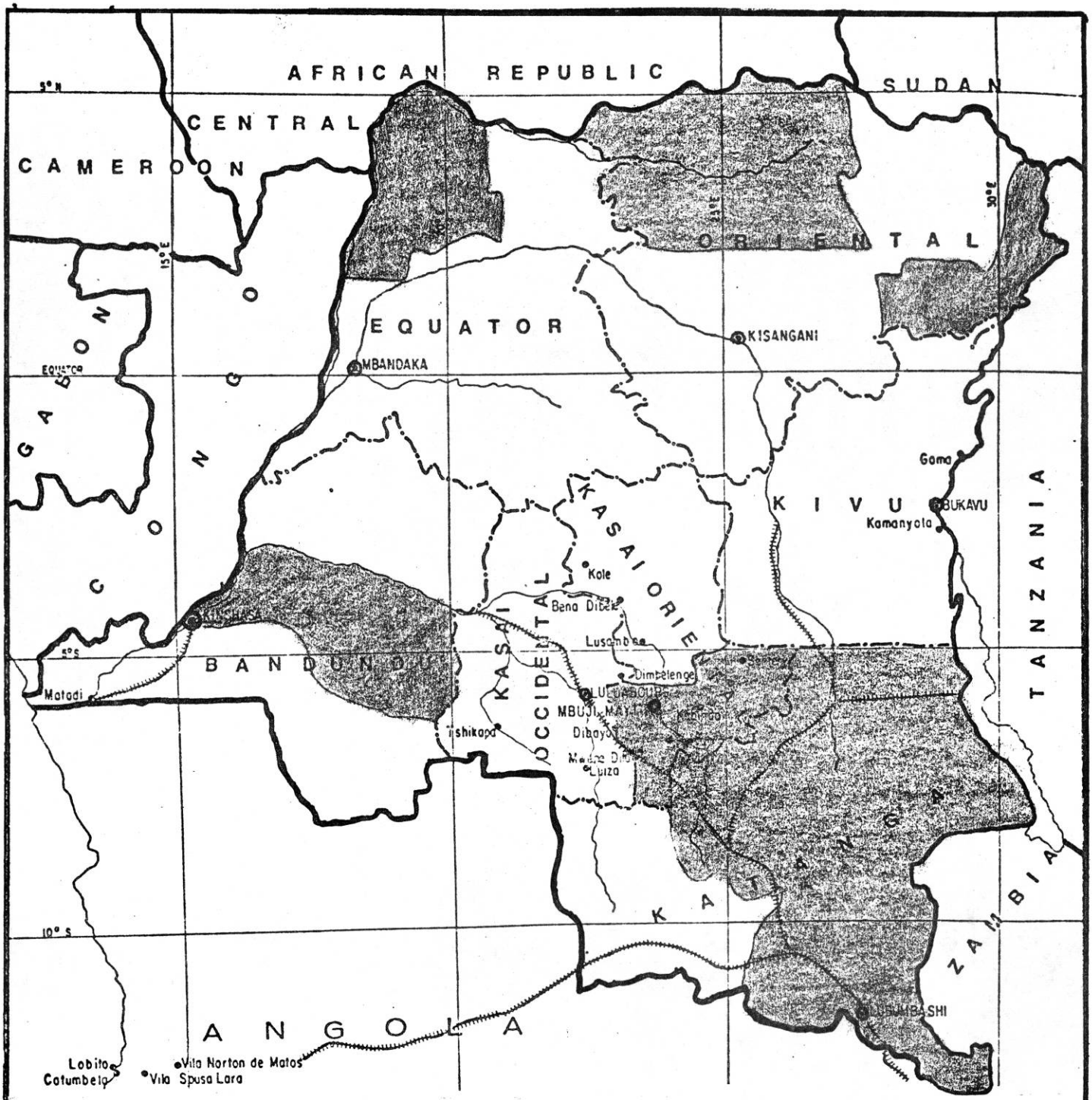
Although maize is produced throughout Zaire the principal regions for maize production in 1970 were the Kwilu sub-region of the Bandunda region, the Ituru sub-region of the Haut-Zaire Region, Kabinda sub-region of the Kasai Oriental Region and throughout most of the Shaba region in southern Zaire. See Figure 1.

Maize is almost universally grown in a crop mixture with other staples. Kamuanga [1973] estimates that only 13 percent of the total maize acreage is planted in pure maize. Predominantly maize is grown in a mixture with groundnuts, cotton, manioc, beans or yams. Within the crop rotation maize is usually planted soon after the land is initially cleared and is often planted directly in the ashes of clearing fires. [Miracle 1966].

(B) Specific Characteristics of the Kasai Oriental Region. We have specifically focused on the Kasai Oriental region because of: (1) its current role as a major producer of maize in southern Zaire, (2) its proximity on the main rail link between three urban growth centers of Kananga, Mbuji-Mayi, and Lubumbashi--a major food deficit area, (3) the soil and climatic factors giving the area greater potential for increase in production, (4) the location of on-going maize improvement research of CIMMYT, INERA and other areas, and (5) the importance which maize holds as a traditional dietary staple among major ethnic groups in the region.

(1) Geological and topographical factors. The Kasai Oriental Region is on the southern slope of the Zaire River basin and is primarily a plateau dissected by the Lubilash and Lomani Rivers flowing in a north-northwest direction. Although the region stretches from 3^{o} south with an altitude of about 2,000-2,50 feet above sea level and about 25^{o} east of the Prime meridian longitudinally.

FIGURE 1: **MAJOR MAIZE PRODUCING AREAS**
IN THE REPUBLIC OF ZAIRE



Source: Kamuanga, Mulumba K.B. Le Mais au Zaire. Unpublished thesis for the degree d'Ingenieur Agronome. Universite Nationale du Zaire Kinshasa, Rep. du Zaire. pg. 41, 1973.

The soils in the Kasai Oriental Region are developed from either the Bushimayi siltstone rock formation or from the Karoo or Kalahari Sandstone [Kamuanga 1973, p. 23] [De Lew, Cather International, Inc., 1970], which weather easily under the influence of high temperature and humidity to the deep lateritic soils common to tropical Africa. Even the areas underlain by harder rocks, such as granite and gneiss, are so deeply weathered that hard rock outcrops are uncommon. The generally sandy nature of the soil and rock allows the retention of much moisture and the development of dense stands of grass throughout the region. (See Appendix II for map of major soil types.)

Generally those derived from the Bushimayi formation possess more of the characteristics desired for agronomic purposes.

Black industrial diamonds are found throughout much of the southern half of the region.

(2) Climatic factors.

The climate of the Kasai Oriental is typical of tropical Africa, although conditions are modified somewhat by elevation. The mean variation in monthly temperature is probably no more than 8^{o} F. The annual average precipitation is about 65 inches. The dry season lasts for about 60 days in the northern Kasai Oriental to about 120 days in the south where higher elevations prevail. This usually occurs with about a two month dry season beginning in mid-May and a second three week dry season in early January.

At Gandajika, the specific area of interest, the mean monthly temperature ranges from about 85^{o} to 90^{o} F over the year, with an annual average of about 87^{o} F. The mean monthly precipitation varies from less than 0.5 inches in June, the dryest month, to about 9 inches in November, the wettest month. April and November are the months with the greatest average amount of precipitation. [De Lew, Cather International, Inc. 1970].

Appendix III gives major rainfall belts for a ten year period of an earlier era which may have altered some in recent years.

(3) Demographic factors

The Kasai Oriental Region experienced a 100 percent increase in population between 1958-1970. Much of this was due to the return of the Baluba people to their native homeland from widely scattered parts of Zaire due to conflict after independence.

Table 3 shows the population density distribution in the Kasai Oriental Region for 1972.

(4) Tehnographic factors

As shown in Appendix IV, the Luba and the Songe form two of the dominant groups in the Kabinda Sub-region. The Luba also continues well into Shaba Region,another maize producing area. Maize does not hold such a dominant position in the diets of the Kete, Kanioka, or Kalundwe groups immediately to the south of the area of interest.[1/]

IV. Evolution of National Maize Policy

A. Historical Description

Maize is not an indigenous crop to Zaire. Portuguese voyagers first introduced both maize and cassava at the mouth of the Congo River in 1482 [Miracle, 1967]. Maize and cassava production spread rapidly inland in response to the growing demand from Arab and British slave ships. Throughout the later 19th century maize cultivation was encouraged by local administrators of the Congo Free State. In February 1917 the Colonial government passed legislation by the Colonial Government [Miracle, 1967, p. 242]. In 1933 Prince Leopold of Belgium established an agricultural research organization for the

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[1/] For standard ethnological references of the area, see: Theuws (1964), Mukenge (1967) and Göhring (1970).

TABLE 3 : POPULATION DENSITY

Administrative Subdivision	Population	Area Km^2	Density / Km^2
Mbuji - Mayi City	261 310	64	4 083.1
Gandajika	145 320	5 726	25.2
Kabinda	166 472	14 373	11.6
Kamiji	19 056	2 100	9.1
Tshilenge	543 050	7 395	73.4
Nwene Ditu	200 380	11 747	17.1
Lubao	87 329	22 480	3.9
Kabinda (Sub-region)	1 161 707	63 821	18.2
Katako Kembe	134 662	25 490	5.3
Kole	55 856	17 682	3.2
Lodja	179 497	12 054	14.9
Lomela	60 820	26 346	2.3
Lubefa	63 215	12 229	5.2
Lusambo	53 015	10 530	5.0
Sankuru (Sub-region)	547 065	104 331	5.2
TOTAL Kasaii Oriental	1 970 082	168 216	11.7
TOTAL Republic of Zaire *	21.6 million	2 347 826	9.2

Source: Bulletin des Statistiques Generales, Region du Kasaii Oriental, 4th Quarter 1972

* included by author

improvement of agricultural crops, primarily export crops. Eventually this organization constituted some 20 research stations under the framework of l'Institute National pour l'Etude Agronomique de Congo Belge (INEAC).[1/] In 1971 the name was changed to INERA, Institute National pour l'Etude et la Recherch Agronomique.

In 1942 Belgian agricultural administrators began a system of "paysannata," a program of resettling subsistence farmers on 7 hectare plots along main infrastructural networks.[2/] The settlement program allowed for quick, less costly introduction of new technology into the area, more effective colonial administration of cultural practices and more efficient extraction of marketable surpluses from the rural area. Villagers were often physically coerced into joining such production schemes. The system of Paysannata was effectively introduced throughout the maize producing region by 1949 [Kamuanga, p. 84]. Immediately after independence, most farmers left the "Paysannata" schemes, as much of the technical and economic support was withdrawn. In the late 1960s and early 70s, some schemes were reactivated in the Kasai Oriental at the request of the Zairéan government for the production of cotton and maize. These schemes are currently operating under the assistance of the European Development Fund (F.E.D.)

B. Le Programme National de Maize

As a result of the food deficits and nutritional problems in Zaire, in 1967-68 the government initiated a multiplicity of high priority programs and projects aimed toward the amerioration of the food grain problem. Le Programme

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[1/] Jurion and Henry (1967) summarize much of pre-independence INEAC research experience.

[2/] Staner (1955) provides an excellent review of the administration of the Paysannata schemes.

National de Mais (PNM) was an agreement between the Government of Zaire, CIMMYT (Center for the Improvement of Wheat and Maize), IITA (International Institute of Tropical Agriculture), and US/AID with the expressed purpose of spreading the technology and application of the Green Revolution to Zaire with the goal of self-sufficiency in maize in the near future.

(1) Maize Pricing and Transport Pricing Policy

Agricultural prices as a whole were relatively unregulated until March 1969 when legislation authorized the Ministry of Economic Affairs and Regional authorities to establish a minimum price received for all agricultural products and services. (Kamuanga 1973, p. 62). These prices were in fact interpreted as maximum prices paid by buyers and have officially remained at that price.

With the monetary reforms in the late 1960s, such legislated prices were adjusted upward slightly for most agricultural commodities. The 1961 legislation also established maximum wholesale prices for maize flour from the mills in Lubumbashi and Kananga which prevented any increase in labor, materials, or capital costs from being passed on to consumers. Consequently the official farm gate price for maize remains at or near the official buying price of 2 K/kg.[1/] (Kamuanga 1973). However Kamuanga (1973) has reported that maize prices within the local market in Kasai Oriental vary from 2 to 10 K/kg depending on time of year; thus indicating that a local market price, more responsive to supply and demand forces than the government's buying practices. The same fluctuation has been reported for the retail price of maize flour.

Within the maize producing areas, as an incentive for commercial maize buyers to collect maize in areas off the main state roads, a system of gradient pricing was established to offset increased transport costs. Table 3 illustrates the price received by farmers on or near main roads.

[1/] 1 zaire = 2 dollars U.S.; 1 zaire = 100 makuta; 1 makuta (K) is approximately 2 cents. Kg = kilogram = 2.2 lbs.

Table 3. Graduated Farm Level Maize Prices

Distance from Main State Roads (km)	Price (K/kg)
0-28	2.00
25-49	1.75
50-74	1.50
75-99	1.25
100-125	1.00

Source: Kamuanga (1973, p. 64)

The purchase of maize in the village and transport to larger food deficit areas is predominately in the hands of Greek, Portuguese, and Pakistani commercial buyers. Since an Executive Degree of November 30, 1973 it is illegal for foreigners to own property and carry on private business related to agriculture in Zaire, and it is not known at this time what public or private delivery system will replace these expatriates. Maize deficits are supplied largely by imports from Angola, Rhodesia, and South Africa, entering Zaire via Zambia. Based on an import price of 3.17 K/kg F.O.B. at the frontier, Kamuanga calculates a price for maize received at the mills in Lubumbashi in the southern copper mining region of 4.237 K/kg. (Kamuanga, 1973, p 68) This leaves a differential of approximately 2.237 K/kg for transport charges, margin of profit storage loss, etc. in order for domestic maize to be competitive with imported maize at current farm gate prices.

(2) Input Supply Policy

Currently few capital inputs, i.e., fertilizer, insecticides, small machines, etc. are available to maize farmers. On the land cultivated under the revised paysonnat schemes in the area, fertilizer, mechanical clearing,

insecticides, etc. are supplied on a subsidized basis by the F.E.D. (European Development Fund). This is specifically for cotton production with maize as the second crop utilizing traces of fertilizer in the soil after the cotton is removed.

V. Objectives of Research

The objectives of this study are to:

A. describe the maize production system in the Kasai Oriental Region by means of:

1) examination of social and cultural systems of major ethnic groups in the area; detailing lines of authority, land tenure and inheritance patterns and other cultural institutions affecting maize production,

2) estimating input-output coefficients, factor proportion ratios, output proportion ratios and

3) identifying local price, income and market practices,

B. identify internal and external constraints governing smallholder economic behavior and current maize production,

C. to analyze national pricing, marketing and research policies affecting maize production,

D. evaluate alternative strategies for improving maize production, including proposed revisions in government policy consistent with the smallholder decision making framework and governmental goals and,

E. contribute to the theory of smallholder economic behavior in tropical Africa and in particular his decision making framework governing resource allocation under conditions of uncertainty.

VI. A Framework for Smallholder Decision Making: A Review of Literature and Specification of Hypotheses to be Tested.

We shall first review the literature on the individual decision maker in

traditional agriculture under conditions of risk and uncertainty. In the hypothetical situation of pure subsistence production, output and consumption are jointly dependent and "technical" production risks dominate the decision maker's choice production and consumption patterns. As we move from this hypothetical position, the smallholder must be willing and able to accept additional risks in the form of variability in factor prices, product prices, market accessibility, consumer-goods prices, as well as institutional performance risks all of which may be considerable in developing countries. Because of the predominance of subsistence or local village market orientation in the area, the type of extension strategy which will effectively encourage the production of a marketable surplus in staple food crops must consider the risk and uncertainty facing the smallholder decision maker.

This study will incorporate risk and nonmonetary factors in the smallholder decision making framework and policy evaluation. It will also determine the range of income levels in which alternative objective functions are relevant to economic behavior of small farmers in the Kasai Oriental.

Four possible categories of interacting influences in the decision making framework will be considered. It is proposed that a smallholder's allocation of resources among alternative activities and his choice of any particular technology will be the result of the interaction among the following: (1) the technical production function, (2) the individual decision maker's preference or goal function, (3) the economic and institutional environment facing the decision maker including the extent of surplus over subsistence requirements and (4) the beliefs and expectations of the decision maker himself.

A. Technical production function:

The farmers' crop diversification and cultural practices, pattern and in particular the relative importance of maize production is in part a function of the farmers' estimation of the production function for maize vis-a-vis other food and cash crops. In this the farmer's knowledge or estimation of soil types, rainfall, and other micro climatic factors will influence his production decisions.

Byerlee and Anderson [1969, p. 119] discuss the production function in the following form which explicitly considers uncertainty and controlability of agricultural production inputs:

$y = f\ (x_i x_j x_k)$, (i=1,2,...n; j=n+1, n+2, ...m; k=m+1, m+2, ...r)

They specify that x_i is the known level of the i^{th} controlled input such as acres of land, family labor, etc., x_j is the uncontrolled inputs known at the time of the production decision such as soil structure, initial soil nitrate, etc. and x_k being the uncontrolled input unknown (uncertain) at the time of decision such as rainfall, pests, disease. This study proposes to identify and examine the magnitude of these "technical risk" factors such as climate both in the form of rainfall during critical plant growing periods as well as drying conditions in preparation for storage and/or marketing.

The individual producer must assess the erosion potential, water holding capacity, ion exchange capacity, nutrient level, and general fertility of the land available to him through such indicators as (1) the type of climatic vegetation growing on it, i.e. dense shrubs and ferns or sparse lowlying

grass cover (2) the color of the soil, yellow, red, to deep orange (3) the presence of moss or growth fungus and relative moistness of soil in different plots, (4) soil texture or relative proportion of sand, (5) slope or erosion problems.

The first hypothesis is that the smallholder's subjective estimate of the uncontrolled and unknown inputs such as rainfall, pests, and plant diseases as well as judgments of available soil fertility does significantly affect his choice of cropping pattern and resource allocation in maize production.

In considering the individual's production function for maize and other staple crops competing for family resources, Heyer (1972), Spencer (1972), and Norman (April 1973) considered family labor allocated to farm production in terms of male adult equivalents as a relatively homogeneous unit.

If in fact there is a sexual division of labor among agricultural activities in the area as Miracle (1967) and Vansina (1962) seem to indicate, then arbitrary coefficients conventionally used to arrive at the homogeneous labor unit would not be appropriate. Skills required or cultural values or taboos might dictate that one man equivalent contributed by women for a particular task cannot be replaced by one man equivalent contributed by men. As a minimum, labor equivalent coefficients used in discounting various labor inputs would need to be specific of age, activity and sex. Total production may be limited to the particular type of family labor available rather than the total adult equivalent available. For example, cereal production may be limited by the amount of female labor available for harvesting or weeding rather than the total man equivalents of labor available at time of clearing and land preparation.

The second hypothesis is that farmers' allocation of resources among crops is significantly affected by the sexual division of labor and, in particular,

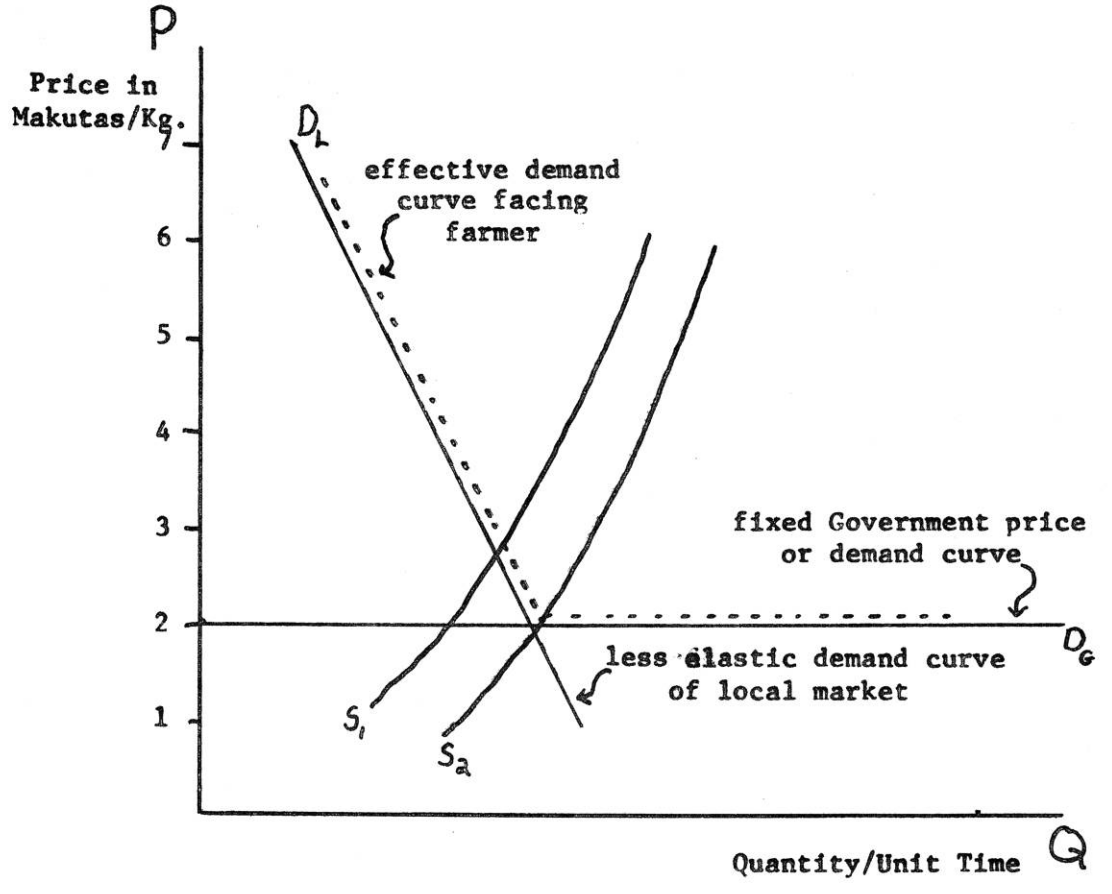
the amount of female family labor available at critical periods in the cropping cycle.

B. Socio-Economic-Institutional Environment

As the farmer moves from subsistence production to greater and greater market orientation he becomes more vulnerable to changes in factor, product and consumer good prices. As a result, the degree of market orientation affects future cropping patterns.

Current information on pricing system facing maize producers is conflicting and incomplete. As discussed earlier, an official maize price of 2K/kg has been established but preliminary evidence suggests that a second less elastic demand schedule of local consumers may in fact be the demand to which farmers gear their production decisions. Figure 2 graphically illustrates why farm

Figure 2. Supply of Marketable Surplus Available for Export From the Region



production decisions hypothetically would generate a surplus exportable to food deficit areas at the official purchasing price, only if the marginal cost of production taking opportunity costs into account resulted in a supply curve to the right of S_2.

At other supply schedules to the left of S_2 farmers would adjust production to the local demand only, and only a small amount, if any, would be sold through the official pricing system. Non-economic factors such as peer pressure by the local political party unit, or low price as during periods of surplus in local markets at the time of harvest could result in some export of maize at the official purchase price.

The third hypothesis is that given the current official maize price, and the on farm opportunity cost of labor in producing maize, farmers' maize production decisions are primarily geared to the less elastic local demand schedule.

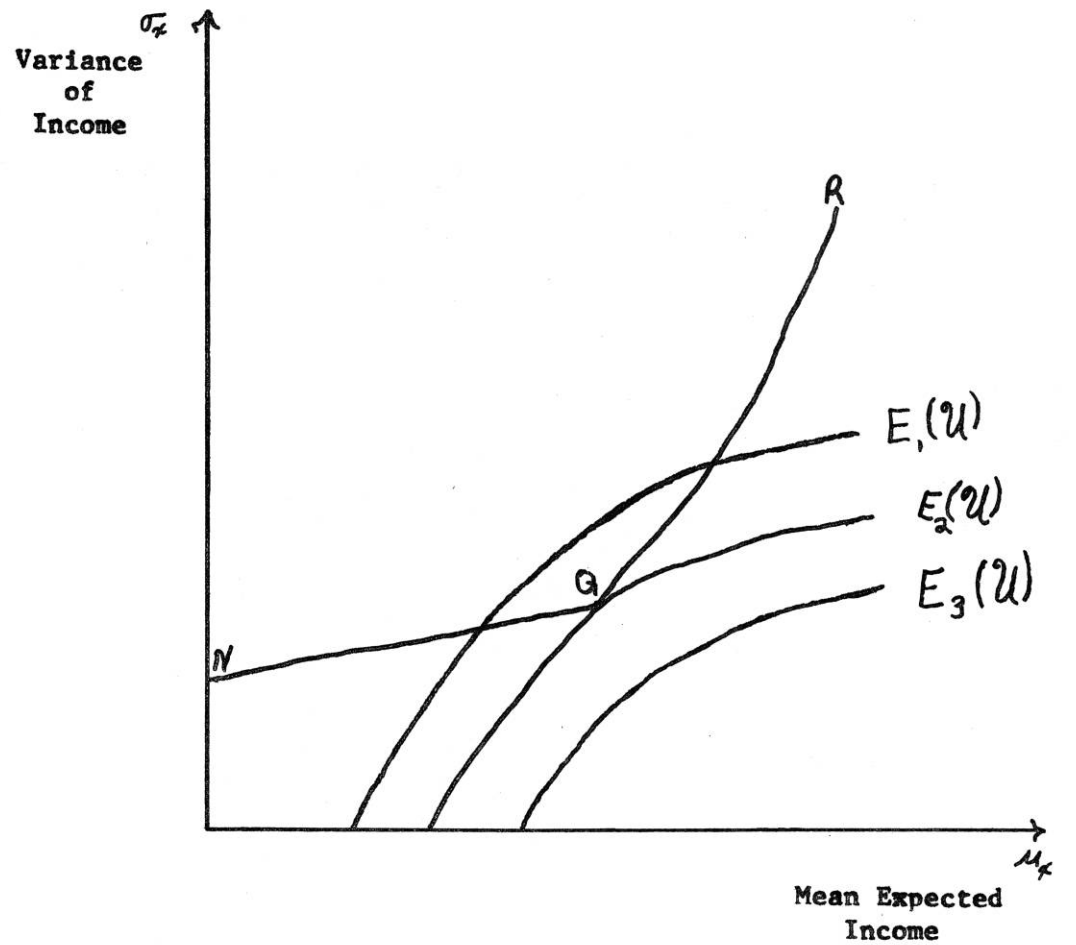
The exact effect of such an official price policy is open to debate but Nowsherrani (1971) explains much of the existing cropping patterns in Bangladesh in terms of the relative degrees of price uncertainty of food versus cash crops. From his mathematical model he concludes that a government price stabilization policy for cash crops would result in an increase in land devoted to cash crops since it would decrease the variance in returns to cash crops relative to food crops. However, stabilization of food crop prices may result in less land devoted to food crops especially the smaller the amount of land currently used for food production. Because with the decreased variance in food crop prices, the variance of the farmers real income would then be less and since he is assured of fixed food prices he may switch to higher yielding cash crops.

Other institutional factors may influence the extent of market oriented production and the choice of new technology. Porter [1959] examined some of

the institutional risk factors affecting the choice of technology and the decision to increase cash crop productions. According to Figure 6, the farmer can increase his mean expected income, u_x, by increasing acreage using traditional techniques over the ranges NQ with a gradual increase in variance, σ_x due to climate, family health, price, etc.

FIGURE 3

Porter's Mean-Variance Representation of Risk Averse Behavior in the Choice of Technology



However, any increase beyond point Q would require adopting a new technology, i.e., hired labor, new varieties, new managerial practices, etc. Over the range, QR, the farmer experiences a sharp increase in his perceived variance because of (1) his lack of skill or knowledge needed to apply the new technology, (2) his inadequate credit position as a result of high initial costs of the new technology, and (3) the credibility gap between his source of information and supply for new technological inputs.

Assuming the farmer is a risk averter, we would hypothesize the shape of his iso-expected utility curve of the shape E(U), shown in Figure 3. In attempting to reach the highest iso-expected utility curve possible within his opportunity frontier, the farmer would logically and rationally choose point Q, the point of tangency using his traditional technology, attaining $E_2(U)$. The quality and reliability of performance for those credit, extension, and marketing institutions serving him largely effect the slope of QR. The degree of efficient timely credit, input, and informational delivery system will determine the degree to which the farmer discounts new incentives for increased market production.

C. Preference and Motivational Function

Within economic literature, efficiency in the allocation of resources is meaningful only when analyzed with respect to whose resources and toward what specific goals or preference systems are the resources utilized. There are a number of models of motivational behavior used as frameworks for analyzing resource allocation. These include (1) profit maximization, (2) utility maximization and the "safety-first" principle or focus loss constraint, and (3) other goals. In summary, the study will attempt to formulate a preference

or motivational schedule which is hypothetically consistent with empirical studies in the Kasai Oriental.

1. Maximization of Expected Profits. Much of the literature on resource allocation or supply response of traditional agriculture has generally assumed the framework of profit or net income maximization as the objective function of agricultural decision makers. Although some scholars have identified risk and uncertainty as important factors affecting supply response, few have incorporated it into the analysis.

Within the largely deterministic model of profit maximization, the decision maker theoretically allocates resources among alternative activities as though he desired to establish $\frac{MVP}{MFC}$ for all inputs used in all production activities, the ratio of the $\frac{MVP}{MFC}$ being equated to one. The risk element is indirectly included in that it is assumed that relative prices among inputs and various output would account for different returns to risk bearing.

Literature as early as Sol Tax's study (1953) considered the economy of Guatemalan community to be largely governed by economic rationality even within the customary exchange of gifts. He defines economic rationality as the "planned distribution" of good or services among alternatives which are in agreement with the estimation of expected costs, however inaccurate that may be. Later W. O. Jones (1960) cites numerous cases throughout Africa which support the concept of "economic man in Africa" not only in exchange but in production, savings and investment as well. Jones advances limited quantitative support for his conclusion that the production of African farmers is adjusted to both cost and price changes "in order to maximize net revenue." Within this same framework of profit maximization, Schultz (1964, pg. 37) concludes that within traditional agriculture, "allocation is near optimum with few significant

inefficiencies in the allocation of factors of production." However, Schultz is careful to define traditional agriculture as one in which an equilibrium condition has been reached by means of trial and error over a long period of time, the state of the arts, tastes, preferences, and motives have reached a state of near optimum constancy. Schultz recognized that decision makers would consider risk in the form of expected variance of returns in their choice of new innovations. Hopper (1965) in his detailed empirical study of 43 village farmers in Uttar Pradesh India, tested the Schultzian hypothesis of rational profit maximizing allocations of four major inputs to four production alternatives and concluded that traditional farmers in fact did economize the use of scarce resource to attain particular values as guided by the market prices of products. However, price, yield, and market uncertainties were not considered in his framework of analysis. Yotopoulas (1967) and Behrman (1968) tend to support Schultz's general "poor but efficient" position.

Other economists Boeke (1953) Samuelson (1970), clearly recognize the role of "psychology of custom" or the non-economic institutional factors which may tend to dominate among subsistence farmers. Behrman (1968) and Wharton (1969) summarize the fundamental issues of the traditional farmers supply response in three major positions: (1) the traditional farmer is highly rational and economic in his response to price changes and will allocate resources where economic gains outweigh any losses, (2) the institutional factors so constrain any price response of the subsistence farmer that profit maximizing output changes are insignificant and (3) the institutional factors are so dominant that the response in marketed production is inversely related to price. Dillon and Anderson (1971) reexamined the empiracle studies of Chennareddy (1967), Yotopoulos (1967) and Hopper (1965) and found the evidence inconclusive in that some support the hypothesis of a profit maximizing resource allocation

while others are inconclusive or relatively unfavorable to the hypothesis. Dillon and Anderson proposed the hypothesis of utility maximization as an alternative behavioral explanation.

In light of the conflicting evidence as to the assumption that producers are motivated to allocate resources so as to maximize expected profits, this study proposes to test its applicability to the maize producers in the Kabinda region of Kasai Oriental.

The fourth hypothesis to be tested is that over a major proportion of the population tested, profit maximization does not adequately explain current resource allocative behavior and that other behavioral models will be more consistent with descriptive data of current allocative patterns.

2. Utility Maximization

Accordingly, the farmer will allocate resources among activities of uncertain outcome to maximize the expected utility derived from the total resources available, taking into account the variance as well as the expected output.

This model is intended to alleviate a major criticism of the profit maximizing hypothesis, that being that the strength of motivational goals or values cannot be reduced to a common denominator or implicit monetary value. But at the same time utility maximization creates an equally difficult problem of quantifying in some manner the relative extent of utility or satisfaction derived from different activities so as to be able to determine a utility maximizing position. Officer (1967), and Officer and Halter (1968), and Halter and Dean (1971) discuss the empirical testing of various models for utility estimation, i.e., Von Newman-Morgenstern, Ramsey, and the modified Von Newman-Morgenstern in the study of Australian farmers' decision making concerning the level of fodder reserves to be stored for

probable droughts. The study attempted to derive the farmers' utility function for various amounts of money under various perceived risk conditions. The study hypothesized that the farmers' allocation decisions involving risk were consistent with the criteria of minimizing expected disutility. However, this again assumes that all the decision makers goals can be reduced to a single utility function of money.

Accurate estimations of small farmer utility functions for various incomes are difficult to attain, however some indication of expected utility derived from different uncertain outcomes can be attained through the analysis of decision maker's reaction to activities possessing differing degrees of variance in their expected outcomes.

Wharton (1968) hypothesized farmers choice among alternative technologies and resource investment alternatives on the basis of estimated variance rather than mean yields. Farmers would perfectly logically choose those alternatives whose estimated variance did not result in yields below a given specified minimum. Empirically Heyer (1972) found that Masaii farmers in Kenya allocated land and labor among alternative cropping systems that would result in the least variance in net farm output. Collinson (1972) found similar behavioral characteristics among Sukumaland cotton producers.

From his investigations largely in English speaking Africa, Collinson discusses several insurance techniques which in practice reduce the annual and seasonal variation in total net returns such as: (1) inter-cropping of several crops within the same plots, (2) staggered planting of the same crop at different time intervals throughout the season, (3) special low risk crops such as cassava, (4) fragmentation of staple crop fields to offset micro climatic variations and localized pest attacks, and (5) the hoarding of livestock as insurance of food or cash income in time of need. (Collinson 1973, ch. I)

The fifth hypothesis is that traditional farmers in Kasai Oriental allocate resources among different alternatives so as to constrain the variance in total annual as well as seasonal net returns (total output-consumption needs) in a risk aversive manner.

Other economists, in studying the resource allocation behavior of traditional farmers hypothesize a constrained maximization behavior as a special form of the estimated utility function. Roy (1952) incorporated risk concepts into resource allocation decisions in his development of the "safety-first principle." This purports that in practice resources are allocated not so much as to maximize profit or net satisfaction but primarily so as to reduce the possibility of certain "disasterous" positions or income levels which would drastically disrupt the operation of the system. Boussard and Petit (1967) formulate similar behavior concepts in their analysis of farmers' decisions concerning expected price of irrigation water in southern France. They conceptualize farmer behavior as being maximizing net income subject to the constraint that the possibility of attaining a net loss in the amount equal to some implicit fraction of the total possible net loss would be negligable.

(3) Other Goals

In a region where formalized credit or saving institutions are either non-existent or ineffective in servining the traditional farmer, the particular timing and diversification of crops may be affected by the sequence of particular specified needs throughout the year.

Collinson (1972) has supported this behavior in outlining four primary types of motivation dominating decision making and resource allocation in traditional Africa; namely (1) quantity of food, (2) nutritional quality, (3) realibility of supply, and (4) preferred taste for particular seasonal periods throughout the cropping year. For example, planting time may be

staggered so as to assure that harvest will coincide with particular cash requirements, i.e. school fees, village ceremonies, or to fulfill a particular nutritional gap at the end of dry season.

In an indepth study of three villages in Zaria region of northern Nigeria, D. W. Norman (January, 1973) incorporates risk in his consideration of farm resource allocation with respect to two alternative goals: profit maximization and security. Norman develops empirical evidence for both motives in the study of (1) intercropping, a form of crop diversification, (2) locating food crop mixtures closer to residential areas, consequently receiving greater attention than cash crops planted further away, and (3) determining the correlation between the farmer's degree of market orientation and his goal of profit maximization. Although Norman notes that game theory is relevant in testing the validity of the security goal, he does not use it in analyzing his data.

It is the sixth hypothesis that traditional farmers allocate resources among alternative activities so as to maximize the probability that at least a minimum or expected level of staple output or cash asset will be on hand to meet family obligations at specific times during the year. (Maximin Strategy)

(4) Summary of Motivational Frameworks

We have reviewed several behavioral models of farmer behavior. This research study proposes that each motivational factor is likely to be important over a particular range of income levels and growth stages in the economic life cycle of the traditional owner-operator farm firm.

As the age of the male head of the farm production-consumption unit changes, so the goals motivating his resource allocation change. One would expect to find that older operators who are at that stage when the number of individuals and total resources responsible to the firm is declining, would be

less motivated by profits and would allocate resources more according to the dictates of cultural and ethnical values. As in the psychological concept of primary and secondary drives, this study proposes a possible hierarchy or balance of motivational factors. Collinson states the importance of such a motivational framework in that, "Diagnosis of the balance of motivational forces in productive activity is a prerequisite for effective problem identification and solution." (1972, p. 22).

This study proposes that below a minimum level of living, specified in part by individual, biological, and societal norms, resource allocation is primarily governed by security factors such as exemplified by the sixth hypothesis. It is proposed that the factors of constrained variance dominate the decision making framework for the farmers who are above the minimum level of living. Within this level, market price and cost variability, market access variability as well as the usual yield variability are critical factors in the farmers' cropping pattern and choices of technology used. Gradually as the realized level of living increases, it is proposed that the maximization behavioral models become more applicable; first the maximization of utility derived from market and non-market activities and then gradually as he becomes more market oriented the maximization of expected profits.

D. Beliefs and expectations

The last major factor affecting the farmers' decision making framework in determining his choice of cropping pattern and production technology is his beliefs in himself, his relationship with his community and the credibility of his sources of information as well as his expectations of the net result of crop yield, merchant buying practices, consumption needs, etc., within his future planning horizon.

In making production decisions in light of past experiences, the farmer operates within some implicit expectational model. He may disregard all past experience assuming no correlation between the outcome of past events and current marketing, consumption, or production practices to be followed. At the other extreme he may assume perfect correlation and base his current decisions for future production as though all factors will remain constant.

O'Mara (1972) attempts to examine empirically the subjective expectational models of maize farmers in the Chapingo area of Mexico concerning the possible results of adoption of a package of maize technology including seed, fertilizer, insecticides, extension advice, etc. O'Mara found that the expectational models of adopters and non-adopters were periodically revised as economically relevant information became available to the potential adopter. For example, as contact with the package became more widespread and demonstration results on neighboring farmers were analysed, the expectational model of the farmer towards the package became more closely alligned with reality. O'Mara's conclusions support a theory of cognitive dissonance in the diffusion of innovations. Therefore, one would expect that farmer beliefs of the reliability or other performance characteristics of the input delivery system, i.e. extension service, research facilities as well as physical input supplies, and the output marketing channel would alter his resource allocation decisions. The seventh hypothesis is that farmer expectations of the performance of new technological and institutional innovations vary according to the frequency of direct contact with the innovation and the informational sources used by the farmers to gain knowledge of the innovation.

VII. Maize Marketing and Service Supply Industries

Data concerning the efficiency of the maize marketing channel including the timely supply of quality inputs is at best incomplete. The smallholder often looks with suspicion at agribusiness industries with which he interacts. Since independence, Zaire has experienced considerable changes in the ownership and orientation of its agricultural marketing systems. During this transition period, many changes came at the cost of less reliability and stability in performance standards.

Jones (1972) examines the marketing efficiency in four African countries largely through the Structure-Conduct-Performance framework. Particular criteria of efficiency used by Jones and which seems relevant in the examination of maize marketing in Zaire are: (1) the accuracy and speed with which price variations reflect changes in supply and demand over the cropping season and between geographically distributed markets, (2) the cost of allocating and distributing commodities and (3) other structural and cultural factors such as the length of the marketing chain or the seasonality of supply, i. e. what determines the rate and concentration at which goods enter the market such as timing of harvest, storability of produce, producers felt need for cash, etc.

Not only are price, yield and cost uncertainty important in the farmers' consideration to constrain the variance in total net returns but particularly in the Kasai Oriental, the uncertainty of market accessibility may be a critical factor in production decisions. In the Kasai Oriental the State has classified certain roads of "interet general" while others are of "interet locale." State or provincial funding is used to maintain only the main roads of general interest while the feeder roads of locale interest are of much poorer quality and rapidly deteriorating after independence. See Appendix V for map of State and Feeder Road Network. Commercial trucks travel only on the main state

roads and the changes of a farmer getting his produce to market from more remote feeder roads via vehicle are slim. In 1968, "the year of agriculture" many farmers responded to government exhortations to increase the area cultivated to cash crops, only to find that commercial buyers would not come over rough feeder roads to purchase the increased productions. The farmer being limited to his bicycle, his back or his head as possible modes of transporting his goods to market would tend to decrease commercial production to the amount which he could deliver to the nearest main road outlet.

This study proposes to test the eighth hypothesis that farmer production decisions are significantly affected by his expected marketing cost at the time produce is ready for sale.

VIII. Policy Analysis

The micro data will be analyzed through partial budgeting, linear programming, and possibly other programming techniques to determine the magnitude of interacting variables in the micro functioning of the farm firm. This information will help policy makers determine the type of techno-organizational systems necessary to implement the national maize program. It will also indicate possible future research and development needs in the area.

IX. Operationalizing the Research

The means by which the study proposes to collect the data and identify the internal and external effective constrains may be discussed first as "survey methodology" -- the exact manner of data collection and then "analytical methodology" -- the analytical techniques used depending on the kind of data obtained and the objective in its analysis.

A. Survey Methodology

1. Stratification

Because of the nature of the hypotheses which we propose to examine, the potential universe of farmers in Kasai Oriental will be stratified in several ways so as to obtain desired degrees of variance between the random samples taken. First of all, because of financial, time, and logistic constraints as well as prior knowledge of the area, only the southern sub-region of Kabinda will be examined. Kamuanga [1973, p. 41] shows that the relative proportion of land allocated to maize in the northern sub-region of Sankuru is less than one-half that of the national proportion while Kabinda sub-region has over two and one-half times the national proportion of maize surface area relative to the total land area. [See Appendix VI]

Secondly, within the sub-region of Kabinda, the study will stratify its population of interest by selecting two areas within which to select its master sample. The first area will be in the zone of Gandajika while the second in the zone of Kabinda. The first area is characterized by a higher population density, 25.2 inhabitants/Km^2, relatively level soil, as well as its close proximity to central maize research and extension facilities at the INERA Research station near Gandajika proper. The second area has much lower population density of 11.6 inhabitants/Km^2 as well as being a greater distance from the central research facilities.

Thirdly, within each area of interest, the study will select three localities stratified by distance from the main state roads and urban centers. This stratification will roughly coincide with the gradient pricing of maize as discussed earlier.

2. Phase A Surveys

As suggested by Norman [1973] and Spencer [1972] data collection will primarily take place in three phases, A--a general data collection from a large sample of randomly selected farms within each locality. This survey will help to define the population of interest and will obtain data on: number of hectares under cultivation, size of farm labor force, major activities undertaken, age, and educational standard of farm operator, etc.

3. Phase B surveys

Phase B will comprise a series of more intense surveys conducted over a 12-14 month period with a randomly selected sample of 18 farmers per locality. Farmers will be interviewed twice weekly during production cycle[1/] so as to obtain a flow pattern of (1) labor and capital inputs utilized, (2) non-crop income and expenditures, (3) harvested output, (4) consumption requirements. Another set of questionnaires will be administered infrequently (monthly or bi-monthly) covering such topics as (1) the stock of farm inputs, food stocks, etc. initially as well as ending inventory, (2) mid-season field allocations and cropping mixtures, (3) attitudinal surveys concerning (a) credit behavior, (b) perceived risks, (c) attitudes and expectations of new technology, (d) sources of information, and (4) monitoring or retail farm gate prices of basic food and cash commodities in major regional markets within the area.

4. Market surveys

A third phase will be conducted to derive some indication of pricing and allocation efficiency within the marketing channels. This will take place over two relatively short periods of time. The researcher proposes to monitor various wholesale markets and major transport terminals as maize flows from

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[1/] Depending on the description of activities and resources obtained in Phase A, in-depth interviews during slack seasons may be conducted weekly so that enumeration time may be utilized most efficiently.

the major producing area to the major milling facilities in Lubumbashi and Kananga and the return of maize flour to major consumption centers in the area. This is a similar technique employed by Welsh (1964) in the analyses of rice marketing in Nigeria. Hopefully, this will give some indication of the variation in prices, transportation and marketing costs; possibly illuminating the structural framework within which the firm operates and potential inefficiencies in the larger marketing system.

B. Analytical Methodology

In the development and testing of the smallholder decision making constraints and in analyzing its possible implications for future development strategies, linear programming and partial budgeting techniques will be the primary tool of analysis.

(1) Linear Programming

Beneke and Winterboer (1973) point out some of the limitations of the Linear Programming technique, primary of which is the assumption of linearity or constant returns to scale. Decreasing returns can be taken into account by increasing the number of activities, each having a relatively shorter range of applicability. The increasing number of activities soon make the tableau extremely large. Linear programming in effect chooses the optimum solution among a limited number of solutions. The stability of this optimum can then be examined considering a range of alterations in independent variables considered.

Activities involving decreasing costs of production can not be treated adequately using conventional linear programming techniques.

Heyer (1972) encorporates some risk consideration in the L.P. model used to examine the major constraints and their effect on the production practices of Masaii farmers in southern Kenya. Basically she treated land and labor as each being homogeneous resources and analyzed their allocation among

different cropping patterns. She found that farmers behavior could best be explained by an allocation decision based on the assumption of extremely unfavorable natural conditions.

McInerney [1967] develops a maximum programming model which will be expanded on to empirically examine farmer behavior in facing uncertainty in the Kasai Oriental province. This model has the objective function of:

Maximize: $V = C_{ij} P_i$

Subject to n - 1 constraints in the form of:

$$a_{ij} P_i = 0 \quad \text{(the "maximin" constraints)}$$

and r constraints of the form:

$$d_{ik} P_i \leq bk \quad \text{(the "farm" constraints)}$$

and $P_i \geq 0$

where "V" is the maximum of the minimum returns from production alternatives; Pi is the proportion of resources available that should be allocated to the production alternative A_i. C_{ij} represented the possible returns to a particular activity under a subsequent state of nature. "n" represents different states of nature.

In essence this model derives a mixed strategy in "terms of proportions of resources allocated to each activity indicating the best combination of farm activities to derive some guaranteed minimum level of income in the uncertainty situation specified." McInerney[1967, p. 283].

By comparing the imputed shadow prices for various farm inputs with their approximated market prices, we will get some indication of (1) what are the major constraints on the maize production system and (2) how do these constraints influence the farming system.

(2) Partial Budgeting

Partial budgeting will be used in conjunction with the linear programming analysis to examine potential changes in the maize producing system and their effect on the individual operations. Through partial budgeting of various farms representative of different stratified categories of the farming population, some indication of the distribution of effects of policy changes in the input delivery and product marketing networks.

X. Summary

The proposed study attempts to integrate two primary purposes in the examination rural development in Zaire. (1) Through the examination of the rural maize producing subsector, it is the intention to precipitate directives in the practical problems of the future development of maize production. (2) Through the in-depth analysis of smallholder resource allocation, the study hopefully contributes to the disciplinary understanding of the internal and external constraints affecting smallholder economic behavior. Although the all of the concepts and factors involved in integrated agricultural development are too vast for such a study, it intends to identify for policy makers consideration some of the constraining factors limiting an expansion of maize production in the Kasaii Oriental province, and suggested areas to be researched in greater depth in the future.

APPENDIX I

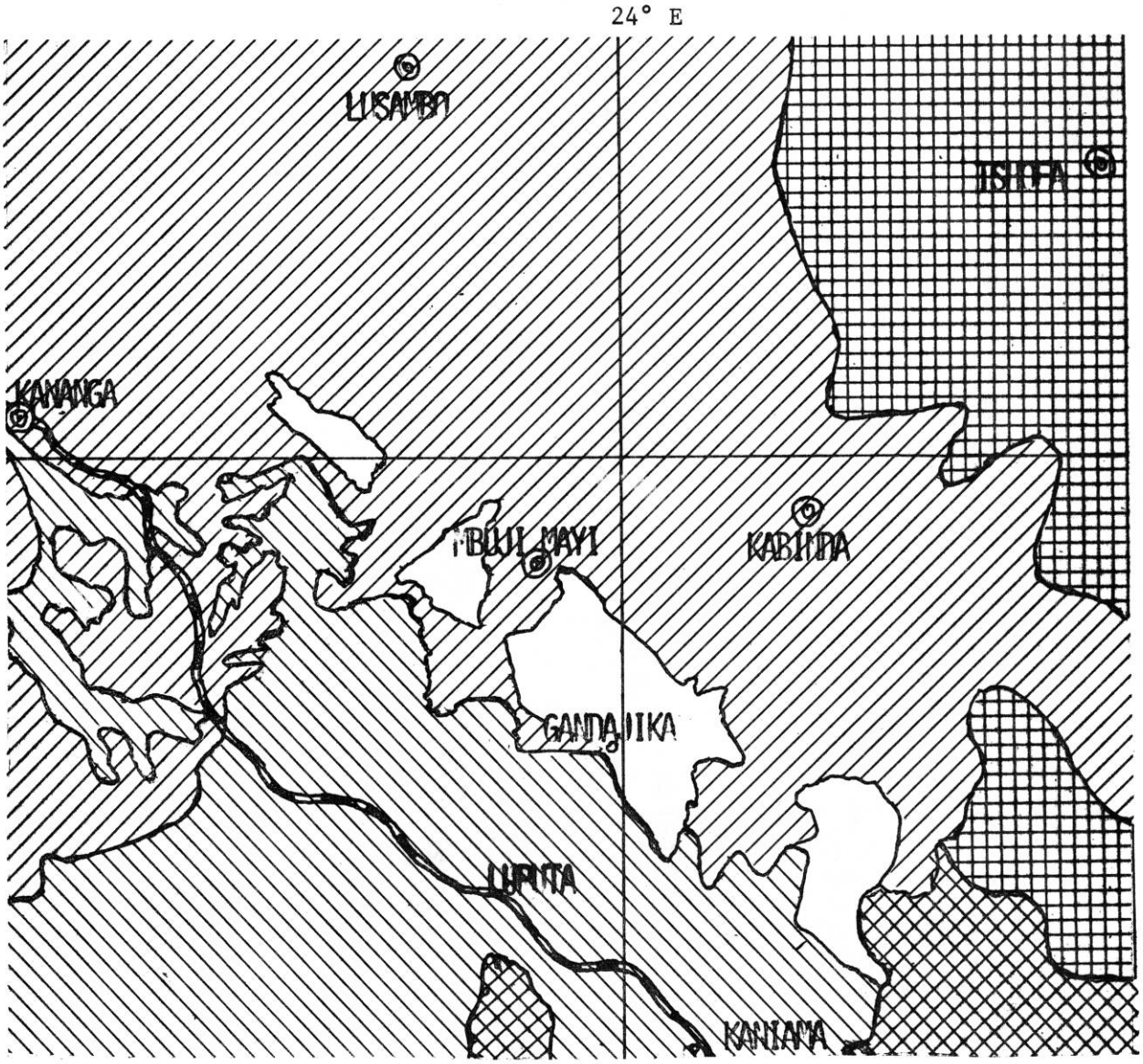
AGRICULTURAL ECONOMIC AID TO ZAIRE
Aid in Kind (all Countries)
(Quantities Recieved by Product 1960-65)
in metric tons

PRODUITS	1961	1962	1963	1964	1965	TOTAL
Farine de blé	35 072	54 077	68 839	54 096	66 115	278 199
Farine de maïs	5 517	1 036	4 756	331	748	12 388
Riz	10 816	23 555	30 010	20 322	22 249	106 952
Lait écrémé en poudre ...	2 491	3 573	11 637			17 701
Lait entier en poudre		1 452	3 299	671	1 170	6 592
Lait en boîte (condensé)..	424	3 998	7 454	1 928	1 323	15 127
Beurre			440	521		961
Fromage			85			85
Fruits en boîte		180				180
Poulets congelés		584	2 074		146	2 804
Poulets en boîte			2 094			2 094
Haricots (pois)	498	562	7 977	413	529	9 979
Maïs	498	9 506	57 975	9 934		77 913
Huiles végétales	18	779	2 756	136	290	3 979
Coton			118	56	9 937	10 111
Tabac		598	1 297	1 684	2 684	6 263
Total	55 334	99 900	200 811	90 092	105 191	551 328

Sources : Statistiques fournies par les bureaux de l'U. S. A. I. D./Kinshasa; Conseil monétaire, *Circulaire n° 106*, 28 janvier 1963; Services techniques des ambassades à Kinshasa.

APPENDIX II

MAJOR SOIL TYPES IN KABINDA SUB-REGION



Red to Yellow Latosoils Developed From Kalahari Sandstone

Red Latosoils Derived from Bushmayi Siltstone

Red Latosoils Derived From Calcarious Rock and Karoo Sandstone

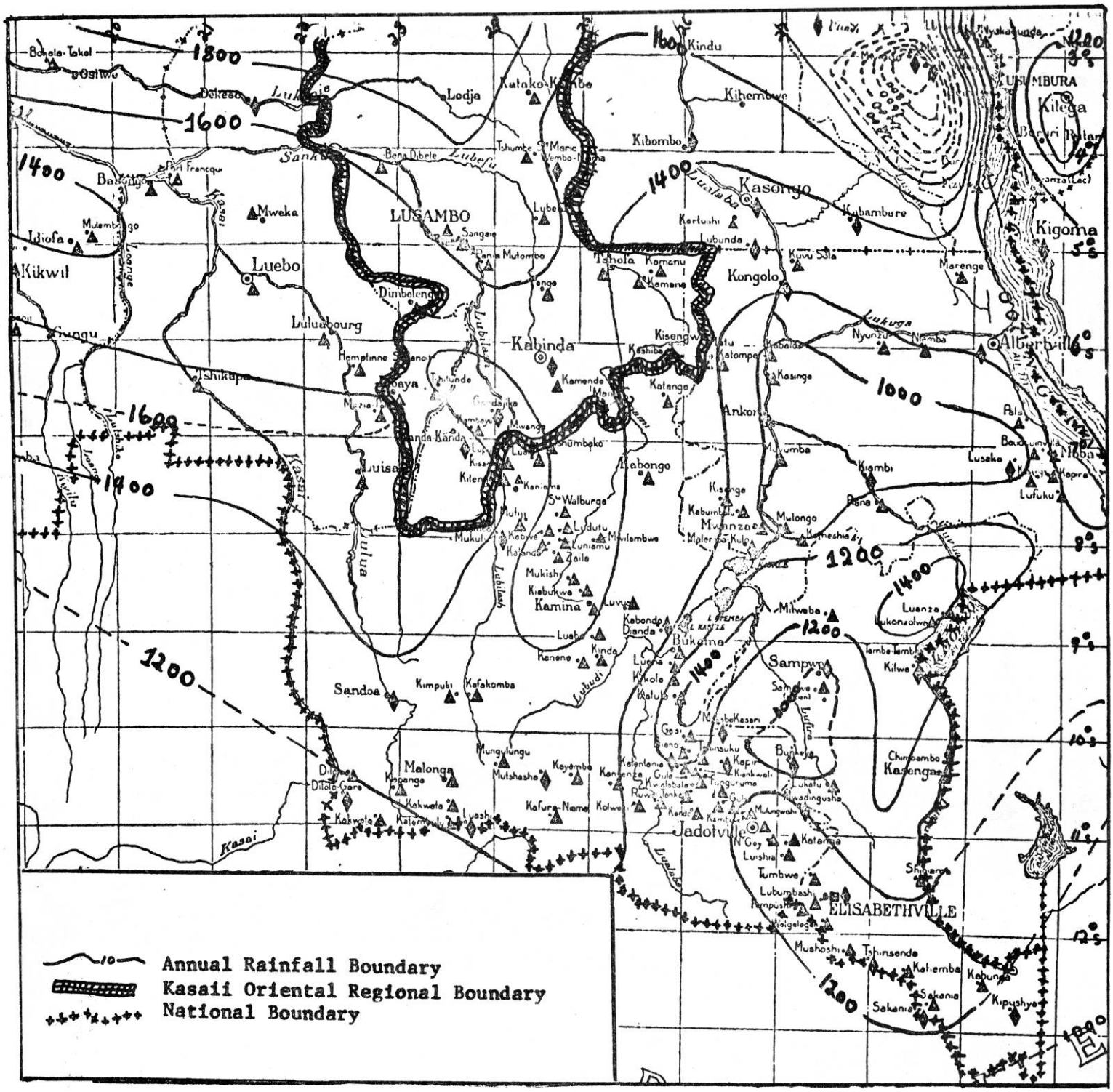
Ochre-red and Yellow Latosoils Derived From Crystaline Rock

Red Latosoils Derived From Carbacious Rock and Karoo Sandstone

Source: Cahen, L, et J. Lepersonne. "Carte Géologique." Index No. 31. Brussel: Institute Royal Colonial Belge. 1950.

APPENDIX III

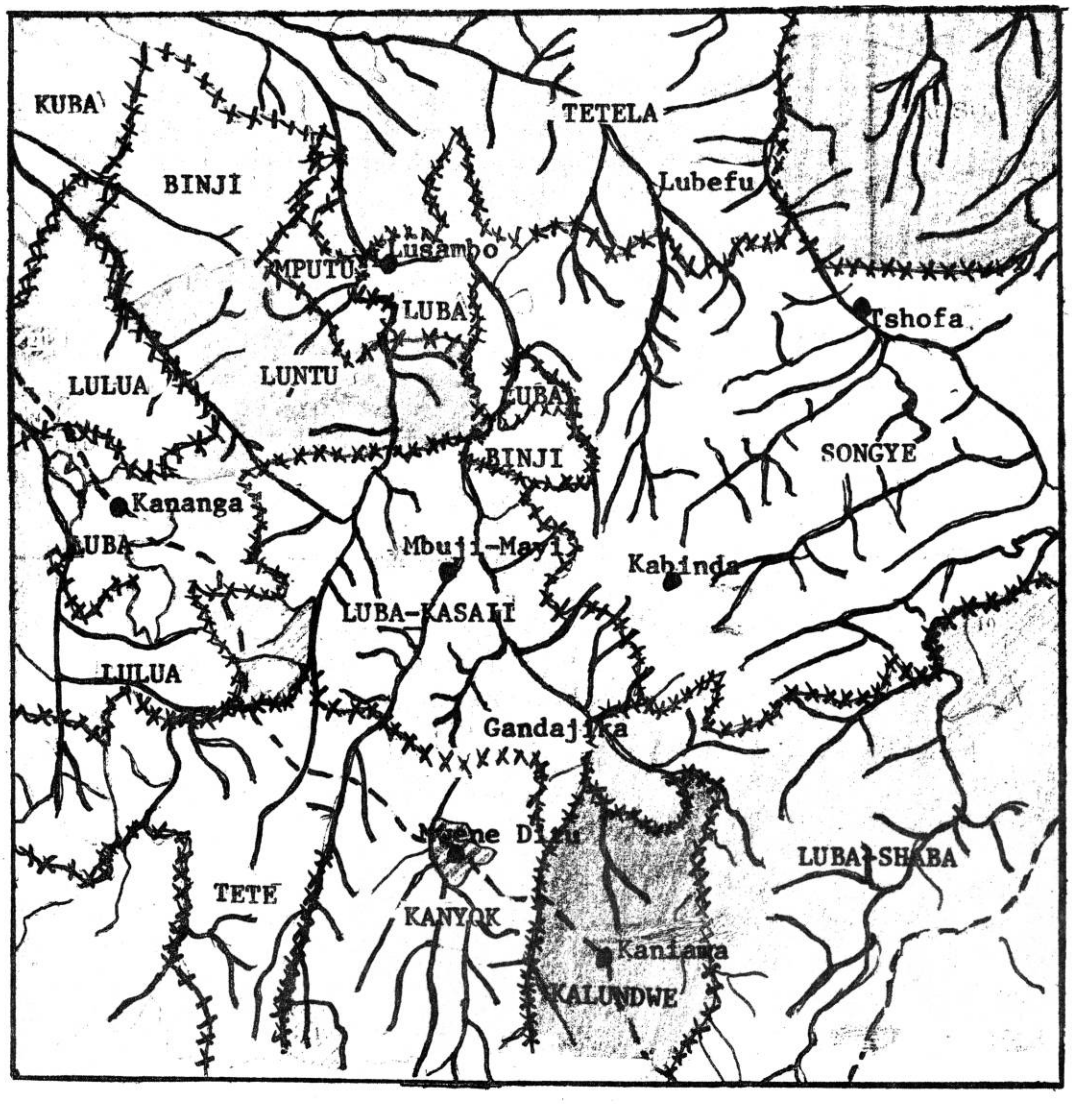
ANNUAL RAINFALL ZONES
1930-40 averages
(millimeters)



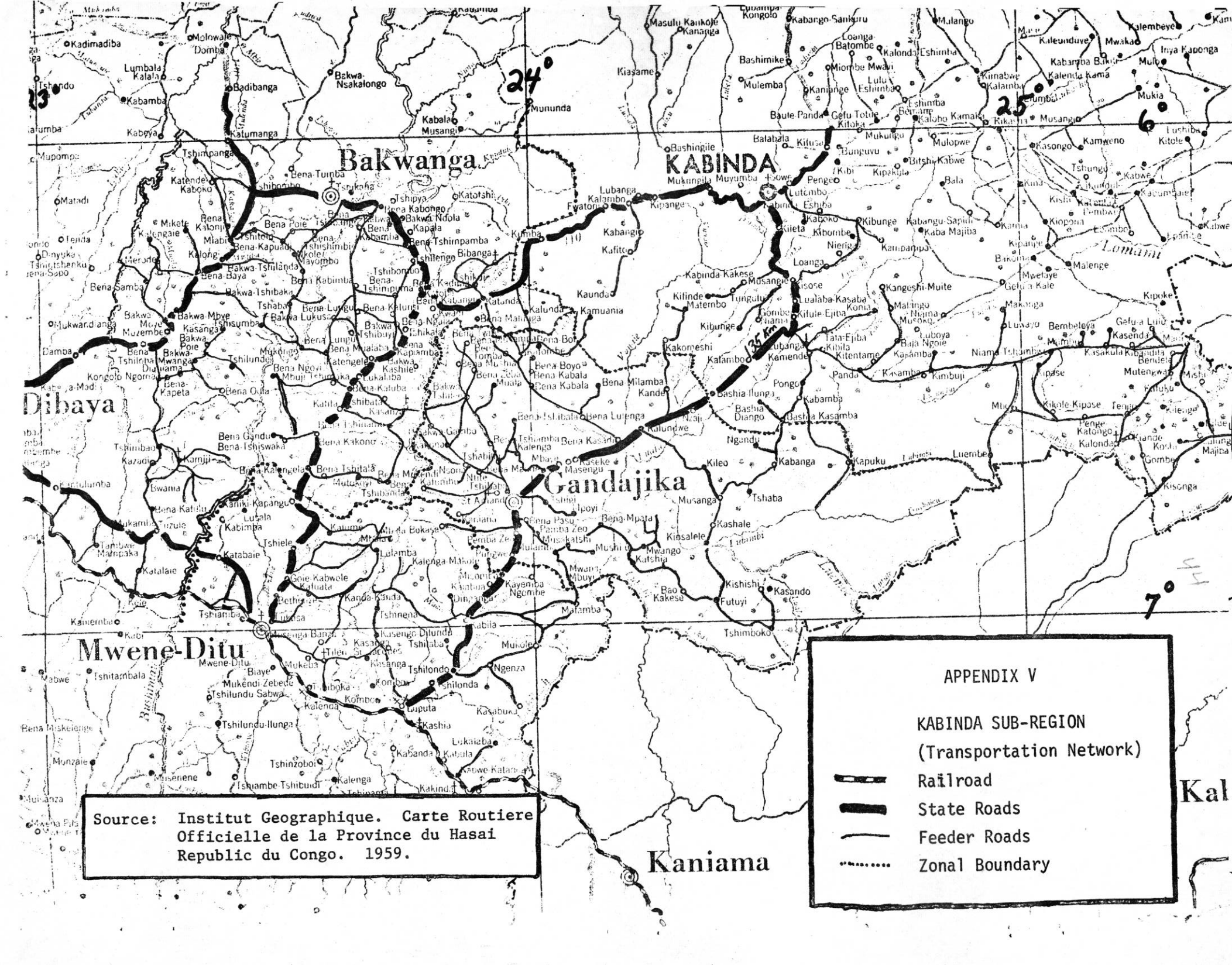
Source: Carte des Stations Meteorologiques et des Hauteur Annuel Normales des Pluies Exprimies en Millimetres Pour la Periods 1930-40 Brussels: Ministry of Colonies. January, 1942.

APPENDIX IV

ETHNOGRAPHY OF KABINDA SUB-REGION



Source: Gohring, Heinz. Baluba: Studia Ethnologica. Band 1. Verlag Anton Hain, 1970.


Bakwanga
KABINDA
Dibaya
Gandajika
Mwene-Ditu
Kaniama
24°
25°
6°
7°
135 Km
APPENDIX V
KABINDA SUB-REGION
(Transportation Network)
Railroad
State Roads
Feeder Roads
Zonal Boundary
Source: Institut Geographique. Carte Routiere Officielle de la Province du Hasai Republic du Congo. 1959.


APPENDIX VI
KASAII ORIENTAL
(Administrative Units)
Regional Boundary
Sub-Regional Boundary
Zonal Boundary
Regional Capitol
Sub-Regional Capitol
Zonal Capitol
Source: Ministere des Affairs Etrangeres et du Commerce Exterieur. "Republic du Zaire" Section Cartographie, Bruxelles: 1972.
Ikela
Lomela
Kole
Lodja
Katako-Kombe
Lubefu
LUSAMBO
Demba
Dimbelenge
KANANGA
KABINDA
Kazumba
Luiza
Kasongo
Kongolo
Kabalo
Sentery
Kabam
Malemba-Nkulu

APPENDIX VII

ORGANIZATION OF FIELD RESEARCH

The proposed study is scheduled to be completed in three stages. Beginning approximately May 1, 1974, the author plans to spend two weeks in Kinshasa reviewing current government legislation concerning maize. Once settled in Sandajika, the author will spend six to eight weeks in an intensive study of Tshiluba with the aid of private tutors. During this period the author will become familar with local administrative and research officials as well as village production and marketing systems.

During July, 1974, the author will prepare preliminary survey questionnaires and hire six fifth year secondary school leavers as enumerators. These enumerators will have a two week training session in August and the questionnaire will be pretested and the sample population chosen.

By mid September, 1974 the enumerators should be in the field to begin interviews to be taken over the next twelve month period.

In March 1975 the author will follow the maize marketing channel from producer to the mills in Lubumbashi and Kananga and the return of maize flour to Kasaii Oriental Province.

Preliminary field evaluation will be completed by November, 1975. The author will interact with local, provincial, and national authorities in the Ministry of Agriculture throughout the research period and will leave a copy of all data and preliminary analysis with them before leaving Zaire in November, 1975.

Complete analysis of the data will be undertaken at Michigan State University in early 1976 and resulting publications made available to the Ministry

of Agriculture, Republic of Zaire, the Ford Foundation Foreign Area Fellowship Program and the Department of Agricultural Economics, Michigan State University.

The author is grateful to Ford Foundation Foreign Area Fellowship Program for financially making this study possible.

APPENDIX VIII

RESUME

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EDUCATION:

1964-66, 1969-71	University of Nebraska, Lincoln, Nebraska
Degree	B.S. with distinction
Major Areas	Agricultural Economics and Agronomy
1971-Present	Michigan State University, East Lansing, Michigan
Degree Program	Ph.D. Candidate
Major Areas:	Economic Analysis, General Agricultural Economics, Economics of Agricultural Development, Agricultural Marketing, African Studies

FOREIGN LANGUAGES: Partial fluency in French, fluent in Gipende (Bantu dialect of Kasaii Occidental, Zaire)

AWARDS:

1964-65	Christian Service Scholarship, Bethel College
1970-71	Baker-Gooding Scholarship, University of Nebraska
1970-71	University of Nebraska Regents Scholarship, University of Nebraska
1971	Award of Outstanding Scholastic Achievement, University of Nebraska
1972	Graduate Research Fellowship, Michigan State University
1974-75	Ford Foundation Foreign Area Fellowship

PROFESSIONAL EXPERIENCE:

1966-69	30 months as village extension agent with SEDA, Service du Developpement Agricole, Tshikapa, Zaire in infield training of national extension agents
1972	3 months as economic consultant with World Bank, Washington, D. C. analyzing rural development aspects of Tanzanian tobacco projects
1971-Present	Research Assistant at Michigan State University

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