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GOVERNMENT FINANCING OF THE DEVELOPMENT
OF SMALL FARM AGRICULTURE IN THE
CENTER-SOUTH PROVINCE OF CAMEROON

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GOVERNMENT FINANCING OF THE DEVELOPMENT
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The development of small farm agriculture has become an increasingly important issue for the economic development of the less developed countries. Economists and the agricultural economists in particular have been trying to understand the complex environment of the small farmer. This understanding is of critical importance as it must precede any economic development program in which the small farmer will play an important role.

The development of small farm agriculture is of special concern to Cameroon for two main reasons: (a) Cameroon economy is largely agricultural, and (b) nearly all farms are small farms. Numerous factors constrain the development of these small farms. Some of those factors include: inadequate technology and markets, unavailability of purchased farm inputs, and underdeveloped physical infrastructure. It is plausible to assume that all these factors carry equal weight in furthering the solution to the small farmers' numerous problems.

This study assumes that all other constraints on the development of the small farm are removed in order to focus sharply on one of them, namely, the financial environment of the small farmer. Constrained capital has been shown to limit farmers' use of purchase inputs, and by extension limits their output and income. In order to reduce the effects of this capital constraint on farmers' production, the government intervenes in the supply of off-farm inputs. This service is supplied at minimal fees in spite of

the very high returns the farmers enjoy. The loans are disbursed in kind in order to assure their use for a specific purpose (increase in the agricultural output).

An economic evaluation of such a credit program, "Opération Ceinture Verte," in the Center-South province of Cameroon, reveals very high returns for the whole economy. A financial evaluation of the same program reveals even higher returns for the participating farmers, but the project agency incurs considerable financial losses. In addition to the cost-benefit-analysis used to determine the three returns enumerated above, a linear programming model is used to determine the effects of, (a) interest rate, (b) size of loans, (c) restrictions on the use of loan proceeds, and (d) the liquidity management needs of the producers, on the farm organization. The analysis leads to the following major followings.

1. The small farmer is not as sensitive on the level of interest rate as the agricultural credit policy makers believe he is. In other words, a substantial increase in the interest rate he is charged does not affect his production organization.

Indeed, should an interest be charged that is high enough to make the credit program more secure, the farmer may be led to ascribe greater permanence to the program. One consequence would likely follow: he would then consider program credit in reserve to be valuable to him and thus be a substitute for cash in meeting his liquidity requirements.

The liquidity needs of the smaller farmer are real needs as shown by the large amount of cash he holds in reserve in order to counter various contingencies. A more permanent source of

cash leads him to commit more of his reserved cash to his production process.

2. The size of the loans the small farmer obtains is more powerful in affecting farm organization than the interest rate he has to pay. This particular finding reinforces the point that limited capital supply is more limiting on the growth of the small farmer's income than is the cost of capital, provided of course that these costs are kept within "reasonable" limits.
3. The relaxation on the use of government loan proceeds does not have a negative effect on farm output, as often believed by the policy makers. The study shows a considerable increase in the farmer's net cash flow when loans are disbursed in cash. This restriction implicitly assumes that the small farmer's household expenses can be clearly distinguished from his production or investment expenses; but this assumption does not reflect the well known interrelationship between the small farmer's consumption and his production expenses.
4. Though not substantiated by any empirical evidence, it is logically demonstrated that the policy of subsidized rate of interest worsens the income distribution.

It is extremely important to emphasize that the findings above are derived from an optimal farm organization and should not be expected to be found in any particular farm. They are derived under the various and rather strict assumptions of the mathematical model which was used. Finally, the implementation of any policy suggestion derived from the findings is to be attempted in an integral process, taking into consideration all other limiting factors.

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TABLE OF CONTENTS

<u>CHAPTER</u>		<u>Page</u>
1	INTRODUCTION	1
	1.1 <u>Characteristics of Cameroon's Agricultural Economy</u>	2
	1.2 <u>Economic and Historical Background.</u>	6
2	STATEMENT OF THE RESEARCH PROBLEM.	16
	2.1 <u>Previous Research on the Development of Small Farm Agriculture.</u>	16
	2.2 <u>Capital Shortage as a Restraint on the Development of the Small Farm</u>	23-
	2.3 <u>Nature of the Problem</u>	33
	2.4 <u>Objectives of the Study</u>	38
	2.5 <u>Methodology</u>	40
3	ANALYTICAL PROCEDURES AND SOURCES OF DATA.	47
	3.1 <u>Analytical Procedures</u>	47
	3.1.1 <u>Capital-Budgeting or Cost-Benefit Approach</u>	47
	3.1.2 <u>Mathematical Programming</u>	53
	3.2 <u>Data and Their Sources.</u>	58
	3.2.1 <u>Description and Sources of Data.</u>	59
	3.2.2 <u>Area of Study.</u>	61
	3.2.3 <u>Population and Sampling Method</u>	61
4	ECONOMIC, FINANCIAL, AND SOCIAL EFFECTS OF THE POLICY OF CONCESSIONAL RATES OF INTEREST.	64
	4.1 <u>Interest Rates and the Aggregate Capital Market</u>	64
	4.1.1 <u>Role of Interest Rates</u>	64
	4.1.2 <u>Interest Rate Policies in the LDC's.</u>	65
	4.1.3 <u>Impact of the Concessional Interest Rates on the Aggregate and Rural Capital Markets.</u>	67
	4.2 <u>Economic and Financial Evaluation of the Plantain Project</u>	71
	4.2.1 <u>Brief Presentation of the Plantain Project</u>	71
	4.2.2 <u>Economic and Financial Analysis - General</u>	74
	4.2.3 <u>Economic Analysis of the Plantain Project.</u>	79
	4.2.4 <u>Financial Analysis of the Plantain Project</u>	84
	4.3 <u>Distributional Effects of Concessional Rates of Interest</u>	103

<u>CHAPTER</u>		<u>Page</u>
5	MODELING THE FINANCIAL ENVIRONMENT OF THE SMALL FARMER AND THE GOVERNMENT AGRICULTURAL CREDIT PROGRAMS	109
	5.1 <u>Presentation of the Linear Programming Model</u> . . .	109
	5.2 <u>The Objective Function of the Model</u>	112
	5.3 <u>Constraints and Requirements of the Model</u>	112
	5.4 <u>Activities of the Model</u>	123
6	RESULTS OF THE ANALYSIS AND THEIR INTERPRETATION . . .	156
	6.1 <u>Effects of Funds Use Restriction on Input Mix and Profits</u>	158
	6.2 <u>Effects of Liquidity Management Needs on the Behavior of the Small Farmer</u>	162
	6.3 <u>Effects of a Financially Viable Government Credit Institution on the Small Farm</u>	165
	6.4 <u>Effects of the Size of Loans on the Small Farmer Situation</u>	168
	6.5 <u>Effects of Higher Interest Rates for Government Loans on the General Model</u>	172
7	SUMMARY, CONCLUSIONS, AND IMPLICATIONS OF THE STUDY	181
	7.1 <u>Summary and Conclusions</u>	181
	7.2 <u>Implications for Policy</u>	182
	7.3 <u>Policy Recommendations</u>	184
	7.4 <u>Implications for Further Research</u>	186
	APPENDIX	188
	BIBLIOGRAPHY	209
	VITA	215

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1: Evolution of the Population of Yaoundé as compared with the Rest of the Republic.	8
2: Evolution of the Population of Yaoundé as compared with the Population of the Four Administrative Divisions Which Supply Plantain to the Yaoundé Plantain Market.	9
3: Demand and Supply Estimates for Plantain for the City of Yaoundé	12
4: Center-South Province: Population Breakdown.	62
5: Economic Return of the Project.	83
6: Financial Profitability of the Farmer	85
7: Financial Returns to the Project with a 10 Percent Default Rate.	94
8: Financial Returns to the Project with a 38 Per Unit Default Rate.	95
9: Determination of the Interest Rate to be Charged in Order to Break Even.	96
10: Effects of Varying the Interest Rate on the Farmer's Profitability and Project's Costs.	99
11: Effects of Varying the Default Rate on the Project's Costs	100
12: Effects of a Simultaneous Variation of the Rate of Interest and Rate of Default on the Project's Costs.	102
13: Model Constraints and Requirements.	113
14: Model Activities.	125
15: The Linear Programming Model-Vectors.	138
16: Cash Reservation Prices	153
17: Credit Reservation Prices	153
18: Specifications of the Variations of the General Model	155

<u>Table</u>	<u>Page</u>
19: Optimum Organization Given the Availability of Government Loans in Kind: No Liquidity Management.	157
20: Optimum Organization Given the Availability of Government (in Kind) and Moneylender Loans: No Liquidity Management.	159
21: Optimum Organization Given the Availability of Government and Moneylender Loans in Cash: No Liquidity Management	161
22: Optimum Organization Given the Availability of Government Credit in Cash (Perceived as Temporary) and Moneylender Credit: Liquidity Management Specifications for Cash and Moneylender Credit.	164
23: Optimum Organization Given the Availability of Government Credit (Perceived as Permanent) and Moneylender Credit with Liquidity Management Specified for Both, as Well as for Cash	167
24: Optimum Organization Given the Availability of Government Credit in Cash (at Specified Level(s)) and Moneylender Credit, Liquidity Management Specified for Both, as Well as for Cash	170
25: Optimum Organization Given the Availability of Government Credit in Cash and Moneylender Credit Limits (at Specified Level(s)), Liquidity Management Specified for Both, as Well as for Cash	171
26: Optimum Organization Given the Availability of Government and Moneylender Credit in Cash with the Government Interest Rate for Plantain Loans at Specified Level(s), Liquidity Management Specified for Both, as Well as for Cash	174
27: Optimum Organization Given the Availability of Government and Moneylender Credit in Cash with Government Interest Rate for Plantain Loans at Specified Level(s), Liquidity Management Specified for Both, as Well as for Cash, No Cocoa Activities in the Model.	176

<u>Table</u>	<u>Page</u>
28: Optimum Organization Given the Availability of Government and Moneylender Credit in Cash with Government Interest Rate for Both Plantain and Cocoa Loans at Specified Level(s), Liquidity Management Specified for Both, as Well as for Cash.	177
29: Models 1 Through 5 Compared	180

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	: Price Index Numbers in Cameroon	10
2.1	: Capital Constrained Optima in use of the Variable Input , X.	26
2.2	: Equilibrium in Credit Allocation.	28
2.3	: Value of Cash in Reserve.	30
2.4	: Value of Credit in Reserve.	30
2.5	: Effects of Low Interest Rates on the Supply and Demand of Funds	36
2.6a:	Demand for Loan Funds as a Function of the Interest Rate	43
2.6b:	Farm Output as a Function of the Size of Available Funds.	43

CHAPTER 1

INTRODUCTION

1.1 Characteristics of Cameroon Agricultural Economy:

Cameroon covers an area of 475,450 square kilometers with a population estimated at 7.6 million (1976). It has often been referred to as "Africa in miniature" because of its ethnic, cultural, climatic, linguistic, and topographic diversity. There are five different physical regions: the coastal region, the old plateaus of the South, the highlands of the Center, the mountains of the West, and the northern region. The vegetation is determined by all the various forms of humidity (rainfall, evapotranspiration, drainage, etc.) and by the temperatures. Four different zones of vegetation (equatorial, subequatorial, sudanese, and sahelian, going from South to North) correspond to four types of hydrology (equatorial type, tropical type of transition, tropical type, mixed type with sahelian influences). Two major types of climate correspond to two major zones of rainfall (ideally equatorial and tropical). Between those two major types of climate, there exists a wide range of microclimatic zones. These microclimates develop as a result of the considerable variation in altitudes, as well as of other factors.

The population in Cameroon is not evenly distributed. The population density varies from a low of 2.8 inhabitants per sq. km. to a high of 77.6 . In 1970, 20.3 percent of the total population was urban and

this proportion was estimated at 32 percent in 1975 [12,57]. The process of urbanization is much faster in the Littoral and Center-South provinces. Indeed in 1970, 68 percent of the population of the Littoral province were already urbanized, and 23 percent for the Center-South. In 1975, those figures were supposed to have reached 71 and 27 percent respectively.

Economic Activity of the Agricultural Sector:

The population is largely rural as suggested by the figures given above. In 1971, 36 percent of the gross domestic product came from agriculture. The export of agricultural products represented more than 70 percent of total exports in 1971 and nearly the same in 1975. Agriculture therefore remains the foundations of the Cameroon's economy. Because of the geographical and climatic diversity mentioned above, Cameroon grows a large variety of crops. The major industrial or export crops include cocoa, coffee and banana in the southern and western regions, cotton and peanuts in the northern region. In 1970-71 cocoa exports accounted for about 22.5 percent of the value of total exports, and coffee accounted for 23.2 percent. In 1975, those figures were 27.8 and 19.3 percent respectively.

Food production benefits from very favorable climatic conditions. As a consequence, the composition of food crops is quite varied as one travels from South to North. In general, the major food crops in the South include coco-yams, cassava, and plantain. In addition to these major crops, one finds corn, peanuts, yams, sweet potatoes, etc. In the northern half of the country, the most important food crops are made up of the different

varieties of sorghum or millet. The western region is quite favorable to the production of vegetables (beans, tomatoes, cabbage, etc.).

Of all the crops mentioned above, less than 5 percent are grown on "modern" or commercial farms. Therefore 95 percent of all farms (industrial and food crops) average about 1.5 hectares per farm. They are mostly subsistence farms, and the farmers are engaged in the production of a wide variety of crops, industrial or export as well as domestic food crops.

Alongside this small farm production, the government has intervened directly in the production of some important agricultural products. The intervention in the production of these products is based either on (a) their relative capacity as foreign exchange earner, (b) their potential as raw products for domestic industries, (c) their potential to substitute for imports and save foreign exchange, and (d) their impact on the improvement of local nutrition. It is evident that the four objectives above are not mutually exclusive. Actually the government is involved in the production and processing of sugar cane (SOSUCAM and CAMSUCO), rice (SEMRY and MIDERIM), cotton (CFDT), palm oil (PAMOL, SOCAPALM), wheat (SODEBLE), local food crops (MIDEVIV).

The rapid rate of urbanization as mentioned earlier (3.8 percent in 1970 and 7.5 percent between 1971 and 1975) and the subsistence character of food production with its low productivity, have contributed to a relative shortage of food supply in the urban centers. The government has shown its concern for this situation by launching the "Opération Ceinture Verte," which is an agricultural scheme intended to increase food supply in the large urban communities.

Cameroon also has very favorable conditions for meeting its animal protein needs; but in spite of this favorable environment, the supply of animal proteins is by far less than adequate. Indeed despite its high potential, Cameroon imports meat (estimated at 60,000 head of cattle per year, 1969-1970). This shortage in the domestic production of meat results directly from the way the herd is exploited. In more cases, it has remained a traditional type of ranch. The average weight of a cow is about 150 kg, 3 times lower than that of an animal, bred and raised in a shorter time, using the simplest modern animal production techniques.

Because of the shortage in animal proteins and the existence of a tremendous potential, the government, in its Third Five-Year Economic Plan (1971-1976), had defined some actions to be undertaken in order to alleviate the shortage. These actions included:

- (1) better exploiting of pastures,
- (2) eradication of and protection against various diseases,
- (3) better management of the herd, and
- (4) improvement of marketing channels.

In general, economic life in Cameroon is based predominantly on agriculture in its widest meaning. This dependence on agriculture is even more accentuated because of the very limited importance of mining (at least at the present time). More than 80 percent of agricultural production is represented in subsistence farming. Nomadic cattle-raising in northern Cameroon provides some animal proteins, but their supply is still inadequate. Therefore the diet of the people which in general is sufficient in calories is inadequate in proteins, as the production of vegetables is very small relative to the needs.

The Center-South Province and the Region of Yaoundé:

The administrative province of the Center-South is in the physical region identified earlier as the "old plateaus of the South." The average altitude is about 650 meters. The temperatures range between a low of 15° to a high of 31°C. The largest amplitudes occur during the dry seasons. The rainfalls are less heavy than in the coastal region; they register minima and maxima of 1,500 to 2,000 millimeters, respectively. This province, with its subequatorial climate has four seasons: (a) a light rainy season from mid-March to the end of June, (b) a short dry season in July and August, (c) a heavy rainy season from September to mid-November, and (d) a long dry season from mid-November to mid-March.

The vegetation is made up of three distinct zones: a zone of dense primary forest in the South, a zone of sparse secondary forest in the Center, and a transitional zone of shrubs in the North. The population, estimated at 1.50 million in 1976, is very unevenly distributed. The area of very low density is situated in the North of the region (Mbam and Upper-Sanaga divisions) and the region of relatively high density (12-60 per sq. km) is around Yaoundé (Lekié and Mefou divisions).

The economy of the Center-South is as that of the whole country, largely agricultural. More particularly it is based on cocoa farming (90 percent of the national production comes from this region). The major food crops of the region include: cassava (manihilot ultissima), yams (dioscorea alata), coco-yams (xanthosoma sagittifolium), peanuts, maize, rice, and several other vegetables. The most important food crops in the region and especially around the town of Yaoundé is plantain (musa paradisiaca) which is to be distinguished from banana (musa sinensis or musa

sapientium). The environment in the Center-South is not very favorable to bovine-raising; though swine production is developing in the region.

Nearly all farms here are of the traditional type: small in size (.5 - 2 hectares), producing a wide variety of crops (export crops for cash and food crops mainly for home consumption with a marginal "surplus" for sales). They are thus subsistence farms, characterized as we mentioned above by a very low productivity, the result of a traditional technology. As a consequence of this low productivity and of the rural exodus of the young population, food production has remained relatively stagnant and is now unable to meet the needs. This situation constitutes a serious bottleneck to the development of this region, as of the country as a whole and the Third Five-Year Plan had identified this as a major problem to be resolved.

The rate of growth of the urban population, and especially of the city of Yaoundé is so rapid that the food supply in Yaoundé has become increasingly short, as will be shown in more detail in the following pages. This situation did call for a specific action which came from the government. This government action constitutes the case-study of this research.

1.2 Economic Background:

The process of economic growth and development in Cameroon as in other less developed regions of the world is characterized among other things by a high rate of population growth, compounded by an even higher rate of urbanization. Between 1963 and 1970 the population growth rate averaged about 2.3 percent per year, from 5.0 million to 5.8 million.

During the same period, the population of Yaoundé, the capital city of Cameroon, grew from 95,000 to 178,000 inhabitants, or a compound annual rate of growth of 10.3 percent [12] (see Table 1 below). In 1975 the population of Yaoundé was estimated at 290,000 and should reach 474,000 in 1980. Table 1 clearly shows that the rate of population growth in Yaoundé is about 5 times as high as the national average. As expected, the rural areas surrounding Yaoundé have recorded negative rates of growth as indicated in Table 2 below.

The type of agriculture prevailing in the Yaoundé region and in the rest of the Republic, as briefly discussed in section 1.1 above, has not been able to keep pace (aggregate output) with the increasing demand for food in the cities. This relative shortage of food supply in the major urban centers has led, as expected, to rapidly increasing food prices (see Figure 1). Though accurate production figures are not readily available, the point can be made that food production in general has remained stagnant or has increased very little. In the particular case of Yaoundé, sharp increases in food prices have been reported: Between 1965 and 1972, price increases of about 300 percent for cassava, 125 percent for cocoyams, 134 percent for yams, and 110 percent for plantain [56]. If the increase in the general price level (from 108.0 to 133.7) during the same period is taken into account, the 110 percent increase in the price of plantain in Yaoundé can be translated into an increase of 84.3 percent in real terms for that period. Between 1971 and 1972, the rise in the price of plantain has kept pace with the general price increase at about 16 percent annual rate of increase [56,58]. Production and

**Table 1: Evolution of the Population of Yaoundé
as Compared with the Rest of the Republic
(In Thousands)**

Provinces	1963 ^a	1965 ^b	1968 ^b	1970	Average ^c Annual Growth Rate (%)
Center-South	1,050	1,072	1,107	1,130	1.08
East	235	247	268	280	2.73
Littoral	540	571	623	650	2.91
North	1,450	1,485	1,539	1,580	1.28
North-West and South-West	1,020	1,071	1,154	1,200	2.52
West	710	794	941	1,000	5.83
Total Republic	5,005	5,240	5,632	5,840	2.38
City of Yaoundé	95	111	144	178	12.48

SOURCES: Compiled from (1) Cameroon's Third Five-Year Economic and Social Plan (1971-1976), (2) Direction de la Statistique et de la Comptabilité Nationale.

^a Actual figures from the above sources.

^b Figures computed using annual steady growth rates derived from the 1963 and 1970 actual figures.

^c The rates shown above represent a simple growth rate obtained as the difference between the beginning and ending years divided by the number of years. They are used by the project as a basis for projecting production figures.

The compound rates of growth given by the following general formula,

$$Pt_o (1+r)^n = Pt_n$$

where,

- r = Annual rate of growth
- Pt_o = Population at the initial period
- n = Number of years
- Pt_n = Population at the ending period

gives a more realistic growth rate.

Using this formula, and solving with logarithms gives an annual rate of growth of about 10.3 percent as compared to 12.48 for the city of Yaoundé.

Table 2: Evolution of the Population of Yaoundé
as compared to the Population of the Four Divisions
Which Supply Yaoundé Plantain Market
(In Thousands)

Divisions	1965	1966	1967	1968	1969	1970	Annual Growth Rate (%)
Mefou	273	279	284	290	296	301	+ 2.0
Yaoundé	111	122	133	144	160	178	+10.9
Mefou minus Yaoundé ^a	162	157	151	146	136	123	- 5.6
Lekié	160	164	167	170	173	182	+ 1.9
Nyong & Kellé	70	71	73	74	75	77	+ 1.9
Nyong & So	68	69	71	72	73	75	+ 2.0
Total	571	583	595	606	617	629	+ 2.0

SOURCES: Direction de la Statistique et de la Comptabilité Nationale.

^aThe City of Yaoundé is within Mefou division

Production and demand estimates (Table 3 following) in the project, show traditional production falling behind demand by more than 50 percent by 1980. When the expected production of the project is added to the traditional production, then, the deficit will be eliminated around 1979 with a slight surplus

SOURCE: U.N. Economic Commission for Africa (1974)

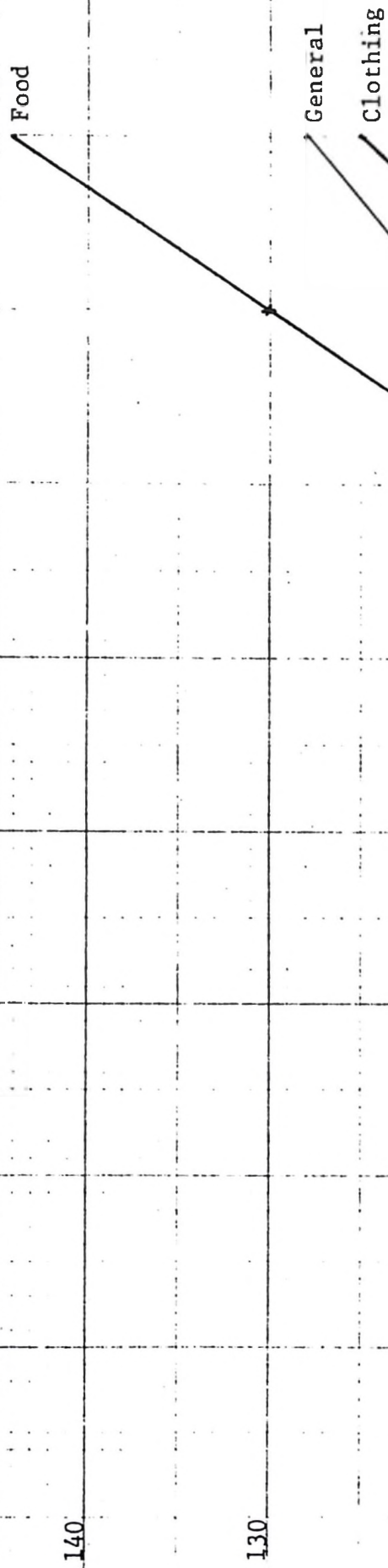


Figure 1: Price Index Numbers in Cameroon (1968 = 100)

demand estimates as shown by Table 3 below, illustrate the lag in production in the face of a rapidly increasing demand. This unbalance in production and demand can be explained by three factors which can be briefly mentioned, their full discussion falling outside the scope of this study. They are: (a) limited technological and financial resources which characterize all subsistence or small farmers, (b) lack of adequate infrastructure and market incentives, and (c) rural exodus of the young and dynamic population. All three are of course closely interrelated.

Of the three factors enumerated above, factor (c), or the rural exodus of the young and dynamic population, could be reasonably perceived as a direct consequence of either factor (b) or (a) or both. Perceived as such, the range of the problem to be investigated is reduced to factors (a) and (b).

The relevance of factor (b), lack of adequate infrastructure is quite evident in any economic or simply agricultural development program. Infrastructure here is used in its widest sense as to include investments in power plants, steel, transportation, housing, health, education, agricultural production facilities such as irrigation schemes, marketing facilities such as a grading system and storage spaces, government services, etc.

All these investments are generally broken into two general groups: investments in physical capital and investments in human capital. Until very recently, the objective of adding to the stock of physical capital had dominated all investment discussions. It has become nowadays evident that, though the accumulation of physical capital remains necessary, "the

Table 3: Demand and Supply Estimates
for Plantain for the City of Yaoundé
(In Metric Tons)

	Estimated Consumption in Yaoundé ^a	Estimated Production of Traditional Sector Sold in Yaoundé ^b	Project Production	Deficit (-) or Surplus
1971/72	39,750	36,750	-	- 3,000
1972/73	43,900	36,750	-	- 7,150
1973/74	48,450	36,750	-	-11,700
1974/75	53,500	37,500	1,100	-14,900
1975/76	59,050	38,250	4,350	-16,450
1976/77	65,200	41,365	11,000	-12,835
1977/78	72,000	42,190	23,550	- 6,260
1978/79	79,500	43,030	36,900	+ 430
1970/80	87,750	43,890	45,700	+ 1,840

SOURCES: "Opération Ceinture Verte," Ministry of Agriculture, Department of Agriculture and Rural Animation, July 1973.

^aThe estimated consumption is computed using an annual increase in the demand for food derived from the following formula for the rate of increase of the demand for food: $D = P + ng$,

Where D = Annual rate of increase of demand for food (in percentage)

P = Annual growth rate of population (10%, see source above)

n = Income elasticity of demand for plantain (.10, source above)

g = Annual growth rate of income per capita (3.5% source above)

This rate, which represents a national average, will be used though the urban centers are expected to exhibit higher rates.

^bThe production of the traditional sector would remain at most stagnant, unless stimulated by one way or another. After the project has started, the production of this sector may increase slightly, say about 2 percent (Project estimates) due to effects induced by the present project, such as better market incentives.

All figures above are estimations of the projects, derived from the 1964-65 survey of the level of living in Yaounde (see Enquête sur le Niveau de Vie à Yaoundé, Rapport provisoire, No. 3, Décembre 1965, SEDES).

It should be kept in mind that even the 1965 estimates are large approximations as a consequence of the absence or the inadequacy of a statistical base, a general shortcoming in less developed countries.

acceleration of development may be seriously thwarted by a deficiency in the knowledge and skills embodied in human beings" [53]. The positive impact of investment in human capital in advanced countries is shown by various statistical studies. These investigations indicate a higher increase in output than can be explained by an increase in only the physical inputs (labor and physical capital). The "residual" difference between the rate of increase in output and the rate of increase in physical capital and labor is explained mainly by an improvement in the quality of inputs, in particular, labor. The improvements in intangible human qualities therefore account for most of the increase in output not explained by the increase in physical inputs and labor.

The role of this more recent type of investment (investment in human or social capital) is so important that there have been attempts to find an adequate balance between investment in material capital and investment in human capital so as to speed up the processes of economic development and growth. Thus, it appears that the concept of overhead capital has to include as a necessary element, some social overhead capital. The capital stock of any country should, therefore, be interpreted in broader terms to include the body of knowledge possessed by the population or its ability to use the physical capital effectively. Investments on formal education, professional training, health and research contribute to the increase in productivity by raising the quality or know-how of the population.

The increase in physical and social overhead capital, or in other words, an improvement in the physical and social infrastructure, has become a must in any economic development plan.

If infrastructure is now defined in broader terms to mean the institutional system for transmitting information, materials and financial services, then the organization and the improvement of the capital market, market for the transmission of financial services or instruments (debt and claim instruments), becomes another necessity in the economic development process. This is exactly the first factor listed above as causing the supply of food to lag behind demand.

The small farmer of the Yaoundé area is ill-equipped to respond effectively to the new economic opportunities mentioned above. His response is limited by his limited access to off-farm capital as already mentioned and also by the inadequacy of the technology at his disposal. Though not yet adequate, efforts have been made to develop or adapt some technology for use by small farmers. While the improvement of this technology requires continuous and sustained emphasis, it is quite apparent that lack of capital remains one of the major constraints on the economic and social progress of small farmers in this region, since relatively few farmers have access to the technology (off-farm inputs) currently available.

In order to alleviate the food shortage mentioned earlier, the government in Cameroon has intervened in its production by providing the small farmers with financial resources in addition to its investment in agricultural research. As it had done in the area of such export crops as cocoa (with mixed results), it has decided to provide the small farmers with loans at concessionally low interest rates. In so doing, the government had hoped to (1) increase aggregate output of plantain so as to meet

the raising demand, and (2) help the participant farmers improve their welfare or income position [56]. The "Opération Ceinture Verte," an agricultural development program to increase food supply in the major urban centers, was created in 1973.* Because of the relative importance of plantain in the diet of the population of Yaoundé, the plantain project which constitutes the case-study of this research was chosen.

One of the project's main activities is to lend to the small farmers those off-farm inputs needed to increase their output, and by extension, their welfare. The effectiveness of the government agricultural credit policies (as reflected in this project) is the central theme of this study. Chapter 2 presents the research problem in its general terms. Chapter 3 describes the analytical procedures of the study and the sources of data used. Chapter 4 evaluates the economic, financial and social effects of the government policy of concessional rates of interest. Chapter 5 describes the mathematical programming model used to evaluate the effects of loans in kind and of the liquidity needs of the household. Chapter 6 presents and interprets the results of the mathematical programming model and Chapter 7 summarizes the findings, policy recommendations, and further research implications.

*The authority in charge of the implementation of this program is called "Mission de Développement des Cultures Vivrières, Maraichères et Fruitières autour des Centres Urbains (MIDEVIV).

CHAPTER 2

STATEMENT OF THE RESEARCH PROBLEM

2.1 Previous Research on the Development of Small Farm Agriculture:

Academic interests in the area of the development of the small farm are relatively recent. Early researchers have focussed their studies of the small farms on the descriptive or definitional problems [54,59,29]. Small farmers then refer to"That group with limited productive resources whose annual output is equal to or only slightly above subsistence needs. At the end of the production year, net savings are zero or close to it. Therefore there is, little or no capital improvements on which productivity increases are based and limited ability to acquire additional land and expand operations 'horizontally'..." [19]. Small farms also have been defined in terms of their average size, their yield and output, their ability to meet the consumption needs of their owners and/or operators, and to generate any marketable surplus for needed cash. This definition of small farms was essentially based on their structural characteristics. These definitional problems were further complicated by the link between small farm agriculture and subsistence agriculture [54,29]. Are small farms necessarily subsistence farms? This question could not be answered satisfactorily. This early approach attempted to consider small farmers as a homogeneous group.

Early in the sixties, some writers objected to this strict generalization of the small farmers. Gupta [29] and Miracle [59] argued that small farmers vary substantially in their potential contribution to economic development and therefore cannot constitute a homogeneous group. Miracle suggested that a different set of criteria which reflect meaningful differences in decision-making experience should be developed to characterize the small farmers in lieu of the common structural characteristics. Mellor [54] suggested that some small farmers, in spite of the subsistence element which characterizes them, do produce a significant marketable surplus, and thus enter into the market economy, at least marginally.

In the mid and late sixties, the focus shifted from the descriptive and definitional aspects of small farmers to a more analytical approach of the problem. Economists and agricultural economists became more interested in the production economics or microeconomics of the small farmers. They were interested in the values and goals or objectives of small farmers which are of major significance in influencing their economizing decisions [53,40]. Schultz [72,83] in his well-known work rejected most of the previous beliefs about the small farmers' economic behaviour, and in particular the held notions that small farmers neither respond to economic incentives nor allocate their resources efficiently. Yet these previous notions were still held as late as 1969 by some writers such as Rogers [70]. All these previous notions about the behaviour of the small farmers tended to imply, in the language of neo-classical economics, that their behaviour violates the rationality assumption.

Jones [40] as early as 1960 and Schultz in 1964 and 1969 [72,73] maintained that small farmers are entirely responsive to economic stimuli. Schultz in particular, treats traditional* agriculture as a special type of economic equilibrium. Three major assumptions, Schultz suggested, underlie this type of equilibrium, (1) the technology or the state of the arts remains constant, (2) the state of preference and motives for acquiring and holding additional sources of revenues remains constant, (3) the third assumption, in a summary requires that both (1) and (2) remain constant long enough. Under these rather restrictive assumptions, he proposed the following hypothesis:

There are comparatively few significant inefficiencies in the allocation of the factors of production in traditional agriculture [73].

The notion that small farmers are inefficient imply that they are not profit maximizers, which violates the major assumption of micro-economic theory (market economy). Though traditional farmers may not be maximizers of monetary profit, it remains without any question that all are utility maximizers. It is now accepted by many writers that traditional farmers pursue multiple goals or objectives which cannot be adequately described by the profit motive. Their utility may be made up of their social status, the number of animals they own, number of people working for them, number of people they feed, etc. In order to maximize their utility, the small farmers have to maximize all those specific goals simultaneously or sequentially.

*In this work, the terms small farmers, subsistence farmers, and traditional farmers will be used interchangeably.

The rationality of the traditional or subsistence farmers is widely accepted in the current literature. It is this wide acceptance that justifies the planning and execution of various programs for the development of small farm agriculture. With the structures left nearly untouched, several countries have decided to supply the traditional farms with new and adapted technology and other farm inputs, in order to develop their traditional agriculture. Despite the acceptance of this rationality antithesis by a large number of economists, most empirical investigations on this issue have led to conflicting results. Tax [78] in Guatemala in 1953, Edwards [23] in Jamaica in 1961, Hopper [38] in India in 1965, and Yotopoulos [85] in Greece in 1968 came up with conclusions corroborating this small farmers' rationality. At the same time, empirical evidence was being provided to negate this rationality of subsistence farmers. Clayton [17] in 1961 concluded that Kenyan farmers are economically inefficient, though they did exhibit some technical efficiency. His study was based on a linear programming model. Desai [20] in 1953 used the same model to demonstrate that traditional farmers of West India allocate their resources inefficiently.

Several public policy options or alternatives have been debated and adopted as a means to rapidly promote the development of small farm agriculture. These policy alternatives include the following broad categories: (a) Land reforms with all their variations, (b) development of a technology adapted to small farm agriculture, (c) development of human resources through various forms of education, (d) development of an adequate infrastructure including marketing, (e) increasing supply of farm inputs necessary for the adoption of the newly developed or adapted technology,

(f) income transfer programs, (g) improvement in the standard of rural life. The evidence is also conflicting regarding the impact of these various policy alternatives on the development of small farms.

In Cameroon in particular, alternatives of category (e) above have dominated the various approaches to agricultural development policy. Several attempts to set up an effective farm credit system have been undertaken with various degrees of success. These efforts have been aimed at improving the structures and the performance of the institutional credit system. Thus, from the "Sociétés Indigènes de Prévoyance, de Secours et de Prêts Mutuels Agricoles" (S.I.P.), or Native Societies for Insurance, Help and Mutual Agricultural Loans in 1934 [45], to the Fonds National de Développement Rural (FONADER), or National Funds for Rural Development in 1973, through the Sociétés Africaines de Prévoyance (S.A.P.)^{*} or African Insurance Societies in 1960, the Sociétés Mutuelles de Développement Rural (SOMUDER) or Mutual Societies for Rural Development in 1970, and many others, the agricultural credit system has been continuously revised.^{**}

This continuous review and reevaluation is both an illustration of the inadequacy or inadaptation of those different structures and the search for a system that can best meet the needs of the farmers and of the government. It is implied here that the different credit programs we mentioned

*Because of the pejorative meaning which the word "Indigène" (native) had taken in the early fifties, it was decided to substitute "Africaine" for it, and thus, the S.I.P; became SAP. It should be recalled that these structures were not national, but for most French African Colonies and Trust Territories.

**Only the evolution in the former East Cameroon has been reviewed here.

above and many others we voluntarily omitted, have faced difficulties of various natures and had known some degree of failure.

A prime illustration of the inadequacy, the inadaptation and some failure of the institutions listed above was given by the Cameroon's Head of State himself at the opening ceremonies of the Agricultural Show in Buea.

...Thus studies are being actively carried out with the aim of defining general conditions for the point of view of agricultural credit structures themselves and from the point of view of the organization of rural supervisory structures to carry out the distribution of credit among farmers, control over the use of such credit, and subsequently, its repayment.

We are convinced in fact that a properly organized, capably administered, and soundly managed agricultural credit system could open up possibilities for the small holder to use improved farming methods, fertilizers, pest control products, agricultural machinery, selected planting material and modern means of preparing, keeping and storing crops. It could thus contribute to increasing the output of work and to raising market production...[2]

A brief review of the literature on the small farmer credit programs tends to indicate that several credit programs for small farmers have failed, at least with regard to some objectives of the programs [22]. Indeed while some programs may have achieved some success in terms of their welfare or income transfer effects, most have had little effect on production. In addition, as a result of their financial difficulties, none has developed into a financially viable institution. The financial difficulties of these programs all arise from the low rate of repayment and the low interest rates they charge on loans. Dumont [22] summed up this situation in the following paragraph:

...Lastly, to avoid wastage of these rare funds and direct them into areas of high productivity, interest on loans should be much higher than in developed countries, as was the rule everywhere before

development. The current low rates, which are patterned after the European rates, have contributed to the deficit in the banks....Low rates have also encouraged borrowers to go into debt thoughtlessly, the more so because the hope that they will not have to repay persists.

Dumont further mentioned the rates of 13 to 16 percent encountered in the suburb south of Peking in 1955 as an illustration that the African rates are much too low.

Several writers [62,22,69,45] have attributed this failure to a general misunderstanding of the economic environment and behaviour of the small farmers. Baker [3] and Baker and Bhargava [6] in particular have maintained that the conditions for success of production credit in small farm agriculture are more stringent than commonly thought. In most situations those conditions are not entirely met and the small farmers' credit programs fail to accomplish their objectives. Baker [4] stresses the point that most small farm credit programs are narrow in terms of small farmer concerns and broad in terms of national concerns, which contributes to failure, relative to expectations. In order to fully understand the concerns of the small farmers, Baker [4] suggests a thorough study of the financial behaviour and environment of the small farmers, since financial behaviour is a part of the economic behaviour. He outlines a financial liquidity or reserves management approach to study the development process of small farms.

The development of small farm agriculture remains very much open to debate. If we adhere to Schultz's thesis of the economic rationality of the small farmers, response to new economic opportunities is constrained by his lack of off-farm inputs. However, faced with government production

credit programs at nominal costs, their behaviour tends to indicate that they reject these programs. This rejection is illustrated by some farmers not participating in the programs and others defaulting and falling back on the private money lenders from whom they borrow at extremely high costs. The answer to this paradox may lie in a complete redefinition of the role played by credit in the process of development of small farm agriculture.

2.2 Capital Shortage as a Restraint on the Development of the Small Farm:

Economic development in general and the development of agriculture in particular are very complex phenomena. The special case of small farm agriculture is even more complex because of the relatively little attention it has received in the literature. Several factors, some natural and others man-made, affect this development process in various degrees. These factors can be broadly classified into the following 3 groups:

- (a) **Technology:** Technology here includes such areas as development of better plant varieties, fertilizer and pesticide treatment trials, irrigation and drainage patterns, agricultural mechanization and education, etc.
- (b) **Infrastructure:** Transportation system to facilitate the movement of inputs to farmers and products to consumers; economic incentives to produce, such as land tenure, pricing policy for inputs and products and increasing income for consumers, etc.
- (c) **Capital:** Loan facilities to make off farm inputs available to farmers, to meet their consumption needs during the

off-season periods. These loans are often necessary for the adoption of any developed technology.

While recognizing the critical importance of all the 3 groups above [55,64,80] the present study will focus on group (c), since in many instances its unavailability may render both technology and infrastructures inoperative (though the reverse may be equally true).

One of the several features which most distinguishes modern or commercial agriculture from traditional or subsistence agriculture is the ability of the former to absorb more productively a much greater quantity of inputs. Nearly all new forms of inputs (non-organic fertilizers, pesticides, improved seeds, etc.) which account for higher yields as exhibited in commercial agriculture, tend to be produced off the farms and hence need to be purchased by the farmer. Modern farming is therefore subject to a large sectoral cash flow, and the shortage of capital is expected to have restraining effects on the economic choices of the farmers. This section of the study briefly reviews these restraining effects.

Limited capital has the same effects, though to a different degree, on small farmers as on large farmers. In agricultural production as in other economic enterprises Baker defines capital to include:

All forms of productive resources that have monetary (capitalized) value--traditional or post-traditional, physical or human, and social overhead capital (roads, schools, etc..., built by society and facilitating production). [3]

"Capital" as used in this study refers to short term or seasonal cash necessary to acquire off-farm inputs (or its equivalent) or to meet broad

consumption needs. This form of capital with no doubt is limited in Cameroon as in other less developed countries (LDC's). Increases in capital supply will increase total agriculture output which in turn increases agriculture's contribution to gross national product (GNP).^{*} Assuming that everything else remains constant, this increase in GNP will lead to economic growth and perhaps to economic development. It is therefore of great importance for agricultural development planners, that means be devised to reduce the limiting effects of the inadequate supply of capital on the process of growth. The use of credit seems to be an important tool in this "strategically important task" [3]. If the farmer is limited in his capital supply, he is directly restrained in his use of off-farm or purchased inputs.

Figure 2.1 below is an illustration of how a producer decides to use an input, X, in producing a given product.^{**} The increasing use of X, yields incremental returns indicated by its marginal value product (MVP_x, measured by the height of the curved line). Under perfect competition, X is priced at a constant level, C₀. If the producer has unlimited access to X, he will maximize his profits at a use-level, X_E (where the marginal return from X is equal to its marginal cost). At this level of use, the gross returns are represented by the area AEX_EO, and the net returns or the returns above the cost of X, are represented by the area

*It is assumed of course that the additional capital is properly invested in the sense that the returns on investment are greater than the opportunity cost of capital.

**This section draws heavily from Baker's article "Limited Capital As a Restraint on Agricultural Development" [3]. Figure 2.1 is reproduced from that source.

$$\frac{\partial R}{\partial X} \text{ or } \frac{\partial C}{\partial X}$$

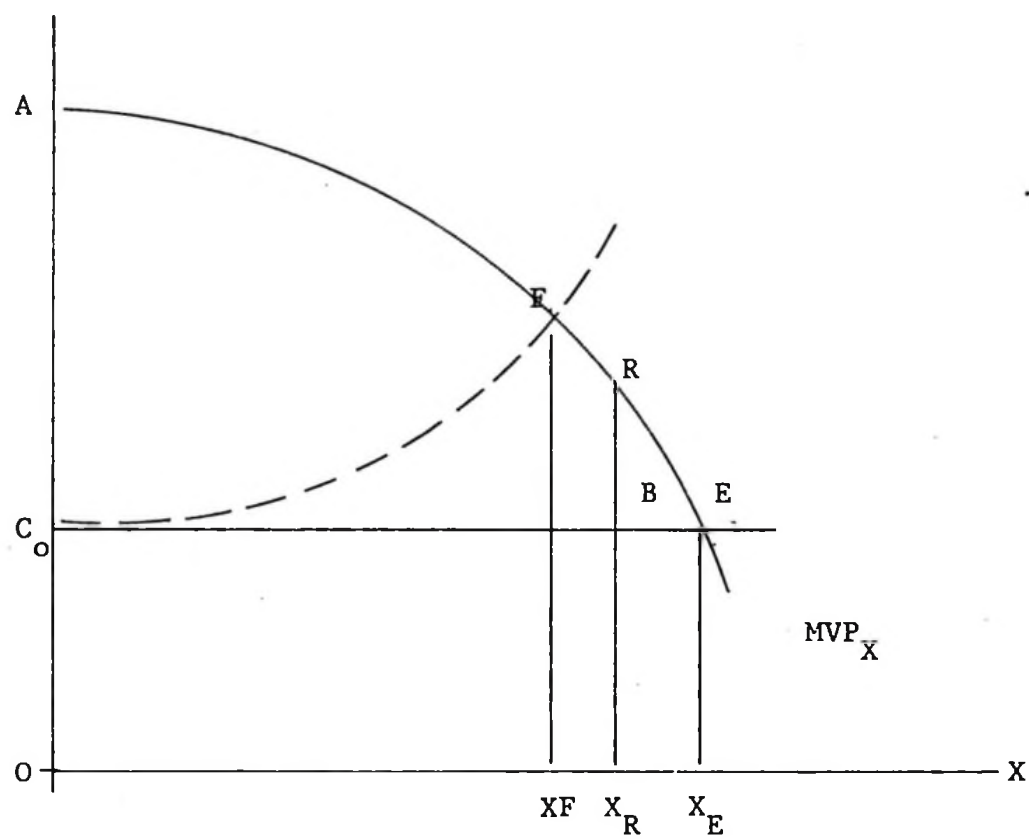


Figure 2.1: Capital Constrained Optima
in use of the Variable Input,
 X .

$AC_{OE} = (AEX_{EO} - C_{OE}X_{EO})$. If the input, X, is financed with a loan, and if the cost of borrowing for the farmer is fixed, or in other words if the interest rate on this loan is independent of the size of loan, the optimal use-level of X is still X_E . Under this assumption of fixed interest rate, and no capital rationing, the producer's access to input, X, is still unlimited.*

The optimization process described above is, however, not realistic, since in nearly all practical situations, there are various types of restraints on the use of X. The restraint may be a fixed and absolute amount of loan, capable of purchasing a maximum amount of input X_R . The effect of this restraint is to reduce the use of X to e.g., X_R , and net earnings to C_{OARB} , or a net loss in potential returns of BRE.

Access to input X may be limited by means other than a fixed constraint or interest costs. In his "principle of increasing risk," Kalecki [41] maintains that the effective cost of adding more capital units increases if adding the units subjects the firm to added risk. Thus the "real" marginal cost of X slopes upwards, e.g., C_{OF} , if the capital is borrowed, since borrowing adds financial risk. This situation is easily explained if we define credit as the producer's capacity to borrow. Credit then is an asset that the producer may choose to use to borrow or to hold as reserve. The total cost of borrowing therefore includes, in addition to the interest rate, which is fixed, another element, the liquidity value of the credit used [6].

*It is conceivable however that, if some proper consideration is given to the dimensionality (time and space) problem, C_{O} could increase to a higher level. But the same consideration could lead to an upward shift of the MVPx curve, thus reducing the effects of the increase in C_{O} .

The inclusion of this liquidity element in the cost of borrowing is illustrated by Figure 2.2 below reproduced after Hopkins et al. [37].

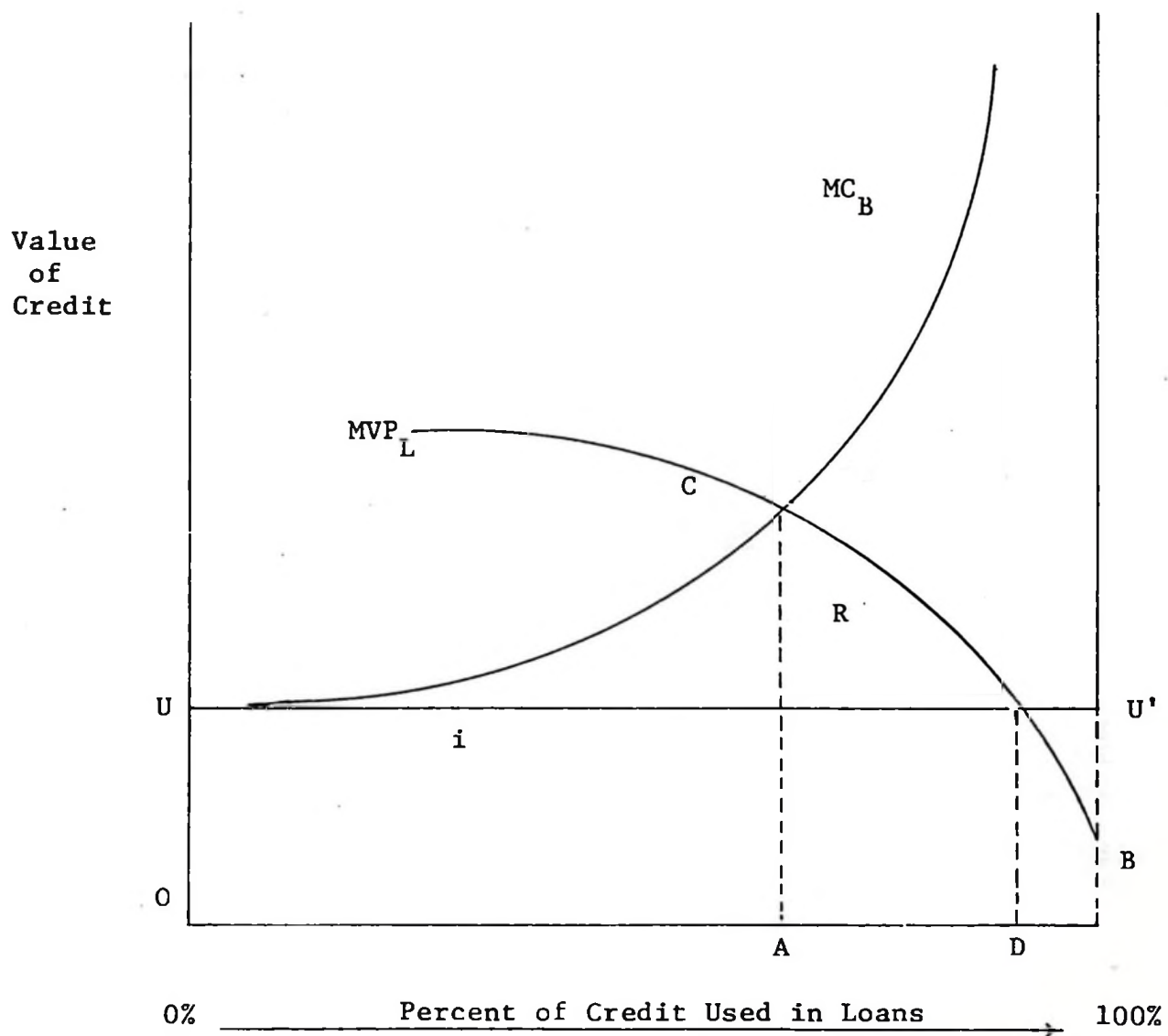


Figure 2.2: Equilibrium in Credit Allocation

The upward sloping MC_B (marginal cost of borrowing) represents the liquidity value of the remaining units of unused credit. The addition of the liquidity value R , measured by the vertical distance between MC_B and UU' , to the interest rate i , determines the total cost of borrowing. The optimal use of credit (or the optimum amount of borrowed funds) is obtained by equating $MC_B (= i + R)$, the marginal cost of borrowing with MVP_L , the marginal return from loans, or OA . If (R) were considered to be zero, then the optimal use of credit would be given by equating MVP_L with (i) .

A Theory of Liquidity Management:

As developed by Baker [4,6], any firm can be conceived as a collection of assets with an aggregate value above the sum of the values given by separable sale of the assets. Were this relation not thus, the separable assets would be disposed of and the firm would no longer exist. This is the basis for ascribing liquidity values to assets.

The behavioral assumptions underlying liquidity management can be represented as in Figures 2.3 and 2.4 below, reproduced after Baker. Figure 2.3 relates to cash and Figure 2.4 relates to credit. On each figure, the vertical axis shows the value of liquidity of cash (2.3) used or reserved and of credit (2.4) used or reserved. The nonlinearity of these relations is intended to reflect the common assumption of diminishing marginal returns from either cash or credit as the proportion in reserve increases.

One very important implication of Figures 2.3 and 2.4 is the possibility that a rational firm may prefer external financing (borrowing) even in the presence of a positive cash balance. (Note that at 100 percent

cash reserved, the value of a unit of cash in reserve is greater than one, indicating that one unit of cash reserved is worth more than a unit of cash to be received, but not only due to the time value of money.). Given a positive interest rate, conventional firm theory cannot explain borrowing with a positive cash balance.

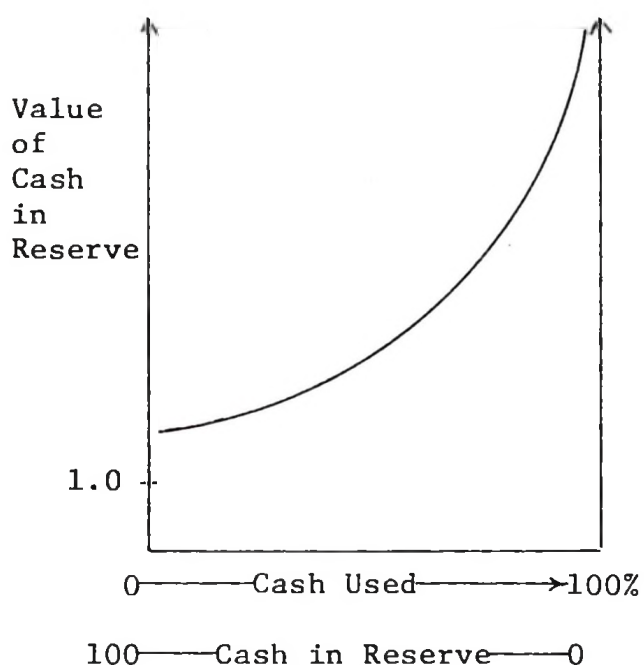


Figure 2.3: Value of Cash in Reserve

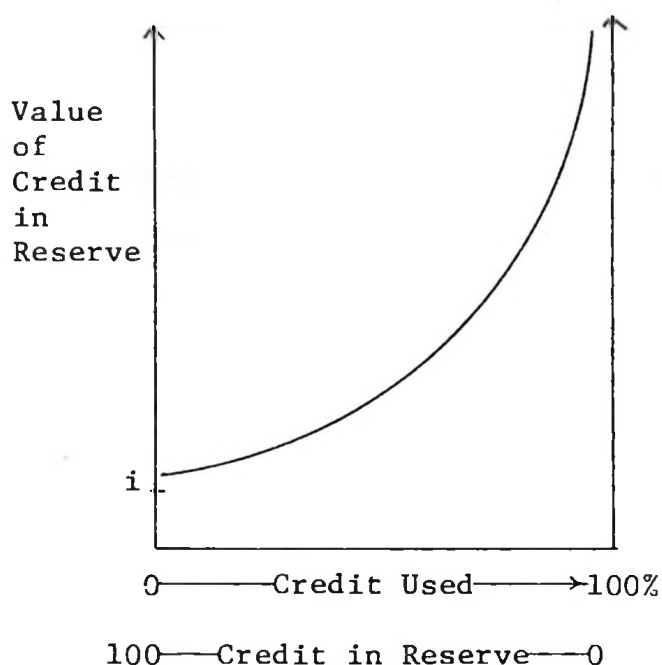


Figure 2.4: Value of Credit in Reserve

The heights and slopes of relations 2.3 and 2.4 measure some subjective response of the decision-maker faced with an uncertain economic environment. Those relations would be higher and/or steeper for the more risk-averse decision-maker than for the less risk-averse one. The problem

remains in obtaining reliable and meaningful numerical estimates for parameters of Figures 2.3 and 2.4 . In spite of this limitation, it is extremely important to recognize and consider the qualitative relationships.

The government credit programs have been found to be limited in their outreach (farmers' participation) as mentioned above. This limited outreach has been explained in part by the programs' prohibitive cost structure. In a more fundamental sense, one could ask whether the programs' policies are compatible with the small farmers' objectives, their expectations or in general their behaviour. This study, centered on the financial aspect of the small farmers' economic development and growth, focusses also on the government credit policies and the financial behaviour of the small farmer.

The farm family requires a cash flow as well as a risk management stock. Its financial management requires working capital for farm operations, for household consumption expenses, for technology improvement, and liquid reserves for emergencies. Government credit programs generally address themselves to only one of those needs, namely the supply of off-farm inputs. By not providing for other financial needs of the farmers, these programs curtail their (farmers) flexibility in financial management. The farmers therefore cannot rely on these sources for meeting their emergency cash needs. The outreach of these programs would be highly improved if these liquidity requirements were recognized by allowing a more flexible use of loan funds. The study also investigates the potential effects of this liquidity management concept.

The brief discussion above was intended to stress the point that farm production may be limited by the farmer's lack of capital. Figures 2.1 and 2.2 have illustrated that financial criteria do limit the use of purchased inputs and consequently may have important effects on production equilibria. Figures 2.3 and 2.4 have illustrated the importance of "liquidity value" of cash and/or credit used or held in reserve. This liquidity value affects the farmer's decision on how much of his own cash he can commit to his production enterprises. Because of the general capital shortages in the LDC's, alternatives have to be found to reduce these shortages. One important tool in this task is to increase the rate of saving in order to generate investible funds, or to increase the incentives to commit to production the savings that are available. Equally important is the development of an adequate structure to transfer these investible funds from savers to investors. The development of such a structure will require among other things, to promote a system of financial intermediaries, private or public. It involves a long-run program to improve the financial markets.

In the particular case of the small farmers, the solution is urgent, if they have to produce enough food to help avert the various food shortages mentioned in Chapter 1, and to increase their own income in order to meet their increasing consumption requirements. The private sector's supply of these funds to the small farmers has proven inadequate in terms of their size and their costs to the borrowers. As a consequence, the public sector has been compelled to intervene in these loans to small farmers. The government in Cameroon as in other less

developed and more developed countries has established several farm loan programs. These programs have had mixed results in terms of their impact on aggregate production and on farmers' income. The reasons behind these mixed results will be fully discussed later in Chapters 4 and 5.

2.3 Nature of the Problem:

In the previous section, it was established that limited access of the small farmer to off-farm capital seriously constrains his ability to increase his output and his productivity in response to a continuously rising demand. This is particularly true in the subsector of food production.

The government has attempted to meet the small farmer's need for capital by providing him with loans at concessionally low interest rates. These loans are intended to allow the small farmer to increase his output so as to generate a greater marketable surplus and to improve his income, as mentioned in the previous chapter.

These loans have been limited in amount as a consequence of a general shortage of public funds, and in range of permissible use, in order to secure an increase in the output of some specific products for which funds are disbursed.

On the other hand, the government programs have been very costly due to a general shortage of capital with its resulting high opportunity cost, and to nearly prohibitive administrative and default costs. As a result of these high costs, the current credit programs have been themselves limited in terms of success with respect to meeting the government's objective as stated in the introduction, namely, a substantial

increase in the aggregate output and in farmers' income. Another direct consequence of these high costs has been the limitation of the programs in terms of their outreach. Relatively few farmers indeed participate in most of these programs. One immediate concern of the programs should therefore be how to reduce their costs and, ipso facto, how to extend their outreach.

The high costs of the programs, as mentioned above, result from four main sources: high opportunity costs of capital, high administrative costs, high default costs, and concessionally low interest rates charged to farmers. Among these four causes, the opportunity cost of capital is evidently beyond the control of the program planners. If we assume the conditions of a perfect or near perfect market (which is not entirely an unrealistic assumption) then we can conclude that there is very little the planners can do to reduce the cost of capital.

The administrative and default costs are, to some extent, related to the organization and performance of the programs. In addition, there exists some trade-off or some inverse relationship between the size of the administrative costs and the rate of default. Given that everything else remains as it is, an attempt to reduce the size of administrative costs will very likely increase the default rate, and conversely any attempt to reduce the default rate will undoubtedly increase the size of the administrative costs. It is therefore apparent that in order to improve the structure of administrative and default costs, an organizational change is imperative. Such a change cannot be effectively achieved overnight; as it may require some socio-political reorientation. The nature of such a change will be discussed later in the study.

From the brief statements above, it is clear that one is left with only the concessionally low interest rate as a decision variable in the search of devices for reducing the costs of the program, under the current organization. This study focusses sharply on these concessional interest rates as their upward readjustment will be shown to be crucial even for the reorganizational problem.

Specifically, this policy of concessionally low interest rates, low in the sense that they fail to reflect the scarcity or opportunity cost of capital, in addition to the general misallocation of resources it creates, may lead to the following negative effects:

- (i) The low rate of interest increases the already high costs of channeling funds to farmers and hence limits the reach of the program in terms of number of participating farmers.
- (ii) Some farmers perceive such "cheap" funds as temporary and will take advantage of the program by defaulting (which increases the cost still further) in expectation of falling back on their traditional sources of funds.
- (iii) Low interest rates, when generalized in the whole economy, will not create incentives to save (yet, the key role of savings in the process of economic development is widely accepted), or when savings do take place for contingency purposes, they are usually kept in non-productive (hence very costly) forms such as cash and jewelry.*

*It could be argued that under inflationary conditions the holding of gold or jewelry or other physical assets is less costly for the hoarders. Holding cash and gold also contributes to the liquidity management of the hoarders.

- (iv) At low interest rates, the supply of funds is inadequate to meet the demand; a rationing system, with all its subjectivity is necessary for allocating the available funds.
- (v) In the interim, such interest rates may create undesirable income transfers favoring participating farmers and/or consumers. These subsidized rates constitute a regressive system of income redistribution as we shall expand later on in Chapter 4.

The situation described under (iv) above may be illustrated graphically as follows:

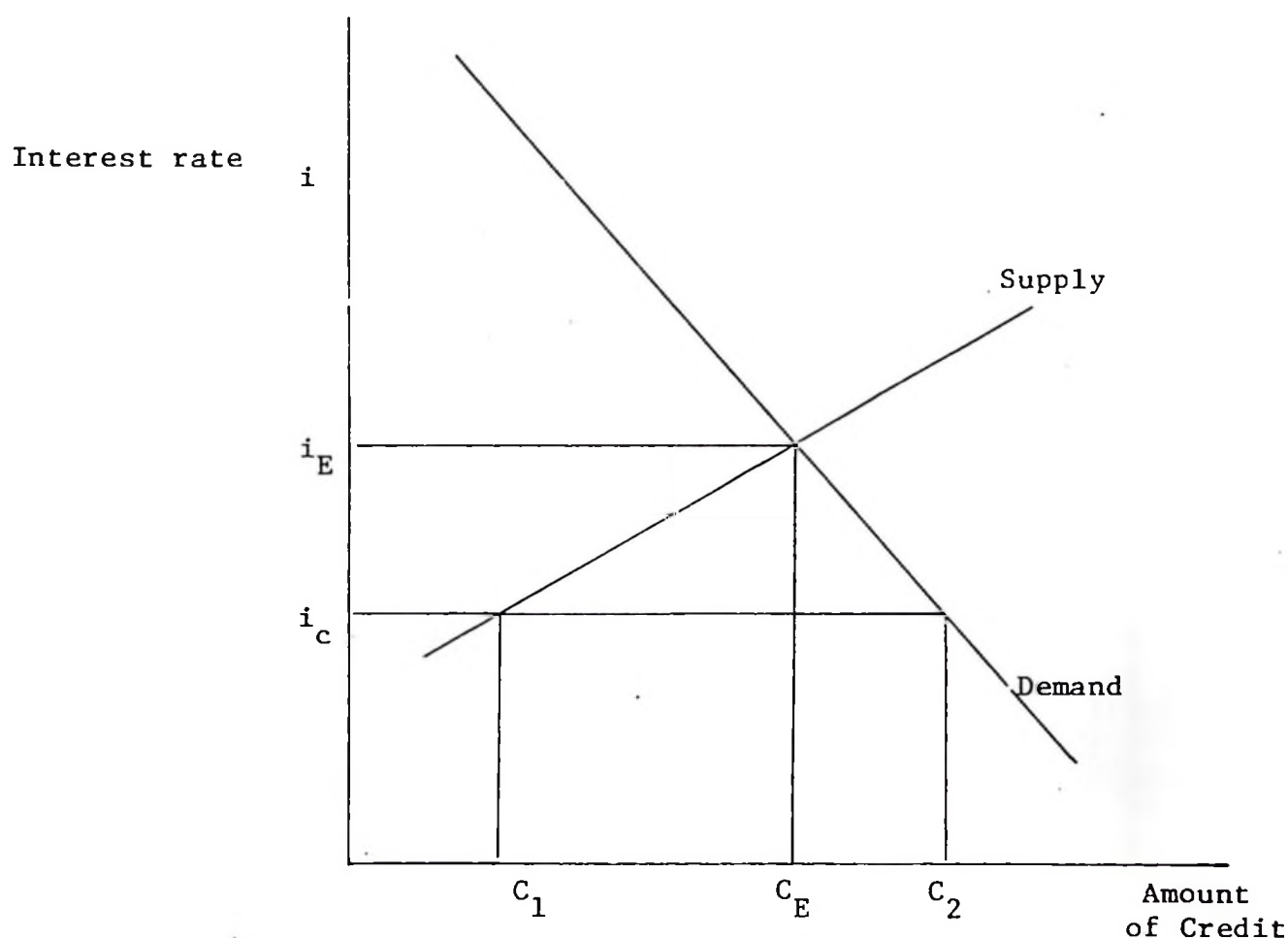


Figure 2.5: Effects of Low Interest Rates on the Supply and Demand of Funds

In the diagram (Figure 2.5), at the realistic market interest rate, i_E , there is an outstanding amount of forthcoming credit C_E . At the government concessional interest rate i_c , the farmers would like to borrow C_2 , but the supply is only C_1 . At that concessional rate, the government will need to fill the gap $C_1 C_2$, if the lower rate, i_c is to be achieved by economic means. Filling this gap requires huge sums of money which most governments in LDC's cannot afford. In case the government is unable to provide the amount $C_1 C_2$, then credit available to farmers will be reduced to C_1 and the farm output would be proportionately reduced (assuming that credit is exclusively intended for production inputs). Lower interest rates would be advantageous to borrowing farmers but not if they are achieved by reducing the amount of funds available for farm loans. The suggested increase in the rate of interest to be charged to farmers will increase the project revenues, and thus allow its outreach in time and space. This increase will help the project to better meet one of the government's objectives, increase in aggregate farm output.

Another limitation of the government credit program, as already mentioned, is the restriction imposed on the use of loan funds (restriction implemented by providing loans in kind). It is the contention of this study that such a restriction may not allow the farmer to allocate his resources efficiently, and that therefore, his welfare, identified as his total income or profits, will be lower under such a restriction. The study will attempt to verify this contention. Assuming that the contention is upheld by the findings, then it would be clear that a

rapid or optimal increase in aggregate output will require, among other things, the relaxation of such a restriction. The relaxation of this restriction would also reduce administrative costs--and perhaps default costs as well, inasmuch as less (or un-) restrained use of loan proceeds leads borrowers to value the credit more highly and thus to protect it by meeting loan obligations

2.4 Objectives of the Study:

General Objective:

Several agricultural projects show high economic rates of return for the whole economy, and even higher financial rates of return for participating farmers [25]. Some of these projects may show very low to negative financial returns to the public agencies in charge of the projects [43]. These negative financial rates of return which result from prohibitive costs of the agency as mentioned under (i) above, invariably limit the expansion of the project and therefore limit the gains for the whole economy as well as for the farmers.

The general objective of this study is to determine what modifications would be necessary within the current program in order (a) for the economy to benefit more from these high returns through a reduction in the high costs the lending agency incurs, thus making it possible for more farmers to benefit from the above mentioned high financial returns; and (b) for the participating farmer to maximize his income. In essence, the study attempts to identify what conditions are required to make the projects financially viable or self-supported, at least to an acceptable

degree, on a permanent basis, since it appears that the continuation and the expansion of the program under the current policy, let alone the heavy drain they require on public resources, may be financially not achievable in the longer run.

Major Objectives of the Study:

- I. To determine the effects of low interest rates on the long-run financial performance of the lender and borrower and the impact on the overall performance of the agricultural economy.
- II. To evaluate the effects of the restriction in the use of loan funds (loans in kind) on the efficiency of capital use.
- III. To determine the effects of liquidity management on the farmers' financial behaviour.

Specific Objectives:

- (i) To assess the economic and financial returns for the plantain project, and the financial returns for the participant farmers.
- (ii) On the basis of returns established in (i), to determine an interest rate that would permit the project to reduce its costs within the constraints imposed by the farmers' profitability or their financial returns and aggregate production requirements.
- (iii) To evaluate the effect of relaxing the restriction imposed on the use of funds on the efficiency of factor use among plantain producers. The relaxation of this restriction has to take place under another constraint set to secure adequate aggregate production.

- (iv) To determine the impact of the government credit program on the small farmer when the latter views the program as permanent.

2.6 Methodology:

The establishment of various returns as specified under specific objective (i) above will be achieved by the use of the capital budgeting technique. A cost-benefit analysis will provide the level of economic return of the project on the whole economy, and the financial returns to the various participants.

The government agricultural project to be evaluated in this study is the plantain project, a multipurpose agricultural project around Yaoundé, the capital city of the United Republic of Cameroon.

A preliminary study of the plantain project, using projection data did reflect a very high economic rate of return of about 44 percent and an even higher financial rate of return for the participant farmer; 84 percent. The study on the other hand showed very high financial losses for the loan agency. The negative returns were attributed mainly to high administrative costs, high risk premium, and low interest rates charged to farmers for the use of funds [48].

In a similar agricultural project, though of greater economic impact, the Ivory Coast Cocoa project showed estimated economic rate of return of 35 percent, financial returns of 56 and 52 percent to the farmer and government, respectively [25].

A Tamil Nadu Agricultural Credit Project shows projected financial returns of the order of 27-30 percent for the project [25].

The fact that the plantain project shows very large financial losses whereas relatively similar projects in other countries show high financial gains for the project indicates that there is room for improvement in the financial management of the project. Administration costs and the risk premium, two of the major elements of the cost structure, as mentioned above, are somewhat deeply rooted in the current organization. Any improvement in these two areas will therefore require some organizational or institutional reforms, and such reforms, I already mentioned, cannot be expected to be successful without a relatively long period of experimentation. Reducing the administrative costs and the risk premium is therefore a somewhat long-run approach. Any immediate improvement hence necessitates an increase of the project's returns, by charging the farmers a higher rate of interest. Interest payments constitute the only reliable source of revenue for the project. This explains why the study focusses sharply, though not exclusively, on the lending component of the project.

While the preliminary study relied entirely on planning data to obtain numerical estimates of costs and returns, the present study uses a combination of planning, record and simulated data for estimating these figures. The limited record data were provided by the project head office.

In addition to these data a survey was conducted to generate some additional data needed in the analysis.

The profitability estimates established under specific objective (i) along with the cost figures will serve as a basis in searching for solutions capable of reducing the costs to the public agency, and of

maintaining the willingness and the ability of farmers to still participate profitably. It is hypothesized that a considerable increase of the interest rate currently paid by the farmers is possible with the farmers still operating at a profitable level.

The basis for increase will be, (a) the high financial rate of return enjoyed by farmers under the current policy, (b) the farmer's ability and willingness, when confronted with alternatives, to absorb additional funds, (c) the actual opportunity cost of capital, and (d) the rates they actually would pay in order to obtain additional funds from alternative resources. In other words, the constraint on how much the interest rate can be increased is dictated by (1) the rate of return of the farmer, which is reflected in his ability to repay the loan and (2) the requirements of aggregate production.

Conceptually, one can envision a schedule of the amount of funds the farmers are willing to borrow as a function of the interest rate they have to pay. Such a schedule could be interpreted as a demand curve for loan funds, which is inversely related to the interest rate. It is equally possible to conceive the farmer's output as a function of the funds available to him (assuming that funds are disbursed for the sole purchase of various production inputs). The diagram below illustrates how the interest rate affects the size of borrowed funds and subsequently the aggregate farm output.

Figure 2.6 a shows (as expected) that the higher the interest rate, the less farmers are willing to borrow, since the interest rate represents the cost (or price for the lender) of funds, hence a negatively sloped

demand curve (M). Figure 2.6 b illustrates the positive effect of borrowing on production, the more the farmer is able to borrow (for production purposes) the more he can produce at least up to a certain point. The product curve (Y), positively sloped, but with a decreasing rate of increase, exhibits the well known diminishing marginal productivity of funds (or of inputs purchased with these funds).

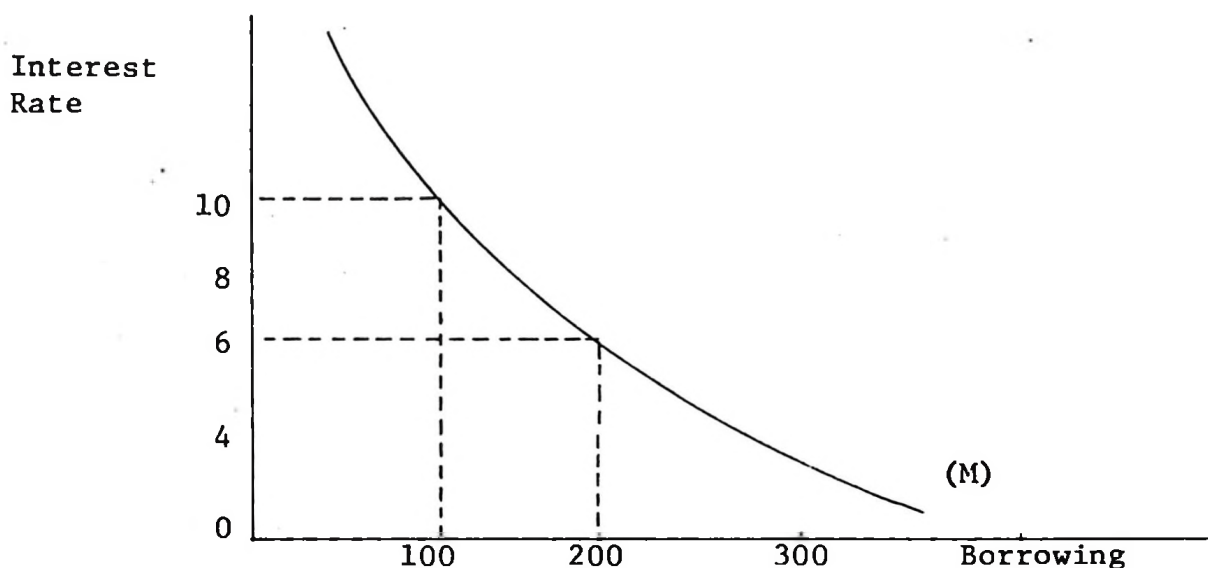


Figure 2.6 a : Demand for Loan Funds as a Function of the Interest Rate

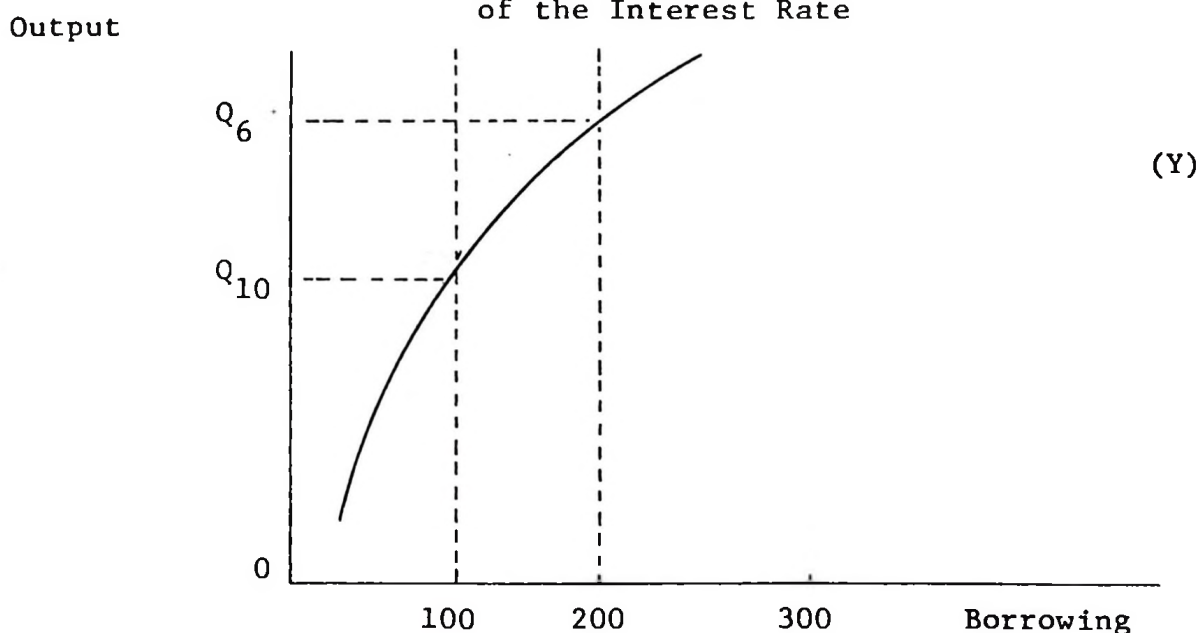


Figure 2.6 b : Farm Output as a Function of the Size of Available Funds

Note that at a 6 percent interest rate, the farmer is willing to borrow 200 units of funds (Figure 2.6 a). With these 200 units, he can produce Q_6 units of output (Figure 2.6 b). When the interest rate is increased to 10 percent, the farmer is now willing to borrow less than 100 units of funds, and produces only Q_{10} units of output. It could be argued, therefore, on theoretical grounds, that if the government increases the rate of interest it charges the farmer, then it foregoes some output, and if increasing aggregate output is one of the objectives of the program, and it is, then increasing the interest rate may be a defeating force for that particular objective.

In practice, however, the financial environment of the small farmer does not allow him to respond in the way indicated by such an economic theory. The amount the farmer can borrow is relatively fixed by the lender (at least for the particular case of the project under study). There are lower and upper limits determined by what the planners have set as minimum input requirements and financial resources of the projects, respectively. If we assume that (a) the small farmer has no cheaper alternative source of funds, (b) there is no alternative use for his labor, (c) leisure is not an economic good for the small farmer, and (d) there are incentives for a higher income, then we can conclude that as long as his net return is positive, the farmer will borrow at least the minimum amount of funds required per unit area, regardless of the level of interest rate. Under these conditions, the aggregate output constraint which is an "equal or greater than" constraint will be met at least at the lower limit.

While the demand for funds (M) was shown to be dependent on the interest rate, it should be noted that in real life, it depends on several other factors,* such as rate of return, equity capital, liquidity or credit reserves, etc.

Various studies [77,82] have shown in fact that the small farmer is more responsive to an increase in the size of loans and to the liberalization of their uses than he is to the changes in the interest rate. Therefore an increase in the interest rate within a certain range may not necessarily have negative effects on aggregate production. Further, this increase in the interest rate may render more difficult the transactions of borrowed funds (or inputs) among farmers. These transactions (borrowers lending to other farmers) often are causes of low repayment from the "borrower-lender" farmers whose production has failed to increase because of lack of additional inputs. The changes in interest per se, therefore, will be assumed to have minimal or negligible effects on

*It is therefore conceivable to express the demand for funds, (M) as:

$$M_t = f(I_t, R_{t+1}, E_t, L_t, U_t)$$

Where:

- M_t = Demand for funds at time, t;
- I_t = Rate of interest in percent, at time, t;
- R_{t+1} = Expected rate of return at time, t+1;
- E_t = Equity capital at time, t;
- L_t = Liquidity or Credit reserves at time, t;
- U_t = Disturbance term at time, t.

A sufficient number of observations on all these variables may enable the estimation of this demand function, by using a multiple regression model.

production. Their effects on the costs and revenues of the project and the farmers are evaluated through some "simulations."

In order to achieve specific objective (iii), a survey was conducted to determine how farmers generally feel about this restriction in the use of funds. In addition, a mathematical programming model is used to determine the potential effects of this restriction on the efficiency of resource allocation by the farmer. In other words the mathematical model provides results on production and profits after the restriction has been removed, and these results are compared with those of the current situation.

CHAPTER 3

ANALYTICAL PROCEDURES AND SOURCES OF DATA

3.1 Analytical Procedures:

In order to achieve the major objectives of the study, two main analytical tools will be used: a capital budgeting or cost-benefit analysis technique, and a mathematical programming (linear programming) technique.

3.1.1 Capital-Budgeting or Cost-Benefit Approach:

Capital budgeting is often defined as a procedure for processing data in order to produce information relevant to an investment decision. It is therefore a means of helping planners make their choice on various investment alternatives.

There are various criteria for evaluating investment proposals through capital budgeting, such as the pay-back period, the simple benefit-cost ratio or the accounting rate of return, the net present value (NPV), and the internal rate of return (IRR).

The payback period and the accounting rate of return procedures fail to take into account the time pattern of returns and the time value of money and therefore are not theoretically very sound, even though they are used by many investors. The NPV and IRR procedures reflect the difference between the present value of a stream of future income and the present value of all cash outflows, all discounted at some "appropriate" discount rate.

The Net Present Value Criterion:

Mathematically, the net-present value of an investment proposal with a lifetime of n years, may be given as

$$NPV = A_0 + \frac{A_1}{(1+k)} + \frac{A_2}{(1+k)^2} + \dots + \frac{A_n}{(1+k)^n} \quad (3.1)$$

where each $A_0, A_1 \dots A_n$, represents a net cash flow for each period, k , the discount rate. In a condensed form, equation (3.1) can be expressed as

$$NPV = \sum_{t=0}^n \frac{A_t}{(1+k)^t} \quad (3.2)$$

where A_t is the net cash flow for period t . The proposal is accepted if the NPV is equal to, or greater than, 0, if not, it is rejected.

The Internal Rate and Return Criterion:

The internal rate of return of an investment proposal is the discount rate that equates the present value of the expected cash outflows with the present value of the expected cash inflows. Mathematically it is represented by that rate, r^* , such that

$$A_0 + \frac{A_1}{(1+r^*)} + \frac{A_2}{(1+r^*)^2} + \dots + \frac{A_n}{(1+r^*)^n} = 0 \quad (3.3)$$

In the equation above, it is assumed that the initial cash outlay or cost occurs at time 0.

Equation (3.3) can be expressed as

$$\sum_{t=0}^n \frac{A_t}{(1+r^*)^t} = 0 \quad (3.4)$$

where A_t is the net cash flow for period t . The rate of discount, r^* , now

is given the name internal rate of return.

The acceptance criterion generally used with the internal-rate-of-return method is to compare the IRR with a required rate of return, also known as the cutoff rate. In practical situations the cutoff rate would be the borrowing or lending rate or the prevailing interest rate, the opportunity cost of capital. The proposal is accepted if the IRR is at least equal to the cutoff rate, if not, it is rejected.

The above formulas are derived under the assumption that monetary payments, interest-compounding, and discounting all take place at discrete points in time. In other words, these formulas are used if the interest is discounted once, twice, ..., or x times per year.

If interest is compounded continuously, or if x , the frequency of compounding, approaches the value of infinity, then the terminal value of a \$A investment compounded at 100 per cent per annum, at the end of one year is given by the number*

$$\lim_{x \rightarrow \infty} A \left(1 + \frac{1}{x}\right)^x \quad (3.5)$$

For an investment of \$1, equation (3.5) becomes $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$, which by definition is equal to the base of natural or Napierian logarithms, denoted by $e \approx 2.718$.

More generally, if \$A is invested at an annual rate of r , compounded continuously, the value of the investment at the end of n years is given by the number

$$\lim_{x \rightarrow \infty} A \left(1 + \frac{r}{x}\right)^{nx} \quad (3.6)$$

*For more details on this mathematical section see Mao, J. C. T. [50] and Van Horn, C. J. C. [81].

If we let $\frac{x}{r} = h$, then (3.6) may be rewritten as

$$\lim A\left(1 + \frac{1}{h}\right)^{hrn} = A(e)^{rn} \quad (3.7)$$

It follows from equation (3.7) that the present value of \$A due n years from now, discounted continuously at an annual interest rate of r, is equal to $A(e)^{-rn}$ dollars.

If the above investment is expected to generate cash of $f(t)\Delta t$ dollars between t and $t + \Delta t$, where t is a point in the interval $0 \leq t \leq n$, and if the annual interest rate is a constant r , the present value of the cash stream is approximated by the expression

$$\sum f(t)e^{-rt} \Delta t \quad (3.8)$$

As the division of the interval becomes smaller and smaller, that is, as t approaches zero, the above expression becomes the integral

$$\int_0^n f(t)e^{-rt} dt \quad (3.9)$$

which is exactly the present value of the cash stream, where rt is the discounting factor which converts future dollars into present dollars.

Both equations (3.2) and (3.4), expressions of NPV and IRR, respectively, can be rewritten in a form that assumes not a discrete discounting time period, but a continuous discounting time period. Under this new assumption then (3.2) becomes

$$NPV = \int_0^n f(t, A_0)e^{-kt} dt - A_0 \quad (3.10)$$

Equation (3.4), which represents the IRR becomes

$$\int_0^n f(t, A_0) e^{-r^* t} dt - A_0 = 0 \quad (3.11)$$

In equations (3.10) and (3.11), A_0 is the cost of the investment at time $t = 0$. All other symbols are defined as previously.

In this study, the IRR measure will be used, since this measure is used by the World Bank for practically all its economic and financial analysis of projects. The same measure is equally used by most other international financing agencies.

Cost-Benefit Analysis:

In a simplistic fashion cost-benefit analysis* is nothing but capital budgeting as applied to the public sector. The distinction between capital budgeting as used in the private sector and cost-benefit analysis resides in the familiar thesis that "what counts as a benefit or a loss to one part of the economy - to one or more persons or groups - does not necessarily count as a benefit or a loss to the economy as a whole" [61].

A private enterprise usually comprises only a small segment of the economy. Whatever means it employs in pursuing its objectives, from simple rules of thumb to more formalized and sophisticated techniques such as mathematical programming models, the private enterprise is always guided by commercial criteria that require revenues to exceed costs; it is guided

*Cost-benefit analysis will be used in this study in a restricted sense. Though many writers use capital budgeting and cost-benefit interchangeably, this study will use cost-benefit analysis as an exclusive tool for evaluating public projects. From the private point of view, the benefits and costs are limited to those internal to the operation of the project, but from the social point of view the externalities must be considered.

by a profit motive. Cost-benefit analysis as used here, further differs from capital budgeting in the private sector by the interpretation of revenues or benefits and costs in the public sector.

The familiar concept of external economies or diseconomies* helps to explain this different interpretation. In cost-benefit analysis, the economist will attempt to price or measure these externalities while they go unnoticed by the accountant of the private enterprise. On the other hand, some costs and returns relevant to private enterprise are irrelevant in social accounting.

The economist in charge of a cost-benefit appraisal of an investment project, in essence then, "is not asking a different sort of question from that being asked by the accountant of a private firm" [61]. The economist asks the same sort of question about a wider group of people, about the whole society or economy. He substitutes the less clear concept of social benefits for the more precise concept of revenue of the private firm and the concept of social or opportunity cost for the costs of the private firm.

Therefore, in order to achieve my first major objective as stated above, an attempt will be made to redefine the costs and benefits such that they reflect as accurately as possible their total social impact. Then the technique of capital budgeting will be used to derive the various rates of

*An external economy or diseconomy occurs when an action taken by an economic unit results in uncompensated/or unpriced benefits or costs to others. Baumol and Oates provide the following definition.

"An externality is present whenever some individual's utility or production relationships include real (that is, nonmonetary) variables whose values are chosen by others (persons, corporations, governments) without particular attention to the effects on A's welfare" [Baumol and Oates 1975, p. 17].

return.

3.1.2 Mathematical Programming:

Mathematical programming is an area of operations research concerned mostly with how to allocate limited resources among competing activities in the best possible or optimal way. This analytical tool includes both linear and nonlinear programming. The most commonly discussed nonlinear programming model is the quadratic programming model. The present study intends to use the familiar tool of linear programming to achieve its second major objective.

A linear programming (LP) model uses a mathematical model to describe the problem of concern. The ultimate goal is to optimize a given objective (e.g. maximize profit or minimize costs), called the objective function, under certain restrictions, be they financial, fiscal, functional, legal, physical, political, social, technological, or otherwise. These restrictions are often called constraints and consist of equalities or inequalities. The adjective "linear" means that the mathematical functions in the model are required to be linear in both the objective function and constraints.

Mathematically, the single period linear programming model may be specified as

$$\text{Maximize } Z = \sum_{j=1}^n c_j X_j \quad (3.12)$$

$$\text{subject to } \sum_{j=1}^n a_{ij} X_j \begin{matrix} > \\ < \end{matrix} b_i \quad \begin{matrix} j = 1, \dots, n \\ i = 1, \dots, n \end{matrix} \quad (3.13)$$

$$\text{and } x_j \geq 0 \quad (3.14)$$

where Z = Value to be maximized or maximand

C_j = Contribution of the j^{th} activity for valuation of the objective function

X_j = The level of the j^{th} activity

a_{ij} = The rate of use of the b_i^{th} constraint in a unit of the j^{th} activity

b_i = Constrained level for the i^{th} constraint.

Equations (3.12) (3.13) and (3.14) above are the objective function, the system of constraints, and the nonnegativity constraints, respectively.

The following assumptions underlie every linear programming model:

- (i) Additivity: The total output must be the summation of output of each activity, and the total resources used are also the summation of resources used by each activity.
- (ii) Deterministic: All the parameters of the model (c_j , a_{ij} , b_i) are known constants.
- (iii) Divisibility: All activity units can be divided into any fractional levels, so as to allow non integer values for the decision variables (X_j).
- (iv) Finiteness: The number of competitive activities has to be finite.
- (v) Proportionality: For each activity, the ratio between two inputs and between input and output is constant.

The linearity requirement assumed earlier is guaranteed by assumptions (i) and (v) above. The model is specified as a single period linear programming model. If the production or marketing process is to extend over one period, then a multi-period LP model will be used.

In order to evaluate the effects of the restricted use of funds on the efficiency of factor use, as specified under the second major objective,

these restrictions on the use of funds will be relaxed and condensed into a constraint on the level of working capital (loan funds available).

This study's hypothesis is that relaxing the restriction on the use of funds will improve the allocation of resources resulting in higher output and profits for farmers. In order to guarantee that the overall objective of increased aggregate output will be met, a new constraint is introduced as a production quota per producer.

This particular aspect of the study is intended to test the hypothesis that loans (limited in size due to a limited supply of loanable funds) at low interest rates and specific in their use are conducive to the increase of small farmers' output, and to the improvement of their economic status or welfare. This hypothesis is implicitly held by the public planning board.

This study maintains that this policy not only does not lead to an improvement in the economic status of the small farmers, but that it leads to an inefficient allocation of resources as well as to the many negative effects identified under the definition of the problem. The study attempts to evaluate the effects of this use constraint on production, profits, and factor use by the small farmer. The importance of the liquidity preference concept as briefly introduced in Section 2.2 of Chapter 3 is also evaluated by its inclusion in the model.

The hypothesis of this study therefore is that factors other than lower rates of interest, such as more flexible use of funds and an increase in the average size of unit loan are most conducive to farmer's economic and social improvement. While a LP model such as the one briefly described above can be used to measure the importance of the flexibility in loan use, that of the average size of a unit loan can be visualized through a

mathematical formulation of the rate of growth of the farm firm as developed by Hopkin, Barry and Baker [37].

According to them, the rate of growth of the firm can be expressed as

$$G = \frac{\Delta E}{E} = [D/E(r-i) + r][(1-c)(1-t)] \quad (3.15)$$

where G = Rate of growth of equity,

D = Debt or total liabilities,

r = The net rate of return,

i = Average interest rate paid on debt,

E = Equity capital

t = Tax rate,

c = Rate of consumption.

If we assume that the economic improvement of the small farmers can be adequately described by the increase in his disposable income, his disposable income here, being identical to his returns from farming, then it is possible to adjust the preceding formula so as it represents the rate of growth of total returns after tax. Then the rate of growth may be reformulated as follows:

$$\frac{\Delta Q}{Q} = G = \left[\frac{D}{Q} (r-i) + r \right] [1 - t] \quad (3.16)$$

Where Q = Total net revenues

The crucial importance of debt, (D), is evident from (3.15). The term $(1-c)$ has been dropped as the distinction between the firm and the household cannot be made in the case of the small or subsistence farmer. Therefore the size of debt constitutes a major factor in the growth of the small farmer's income, assuming that the net rate of return (r) is greater than the average rate paid on debt (i). Because of the flat tax rate in the

rural areas, the growth rate may be expressed relative to net returns before tax. In this case, equation 3.15 becomes

$$\frac{\Delta Q}{Q} = G = \left[\frac{D}{Q} (r-i) + r \right] \quad (3.17)$$

The current government program with its low interest rate and limited loanable funds calls for an inevitable rationing or subjectivity in allocating the restricted funds to the many qualified farmers. It leads inevitably to some distortion in income distribution in favor of the already larger farmers, who present a greater potential or ability (but not necessarily willingness) to repay.

If the current policy is to be continued, then measures have to be found to redress these distortions. This may be achieved through several methods, among which, higher income tax or sales tax to be paid by participant farmers, the tax receipts being used to increase loanable funds. This approach could be used to generate more funds so as to lend to the smaller farmers.

This approach may not be quite effective in Cameroon because of the flat tax system in the rural areas. Since the flat tax is historically inflexible downward for a given farmer, most farmers will be reluctant to participate, on the basis that once they enter the program, they will be charged a higher flat amount of tax, on the expectation of their higher income. This amount will have to remain the same for sometime regardless of whether they borrow or not.

A form of sales tax^{*} to be paid by farmers or some sort of taxation on the consumers who may be beneficiaries of the programs by paying lower

*By sales tax here, it is to be understood that a given percentage of the selling price (the price is determined by public officials) will have to be withheld by buyers for remittance to the Government.

prices resulting from increased production could be devised.

The difficulties experienced today in collecting taxes in the rural areas and the irregularity of sales of plantain reduce the appeal of any form of taxation, because of the problems involved in implementation. The study will not explore these avenues, though they could be successfully studied.

It is the contention of this study to show that a simple increase in the interest rate on loans with some relaxation on the use of these loan funds will be more effective in meeting the government's objective of greater aggregate farm output and the farmer's objective of increased income or improved economic status. In addition, this modification will lessen the income distribution distortions.

The higher interest rate will achieve these three objectives by (a) reducing the financial losses and thus, increase the outreach of the programme, (b) capturing some of the windfall gains to the major beneficiaries of the project in order to increase the loanable funds. The flexibility in the use of funds by the farmer will allow him to allocate his resources between production and consumption so as to maximize his own welfare or utility [75,80].

3.2 Data and Their Sources:

3.2.1 Description and Sources of Data:

One major objective of this study as already mentioned in Section 2.3, is to determine the effects of the current policy on farm loans in small farm agriculture, namely the policy of concessional rates of interest, on the long-run financial performance of both the lender and the customer. In order to achieve this objective, detailed information was needed on the

different operations of an agricultural lending project, in this case the plantain project with its lending component.

The plantain project* is a multipurpose agricultural project including extension, marketing, loans and even research. It is part of the Food Development Authority, or MIDEVIV (see footnote on Section 1.2). One of the major activities of the project was to supply small farmers with off-farm inputs for plantain production. Though MIDEVIV is actually interested in nearly all food crops, a special emphasis is placed on plantain (Musa Paradisiaca) production, because of its relative importance in the diet of the region as was already mentioned in the introduction.

Since we are interested in determining both the economic or social and the financial returns of the project, data on its cost and return activities were needed. On the cost side, figures related to the salary of management and extension personnel were needed, as well as the cost of materials and equipment, vehicles, supplies, family and hired labor, etc. On the return side, data on farm output, interest payments, etc., were to be found.

In the research plan, it had been hoped that all these data could be obtained from the records of the head office of MIDEVIV. However the actual organizational set-up of the project was found to be very different from the planned set-up. Figures on costs and especially on returns were difficult to find and even when found were impossible to sort out. As an example, the farm sales of the project originated not only from the project output, but from other sources as well. In this case, the returns could not

*For more details on the organization of the plantain project, see "Opération Ceinture Verte" [56].

be directly related to the costs, and for our purpose, this relation needed to be established. In view of the absence of most needed recorded data and of the inadequacy of others, we had necessarily but reluctantly to resort to planning data. These planning data, however, had to be slightly modified so as to reflect some on the field observations and to meet our particular purpose.

The second set of data used in the programming section of this study is derived from a survey conducted in five administrative divisions of the South-Center province. These 5 divisions were chosen mainly because they surround Yaoundé and constitute the major food and most of the plantain suppliers for the city. These 5 divisions are Lekié, Mefou, Mfoundi, Nyong and Kelle, Nyong and So. In nearly all the area covered by the survey each farmer produces a wide range of crops. Most of the crops produced entered the market only marginally, except for cocoa and plantain. Since our research is centered on commercial plantain producers, the population of the survey was further reduced, as several commercial plantain farms recently established had not yet entered their productive stage.

The survey provided information on the following broad areas: personal information on producers, farm operations, farm financing. Thus some data were to be obtained on the age of the producer, the size of the household expressed in terms of its daily calories requirements, kinds and sizes of crop produced, off-farm inputs used, sales, consumption, purchases, borrowings, etc. In several instances some needed information was entirely lacking or very inaccurate. This was the case for figures on area cultivated for various crops, family labor utilization, home consumption, food purchases, borrowing in cash or in kind from the informal sources, etc.

3.2.2 Area of Study:

As mentioned above, the area covered by this study comprises 5 administrative divisions of the Center-South province in Cameroun. Several attempts were made to obtain record data from the headquarters of the MIDEVIV, at the Marketing Division of the Porject, and at the headquarter of FONADER (National Funds for Rural Development). Those attempts, did not give usable information.

The areas surveyed is the immediate surroundings of Yaoundé. Though the actual reach of MIDEVIV is considerably wider, the study area for this research is limited to the 5 divisions listed above.

The choice of these 5 divisions was dictated by two major considerations. First, those 5 divisions are the main producers of plantain coming into the Yaoundé market, and our study has special reference to plantain. Second, time and financial constraints restricted the survey to extend beyond the specified time and space dimensions.

The 5 divisions included in the survey represent above 15 per cent of the total surface area of the Center-South province, and about 55 per cent of its population. The breakdown is given in Table 4.

As it can be seen on the table above, the area is very sparsely populated except for the town of Yaoundé and the Lekié division. Therefore, it can be said that, in general, besides the Lekié division, land availability is not expected to constitute a serious constraint to production, at least with respect to quantity.

3.2.3 Population and Sampling Method:

For the survey, it was not possible to obtain an exhaustive list of commercial plantain farmers operating in the 5 divisions. Our population

Table 4: Centre-South Province: Population Breakdown
(1977-1975 Estimates)

DIVISIONS	AREA IN SQUARE km	POPULATION	DENSITY
DJA-AND-LOBO	19,855	104,800	5.27
UPPER - SANAGA	11,875	53,900	4.53
LEKIE	3,000	190,900	63.63
MBAM	33,030	167,700	5.07
MEFOU-MFOUNDI-YAOUNDE	4,950	404,600	81.73
NYOUNG-AND-MFOUMOU	6,180	77,300	12.50
NYOUNG-AND-KELLE	6,400	82,300	12.85
NYONG-AND-SO	3,615	77,400	21.41
OCEAN	11,270	65,400	5.80
NTEM	16,000	131,100	8.19
TOTAL OR AVERAGE	116,175	1,354,400	Ave: 22.09

Source: United Republic of Cameroun

Ministry of Economic Affairs and Planning

Fourth Five-Year Economic, Social and Cultural

Development Plan (1976-1981). Provincial Programmes.

therefore is derived from information compiled from three main sources:

(a) the MIDEVIV Production and Marketing Divisions, (b) the headquarters of FONADER, (c) personal visits at the head offices of the 5 divisional delegations of agriculture. From these different sources, we obtained a population size of 120 farms or about 150 farmers. A subsample of farmers were drawn in each division using a table of random numbers. The size of each subsample was weighed by the size of the sampled population* of the particular division. From these subsamples, we derived a sample of 70 farms by summing up the 5 subsamples, which represented about 58 per cent of the population. From this sample of 70 we obtained 51 respondents or about 72 per cent of the sample and 42 per cent of the population.

The interviews were conducted mainly by two professional interviewers on a personal basis following a written questionnaire. Because of the financial limitations imposed, it was not possible in spite of our wish to pretest the questionnaire.

*Population here should be understood on a purely statistical sense, namely, the totality of the set of objects currently being considered. The population here is the sampled population, though the attempt is to study the target population (For distinction between sampled and target population, see Snedecor, P. 30 [76]).

CHAPTER 4

ECONOMIC, FINANCIAL, AND SOCIAL EFFECTS
OF THE POLICY OF CONCESSIONAL RATES OF INTEREST4.1 Interest Rates and the Aggregate Capital Market:

4.1.1 Role of Interest Rates:

Interest rates represent the price of the future in terms of the present. In other words, they are relative prices. At equilibrium then the interest rate indicates the marginal rate of transformation of present production into future production. It also determines the marginal rate of substitution between present and future consumptions, and this latter rate is dependent on individual and social tastes and preferences. These rates deeply affect savings and investment versus consumption decisions, and these decisions are critically important to economic growth and development.

Interest rates are the price (for lenders) or the cost (for borrowers) for temporary ownership transfers. Low interest rates tell savers not to bother with savings, that the future is cheap and will be easily provided for. High rates of interest tell consumers that the future is expensive and that savings will be highly rewarded. High rates of interest remind investors that funds are scarce and that capital goods will be expensive. Rates of interest are also the relevant prices in financial markets.

As the price of an input, the rates of interest will affect the capital intensity of the production process, that is, they affect the "choice of techniques".

4.1.2 Interest Rates Policies in LDC's:

In most LDC's, rates of interest are very low (-2 to 8 per cent in real terms) relative to the scarcity of capital. This policy of low interest rates is a deliberate and conscious choice. The policy is in no way an innovation by LDC's, as one may be led to believe, but an imitation of interest rate policies as practiced in some advanced countries. Such policies in many instances have been recommended to the LDC's by some development "experts".

GONZALEZ-VEGA [26,27] has identified two types of reasons underlying the adoption of these low-interest policies in the formal financial markets. The first type of reasons reflects the general nature of financial and monetary policies in LDC's. The second type is directly related to problems surrounding agriculture in general, and particularly small farm agriculture.

At the macro-economic level, most LDC's economic-policy-makers have deliberately excluded interest rates as a policy instrument or tool. Policy-makers in LDC's, as Gonzalez writes "have been more preoccupied with the nominal level of the rates and with the "moral" implications of usury (in spite of these measures, usurers' rates as high as 360 per cent have been reported in Cameroun) than with the possibility of enlisting the rate of interest as a powerful instrument for development".

The low level at which interest rates have been maintained is based on Keynesian theories of unemployment and depression. But it has to be recalled that this Keynesian analysis was based on the specific conditions of advanced economies and the results are not directly applicable in LDC's.

At the micro-economic level the low-interest-rate policies of the LDC's are based on the orthodox assumption that little voluntary savings

capacity exists in rural areas. This lack of adequate savings limits the small farmer in the proper exercise of his economic choice. The limited net worth of the small farmer leaves him dependent for loans upon high cost lenders, called "informal" lenders. These limitations seriously affect the small farmer in terms of his choice in production, marketing and even consumption.

In order to stimulate the small farmer to adopt some newly developed or introduced technology, and to reduce his dependence on high cost lenders (who keep the small farmer in the perpetual condition of subsistence producer), it is argued, the public sector or some institutional credit agency has to supply the small farmer with lower cost capital.

Though appealing the reasoning suffers from the failure to specify the basis for reducing this cost of capital. The most logical reference for reducing this cost is to look at the opportunity cost or the rate-of-return of capital.

By setting the interest rates on credit-savings unusually low (much lower than the opportunity cost of capital), small farmers are penalized in two ways: First, they are limited in their access to the institutional channels of credit (since these low rates lead the lenders to select only borrowers with excellent credit ratings). Second, they are denied access to financial saving instruments which could earn a significant rate-of-return.

In summary, the LDC's have kept interest rates far below equilibrium levels. They have, in so doing, consciously rendered them inoperative. What is the impact of this policy on the aggregate capital market (urban and rural)? The next section will briefly discuss this impact.

4.1.3 Impact of the Concessional Interest Rates on the Aggregate and Rural Capital Markets:

In formulating the nature of the research problem in Chapter 2, Section 2.2, it was clearly pointed out how the policy of low interest rates affects the loan program, mostly with respect to its financial performance (hence its survival), its reach, its distributional effects, etc. In a more fundamental sense, these interest rates are said to be low because they fail to equate the demand for and supply of credit, as shown on Figure 2.3. These rates are therefore below equilibrium rates.

The Aggregate Capital Market:

The classic argument against these below equilibrium rates is that they impoverish an economy by deepening the imperfections of the capital market - "the most fundamental of all kinds of market imperfection" [35]. They create excess demand for the factor that is already scarce, that is capital (at least in the LDC's), and increase the excess supply of those complementary factors, labor in particular, that are plentiful. Subsidization of the interest rate thus "distracts an economy from the processes and products that make best use of relative factor supplies and shrinks the frontier of production possibilities" [74]. In lagging economies in particular, these rates are prevented from doing their job, that "of reporting capital's marginal product in alternative uses, and that of equating demand for investment with the savings flow" [74].

In a more practical sense, these subsidized rates decrease the efficiency of portfolio management. In other words, they affect the allocation of savings among various categories of investments or assets, some of them evidently more socially or economically productive than others. Savings kept as jewelry, gold or other luxurious inventories (as the result

of the unattractiveness of the interest rates on bank-deposits for example) have very little if any, social or economic productivity. Low interest rates on the one hand many motivate consumers to bid more resources into consumption whereas on the other hand, they (low interest rates) encourage investors to bid them away from consumption into less productive investments. This conflict can be resolved only by the device of credit rationing.

The policy described above, referred to as the strategy of "financial repression" by Edward Shaw [74] is partly responsible for the high unemployment in lagging economies. Scarce savings indeed supply labor inadequately. Such a strategy, in addition to its resulting distorted capital market where usury is rampant, produces a dual* labor market. A relatively small proportion of the labor force is recruited for capital-intensive enterprises that benefit from low prices for capital, foreign exchange, domestic inputs. Unionized industrial labor is granted minimum-wage rates that, despite the erosion of its purchasing power during inflation, draw rural labor into urban unemployment. The limited savings available flow to capital-intensive production even though capital is scarce and labor plentiful, as previously mentioned. The strategy, then, conceals the comparative advantage of labor-intensive production: agriculture and indigenous manufacturing.

*Here, dual retains its common meaning as often used in development economics. It refers to the development of a modern sector of money economy alongside a traditional indigenous sector only partly monetized.

Dual labor market refers to the existence of a highly organized (unionized) and powerful, relatively well paid labor market in the industrial or modern sector, next to a indigenous, powerless labor market in the traditional sector, with nominal wages.

For further discussion on dualism, see Meir [53] pp. 121-152 and Higgins [36] pp. 380-384.

The Rural Capital Market:

While the above discussion on aggregate capital market remains valid for the rural capital market, this sector of the whole capital market deserves a particular evaluation, because of its relative importance (due to the number of the potential savers and borrowers in this sector) and because of the orientation of this study.

In nearly all LDC's, formal* capital markets exhibit a very low degree of organization, in terms of their structure and performance. These markets are therefore very inefficient** in their abilities to transfer capital from savers to borrowers at low costs. Various reasons can be identified for this poor performance.

Adams [1] has identified three sets of policies that are largely responsible for the debilitation of rural credit systems in LDC's. They are:

- (1) Distortion in the prices of products and/or inputs, under-investment in marketing facilities and in research for new agricultural technology with the resulting very low profit margins on loan use by small farmers.
- (2) Interest rates and other policies on agricultural, loans, creating serious distortions in the process of loan allocation by lending

*"Formal" capital markets here refers to financial institutions such as banks, savings and loans associations, credit associations and cooperatives. "Formal" and "institutional" will be used interchangeably in this study as opposed to "informal" markets made up of friends, relatives, local merchants and individual money lenders.

**Here, efficiency just refers to the ability of the market to provide adequate and low cost transactions (or ownership transfers) from savers to borrowers. For the market to be efficient the price (rate of interest) it generates has to be profitable to both the lender and the borrowers. For more discussion on market or marketing efficiency see Bressler and King [15] pp. 402-416.

institutions.

- (3) Interest rates and other policies on financial savings, which constrain the lending institutions to continually search outside the rural area for sources of funds, and, in so doing, limit the incentives to save in the rural areas.

With respect to our particular concern in this study, policies (2) and (3) above are expected to have a highly negative impact on the development of rural capital markets. These policies, and especially low interest rates, have limited the accumulation of savings in the rural areas. Indeed, as we said earlier these policies are real disincentives for peasants to defer consumption in favor of financial savings. This tendency is particularly strong in some LDC's where rampant rates of inflation make institutional interest rates negative in real terms.

The inability of formal markets to meet the needs of borrowers results in the ridiculously high rates these borrowers pay to informal lenders or to usurers. Rates as high as 144 per cent have been recorded in the Ivory Coast [28] for agricultural loans. The low rates charged by institutional credit agencies jeopardize their financial viability, owing to the high costs and losses they incur, with revenue insufficient to offset the resulting lending costs.

Indeed, as already mentioned above, these low rates make the peasants hold their financial saving, mainly in less productive forms such as cash, jewelry, gold, etc. With no incentives to hold their financial savings in reproducible financial assets, such as time deposits and others, the farmers will, for a long time, remain outside the national capital

market, and their marginal propensity to save may even decrease over time. This situation will be most damaging to capital accumulation, which is an essential part of the developmental process. It is to be recognized however, that constrained capital accumulation is not only due to low interest rates, but also to low rates of return on capital investments in the rural areas. Indeed what is suggested here is that higher interest rates open up possibilities for more savings, and not that they automatically lead to capital formation.

Another major and continuous concern to all economic units, be they individuals, households, private and public firms, and governments, is their liquidity position, that is their ability to meet their cash expenses as they become due. Liquidity is important as a tool for risk management. Liquidity management is thus to be seriously considered by any economic unit, and it is even more so for subsistence producers. The policy of low rates of interest may adversely affect liquidity management. Indeed, this policy which dampens any incentives to save, and which discourages the holding of the required savings in reproducible assets, as we just mentioned above, does probably have a negative effect on liquidity management, in the sense that it leads farmers to liquidity management practices that are more costly than could otherwise be achieved.

4.2 Economic and Financial Evaluation of the Plantain Project:

4.2.1 Brief Presentation of the Plantain Project:

The general objective of this project, which is a government project is to create modern plantain farms in the villages around the capital city, Yaounde. The project is borne out of a rapid increase in the price of plantain, increasingly diagnosed as, or attributed to a shortage in supply.

The ultimate goal is therefore to increase supply and reduce prices to an acceptable level.

As a multipurpose project, it intends to provide participating farmers with technical, financial and marketing assistance. This assistance is necessary if the participating farmers have to shift from their traditional or subsistence production practices to modern or commercial production patterns.

Extension: The project will provide farmers with the know-how in plantain production. The operation of commercial farms requires new cultural practices, fertilizer and insecticide application. Special training for plantain production will be provided primarily by field workers who will be in direct contact with the farmers. The former will insure through their daily visits that all the cultural operations are performed according to the technical specifications.

Loans: This component of the project assists the farmer by providing him with all the necessary inputs (in kind). These inputs include fertilizers, insecticides, pesticides, light farm equipment and farm tools. In addition, the felling of large trees and logging are conducted by the project personnel at no charge to the farmers. The inputs supplied to the farmer are to be repaid in cash with a 5 per cent annual interest rate at the time of harvest. The field workers assist in the distribution and collection of loans.

Because of the high default rate experienced in the first two years of its operation, the lending component is in the process of being transferred to another agricultural lending institution (FONADER).

The funds used for these loans are from the general appropriation funds of the government which will supply the project with the funds

necessary to finance the expansion of the project and to cover any eventual deficit. These government funds are actually disbursed each year by the National Fund for Rural Development (FONADER).

Marketing: The project had planned to have the farmer's output purchased by some licensed merchants. The sales were to be conducted under the supervision of the field workers who were to insure that the purchasing price is as specified by the project, and who will also help in the collection of loans.

Because of the lack of enthusiasm from the merchants (the profit margins are not attractive to them) provisions have been made by the project for the direct purchase of farm output. These operations have helped the project to widen its resource base. But financial resources are still limited as illustrated by their inability to reach on time all the supply centers.

Research: The project also attempts to improve the planting stock to be sold to farmers. This research involves selection and breeding to improve and increase yields as well as resistance to disease and to wind. It also carries out fertilization trials on plantain in order to determine adequate rates of fertilizer applications.

It is to be recalled that the above presentation of the project follows closely the planned project [56]. Some minor additions or deletions have been made following some on-the-field observations.*

*The whole Food Development Authority (MIDEVIV) has now expanded its action into the purchase and sale of food items other than plantain such as coco yams, yams, palm oil . . . etc. but plantain production and marketing remain its main activity.

4.2.2 Economic and Financial Analysis:

A General View:

It is often argued that government projects should be evaluated only in terms of their economic or social impact and not in terms of their financial profitability, since the overall government objective is not to achieve financial profitability. However, since social equity, as reflected at times by income distribution, has become more and more important to the development economist and to the political leadership, some emphasis should be given to the financial outcomes of the various participants or participant groups. The answer to the question, "who gains and who loses" may be determining on the decision to carry out the project.

Therefore, along with economic analysis, some consideration should be given to financial analysis. In short, project evaluation should include determination of its feasibility from many aspects, and particularly from those two aspects indicated above.

A. Economic Analysis: The goal of an economic analysis is to determine the contribution of the project to the economy as a whole, and to further establish whether this contribution is significant relative to the costs of the project or to the use of the scarce resources which the project will require.

As suggested by Leon A. MEARS, [52] three types of questions may be asked in economic feasibility:

- "1. Is the particular sector involved one that might contribute significantly to the economic development of the country at the particular time in question?"

2. Within this sector, will this project contribute effectively to the sector's development? And,
3. Is the contribution apt to be sufficiently high to justify use of the resources involved?"

Most economic analysis work will focus on answering question (3) above. In other words, the project analyst is primarily interested in appraising the total benefits of the project relative to its total costs. For this appraisal he may use several estimates, of which the most common are:

Benefits-Cost Ratio:

As the name indicates, this measurement is the ratio of total benefits to total costs, both benefits and costs being discounted to the present.

Thus

$$\text{Benefit-cost ratio} = \frac{\text{Present worth of benefits}}{\text{Present worth of costs}}$$

In mathematical form, the benefit-cost ratio may be stated as follows:

$$\text{Benefit-cost ratio} = \frac{\sum_{t=1}^N \frac{B_t}{(1+r)^t}}{\sum_{t=1}^N \frac{C_t}{(1+r)^t}} \quad (4.0)^*$$

Where: B_t = Benefits for year t

C_t = Costs for year t

N = Planning horizon

r = Discount or interest rate

The benefit-cost ratio is extensively used as a measure of social profitability. The value of the ratio has to be greater or equal to one

*Equation (4.0) can be simplified to $\sum_{t=1}^N \frac{B_t}{C_t}$, so that r , the discount rate, is not really relevant in this formulation of the problem.

for the investment project to be undertaken. If the benefit-cost ratio is equal to one, then the benefits are just equal to the costs and the investor is just breaking even.

A second way to estimate the profitability of a project is through the use of discounted cash flow measures. This discounted cash flows are obtained by subtracting the costs from the benefits on a yearly basis and to derive the net benefits stream which is then discounted at any appropriate discount rate. Theoretically, the best value for the discount rate would be the "opportunity cost of capital"--that is the return of the resources used for the project when invested in their best alternative opportunity. The prevailing or market interest rate, or the borrowing rate for the project to be financed, and the social rate of discount are other suggested measures. For a detailed discussion on the social rate of discount, see Baumol [8] and Pauly [67]. Whatever measure one chooses to adopt, the major problem is to obtain an adequate value for it, and this difficulty is compounded in the LDC's given the nature of their capital markets. There are two major discounted cash flow measures for evaluating profitability as already discussed under Section 3.1 of Chapter 3: they are the Net Present Value (NPV) and the Internal Rate of Return (IRR).

All the three measures of profitability indicated above--benefit-cost ratio, net present value, and internal rate of return--are differently efficient depending upon whether they are used as decision criterion or as a ranking criterion. The choice of one or the other may depend also on whether the alternatives we are evaluating are mutually exclusive or not.

The determination of social profitability of projects involves many other problems which may just be mentioned, their discussion falling out of the scope of this paper. They comprise:

1. The Scope and Nature of the Benefits or Costs:

At the outset there is the very important question of deciding on the benefits and costs to be considered in the analysis. It is not a simple issue in settling what benefits and costs should be included or excluded in the evaluation of the project. Gittinger [25] refers to this phase of analysis as the identification phase.

2. Market Prices Versus Accounting Prices:

The market price in some cases may not reflect the social value or the social cost. In order to estimate the real social profitability, inputs and outputs may have to be evaluated at a set of prices that reflect their social value better than the market prices. These are called the "accounting prices". The same argument may be used to adjust the wage rate or the rate of interest.

3. External or Secondary Effects:

This is used in analyzing projects whose social profitability is thought to be higher than the profitability from the standpoint of the enterprise [46]. There may be external economies related to inputs and to outputs which lead to "backward linkage" and "forward linkage" secondary benefits respectively. One needs to distinguish between these externalities what is technical or technological "spillovers" from the monetary or pecuniary "spillovers". Prest and Turvey [68] present a discussion on this distinction. The problem here again remains an accurate estimation of these secondary costs or benefits.

4. Intangible Benefits and Costs:

When projects are evaluated on the basis of their overall or social profitability, there may be several important variables which are often ignored in the computation of the three measures of profitability

indicated above. These intangible effects are often ignored partially because of the serious problems involved in their quantification.

Therefore taking account of these effects in economic analysis will invariably involve an element of subjectivity from the analyst. The common intangible effects may include a better income distribution, national unity or integration, political stability, regional economic equilibrium, national security, economic independence, social unrest, crime rate, etc.

B. Financial Analysis: In addition to analyzing a proposed agricultural investment project, to be certain it will contribute social benefits in excess of its social costs, and to determining the magnitude of this contribution, it is equally important to assess whether the farmers, government agencies or private firms each will have both the necessary incentives and timely adequate cash flows that will enable them to participate. This is the major concern of financial analysis, and its objectives as outlined by Gittinger [25] are as follow:

- "1. To insure that there are adequate incentives for farmers and other participants.
2. To assess the financial impact of the project on farmers and other participants. This assessment is based on an analysis of the participants' current financial position and on projections of their future financial positions as the project is implemented.
3. To provide a sound financing plan for the project.
4. To determine whether the financial requirements of the individual participants in the project are properly coordinated. This determination is made on the basis of an overall financial projection for the project as a whole.

5. To assess the financial management competence, especially of the larger firms and project entities, in order to form a judgement about how well they will be able to discharge their responsibilities for project implementation and what management changes may be necessary."

In summary then, financial analysis deals primarily with the revenue earning considerations of the project. It is concerned with establishing whether or not the project can achieve some financial viability, and if not, as a government project for example, how much will be needed for subsidy. This analysis, therefore, does not address itself to such considerations as externalities or secondary effects, intangible or unquantifiable effects.

After this brief general discussion on project evaluation, the next section will present the planned cost and return data that will be used to determine the profitability of the plantain project. As will be explained throughout the discussion in the next section, some slight adjustments have been found necessary so that the data may fit the particular objectives of this study.

4.2.3 Economic Analysis of the Plantain Project:

The measure selected for evaluating the profitability of this project is one of the discounted cash flow measures mentioned in Chapter 3 and namely the internal rate of return (IRR). The reason for this selection is the same as explained in the previous chapter.

Economic Costs of the Plantain Project: The various economic costs incurred by the project include administrative costs incurred in the direction, control, clerical works, office supplies, etc. The extension costs are made up of the salaries of the extension workers and their equipment and, in this particular case, the purchase, operating and insurance

expenses for the field workers. The labor costs include both family and hired labor. There are costs related to the various farm inputs (fertilizers, pesticides, seeds, ...) and farm equipment (cutlasses, wheelbarrows, files, etc.). There are also some research and training costs incurred in the experiment center of the project. The costs of land could be introduced at its rental value or opportunity cost. However, for the practical reason that no other crop is being displayed by plantain, the land is entered in the project at zero cost. The different cost figures related to the cost items enumerated above can be found in Table A1 of the appendix.

Economic Benefits of the Plantain Project: While economic cost items are relatively easy to identify, some economic returns are difficult to identify and even more difficult to quantify. The economic benefits include the value of farmers' output, the value of the research station output, and the gain to consumers as a result of lower prices. Other economic benefits which will not be quantified are employment generated by the project, which in turn, may reduce social unrest and the crime rate; higher consumption level resulting from additional food provided by the project, which may lead to better nutrition and consequently to better health, and which is an implicit reduction in social expenses and a certain improvement in productivity.

Valuation of the Economic Effects: Costs and benefits as indicated above pose some serious problems with respect to their valuation. The costs often have been estimated using accounting prices. The cost of family labor for example, could be estimated using what Gittinger [25] calls "shadow"*

*The term "shadow" here has no reference to the well known "shadow prices" as derived from the mathematical technique of linear programming. Gittinger probably means "accounting" wage rate.

wage rate. The valuation of output or benefits poses many more problems than the valuation of costs. A full discussion would go beyond the scope of this study. I will, therefore, indicate only one of these valuation problems as it relates directly to the plantain project. It is the valuation of the monetary gain accrued to consumers as the result of lower prices for plantain brought about by the project.* Should the gain be valued at the "old" plantain price or at the "new" price? In essence, this is nothing but the net increase in consumer surplus.

Indeed for the project under study, the price at which the output is sold "with" the project is much lower than the price "without".** The gain in this study is measured by pricing it at the difference between the price "without" and the price "with" the project. In other words, the output should be valued at the old price if we assume that the investment is small. It is also suggested that the arithmetic mean of the two be used [46].

The evaluation which follows uses the planning data as suggested in Chapter 3. Some of these planning data will be adjusted so that they may represent more realistic conditions as observed in the field. These adjustments will be all mentioned as they are introduced. The cost and return figures are summarized from the detailed costs and returns of the plantain project, which can be found in Tables A1, A2 and A3 of the appendix.

*There is no general agreement on how this valuation should be carried out. Several economists contend that even attempting to value these gains will lead to some double counting problems (see Prest and Turvey, op. cit.). The real issue remains that there is no agreement on what is a gain what is not.

**This "with" and "without" approach is suggested by Gittinger [25]. The "before" and "after" approach may lead to serious omissions.

Table 5 on the following page summarizes data from Tables A1, A2, and A3 of the appendix. The cost data are all from Table A1 of the appendix while the return figures are from Tables A2 and A3.

In addition to the data in those two tables, it has been necessary to introduce a new return item. This is the monetary gains accruing to the consumers as the result of lower prices for plantain, as we already mentioned above. These gains have been evaluated following not the price differential anticipated by the project planners, but rather following the observed price differential as reported by the MIDEVIV Marketing Division. From a survey conducted by this Division in 1976, there was a price differential of 17.8 CFA francs per kilogram of plantain between the MIDEVIV price and the average price of the various city markets [63].

Calculating a weighted price average for the seven markets in the city of Yaounde gives a figure of 15 CFA francs, and this is the figure used in the following calculations. The different calculations lead to a profitability rate of about 56 per cent. The method used is that of IRR, but since we are dealing with the overall economy in this section, this rate is termed "internal economic return" (IER), so as to distinguish it from the internal rate of return as used in financial analysis.

The internal economic return of 56.16 per cent indicates that the project will rank very high in terms of its social return or profitability. It has to be recalled that the costs and returns considered here are limited to monetary and quantifiable gains, owing to our inability to quantify some of the intangible benefits such as improvement in health resulting from better nutrition, less social unrest and others. This implies that the real and total social benefits go beyond the monetary gains, and the same may be valid for the social costs.

Table 5: Economic Return of the Project (Million CFA Francs)

Year	PROJECT COST ESTIMATES					PROJECT RETURN ESTIMATES					DISCOUNTED AT				
	Materials & Operating Costs (1)	Equipment & Vehicles (2)	Management & Extension (3)	Family & Hired Labor (4)	Research Supplies & Others (5)	Total Cost of the Project (6)	Value of Farmers' Output (7)	Research Station Sales (8)	Gains To Consumers (Lower Price) (9)	Total Monetary Returns (10)	Net Benefits (11)	55%		60%	
												Discount Factor (12)	NPV (13)	Discount Factor (14)	NPV (15)
1	12.785	18.074	17.172	3.015	41.100	92.146	---	---	---	-92.146	1.000000	-92.146	1.000000	-92.146	
2	38.318	20.330	21.850	10.268	23.100	113.866	12.950	.500	16.500	29.950	.645161	-54.139	.625000	-52.447	
3	84.218	15.116	24.344	24.585	15.800	164.063	50.325	1.500	65.250	117.075	.416233	-19.557	.390625	-18.354	
4	139.113	24.203	30.024	46.073	16.200	255.613	119.000	2.300	165.000	286.300	.268537	8.240	.244040	7.491	
5	199.545	34.525	33.094	65.368	16.600	349.132	244.000	6.100	353.250	603.350	.173249	44.041	.152587	38.790	
6	221.393	29.780	30.274	76.248	25.600	383.295	378.000	11.500	553.500	943.000	.111774	62.560	.095367	53.377	
7	237.620	26.130	23.259	81.063	20.500	388.572	466.000	15.200	685.500	1166.700	.072110	56.110	.059604	46.379	
Total	432.992	168.158	180.017	306.620	158.900	746.687	1270.275	37.100	1839.000	3146.375	---	+5.111	---	-16.910	

Source: From Tables A1, A2, and A3 of the Appendix.

$$\text{Internal Economic Return: (I.E.R.)} = 55 + 5 \left(\frac{5.111}{5.111 - (-16.910)} \right) = 56.16\%.$$

(By Interpolation)

1 U.S. Dollar = 246 CFA Francs

Given these high social returns from the project, the question may be asked about the viability of this project, or its ability to provide these social benefits for a longer period. The question may be equally asked about its financial impact on the various participants, or its effects on the current income distribution. The next section which deals with the financial analysis of the project will address itself to these questions.

4.2.4 Financial Analysis of the Plantain Project:

As already indicated under the general discussion on project analysis, financial analysis deals primarily with revenue earning considerations of the various participants in the project. This section will therefore estimate the financial returns (a) to the representative farmer, (b) to the project or the government. The measure to be used here is again the internal rate of return (IRR).

Financial Returns to the Farmer:

The costs to the farmer for participating in the project are his family labor, and/or some hired labor, his equity capital, and the interest payments on loans (he must pay 6 per cent on loans received). It was assumed in the previous section that the opportunity cost of land is zero, since the farms are created on new lands and no other crop is being displaced.

The benefits to him are the value of his output which comprises plantain (fruits) and planting stock, and an increase in the value of his labor as translated into the value of his output.

The figures used in deriving the IRR for the farmer are all computed from Table A2 of the appendix. No adjustment has been found necessary. The results are shown on Table 6 following.

Table 6: Financial Profitability of the Farmer
(Figures are in Thousands of CFA Francs)

Year	FARMER'S EXPENSES					FARMER'S RETURNS				Net Cash Flow (9)	DISCOUNTED AT			
	Equity & Labor (1)	Loans (Not an Expense) (2)	Loan Repayment		Total Cash Outflow (5)	From Sales of Plantain (6)	From Sales of Planting Stock (7)	Total Cash Inflow (8)	80%		NPV (11)	85%		
			Principal (3)	Interest (6%) (4)					Discount Factor (10)			Discount Factor (12)	NPV (13)	
1	43,750	122,000	---	---	43,750	---	---	---	1.0000	-43,750	1.0000	-43,750		
2	59,000	33,000	110,000	7,320	176,320	200,000	9,750	209,750	.5555	18,570	.5405	18,068		
3	91,550	---	45,000	2,700	139,250	160,000	9,750	169,750	.3086	9,412	.2921	8,909		
4	114,200	90,000	---	---	114,200	120,000	9,750	129,750	.1714	2,665	.1579	2,455		
5	92,000	---	90,000	5,400	187,400	250,000	9,750	259,750	.0952	6,887	.0853	6,171		
6	89,000	---	---	---	89,000	200,000	9,750	209,750	.0529	6,387	.0461	5,566		
7	59,950	---	---	---	59,950	150,000	9,750	159,750	.0294	2,034	.0249	2,485		
Total	549,450	245,000	245,000	15,420	809,870	1,080,000	58,500	1,138,500	-----	+3,015	-----	-96		

Source: Derived from Table A3 of the Appendix.
Internal Rate of Return for the Farmer: $(IRR) = 80 + 5 \left(\frac{3015}{3015 - (-96)} \right) = 84.85\%$

The calculations show a profitability rate of nearly 85 per cent for the typical farmer participating in his financial rate of return.

Two very important implicit assumptions underlie the calculations leading to this high rate of return. First, it must be indeed assumed that all plantain produced on the commercial farms are sold and none is home-consumed. This assumption is necessary as it is very hard to estimate any induced increase in the plantain consumption in the household. It is quite conceivable that due to the increase in his total plantain production, the farmer may raise his consumption, the increase coming off his commercial production.

Even if it had been possible to estimate that increase, there would still remain the additional problem of valuing it. Valuing it at the price at which the farmer sells his output will obviously lead to the same IRR as shown above, but it would not be realistic. The real price to be charged for this increase in consumption would be the price at which the farmer himself valued his home-consumed plantain before entering into the project.

The second assumption is an implicit assumption about income and price elasticities for plantain. The project planners have maintained that the increase in plantain supply will reduce the retail price, and that producers will increase their revenues, as shown by the high rate of return (IRR of 85 per cent).

The validity of this contention depends largely on the magnitude of the income and price elasticities for plantain; none of these figures was estimated by the planners, though some FAO estimates they indicate an income elasticity of 10 per cent. The general knowledge about demand

elasticities of agricultural products, and in particular of a basic staple food like plantain tends to indicate that both income and price elasticities of demand are quite small, that is they are much smaller than one. Thus price decrease resulting from an increase in supply will lead to lower total revenues for the producers.

Assuming zero income elasticity, or in other words, assuming that the income effect of the price change in this case is zero, which is saying that all the change in consumption is attributed to the substitution effect, we have attempted to estimate the price elasticity as implicitly assumed by the planners.

We used data provided by Table 3 of Chapter 1. We found the average increase in consumption for the period 1974/75 to 1979/80. Given the planned reduction in price from 25 CFAF to 19 CFAF, we used the price elasticity formula,

$$\frac{\Delta Q}{Q} \frac{\Delta P}{P} = \epsilon_p.$$

A figure of about 2.2 was obtained from these calculations.* This figure is evidently too high. It will still remain high even if some adjustments are made to compensate for the income effect which has not been considered.

*Average (estimated) consumption: 60,492 Tons
 Average traditional production: 40,628 Tons
 Average increase in consumption = 60,492 - 40,628 = 19,864 Tons $\Delta P = 25 - 19 = 6$

$$\epsilon_p = \frac{\Delta Q}{Q} \frac{\Delta P}{P} = \left(\frac{19,864}{37,500}\right) \left(\frac{25}{6}\right) \approx -2.2$$

It is assumed in the calculations above that:

- (a) All the increase in consumption comes from the project farms
- (b) Without the project, the consumption would have come only from the traditional production.

Assuming that the farmer's rate of return is as high as shown above, 85 per cent, we conclude that the farmers participating in the project draw exceptional high financial benefits. What is the financial rate of return for the project as a whole? The next section will look into this question.

Financial Returns to the Project:

Since the whole project is financed through government general revenues, one may be interested in knowing what are the government receipts. The government here is used to mean the project agency and they will be used interchangeably throughout this section. It seems useful to find out what the agency's financial returns are, i.e., to establish how efficient the project is in the use of public funds. It should, therefore, be emphasized that as understood here, the government or the project agency is no identical to society as a whole.

What then are the costs and benefits of the project? The costs incurred by the project are made up of economic costs identified above minus farmers' own capital, family and hired labor. To these must be added some other cost items which were not relevant in Section 4.2.3, but which are of great importance in this section. They are:

(1) The opportunity cost of capital: The cost of the capital used in loans constitutes an additional real cost to be taken into account. While some public lending institutions receive government loans for which they are required to pay nominal interest charges, others operate with government-provided equity funds. This is the case for the plantain project. Whatever the source and the use of capital, there is an opportunity cost of using funds drawn from some alternative programs. There is a substantial amount of literature on the opportunity cost of capital in LDC's. The various estimates are often 8 per cent or more in real terms.

The estimate for Cameroon, though not entirely satisfactory, could be the price the country as a whole is willing to pay for international loans, as opposed to the price of internal financing through taxes or money "printing". The interest rates paid on loans from the World Bank are chosen as a proxy. They average 8 per cent per annum [16]. This cost element, which was not considered in the original project, and which has been disregarded in establishing the internal economic return (IER) in Section 4.2.3, has to be included here in order to meet both practical and theoretical requirements. Indeed, if we are concerned about efficiency, (not equity) it is conceivable to visualize the project as a private economic unit, and thus, we can establish its internal rate of return (IRR).

(2) Taxes and Duties: If we visualize the project as a private economic unit, then custom duties and taxes have to be considered as cost items to the project. These two items were just ignored in economic analysis as it concerned itself with only the aggregate impact of the project. The figures for these items are all from Table 1 in the appendix.

(3) Risk Premium and Delinquency:^{*} For purposes of simplification, we will assume that delinquency is outright, though this is not realistic.

*In this study, where delinquency is assumed outright, there is no distinction between default and delinquency and they are used interchangeably.

Following Bottomley's argument as mentioned above [14], Baker [5] adapted the following mathematical formulation of the risk premium:

$$\text{Risk premium } \gamma_p = \frac{dP + dP(a+f)}{P - dP}$$

where γ_p = Risk premium.

d = default or delinquency rate.

P = Principle (loan).

a = administrative cost, expressed as a percentage of total loan.

f = Interest rate paid on lending funds or opportunity cost of capital, expressed as a percentage of total loan.

The above equation can be rearranged and rewritten as follows:

$$\gamma_p = \frac{d}{1 - d} (1+f+a).$$

The coefficient, $\frac{d}{1 - d}$, is what Bottomley defines as lending risk factor.

There is a cost element incurred by the lender as some of the borrowers default. Default cost is only part of the premium for risk which, although derived from default, is not identical to it. Bottomley [14] illustrated this point by using some hypothetical figures. A mathematical formulation of risk premium is provided by Baker [5]. In economic analysis, risk premium is just negative taxes or transfer payments within the same economic unit (country). They were left out in Section 4.2.3. As already mentioned, they are real costs to be paid by a private economic unit. In the current project, an optimistically low rate of default, 10 per cent,^{*} was assumed. The default rates on institutional agricultural loans in Africa average about 38 per cent (see Table A4 in the appendix). The assumed plan default rate will be used in the following calculations of Table 7. The same calculations are carried out on Table 8, but now using the observed average default rate of 36 per cent.

The results of the calculations as shown on the following Table 7, bring out a tremendous financial loss to the project. This financial loss was expected, as the project charges 6 per cent interest rate for funds obtained at 8 per cent opportunity cost. It is noteworthy to recall that the 8 per cent opportunity cost of capital really represents the lower limit of the true cost of capital, given its relative scarcity in Cameroon. It should, therefore, be kept in mind that the loss is very much underestimated because of the underestimation of the cost of capital and also

*The project planners have based their calculations on two repayment hypothesis. There is a "low" repayment hypothesis of 90 per cent or 10 per cent default and a high repayment hypothesis 98 per cent or 2 per cent default. The optimism of their "low" repayment hypothesis is obvious as we look at the record as shown by Table A4 of the appendix.

because of the 90 per cent repayment rate assumed for the project assumed.

Table 7 shows all net cash flows to be negative. This poses a mathematical problem with respect to finding the IRR of the project. Indeed there exists no value of IRR which will make the sum of all the discounted net cash flows exactly equal to zero. Therefore, we can only estimate the value of IRR for which the sum of the discounted net cash flows will asymptotically approach zero. The value of IRR estimated in this manner will have to be negative, and will theoretically represent the internal rate of negative returns or the rate of loss. The actual calculations lead to negative rate over 600 per cent. Therefore, in order for the project to break even while maintaining the interest rate it charges borrowers at 6 per cent, it will have to be subsidized by the government at the rate of about 600 per cent.

Higher Economic Returns and Negative Financial Returns for the Government: A Dilemma?

From the economic and financial analysis presented above, it has been estimated that the society as a whole enjoys a rate of return of about 56 per cent (Table 5) and the typical participant farmer enjoyed an even higher rate of return, about 85 per cent (Table 6). But the project, seen as a government economic unit suffered a financial loss of nearly 528 million CFA francs.

How can the financial loss incurred by the project be reconciled with the very high economic return? The reconciliation is at the very heart of the distinction between economic and financial analysis as we introduced it at the beginning of this chapter. It brings into a sharper focus the importance of the financial analysis.

The financial loss implies or suggests that though the economic returns are very high, there are some serious limitations on the availability of those resources required to produce these high returns. In other words, the financial viability of the project and hence its viability through time is, to say the least, uncertain. It is rather evident that the government (project) would want to extend these high economic returns in space as well as in time (extend the outreach of this project). The financial loss curtails the extension of this outreach.

It is to be noted that this financial loss could be seen at the outset, as the project was charging the borrowers a 6 per cent rate of interest for funds obtained at a cost (opportunity cost) of 8 per cent, since the interest payments constitute the major source of the projects own revenues.

The figures given above suggest a tremendous subsidization of the farmers. Should farmers who are enjoying an 85 per cent return on their investments be so highly subsidized? Such large subsidies can hardly be explained when government revenues are already known to be quite inadequate in meeting its needs.

The point is that the economic returns for the society and the farmers' financial returns can be maintained (at lower levels) for a longer period and for a larger farm population if the financial viability of the project is secured. This financial viability can be secured by reducing the project net costs. In addition to the serious strain these subsidies put on limited government revenues, they lead to another problem, namely their impact on income distribution, as will be discussed later in this chapter. It could, therefore, be said that in evaluating public projects, economic analysis is but a necessary condition, while financial analysis is a sufficient condition. Both conditions have to be met.

With the more realistic default rate of 36 per cent (average for several African institutional lending agencies) the accumulated net cash flow for the 7-year period is negative 847.20 million CFA francs.

The high costs of these small farmer loans is an economic fact because of both the small size of loans, the cost of supervision, and various problems related to debt collection. Several approaches have been suggested for curbing these high losses. These suggestions include among others, group lending, simplification of lending procedures, disassociation of the credit function from other technical assistance services, raising the interest rate they charge to reflect the scarcity of funds, lowering the default rate, etc.

Though all the suggestions above could be implemented simultaneously or with various mixes, this section focuses only on two of the above suggestions: the rate of default and the interest rate charged to borrowers. It is held that an upward adjustment of the current rate of interest is necessary for the viability (financial) of the lending institution, as is the reduction in the rate of default.

One recognizes that the project agency is not a profit-oriented institution. However, as an efficient government agency, it should (at least in an idealistic sense) operate in such a way as to break even on the average. According to this break-even concept, the project should adjust the interest rate it charges the borrowers so that the total revenues will just be equal to the total costs of extending and collecting loans (over some time period). This interest rate is given by the total costs of extending loan services, total costs expressed as a percentage of total loans extended for a given period, *ceteris paribus*.

Table 7: Financial Returns to the Project (Million CFAF)
(A 10% Default Rate is Assumed)

Year	Loan Funds (1)	PROJECT EXPENSES							PROJECT RETURNS			Net Cost Flow (12)
		Cost of Loan Funds (8%) (2)	Adminis- tration (3)	Default 10(%) (4)	Risk Premium (5)	Research Station Input Delivery (6)	Taxes and Duties (7)	Total Cash Outflow [(2)+(3)+(5) + (6) + (7)] (8)	Research Station Sales (9)	Interest on Loans (6%) (10)	Total Cash Inflow (11)	
1	12.20	.97	12.42	1.22	2.84	5.57	7.80	29.60	---	---	---	-29.60
2	33.80	2.70	20.45	3.38	6.32	11.40	8.50	49.37	.50	.73	1.23	-48.14
3	69.20	5.53	33.83	6.92	12.05	14.03	10.90	76.36	1.50	2.02	3.72	-72.62
4	110.90	8.87	50.23	11.09	18.87	18.73	17.70	114.40	2.70	4.15	6.65	-107.95
5	118.80	9.50	42.32	11.88	18.93	20.51	26.50	117.76	6.10	6.65	12.75	-105.01
6	95.30	7.62	39.00	9.53	15.75	24.61	27.70	114.68	11.50	7.12	19.62	-95.06
7	8.20	.65	30.10	.82	4.32	24.08	28.10	87.25	15.20	5.71	17.91	-69.34
Total	448.40	35.84	228.35	44.86	79.08	118.93	127.20	589.40	37.10	26.38	61.68	-527.72

Source: Computed from Tables 1, 2, 6, and 7 of the appendix.

$$\sum_{t=1}^T \frac{NCF_t}{(1+k)^t} \rightarrow 0, \text{ for a certain value of } k.$$

Table 8: Financial Returns to the Project (Million CFAF)
(A 38% Default Rate is Assumed)

Year	Loan Funds (1)	PROJECT EXPENSES							PROJECT RETURNS				Net Cash Flow (12)
		Cost of Loan Funds (8%) (2)	Cost of Administration (3)	Cost of Default (38%) (4)	Risk Premium (5)	Research and Input Delivery (6)	Taxes and Duties (7)	Total Cash Outflow [(2)+(3)+(5)+(6)+(7)] (8)	Research Station Sales (9)	Interests on Loans (6%) (10)	Total Cash Inflow (11)		
1	12.20	.97	17.42	4.63	15.68	5.57	7.80	42.44	---	---	---	-42.44	
2	33.80	2.70	20.45	12.84	34.90	11.40	8.50	77.95	.50	.73	1.23	-76.72	
3	69.20	5.53	33.83	26.29	66.53	14.03	10.90	130.82	1.50	2.02	3.72	-127.10	
4	110.90	8.87	50.23	42.14	104.19	18.73	17.70	199.72	2.30	4.15	6.45	-193.27	
5	118.80	9.50	42.32	45.14	104.57	20.51	26.50	203.40	6.10	6.65	12.75	-190.65	
6	95.30	7.62	39.00	36.21	86.98	24.61	27.70	185.91	11.50	7.12	19.62	-166.29	
7	8.20	.65	30.10	3.11	23.87	24.08	28.10	106.80	15.20	5.71	17.91	-88.89	
Total	448.40	35.84	228.35	170.36	436.72	118.93	127.20	947.04	17.10	26.18	61.68	-885.36	

Source: Modified from Table 6 above.

Table 9: Determination of the Interest Rate to be Charged in Order to Break Even

Year	Loan Funds (1)	LENDING EXPENSES							LENDING RECEIPTS		Rate of Interest Required To Break Even (%) (10)
		Cost of Funds (2)	Administration Costs (3)	Default Costs (10%) (4)	Risk Premium (5)	Taxes & Duties 12% of (1) (6)	Cash Outflow (7)+(3)+(5)+(6) (7)	Interest To be received on Loans* (8)	Net Cash Flow** (9)		
1	12.20	.97	7.88	1.22	1.78	1.46	7.09	---	-7.09	---	
2	33.80	2.70	7.99	3.38	4.93	4.05	19.67	20.85	+1.18	170.90	
3	69.20	5.53	16.37	6.92	10.11	8.30	40.31	41.49	+1.18	122.75	
4	110.90	8.87	26.24	11.09	16.20	13.30	64.61	65.79	+1.18	95.07	
5	118.80	9.50	28.10	11.88	17.36	14.25	69.21	70.39	+1.18	63.47	
6	95.30	7.62	22.54	9.53	13.92	11.43	55.51	56.69	+1.18	47.71	
7	8.20	.65	1.94	.82	1.19	.98	4.76	5.94	+1.18	6.23	
Total or Average	448.40	35.84	106.06	44.84	65.49	53.77	316.84	261.15	0	84.35	

Sources: Condensed from Tables 1, 2, 11 and 12 in the appendix.

*Computed by summing columns (7) and (9).

**In order to break even after 7 years, it has been assumed that the 7.09 million CFA Francs negative returns incurred in year 1 will have to be recovered in 6 equal positive returns for the remaining 6 years.

***It should be noted that the interest paid in year 1, pertains to the loan extended in year t-1.

It should be noted that in Table 9 the following cost and return figures are related to those costs resulting only from the disbursement and collection of loans. Indeed, Table 9 shows only those costs and returns that relate to the lending component of the project. The average break-even interest rate is found to be about 84 per cent. Of course, no institution will charge farmers such a rate of interest. What this high rate implies in fact, is that in addition to adjusting the interest rate, various improvements are needed to reduce administrative costs and improve the repayment rate.

In these efforts to reduce the costs of lending to small farmers, a serious and considerable attention has to be paid to default and delinquency. Default management is crucial to any lending agency because of the multiplicative effect it has on other components of lending cost.*

In order to evaluate the magnitude of the effects of interest rate and the default rate on the cost structure of the lending institution and on the profitability of the borrower, both rates were parameterized. First the interest rate was parameterized (Table 10), then the default rate was parameterized (Table 11), and finally both were parameterized simultaneously (Table 12).

*From Baker's mathematical formulation of risk premium given in the preceding footnote, the following equation of the lending cost may be derived.

$$LC = f + a + \gamma p.$$

Substituting γp by its value as found in the previous footnote gives,

$$LC = f + a + \frac{d}{1-d} (1+f+a).$$

Where a , f , d , are defined as above. The multiplicative effect of default as mentioned above is illustrated through the term, $\frac{d}{1-d} (1+f+a)$.

The results are shown on the following tables. The change in the interest rate the borrower pays from the current 6 per cent to a higher rate of 26 per cent (a rate more in line with the scarcity of funds) reduces the farmer's net returns by 49,000 CFA francs or about 15 per cent.

What is striking here is that with the 49,000 CFA francs decrease in the farmer's net returns, the latter still enjoys an internal rate of return of about 50 per cent (see Table 10), which is still a very high profitability rate. More important, is the magnitude of the increase in total revenues (89.68 million) represents 20 per cent of the total loans (448.4 million). This is significantly important as it shows how many more farmers could be served should the project increase the rate of interest it currently charges the participating farmers.

The effects of the second variation introduced, the variation in the default rate, are illustrated in Table 11 of the following page. We have varied the interest rate from the current 6 per cent to a common rate of 36 per cent, which is equal to the African average (see Appendix, Table A4) and to zero per cent. The project total costs decrease from 911.20 million CFA francs to 510.35 million CFA francs, or about a 44 per cent decrease in cost. The same reduction is illustrated through the net cash flow which increases from minus 847.2 million to minus 446.35 million CFA francs. These figures obviously deserve a word of caution, as the zero-to-six per cent range of default rate is rather idealistic and, not often achieved.

The two variations introduced above have been made only in specific directions: the changes in the rate of interest have been limited to increases while the changes in default rate have been limited to decreases

Table 10: Effects of Varying the Interest Rate on the Farmer's Profitability and Project Costs

Rate of Interest (%)	FARMERS (CFAP)			PROJECT (Million CFAP)		
	Cost	Net Returns	IRR (%)	Interest Received on Loans	Total Revenues	Increase In Revenues
6	809150	329350	78.91	26.90	64.00	0
8	814050	324450	74.75	35.87	72.97	8.97
10	818950	319550	71.00	44.87	81.94	17.94
12	823850	314650	67.56	53.81	90.91	26.91
14	828750	309750	64.30	62.78	99.88	35.88
16	833650	304850	61.34	71.74	108.84	44.84
18	838550	299950	58.57	80.71	117.81	53.81
20	843450	295050	55.95	89.68	126.78	62.78
22	848350	290150	53.55	98.65	135.75	71.75
24	853250	285250	51.25	107.62	144.72	80.72
26	858150	280350	49.93	116.58	153.68	89.68

Table 11: Effects of Varying the Default Rate
On the Project Costs

Default Rate(%)	Total Default	Cost Due To Risk Premium	Project Total Costs	Amount of Principal Repaid	Net Cash Flow	Reduction in Costs
36	161.42	400.85	911.20	286.98	-847.20	0
34	152.46	367.11	877.46	295.94	-813.46	33.74
32	143.49	335.35	845.69	304.91	-781.69	65.51
30	134.52	305.41	815.75	313.88	-751.75	95.45
28	125.55	277.13	787.47	322.85	-723.47	123.73
26	116.58	250.38	760.72	331.82	-696.72	150.48
24	107.62	225.04	735.38	340.78	-671.38	175.82
22	98.65	201.00	711.34	349.75	-647.34	199.86
20	89.68	178.16	688.50	358.72	-624.50	222.70
18	80.71	156.43	666.77	367.69	-602.77	244.43
16	71.74	135.74	646.08	376.66	-582.08	265.12
14	62.78	116.01	626.35	385.62	-562.35	284.85
12	53.81	97.18	607.52	394.59	-543.52	303.68
10	44.84	79.18	589.52	403.56	-527.52	319.68
8	35.87	61.97	572.31	412.53	-508.31	338.89
6	26.90	45.49	555.83	419.38	-491.83	355.37
4	17.94	29.69	540.03	430.46	-476.03	371.17
2	8.97	14.54	524.88	439.43	-460.88	386.82
0	0.00	0.00	510.35	448.40	-446.35	400.85

from the observed African average of 36 per cent. These variations have been limited to the respective directions so as to respond to specific policy goals. In other words, the simulations introduced are only those which will improve the cost structure of the project.

The simultaneous variation of the rate of interest and the rate of default is illustrated in Table 12 following. Though not clearly shown in Table 12 the combined effect of Tables 10 and 11 results in an increase of 490.53 million CFA francs a reduction of 89.68 million in cash outflow plus an injection of 400.85 million in cash inflow). The same simultaneous variation leads to an increase in net cash flow of 563.21 million CFAF.*

From the three tables above and from the brief comments which precede, two important observations can be made: First, it is clear that any of the two changes and particularly both of them combined add tremendously to the financial base of the project and by so doing may allow it to lend to other needy farmers, or in other words, extend its outreach, which is highly desirable. Second, in spite of the very large (practically unachievable) addition to the financial basis of the project by the improvement suggested above, the project net cash flow is still substantially negative, minus 446.35 million in Table 11 and minus 284.92 million in Table 12. These results suggest the very importance of the necessity of a comprehensive package of changes to be all introduced simultaneously, as it was already mentioned in the previous pages of this section.

1

*The two figures differ because in Tables 9 and 10 the rate of interest and the default rate are varied from 6 to 26 and from 36 to zero per cent respectively while on Table 11, the interest rate is varied from 6 to 42 per cent.

Table 12: Effects of a Simultaneous Variation
of the Rate of Interest and Rate of Default
On the Project Costs

Default Rate (%)	Total Default	Cost Due To Risk Premium	Project Total Costs	Interest Received On Loans	Project Total Revenues	Net Cash Flow	Reduction In Costs + Increases In Revenues	Rate of Interest (%)
36	161.42	400.85	911.20	26.90	64.00	-847.20	0	6
34	152.46	367.11	877.46	35.87	72.97	-804.49	42.71	8
32	143.49	335.35	845.69	44.84	81.94	-763.75	83.45	10
30	134.52	305.41	815.75	53.81	90.91	-724.84	122.36	12
28	125.55	277.13	787.47	62.78	99.88	-687.59	159.61	14
26	116.58	258.38	760.72	71.74	108.84	-651.88	195.32	16
24	107.62	225.04	735.38	80.71	117.81	-617.57	229.63	18
22	98.65	201.00	711.34	89.68	126.78	-584.56	262.64	20
20	89.68	178.16	688.50	98.65	135.75	-552.75	294.45	22
18	80.71	156.43	666.77	107.62	144.72	-522.05	325.15	24
16	71.74	135.74	646.08	116.58	153.68	-492.40	354.80	26
14	62.78	116.01	626.35	125.55	162.65	-463.70	383.30	28
12	53.81	97.18	607.52	134.52	171.62	-435.90	411.30	30
10	44.84	79.18	589.52	143.49	180.59	-408.93	436.27	32
8	35.87	61.97	572.31	152.46	189.56	-382.75	464.59	34
6	26.90	45.49	555.83	161.42	198.52	-357.31	489.89	36
4	17.94	29.69	540.03	170.39	207.49	-332.54	514.66	38
2	8.97	14.54	524.88	179.36	216.46	-308.42	539.28	40
0	0.00	0.00	510.35	188.32	225.43	-284.92	563.21	42

This comprehensive package approach will be discussed in a little more detail in Chapter 6, where we will attempt to deal with the policy implications and suggestions resulting from the study.

4.3 Distributional Effects of Concessional Rates of Interest:

Public credit programs like any other public activity are evaluated on the basis of two major considerations: efficiency (that is comparing the benefits or returns generated by the programs with the costs incurred in its implementation) and equity (that is the impact of the program on the income distribution). These two criteria for evaluating public policies are at times in conflict, and this has led some writers to talk of an "efficiency equity quandry". In the particular case of a credit program there is a third and very important consideration, that is the financial and institutional viability of the program.

The impact of the policy of concessional rates of interest on the efficiency consideration has been discussed at some length in the finance literature by such economists as Gordon [28], McKinnon [51], Shaw [74], etc. The impact of this same policy on equity and the viability of the lending institution has not received enough attention. This part of the study discusses very briefly the distributional effects of subsidized rates of interest.

The agricultural sectors of most developing countries have received large injections of funds originating either from local sources or from international agencies. These funds have been channelled to farmers through some institutional or formal credit program. The expansion of this formal lending program is bound to affect or alter the allocation of resources and, by extension, the income distribution in the recipient areas.

This expansion has had as one of its features the concentration of a larger volume of formal loans into fewer hands. As illustrated on Table A14 of the appendix, the proportion of African farmers receiving loans from formal sources is less than 5 per cent. Santos [71] for example, has shown that in Honduras, among those farmers receiving formal loans (10 per cent of the farm families) 9 per cent obtain nearly 81 per cent of the total value of total loans outstanding. The loans granted to these borrowers average about 50 times greater in size than those granted to others. The expansion of these formal loans, therefore, does have a negative impact on the income distribution, not because of the expansion per se, but, as will be shown, because of the policy of low rates of interest which goes with it. Here we will look at how these rates affect both the current distribution of income and the growth of the farmer's income.

Subsidized Rates of Interest: Effects on Income Growth and Income Re-distribution:

The following discussion will be quite brief. A more detailed discussion of this issue can be found in Gonzalez-Vega [26,27]. Any producer's net income is some function of his internal resources or endowments, his production and marketing opportunities, his external investment opportunities, and his access to external physical, managerial and financial resources.

In order to simplify the following discussion, it will be assumed that, though it is unrealistic, all farmers are faced with the same internal resources, and the same production and marketing opportunities. The only relevant variable, therefore, will be their differentiated access to external resources which will be reduced in this case to external

financial resources, since access to the latter resources automatically leads to access to other external resources (physical and managerial).

As already mentioned in the previous pages, subsidized rates of interest constitute an outright income transfer to the borrower, and the policy makers often use these rates as an exclusive mechanism to transfer income to small farmers who supposedly are exploited by the private money brokers. The size of the subsidy or grant will be directly proportional or will be a direct function of the size of each loan.

The value of the subsidy may be represented with the following mathematical expression:

$$S = (r_e - r_c)L \quad (4.1)$$

where S represents the size of the subsidy, r_e , the equilibrium rate of interest or the real opportunity cost of capital, r_c , the concessional or the actual rate charged, and L represents the size of the loan. It is obvious from equation (4.1) that as the size of the loan increases so will the size of the subsidy it carries with it, and that the larger the difference between r_e and r_c , the larger S will be.

Now, if, following Gonzalez-Vega [27], we assume that the size of the loan is highly correlated with the size of the borrower or the size of his wealth endowment or even his social ranking, or in short, his "collateral,"* then the amount of subsidy he receives can also be expressed as a function of his "collateral"; say the size of the loan is some positive function g

*Collateral here includes in addition to physical and financial assets, some measure of his social or political influence, the latter becoming often more important than the physical and financial assets.

of the borrower's wealth or his social influence or rank which will be represented by w , the size of the subsidy is then re-written as follows:

$$S = (r_e - r_c)gW \quad (4.2)$$

Equation (4.2) shows that the farmer with the larger wealth will obtain loans of larger size and the farmers who do not obtain any loans, who are usually the smallest and the poorest, do not benefit at all from the program; they receive no subsidy. This mechanism of income transfer, therefore, worsens the overall income distribution. This worsening of the income distribution resulting from the practice of low rates of interest has been summed up by Gonzalez-Vega [27] in what he calls the iron law of interest rate restrictions; in this law, Gonzalez-Vega claims that

"As a ceiling imposed on loan rates of interest becomes more restrictive, the size of the loans granted to borrowers who are rationed declines and the size of loans granted to borrowers who are not rationed increases".

In addition to the increasing size of the subsidy received by the larger farmers,^{*} the income distribution is further affected by the impact of these subsidies on the growth of the farmer's income. The mathematical formulation of the growth of the income of the firm household unit which was given in Chapter 3 (see equation 3.17, Chapter 3), is helpful in discussing the effects of increasing subsidies on the income growth of the farmers.

*Gonzalez draws his conclusions mainly from observations gathered in Costa Rica. The difference between small and large farmers is indeed considerable in Latin America. For example there is a great difference in farm size between the well-known latifundistas and other small farmers. In Africa however, differences of this magnitude are rarely found. Thus, the effects of the subsidies on income distribution between large and small farmers, though present, are somewhat reduced.

In that formulation, the rate of growth G , relative to net returns before tax, was expressed as follows:

$$\Delta Q/Q = G = [D/Q (r-i) + r] \quad (4.3)$$

G , D , r , i , are all defined as in Chapter 3. The rate of return, r , for farmers using these subsidized loan funds was estimated at about 85 per cent (see Table 5 in Section 4.2.4 of the current chapter). The rate of interest charged on loans was a mere 6 per cent.

From examining equation (4.3), it is evident that the two factors which affect directly the rate of growth, G , are D , debt capital (borrowed funds), and $(r-i)$. The value of r obtained in Table 5, (85 per cent) with a 6 per cent rate of interest (i), and even that obtained in Table 9 (50 per cent) with a 26 per cent interest rate, indicate that the term $(r-i)$ is of a considerable magnitude. For a short period analysis, we can assume that term to remain constant as i is policy-determined.

Under those conditions, the only variable in equation 4.3 is D , debt capital, and G is a direct and positive function of D . If we assume that the subsidized lending program is the only source of external finance for the farmers, then D will be identical to L in equation 4.1 above.

From equation (4.1), L can be expressed as follows:

$$L = \frac{S}{r_e - r_c} = D \quad (4.4)$$

Now equation (4.3) can be rewritten by substituting D by its value as in expression (4.4).

$$\Delta Q/Q = G = [1/Q \left(\frac{S}{r_e - r_c} \right) (r - r_c) + r]^* \quad (4.5)$$

Equation (4.5) is more revealing in this section than equation (4.3). Indeed it shows how the size of the subsidy (not the debt) affects the rate of growth of income.

The rate of growth of farmer's income is some direct and positive function of the size of the subsidy. Therefore, access to these subsidized lending funds has a great impact on the farmer's growth possibilities.

As a summary of the brief discussion of this section, the following observations can be made:

- (i) The larger farmers receive increasingly larger loans and the smaller farmers' share of the total lending funds declines.
- (ii) The larger farmers benefit from increasingly larger subsidies or income transfers as the result of the increase in the size of the loan they receive and because a larger proportion of these loans constitutes subsidies.
- (iii) The impact of external finance (and mostly of subsidized finance) has a great bearing on the growth possibilities of farmers' income, and this in turn affects the distribution of income through time.

It can, therefore, be held that the interest-rate subsidy is a regressive mechanism for income redistribution.

*Note that i in equation (4.3) is the same as r_c in equation (4.1). Thus in equation (4.5) i has been substituted for by r_c .

CHAPTER 5

MODELING THE FINANCIAL ENVIRONMENT OF THE SMALL FARMER
AND THE GOVERNMENT AGRICULTURAL CREDIT PROGRAMS

The current chapter will present the mathematical model used in monitoring the financial behavior of the small farmer. After a general and brief description of the model, the objective function, the constraints, and the activities of the model will be presented. The results of the analysis will be discussed in the next chapter.

5.1 The Linear Programming Model:

The general model was described in Chapter 3, Section 3.1.2. Most of the data used in constructing this LP model were obtained from a survey carried out for this study. These data represent averages for the sampled farmers as briefly described in Chapter 3. The unit under study, therefore, represents a typical farm household in the Center South province of Cameroon. The representative household is a unit of 8 persons of which 4 children under 15 years old. The average size of the area farmed is 2.5 hectares and the average age for the head of the household is 45 years.

In addition to these survey data, other empirical information needed for the study and not available from the survey have been estimated from various sources, and at times have had to be assumed. The data and their derivation can be consulted in Appendix B.

Each household, for the purpose of the model is assumed to produce cocoa as a cash crop, plantain as a cash and home consumed crop, and other subsistence food crops exclusively for home consumption. Food requirements

not met by plantain and other subsistence crops have to be purchased by the household out of its cash income. The household cash income is assumed to be derived only from the sales of cocoa and plantain and from its borrowing from the private moneylender who has been introduced in the financial environment of the small farmer, though no reliable information about his (moneylender) activities was obtained from the survey. Cash expenditures are carried out to meet production inputs requirements (fertilizer, insecticide, hired labor, etc.), food consumption requirements, other living expenses (education, clothing, sickness, etc.) requirements, and debt repayment requirements.

The general model includes a liquidity management component described as in Chapter 3 and specified in Section 5.3 of the present chapter. The study in this section assumes that the goal of the decision-making unit is to maximize the net cash-flow and the liquidity values subject to the restrictions imposed by land, labor (family and hired), credit (in kind and in cash), etc.

Though plantain is a 3-year crop and cocoa is about a 25-year crop (economic life cycle), the present LP model is specified as a single period model. In order to do this, all data have been annualized; in other words, we have computed the annual average for each datum and for each crop over the respective economic life cycle of the crop. All coefficients which appear (even those coefficients we estimated or assumed) represent annual averages.

In order to meet some of the objectives of the study, namely objectives (iii) and (iv) of Section 2.4, Chapter 2, several variations of the general model were specified. Model 1 is the optimization of the current situation, where government credit is the only source of loans.

The current government policy and philosophy is illustrated by loans disbursed in kind with no consideration given to the small farmer's need for liquidity. Model 2 modifies model 1 by the introduction of another source of credit, the village merchant or moneylender; no provision is made yet for the small farmer's liquidity management. Model 3 includes again the moneylender and the government credit program; this time the government credit program disburses its loans in cash rather than in kind as in model 2. The small farmer therefore has to make his economic choices in the input mix he chooses for his production process.

In all the following models, the very important concept of liquidity management is recognized. In model 4, however, the government credit program, because of its policy of concessionally low rates of interest, is rightly perceived by the small farmer as a temporary institution. He thus cannot rely on it for liquidity needs. For this reason, model 4 recognizes liquidity management only for the moneylender credit.

Model 5 is the complete model of the study. The government credit program is now viewed as permanent and can be used as a source for liquidity. As explained further in the activities section, the government credit program is made permanent by valuing its reserves in the objective function.

Models 6, 7 and 8 result from parameterizing the levels of government and moneylender credit limits, and the interest rates on government loans, respectively. The next model, model 9, is a modified model 5. It is derived by assuming a higher interest rate for the government loans, in order to make the program viable and therefore more permanent.

Model 9 modifies model 5 by dropping the cocoa activities from the general model. Indeed, since loans on cocoa are free of interest charge, the increase in interest rate on plantain loans as carried out in model 8

is logically expected to shift resources away from intensive plantain production, as will be shown in the next chapter.

Model 10 finally reintroduces all cocoa activities and charges the cocoa loans the same interest rate as for plantain loans. The interest is then parameterized for both loans.

The following sections 5.2, 5.3 and 5.4 describe the objective function, the constraints and requirements, and the activities of the complete model, respectively.

5.2 Objective Function of the Model:

The objective function of the model, specifies as the maximand the net cash-flow at the end of the period. This end-of-period net cash flow is given by the level of cash transfer activity, coded as TCSHEPZ on Table 14, to follow. This level of cash transfer includes the values of cash and credit held in reserve once they are activated. These values are described in detail in Section 5.4, to follow. Their inclusion here accounts for the liquidity preference component introduced in the model. They are not to be interpreted as actual cash flows. The value of the objective function generated by the model, therefore, has to be reduced by the liquidity values in order to obtain the actual net cash flow of the household.

5.3 Constraints and Requirements of the Model:

The different constraints to which the model is subjected to are all listed on Table 13 to follow along with their resource level. The derivation of the right hand side (RHS) values of each row is explained in Appendix B. The row number zero, coded as Z is the objective function, and as such, has no right hand side value. All the different restrictions on the model are regrouped and described below.

Table 13: Model Constraints and Requirements

Row (1) Number	Row (2) Identification	Row (3) Row Description	Row (4) Relation	Row (5) Level	Row (6) Unit
0	Z	Objective Function	N		CFAP
1	L A N D	Land Supply	LE	6.75	Hectares
2	F M W 1	Family Labor in Season 1	LE	240	Man-Days
3	F M W 2	Family Labor in Season 2	LE	140	Man-Days
4	F M W 3	Family Labor in Season 3	LE	171.80	Man-Days
5	F M W 4	Family Labor in Season 4	LE	274.20	Man-Days
6	F P L	Fertilizer Used for Plantain	LE	750.00	Kilograms
7	I P L	Insecticide Used for Plantain	LE	117.00	Kilograms
8	P P L	Pesticide Used for Plantain	LE	52.00	Kilograms
9	I S C C	Insecticide Used for Cocoa	LE	12.00	Kilograms
10	F N C C	Fungicide Used for Cocoa	LE	200.00	Sachets
11	P L S 1	Plantain Suckers Inventory in Season 1	E	60.00	Suckers
12	P L S 3	Plantain Suckers Inventory in Season 3	E	60.00	Suckers
13	P L F 1	Plantain Fruits Inventory in Season 1	E	0.15	Metric Tons
14	P L F 2	Plantain Fruits Inventory in Season 2	E	0.15	Metric Tons
15	P L F 3	Plantain Fruits Inventory in Season 3	E	0.15	Metric Tons
16	P L F 4	Plantain Fruits Inventory in Season 4	E	0.15	Metric Tons
17	C C O A	Cocoa Inventory (Annual)	E	0.00	Kilograms
18	P T R 1	Protein Consumption Requirement for Season 1	E	44.06	Kilograms
19	P T R 2	Protein Consumption Requirement for Season 2	E	25.55	Kilograms
20	P T R 3	Protein Consumption Requirement for Season 3	E	31.30	Kilograms
21	P T R 4	Protein Consumption Requirement for Season 4	E	49.41	Kilograms
22	F T R 1	Fat Consumption Requirement for Season 1	E	42.57	Kilograms
23	F T R 2	Fat Consumption Requirement for Season 2	E	24.69	Kilograms
24	F T R 3	Fat Consumption Requirement for Season 3	E	30.24	Kilograms
25	F T R 4	Fat Consumption Requirement for Season 4	E	47.74	Kilograms
26	I N R 1	Iron Consumption Requirement for Season 1	E	7,022.00	Milligrams
27	I N R 2	Iron Consumption Requirement for Season 2	E	4,073.00	Milligrams
28	I N R 3	Iron Consumption Requirement for Season 3	E	4,988.00	Milligrams
29	I N R 4	Iron Consumption Requirement for Season 4	E	7,875.00	Milligrams

Table 11: Model Constraints and Requirements (Cont.)

Row (1) Number	Row (2) Identification	Row (3) Row Description	Row (4) Relation	Row (5) Level	Row (6) Unit
30	V A R 1	Vitamin A Consumption Requirement, Season 1	E	2,477.00	1,000 I.U.
31	V A R 2	Vitamin A Consumption Requirement, Season 2	E	1,437.00	1,000 I.U.
32	V A R 3	Vitamin A Consumption Requirement, Season 3	E	1,760.00	1,000 I.U.
33	V A R 4	Vitamin A Consumption Requirement, Season 4	E	2,778.00	1,000 I.U.
34	L E X 1	Cash For Family Living Expenses, Season 1	E	10,000.00	C F A F
35	L E X 2	Cash For Family Living Expenses, Season 2	E	8,000.00	C F A F
36	L E X 3	Cash For Family Living Expenses, Season 3	E	15,000.00	C F A F
37	L E X 4	Cash For Family Living Expenses, Season 4	E	15,000.00	C F A F
38	C S H 1	Cash Supply, Season 1	E	20,000.00	C F A F
39	C S H 2	Cash Supply, Season 2	E	5,000.00	C F A F
40	C S H 3	Cash Supply, Season 3	E	15,000.00	C F A F
41	C S H 4	Cash Supply, Season 4	E	25,000.00	C F A F
42	C S H E P	Cash Supply, End of the Period	E	0.00	C F A F
43	C C P 1	Commitment to Plantain Production	E	1.00	C F A F
44	C A C 1	Cash Accounting Equality, Season 1	E	0.00	C F A F
45	C A C 2	Cash Accounting Equality, Season 2	E	0.00	C F A F
46	C A C 3	Cash Accounting Equality, Season 3	E	0.00	C F A F
47	C A C 4	Cash Accounting Equality, Season 4	E	0.00	C F A F
48	C R 1 0 0	Cash Reserve, Season 1 at zero percent	E	0.00	C F A F
49	C R 1 2 0	Cash Reserve, Season 1 at 20 percent	E	0.00	C F A F
50	C R 1 4 0	Cash Reserve, Season 1 at 40 percent	E	0.00	C F A F
51	C R 1 6 0	Cash Reserve, Season 1 at 60 percent	E	0.00	C F A F
52	C R 1 8 0	Cash Reserve, Season 1 at 80 percent	E	0.00	C F A F
53	C R 2 0 0	Cash Reserve, Season 2 at zero percent	E	0.00	C F A F
54	C R 2 2 0	Cash Reserve, Season 2 at 20 percent	E	0.00	C F A F
55	C R 2 4 0	Cash Reserve, Season 2 at 40 percent	E	0.00	C F A F
56	C R 2 6 0	Cash Reserve, Season 2 at 60 percent	E	0.00	C F A F
57	C R 2 8 0	Cash Reserve, Season 2 at 80 percent	E	0.00	C F A F
58	C R 3 0 0	Cash Reserve, Season 3 at zero percent	E	0.00	C F A F
59	C R 3 2 0	Cash Reserve, Season 3 at 20 percent	E	0.00	C F A F
60	C R 3 4 0	Cash Reserve, Season 3 at 40 percent	E	0.00	C F A F
61	C R 3 6 0	Cash Reserve, Season 3 at 60 percent	E	0.00	C F A F
62	C R 3 8 0	Cash Reserve, Season 3 at 80 percent	E	0.00	C F A F
63	C R 4 0 0	Cash Reserve, Season 4 at zero percent	E	0.00	C F A F

Table 13: Model Components and Requirements (Cont.)

Row (1) Number	Row (2) Identification	Row (3) Row Description	Row (4) Relation	Row (5) Level	Row (6) Unit
64	C R 4 2 0	Cash Reserve, Season 4 at 20 percent	E	0.00	C F A F
65	C R 4 4 0	Cash Reserve, Season 4 at 40 percent	E	0.00	C F A F
66	C R 4 6 0	Cash Reserve, Season 4 at 60 percent	E	0.00	C F A F
67	C R 4 8 0	Cash Reserve, Season 4 at 80 percent	E	0.00	C F A F
68	C C L 1	Government Credit, Season 1	E	160,800.00	C F A F
69	G C L 3	Government Credit, Season 3	E	18,420.00	C F A F
70	G C A C 1	Government Credit Accounting, Season 1	E	0.00	C F A F
71	G C A C 3	Government Credit Accounting, Season 3	E	0.00	C F A F
72	G R 1 0 0	Government Credit Reserve, Season 1 at zero percent	E	0.00	C F A F
73	G R 1 2 0	Government Credit Reserve, Season 1 at 20 percent	E	0.00	C F A F
74	G R 1 4 0	Government Credit Reserve, Season 1 at 40 percent	E	0.00	C F A F
75	G R 1 6 0	Government Credit Reserve, Season 1 at 60 percent	E	0.00	C F A F
76	G R 1 8 0	Government Credit Reserve, Season 1 at 80 percent	E	0.00	C F A F
77	G R 3 0 0	Government Credit Reserve, Season 3 at zero percent	E	0.00	C F A F
78	G R 3 2 0	Government Credit Reserve, Season 3 at 20 percent	E	0.00	C F A F
79	G R 3 4 0	Government Credit Reserve, Season 3 at 40 percent	E	0.00	C F A F
80	G R 3 6 0	Government Credit Reserve, Season 3 at 60 percent	E	0.00	C F A F
81	G R 3 8 0	Government Credit Reserve, Season 3 at 80 percent	E	0.00	C F A F
82	M L C 1	Moneylender Credit Limit, Season 1	IE	15,000.00	C F A F
83	M L C 2	Moneylender Credit Limit, Season 2	IE	25,000.00	C F A F
84	M L C 3	Moneylender Credit Limit, Season 3	IE	2,000.00	C F A F
85	M L C 4	Moneylender Credit Limit, Season 4	IE	1,000.00	C F A F
86	M C A 1	Moneylender Credit Accounting, Season 1	E	0.00	C F A F
87	M C A 2	Moneylender Credit Accounting, Season 2	E	0.00	C F A F
88	M C A 3	Moneylender Credit Accounting, Season 3	E	0.00	C F A F
89	M C A 4	Moneylender Credit Accounting, Season 4	E	0.00	C F A F
90	M R 1 0 0	Moneylender Credit Reserve at zero percent, Season 1	E	0.00	C F A F
91	M R 1 2 0	Moneylender Credit Reserve at 20 percent, Season 1	E	0.00	C F A F
92	M R 1 4 0	Moneylender Credit Reserve at 40 percent, Season 1	E	0.00	C F A F
93	M R 1 6 0	Moneylender Credit Reserve at 60 percent, Season 1	E	0.00	C F A F
94	M R 1 8 0	Moneylender Credit Reserve at 80 percent, Season 1	E	0.00	C F A F
95	M R 2 0 0	Moneylender Credit Reserve at zero percent, Season 2	E	0.00	C F A F
96	M R 2 2 0	Moneylender Credit Reserve at 20 percent, Season 2	E	0.00	C F A F

Table 13: Model Constraints and Requirements (Cont.)

Row (1) Number	Row (2) Identification	Row (3) Row Description	Row (4) Relation	Row (5) Level	Row (6) Unit
97	M R 2 4 0	Moneylender Credit Reserve at 40 percent, Season 2	E	0.00	C F A F
98	M R 2 6 0	Moneylender Credit Reserve at 60 percent, Season 2	E	0.00	C F A F
99	M R 2 8 0	Moneylender Credit Reserve at 80 percent, Season 2	E	0.00	C F A F
100	M R 3 0 0	Moneylender Credit Reserve at zero percent, Season 3	E	0.00	C F A F
101	M R 3 2 0	Moneylender Credit Reserve at 20 percent, Season 3	E	0.00	C F A F
102	M R 3 4 0	Moneylender Credit Reserve at 40 percent, Season 3	E	0.00	C F A F
103	M R 3 6 0	Moneylender Credit Reserve at 60 percent, Season 3	E	0.00	C F A F
104	M R 3 8 0	Moneylender Credit Reserve at 80 percent, Season 3	E	0.00	C F A F
105	M R 4 0 0	Moneylender Credit Reserve at zero percent, Season 4	E	0.00	C F A F
106	M R 4 2 0	Moneylender Credit Reserve at 20 percent, Season 4	E	0.00	C F A F
107	M R 4 4 0	Moneylender Credit Reserve at 40 percent, Season 4	E	0.00	C F A F
108	M R 4 6 0	Moneylender Credit Reserve at 60 percent, Season 4	E	0.00	C F A F
109	M R 4 8 0	Moneylender Credit Reserve at 80 percent, Season 4	E	0.00	C F A F
110	P L P R R	Plantain Production Requirement	F	16.00	Metric Tons
111	L Q R S 1	Liquidity Reserve Requirement for Season 1	GE	20,000.00	C F A F
112	L Q R S 2	Liquidity Reserve Requirement for Season 2	GE	15,000.00	C F A F
113	L Q R S 3	Liquidity Reserve Requirement for Season 3	GE	25,000.00	C F A F
114	L Q R S 4	Liquidity Reserve Requirement for Season 4	GE	25,000.00	C F A F
115	G D P L	Debt Requirement for Government Loans for Plantain	E	0.00	C F A F
116	G D C C	Debt Requirement for Government Loans for Cocoa	E	0.00	C F A F
117	M L D D 1	Debt Requirement for Moneylender Loan, Season 1	E	0.00	C F A F
118	M L D D 2	Debt Requirement for Moneylender Loan, Season 2	E	0.00	C F A F
119	M L D D 3	Debt Requirement for Moneylender Loan, Season 3	E	0.00	C F A F
120	M L D D 4	Debt Requirement for Moneylender Loan, Season 4	E	0.00	C F A F

Land Supply Constraint (Row number 1):

The land area (regardless of productive quality) available to a typical household is estimated at 6.75 hectares. This value is the average from the survey sample. Its relation is "less or equal" to insure that no more land than available can be used and to incorporate the possibility of having some land unused.

Labor Constraints (Rows 2-5):

Labor requirements are specified seasonally for plantain, cocoa, and for the subsistence crops (4 seasons). FMWi refers to family labor used in the i th season. The annual labor supply given by the survey is allocated among 4 seasons proportionately to the length of each season. An average of 250 working days per year has been estimated and it was assumed that every working adult in the household supplies a man-day of work while each child between 10 and 18 years old will supply approximately .25 man-days of labor. This estimation takes into account that some children within this age group stay at home while others go to school. Sickness and other work-prevention events have been taken into account while estimating the 250 working days per year. It is assumed that all the adult males and females devote all their time to farming. In addition to family labor, there is a possibility for the farming unit to hire some labor. It is assumed that both hired and family labor are homogeneous as inputs and further that hired labor is in sufficient supply to meet the needs of the farming household. For this reason, there is no constraint (no hired labor now) on hired labor. The relation again, for the same reasons given above is a "less or equal" relation.

Constraints on Chemical Inputs (Rows 6-10):

The restrictions on the use of chemical inputs are imposed through the government practice of extending loans exclusively in kind, and through the limitations on the amount loaned out per unit area farmed. These constraints are described in detail on Table 13. The level of these constraints is, therefore, from upper limits the government imposes on its loans.

Crop Inventory Constraints (Rows 11-17):

The inventory requirements are intended to allocate crop output to either consumption or marketing activities. Inventories are provided for output of the production activities. Since for each crop the whole inventory has to be disposed of by selling, by consuming or by creating a new inventory at the end of the period, the relation has to be an "equal" relation, implying that the requirement has to be exactly met. The RHS for each inventory row represents its starting level. Cocoa inventory is specified annually (1 row), plantain suckers inventory is specified in two seasons, and plantain fruits inventory is specified in four seasons.

Dietary Needs Constraints (Rows 18-33):

The dietary requirements have been set so as to secure the household with a daily balanced diet. The right hand side of each row is therefore, an optimal level to be met for that particular dietary need. This procedure of setting dietary requirements is quite consistent with the model being used (an optimization model). Dietary levels are computed following some recent FAO recommendations. Their relation is an "equal" relation as they have to be exactly met. The dietary needs to be met in cash (purchases) are handled in the cash accounting rows to follow.

Other Family Living Expenses Constraints (Rows 34-37):

In addition to the family consumption (food) needs met through producing plantain and other subsistence food crops, and purchasing food, other expenses have to be incurred in cash, mainly schooling, clothing, health, and other traditional, civil, or religious obligations. These restrictions are also specified by season. Again, because of a lack of reliable data on these expenses, the right hand side of these rows have been assumed. The relation is also an "equal" relation, suggesting that the requirement is to be met.

Cash Requirements (Rows 38-42):

These requirements are differentiated seasonally. Cash requirements for season 3, for example, is coded as CSH3. Cash for season 1 (CSH1) represents cash required as of the first day of season 1, or March 15th. The right hand side for each row (season) is assumed and its magnitude reflects the length of the season, its cash sources, and its cash needs. A sum of 20,000 CFAF for example, is assumed to be available to the household on March 15th. The "equal" relation of these rows requires all available cash to be transferred to the cash accounting and cash reserve rows from where it is allocated to consumption in a general sense, debt repayment, liquidity requirements, and to the objective function.

Commitment of Cash to Plantain Production Requirements (Row 43):

Government loans for plantain production are conditional loans. Indeed, in order to obtain a loan, the producer must come up with 14,000 CFA Francs in order to participate in the credit program. Therefore, the total value of the loan the farmer receives in kind, is equal to his needs (determined by the area farmed) minus 14,000 CFA.

Cash Accounting Restrictions (Rows 44-47):

These rows are differentiated by season as the cash supply rows provide for the allocation of available cash to its alternative uses. Additions to cash in the cash accounting rows will come from transfers from cash supply rows and from borrowing from the moneylender. Subtractions of cash from the cash accounting rows occur to provide for consumption needs, input purchases, and debt repayment. The equality relation and the zero restriction level is satisfied through an automatic transfer of any cash surplus to the next season or to the objective function.

Cash Reserve Requirements (Rows 48-67):

These requirements have been introduced in order to handle any cash reserves derived from cash allocation activities as will be shown later as we describe the different activities of the model. These rows describe cash held in reserve. Row CR_{ij}, for example, refers to the cash reserve in the *i*th season and at *j*th percentage reservation. Thus, rows CR300 and CR480 refer to cash reserved at zero per cent in season 3 and at 80 per cent in season 4. The rows are specified as equality relation to make sure that all cash, once they are transferred to the reserve rows through the cash allocation activities (still to be described later) are valued in the objective function by the cash valuation activities.

Government Credit Restrictions (Rows 68 and 69):

The restrictions on government loans are specified by season. Government loans are disbursed for cocoa (with no interest charge) and for plantain (with a 6 per cent interest charge) at the beginning of each planting season, March for planting season one and September for planting

season two. The limits on the loans are set by the application rates per hectare for fertilizers, insecticides and other inputs, these rates are determined by the agricultural services. The row is a "less or equal" relation allowing for the possibility of a farmer obtaining less than prescribed.

Government Credit Accounting Restrictions (Rows 70 and 71):

These rows are differentiated as are the ones above and are created for the same reasons as are the cash accounting rows described above. The equality relation insures that all credit provided for should be used for borrowing or for reserve.

Government Credit Reserve Rows (Rows 72-81):

Credit available at the government source could be used by the farmer for borrowing, adding to his production assets, since the credit is provided in kind, or for reserve assuming that the Government can extend loans in cash. It may be useful to recall the rather technical definition of credit given earlier, namely, the producer's capacity to borrow. If the Government extends loans also in cash, then the farmer may choose to use his government "credit" to borrow in cash or in kind or may choose to hold it in reserve, with the assumption that the proportion held in reserve could be converted into cash (by borrowing) when needed. Like the cash reserve rows, the present rows are differentiated by season and by percentage held in reserve. GR_{ij} refers to Government Credit Reserve in season *i*, when *j*, percent is held in reserve. Thus, GR340, means government credit reserve in season 3 when 40 per cent is held in reserve. The "equal" right hand side is explained just as in the cash reserve rows.

Moneylender Credit Limits (Rows 82-85):

The upper limits on the moneylender's loans have been assumed to be 25 per cent of the borrower's net worth. The producer's net worth itself, because of the lack of information has been assumed to be approximately 50 per cent of his gross annual monetary income, obtained from the survey. The limits are differentiated by season owing to the fact that the needs and the ability to repay the loans vary per season: The magnitude of the level of these limits or their right hand side reflects this seasonal variation. The relation is a "less or equal" relation for the same reasons as given for the government credit limits.

Moneylender Credit Accounting Restrictions (Row 86-89):

These rows are created just like the cash accounting rows. They too are differentiated by season. Their right hand relation is the same as that of government credit accounting rows and for the same reasons.

Moneylender Credit Reserve Restrictions (Rows 90-109):

Their description resembles that of government credit reserve rows. It should be recalled that the moneylender extends his loans in cash. These rows, differentiated both by season and by proportion of credit held in reserve, have the same right hand side as the government credit reserve rows.

Plantain Production Requirement (Row 110):

This restriction is imposed on the model to secure that a minimal quantity of plantain is produced (a justifiable government concern) once the restriction of disbursing loans in kind is removed. The level of the

restriction is set at 15 tons per hectare per year, based on the estimated yield. The relation evidently is a "greater or equal" relation.

Liquidity Reserve Restrictions (Rows 111-114):

The household needs some minimal reserve in cash (liquidity) in order to meet some unexpected cash expenses. These reserves have been assumed to be 10 per cent of the producer's annual monetary income or about 20,000 CFAP. It is differentiated by season and a different amount is held in reserve every season to reflect the different risk factor each season carries (possibility of a drought, epidemy, plant destruction by insects, price level for card crops, etc.). This requirement is met by either or both cash and credit valuation activities. The relation is a "greater or equal" relation.

Debt Balance Requirements (Rows 115-120)

Borrowing creates debts which must be repaid or carried over as liabilities to the producing unit, if unpaid. These rows are differentiated by the source of borrowing (government or moneylender), the use of loans for government loans (plantain or cocoa) and the season at which the repayment takes place. All debts created must be repaid so that the right hand side is zero with an "equal" relation.

5.4 Activities of the Model:

The various activities of the model are summarized in Table 14 below. They are all regrouped and described in some detail in the following headings and are spelled out further by the activity vectors in Table 15, to follow.

Production Activities (columns 1-3, 22, 24-27):

The representative farm modelled in this study is assumed to produce plantain, cocoa and other subsistence crops. Cocoa is grown exclusively as a cash crop while plantain is grown for cash and for home consumption. Subsistence crops are grown exclusively for home consumption. This latter assumption, though not very realistic, is introduced to keep the model relatively simple. Cocoa and plantain are perennial crops while the major items under subsistence crops are biannual crops (2 crops a year). The derivation of most coefficients is from the survey, from some other estimates or is purely assumed.

The entries in the land row indicate that for each hectare in production there is a corresponding reduction in land available. The coefficients in the family labor rows indicate the number of man-days necessary to produce one hectare of a given crop. The positive entries in the chemical inputs rows indicate the per hectare application rate. The positive entries in the cash accounting rows indicate the cash requirement to produce one hectare of crops. The negative entries in the crop inventory rows are the yields per hectare from producing a particular crop (see Table 15).

Marketing Activities (columns 4-21, 23):

Crop marketing activities are specified by season and by the type of crops being marketed (plantain or cocoa). Cocoa marketing is specified annually. MKPL1 refers to marketing plantain in season 1. Each of these column vectors will contain a positive 1 entry in the relevant inventory row suggesting that for every unit sold there is a corresponding reduction in the inventory. For example marketing 1 unit of plantain A in season 3 (MKPLA3) reduces plantain inventory in season 3 by 1, i.e., a positive 1 in

Table 14: Model Activities

Column Number	Column I.D.	Column Description	Unit
1	PRPLA	Produce Plantain With High Level of Fertilizer	Hectares
2	PRPLB	Produce Plantain With Moderate Level of Fertilizer	Metric Tons
3	PRPLC	Produce Plantain With Low Level of Fertilizer	Metric Tons
4	MKPLA1	Market High-Fertilizer Plantain Fruits in Season 1	Metric Tons
5	MKPLA2	Market High-Fertilizer Plantain Fruits in Season 2	Metric Tons
6	MKPLA3	Market High-Fertilizer Plantain Fruits in Season 3	Metric Tons
7	MKPLA4	Market High-Fertilizer Plantain Fruits in Season 4	Metric Tons
8	MKPLB1	Market Moderate-Fertilizer Plantain Fruits in Season 1	Metric Tons
9	MKPLB2	Market Moderate-Fertilizer Plantain Fruits in Season 2	Metric Tons
10	MKPLB3	Market Moderate-Fertilizer Plantain Fruits in Season 3	Metric Tons
11	MKPLB4	Market Moderate-Fertilizer Plantain Fruits in Season 4	Metric Tons
12	MKPLC1	Market Low-Fertilizer Plantain Fruits in Season 1	Metric Tons
13	MKPLC2	Market Low-Fertilizer Plantain Fruits in Season 2	Metric Tons
14	MKPLC3	Market Low-Fertilizer Plantain Fruits in Season 3	Metric Tons
15	MKPLC4	Market Low-Fertilizer Plantain Fruits in Season 4	Metric Tons
16	MKPSA1	Market High-Fertilizer Plantain Suckers, Season 1	Metric Tons
17	MKPSA3	Market High-Fertilizer Plantain Suckers, Season 3	Metric Tons
18	MKPSB1	Market Moderate-Fertilizer Plantain Suckers, Season 1	Metric Tons
19	MKPSB3	Market Moderate-Fertilizer Plantain Suckers, Season 3	Metric Tons
20	MKPLS1	Market Low-Fertilizer Plantain Suckers, Season 1	Metric Tons
21	MKPLS3	Market Low-Fertilizer Plantain Suckers, Season 3	Metric Tons
22	PRCC	Produce Cocoa	----
23	MKCC	Marketing Cocoa	----
24	PSC1	Produce Subsistence Crops, Season 1	Kilograms
25	PSC2	Produce Subsistence Crops, Season 2	Hectares
26	PSC3	Produce Subsistence Crops, Season 3	Hectares
27	PSC4	Produce Subsistence Crops, Season 4	Hectares
28	MPR1	Meet Protein Requirement in Cash, Season 1	Kilograms
29	MPR2	Meet Protein Requirement in Cash, Season 2	Kilograms
30	MPR3	Meet Protein Requirement in Cash, Season 3	Kilograms
31	MPR4	Meet Protein Requirement in Cash, Season 4	Kilograms
32	MFR1	Meet Fats Requirement in Cash, Season 1	Kilograms
33	MFR2	Meet Fats Requirement in Cash, Season 2	Kilograms
34	MFR3	Meet Fats Requirement in Cash, Season 3	Kilograms
35	MFR4	Meet Fats Requirement in Cash, Season 4	Kilograms

Table 14: Model Activities (Cont.)

Column Number	Column I.D.	Column Description	Unit
36	MIR1	Meet Iron Requirement in Cash, Season 1	Milligrams
37	MIR2	Meet Iron Requirement in Cash, Season 2	Milligrams
38	MIR3	Meet Iron Requirement in Cash, Season 3	Milligrams
39	MIR4	Meet Iron Requirement in Cash, Season 4	Milligrams
40	MVAR1	Meet Vitamin A Requirement in Cash, Season 1	1,000 I.U.
41	MVAR2	Meet Vitamin A Requirement in Cash, Season 2	1,000 I.U.
42	MVAR3	Meet Vitamin A Requirement in Cash, Season 3	1,000 I.U.
43	MVAR4	Meet Vitamin A Requirement in Cash, Season 4	1,000 I.U.
44	HRW1	Hire Labor, Season 1	Man-Days
45	HRW3	Hire Labor, Season 2	Man-Days
46	HRW3	Hire Labor, Season 3	Man-Days
47	HRW4	Hire Labor, Season 4	Man-Days
48	BGPL	Borrow From Government for Plantain	CFA Francs
49	BGCC	Borrow From Government for Cocoa	CFA Francs
50	BML1	Borrow From Moneylender, Season 1	CFA Francs
51	BML2	Borrow From Moneylender, Season 2	CFA Francs
52	BML3	Borrow From Moneylender, Season 3	CFA Francs
53	BML4	Borrow From Moneylender, Season 4	CFA Francs
54	CCP	Commit Cash for Plantain Enterprise	CFA Francs
55	MGDP12	Repay Government Season 1 Debt, Beginning Season 2	CFA Francs
56	MGDP13	Repay Government Season 1 Debt, Beginning Season 3	CFA Francs
57	MGDP14	Repay Government Season 1 Debt, Beginning Season 4	CFA Francs
58	MGDP1Z	Repay Government Season 1 Debt through Objective Function	CFA Francs
59	MGDCC34	Repay Government Season 3 Debt, Beginning Season 4	CFA Francs
60	MGDCC3Z	Repay Government Season 3 Debt, Through Objective Function	CFA Francs
61	MMLD12	Repay Moneylender Season 1 Debt, Beginning Season 2	CFA Francs
62	MMLD13	Repay Moneylender Season 1 Debt, Beginning Season 3	CFA Francs
63	MMLD14	Repay Moneylender Season 1 Debt, Beginning Season 4	CFA Francs
64	MMLD1Z	Repay Moneylender Season 1 Debt through Objective Function	CFA Francs
65	MMLD23	Repay Moneylender Season 2 Debt, Beginning Season 3	CFA Francs
66	MMLD24	Repay Moneylender Season 2 Debt, Beginning Season 4	CFA Francs
67	MMLD2Z	Repay Moneylender Season 2 Debt through Objective Function	CFA Francs
68	MMLD34	Repay Moneylender Season 3 Debt, Beginning Season 4	CFA Francs
69	MMLD3Z	Repay Moneylender Season 3 Debt through Objective Function	CFA Francs
70	MMLD4Z	Meet Moneylender Season 4 Debt through Objective Function	CFA Francs

Table 14: Model Activities (Cont.)

Column Number	Column I.D.	Column Description	Unit
71	PFPL	Purchase Fertilizer for Plantain	CFA Francs
72	PINSPL	Purchase Insecticide for Plantain	CFA Francs
73	PPSPL	Purchase Pesticide for Plantain	CFA Francs
74	PINCC	Purchase Insecticide for Cocoa	CFA Francs
75	PFNCC	Purchase Fungicide for Cocoa	CFA Francs
76	ACS100	Allocate Season 1 Cash at Zero Percent Reserve	CFA Francs
77	ACS120	Allocate Season 1 Cash at 20 Percent Reserve	CFA Francs
78	ACS140	Allocate Season 1 Cash at 40 Percent Reserve	CFA Francs
79	ACS160	Allocate Season 1 Cash at 60 Percent Reserve	CFA Francs
80	ACS180	Allocate Season 1 Cash at 80 Percent Reserve	CFA Francs
81	ACS200	Allocate Season 2 Cash at Zero Percent Reserve	CFA Francs
82	ACS220	Allocate Season 2 Cash at 20 Percent Reserve	CFA Francs
83	ACS240	Allocate Season 2 Cash at 40 Percent Reserve	CFA Francs
84	ACS260	Allocate Season 2 Cash at 60 Percent Reserve	CFA Francs
85	ACS280	Allocate Season 2 Cash at 80 Percent Reserve	CFA Francs
86	ACS300	Allocate Season 3 Cash at Zero Percent Reserve	CFA Francs
87	ACS320	Allocate Season 3 Cash at 20 Percent Reserve	CFA Francs
88	ACS340	Allocate Season 3 Cash at 40 Percent Reserve	CFA Francs
89	ACS360	Allocate Season 3 Cash at 60 Percent Reserve	CFA Francs
90	ACS380	Allocate Season 3 Cash at 80 Percent Reserve	CFA Francs
91	ACS400	Allocate Season 4 Cash at Zero Percent Reserve	CFA Francs
92	ACS420	Allocate Season 4 Cash at 20 Percent Reserve	CFA Francs
93	ACS440	Allocate Season 4 Cash at 40 Percent Reserve	CFA Francs
94	ACS460	Allocate Season 4 Cash at 60 Percent Reserve	CFA Francs
95	ACS480	Allocate Season 4 Cash at 80 Percent Reserve	CFA Francs
96	AGC100	Allocate Season 1 Government Credit at Zero Percent Reserve	CFA Francs
97	AGC120	Allocate Season 1 Government Credit at 20 Percent Reserve	CFA Francs
98	AGC140	Allocate Season 1 Government Credit at 40 Percent Reserve	CFA Francs
99	AGC160	Allocate Season 1 Government Credit at 60 Percent Reserve	CFA Francs
100	AGC180	Allocate Season 1 Government Credit at 80 Percent Reserve	CFA Francs
101	AGC300	Allocate Season 3 Government Credit at Zero Percent Reserve	CFA Francs
102	AGC320	Allocate Season 3 Government Credit at 20 Percent Reserve	CFA Francs
103	AGC340	Allocate Season 3 Government Credit at 40 Percent Reserve	CFA Francs
104	AGC360	Allocate Season 3 Government Credit at 60 Percent Reserve	CFA Francs
105	AGC380	Allocate Season 3 Government Credit at 80 Percent Reserve	CFA Francs

Table 14: Model Activities (Cont.)

Column Number	Column I.D.	Column Description	Unit
106	AMC100	Allocate Season 1 Moneylender Credit at Zero Percent Reserve	CFA Francs
107	AMC120	Allocate Season 1 Moneylender Credit at 20 Percent Reserve	CFA Francs
108	AMC140	Allocate Season 1 Moneylender Credit at 40 Percent Reserve	CFA Francs
109	AMC160	Allocate Season 1 Moneylender Credit at 60 Percent Reserve	CFA Francs
110	AMC180	Allocate Season 1 Moneylender Credit at 80 Percent Reserve	CFA Francs
111	AMC200	Allocate Season 2 Moneylender Credit at Zero Percent Reserve	CFA Francs
112	AMC220	Allocate Season 2 Moneylender Credit at 20 Percent Reserve	CFA Francs
113	AMC240	Allocate Season 2 Moneylender Credit at 40 Percent Reserve	CFA Francs
114	AMC260	Allocate Season 2 Moneylender Credit at 60 Percent Reserve	CFA Francs
115	AMC280	Allocate Season 2 Moneylender Credit at 80 Percent Reserve	CFA Francs
116	AMC300	Allocate Season 3 Moneylender Credit at Zero Percent Reserve	CFA Francs
117	AMC320	Allocate Season 3 Moneylender Credit at 20 Percent Reserve	CFA Francs
118	AMC340	Allocate Season 3 Moneylender Credit at 40 Percent Reserve	CFA Francs
119	AMC360	Allocate Season 3 Moneylender Credit at 60 Percent Reserve	CFA Francs
120	AMC380	Allocate Season 3 Moneylender Credit at 80 Percent Reserve	CFA Francs
121	AMC400	Allocate Season 4 Moneylender Credit at Zero Percent Reserve	CFA Francs
122	AMC420	Allocate Season 4 Moneylender Credit at 20 Percent Reserve	CFA Francs
123	AMC440	Allocate Season 4 Moneylender Credit at 40 Percent Reserve	CFA Francs
124	AMC460	Allocate Season 4 Moneylender Credit at 60 Percent Reserve	CFA Francs
125	AMC480	Allocate Season 4 Moneylender Credit at 80 Percent Reserve	CFA Francs
126	VCR100	Value Season 1 Cash at Zero Percent Reserve	CFA Francs
127	VCR120	Value Season 1 Cash at 20 Percent Reserve	CFA Francs
128	VCR140	Value Season 1 Cash at 40 Percent Reserve	CFA Francs
129	VCR160	Value Season 1 Cash at 60 Percent Reserve	CFA Francs
130	VCR180	Value Season 1 Cash at 80 Percent Reserve	CFA Francs
131	VCR200	Value Season 2 Cash at Zero Percent Reserve	CFA Francs
132	VCR220	Value Season 2 Cash at 20 Percent Reserve	CFA Francs
133	VCR240	Value Season 2 Cash at 40 Percent Reserve	CFA Francs
134	VCR260	Value Season 2 Cash at 60 Percent Reserve	CFA Francs
135	VCR280	Value Season 2 Cash at 80 Percent Reserve	CFA Francs
136	VCR300	Value Season 3 Cash at Zero Percent Reserve	CFA Francs
137	VCR320	Value Season 3 Cash at 20 Percent Reserve	CFA Francs
138	VCR340	Value Season 3 Cash at 40 Percent Reserve	CFA Francs
139	VCR360	Value Season 3 Cash at 60 Percent Reserve	CFA Francs
140	VCR380	Value Season 3 Cash at 80 Percent Reserve	CFA Francs

Table 14: Model Activities (Cont.)

Column Number	Column I.D.	Column Description	Unit
141	VCR400	Value Season 4 Cash at Zero Percent Reserve	CFA Francs
142	VCR420	Value Season 4 Cash at 20 Percent Reserve	CFA Francs
143	VCR440	Value Season 4 Cash at 40 Percent Reserve	CFA Francs
144	VCR460	Value Season 4 Cash at 60 Percent Reserve	CFA Francs
145	VCR480	Value Season 4 Cash at 80 Percent Reserve	CFA Francs
146	VCR120	Value Season 1 Government Credit at 20 Percent Reserve	CFA Francs
147	VCR140	Value Season 1 Government Credit at 40 Percent Reserve	CFA Francs
148	VCR160	Value Season 1 Government Credit at 60 Percent Reserve	CFA Francs
149	VCR180	Value Season 1 Government Credit at 80 Percent Reserve	CFA Francs
150	VCR100	Value Season 1 Government Credit at 100 Percent Reserve	CFA Francs
151	VCR320	Value Season 3 Government Credit at 20 Percent Reserve	CFA Francs
152	VCR340	Value Season 3 Government Credit at 40 Percent Reserve	CFA Francs
153	VCR360	Value Season 3 Government Credit at 60 Percent Reserve	CFA Francs
154	VCR380	Value Season 3 Government Credit at 80 Percent Reserve	CFA Francs
155	VCR300	Value Season 3 Government Credit at 100 Percent Reserve	CFA Francs
156	VMR120	Value Season 1 Moneylender Credit at 20 Percent Reserve	CFA Francs
157	VMR140	Value Season 1 Moneylender Credit at 40 Percent Reserve	CFA Francs
158	VMR160	Value Season 1 Moneylender Credit at 60 Percent Reserve	CFA Francs
159	VMR180	Value Season 1 Moneylender Credit at 80 Percent Reserve	CFA Francs
160	VMR100	Value Season 1 Moneylender Credit at 100 Percent Reserve	CFA Francs
161	VMR220	Value Season 2 Moneylender Credit at 20 Percent Reserve	CFA Francs
162	VMR240	Value Season 2 Moneylender Credit at 40 Percent Reserve	CFA Francs
163	VMR260	Value Season 2 Moneylender Credit at 60 Percent Reserve	CFA Francs
164	VMR280	Value Season 2 Moneylender Credit at 80 Percent Reserve	CFA Francs
165	VMR200	Value Season 2 Moneylender Credit at 100 Percent Reserve	CFA Francs
166	VMR320	Value Season 3 Moneylender Credit at 20 Percent Reserve	CFA Francs
167	VMR340	Value Season 3 Moneylender Credit at 40 Percent Reserve	CFA Francs
168	VMR360	Value Season 3 Moneylender Credit at 60 Percent Reserve	CFA Francs
169	VMR380	Value Season 3 Moneylender Credit at 80 Percent Reserve	CFA Francs
170	VMR300	Value Season 3 Moneylender Credit at 100 Percent Reserve	CFA Francs
171	VMR420	Value Season 4 Moneylender Credit at 20 Percent Reserve	CFA Francs
172	VMR440	Value Season 4 Moneylender Credit at 40 Percent Reserve	CFA Francs
173	VMR460	Value Season 4 Moneylender Credit at 60 Percent Reserve	CFA Francs
174	VMR480	Value Season 4 Moneylender Credit at 80 Percent Reserve	CFA Francs
175	VMR400	Value Season 4 Moneylender Credit at 100 Percent Reserve	CFA Francs

Table 14: Model Activities (Cont.)

Column Number	Column I.D.	Column Description	Unit
176	MFLE1	Meet Other Family Living Expenses, Season 1	CFA Francs
177	MFLE2	Meet Other Family Living Expenses, Season 2	CFA Francs
178	MFLE3	Meet Other Family Living Expenses, Season 3	CFA Francs
179	MFLE4	Meet Other Family Living Expenses, Season 4	CFA Francs
180	TCSH12	Transfer Cash From Season 1 to Season 2	CFA Francs
181	TCSH23	Transfer Cash From Season 2 to Season 3	CFA Francs
182	TCSH34	Transfer Cash From Season 3 to Season 4	CFA Francs
183	TCSH4EP	Transfer Cash From Season 4 to End of Period	CFA Francs
184	TCSHEP7	Transfer Cash From End of Period to Objective Function	CFA Francs

row PLF₃ (see Table 15). The negative entries in the cash accounting rows, referring to cash added to the system through selling activities.

Meet Dietary Requirements Activities in Cash (columns 28-43):

In this model, the food requirements for the household are expressed in terms of its nutrients or dietary requirements. Four major nutrients have been chosen to estimate these requirements. The four nutrients were chosen after consultation with some personnel from the School of Human Resources and Family Studies. The food needs which are usually expressed in terms of calories are here expressed in terms of protein, fat, iron and vitamin A needs. Due recognition has been given to the fact that energy intakes are of first consideration in establishing any diet. The method used here secures a safe level of energy (calories) intakes through the safe levels set for the four nutrients. Various FAO documents have been relied upon to establish these safe levels of energy and nutrient intakes.

The dietary needs can be met from two sources: from producing subsistence crops, from producing plantain, and from food purchases. Food purchases supplement food produced within the unit. Food produced by the household is converted into its various nutrient equivalents (protein, fat, iron and vitamin A). By subtracting these nutrient equivalents from the safe levels established from the various FAO sources, the balance to be met by purchasing is determined. This balance is converted into actual weight of food and then converted into its cash requirements. In order to allow the household to choose freely among the different sources of nutrients (or among the different food items), the most expensive source for each nutrient is chosen to calculate that nutrient cash need. In so doing, the model provides the household with some needed flexibility in making up its daily diet.

In each of these columns positive 1 entries in the dietary requirements rows (21-36) indicate that for each unit of nutrient consumed that nutrient inventory requirement is reduced by one unit. The positive entries in the cash accounting show the cash expenses for each nutrient. The dietary requirements activities are differentiated by the type of nutrient and by the season. For example, MPR3 and MVAR2 refer to cash required to meet protein needs in season 3 and vitamin A needs in season 2.

Labor Hiring Activity (columns 44-47):

This activity is differentiated only by season. Hired labor is assumed to be identical to family labor (in quality) and is available in sufficient quantities as already mentioned under family labor rows above. The columns will contain entries in the cash accounting rows for daily wage rates.

Borrowing Activities (columns 48-53):

Two sources of borrowing are open to the household: borrowing from the public program and borrowing from the village moneylender. Although the survey did not produce usable data for borrowing outside the public program, it is believed that it is rather a problem of not being able to pick up those transactions than that of their inexistence. Therefore, it has been thought necessary to introduce this second source of borrowing (borrowing from the moneylender) to the model. The inclusion of this second source is justified by the observed informal lending transactions taking place in the rural and even in the urban milieu. The village moneylender is believed to be an integral and important part of the small farmer's financial environment.

Borrowing activities are differentiated by their source, their use (for public loans) and their season. Borrowing from the public program can be used for plantain or for cocoa, and as already mentioned above, these loans are exclusively in kind. Borrowing from the moneylender, in order to keep the model simple, is assumed to occur only in cash with a 50 percent annual rate of interest. Public loans also carry an annual rate of interest, 6 percent for plantain and none for cocoa loans.

In the borrowing activities from the government negative coefficients are entered in the chemical inputs rows (6-13) for the quantities of physical inputs added to the production process when the equivalent of 1 CFAF is borrowed from the government. Since moneylender loans are in cash, no such coefficient appears in the borrowing from the moneylender activity columns. Instead negative 1 entries in the cash accounting rows indicate that for each CFAF borrowed from the moneylender there is an addition of 1 CFAF to the system. The model also assumes that the moneylender and the government credit program interact, somewhat like in the Chamberlin Model of oligopolistic competition [49]. Thus the moneylender is assumed to reduce his credit availability to the producer by .50 CFAF when the latter borrows 1 CFAF from the government credit program and the government credit program is assumed to reduce its credit availability to the producer by a full unit when the latter borrows one unit from the moneylender.* These reactions are shown by the positive entries in the government and moneylender

*These coefficients are chosen so as to reflect each lending agent's ability to recover loans it disburses. The well known low repayment record of the government credit programs is reflected by a reduction of its loan as a response to the borrower's commitment to another lender. The private moneylender has enjoyed over the years a very high repayment record. Therefore, he reacts to the borrower's commitment to the public lender by reducing his credit availability only by 50 percent.

credit restrictions rows, 71-72 and 85-88 respectively. Borrowing from either source also reduces the level of the credit account of that particular source. Thus the credit accounts of both government program and moneylender are reduced by one unit everytime a unit is borrowed, and this is shown by the 1 entries in the credit accounting rows. Borrowing finally creates a debt, reflected by negative 1 coefficients in the debt repayment rows. The accumulated debt balances will have to be repaid through debt repayment activities.

Cash Commitment to Plantain Activities (column 54):

Cash commitment activities are differentiated by planting seasons. The farmer must commit 14,000 CFA francs in cash for every planting season if he desires to obtain government loans. This commitment is indicated in this column by the positive entries in the cash accounting rows (47 and 49). Once one unit of this commitment is met the government credit available to the producer is increased by a corresponding 1 unit. Hence the column also contains negative 1 entries in the government credit rows (71 and 72). Finally, the government debt balance is reduced through cash made available because of the possibility of borrowing, a possibility created by the cash commitment activity. Thus entries in this column, in government debt balance rows, (122 and 124) are positive.

Debt Repayment Activities (columns 55-70):

The debt repayment activities are differentiated by the source of debt, the use of funds borrowed, the season the debt was contracted, and finally the season the debt is repaid. Thus MGP12, MMLD24 (columns 55 and 66, Table 14) mean government plantain debt contracted in season 1 and repaid at the beginning of season 2, and moneylender debt contracted in

season 2 and repaid at the beginning of season 4. It is assumed that in general, a debt is contracted the first day of the season, and the earliest repayment date is the first day of the following season. Each positive coefficient in these columns that is entered in a cash account row represents the amount of cash removed to repay a unit of debt. The coefficients are calculated by adding the interest charge due at the period of repayment to the principal unit borrowed, which is one. Debt repayment activities will reduce the debt balance through the positive 1 entries in the debt balance rows.

Input Purchasing Activities (columns 71-75):

Though the current policy provides for government loans to be disbursed exclusively in kind, the complete model of this study attempts to determine the effects of this policy on the net cash flow of the small farmer. These effects, if any, are determined by the removal of this constraint on the use of loan proceeds. This is achieved by having the loans disbursed in cash and allowing the farmer to choose his input mix through the introduction of input purchases activities. The negative entries for these columns in the chemical input rows (6-10) indicate the addition of inputs to the production process resulting from 1 unit of purchase activities. The positive 1 entries in the cash accounting rows indicate that for every unit of purchasing activities, there cash account is reduced by 1 CFAF.

Cash Allocation Activities (columns 76-95):

Cash available through the different cash-producing columns is used in two general ways: either it is used for cash-requiring activities or it

is held in reserve. The proportion of cash used through cash-requiring columns and that of cash held in reserve must always add up to one, so that the cash accounting rows have a zero right hand side. The activities are differentiated by season and by the proportion of cash held in reserve, which is always one minus the proportion committed to cash-requiring activities. Thus, ACSH240 means allocate 40 percent of cash to reserve in season 2, implying that 60 percent is allocated to other cash-requiring columns.

Cash supply will be reduced through positive 1 entries in the cash supply rows. Negative entries in the cash accounting and cash reserve rows show the proportions in which the cash available is distributed between accounting and reserves. It is obvious from the cash management vectors, that for each column, the proportions add up to 1.

Credit Allocation Activities (columns 96-125):

Government credit is an asset which the borrower chooses to allocate between credit account and credit reserve. The proportion which is allocated to credit account is used for borrowing while the rest is kept in reserve. These activities are specified just like the cash allocation activities described above.

The positive entries in the government credit supply rows reduce the credit available through its removal to account and/or reserve columns. The negative coefficients in the credit account and reserve rows add credit to the account or reserve supplies respectively, as shown by the various proportions. The moneylender credit allocation activities are identical to those of the government credit.

Cash Valuation Activities (columns 125-145):

These activities value cash held in reserve in the cash reserve rows. As discussed briefly in Chapter 2, Section 2.2 under the "Theory of Liquidity Management," the value of cash in reserve increases as the percentage held in reserve decreases. Entries in these columns in the cash reserve rows are all positive 1, since for each unit of CFAF produced through this valuation activity, 1 unit of CFAF must be taken out of the cash reserve. One unit of cash held in reserve is valued at greater than one since it contributes a liquidity value higher than 1 (see Graphs 2.3 in Section 2.2 of Chapter 2). That value of a CFAF held in reserve is the liquidity value equivalent to the reservation price the producer arbitrarily sets for his reserved cash. That price is what the activity contributes to the objective function. These reservation prices were purely assumed, following Bhargara's approach [11]. Table 15 below shows these reservation prices. Since cash reserve is a source of liquidity, positive entries of 1 in these columns, in the liquidity requirement rows, indicate that every unit of cash reserve satisfies 1 unit of liquidity requirement. The values of cash in reserve are differentiated by season, and their size reflects the risk associated with each season as already mentioned under the liquidity reserve restrictions.

Credit Valuation Activities (columns 145-175):

Credit valuation activities are differentiated by season, by percentage of credit held in reserve, and by the source of credit. VGR160 refers to valuation of government credit in season 1, when 50 percent is held in reserve, VMR480 refers to valuation of moneylender credit in season 4, when 80 percent is held in reserve. The entries are just like those of the cash

Table 15: The Linear Programming Model - Vectors

Activities		PRPLA	PRPL3	PRPLC	MKPLA1	MKPLA2	MKPLA3	MKPLA4	MKPLB1	MKPLB2	MKPLB3	MKPLB4	MKPLC1	MKPLC2	MKPLC3
Rows	I.D.														
I.D.															
LAND		1.00	1.00	1.00											
FMW1		70.32	70.32	70.32											
FMW2		39.00	39.00	39.00											
FMW3		45.15	45.15	45.15											
FMW4		64.17	64.17	64.17											
FPI		750.00	343.00	250.00											
IPL		69.30	69.30	69.30											
PPL		10.87	10.87	10.87											
PLS1		-325.00	-250.00	180.00											
PLW3		-325.00	-250.00	180.00											
PLF1		-4.69	-3.50	-1.56	1.00				1.00						
PLF2		-2.72	-2.04	-1.10		1.00				1.00			1.00		1.00
PLF3		-3.33	-2.50	-1.35			1.00				1.00				
PLF4		-5.26	-3.96	-2.54				1.00				1.00			
CSH2					-20097.14										
CSH3						-20097.14									
CSH4							-20097.14								
CSHEP								-20097.14							

Table 15: The Linear Programming Model - Vectors (Continued)

Activities		PSC1	PSC2	PSC3	PSC4	MFR1	MFR2	MFR3	MFR4	MFR1	MFR2
Rows	I.D.										
	I.D.										
	LAND	1.00		1.00							
	FNM1	114.00									
	FNM2		51.30	85.50							
	FNM3										
	FNM4				34.20						
	PTR1	40.00				1.00					
	PTR2		23.55	27.25			1.00				
	PTR3							1.00			
	PTR4				49.35				1.00		
	FTR1	39.13								1.00	
	FTR2		22.70	27.80							1.00
	FTR3										
	FTR4	4878.00			43.88						
	INR1										
	INR2		2830.00	3466.00							
	INR3				6471.00						
	INR4										
	VAR1	1286.00									
	VAR2		744.00	912.00							
	VAR3				1440.00						
	VAR4					2302.95	2302.95				
	CAC1							2302.95			
	CAC2								2485.46	2485.46	
	CAC3							2302.95			
	CAC4								2302.95		

Table 15: The Linear Programming Model - Vectors (Continued)

Activities	MCP12	MCP13	MCP14	MGPIZ	MGDCC4	MGDCC7	MMLD12	MMLD13	MMLD14	MMLD17	MMLD23	MMLD24	MMLD2Z	MMLD34
Rows I.D.														
CAC1	1.015						1.125							
CAC2		1.030						1.250			1.125			
CAC3			1.045						1.375			1.250		1.125
CAC4	1.00	1.00	1.00	1.00										
GNFL					1.00									
GNCC						1.00								
MLDD1							1.00			1.00				
MLDD2											1.00			
MLDD3												1.00		1.00
MLDD4														
OBTF				-1.060		-1.00				-1.50			-1.375	

Table 15: The Linear Programming Model - Vectors (Continued)

Activities		MMLD4Z	MMLD4Z	TCSH12	TCSH23	TCSH34	TCSH4EP	TCSHEPZ	ACS100	ACS120	ACS140	ACS160	ACS180	ACS200	ACS220	
Rows	I.D.															
CAC1			1.00													
CAC2			-1.00		1.00				-1.00	-0.80	-0.60	-0.40	-0.20	-1.00	-0.80	
CAC3				-1.00												
CAC4					1.00											
CSH1				-1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00	1.00	
CSH2																
CSHEP																
MLDD3		1.00					-1.00	1.00								
MLDD4			1.00													
CR120										-0.20						
CR140																
CR160																
CR180																
CR220																
OBJF		-1.250	1.125										-0.80			-0.20

Table 15: The Linear Programming Model - Vectors (continued)

Activities		VCR140	VCR160	VCR180	VCR100	VCR220	VCR240	VCR260	VCR280	VCR200	VCR320	VCR340	VCR360	VCR380	VCR300
Rows	I.D.														
	CSH1				1.00					1.00					
	CSH2														1.00
	CSH3														
	CSH4														
	CR140	1.00													
	CR160		1.00												
	CR180			1.00											
	CR220				1.00										
	CR240					1.00									
	CR260						1.00								
	CR280							1.00							
	CR320								1.00						
	CR340									1.00					
	CR360										1.00				
	CR380											1.00			
	LQRS1	1.00	1.00	1.00	1.00									1.00	
	LQRS2				1.00	1.00	1.00	1.00	1.00	1.00					
	LQRS3										1.00	1.00	1.00	1.00	1.00
	LQRS4											1.00	1.00	1.00	1.00
	OBJF	1.70	1.45	1.30	1.20	2.00	1.60	1.35	1.20	1.10	2.20	1.80	1.55	1.40	1.30

Table 15: The Linear Programming Model - Vectors (Continued)

Activities															
Rows	I.D.	AMC300	AMC320	AMC340	AMC360	AMC380	AMC400	AMC420	AMC440	AMC460	AMC480	VNR120	VNR140	VNR160	VNR180
I.D.															
MCA3		-1.00													
MCA4			-0.80	-0.60	-0.40	-0.20									
NR320			-0.20				-1.00	-0.80	-0.60	-0.40	-0.20				
NR340				-0.40											
NR360					-0.60										
NR380						-0.80									
NR420								-0.20							
NR440									-0.40						
NR460										-0.60					
NR480											-0.80				
MLC3		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
MLC4												1.00			
MR120													1.00		
MR140														1.00	
MR160															1.00
MR180															1.00
LQRS1												1.00	1.00	1.00	
OBJF												1.60	1.35	.90	.65

Table 15: The Linear Programming Model - Vectors (Continued)

Activities		VNR100	VNR220	VNR240	VNR260	VNR280	VNR200	VNR320	VNR340	VNR360	VNR180	VMR300	VNR120	VNR440	VNR460	VNR480	VNR400
Rows	I.D.																
	MR220	1.00															
	MR240		1.00														
	MR260			1.00													
	MR280				1.00												
	NR320					1.00											
	MR340						1.00										
	MR360							1.00									
	MR380								1.00								
	MR420									1.00							
	MR440										1.00						
	MR460											1.00					
	MR480												1.00				
	LQRS1	1.00															
	LQRS2		1.00														
	LQRS3			1.00													
	LQRS4				1.00												
	MLC1	1.00															
	MLC2						1.00										
	MLC3																
	MLC4																
	OBJF	.50	1.30	1.10	.65	.40	.35	1.70	1.45	1.00	.75	.60	1.70	1.45	1.00	.75	1.00

valuation activities. The reservation prices are assumed again, and are different from those of cash reserve and are further different for the two sources of credit. Table 16 shows these reservation prices.

The magnitudes of these reservation prices differ between cash and credit reserves to reflect the assumed producer's attitude of valuing cash reserve more than credit reserve. The difference, as can be noted in Tables 16 and 17, is substantial. Further, the difference in the reservation price levels between the government and the moneylender credits is intended to reflect the well known lengthy procedure required to secure a loan from the government program. This lengthy procedure lessens the value of government loans because of unreliability in terms of the timing of their availability.

Meet Other Family Living Expenses Activities (columns 176-179):

These activities are differentiated by season. Meeting a given season's living expenses of 1 CFAF reduces the living expenses requirements of that season by a corresponding 1 CFAF, as is shown by the positive 1 entries in the living expenses requirement rows. Negative 1 entries in the cash accounting rows reflect cash used to meet the expenses requirements of those rows.

Cash Transfer Activities (columns 180-184):

Cash transfer activities are introduced to move any surplus cash generated in any cash accounting row to the next season. Thus column TCSH23 transfers any cash surplus generated in cash accounting row number 2, or in the cash account of season 2 into that of season 3. Positive 1 entries indicate that 1 CFAF transferred from a given season through the cash transfer activity removes 1 CFAF from the cash account of that season, and

Table 16: CASH RESERVATION PRICES

Percent of Cash in Reserve	Percent of Cash Used	Value of Reserve Cash			
		Season 1	Season 2	Season 3	Season 4
100	0	1.20	1.10	1.30	1.30
80	20	1.30	1.20	1.40	1.40
60	40	1.45	1.35	1.55	1.55
40	60	1.70	1.60	1.80	1.80
20	80	2.10	2.00	2.20	2.20

Table 17: CREDIT RESERVATION PRICES

Percent of Credit in Reserve	Percent of Credit Used	Value of Reserve Moneylender Credit					
		Season 1	Season 2	Season 3	Season 4	Season 5	Season 6
100	0	.50	.35	.60	.60	.40	.45
80	20	.55	.40	.75	.75	.50	.55
60	40	.90	.65	1.00	1.00	.75	.85
40	60	1.35	1.10	1.45	1.45	1.15	1.30
20	80	1.50	1.30	1.70	1.70	1.45	1.55

conversely, a CFAF transferred into a given season by the same activity increases the level of cash account of that season by 1 CFAF and is indicated by negative 1 entries.

As already mentioned above, the description of the objective function, requirements and activities which precede applies mostly to model 3. The variations of the general model are summarized in Table 17 below.

Timing of Cash Availability and Use:

Throughout the model it is assumed that cash from marketing activities in any given season is made available only at the beginning of the next season. Other cash-generating activities (government and moneylender borrowing) occurring in any given season make cash available at the beginning of the said season. Cash-consuming activities (input purchases, debt obligations, dietary needs in cash, etc.) require cash at the beginning of the season for which they are to be carried out. Cash generated by season 4 activities are available at the end of that season, or what is referred to as the end-of-period cash row. Cash obligations due after season 4 are met through negative entries in the objective function row.

Table 18: SPECIFICATIONS OF THE VARIATIONS OF THE GENERAL MODEL

	Fixed Loan Limit		Money-lender Credit	Variable Loan Limits		Variable Interest Rate		
	Government Credit Program			GVT Credit Program	Money-lender Credit	Complete Model	Model Minus Cocoa Production	Model With Interest Charge On Cocoa Loans
	Loans in Kind	Loans in Cash Temporary-Permanent						
1 Lender No Liquidity Management Plus Liquidity Management	1							
	2	3,4	2,3					
2 Lender No Liquidity Management Plus Liquidity Management		5,6,7,8 9,10	4,5,6,7 8,9,10	6	7	8	9	10

*Variable Interest Rates for Government Loans for Plantain Production

CHAPTER 6

RESULTS OF THE ANALYSIS AND THEIR INTERPRETATION

The present chapter presents and briefly discusses the results from applying the general mathematical model described in the previous chapter. The optimal solution of each variation of the general model will be presented and commented upon with respect to the various objectives of this study.

Model 1, as explained in the previous chapter, is the farm optimization given the current situation. The solution of Model 1 produces a point on the efficiency surface for the representative farm. It is plausible to assume that in fact the representative farm is rather within the efficiency frontier. Optimization given the current situation is necessary as the study intends to make comparative statements between farm organizations under this situation and under situations as specified in alternative models. Table 19 reports the results of the optimization given the current situation. The total net cash transferred to the objective function is 685,785 CFA francs. This value includes returns to family labor as it was not found practical to distinguish between the farm household and the farm firm.

It should be recalled for this model as well as for all other models that these results describe a typical year and not any given year in the 3-year plantain production cycle, or a given year in the 25-year cocoa

Model 1

Table 19: Optimum Organization Given the
Availability of Government Loans in Kind:
No Liquidity Management

Activities	Level	Unit
Produce Plantain	2.55	Hectares
Produce Cocoa	2.02	Hectares
Produce Subsistence Crops	1.08	Hectares
Sell Plantain Fruits	38.73	Metric Tons
Sell Plantain Stock	1276.00	Suckers
Sell Cocoa	1474.75	Kilograms
Meet Protein Requirement in Cash	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	Milligrams
Meet Vitamin A Requirement in Cash	3814.12	I.U.
Purchase Fertilizer for Plantain	546.06	Kilograms*
Purchase Insecticide for Plantain	117.00	Kilograms*
Purchase Pesticide for Plantain	236.47	Kilograms*
Purchase Insecticide for Cocoa	99.54	Kilograms*
Purchase Fungicide for Cocoa	200.00	Sacks
Hire Labor	287.46	Man-Days
Borrow from Government for Plantain	237691.00	CFA Francs**
Borrow from Government for Cocoa	13602.00	CFA Francs
Borrow from Moneylender	xxxx	CFA Francs
Repay Government Plantain Debt	237691.00	CFA Francs
Repay Government Cocoa Debt	13602.00	CFA Francs
Repay Moneylender Debt	xxxx	CFA Francs
Meet Other Family Living Expenses	48000.00	CFA Francs
Reserve Cash	xxxx	CFA Francs
Reserve Government Credit	xxxx	CFA Francs
Reserve Moneylender Credit	xxxx	CFA Francs
Transfer Cash to Objective Function	685785.00	CFA Francs

*These amounts are not actually purchased in the current model, but disbursed in government loans.

**1 U.S. Dollar \cong 246 CFA Francs

production cycle. Though the general model is seasonally specified, it has been found convenient to summarize the results in annual terms. The optimal net cash flow is about 3 times the annual cash income observed in the survey. The farmer produces 2.55 hectares of plantain (2.43 hectares is the average from the survey) and 2.02 hectares of cocoa.

Model 2 modifies the current situation by introducing another source of financing, the private moneylender. As in the current situation, government loans are disbursed in kind. The optimal solution shows the small farmer shifting completely to plantain production, borrowing 70,000 CFA from the moneylender (which is the upper limit). He also borrows from the government credit source to its upper limit. The cash flow is increased to 765,245 CFA francs despite the 50 percent rate of interest charged by the moneylender.

The area farmed under plantain has more than doubled, while the government limited its loans to the 2 hectares. Hired labor has increased from 287 to 425 man days. Model 2 clearly shows the possibility of inducing changes in crop mix by changing the availability of loans. The results of model 2 are summarized in Table 20.

6.1 Effects of Funds Use Restriction on Input Mix and Profits

One of the specific objectives of this study, namely objective (iii) in section 2.4 of Chapter 2, was to evaluate the effects of the government policy of restricting the loans to specific uses by disbursing loans exclusively in kind. Model 3 investigates these effects by assuming

Model 2

Table 20: Optimum Organization Given the
Availability of Government (in Kind)
and Moneylender Loans:
No Liquidity Management

Activities	Level	Unit
Produce Plantain	5.66	Hectares
Produce Cocoa	xxxx	Hectares
Produce Subsistence Crops	1.08	Hectares
Sell Plantain Fruits	68.53	Metric Tons
Sell Plantain Stock	2830.00	Suckers
Sell Cocoa	xxxx	Kilograms
Meet Protein Requirement in Stock	31.84	Kilograms
Meet Fat Requirement in Cash	34.10	Kilograms
Meet Iron Requirement in Cash	9101.95	Milligrams
Meet Vitamin A Requirement in Cash	4806.17	I.U.
Purchase Fertilizer for Plantain	927.49	Kilograms*
Purchase Insecticide for Plantain	283.00	Kilograms*
Purchase Pesticide for Plantain	563.27	Kilograms*
Purchase Insecticide for Cocoa	xxxx	Kilograms*
Purchase Fungicide for Cocoa	xxxx	Sacks
Hire Labor	425.86	Man-Days
Borrow from Government for Plantain	321600.00	CFA Francs
Borrow From Government for Cocoa	xxxx	CFA Francs
Borrow From Moneylender	70000.00	CFA Francs
Repay Government Plantain Debt	321600.00	CFA Francs
Repay Government Cocoa Debt	xxxx	CFA Francs
Repay Moneylender Debt	70000.00	CFA Francs
Meet Other Family Living Expenses	48000.00	CFA Francs
Reserve Cash	xxxx	CFA Francs
Reserve Government Credit	xxxx	CFA Francs
Reserve Moneylender Credit	xxxx	CFA Francs
Transfer Cash to Objective Function	765245.00	CFA Francs

*As in Table 19

now that government loans for both plantain and cocoa are disbursed in cash. The farmer will then have to decide on the input mix and its intensity.

In order to achieve this, the model respecified 3 levels of intensity for chemical inputs. By observations, yields have been found to be far more responsive to fertilizer application rates than to either insecticide or pesticide. In other words, varying the amount of fertilizers used (of course up to some limit) affects the yield much more than varying the amount of insecticide and pesticide. For this reason, the model respecified 3 levels of intensity for fertilizer use only. Level 1, or highly intensive, assumes that the farmer uses 750 kilograms of fertilizer per hectare (as Recommended); level 2, or moderately intensive assumes he uses 343 kilograms per hectare, and level 3, low fertilizer application, assumes he uses 250 kilograms per hectare. Model 3 then, in its optimal solution, chooses a given level or any combination of the 3 levels, as each level corresponds to a different yield. The results are reported in Table 21.

The optimal solution shows that the farmer chooses to produce with technology which is highly intensive in terms of fertilizer, or technology level 1. This result is contrary to the commonly held beliefs of the government credit managers. Indeed, one reason why credit is disbursed in kind is to insure that credit funds are not diverted to other non-productive uses. Though these results are derived from an optimal resource allocation which is rarely if ever achieved on actual farms, there seems no theoretical reason to suppose the small farmer to be irrational in allocating his resources so as to approximate this optimal allocation.

Model 3

Table 21: Optimum Organization Given the
Availability of Government and Moneylender Loans
in Cash: No Liquidity Management

Activities	Level	Unit
Produce Plantain	6.75	Hectares
Produce Cocoa	xxxx	Hectares
Produce Subsistence Crops	xxxx	Hectares
Sell Plantain Fruits	107.98	Metric Tons
Sell Plantain Stock	4186.00	Suckers
Sell Cocoa	xxxx	Kilograms
Meet Protein Requirement in Cash	150.32	Kilograms
Meet Fat Requirement in Cash	145.24	Kilograms
Meet Iron Requirement in Cash	23958.00	Milligrams
Meet Vitamin A Requirement in Cash	8452.00	I.U.
Purchase Fertilizer for Plantain	5062.50	Kilograms
Purchase Insecticide for Plantain	789.75	Kilograms
Purchase Pesticide for Plantain	357.00	Kilograms
Purchase Insecticide for Cocoa	xxxx	Kilograms
Purchase Fungicide for Cocoa	xxxx	Sacks
Hire Labor	739.70	Man-Days
Borrow from Government for Plantain	885400.00	CFA Francs
Borrow from Government for Cocoa	xxxx	CFA Francs
Borrow from Moneylender	177528.00	CFA Francs
Repay Government Plantain Debt	885400.00	CFA Francs
Repay Government Cocoa Debt	xxxx	CFA Francs
Repay Moneylender Debt	177528.00	CFA Francs
Meet Other Family Living Expenses	48000.00	CFA Francs
Reserve Cash	xxxx	CFA Francs
Reserve Government Credit	xxxx	CFA Francs
Reserve Moneylender Credit	xxxx	CFA Francs
Transfer Cash to Objective Function	933212.00	CFA Francs

From the survey, it is recalled, the farmer was producing under technology level 2, though he was given in kind the equivalent for technology level 1. The difference in fertilizer use between models 1 and 3 probably reflects the farmer's differential valuation of a unit of fertilizer whether it is loaned to him or whether he purchases it in cash. It is a reflection of the reservation price concept as discussed under "Cash Valuation" in section 5.3 of the previous chapter. The impact of these reservation prices are discussed with the results of models 4 and 5.

In model 3, all available land (6.75 hectares) is farmed and labor hired increases to 739.7 man days. The solution implies no production of subsistence crops for home consumption. Thus all dietary requirements are met in cash. The cash flow transferred to the objective function is 933,212 CFA francs.

This model may not be very realistic because of some inadequacies in representing the physical infrastructure of the small farmer's environment. The model assumes a marketing system capable of supplying the farmer with all the inputs and all the consumption goods (food in particular) he will need to purchase. It equally assumes that the farmer has no problems marketing his own output. The present situation indicates that considerable improvements will need to be made before these conditions are realized. Yet the results from model 3 are of interest in suggesting the gains that might be won from such improvements in infrastructure.

6.2 Effects of Liquidity Management Needs on the Behavior of the Small Farmer

Specific objective (iv) of this study is to determine the impact of the government credit program on the small farmer when the latter views

the program as a permanent institution. The government program, if permanent, will provide the small farmer with another source of liquidity which is believed to be an essential element for his overall decision-making process. Lending in cash instead of in kind does not make the government credit more permanent, though it makes it more appealing as shown by the results of model 3.

Model 4 assumes that the government is viewed as a temporary source of loans and that the small farmer relies only on the moneylender credit for meeting some of his liquidity requirements. In model 4, in addition to all the activities and constraints of the preceding model, the following are included: cash allocation and valuation activities, moneylender credit allocation and valuation activities. The inclusion of these activities above introduces the following rows or restrictions to the model: cash and moneylender credit reserve rows, cash and moneylender credit accounting rows, and finally liquidity reserve requirements. The results are summarized in Table 22. There are no reservations for government credit.

There is a striking difference in the optimal solutions of models 3 and 4. This difference can be attributed only to the fact that model 4 recognizes another basic and real need of the small farmer, namely his need for risk management by the only tool at his disposal, liquidity management.

The optimal area farmed under plantain has dropped to 1.00 hectares in model 4, while the area under cocoa, zero in the previous model, is now 2.54 hectares. The shift in the crop mix may be explained by the

Model 4

Table 22: Optimum Organization Given the
Availability of Government Credit in Cash
(Perceived as Temporary) and Moneylender Credit:
Liquidity Management Specifications for Cash and Moneylender Credit

Activities	Level	Unit
Produce Plantain	1.00	Hectares
Produce Cocoa	2.54	Hectares
Produce Subsistence Crops	2.17	Hectares
Sell Plantain Fruits	16.00	Metric Tons
Sell Plantain Stock	650.00	Suckers
Sell Cocoa	1847.59	Kilograms
Meet Protein Requirement in Cash	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	Milligrams
Meet Vitamin A Requirement in Cash	3814.12	I.U.
Purchase Fertilizer for Plantain	750.00	Kilograms
Purchase Insecticide for Plantain	69.30	Kilograms
Purchase Pesticide for Plantain	10.87	Kilograms
Purchase Insecticide for Cocoa	30.48	Kilograms
Purchase Fungicide for Cocoa	508.00	Sacks
Hire Labor	217.02	Man-Days
Borrow From Government for Plantain	130000.00	CFA Francs
Borrow From Government for Cocoa	46786.80	CFA Francs
Borrow From Moneylender	15000.00	CFA Francs
Repay Government Plantain Debt	130000.00	CFA Francs
Repay Government Cocoa Debt	46785.80	CFA Francs
Repay Moneylender Debt	15000.00	CFA Francs
Meet Other Family Living Expenses	48000.00	CFA Francs
Reserve Cash	404673.66	CFA Francs
Reserve Government Credit	xxxx	CFA Francs
Reserve Moneylender Credit	45000.00	CFA Francs
Transfer Cash to Objective Function	679351.86	CFA Francs

reservation prices specified for cash and moneylender credit held in reserve. The introduction of liquidity requirements has made cash less available for production expenses. Plantain production is more capital (fertilizer) intensive than cocoa production. It is therefore expected that making cash more valuable will bring the producer to shift his farming toward less cash-requiring enterprises.

The amount of cash held in reserve is considerable, and its magnitude evidently depends on the assumed magnitude of the cash reservation prices, relative to earning rates for cash committed to production. The value of the objective function as generated by the model, includes the value of liquid reserves (cash and moneylender credit). The value reported here (678,351.86 CFA francs) has been reduced by the value of liquid reserves. However, as shown in Table 22, 404,673.66 CFA francs are being held in reserve, and should be added to the reported value of the objective function in order to obtain the value of total cash available to the household.

6.3 Effects of a Financially Viable Government Credit Institution on the Small Farmer

In Chapter 4 of this study, it was shown that under its current policies, the government credit program incurs considerable financial losses and its financial viability is highly questionable. Under those conditions the farmer perceives, and rightly so, that the institution is likely to be short-lived. The program thus lacks the permanent nature which is needed for each institution in order to give its customers any long-term trust.

Model 5, which is the complete model in this study, assumes that the government credit program is perceived as permanent. Given cash disbursement as well, this new feature is reflected in the model by specifying government credit allocation and valuation activities and government credit reserve and accounting rows. The government credit reserve is valued at reservation prices shown in Table 16 of the previous chapter. The prices are used just like cash reservation prices to value government credit reserve in the objective function.

The results of this model are summarized in Table 23. There is no difference in the production activities between models 4 and 5. The small farmer's borrowing from the government credit is at the upper limit and borrowing from the moneylender is reduced to 15,000 CFA francs. Cash held in reserve is, as expected, reduced to 301,018 CFA francs. This is exactly the contention this model has maintained. The farmer's perception of government credit as a permanent source of liquidity will induce him to commit more cash to production purposes, since he now can substitute credit reserves for cash reserves. It is to be recalled that the most serious argument against assets held in reserve in the form of cash or other near-liquid forms is their unproductive nature. Committing more of these assets to production processes just values them a lot more than when they are held in reserve to meet liquidity requirements. Committing more assets to production further reduces the burden of the government in its attempts to generate more funds for loans.

Models 3 and 5 reflect two different approaches in the determination of the effects of government program restrictions on the producer. Model

Model 5

Table 23: Optimum Organization Given the
Availability of Government Credit (Perceived as Permanent)
and Moneylender Credit with Liquidity Management
Specified for Both, as Well as for Cash

Activities	Level	Unit
Produce Plantain	1.00	Hectares
Produce Cocoa	2.54	Hectares
Produce Subsistence Crops	2.17	Hectares
Sell Plantain Fruits	16.00	Metric Tons
Sell Plantain Stock	650.00	Suckers
Sell Cocoa	1847.59	Kilograms
Meet Protein Requirement in Cash	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	Milligrams
Meet Vitamin A Requirement in Cash	3814.12	I.U.
Purchase Fertilizer for Plantain	750.00	Kilograms
Purchase Insecticide for Plantain	69.30	Kilograms
Purchase Pesticide for Plantain	10.87	Kilograms
Purchase Insecticide for Cocoa	30.48	Kilograms
Purchase Fungicide for Cocoa	508.00	Sacks
Hire Labor	217.06	Man-Days
Borrow From Government for Plantain	122631.00	CFA Francs
Borrow From Government for Cocoa	46786.80	CFA Francs
Borrow From Moneylender	15000.00	CFA Francs
Repay Government Plantain Debt	122631.00	CFA Francs
Repay Government Cocoa Debt	46786.80	CFA Francs
Repay Moneylender Debt	15000.00	CFA Francs
Meet Other Family Living Expenses	48000.00	CFA Francs
Reserve Cash	301018.48	CFA Francs
Reserve Government Credit	38169.00	CFA Francs
Reserve Moneylender Credit	24474.00	CFA Francs
Transfer Cash to Objective Function	756753.25	CFA Francs

3 investigates the effects of an explicit restriction on the use of loan proceeds and model 5 investigates the effects of an implied restriction on the duration of the program. The results show that removing those two restrictions improves the optimal solution substantially.

6.4 Effects of the Size of Loans on the Small Farmer Situation

The effects of the size of loans were briefly discussed in sections 3.12 of Chapter 3 and 4.3 of Chapter 4, respectively. The present mathematical model is used to evaluate those effects. In order to achieve this goal, a post-optimal simulation procedure called parametric programming was performed on the model.

The first parameterization procedure involved variation of the government credit limits, which is an operation on given elements of the right hand side column. This operation is performed on the optimal solution of the complete model, model 5. Liquidity management theory, as discussed in section 2.2 of Chapter 2 indicates that the reservation prices on cash is some inverse relationship of cash availability. Increasing the government credit limits, evidently increases the options available to the farmer in meeting his liquidity requirements. Cash held in reserve, therefore, is valued less than initially. For this reason, the increased government credit limits are matched up with decreases in the prices or liquidity values of the cash reserves.

This parameterization is carried out in model 6. The government credit limit is increased by from 10 percent to 50 percent in 5 equal intervals. The reservation prices on cash are equally reduced by 10 percent in

5 equal increments. The increase in the credit limits for the government program, for reasons analogous to those given above, should bring the producer to value this source of credit more than in model 5. The reservation prices for reserved government credit are therefore increased by 10 percent, up to 50 percent, in 5 equal increments.

The results are shown in Table 24. The parameterized model does not affect the level of production in the optimal solution. Though the credit limits are increased for both plantain and cocoa, the farmer increases only his borrowing from the plantain loan source. Borrowing for cocoa production remains at the previous level. After a 20 percent increase in the credit limit, the farmer's borrowing for plantain is stabilized at 192,950 CFA francs. After a 30 percent increase, the producer no longer borrows from the moneylender, and this is expected because of the excessively high rate of interest charged by the latter. The size of government loans as well as removal of restrictions on use of loan proceeds, is, therefore, an important factor in freeing the small farmer from the "exploitation" of the moneylender.

Model 5 was again parameterized to produce model 7 by varying the moneylender credit limit. The variations imposed on the moneylender credit limits were similar to those of model 6. The results of model 7 are shown in Table 25 below. The level of cash reserve is lower at each increment, the level of moneylender credit reserve increases, and the level of government credit reserve decreases.

The increase in the moneylender credit limits does not affect plantain production. Since the moneylender source of financing is a very

Table 24: Optimum Organization Given the Availability of Government Credit in Cash (at Specified Level(s)) and Moneylender Credit, Liquidity Management Specified for Both, as Well as for Cash

Activities	Model 5	Level 10	Level 20	Level 30	Level 40	Level 50	Unit
Produce Plantain	1.00	1.00	1.00	1.00	1.00	1.00	Hectares
Produce Cocoa	2.54	2.54	2.54	2.54	2.54	2.54	Hectares
Produce Subsistence Crops	2.17	2.17	2.17	2.17	2.17	2.17	Hectares
Sell Plantain Fruit	16.00	16.00	16.00	16.00	16.00	16.00	Metric Tons
Sell Plantain Stock	650.00	650.00	650.00	650.00	650.00	650.00	Suckers
Sell Cocoa	1847.59	1847.59	1847.59	1847.59	1847.59	1847.59	Kilograms
Meet Protein Requirement in Cash	2.19	2.19	2.19	2.19	2.19	2.19	Kilograms
Meet Fat Requirement in Cash	3.85	3.86	3.86	3.86	3.86	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	5331.73	5331.73	5331.73	5331.73	5331.73	Millograms
Meet Vitamin A Requirement in Cash	3814.12	3814.12	3814.12	3814.12	3814.12	3814.12	l.u.
Purchase Fertilizer for Plantain	1537.50	750.00	750.00	750.00	750.00	750.00	Kilograms
Purchase Insecticide for Plantain	142.06	69.30	69.30	69.30	69.30	69.30	Kilograms
Purchase Pesticide for Plantain	22.28	10.87	10.87	10.87	10.87	10.87	Kilograms
Purchase Insecticide for Cocoa	30.48	30.48	30.48	30.48	30.48	30.48	Kilograms
Purchase Fungicide for Cocoa	508.00	508.00	508.00	508.00	508.00	508.00	Sachets
Hire Labor	217.06	217.06	217.06	217.06	217.06	217.06	Man-days
Borrow From Government for Plantain	122631.00	176880.00	192960.00	192960.00	192960.00	192960.00	CFA Francs
Borrow From Government for Cocoa	46786.80	46786.80	46786.80	46786.80	46786.80	46786.80	CFA Francs
Borrow From Moneylender	15000.00	8500.00	8500.00	8500.00	8500.00	8500.00	CFA Francs
Repay Government Plantain Debt	122631.00	176880.00	192960.00	192960.00	192960.00	192960.00	CFA Francs
Repay Government Cocoa Debt	46786.80	46786.80	46786.80	46786.80	46786.80	46786.80	CFA Francs
Repay Moneylender Debt	15000.80	8500.00	8500.00	8500.00	8500.00	8500.00	CFA Francs
Meet Other Family Living Expenses	301018.42	282093.68	263198.00	244304.00	225409.28	206514.48	CFA Francs
Reserve Cash	38169.00	54985.00	71802.00	88619.00	05436.00	22253.00	CFA Francs
Reserve Government Credit	24474.00	33920.00	33368.00	32815.00	32263.00	31711.00	CFA Francs
Transfer Cash to Objective Function	756753.25	764198.37	771643.47	779088.00	786533.67	793949.87	CFA Francs

Table 25: Optimum Organization Given the Availability of Government Credit in Cash and Moneylender Credit Limits (at Specified Level(s)), Liquidity Management Specified for Both, as Well as for Cash

Activities	Model 5	Level 10	Level 20	Level 30	Level 40	Level 50	Unit
Produce Plantain	1.00	1.00	1.00	1.00	1.00	1.00	Hectares
Produce Cocoa	2.54	2.88	3.16	3.28	3.19	2.88	Hectares
Produce Subsistence Crops	2.17	2.17	2.17	2.17	2.17	2.17	Hectares
Sell Plantain Fruits	16.00	16.00	16.00	16.00	16.00	16.00	Metric Tons
Sell Plantain Stock	650.00	650.00	650.00	650.00	650.00	650.00	Sackers
Sell Cocoa	1847.59	2108.31	2307.18	2399.05	2330.59	2106.78	Kilograms
Meet Protein Requirement in Cash	2.19	2.19	2.19	2.19	2.19	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	3.86	3.86	3.86	3.86	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	5331.73	5331.73	5331.73	5331.73	5331.73	Milligrams
Meet Vitamin A Requirement in Cash	3814.12	3814.12	3814.12	3814.12	3814.12	3814.12	I.U.
Purchase Fertilizer for Plantain	1537.50	750.00	750.00	750.00	750.00	750.00	Kilograms
Purchase Insecticide for Plantain	142.06	69.30	69.30	69.30	69.30	69.30	Kilograms
Purchase Pesticide for Plantain	22.28	10.87	10.87	10.87	10.87	10.87	Kilograms
Purchase Insecticide for Cocoa	30.48	30.48	30.48	30.48	30.48	30.48	Kilograms
Purchase Fungicide for Cocoa	508.00	508.00	508.00	508.00	508.00	508.00	Sachets
Hire Labor	217.06	265.23	308.52	343.29	365.30	371.28	Man-Days
Borrow From Government for Plantain	127631.00	124631.00	125631.00	131631.00	133631.00	137800.00	CFA Francs
Borrow From Government for Cocoa	46786.80	46786.80	46786.80	46786.80	46786.80	46786.80	CFA Francs
Borrow from Moneylender	15000.00	25060.00	27230.60	27834.00	28186.45	29015.16	CFA Francs
Repay Government Plantain Debt	122631.00	124631.00	125631.00	131631.00	133631.00	137800.00	CFA Francs
Repay Government Cocoa Debt	46786.80	46786.80	46786.80	46786.80	46786.80	46786.80	CFA Francs
Repay Moneylender Debt	15000.00	45060.00	57230.60	67834.00	68186.80	49015.16	CFA Francs
Meet Other Family Living Expenses	48000.00	48000.00	48000.00	48000.00	48000.00	48000.00	CFA Francs
Reserve Cash	301018.48	293595.14	286949.36	265921.61	256834.01	247687.28	CFA Francs
Reserve Government Credit	38169.00	35169.00	32168.00	29169.00	26169.00	23169.00	CFA Francs
Reserve Moneylender Credit	24674.00	27474.00	30474.00	33474.00	36474.00	39474.00	CFA Francs
Transfer Cash to Objective Function	756753.25	793165.98	829263.67	865224.20	900979.21	933953.24	CFA Francs

expensive one, increasing the limits is not expected to shift resources to the relatively capital-intensive enterprise. The additional borrowing from the moneylender goes to cocoa production, as shown in Table 25. The area under cocoa increases with every increase in borrowing from the moneylender. The increased loan proceeds from the moneylender are used for hiring more labor as illustrated by the increase in hired labor.

The effects of models 6 and 7 on cash management are similar to those of model 5. Making the perception of government program permanent and increasing the limits on loans both release some of the cash otherwise held in reserve for liquidity purposes. The cash thus released is substituted for by an increase in credit held in reserve. The releasing of this cash should be of a major concern to a government credit program with its limited funds.

6.5 Effects of Higher Interest Rates for Government Loans on the General Model

Model 8 is derived from model 5 by the parameterization of the government program rate of interest. The rate of interest is permitted to vary from the current 6 percent to 36 percent by 5 equal increments of 6 percent. This model is introduced to determine the effects of higher interest on the borrowing activities and finally on the optimal solution. One of the very interesting and revealing observations, as shown in Table 26 below, is that up to 24 percent interest rate on government loans, there are very few changes in the solution. Production mix and borrowing activities remain at the same level.

This finding is exactly what the study contends when it advocates an upward readjustment of the government interest rate, as discussed in

section 4.2 of Chapter 4. This position was equally held by a large proportion of farmers surveyed for the study, who believed that the magnitude of interest rate is less important to them than several other characteristics of the program. These characteristics will be summarized later in this chapter.

After 24 percent interest rate, the model solution starts to change in terms of crop mix. At 30 percent, the producer now farms 1.10 hectares of plantain, a 10 percent increase from the initial solution. The area under cocoa is reduced by .22 hectares or about 8.6 percent. This result is as expected. The increasing cost of financial resources shifts the production mix away from the capital intensive enterprise. The increase in the interest rate is equivalent to increasing the price of chemical inputs. The shift from plantain production process did not lead to lower area farmed or higher cocoa production, but rather to a lower technological level of plantain production. In section 6.1 of the present chapter, 3 levels of fertilizer intensity were specified. The increase in the rate of interest on government funds has led to a reduction of plantain produced under highly intensive technology, as mentioned above. Let us mention that in the complete model (5) as well as in models 6 and 7, plantain was produced only under the highly intensive technology. In the present model, part of the plantain is now being produced under the moderately intensive technology. The 1.10 hectares of plantain produced, as shown in Table 26, are allocated between technology level 1 (.90 hectares) and technology level 2 (.20 hectares). It should be emphasized that this shift in technology occurs only after the interest rate is raised to 30 percent. The shift increases with increasing interest rates.

Table 26: Optimum Organization Given the Availability of Government and Moneylender Credit
 in Cash with the Government Interest Rate for Plantain Loans
 at Specified Level(s), Liquidity Management Specified for Both, as Well as for Cash

Activities	Level	Level	Level	Level	Level	Level	Unit
	6%	12%	18%	24%	30%	36%	
Produce Plantain	1.00	1.00	1.00	1.00	1.10*	1.12**	Hectares
Produce Cocoa	2.54	2.54	2.54	2.54	2.32	2.31	Hectares
Produce Subsistence Crops	2.17	2.17	2.17	2.17	2.17	2.17	Hectares
Sell Plantain Fruits	16.00	32.00	32.00	32.00	36.89	16.92	Metric Tons
Sell Plantain Stock	650.00	650.00	650.00	650.00	688.00	690.00	Suckers
Sell Cocoa	1847.59	1847.59	1847.59	1847.59	1694.36	1688.37	Kilograms
Meet Protein Requirement in Cash	2.19	2.19	2.19	2.19	2.19	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	3.86	3.86	3.86	3.86	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	5331.73	5331.73	5331.73	5331.73	5331.73	Milligrams
Meet Vitamin A Requirement in Cash	3814.12	3814.12	3814.12	3814.12	3814.12	3814.12	I.U.
Purchase Fertilizer for Plantain	750.00	750.00	750.00	750.00	818.60	792.16	Kilograms
Purchase Insecticide for Plantain	69.30	69.30	69.30	69.30	76.23	66.27	Kilograms
Purchase Pesticide for Plantain	10.87	10.87	10.87	10.87	13.03	13.03	Kilograms
Purchase Insecticide for Cocoa	30.48	30.48	30.48	30.48	27.84	27.84	Kilograms
Purchase Fungicide for Cocoa	508.00	508.00	508.00	508.00	464.00	464.00	Sachets
Hire Labor	217.06	217.06	217.06	217.06	238.16	247.20	Man-Days
Borrow From Government for Plantain	122631.00	122631.00	122631.00	122631.00	122631.00	122631.00	CFA Francs
Borrow From Government for Cocoa	46786.80	46786.80	46786.80	46786.80	46108.00	46786.00	CFA Francs
Borrow From Moneylender	15000.00	15000.00	15000.00	15000.00	15000.00	15000.00	CFA Francs
Repay Government Plantain Debt	122631.00	122631.00	122631.00	122631.00	122631.00	122631.00	CFA Francs
Repay Government Cocoa Debt	46786.80	46786.80	46786.80	46786.80	46108.00	46786.00	CFA Francs
Meet Other Family Living Expenses	15000.00	15000.00	15000.00	15000.00	15000.00	15000.00	CFA Francs
Reserve Cash	48000.00	48000.00	48000.00	48000.00	48000.00	48000.00	CFA Francs
Reserve Government Credit	301018.48	297130.17	297130.17	297130.00	289425.13	289124.06	CFA Francs
Reserve Moneylender Credit	38169.00	38169.00	38169.00	38169.00	38169.00	38169.00	CFA Francs
Transfer Cash to Objective Function	24474.00	34474.00	34474.00	34474.00	34474.00	24474.00	CFA Francs
	756753.25	747105.25	737457.25	727809.25	742309.24	751801.56	CFA Francs

*Allocated into .90 hectares of high-fertilizer plantain and .20 hectare moderate-fertilizer plantain

**Allocated into .93 hectares of high-fertilizer plantain and .29 hectare moderate-fertilizer plantain

In order to determine further the effects of the higher interest rates on the technology mix, model 9 was developed simply by dropping all cocoa activities and its corresponding requirements from model 8. The results are summarized on Table 27. In this table, unlike Table 26, plantain production is distinguished by the technology level used in their production. Plantain A refers to plantain grown under technology level 1 or high fertilizer intensive production process, and plantain B refers to plantain grown under the moderate fertilizer intensive production process. The model does show what one would expect, a gradual shift away from technology level 1 to technology level 2. The substantial decrease in hired labor results both from dropping the cocoa activities and from the shift in technology. Technology level 1 does require substantially more labor than does technology level 2. The value of the objective function has understandably decreased.

The final model of this analysis, model 10, is intended to further determine the effects of higher rates of interest on the optimal solution of the complete model. Let us recall that in all the previous models government loans for cocoa production were free of interest rate charges. The present model assumes that cocoa loans are subject to the same costs as plantain loans, and these costs are parameterized exactly as in model 8. The results are shown in Table 28. They are quite similar to those of model 8, with the exception that the shift from technology level 1 to technology level 2 is a little faster.

The present mathematical modeling of the small farmer's financial environment has provided some very interesting results with respect to the

Table 22: Optimum Organization Given the Availability of Government and Moneylender Credit
 In Cash with Government Interest Rate for Plantain Loans at Specified Level(s).
 Liquidity Management Specified for Both, as well as for Cash, No Cocoa Activities in the Model

Activities	Complete Model				Level 36%	Unit
	With Cocoa i = 6%	Level 6%	Level 12%	Level 24%		
Produce Plantain A	1.00	1.74	1.34	1.02	.88	Hectares
Produce Plantain B	xxxx	xxxx	.50	.72	.86	Hectares
Produce Cocoa	2.54	xxxx	xxxx	xxxx	xxxx	Hectares
Produce Subsistence Crops	2.17	2.17	xxxx	2.17	2.17	Hectares
Sell Plantain Fruits	16.00	24.59	24.19	24.19	24.19	Metric Tons
Sell Plantain Stock	650.00	1008.00	1008.00	1008.00	1008.00	Suckers
Sell Cocoa	1847.59	xxxx	xxxx	xxxx	xxxx	Kilograms
Meet Protein Requirement in Cash	2.19	2.19	2.19	2.19	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	3.86	3.86	3.86	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	5331.73	5331.73	5331.73	5331.73	Kilograms
Meet Vitamin A Requirement in Cash	3814.12	3814.12	3814.12	3814.12	3814.12	Millograms
Purchase Fertilizer for Plantain	750.00	967.19	967.19	967.19	967.19	I.U.
Purchase Insecticide for Plantain	69.30	120.58	120.58	120.58	120.58	Kilograms
Purchase Pesticide for Plantain	10.87	18.97	18.97	18.97	18.97	Kilograms
Purchase Insecticide for Cocoa	30.48	xxxx	xxxx	xxxx	xxxx	Kilograms
Purchase Fungicide for Cocoa	508.00	xxxx	xxxx	xxxx	xxxx	Sachets
Hire Labor	217.06	6.74	6.74	6.74	6.74	Man-Days
Borrow From Government for Plantain	160800.00	171000.00	171000.00	171000.00	171000.00	CFA Francs
Borrow From Government for Cocoa	46786.80	xxxx	xxxx	xxxx	xxxx	CFA Francs
Borrow From Moneylender	15000.00	22368.00	22368.00	22368.00	22368.00	CFA Francs
Repay Government Plantain Debt	160800.00	171000.00	171000.00	171000.00	171000.00	CFA Francs
Repay Government Cocoa Debt	46786.80	xxxx	xxxx	xxxx	xxxx	CFA Francs
Repay Moneylender Debt	15000.00	22368.00	22368.00	22368.00	22368.00	CFA Francs
Meet Other Family Living Expenses	48000.00	48000.00	48000.00	48000.00	48000.00	CFA Francs
Reserve Cash	301018.48	208683.26	208683.26	208683.26	208683.26	CFA Francs
Reserve Government Credit	38169.00	41853.00	41853.00	41853.00	41853.00	CFA Francs
Reserve Moneylender Credit	24474.00	32632.00	32632.00	32632.00	32632.00	CFA Francs
Transfer Cash to Objective Function	756753.25	672463.65	662463.65	661943.65	621423.65	CFA Francs

Table 23: Optimum Organization Given the Availability of Government and Family Lender Credit in Cash with Government Interest Rate for Both Plantain and Cocoa Loans at Specified Level(s), Liquidity Management Specified for Both, as Well as for Cash

Activities	Results Model 5	Level 6%	Level 12%	Level 24%	Level 30%	Level 36%	Unit
Produce Plantain A	1.00	1.00	1.00	1.00	.87	.75	Hectares
Produce Plantain B	xxxx	xxxx	xxxx	xxxx	.13	.37	Hectares
Produce Cocoa	2.54	2.54	2.54	2.54	2.32	2.31	Hectares
Produce Subsistence Crops	2.17	2.17	2.17	2.17	2.17	2.17	Hectares
Sell Plantain Fruits	16.00	16.00	16.00	16.00	16.89	16.92	Metric Tons
Sell Plantain Stock	650.00	650.00	650.00	650.00	688.00	690.00	Sackers
Sell Cocoa	1847.59	1847.59	1847.59	1847.59	1694.36	1688.37	Kilograms
Meet Protein Requirement in Cash	2.19	2.19	2.19	2.19	2.19	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	3.86	3.86	3.86	3.86	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	5331.73	5331.73	5331.73	5331.73	5331.73	Milligrams
Meet Vitamin A Requirement in Cash	3814.12	3814.12	3814.12	3814.12	3814.12	3814.12	I.U.
Purchase Fertilizer for Plantain	750.00	750.00	750.00	750.00	818.60	783.70	Kilograms
Purchase Insecticide for Plantain	69.30	69.30	69.30	69.30	76.23	63.20	Kilograms
Purchase Pesticide for Plantain	10.87	10.87	10.87	10.87	13.03	13.03	Kilograms
Purchase Insecticide for Cocoa	30.48	30.48	30.48	30.48	27.84	27.84	Kilograms
Purchase Fungicide for Cocoa	508.00	508.00	508.00	508.00	464.00	464.00	Sachets
Hire Labor	217.06	183.04	182.00	163.16	190.24	195.17	Man-Days
Borrow From Government for Plantain	160800.00	160800.00	160800.00	150318.00	132480.00	145210.80	CFA Francs
Borrow From Government for Cocoa	46786.80	46786.80	46786.80	46786.80	46786.80	46786.80	CFA Francs
Borrow From Moneylender	15000.00	15000.00	15000.00	15000.00	15000.00	15000.00	CFA Francs
Repay Government Plantain Debt	160800.00	160800.00	160800.00	150318.00	132480.00	145230.80	CFA Francs
Repay Government Cocoa Debt	46786.80	46786.80	46786.80	46786.80	46786.80	46786.80	CFA Francs
Repay Moneylender Debt	15000.00	15000.00	15000.00	15000.00	15000.00	15000.00	CFA Francs
Meet Other Family Living Expenses	48000.00	48000.00	48000.00	48000.00	48000.00	48000.00	CFA Francs
Reserve Cash	301018.48	300987.60	297130.85	297130.85	289425.13	289124.06	CFA Francs
Reserve Government Credit	38169.00	38169.00	38169.00	38169.00	38169.00	38169.00	CFA Francs
Reserve Moneylender Credit	24474.00	34474.00	34474.00	34474.00	34474.00	34474.00	CFA Francs
Transfer Cash to Objective Function	756753.25	756587.47	744132.26	752319.36	751480.34	750806.85	CFA Francs

*The same interest rate and variations are used both for plantain and cocoa.

issues the study set out to investigate. The following insights have been revealed through the various results.

- (i) The introduction of a private moneylender as an alternative source of financing allows the small farmer to greatly increase his total output and his income. This reinforces the point that limited capital supply is more limiting to the growth of the farmer's income than is the cost of that capital, given that these costs are kept within "reasonable" limits.
- (ii) The relaxation of the restriction upon the utilization of government loan proceeds was found to be beneficial to both output and income. Very importantly, the solution reveals that the farmer produces with the high technology process, which is one goal pursued by the said restriction.
- (iii) The liquidity needs of the household are real needs. The farmer holds large amounts of cash and credit in reserve to be able to meet these contingencies. Supplying him with reliable sources for borrowing in terms of cash, in order to meet some of these contingencies, allows him to release some of his cash, otherwise idle or sterile and its equivalents into his production activities. He substitutes some credit reserve, derived from permanent and reliable credit institutions, for the cash he then commits to production.
- (iv) Comparing the results of models 6 and 8 has revealed that the size of loan is a far more important factor in improving the farmer's income than is the rate of interest he has to pay.

A 400 percent increase in the rate of interest (from 6 to 30 percent) reduces the farmer's income by about 2 percent while a 50 percent increase in the loan limits increases his income by about 20 percent (compare models 2 and 3).

All of the findings revealed under (iv) were confirmed by the results of the field survey. Among the following 4 characteristics of a farm loan program, interest rate, average size of loans, flexibility of use of loan proceeds, and the length of time for loan disbursement, 37 percent of the farmers interviewed ranked the flexible use of loan funds as the most important feature of the program, 31 percent chose the rapid disbursement of funds, 27 percent chose the size of loan, and only 5 percent chose the level of interest rate as a major factor in their borrowing decision.

Table 29: Solutions of Models 1 Through 5 Compared

Activities	Model 1 Solution	Model 2 Solution	Model 3 Solution	Model 4 Solution	Model 5 Solution	Unit
Produce Plantain	2.55	5.66	6.75	1.00	1.00	Hectares
Produce Cocoa	2.02	xxxx	xxxx	2.54	2.54	Hectares
Produce Subsistence Crops	1.08	1.08	xxxx	2.17	2.17	Hectares
Sell Plantain Fruits	38.73	68.53	107.98	16.00	16.00	Metric Tons
Sell Plantain Stock	1276.00	2830.00	4186.00	650.00	650.00	Sackers
Sell Cocoa	1474.75	xxxx	xxxx	1847.59	1847.59	Kilograms
Meet Protein Requirement in Cash	2.19	31.84	150.32	2.19	2.19	Kilograms
Meet Fat Requirement in Cash	3.86	34.10	145.24	3.86	3.86	Kilograms
Meet Iron Requirement in Cash	5331.73	9101.95	23958.00	5331.73	5331.73	Milligrams
Meet Vitamin A Requirement in Cash	3814.12	4806.17	8452.00	3814.12	3814.12	I.U.
Purchase Fertilizer for Plantain	546.06	927.49	5062.50	750.00	750.00	Kilograms
Purchase Insecticide for Plantain	117.00	283.00	789.75	69.30	69.30	Kilograms
Purchase Pesticide for Plantain	236.47	563.27	357.00	10.87	10.87	Kilograms
Purchase Insecticide for Cocoa	99.54	xxxx	xxxx	30.48	30.48	Kilograms
Purchase Fungicide for Cocoa	200.00	xxxx	xxxx	508.00	508.00	Sacks
Hire Labor	287.46	425.86	739.70	217.02	217.06	Man-Days
Borrow from Government for Plantain	237691.00	321600.00	885400.00	130000.00	122631.00	CFA Francs
Borrow from Government for Cocoa	13602.00	xxxx	xxxx	46786.80	46786.80	CFA Francs
Borrow from Moneylender	xxxx	70000.00	177528.00	15000.00	15000.00	CFA Francs
Repay Government Plantain Debt	237691.00	321600.00	885400.00	130000.00	122631.00	CFA Francs
Repay Government Cocoa Debt	13602.00	xxxx	xxxx	46786.80	46786.00	CFA Francs
Repay Moneylender Debt	xxxx	70000.00	177528.00	15000.00	15000.00	CFA Francs
Meet Other Family Living Expenses	48000.00	48000.00	48000.00	48000.00	48000.00	CFA Francs
Reserve Cash	xxxx	xxxx	xxxx	404673.66	301018.48	CFA Francs
Reserve Government Credit	xxxx	xxxx	xxxx	xxxx	38169.00	CFA Francs
Reserve Moneylender Credit	xxxx	xxxx	xxxx	450.00	24474.00	CFA Francs
Transfer Cash to Objective Function	685785.00	765245.00	933212.00	679351.86	756753.25	CFA Francs

CHAPTER 7

SUMMARY, CONCLUSIONS, AND IMPLICATIONS OF THE STUDY

7.1.1 Summary and Conclusions:

This study has brought out once again the critical necessity of external financing for the small farmers. This external financing leads to much higher returns for the farmer's enterprise(s), as well as for the economy as a whole, assuming that an adequate technology has been developed. In Cameroon as in several other LDC's, this external financing is carried out mainly by the public sector. This function has proved to be extremely costly to the government, as was shown in Chapter 4.

These prohibitive costs have resulted essentially from three sources: very high administrative costs, low repayment records, and unusually low interest rate charged on funds loaned out. Though several justifications have been brought out in support of these low rates of interest, it remains that they contribute to a misallocation of resources, the weakening and the distortion of capital markets; they create no incentives to save, will induce non-productive forms of liquidity management.

The low repayment records have led the government credit officials to extend loans in kind, as a device to curb down the rate of delinquency and default. Extending loans exclusively in kind ignores one very important element in the farmer's financial behavior. Decision making for

a future time horizon entails an element of uncertainty which has to be taken into consideration. We assume that in general, risk aversion predominates all economic activities, regardless of the income level. The aversion of this risk can be formulated in the production, marketing and financial organization of the firm, depending upon its sources.

In production, risk aversion can take the form of diversification and flexibility; in marketing, it can appear in the form of future contracts; in the financial organization, it can be expressed in the form of insurance and demand for liquid assets. The small farmer of the LDC's who is provided with only few of the services or opportunities mentioned above, relies heavily on liquid reserves for managing the various risks. Liquidity reserves indeed constitute the small farmer's insurance against crop failure (production risk), against falling prices for his products (market risk), against sickness, etc. Extending loans in kind does not contribute to the farmer's ability to meet his liquidity requirements and therefore, such government credit programs are not very appealing to the small farmers.

The several findings of this study tend to indicate that there is large room for improvement in the government agricultural credit programs, and have far-reaching implications for agricultural credit policies and for research.

7.2 Implications for Policy:

It is the contention of this study that the current government policies in the area of agricultural credit programs for small farmers are seriously limited in terms of success. It is of uppermost importance

recognize the fact that criteria for success or for evaluating credit policies are several and diverse, and may be subject to differences of opinion. One could nevertheless list the following: (i) the cost of operating the credit program, (ii) the number of farmers served, or the reach of the program, (iii) the degree to which the farmer's financial needs are met, or the average size of loans available to the farmer, (iv) the level of delinquency and/or default, which is in part reflected in (i) above, (v) increase in farmer's output, income or welfare, and (vi) impact on income equalization or distribution between various farm groups.

In terms of criteria (iii) and (vi), the performance depends largely on the availability of funds to the government, and no real objective appreciation can be made. The allocation of government funds is subject to political decisions which are by nature subjective. In terms of criterion (v) the increase in the farmer's output has been substantial. In terms of all the other three criteria, the results have been much less satisfactory. The program studied exhibited excessive and prohibitive costs. Two major reasons account for these excessive costs. One, the program does not charge its customers for the full cost of the services rendered. Two, the administering of such small credit schemes does require a large amount of supervision, and lending in kind complicates the problem still further. The level of delinquency and default is high and this is due in part to how permanent and reliable the borrower perceives this loan option to be. Only a very small proportion of small farmers are reached by this program.

Of all the current policies of the small farmer agricultural credit programs, the most damaging and the most objectionable of them all is the unrealistically low interest rates they charge. They are objectionable on several grounds, the most serious objection being that they discourage savings and they fail to mobilize the few savings available. This particular policy has serious global implications in the financial market and, by extension, in the whole economy. The various negative effects of this policy were briefly summarized in Chapter 4.

The argument against the practice of low interest rates as presented throughout this study does not ignore the various advantages of a well designed subsidization program for small farmers. Low interest rates to small farmers is justified as an income transfer or equalization mechanism. They may be necessary to induce some small farmers to adopt a given technological improvement. The position of this study is that such subsidization programs should be clearly distinguished in their organization and in their objectives from the credit programs for small farmers. This distinction has not been made and the target population for a subsidization program is identical with the target population for a potential credit program.

7.3 Policy Recommendations :

The preceding remarks call for several policy suggestions of which a few are listed below

- (i) Small farmer credit programs should be reoriented so as to reduce their costs, to give small farmers incentives to save, and of course, to be able to mobilize such savings. In order

to achieve these goals, credit programs should charge substantially higher interest rates to render saving activities attractive. They should secure places for the rural population to deposit their savings. There is therefore a need for creating a savings division within the credit institutions. An interest rate of 18 - 24 percent range has been suggested by various sources [28]. This range was in essence, confirmed by the results of the mathematical modeling as shown in the previous chapter. Mobilizing rural savings will broaden the institution resource base.

- (ii) Credit institutions for small farmers should simplify their lending procedures for a more rapid disbursement of funds. This could be achieved through a complete decentralization of the institution's operations.
- (iii) Because of the inability to clearly distinguish between the household and the farm firm as two separate entities, it is very hard and an unrewarding exercise to attempt to make a clear cut distinction between production and consumption expenses. It is therefore not very realistic for a credit program for small farmers to address itself exclusively to production needs. Consumption needs are at least as important as production. To provide loans in kind is to ignore some of the producer's needs which just cannot be overlooked. Though the reasons for supplying loans in kind are well founded and well understood, these

in kind loans, if necessary, should be supplemented by some loans in cash to provide for the producer's consumption and liquidity management needs; this is the purpose of the "Prets de Soudure" of the B.N.D.A. in the Ivory Coast [60].

- (iv) Government funds intended to be used as income transfer payments should not be channeled to the rural beneficiaries through government credit institutions, or if they are, they should be handled through a specific department or division. The qualifications for benefiting from these income subsidization programs should be clearly defined and distinct from the qualifications required for credit programs. Equally well defined should be the "graduation" criteria for the subsidization program.

7.4 Implications for Further Research:

This study has brought into focus several research issues. The overall conclusion regarding research is that a tremendous research problem is yet to be tackled in order to gain some insights on the financial environment of the small farmers. The study had assumed some key empirical data for which actual figures will prove greatly useful. The small farmer's reservation prices on cash and credit, when and if empirically estimable, will considerably improve our understanding of his liquidity preference. The complete understanding of this liquidity preference is essential in designing programs to meet farmers' financial needs.

Another research area which emerged from this study is the causes and remedies for excessive costs and financial losses incurred by the

government agricultural credit programs. Cost-reducing studies will be of great help in making these government programs self-supporting. The problem of delinquency and default is equally to be researched as it is directly related to the costs of the programs. The reasons behind the high delinquency and/or default rates, if well understood, would facilitate the setting up of a profitable and thus permanent credit scheme.

The various risks the farmer deals with should be seriously studied and ways to alleviate them should be investigated. Measures to be investigated should include among other things, loan guarantees and farm insurance. Most work on small farm financing has been limited to institutional financing. The role played by the moneylender can not be disregarded, in spite of their "exploitative" practices. Their record is impressive in terms of loan recovery and some lessons could be learned from this specific area.

The various policy and research implications and recommendations enumerated above are intended to bring into sharper focus, the critical issues of government credit interest rates and the recognition of the farmer's vital need for liquidity management. These two issues have been the central theme of this study.

APPENDIX

Table A1: BUDGET DE L'EXPLOITATION:

Rubriques	Année 1	Année 2	Année 3	Année 4	Année 5	Année 6	Année 7	Année 8	Année 9
I - La valeur de la production	-	209 750	169 750	129 750	259 750	209 750	159 750	209 750	159 750
- Production des régimes (tonnes)	-	20	16	12	25	20	15	20	15
- Production des rejets (pieds)	-	650	650	650	650	650	650	650	650
- La valeur des régimes à 10 CFA le kg.	-	200 000	160 000	120 000	250 000	200 000	150 000	200 000	150 000
- La valeur des rejets à 16 CFA le pied	-	9 750	9 750	9 750	9 750	9 750	9 750	9 750	9 750
II - Les frais de production	165 750	92 000	91 550	206 200	92 000	89 000	59 950	92 000	59 950
- Pousse-pousse	14 000	-	-	14 000	-	-	-	-	-
- Petits outils	7 000	-	-	7 000	-	-	-	-	-
- Matériel végétal à 25 CFA le pied	12 500	-	-	16 250	-	-	-	-	-
- Coût de l'abattage et du débitage	12 500	-	-	12 500	-	-	-	-	-
- Engrais	27 000	27 000	27 000	45 000	27 000	27 000	18 000	27 000	18 000
- Pesticide	16 000	11 700	11 700	26 000	11 700	11 700	7 800	11 700	7 800
- Insecticide	26 000	26 000	26 000	39 000	26 000	26 000	13 000	26 000	13 000
- Main-d'oeuvre familiale	30 150	27 300	26 850	37 050	27 300	26 850	21 150	27 300	21 150
- Main-d'oeuvre salariée	-	-	-	9 000	-	-	-	-	-
III - Prête de l'Etat au fermier	122 000*	33 000*	-	90 000**	-	-	-	-	-
Total des besoins	135 600	37 000	-	119 350	-	-	-	-	-
- Pousse-pousse	14 000	-	-	14 000	-	-	-	-	-
- Petits outils	7 000	-	-	7 000	-	-	-	-	-
- Matériel végétal	32 500	-	-	16 250	-	-	-	-	-
- Engrais	27 000	-	-	27 000	-	-	-	-	-
- Pesticide	16 600	-	-	16 600	-	-	-	-	-
- Nématicide	26 000	-	-	26 000	-	-	-	-	-
- Coût de l'abattage et du débitage	17 500	-	-	17 500	-	-	-	-	-
IV - Remboursement des prêts avec intérêt de 6% par an	-	117 320	47 700	-	95 600	-	-	-	-
V - Bénéfice net du fermier (I+II) - (III+IV)	- 43 750	+ 33 430	+ 30 500	+ 15 550	+ 72 350	+ 120 750	+ 99 800	+ 120 750	+ 99 800
VI - Revenu du fermier (Bénéfice + main-d'oeuvre familiale)	- 11 600	+ 60 730	+ 57 350	+ 52 600	+ 99 650	+ 155 050	+ 130 950	+ 155 050	+ 130 950

Source: Opération Culture Verte (op. c.v.).

* à 90% du total des besoins en chiffres ronds.

** à 75% du total des besoins en chiffres ronds.

Table A2: CALCUL DU TAUX DE RENTABILITE FINANCIER AU NIVEAU DU PLANTEUR

Années	Recettes du planteur			Dépenses du planteur		Bénéfice net	Actualisé a 80%		Actualisé a 90%	
	Valeur de la production	Prêts	Total	Coût de la production	Remboursement des prêts et intérêts		Facteur	Valeur présente	Facteur	Valeur présente
Année 1	-	122 000	122 000	165 750	-	- 43 750	0,556	- 24 325	0,526	- 23 012
Année 2	209 750	33 000	242 750	92 000	117 320	+ 33 430	0,309	+ 10 330	0,277	+ 9 260
Année 3	169 750	-	169 750	91 550	47 700	+ 30 500	0,171	+ 5 216	0,146	+ 4 453
Année 4	129 750	90 000	219 750	204 200	-	+ 15 550	0,095	+ 1 477	0,077	+ 1 197
Année 5	259 750	-	259 750	92 000	95 400	+ 72 350	0,053	+ 3 835	0,040	+ 2 894
Année 6	209 750	-	209 750	89 000	-	+ 120 750	0,029	+ 3 502	0,021	+ 2 536
Année 7	159 750	-	159 750	59 950	-	+ 99 800	0,016	+ 1 597	0,011	+ 1 098
Total	1 138 500	245 000	1 383 500	794 450	260 420	+ 328 630	-	+ 1 632	-	- 1 574

Source: Opération Ceinture Verte (Op. Cit.)

Le Taux de rentabilité financier au niveau du planteur est calculé comme suit: $80 + 10 \left(\frac{0,42}{3 \cdot 208} \right) = 85\%$

Table A3: CALCUL DU TAUX DE RENTABILITE INTERNE
(millions de francs CFA)

ANNEE	BENEFICE DU PROJET			COUT DU PROJET				CALCUL D'ACTUALISATION			
	Valeur de la production des agriculteurs	Valeur de la production du Centre de multiplication	Valeur totale	Cout total financé par le Cameroun	Taxes et douanes	Coût-taxes et impôts	Bénéfice net	Facteur d'actualisation à 20%	Valeur présente à 20%	Facteur d'actualisation à 17%	Valeur présente à 17%
1973/74	-	-	-	79,1	7,8	71,3	-71,3	0,813	-59,4	0,855	-61,0
1974/75	13,0	0,5	13,5	108,9	8,5	100,4	-86,9	0,694	-60,3	0,731	-63,5
1975/76	50,3	1,5	51,8	161,1	10,9	150,2	-98,4	0,579	-57,0	0,624	-61,4
1976/77	119,0	2,3	121,7	252,6	17,7	234,9	-113,6	0,482	-54,8	0,534	-60,7
1977/78	244,5	6,1	250,6	349,1	26,5	322,6	-72,0	0,402	-28,9	0,456	-32,8
1978/79	378,0	11,5	389,5	383,3	27,7	355,6	+33,9	0,315	+11,4	0,390	+13,2
1979/80	466,0	15,2	481,2	388,6	28,1	360,5	+120,7	0,279	+13,7	0,333	+40,2
1980/81 et suivants	489,0	15,2	504,2	388,6	28,1	360,5	+143,7	1,359	+195,3	1,876	+269,6
Total									-20,0		+43,6

Source: Operation Ce-Inture Verie (Op. Cit.)

Le taux de rentabilité interne est calculé comme suit: $17 + 3 \left(\frac{43,6}{63,6} \right) = 19,1$ arrondi à 19%

Table A4: MEASURES OF LOAN DELINQUENCY OF SELECTED INSTITUTIONS
(Percentages)

Country		Arrears to portfolio	Arrears* rate
Africa			
Ethiopia	Wolamo**	--	3
	CADU**	--	50
Ghana	ADB	--	55
Ivory Coast	BNDA	--	15
Kenya	GMR	25	33
	AFC**	51	36
Malawi	Lilongwe**	--	2
Niger	CNCA**	11	29
Nigeria	WSACC	52	80
	FAID	--	95
Morocco	SOCAP	--	50
	CNCA**	13	5
Sudan	COOP	--	26
	ABS	--	13
Tanzania	NDCA**	28	50
Tunisia	BNT**	66	50
	Local credit unions	--	50
Uganda	COOP	10	--
Asia			
Afghanistan	ADBA**	37	77
Bangladesh	AB	43	76
	IRDP	--	40
India	PCCS	34	7
	PLDB**	12	20
Iran	ACBI	--	44
Jordan	ACC**	41	82
Korea, Republic of	NAFC**	7	15
Malaysia	BPM	6	21
Pakistan	ADB**	36	65
Philippines	Rural banks**	20	18
Sri Lanka	New credit scheme	50	41
Thailand	BAAC	--	50
Turkey	ABT	29	43
Viet-Nam, Republic of	Rural banks	--	5
Latin America			
Bolivia	Agricultural bank**	1	68
Chile	INDAP	16	60
Colombia	Caja Agraria	19	--
	INCORA**	4	16
Costa Rica	BNCR, BCR	35	--
El Salvador	ABC	37	91
Honduras	BNF, Sup. Credit	10	13
Jamaica	ADB	31	10
Peru	Plan Costa	33	--
	BFA**	30	--

Source: From Agricultural Credit
Sector Policy Paper World Bank
Washington, D.C. May 1975

Note: These measures have various shortcomings. Most agencies consider rescheduled loans as having been repaid. A low ratio of arrears to portfolio may not mean much when loans are expanding rapidly and not yet due, while at the same time the repayment rate on previous loans is poor.

*The arrears rate is equal to 100 minus the repayment rate.
**Institutions involved in World Bank-assisted projects.

Table A5: ENCADREMENT ET COUTS CORRESPONDANTS
(Milliers de Francs CFA)

PERSONNEL DESCRIPTION	Salaire ANNUEL, plus Indemnités et Frais Sociaux	NOMBRE ET COUT DE L'ENCADREMENT POUR L'ANNEE FISCALE													
		1973/74		1974/75		1975/76		1976/77		1977/78		1978/79		1979/80 et suivants	
		Nb	Coût	Nb	Coût	Nb	Coût	Nb	Coût	Nb	Coût	Nb	Coût	Nb	Coût
Directeur Général	3.360	1	3.360	1	3.360	1	3.360	1	3.360	1	3.360	1	3.360	1	3.360
Chef de Secteur	2.340	1	2.340	1	2.340	1	2.340	1	2.340	1	2.340	1	2.340	1	2.340
Chef de Service Technique	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872
Chef de Service Administratif, Commercial et financier	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872
Chef de Service, Encadrement	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872	1	1.872
Comptable	780	1	780	1	780	1	780	1	780	1	780	1	780	1	780
Magasinier	230	1	230	1	230	1	230	1	230	1	230	1	230	1	230
Encadreur de base	216	2	432	5	1.080	9	1.944	17	3.672	20	4.320	20	4.320	20	4.320
Chauffeurs	200	6	1.200	9	1.800	10	2.000	12	2.400	13	2.600	14	2.800	14	2.800
Dactylo	216	2	432	2	432	2	432	2	432	2	432	2	432	2	432
Employé de Bureau	230	1	230	1	230	1	230	2	460	2	460	2	460	2	460
Triconneurs	158	7	1.106	18	2.844	22	3.476	33	5.214	40	6.320	30	4.740	7	1.106
Aide-Triconneurs	144	7	1.008	18	2.592	22	3.168	33	4.752	40	5.760	30	4.320	7	1.008
Manoeuvre-Magasin	108	2	216	2	216	3	324	3	324	4	432	4	432	4	432
Planton	114	1	114	1	114	2	228	2	228	2	228	2	228	2	228
Gardien	108	1	108	2	216	2	216	2	216	2	216	2	216	2	216
Total	-	35	17.172	65	21.850	80	24.344	113	30.024	132	33.094	113	30.274	67	23.259

Source: Opération Ceinture Vente (Op. Cit.)

*Les indemnités et frais sociaux sont calculés à 40% pour le Directeur Général à 30% pour les autres cadres supérieurs.

Table A6: COMPTE GLOBAL DU CREDIT AGRICOLE - HYPOTHESE DE REMBOURSEMENT BASE
(EN MILLIONS DE F CFA)

	ANNEE FISCALE									
	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81		
I Nombre d'hectare mis en place:										
- lère plantation	100	250	500	700	600	250	-	-	-	-
- 2è plantation	-	-	-	100	250	500	-	-	-	-
II Crédit agricole										
- Prêts en suspens au commencement de l'exercice	-	12,2	35,0	72,2	116,9	127,2	102,5	11,2		
- Prêts aux planteurs pendant l'année	12,2	33,8	69,2	110,9	118,8	95,3	8,2	-		
- Remboursements	-	8,8	25,6	53,0	88,2	99,4	86,4	5,0		
- Non remboursés	-	2,2	6,4	13,2	20,4	20,6	13,2	2,2		
- Intérêt payé à 6%	-	0,6	1,7	3,5	5,7	6,3	5,3	0,5		
- Prêts en suspens à la fin de l'exercice	12,2	35,0	72,2	116,9	127,2	102,5	11,2	-		
- Déficit de financement	-	-1,6	-4,7	-9,8	-14,7	-14,3	-7,8	-1,7		

Source: Opération Ceinture Verte (Op. Cit.)

Table A7: ADMINISTRATIVE COSTS FOR SELECTED INSTITUTIONS

Country	Institutions	Cost as a percentage of total resources	Cost as a percentage of total resources
Africa			
Ghana	ADB	10.0	10.0
Ivory Coast	CNCA	--	9.0
Kenya	AFC*	--	3.0
Morocco	CNCA*	10.0	3.0
Senegal	BND	--	3.0
Uganda	COOP	50.0	--
Asia			
Bangladesh	KTCC	17.0	10.0
	BKB	--	3.0
China, Republic of	Farmers Association	--	2.5
	Coop. Bank	--	(2.5)
	Land Bank	--	(1.5)
India	LDB*	--	3.0
Indonesia	BIMAS (improved)	25.0	--
Jordan	ACC*	30.0	3.0
Korea, Republic of	NACF*	6.0	4.0
Lebanon	BCAIF	--	3.0
Malaysia	BPM	20.0	--
Pakistan	ADB*	--	3.0
Philippines	Rural banks*	5.0	5.0
Thailand	BAAC	13.0	8.0
Turkey	SCR	5.0	2.0
	BAT	--	6.0
Latin America			
Brazil	ACAR	10.0	--
Colombia	INCORA*	10.0	7.0
Costa Rica	BNCR	7.0	3.0
Ecuador	DAPC	4.0	--
El Salvador	ABC	16.0	11.0
Mexico	FONDO*	3.0	1.0
Peru	ADB	--	6.0

Source: Agricultural Credit
Section Policy Paper
World Bank, Op. Cit.

Note: Capital and, wherever possible, supervisory costs have been excluded. However, it was not possible to obtain comparable figures for different institutions. The very low cost figures reported by such institutions as the KTCC in Bangladesh reflect only the cost of the final lender and not that of the entire agricultural credit system. On the other hand, institutions with very high cost figures are probably providing more services to farmers, the cost of which could not be eliminated from the available data. Other reasons for high costs are that programs are new and of small size but the institutions have already hired the staff that will enable them to expand, as in the case of the BPM in Malaysia, for instance.

*Institutions involved in World Bank-assisted projects.

Table A8: CONDENSED ORIGINAL COST ESTIMATES OF THE PROJECT (4-YEAR PERIOD)
(In million CFA francs)

ITEMS	Year One		Year Two		Year Three		Year Four		4-Year Total Cost	Annual AVR Cost**
	Cost	As % of Total Loan	Cost	As % of Total Loan	Cost	As % of Total Loan	Cost	As % of Total Loan		
I. Administration	33.53	274.83	36.79	253.50	32.91	47.52	40.40	36.42	143.63	35.90
A. Managers' salaries	10.22	83.77	10.22	30.23	10.22	14.75	10.22	9.21	40.88	10.22
B. Clerks' salaries	.77	6.31	.77	2.27	.89	1.28	1.12	1.00	3.55	.88
C. Overhead costs	8.44	69.18	14.00	41.42	15.00	21.66	22.26	20.07	59.70	14.92
D. Office equipment, supplies, miscellaneous	14.10	115.57	11.80	34.91	6.80	9.81	6.80	6.13	39.50	9.87
II. Marketing:	4.45	36.47	10.36	30.65	12.47	18.00	16.37	14.76	43.65	10.91
A. Delivery trucks (operating expenses & depreciation)	3.90	31.96	9.70	28.69	11.70	16.89	15.60	14.06	40.90	10.22
B. Inputs storage (custodians & warehouse)	.55	4.50	.66	1.95	.77	1.11	.77	.70	2.75	.68
III. Extension & education	.43	3.52	1.08	3.19	1.94	2.80	3.67	3.30	7.12	1.78
IV. Defaults & delinquencies*	1.22	10.00	3.38	10.00	6.92	10.00	11.09	10.00	22.61	5.65
V. Total cost	39.63	-	51.61	-	54.24	-	71.53	-	217.01	54.25
Low repayment hypothesis (90Z)	38.65	-	48.89	-	48.70	-	62.64	-	198.88	49.72
High repayment hypothesis (98Z)										
VI. Total funds loaned	12.20	-	33.80	-	69.25	-	110.90	-	226.15	56.53

Source: Computed from Tables 5 and 10 and Annex 1 of "Operation Ceinture Verte," op. cit.

*Computed from the low repayment hypothesis.

**As an arithmetic mean of the 4-year total.

Table A10: ADJUSTED COST ESTIMATES OF THE PROJECT
(Million GFAP)

COST ITEMS	YEAR ONE		YEAR TWO		YEAR THREE		YEAR FOUR*					
	Set-up Costs (Cs)	Current Costs (Cc)	Total Costs (Ct)	Set-up Costs (Cs)	Current Costs (Cc)	Total Costs (Ct)	Set-up Costs (Cs)	Current Costs (Cc)	Total Costs (Ct)	As % of Total Cost	As % of Total Loans	
I. Loan Funds (8% interest)	-	.97	.97	-	2.70	2.70	-	5.43	5.43	8.87	11.08	8.00
II. Administration:	27.70	4.24	31.94	23.58	11.62	35.20	7.18	24.14	31.32	38.81	48.51	35.00
A. Managers' salaries	6.62	.81	7.43	5.17	2.26	7.43	2.80	4.63	7.43	7.43	9.28	6.70
B. Clerks' salaries	.65	.12	.77	.44	.33	.77	.20	.69	.89	1.12	1.40	1.00
C. Overhead	6.00	2.44	8.44	7.40	6.60	14.00	1.16	13.84	15.00	22.26	27.82	20.00
D. Office equipment & supplies	13.36	.74	14.10	9.73	2.07	11.80	2.56	4.24	6.80	6.80	8.50	6.13
E. Rent or depreciation (bidg.)	1.07	.13	1.20	.84	.36	1.20	.46	.74	1.20	1.20	1.50	1.08
III. Marketing:	1.54	4.11	5.65	1.27	10.29	11.56	.75	12.92	13.67	17.57	21.96	15.84
A. Delivery trucks	-	3.90	3.90	-	9.70	9.70	-	11.70	11.70	15.60	19.50	14.06
B. Inputs storage	1.54	.21	1.75	1.27	.59	1.86	.75	1.22	1.97	1.97	2.46	1.77
IV. Extension & education	-	.43	.43	-	1.08	1.08	-	1.94	1.94	3.67	4.58	3.30
V. Default & delinquency	-	1.22	1.22	-	3.38	3.38	-	6.92	6.92	11.09	13.86	10.00
VI. Total cost, non-amortized	29.24 =(Cs ₁) - (Cc ₁)	10.97 = (Cc ₁) - (Ct ₁)	40.21 = (Ct ₁)	24.85 = (Cs ₂) - (Cc ₂)	29.07 = (Cc ₂) - (Ct ₂)	53.92 = (Ct ₂)	7.93 = (Cs ₃) - (Cc ₃)	51.45 = (Cc ₃) - (Ct ₃)	59.38 = (Ct ₃)	80.00	100.00	72.14
VII. Total cost, amortized	8.23*** -10.97	19.20*** 20.82***	37.30*** 38.92***	8.23*** 9.85***	29.07 35.38***	37.30*** 38.92***	8.23*** 9.85***	51.45 57.76***	59.68*** 61.30***	88.24*** 89.86***	100.00	79.56*** 81.02***
1) At 8% for 12 yrs.												
2) At 8% for 20 yrs.												
VIII. Total funds loaned	-	12.20	12.20	-	33.80	33.80	-	69.25	69.25	110.90	110.90	78.96***

Source: Adapted from Table A9

*Year four is considered a typical year, because from this year on, figures for the following years show an approximately constant relationship between total loans and most components.

**Computed from the "low" repayment hypothesis.

***Amortization of the simple sum $\sum_{i=1}^3 Cs_i$, where Cs_i = total set-up costs for a year.

****Amortization of the sum $\sum_{i=1}^3 Cs_i$, where each Cs_i is compounded forward, see explanatory remarks.

Table A11: TYPICAL COST ESTIMATES OF THE PROJECT
(Million CFAF)

	Three-Year Set-up Costs		Typical Costs (Year Four)				
	Set-up	Amortization*	Current	Amortization	Total	% Costs	% Loans
I. Loan funds (8% interest)	-	-	8.87	-	8.87	10.05	8.00
II. Administration:	<u>58.46</u>	<u>7.75</u>	<u>38.81</u>	<u>7.75</u>	<u>46.56</u>	<u>52.76</u>	<u>41.98</u>
A. Managers' salaries	14.59	1.93	7.43	1.93	9.36	10.60	8.44
B. Clerks' salaries	1.29	.17	1.12	.17	1.29	1.46	1.16
C. Overhead	14.56	1.93	22.26	1.93	24.19	27.41	21.81
D. Office equipment & supplies	25.65	3.40	6.80	3.40	10.20	11.55	9.19
E. Rent or depreciation (bidg.)	2.37	.32	1.20	.32	1.52	1.72	1.37
III. Marketing:	<u>3.56</u>	<u>.48</u>	<u>17.57</u>	<u>.48</u>	<u>18.05</u>	<u>20.47</u>	<u>16.27</u>
A. Delivery trucks	-	-	15.60	-	15.60	17.68	14.05
B. Inputs storage	-	.48	1.97	.48	2.45	2.78	2.20
IV. Extension & education	-	-	3.67	-	3.67	4.16	3.30
V. Defaults & delinquencies**	-	-	11.09	-	11.09	12.56	10.00
VI. Total cost	62.02	8.23	80.01	8.23	88.24	100.00	79.55

Source: Adapted from Table A9.

*Amortization factor: (In order to recover 1 million CFAF in 12 years at 8 percent interest, we need to set aside .1327 million every year.) The factor is obtained from the formula

$$C.R. = \left(\frac{i(1+i)^n}{(1+i)^n - 1} \right)$$

**Computed on the basis of the "low" repayment hypothesis.

Table A13: TYPICAL CREDIT COST ESTIMATES
(In million of CFAP)

	Set-up or Planning Costs		Typical Costs	
	Set-up	Amortization	Total	% Costs
Cost of capital	-	-	8.87	19.20
Administration costs	41.12	5.46	26.24	56.80
Managers' salaries	11.07	1.47	7.12	15.41
Clerks' salaries	1.04	.14	.97	2.10
Overhead	7.80	1.03	5.61	12.14
Office supplies & equipment	19.24	2.55	7.65	16.56
Rent or depreciation (bldg.)	1.97	.27	1.22	2.64
Monitoring & collection*	-	-	3.67	7.94
Default & delinquency	-	-	11.09	24.00
Total annual costs	41.12	5.46	46.20	100.00
			8.87	19.20
			20.79	56.80
			5.65	15.41
			.83	2.10
			4.58	12.14
			5.10	16.56
			.96	2.64
			3.67	7.94
			11.09	24.00
			40.74	100.00
			5.46	12.14
			46.20	100.00
			8.00	17.74
			23.66	51.26
			6.42	13.89
			.87	1.88
			5.05	10.93
			6.90	14.93
			1.10	2.38
			3.31	7.16
			10.00	21.63

Source: Computed from Table A-12.

*Because of the importance of monitoring and loan collection, all the costs of the field workers split between lending and non-lending activities in Table A-12 have been imputed to credit.

Table B1: SEASONS SPECIFICATIONS

SEASONS			Total Number Days	Number Working Days*	% of Total
Number	Period of Year	Description			
1	Mid March - End June	Light Rains	107	72.6	29.31
2	July and August	Short Dry Season	62	42.4	17.00
3	September - Mid Nov- ember	Heavy Rains	76	52	20.82
4	Mid November - Mid March	Long Dry Periods	120	83	32.87

*The number of working days have been estimated at 250 days from allowing for 4 official holidays, 9 religious holidays, 50 rainy or sickness or funeral or other celebration days and 52 Sundays.

The number of working days for each season is obtained by using the percentage of total days in every season, percentage shown in the last column.

Determination of Subsistence Consumption:

Table B2: DAILY FOOD CONSUMPTION PER CAPITA (CENTER-SOUTH)

Product or Group Number	Product or Product Group	Weight (grams)	Representative of the group
1	cereals	53	corn
2	roots and tubers	615	cassava
3	palm oil	23	-
4	meat	25	beef
5	fish	8	-
6	legrimes and vegetables	132	cassava beans
7	nuts and other seeds	77	peanut
8	fruits	100	banana
9	plantain*	493	-

Source: Adapted from Annex 4 of Le Niveau de Vie des Populations de la Zone Cacaoyère du Centre Cameroun. Ministère des Affaires Economiques et du Plan, Direction de la Statistique, 1967.

*Though plantain figures on this table, it is assumed in this study that it is produced mainly as a cash crop. The proportion consumed at home is thus marginal.

Table B3: DAILY FOOD CONSUMPTION PER CAPITA
(Nutrients equivalents)

Product or Group Number	Protein (Grams)	Fat (Grams)	Iron (Mgrams)	Vitamin A (1000 I.U.)
1	5.30	2.40	1.25	*
2	9.25	1.20	2.50	*
3	0	23.00	0	.80
4	5.50	5.00	1.00	
5	2.70	2.30	0	
6	6.60	1.32	.50	.50
7	18.40	27.00	0	
8	1.20	3.50	.45	.20
Total Subsistence	48.95	65.72	5.70	1.50

Source: Adapted from Annex 4
Le Niveau de Vie des Populations de la Zone Cacaoyere du Centre
Cameroun (op. cit.)

*Not present in any significant amount.

Table B4: LIST OF SELECTED VARIABLES OF THE FARM HOUSEHOLD

<u>Variable Number</u>	<u>Variable Number</u>
2	39
3	40
4	41
5	42
6	43
7	44
8	45
9	46
10	47
11	48
12	49
13	50
14	51
15	52
18	53
19	54
20	55
21	56
22	57
23	58
24	59
25	61
26	62
29	63
30	64
31	65
32	66
33	67
34	68
35	69
37	70
38	

Age of the head of the household
 Number of children
 Number of persons in the household
 Annual supply of family labor
 Land area available
 Area under farming
 Household calorie requirements (daily)
 Household protein requirements (daily)
 Household fat requirements (daily)
 Household iron requirements (daily)
 Household vitamin A requirements (daily)
 Labor used, year 1 plantain
 Labor used, year 2 plantain
 Labor used, year 3 plantain
 Fertilizer used, year 1 plantain
 Fertilizer used, year 2 plantain
 Fertilizer used, year 3 plantain
 Insecticide used, year 1 plantain
 Insecticide used, year 2 plantain
 Insecticide used, year 3 plantain
 Pesticide used, year 1 plantain
 Pesticide used, year 2 plantain
 Pesticide used, year 3 plantain
 Plantain sales, year 1
 Plantain sales, year 2
 Plantain sales, year 3
 Sales of plantain suckers, year 1
 Sales of plantain suckers, year 2
 Sales of plantain suckers, year 3
 Annual savings
 3-year plantain sales
 Plantain production, year 1
 Plantain production, year 2
 Plantain production, year 3
 3-year plantain production
 3-year plantain sales
 Plantain yield, year 1
 Plantain yield, year 2
 Plantain yield, year 3
 3-year plantain yield
 Monetary income, year 1
 Monetary income, year 2
 Monetary income, year 3
 3-year monetary income
 Household vitamin A needs (I.U.)
 3-year labor used
 3-year fertilizer used
 3-year insecticide used
 3-year pesticide used
 Annual calorie requirement
 Annual protein requirement
 Annual fat requirement
 Annual iron requirement
 Annual vitamin A requirement (I.U.)
 Annual average sales of plantain
 Annual average plantain production
 Annual average sales of plantain suckers
 Annual average plantain yield
 Annual average labor used
 Annual average fertilizer used
 Annual average insecticide used
 Annual average pesticide used
 Annual average monetary income

Table B5: DESCRIPTIVE STATISTICS FOR SELECTED VARIABLES OF THE SAMPLED CENTRE-SOUTH FARMERS
(Number of Variable Refer to Number in Table B4)

VARIABLE	MEAN	STD. DEVIATION	VARIANCE	MINIMUM	MAXIMUM
1)	2,55000D 01	1,44309D 01	2,08250D 02	1,00000D 00	5,00000D 01
2)	4,59600D 01	1,27874D 01	1,63518D 02	2,30000D 01	7,70000D 01
3)	4,40000D 00	3,41760D 00	1,16800D 01	0.0	1,20000D 01
4)	8,14000D 00	6,01668D 00	3,62004D 01	1,00000D 00	4,20000D 01
5)	8,26200D 02	3,30733D 02	1,09384D 05	1,00000D 00	1,50000D 03
6)	1,01079D 03	6,99846D 03	4,89785D 07	3,00000D 00	5,00000D 04
7)	2,43200D 00	5,34725D 03	1,12041D 01	5,00000D-01	2,50000D 01
8)	1,59250D 04	7,40815D 02	5,48806D 07	3,00000D 03	4,37500D 04
9)	4,11840D 02	2,21608D 02	4,91099D 04	6,50000D 01	9,15000D 02
10)	3,97900D 02	2,25462D 01	5,08331D 04	2,00000D 01	9,00000D 02
11)	6,56400D 01	3,66899D 00	1,34615D 03	0.	1,47000D 02
12)	6,95400D 00	3,84631D 02	1,47941D 01	-0.0	1,54000D 01
13)	4,24500D 02	2,12784D 02	4,52771D 04	-0.0	9,97000D 02
14)	2,03020D 02	1,18729D 02	1,40965D 04	-0.0	3,76000D 02
15)	1,70340D 02	1,64737D 01	1,09698D 04	-0.0	3,60000D 02
16)	9,80000D-01	1,40000D-01	1,96000D-02	-0.0	1,00000D 00
17)	2,55000D 01	1,44309D 01	2,08250D 02	1,00000D 00	5,00000D 01
18)	3,34880D 04	1,56033D 04	2,43464D 08	0.0	6,20000D 04
19)	2,87290D 04	1,73098D 04	2,99628D 08	0.0	6,25000D 04
20)	2,68210D 04	1,71749D 04	2,94978D 08	0.0	6,20000D 04
21)	3,39590D 04	2,00550D 04	4,02204D 08	0.0	7,25000D 04
22)	2,92662D 04	2,23166D 04	4,98032D 08	0.0	7,00000D 04
23)	3,10966D 04	2,15717D 04	4,65338D 08	0.0	6,40000D 04
24)	1,79210D 04	1,31122D 04	1,71931D 08	0.0	6,40000D 04
25)	1,16940D 04	1,06370D 04	1,13145D 08	0.0	4,40000D 04
26)	1,00604D 04	1,37310D 04	1,88542D 08	0.0	8,00220D 04
27)	1,98000D 00	1,40000D 01	1,96000D-02	1,00000D 00	2,00000D 00
28)	2,55000D 01	1,44309D 01	2,08250D 02	1,00000D 00	5,00000D 01
29)	2,88480D 05	1,47361D 05	2,17154D 10	2,70000D 04	9,21305D 05
30)	1,99486D 05	1,24620D 05	1,55302D 10	-0.0	4,23800D 05
31)	2,02280D 05	1,94837D 05	3,79613D 18	-0.0	9,21251D 05
32)	6,95802D 03	7,64336D 03	5,84209D 07	0.0	2,87000D 04
33)	7,53700D 03	6,94323D 03	4,82084D 07	0.0	2,26750D 04

Table B5: DESCRIPTIVE STATISTICS FOR SELECTED VARIABLES OF THE SAMPLED CENTRE-SOUTH FARMERS (Continued)

34)	6.71350D 03	6.38345D 03	4.07484D 07	0.0	2.28500D 04
35)	1.16900D 04	1.31373D 04	1.72589D 08	0.0	5.00000D 04
36)	2.94000D 00	4.20000D-01	1.76400D-01	0.0	3.00000D 00
37)	2.12085D 04	1.82021D 04	3.31317D 08	0.0	6.45500D 04
38)	1.44240D 04	7.36807D 03	5.42885D 07	1.35000D 03	4.60653D 04
39)	9.97432D 03	6.23100D 03	3.88254D 07	0.0	2.11900D 04
40)	1.01140D 04	9.74183D 03	9.49032D 07	0.0	4.60625D 04
41)	4.56068D 04	2.45286D 04	6.01652D 08	7.93000D 03	1.09526D 05
42)	6.90246D 05	3.27939D 05	1.07544D 11	1.66350D 05	1.24825D 06
43)	1.03371D 04	8.58045D 03	7.36240D 07	0.0	3.11000D 04
44)	8.49736D 03	8.09296D 03	6.54960D 07	5.40000D 01	6.14203D 04
45)	5.40795D 03	3.21770D 03	1.03536D 07	0.0	1.43623D 04
46)	5.46754D 03	6.75069D 03	4.55718D 07	0.0	4.51504D 04
47)	2.95438D 05	1.49416D 05	2.23251D 10	2.70000D 04	9.21305D 05
48)	2.07023D 05	1.26620D 05	1.60327D 10	0.0	4.42450D 05
49)	2.08993D 05	1.96259D 05	3.85176D 10	0.0	9.33151D 05
50)	7.11455D 05	3.35436D 05	1.12517D 11	1.84925D 05	1.30205D 06
51)	2.31568D 01	1.28082D 01	1.64050D 02	0.0	5.12820D 01
52)	7.97660D 02	3.54824D 02	1.25900D 05	0.0	1.45500D 03
53)	8.90380D 04	4.59790D 04	2.11407D 09	0.0	1.70000D 05
54)	9.43218D 04	5.72748D 04	3.28040D 09	0.0	2.02000D 05
55)	3.96754D 04	3.09269D 04	9.56473D 08	0.0	1.52000D 05
56)	5.81263D 06	2.70397D 06	7.31147D 12	1.09500D 06	1.59688D 07
57)	1.50322D 05	8.08867D 04	6.54267D 09	2.37250D 04	3.33975D 05
58)	1.45234D 05	8.22936D 04	6.77224D 09	7.30000D 03	3.28500D 05
59)	2.39586D 04	1.33918D 04	1.79341D 08	0.0	5.36550D 04
60)	2.53821D 03	1.40390D 03	1.97094D 06	0.0	5.62100D 03
61)	8.45224D 03	4.67499D 03	2.18556D 07	0.0	1.87179D 04
62)	7.06951D 03	6.06737D 03	3.68130D 07	0.0	2.15167D 04
63)	1.52023D 04	8.17620D 03	6.68502D 07	2.64333D 03	3.65086D 04
64)	2.30082D 05	1.09313D 05	1.19493D 10	5.54500D 04	4.16083D 05
65)	1.82251D 03	2.25023D 03	5.06354D 06	0.0	1.50501D 04
66)	2.65887D 02	1.18275D 02	1.39889D 04	0.0	4.85000D 02
67)	2.96793D 04	1.53263D 04	2.34897D 08	0.0	5.66667D 04
68)	3.14406D 04	1.90916D 04	3.64489D 08	0.0	6.73333D 04
69)	1.32251D 04	1.03090D 04	1.06275D 08	0.0	5.06667D 04
70)	2.37152D 05	1.11812D 05	1.25019D 10	6.16417D 04	4.34015D 05

ORDINARY LEAST SQUARES ESTIMATION PROGRAM

Table B6: REPRESENTATIVE HOUSEHOLD ANNUAL

Requirements and Resource Limits

<u>Resources</u>	<u>Unit</u>	<u>Limit</u>	
Land	Hectares	6.75	
Family labor	Man-day	826.00	a/
Fertilizer supply	Kilograms	750.00	b/
Insecticide supply for plantain	Kilograms	117.00	b/
Pesticide supply	Kilograms	52.00	b/
Insecticide supply for cocoa	Kilograms	12.00	c/
Fungicide supply for cocoa	Sacks	200.00	c/
Protein requirement	Kilograms	150.32	d/
Fat requirement	Kilograms	145.14	d/
Iron requirement	Milligrams	23 950.00	d/
Vitamin A requirement	I.U.	8 452.00	d/
Living expenses needs	CFA francs	48 000.00	e/
Cash requirement	CFA francs	65 000.00	e/
Liquidity requirements	CFA francs	85 000.00	e/
Government loans for plantain	CFA francs	160 800.00	b/
Government loans for cocoa	CFA francs	18 420.00	b/
Moneylender loans		70 000.00	e/

a/ From personal estimation

b/ From Operation Ceinture Verte, op. cit.

c/ From Cocoa Project in the Ivory Coast, appendix in Gittinger (25), and Guyer (31).

d/ From FAO Dietary Recommendations and survey averages.

e/ Assumed to be 35 per cent of total monetary income.

All other values are averages from the survey.

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