Problems of Economic Development and Growth in Zambian Agriculture - An Evaluation of the Role of Capital Formation in Agricultural Productivity

by

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¡Zambia necesita es gínte competente

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Kayola Wizasi Kapunzha Mbevya
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ABSTRACT

Problems of Economic Development and Growth in Zambian Agriculture - An Evaluation of the Role of Capital Formation in Agricultural Productivity

by

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Economic development and growth in Zambia has been thought to be attainable through the development of agriculture in the broad context of rural development. However, agriculture is a complex and diverse industry. Its dimensions embrace a broad spectrum of activities and its problems are as intricate, "deep" and diverse as the industry itself. Despite investment programs and political encouragement agriculture in Zambia has been growing in terms of output at a rate lower than the growth in consumption and its contribution to the Gross Domestic Product (GDP) has stagnated at about 11.48 percent over the period 1975 to 1980.

Zambia has therefore continued to face shortfalls in its major staple food, which is maize, since 1970. In addition to this shortfall, changing consumption patterns have accelerated the demand for wheat grains

and this demand has expanded tremendously over the period 1970 to 1980. Production of other agricultural commodities has assumed an upward trend but does not satisfy the entire Zambian demand. In 1963, 20.5 percent of the population lived in urban areas. The figure rose to 29.4 percent, 35.6 percent and finally 41.4 percent in 1969, 1974 and 1980, respectively (1, page 3). Those persons who migrated were mostly young able-bodied male and also mostly literate. Reacting to what constituted a major rural-urban drift creating a shortage of labor in the rural sector and agriculture in particular, taken together with the need to rapidly increase the productivity of agriculture, the government encouraged the rapid mechanization and adoption of other expensive type technologies.

Due to limitation in data, this creative component attempts to evaluate the impact of this capital accumulation approach by regressing a production function of the Cobb-Douglas form. The equation specifies output in agriculture as a function of labor, land and capital embodied in investments of a capital nature.

The results show that ~~that~~ capital's contribution to output is negligible and this finding leads to an examination of alternative strategies and policy options to stimulate agricultural productivity and attain desirable distributive impacts consistent with economic development as defined in this paper and also to meet the objectives of the government as stated in the planning documents.

Problems of Economic Development and Growth in Zambian Agriculture - An Evaluation of the Role of Capital Formation in Agricultural Productivity

I. Introduction

Zambia faces numerous problems in her economic development efforts. Economic development is variously defined in the literature but it clearly is a dynamic, all encompassing phenomenon capturing in its breadth a myriad of changing processes over a long period of time. However, what is central is that the processes entail improvements in the material welfare aiming at and including the persons with the lowest incomes. In a developing country, economic development can be viewed as a process by which to eradicate mass poverty and its related problems of illiteracy, malnutrition and early death. The process of economic development therefore, implies changes in the composition of inputs and outputs and the underlying structures of production. These changes could be brought about through encouragement of those innovations that would form the basis for the development of appropriate technologies. In Zambia, where 57 percent (1, page 3) of the population live in the rural areas where the main activity from which they derive their livelihood is agriculture or agricultural related, the whole question of economic development revolves around the enhancement of agricultural productivity and ways that ensure appropriate distributional impacts. In this connection, the development of appropriate technologies would

be focussed on enhancing the productivity of persons involved in agriculture (and/or other sectors) and also increasing the productivity of land by the use of high yielding seed varieties used together with appropriate fertilizer dosages and also using those kinds of machinery which would be consistent with farm size, being affordable and releasing the labor constraint in agriculture. Further, economic development involves the organization of the economy in ways which make productive employment general among the working population and this necessarily enhances their incomes. Finally, although not exhaustively, the process demands facilitation of greater participation of broadly based groups in decision making concerning the direction of the policies, programs and projects that have direct or indirect impacts on their social-cultural, political and economic well-being.

In the context of the foregoing outline of economic development, after addressing questions pertaining to capital formation and its impact on economic growth which is narrowly defined to mean more output including greater efficiency in terms of production at the lowest cost but excluding considering of societal costs and other distributional impacts, the paper's main focus will be on alternative strategies to enhance agricultural productivity with the relevant desirable distributional impacts. The justification for focussing on ways to increase agricultural productivity is derived from the assumption that the satisfactory performance of the Zambian economy depends on the ability to exploit the agricultural sector's potential. This potential finds

expression in terms of the capacity to meet all foodstuff requirements to provide raw materials for agro-based industries and other growing sectors of the economy, to generate an investable surplus of savings for taxes to support other sectors, selling for cash a market surplus that would raise the demand of the rural population for products of other sectors of the economy and relaxing the foreign exchange constraint through import substitution (2, page 563).

The rest of the paper is organized into six sections. Section II provides some historical background in order to context the discussion in its proper perspective and also outlines the structure of the economy that evolved from the period covered by the background information. Section III is concerned with the definition of capital formation and the estimation of those goods that constitute capital formation in agriculture. Also included is a discussion of capital expenditure in the private sector. In Section IV the analytical model, hypothesis, statistical procedures and data problems are delineated while Section V is a summary of the results and some possible extension of use of the model is eluded to. Since it is clear that output is affected by other variables such as policy, marketing, credit, extension services, appropriateness of technology, transport situation and other variables, Section VI is devoted to these factors and the role that they play, while Section VII is concerned with identification of other factors relating to agricultural productivity and concluding remarks follow in Section VIII.

II. BACKGROUND INFORMATION

Zambia is acknowledged to have great potential to develop because of the existence of a wide range of mineral resources and its natural resources which include a land area of some 750,000 square kilometers with a population of 5.8 million, its water resources and generally satisfactory climatic conditions. In terms of mineral resources, emphasis was placed on the exploitation of copper. With the fluctuating and precitous decline in copper prices, the need to diversify the economic base of the economy has become pressing. This diversification effort includes the widening of mineral resource exploitation. However, due to the nonrenewability of mineral resources, efforts are directed towards making agriculture the cornerstone of the Zambian economy. However, there are many problems being encountered in this diversification effort and in order to understand their origins and nature of some of the difficulties, some background information is in order. The purpose of this information is to context the entire discussion in its proper perspective.

A. The Colonial Era

During the colonial era, which is a period ranging from the 1890s to 1964, the Zambian economy was developed to serve the interest of those in charge of and perpetrating the colonizing effort. Their interest lay in the exploitation of mineral resources and their focus during this period was on the mining of copper. Consistent with this aim, everything else was geared to serve the mining industry. There was no concern

regarding the well-being or condition of the Africans as it was unambiguously stated that "the British Empire is primarily concerned with the furtherance of the interests of British subjects of British race and only thereafter with other British subjects, protected races, and the nationals of other countries in that order" (3, page 147).

A transport system was elaborated and plotted to pass through the most fertile regions in the country to the copper mining region later to be known as the Copperbelt. This transport system combined a railway line running side by side with an all-weather road from the southern border of Zambia to the Zaire border. This design was to ease the shipment of minerals through the present Zimbabwe to Mozambiquan and South African ports.

The colonial administrative structure demanded taxes from all able-bodied male persons and this had the effect of forcing people to work in the mines and other schemes some of which constituted the most disagreeable tasks. This effort had serious impacts on traditional agriculture. Most importantly it seriously prevented a large number of people from gaining or improving experience in agriculture by practicing and also the drift created prejudice against agriculture activities as urban type work tended to pay more and urban living offered some forms of entertainment and health care and some "luxuries" which could not be had in the rural areas. This situation in post independence Zambia compounded the skilled manpower constraint in agriculture and other sectors of the economy.

As far as the development of agriculture was concerned, it was intended only to feed the mining workforce and the food was to be grown by European large scale foreign farmers who were encouraged to settle in the most fertile parts of the country where transportation was easy and around those areas where the British had established administrative centers from which tax enforcement personnel stayed. Government policy alienated Africans from good land. The objective was to maintain African agricultural income at its existing level rather than to provide sufficient land to farm successfully under modern techniques. Baldwin adds that moreover, it was generally believed that because Africans did not "require" the type of fertile soil and access to transportation facilities "essential" for European agriculture, consistent with this policy, the Africans that were close to the railway line were moved further away. It is recorded that one tribal chief was told: "You are very close to the railway. Now the railway is necessary to the white farmer but the natives do not make use of it, nor do they feel want of it" (3, page 147).

It was under these circumstances that the Ministries of European Agriculture and the Ministry of African Agriculture were set up. In this arrangement, European agriculture was conducted on the most fertile soils, close to the means of transportation, supported by credit and extension services and enjoyed subsidized rates on inputs. A marketing arrangement was elaborately specified and put into place. African agriculture, on the other hand, enjoyed none of the foregoing yet the

share of African agriculture in the GDP contributed by the agricultural sector to the total GDP continued to be approximately 75 percent on average during the period 1951 to 1961. The dominance of the African contribution is solely explained by the large numbers of producers and not by the efficiency of their operations nor the quality of their land.

The field of education exhibits several features which continues to hamper the development of agriculture. It was an education designed to prepare Africans to play roles defined by the colonial structure.

For European children, education was made compulsory between the ages of 7 and 15. The facilities for these children were expanded from 37 schools in 1950 to 68 schools in 1959. By 1959 according to Baldwin (3), the teacher/pupil ratio in the primary school was 1:27.5 and 1:17.1 in the secondary schools. These ratios compare with 1:29.6 in England and Wales and 1:35.4 in Australia for primary schools. In the secondary schools, the ratios compare with 1:20.4 in England and Wales and 1:22.8 in Australia.

The above figures relate to the period between 1950 and 1959. However, it may be interesting to note that government did not spend any money on African education until 1925 when it made a contribution of ₺ 348 to the missionary schools. By 1929, there were about 360 boys in school with only 9 of these in standard IV (the equivalent of sixth grade).

The nature of the primary education for Africans was to teach them how to read and write and count with the primary objective of using them

Table 1. Industrial Origin of the Gross Domestic Product of Northern Rhodesia, 1954-1961 (Percentage Distribution)

Industry	1954	1955	1956	1957	1958	1959	1960-1961
Agriculture							
Non-African	2.0	1.6	1.8	2.7	2.4	2.1	2.8
African	11.0	8.8	8.4	10.6	9.5	9.3	9.8
Mining & quarry	52.4	56.8	54.0	39.0	45.4	47.5	44.1
Manufacturing	4	3.9	4.4	6.4	5.6	5.5	5.9
Building & construction	6.1	6.2	6.7	8.6	5.8	4.5	4.1
Electricity & water	.4	.4	1.6	1.9	2.0	2.3	2.2
Transport & communications	9.4	3.4	3.7	5.2	5.0	5.1	5.1
Distribution	5.4	5.1	5.1	6.5	5.2	5.4	5.6
African rural household services	6.6	5.4	4.9	6.4	7.0	6.2	6.9
All other	8.4	8.4	9.4	12.7	12.1	12.1	13.5
Total	100	100	100	100	100		

Source: Robert E. Baldwin, Economic Growth ... page 35.

for basic tasks in mining and European agriculture.

The table below shows some numbers and levels of education for Africans in 1937, 1944, and 1960. By 1964, there had been little change in these numbers and there were one hundred college graduates.

The brief outline of education above refers only to formal education. There was little else in terms of technical colleges and others. It is no wonder, therefore, that there is a persistent shortage of personnel to man the agricultural sector. It is for the foregoing reason that given the present situation, where there are a number of trainable persons, efforts should be directed towards developing strategies that will enhance the planning capabilities of Zambians in the agricultural sector.

The strategy could help attain this by helping, for example, to develop economic planning models for the development of the Zambian agricultural sector, to help officials in the appropriate ministry and government agencies evaluate existing agricultural policies and conduct the development of relevant research programs for the evaluation of appropriateness of technologies used in agriculture and to develop appropriate technologies for the sector. In addition, incentives should be created to attract those persons with some appreciable levels of education into agriculture.

B. Post Independence Era

The period after 1964 led to a strengthening of the migration trend towards the urban centers. This had adverse effects on the agricultural

Table 2. Enrollment of Africans in Primary and Secondary Schools, Northern Rhodesia, 1937, 1944, and 1960

Class		1939		1944		1960	
		Number	Percent	Number	Percent	Number	Percent
Primary							
Substandard	A	15,113	50.92	52,776	51.64	69,234	23.86
	B	6,525	21.99	19,527	19.11	6,001	20.68
Standard	I	3,773	12.71	13,527	13.24	53,115	18.31
	II	2,168	7.30	8,090	7.92	51,317	17.69
	III	1,223	4.12	4,342	4.25	19,943	6.87
	IV	611	2.06	2,425	2.37	17,491	6.03
	V	154	.52	830	.81	8,679	2.99
	VI	110	.37	620	.61	7,756	2.67
Subtotal		29,677	99.99	102,146	99.94	287,536	
Secondary							
Form	I	Nill	Nill	30	.03	1,311	.45
	II	Nill	Nill			747	.26
	Remove (a)	Nill	Nill			235	.08
	III	Nill	Nill			139	.05
	IV	Nill	Nill	19	.02	111	.04
	VI (1st year)	Nill	Nill			28	.01
	VI (2nd year)	Nill	Nill			28	.01
Subtotal		0	0	49	.05	2,599	.90
Grand Total		29,677	99.9	102,195	99.99	220,135	100.00

Source: Baldwin, Robert E. Economic Development and Export Growth - A Study of Northern Rhodesia, page 50.

Note: (a) This class is in session for 6 months and links the Northern Rhodesia school year ending June with the "Cambridge" year ending in December.

productivity of the rural sector.

The country's economy was dependent on copper mining and migration into urban centers led to the development of an industrial structure of the manufacturing and assembly type establishments which was itself based on imported inputs which include raw materials, machinery, and spare parts and in some cases, foreign expertise.

In addition to the migration into urban centers, there developed a strong emigration trend in the years soon after 1964 of expatriate commercial farmers. It has to be clarified here that although the share of noncommercial farmers in the total GDP for agriculture has always been greater than that of the non African farmers, it is non African farmers or expatriate commercial farmers' output that enters the market for purposes of feeding the urban population and indeed in some cases used to meet shortfalls experienced in the subsistence sector. It is for this reason that the rapid decline in the number of commercial farmers is of relevance in questions pertaining to food and availability of raw materials.

The Post Independence era, therefore, saw an increase in manufacturing and assembly type establishments usually located in the urban centers and depending on imported inputs and expertise. This was accompanied by rapid urbanization and therefore represented an increase in the number of people outside agriculture who had to be fed. Unfortunately, this was going on at a time when large-scale commercial farms were folding up and thereby necessitating a search for sources of food in addition to

the demands of the foreign input industrial structure.

What we have then is a situation where there is a concentration of demands from the whole economy on the earnings of one industry. It may also be added that in addition to the issues addressed above, there was a general pressure for development funds to finance the setting up of training and health institutions and other economic infrastructures.

From the foregoing, it is apparent that the faltering of the mining sector would create extremely trying conditions. In the early part of the 1970s, the mining industry entered the most serious period in the post World War II era and as the earnings from the mines rapidly declined, the quicker became the transformation of more rhetoric on the need to diversify the economy into concrete steps being taken.

There are several programs intended to diversify the base of the Zambian economy, not only in agriculture but also in other types of industry.

These programs can be generally characterized as favoring capital intensive production techniques in agriculture. Available evidence indicates rapid expansion of credit to agriculture. This credit has not always been utilized for the purchase of items of a capital nature. However, there exists an observable trend in the increase of capital items in Zambian agriculture occurring at the same time with the rapid increase in credit to the agricultural sector. The rapid increase in capital formation in agriculture is linked to the notion that an expansion of physical inventory particularly mechanization can lead to an

acceleration in the level of agricultural output. It must be pointed out that if credit is directed towards the acquisition of capital, capital formation can be accelerated. However, the acceleration in capital accumulation does not in itself necessarily lead to an increase in output. This is so because output is a function of several other variables which must be controlled so that their effects would complement the use of capital. In fact, this paper with a limited set of data sets out to measure the impact of capital formation on the growth of output in the agriculture sector.

With the foregoing background, I now wish to briefly review the structure of the Zambian economy in general and Zambian agriculture in particular.

C. The Structure of the Zambian Economy and Agriculture

(i) Zambian economy

The Zambian economy is generally said to be a dual economy with a distinct urban, modern industrial sector and a rural sector where about 57 percent of the population numbering about 722,200 households reside and engage in a variety of agricultural activities.

The economy as a whole is dominated by the mining industry which accounts for about 95 percent of exports. The mining industry has influenced the location of other secondary and tertiary activities in such a way that they are concentrated in the urban areas and are structured to utilize imported raw materials and geared to serving urban needs.

(ii) Structure of agriculture

There are three categories of Zambian farmers. These are commercial, emergent and traditional small-scale peasant or subsistence farmers. Commercial farmers are those who

(a) Sell to the National Agricultural Marketing Board or to any other cooperative union, any such crops valued at K 600.00 or more being the value of 150 x 90 kg bags of maize at the 1973-74 crop season price level.

(b) Any farmer who grew tobacco in his own name and was registered with the Tobacco Board of Zambia.

(c) Any farmer who sold dairy produce.

(d) Any farmer who bred and/or fattened cattle or poultry and sold them to the Cold Storage Board of Zambia or to any licensed butcher or supermarkets.

(e) Any farmer who bred and/or fattened pigs and sold them to Zambia Pork Products or to the Cold Storage Board of Zambia or to any licensed butcher or supermarkets.

(f) All hybrid poultry producers.

(g) All state farms operated by the Projects Division (of the Ministry of Agriculture and Water Development) and any other agencies operating on a commercial basis (4, page 1).

Emergent farmers are those whose produce enters the marketing system but fail to meet any of the specifications that define a commercial farmer and subsistence farmers are characterized as peasant or village farmers who typically produce to meet their own consumption.

There were approximately 1466 (4, page 2) commercial farmers and emergent farmers in 1974 and about 722,200 households (subsistence farmers) in 1978 (5, page 1).

The structure of services to agriculture are continuously being developed. However, it is evident that marketing, transport setting, credit, research and extension which is conducted by the government agriculture research stations are still biased in favor of commercial farmers, although the bias is not by design but by mere proximity. It is important at this juncture to observe the absence of private agricultural research. This is linked to the problem of price control of agricultural commodities which are pegged at levels that constitute a disincentive to the conduct of private research. This subject is argued further in a later section under price policy. With the foregoing background, I turn to the study procedure employed in the measurement of capital accumulation and its impact on growth of output in the agricultural sector.

III. Study Procedure

Part of this study investigates the existence of a relationship between capital formation and the growth of output in the agricultural sector and then attempts to measure the impact of capital formation on the growth of GDP arising from the agricultural sector. Further, I hypothesize on the transmission of growth from the agricultural sector to other sectors and finally I briefly outline other factors that influence the growth of output in the agricultural sector and then alternative strategies are advanced to counteract the constraints and hence allowing agriculture to play its full role in economic development.

Since this paper concerns itself with the measurement and impact of capital formation on agricultural productivity, and since capital in agriculture takes various forms and its measurement is acknowledged to be a difficult task, the meaning of capital formation as used in this paper will therefore have to be clearly defined.

In this paper capital refers to both physical and human capital. However, due to the difficulties of isolating and measuring human capital accumulation in agriculture, this paper focusses on physical capital. The focus on physical capital itself does not provide an easy and exact measurement either, but methods have been developed that can be said to be reasonably reliable for the purpose of carrying out research in that area.

Physical capital formation which I will refer to as capital forma-

tion hereafter, includes those expenditures on land reclamation, land clearing, irrigation and flood control projects, plantation and vineyard development, farm buildings, agricultural machinery such as harvestors, threshers, plows, harrows, tractors, and expenditures on any other items of capital nature which are directly linked to farming. The foregoing itemization is not exhaustive and we remain congnisant of the fact that there are varied other forms of capital formation which influence agricultural output. These other forms include government expenditure on road projects, dam building and others. However, this paper will not focus on these types of capital investments by the government in off-farm projects although it is acknowledged that these expenditures may have some bearing on the growth of output in agriculture. This is so due to the multiplicity of uses to which they may be put which consequently introduces some difficulties in estimating the proportion of investment which can subsequently be linked to agricultural output.

On the human side, capital formation includes expenditures on education, acquisition of farm skills, and health projects. Unlike the case of physical capital, and although investment in these spheres is open to use not only in agriculture, the investment in formal education does bear a strong relation to subsequent specific training which relates to farm skills. Also, because of the recognition of the role that health plays in the effectiveness of individuals in the performance of tasks in agriculture and other spheres, expenditures on health can be used as indicators of capital formation. However, again it is difficult to isolate

expenditures on health for the agricultural sector and also it is recognized that expenditures on health include a substantial portion of people who are not engaged in agricultural institutions. It must be pointed out, however, that any expenditures in support of a health institution located in the outlying rural areas where the main activity is agriculture does justify the view that expenditure in health can be directly linked to growth of output in agriculture. Although the physical and human aspects of capital have been specified above, due to lack of data and the involved nature of this subject, human capital formation will not be discussed further in this study. In this paper therefore, capital formation refers only to items of a physical nature directly related to agriculture as stated earlier.

As it will be shown later, there exists a number of approaches that can be utilized in estimating capital formation. All the methods have their own short-comings and the approach followed in this study is affected by those same problems.

This paper utilizes loans disbursed to agriculture by official agencies which include the Agricultural Finance Company, commercial banks and the Zambia State Insurance Corporation. These loans are made available to farmers on different criteria depending on the type of organization giving the loan. For example, the Zambia State Insurance Corporation extend agricultural loans only to those people who have insurance policies with them and the loans disbursed each year are restricted to a certain amount determined by its board of directors. Com-

mercial banks lend to only their customers who must also have some other forms of collateral security. The Agricultural Finance Company deals with any person of Zambian or non Zambian nationality, engaged in farming and resident in Zambia. Its funding depends on government budget appropriations and in this sense the availability of those funds are directly linked to the level of the government budget. This organization is the most accessible one to farmers of all descriptions; however, available evidence indicates a bias in the allocation of its funds towards areas that are nearest to urban centers and in the already established large scale farming areas as shown in the table below.

The justification for utilizing loan statistics from the official organizations cited above is mainly due first to the availability of such data and second to the comparative ease in decomposing them to the extent that the data could be used for purposes of this analysis. Despite these advantages and the justification of using these data, problems were still encountered in using these data.

The first problem encountered was that of disaggregating the data and to isolate expenditures on items of a capital nature. In addition to the disaggregation of the data, there were problems of gaps in the data. On a broader scale, we may add other forms of investment of a capital nature that are simply not accounted for. In the traditional sector, for example, credit is not easy to come by yet investments in equipment like scotch carts, hoes, axes, machetes, cattle (or tractors), fencing, and a host of others go on. It is clear therefore that the

Table 9: Amount of Loans Released to Farmers by Provinces (1970-71 to 1979-80)

(Kwacha)

Province	1970-71	1971-72	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Central	6,256,513	6,560,098	9,596,845	12,920,248	9,843,306	12,723,386	11,452,734	12,762,287	20,184,231
Lusaka	Included in Central Province				20,948,812	21,813,910	28,387,451	15,522,991	15,074,235
Southern	4,967,197	5,736,512	6,097,088	9,953,256	7,351,472	11,078,742	15,767,988	29,744,931	19,795,044
Copperbelt	280,111	238,024	1,119,244	737,553	804,778	1,778,150	1,973,892	2,908,135	2,892,360
Eastern	235,521	368,829	317,085	4,052,444	1,565,731	3,111,208	3,298,994	9,739,184	4,822,205
Luapula	98,843	100,935	134,521	29,849	85,405	117,801	384,215	77,452	406,748
Northern	102,981	146,221	34,631	107,658	271,274	531,755	1,420,913	676,094	1,659,222
N. Western	90,893	112,775	26,483	9,149	104,429	158,818	383,631	117,879	518,946
Western	60,960	53,049	22,171	174,167	31,506	58,668	127,865	160,026	336,668
Zambia (Total)	12,093,019	13,316,443	17,348,068	27,984,324	41,006,713	51,372,438	63,197,683	71,708,979	65,689,659

Source: Central Statistical Office.

Note: (1) The table excludes 1972-73 year for which the survey was not carried out.

(2) Lusaka Province figures prior to 1978/9 may include loans given to NAMB (roughoy 3 to 4 million kwacha/year) and some amount given to farmers of Southern and Central Provinces.

loans expended in the agricultural sector by commercial banks and other financial institutions do not represent the entire investment.

The problems outlined in the foregoing paragraphs clearly show that there exists problems of estimating capital formation using this approach and consequently, the figures used may underestimate the level of investment and thereby affect the results of our regression analysis. However, for purposes of this study, this approach remains the most practical. We now turn to factors influencing capital formation, estimation procedures, choice and justification for choice of procedures used in this study.

There are several factors that may influence rate and type of capital accumulation. This paper reviews only four of the ones on which a considerable amount of data can be collected to facilitate a realistic analysis of issues under investigation. The factors influencing the direction of the flow of investment and hence influencing capital formation in Zambia include inter-regional differences, economic, social and institutional conditions, size of farms, and land tenure systems.

There exists several forms of natural differences between different regions within any one country. These differences are characterized by different endowment of minerals, soil fertility, water or rainfall variations, presence or absence of animal or human disease transmitting insects, and many others. These differences can and have historically determined the patterns of human settlement and the evolution or development of economic activity most consistent with prevailing economic con-

ditions. As an illustration, a mining industry, crop farming or cattle rearing will occur in those regions where conditions are most agreeable to the development of the respective activities.

As we point out later, the development of the Zambian economy was consistent with the objective of the colonizing power. In the circumstances, copper mining was developed as it was to them the most profitable industry in the whole country. Clearly therefore, the pattern of investment of the colonial administration was geared towards the development of the copper mines and industries in the proximity, in support of and directly relevant to that objective.

In addition to the natural causes that bring about inter-regional differences is the pace and pattern of investment, the rapporteus report on capital formation in Indian agriculture states that "In their gamut of causes, they (authors) have included various economic, social, and institutional factors such as irrigation, commercialization, crop intensity, urbanization, etc." (6, page 3). It is clear, therefore, that the factors cited above do have influence on capital formation.

In regions where agriculture is the main activity, the availability of arable land which is determined by population intensity may influence farm size. Farm size in turn does play a part in the determination of the pace and pattern of investment on the farms. Clearly small farms cannot attract investment in heavy machinery while large farms cannot be expected to depend on hoes and machetes. This proposition is consistent with assertations of "Production functions of the classical type which in-

clude ranges of increasing marginal returns, decreasing marginal returns, and negative marginal returns ..." (27, page 90).

Another factor cited as influencing capital formation is tenancy situation. There are a number of variations in tenure systems according to different authors. Snodgrass and Wallace include, "Crop-share, share-cash, croppers, (in the south only-USA), cash tenants and livestock share tenants," (8, pages 146-147) and (1) owner cultivators, (2) part owner and part tenants, (3) share croppers, (4) non-cultivating owners of land and (5) others" (6, page 9). Clearly, there are varying conditions of tenure and these determine the security of operators depending on their duration. Since the land tenure systems conveys the level of security to the farmers, it may well be ascerted that "The land tenure system constitutes a major force in creating an environment for cultivation that will maximize the accretionary formation of capital in agriculture and insure that available surpluses above subsistence levels are reinvested in the productive plant" (9, page 166). It may well be noted here that the more secure a farmer feels in terms of specific rights he has to the land he had including specific uninhibiting inheritance provisions, the more likely he is to invest more and following a long term pattern of investment in his farm. In Zambia there are basically two types of tenancy arrangements. One arrangement involves farming on state land where the tenure situation provides a farm operator specific rights to a defined piece of land for a period of 99 years and this period is renewable hence, inheritance is assured. Further, the operator is free to

sell all investments on the land but not the land itself. The other arrangement is farm operation on traditional land. Although this system operates in the same way as the former, no specific arrangements in writing are entered into and this leaves open the operator to all kinds of dangers like his farm being assigned for other uses without compensating the operator for his investment. In addition to this problem, as farming has become more sophisticated and demanding credit facilities, the farm cannot be pledged as security to the lending institutions especially banks and hence accessibility to credit institutions by farmers on traditional land is limited to the Agriculture Finance Company.

The foregoing sections have focused on a review of factors that influence the pattern and rate of capital formation in agriculture. It is clear that there is capital accumulation going on in the agricultural sector. We now turn to procedures for estimating capital formation in general.

It is an acknowledged fact that measuring investment in agriculture is a difficult task even in the well-documented rich countries and this being the case, the task can be said to be even more difficult in developing countries. In this connection, an overview of the most common procedure is in order and we begin with:

A. Estimation of Production of Goods Used in the Agricultural Sector

Tools mostly used in traditional or subsistence agriculture are locally produced and there exists problems of accounting. There is no

indication of the output of tradition blacksmiths in official or even unofficial statistics. As for the large scale farming establishments, most of their agricultural machinery and tools are imported. This means therefore, that in an industrially backward country like Zambia, an index of production of goods used in agriculture is an inadequate statistic for estimating capital formation. We therefore turn to another method of estimation.

B. Capital Expenditure in the Private and Public Sector

This method is a viable one in situations where data is available. In the Zambian case, data are not available and as for public sector investment, there are many difficulties which would arise regarding whether or not particular items do serve agriculture, or what percentage or proportion of their use may be apportioned to agriculture. A typical example of such an investment would be an investment in roads. Finally, we turn to another estimation procedure.

C. Source of Finance

There are several sources of financing available to a farmer for purposes of meeting his operational and investment needs. These sources include institutional finance, relatives, personal savings, and money lenders.

This paper will utilize the third procedure and particularly institutional finance as a method of estimating capital formation. The choice of this method does not imply that there are no difficulties in using the method as briefly elaborated earlier.

We clarify our earlier elaboration by stating again that institutional financing is not available to everybody in the agricultural sector. In the Zambian case, commercial bank lending to agriculture reflects lending to usually large-scale farming establishments who can provide the necessary collateral security. The disbursements by the Agricultural Finance Company represents a gamut of borrowers. All farmers are eligible for loans from this establishment. Farmers with and those without security do get credit from this organization however, the funds are usually not sufficient to go round as they depend on some kind of revolving fund which is annually supplemented by government appropriation. Given the poor repayment rates, the funding of this organization almost entirely depends on government handouts.

In using this method, it must be admitted there is a sizeable amount of investment which is not necessarily captured by official statistics. There are other sources of finance. These sources include borrowing or gifts by relatives, money lenders and personal savings. However, due to the unavailability of data on these sources, the investigation and analysis in this paper are going to rest on institutional sources.

There are a number of other institutions who provide credit to agriculture besides the Agricultural Finance Company. These institutions are commercial banks which include the Zambia National Commercial Bank, Standard Bank, Barclays Bank, and Grindlays Bank International. Others are the Development Bank of Zambia and the Zambia State Insurance Corporation.

In dealing with institutional statistics to estimate capital formation, total amount of loans made to agriculture were disaggregated in order to arrive at the proportion used on items of a capital nature.

In order to arrive at the proportion of total amount of loans used on items of a capital nature, percentages of the total amounts loan disbursed for the following purposes were identified.

(a) Purchase, repair, and maintenance of agricultural machinery and implements;

(b) Purchase, development and improvement ot farm land; and

(c) Constructions, improvement and maintenance of farm buildings, roads, and other farm structures.

These were summed up for the years 1978-79 and 1979-80. The sum was divided by two. The average was then used to determine the fraction of total lending to agriculture that was used for capital accumulation. Clearly, the average of the two years is not completely representative, but in the absence of data reflecting the percentage or proportion of total disbursement used in the process of capital accumulation, there is justification in using the referred to average which was calculated to be 14 percent. This was the average percentage of all loans made to agriculture that according to the decomposition procedure followed by the author went into capital accumulation. As stated earlier, the growth of output from the agricultural sector and hence the contribution of the

agricultural sector to total GDP depends on a multitude of factors which include credit, price policy, marketing, agricultural research and extension. Since it is widely recognized that the above mentioned factors play a critical role in the development of an agricultural sector, I will devote Section VI to consideration of their relevance, at least hypothetically, in the Zambian context. The consideration is hypothetical to the extent that the relevant data which would support the analysis and possibly conclusions is unavailable to the author. I might hastily add, however, that problems of data availability occur very frequently and it may therefore be stated that there is need to intensify the data collection, collation and expansion of the data base on several spheres of the Zambian economy. The foregoing constitutes a framework for the study procedure and how I turn to an elaboration of the analytical model, statement of the hypothesis and statistical procesures including a brief outline of problems encountered with the data.

IV. THE ANALYTICAL MODEL, HYPOTHESIS AND STATISTICAL PROCEDURE

This section is divided into three parts. The first part presents a general analytical frame of reference on which the analysis is based. The second part states the hypothesis to be tested and the third part elaborates the statistical procedures to be used in the analysis and a discussion of the data.

A. The Analytical Model

Zambia had recognized that copper was a nonrenewable asset whose price setting mechanism lay outside the control of the Zambian authorities. In this connection it became apparent that there was a need to diversify the industrial base and in particular to develop the agricultural sector. It was hoped then that a developed agriculture would lead to the provision of raw materials to industries of an agro-nature and others and also to provide food for the entire population and thereby save foreign exchange used in the importation of foodstuffs. Further, it was envisaged that a growth in output of the agricultural sector would help earn foreign exchange by increasing agricultural exports. The general proposition was that a developed agricultural sector would serve as a source of investable surpluses for the other sectors of the economy and therefore economic development would be enhanced.

The effort to build a viable agricultural industry for reasons outlined above led to a massive infusion of funds and other support programs into the agricultural sector.

This section is concerned with the measurement of the impact of

this investment on the growth of the agricultural sector. This investigation it is hoped will provide insights regarding the proper resource mix and allocation for the growth of the agricultural sector and also the transmission of growth from one sector to another or more broadly to other sectors of the economy. Since it has been suggested that the growth of the agricultural sector would lead to a sustained growth of the rest of the economy, the analytical model to be outlined in this paper will have its fulcrum in such an interaction.

The model being proposed here is merely a theoretical framework usually comprising a set of several equations. In this paper only one regression equation of the Cobb-Douglas form is elaborated while a generalized linear form is also included and estimated (see appendix). The equations are "designed to describe the structure of the model. By relating a number of variables to one another in certain ways, these equations give mathematical form to the set of analytical assumptions adopted" (10, page 8).

In this study we are estimating the manner in which a dependent variable responds to changes in other variables. We are therefore going to set out our behavioral equation as follows:

$$Y_a = f(L, A, K)$$

Where

Y_a = Dependent variable representing GDP from agriculture

L = Labor engaged in the agricultural sector

A = Land area under cultivation

K = Investment on items of a capital nature

There are several other possible forms of input/output relationships that have been developed. Some of the best known include:

(a) Linear production function:

$Y = a_o + bx + cz$ which has an elasticity of substitution

$\sigma = \infty$ because the isoquant is linear

(b) Fixed proportion of leontief production function:

$Y = \text{Min}(ax, bz)$ which has an elasticity of substitution

$\sigma = 0$ that is the isoquant forms right angle

(c) Constant elasticity of substitution (C E S) production function

$Y = \delta(ax^{-\rho} + bz^{-\rho})^{-1/\rho}$; where ρ is the substitution parameter and

$\sigma = 1/1 + \rho$ is the elasticity of substitution between factors (X and Z).

The CES family contains the first two production functions stated above and

(d) Cobb-Douglas production function

$Y = AX^{\alpha} Z^{\beta}$, where $\sigma = 1$ (16)

In the investigation of the relationship between changes in GDP from agriculture (Y_a) and investment (K), we can calculate the changes in the value added to GDP over time by finding the derivative of the behavioral equation with respect to time. Thus we find:

$$\frac{\partial Y}{\partial t} = \frac{\partial Y}{\partial L} \cdot \frac{dL}{dt} + \frac{\partial Y}{\partial A} \cdot \frac{dA}{dt} + \frac{\partial Y}{\partial K} \cdot \frac{dK}{dt}$$

The impact of investment (K) on the level of GDP (Y_A) is given by

$$\frac{\partial Y}{\partial K} \cdot \frac{dK}{dt}$$

where

$$\frac{dK}{dt} = I_t \text{ and}$$

I_t = New Capital Investment over time t.

Due to its theoretical appeal, ease of manipulation and interpretation, this analysis employs the unrestricted Cobb-Douglas production function (linear in the logarithms) of the form:

$$Y_a = \psi L^{\alpha 1} A^{\alpha 2} K^{\alpha 3}$$

where

Y_a = GDP arising from agriculture

ψ = Positive constant also known as the efficiency paramter

L = Labor engaged in the agriculture sector

A = Land area in hectares under cultivation

K = Investment on items of a capital nature

$\alpha 1$ = Positive fraction less than 1 and representing elasticity of Ya with respect to labor

$\alpha 2$ = Positive fraction less than 1 and representing elasticity of Ya with respect to land

$\alpha 3$ = Positive fraction less than 1 and representing elasticity of Ya with respect to capital

and therefore, the marginal productivities of labor, land and capital are respectively:

Labor,

$$\frac{\partial Y}{\partial L} = \alpha_1 \psi L^{\alpha 1 - 1} A^{\alpha 2} K^{\alpha 3}$$

$$\frac{\partial Y}{\partial L} = \alpha_1 \frac{\psi L^{\alpha 1} A^{\alpha 2} K^{\alpha 3}}{L}$$

$$\frac{\partial Y}{\partial L} = \alpha_1 \frac{Y}{L} ,$$

Land,

$$\frac{\partial Y}{\partial A} = \alpha_2 \psi L^{\alpha 1} A^{\alpha 2 - 1} K^{\alpha 3}$$

$$\frac{\partial Y}{\partial A} = \alpha_2 \frac{\psi L A^{\alpha 2} K^{\alpha 3}}{A}$$

$$\frac{\partial Y}{\partial A} = \alpha_1 \frac{Y}{A} \qquad \text{and finally,}$$

Capital,

$$\frac{\partial Y}{\partial K} = \alpha_3 \psi L^{\alpha 1} A^{\alpha 2} K^{\alpha 3 - 1}$$

$$\frac{\partial Y}{\partial K} = \alpha_3 \frac{\psi L^{\alpha 1} A^{\alpha 2} K^{\alpha 3}}{K}$$

$$\frac{\partial Y}{\partial K} = \alpha_1 \frac{Y}{K}$$

In order to estimate the $\alpha 1$, $\alpha 2$, and $\alpha 3$, the Cobb-Douglas production function was transformed into its linear logarithmic form as:

$$\text{Log } Y_a = \text{Log } \psi + \hat{\alpha}_1 L + \hat{\alpha}_2 A + \hat{\alpha}_3 K + E$$

The above can be rewritten as the following probabilistic model:

$$Y = \alpha_o + \alpha_1 L + \alpha_2 A + \alpha_3 K A + E$$

Further, the probabilistic model is finally transformed into a prediction model (without an error term) and we have:

$$\hat{Y} = \hat{\alpha}_o + \hat{\alpha}_1 L + \hat{\alpha}_2 A + \hat{\alpha}_3 K$$

We note that $\hat{\alpha}_o$ = the efficiency parameter and $\hat{\alpha}_1$, $\hat{\alpha}_2$, and $\hat{\alpha}_3$ elasticities of production where elasticity of production is defined as the relative responsiveness of the Gross Domestic Product arising from the agricultural sector (Ya) per unit charge in anyone of the inputs L, A, and K, respectively, keeping the others constant. We find that "the coefficients of the Cobb-Douglas production function can be interpreted as indicating the elasticities of production (in our case Ya) with respect to inputs. Assuming that the factors are correctly specified, the coefficients can also be interpreted as indicating the relative importance of each factor as a source of difference in output among countries" (11, pages 86-111), or regions within a country. As an example, if different regressions were made for different parts or regions of Zambia, one would expect to find different values of the coefficients due to the differences in factor endowments among different regions.

The foregoing model was employed to measure growth within a sector. However, since this paper attempts to measure intersectoral rela-

lationships, the way in which total GDP is affected by the growth of the component sectors in the economy, the following identity is proposed:

$$Yc = \frac{Ya}{Yc} + \frac{Ym}{Yc} + \frac{Ys}{Yc} = 1$$

where

Yc = Gross Domestic Product of the whole country

Ya = Gross Domestic Product from the agricultural sector

Ym = Gross Domestic Product from the manufacturing sector

Ys = Gross Domestic Product from the service sector

It follows that the rate of growth of total GDP can therefore be estimated by:

$$\frac{\partial Yc}{\partial t} \cdot \frac{1}{Yc} = \frac{\partial Ya}{\partial t} \cdot \frac{1}{Ya} + \frac{\partial Ym}{\partial t} \cdot \frac{1}{Ym} + \frac{\partial Ys}{\partial t} \cdot \frac{1}{Ys}$$

Therefore, from the foregoing, the contribution to Yc from Ya, Ym and Ys can readily be isolated. The methodology can therefore be adopted together with other considerations for guiding the evolution of policy in the direction favoring the development of those sectors from which maximum contribution to growth of total GDP and economic development arises.

The two mechanisms, the former measuring the input impact on growth of sectoral GDP and the latter used to identify the sectors contributing most to the growth of the whole economy taken together could constitute a premise on which pragmatic policies leading to economic development may be based.

B. Hypothesis to Be Tested

The regression mechanism elaborated above was tested with data from official Government of Zambia sources and other institutions that provide credit to agriculture. These sources are acknowledged throughout the text. A number of writers have speculated on the role that capital is supposed to play in economic development. Ragnar Nurkse (12) while recognizing that capital is a necessary but not a sufficient condition for progress, does stress other considerations; that the poverty in less developed countries is attributable to lack of adequate capital equipment. Snodgrass and Wallace also state that "Capital is a critical factor in determining the kind, amount, and quality of societies total output or product. Use of capital follows the general law of variable proportions which says that output can be increased by adding more capital if capital is the limiting factor in a production process" (8). Heady (7) in his discussion of net labor product in relation to capital, suggests that an increase in capital leads to a higher net product per worker in agriculture.

Despite the apparent consensus regarding the positive role of capital in the process of economic development and in particular the role of capital in agricultural sector growth, controversy continues over the kinds of capital to add, when to add them, what sector they should be added to and other related questions remain unanswered.

For the Zambian case, there has been a notable increase in capital accumulation and this is attributable to the need to accelerate output

from agriculture by intensifying capital input into the sector. In this regard, the study attempts to test the hypothesis that "increase in capital accumulation leads to an increase in the level of output in the agricultural sector in Zambia." With the above, we turn to statistical procedures and data problems.

C. Statistical Procedures and Data Problems

(i) Statistical Procedures

The statistical procedure used for testing the hypothesis was a regression analysis as outlined by Snedcor and Cochrane (13). The term regression of some variable Y or X in general where Y is the dependent and X the independent variable is used to describe a relationship.

Regression is acknowledged to have many uses. The objectives, therefore, are many and varied. In this study, however, the objective is to determine if there is a relationship between Y, GDP in agriculture, and K the level of capital inputs, to study the type of relationship and to think about the reasons for the relationship. Snedcor and Cochrane say prediction of Y from K in our case, for example, may be the goal. Often the purpose is to estimate the change in Y to be expected from a given increase in K in cases where we are convinced that changes in Y are in the main caused by changes in K. As elaborated earlier, this method enables us to find out which resource is contributing most to growth in an industry. With this type of information, we should be able to reallocate our resources in a fashion to maximize growth of an industry. Our method as outlined in the sections on the elaboration of the model permit

us to find out the extent of the impact of capital on the growth of GDP emanating from the agricultural sector.

(ii) Data problems

Data for this study was obtained from references referred to in the text and bibliography.

When the variables were delineated, it was seen that there were some gaps in the data. These were due to factors like surveys not having been conducted during the relevant period and a variety of other reasons. This definitely leads to some incompleteness in the analysis.

Another data problem arises out of the fact that:

(a) Data covers only those areas that can be reached by the Department of Census and Statistics and most of these data are therefore based on sample surveys. The published figures comprise the most accurate estimates yet they are not completely correct even when some margin of error is worked into the final figures.

(b) Output data relfects marketed production and yet actual production is much higher as can be seen from data on retention rates in the subsistence sector. This, therefore, underestimates outputs.

(c) The data on capital accumulation suffers from a number of deficiencies like: (a) It is not adequately disaggregated by the author due to lack of complete information. This then means that capital formation data may include some aspects of capital that are not necessarily of a long-term nature. Also, government investment in dams and road infrastructure has been left out because of the difficulty of determining just how much of this investment actually ends up as agricultural capital formation. (b) The capital formation figures used in the study do not estimate capital investments made from other sources of funds or actual materials particularly for the small-scale farmers. For this reason, it cannot be claimed that capital accumulation statistics are complete and final. (c) The data from

financial institutions do not indicate the type of farmers to which credit was directed although it may be speculated that commercial banks lending is mostly available to large-scale commercial farmers due to the fact that it is them that can meet exacting collateral requirements demanded by commercial banks. However, a large proportion of the loaned funds is furnished by the Agricultural Finance Company which finances farmers of all sizes. This, therefore, complicates the type of final conclusion to be reached regarding the impact of capital on the growth of GDP in general from the agricultural sector. While our conclusion gives the aggregate impact, it may not be appropriate to generalize the impact of capital formation on different farms facing different problems and also of different sizes. This being the case, the study may well provide useful guidelines for policy formulation following extensive collection of relevant data. Despite these problems, we proceed to illustrate the usefulness of this model as a guide in policy formulation.

D. Extended Use of the Model - Estimating the Demand for Capital

As an illustration of the extended use of the model that has been specified, I will estimate the demand for capital. However, there are a number of assumptions that are being made in the use of this procedure in estimating capital demand or the demand of any input that we may include in the equation and which we wish to estimate. First, the procedure being used assumes the production function of the firm. This procedure presents some problems because when a farm is being assumed to be similar to a firm, it is also being assumed that the use of factors in terms of their proportion and intensity will be similar to those of a firm outside the agricultural sector. However, in reality, this may not be the case and the procedure therefore demands that care must be exercised in using it and interpreting the results. Further, I am assuming that this farm firm uses labor and capital and these are the inputs which need

to be varied. However, it is common knowledge, the production function of a farm firm has many sometimes uncontrollable variables included in it. These include, for example, water, weather, technology, soil quality and others. There are other problems but their existence should not prevent us from attempting to estimate inputs in the agricultural industry. This idea of attempting estimation of input demand is important because the estimates can be used to allocate resources consistent with the level of growth attempting to attain certain levels of expansion of a farm firm or industry. In the light of outlined problems concerning the extended use of the model, the following estimation procedure is being advanced.

I have assumed the following production functional form of the firm as the objective function:

$$Y = \psi L^{\alpha 1} K^{\alpha 2}$$

here

Y = Output

ψ = Efficiency parameter (positive constant)

L = Labor engaged in the firm

$\alpha 1$ = Positive fraction less than 1 and representing elasticity of output Y with respect to labor

$\alpha 2$ = Positive fraction less than 1 and representing elasticity of output Y with respect to capital

I have opted to use this production functional form due mostly to the ease with which it can be manipulated and also its general theoretical

appeal as is evidenced by its widespread use in studies similar to this one.

The derived demand for capital will be found by minimizing the cost of labor and capital by limiting our expenditure to their sum, i.e.

$$TVC = \omega L + rK$$

where

ω = Wage rate

L = Labor (amount of people employed assuming skill homogeneity)

r = Cost of capital (or interest on loans for capital acquisition)

K = Amount of capital

Since we wish to attain a given level of GDP, we attempt maximizing our output while minimizing the cost, we set up our langragian equation by taking the negative of our objective function subject to our expenditure levels and get

$$\mathcal{L} = -\omega L - rk + \lambda(\overline{Y} - \psi L^{\alpha 1} K^{\alpha 2})$$

where

λ = Langragian multiplier

We then take the following first order conditions

(a) $\frac{\partial \mathcal{L}}{\partial L} = -\omega - \lambda\alpha_1 \frac{Y}{L} = 0$

(b) $\frac{\partial \mathcal{L}}{\partial K} = -r - \lambda\alpha_2 \frac{Y}{K} = 0$

(c) $\frac{\partial \mathcal{L}}{\partial \lambda} = \overline{Y} - \psi L^{\alpha 1} K^{\alpha 2} = 0$

Taking the ratio of (a) and (b) we find:

$$\frac{\omega}{r} = \frac{\lambda}{\lambda}\frac{\alpha_1}{\alpha_2}\frac{\frac{Y}{L}}{\frac{Y}{K}} = \frac{MP_L}{MP_K} = MRTS_{LK}$$

where

MP_L = Marginal productivity of labor

MP_K = Marginal productivity of capital

$MRTS_{LK}$ = Marginal rate of technical substitution between labor and capital

Now,

$$\frac{MP_L}{M_K} = \frac{\alpha_1 Y/L}{\alpha_2 Y/K} = \frac{\alpha_1}{\alpha_2} \cdot \frac{K}{L} = MRTS$$

So,

$$\frac{\omega}{r} = \frac{\alpha_1}{\alpha_2} \cdot \frac{K}{L}$$

$$L = \frac{\alpha_1}{\alpha_2} \cdot \frac{r}{\omega} K = \text{This represents the path of expansion of the labor input as the firm grows}$$

Substituting the value of L into the third equation of the first order conditions we get

$$Y = \psi\left[\frac{\alpha_1}{\alpha_2} \cdot \frac{r}{\omega} \cdot K\right]^{\alpha_1} K^{\alpha_2}$$

We find then that

$$K = \left[\frac{Y}{\psi}\left[\frac{\alpha_2}{\alpha_1} \cdot \frac{\omega}{r}\right]^{\alpha_1}\right]^{\frac{1}{\alpha_1 + \alpha_2}}$$

The above equation constitutes the derived demand for capital. Similarly, the derived demands for labor, land or any other given input at a given point in time can be estimated. These findings, could lead to realistic projections of levels of inputs required for attaining given levels of outputs. In this study, outputs represent GDP assuming that elasticities remain constant over the period of the projection. I remain mindful however, that there are lots of other variables that are being held constant. For this reason, a more elaborate scheme to making projections would include mechanisms for making appropriate adjustments to take account of changes occurring in some important variables like factor prices and others. The following section gives a summary of the results of the regressions carried out.

V. RESULTS

Using a Cobb-Douglas Production Functional Form, a linear logarithmic form transformation was made. This linear transformation and a generalized form of a linear equation were regressed using the computer as shown in Appendix A attached. The results of the regression are then used to determine what relationship exists between GDP from the agricultural sector (output) and inputs of labor, land and capital. Limitations of the data have already been cited, and should be borne in mind when interpreting the Cobb-Douglas results. The results from both regressions were very similar.

In addition to estimates of our elasticities, we need to know how tight the relationship is between GDP and our inputs in the model. The value that measures the "tightness" of the relationship or just how good our model is is the coefficient of determination, the R^2. It turns out that our $R^2 = .88$ which means that the model explains 88 percent of the relationship between our dependent and independent variables is close and statistically the model is good.

T values indicate that the coefficients are significantly different from zero and hence the probability that elasticity of labor, land, and capital being zero is very remote. Finally, the test reveals no autocorrelation. Autocorrelation is a problem of an interdependence among successive values of the disturbance term or alternatively known as an "error term." The significance of this result is that autocorrelation concerns the variance of our estimators. Further, according to Kelejian and Oates (77), formulas derived for the variance do not hold if there

is autocorrelation and consequently therefore errors are generated in the t ratios which will in turn render invalid our tests of hypothesis about the values of the parameters in our model. The results obtained are clear from the model.

A. Agricultural Sector Growth

The linear transformation of the Cobb-Douglas Production Function is finally stated with the following values:

$$Y_a = 5.158\ L^{.186}\ A^{.045}\ K^{.078}$$

It is clear from the above that a one percent increase in capital formation leads to a negligible .078 percent in rise of GDP. This is consistent with the findings of J. A. Mollet (18) and others that substantially higher rates of investment in agriculture in a less developed economy tends to yield poor results.. Further, Mollet found that the constant term in the equations which is the efficiency parameter, expressed in terms of their anti-logarithms is about 150% higher in the developed countries (anti-log of 2.04 = 109.6) than in the developing countries (anti-log of 1.64 = 43.7). In the case of Zambia, the efficiency parameter value (anti-log of .712 = 5.158) is even less than the one computed for developing countries in general, thereby revealing a wider gap. The gap measures the performance or output (Ya) from given levels of capital and labor between the two groups of countries.

Note: The efficiency parameter, the estimate of the intercept as shown in the annex - i.e. = ψ = 5.158.

The foregoing results suggest that at least in part growth in the agricultural sector arises from other factors and that capital accumulation should therefore be undertaken only as part of an integrated effort in dealing with the other limiting factors as eluded to earlier.

B. Intersectoral Effects

The present findings suggest that the growth of the agricultural sector itself is very low and hence agriculture's contribution to total growth of the economy is very low. In fact, available evidence indicates that the share of agriculture in the total GDP has stagnated at 11.48 percent as shown in the table below.

Consistent with the concensus that agricultural productivity is function of other variables also, I will now turn to a consideration of these other variables or factors. However, before turning to them, a consideration of the broad objectives of the government concerning rural development and agriculture in particular is in order.

Table 4. Gross Domestic Product by Kind of Economic Activity in Producers Values at Constant (1970) Prices

Kind of Economic Activity	K' Million								
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Total Gross Domestic Product	1394.2	1380.8	1473.9	1438.1	1500.1	1424.4	1458.8	1342.1	1353.7
Agriculture, Forestry, and Fishing	145.6	143.9	150.5	157.0	166.9	168.2	169.0	153.4	166.5
Mining and Quarrying	1178.1	463.1	474.3	427.9	503.2	469.7	504.8	405.3	396.1
Electricity, Gas, and Water	31.4	32.5	46.0	48.9	52.6	57.8	58.3	62.6	66.5
Manufacturing	162.7	165.1	178.9	157.6	151.9	141.4	152.0	151.9	158.9
Construction	94.3	99.9	114.5	138.5	99.5	90.4	82.0	77.6	68.6
Wholesale and Retail Trade	123.7	113.2	128.8	105.0	107.9	197.3	97.1	95.4	96.0
Hotels and Restaurants	18.1	16.9	19.1	18.8	19.3	17.2	17.8	17.6	16.9
Transport, Communication and Storage	54.6	51.7	54.6	57.6	67.0	61.5	62.1	64.3	67.1
Financial Institutions and Insurance	47.8	61.8	57.5	60.4	58.3	48.8	41.0	44.8	39.4
Real Estate	32.2	32.2	33.4	39.8	43.1	44.8	47.8	49.4	49.7
Business Services	23.2	27.3	28.6	32.7	35.0	32.3	33.1	33.8	34.6
Community, Social and Personal Services	163.5	159.4	172.6	180.6	188.4	190.0	191.0	188.6	189.3
Import Duties	29.9	24.8	28.8	26.9	20.1	16.0	12.0	11.5	13.0
Less: Imported Bank Service Charges	10.9	14.0	13.7	13.6	13.1	11.0	9.2	10.1	8.9

Source: Central Statistical Office.

VI. BROAD AGRICULTURAL AND RURAL DEVELOPMENT OBJECTIVES AND CURRENT POLICIES AND OTHER RELEVANT FACTORS AFFECTING THE AGRICULTURAL SECTOR

There have been three development plans in Zambia besides the emergency and the transitional development plans which were of a duration spanning less than 3 years put together since 1964. Their objectives have been similar. The objectives outlined in the Second National Development Plan 1972-1976, were to minimize the inherited imbalance between the urban and rural sectors, develop the production in agriculture, to increase rural incomes and to reduce the country's dependence on copper exports (15, page 139). These objectives have not changed over the years as can be seen from the statement of objectives contained in the Third National Development Plan (TNDP) 1979-1983 document. The objectives relating to agriculture are delineated as:

(a) To achieve self-reliance and self-sufficiency in staple foods, both national and regionally where feasible, and to provide raw materials for the agro-industries.

(b) To stimulate and increase production for exports.

(c) To increase the contribution of the rural sector to GNP and to promote diversification of the rural economy.

(d) To improve rural standards of living and nutritional status and to create a self-reliant and progressive rural society.

(e) To create new employment and income opportunities in rural areas in order to counteract the rural-urban migration and to improve infrastructural services related to increased productivity.

The above objectives constitute a complex agenda of issues to be addressed in the formulation of policy to stimulate agricultural production, to meet local food requirements and also attempting to enter the export market. On the other hand, the policies should also ensure that as output increases, agricultural products should not suffer precipitous falls in prices as this would reduce farm incomes.

The objectives of the government can be met by adoption of certain policies singularly or in combination with others. With the general characterization of the objectives given above, a summary of current policies and how they affect agriculture is appropriate.

The major tool of agovernment policy to stimulate agriculture has been price policy. However, before proceeding to other factors that affect agriculture in equally important ways, I will digress a little to review the role of product and factor prices in resource allocation which is acknowledged to be important by several authors including John Mellor, Hayami, and Ruttan and others. As an illustration, Hayami and Ruttan show that changes in factor prices relative to other factors and also relative to products do influence the innovation and invention of appropriate technology. Technology, whether biological or mechanical, is affected in ways such that the constraints resulting from scarcity of factors due to factor price changes or inelasticity of their supply on the production processes are reduced. This idea of role of factor prices is what constitutes the induced innovation hypothesis which basically seeks to explain how technological changes occur through a

process of resource allocation to develop appropriate technology to ease the constraint resulting from changes in factor prices. To illustrate this process, let us assume a case of a country where population pressure has caused land to be scarce relative to other inputs in agriculture. If prices are set in such a way that they constitute an incentive to engage in a relevant research, technology could be developed

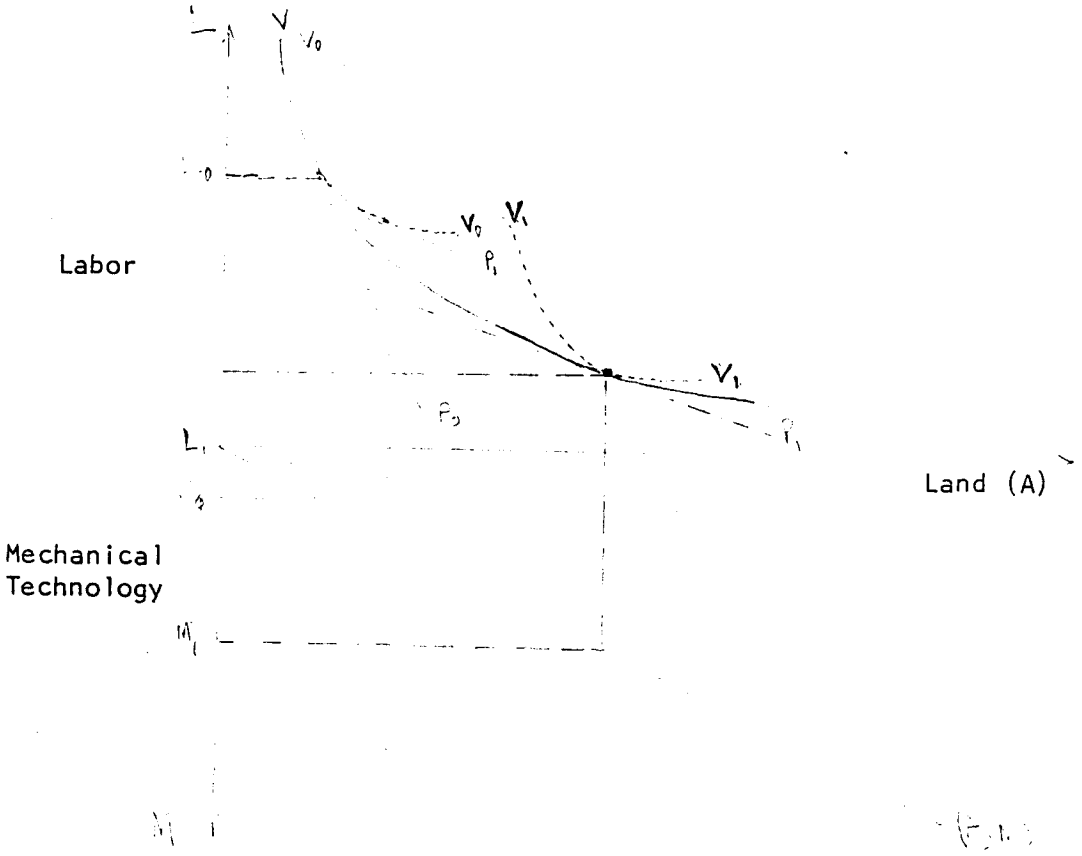

Figure 1. Factor Prices and Induced Technological Change

in such a way that it removes what may be considered to be a binding constraint in a given situation. If, for example, labor is considered to be an important constraint, appropriate mechanical technology could be developed to remove this constraint, and the results are as shown in Figure 1 ~~below~~. On the other hand, if land is considered to be the binding constraint, then the development of high yielding seed varieties may be.

Hayami and Ruttan argue that adjustment in factor proportions in response to relative factor prices represent movements along the isoproduct surface of a metaproduction function. Some technology represented by V_o is (e.g., power tiller) created when a price ratio P_o prevails for a certain length of time. When the price ratio changes from P_o to P_1 another technology V_1 (e.g., small tractor) is induced.

The new technology represented by V_1 generally corresponds to higher intensity of machinery or power per worker. In the figure above, mechanical innovation is conceived as the substitution of a combination of land and power (A, M) for labor (L) in response to a change in wage relative to an index of land and machinery prices.

On the other hand, if land is considered to be the binding constraint, then development of high yielding seed varieties may follow with view to increase output per acre as shown in Figure 2 below.

A decline in the price of fertilizer relative to the price of land from r_o to r_1 makes it more profitable for farmers to search for crop

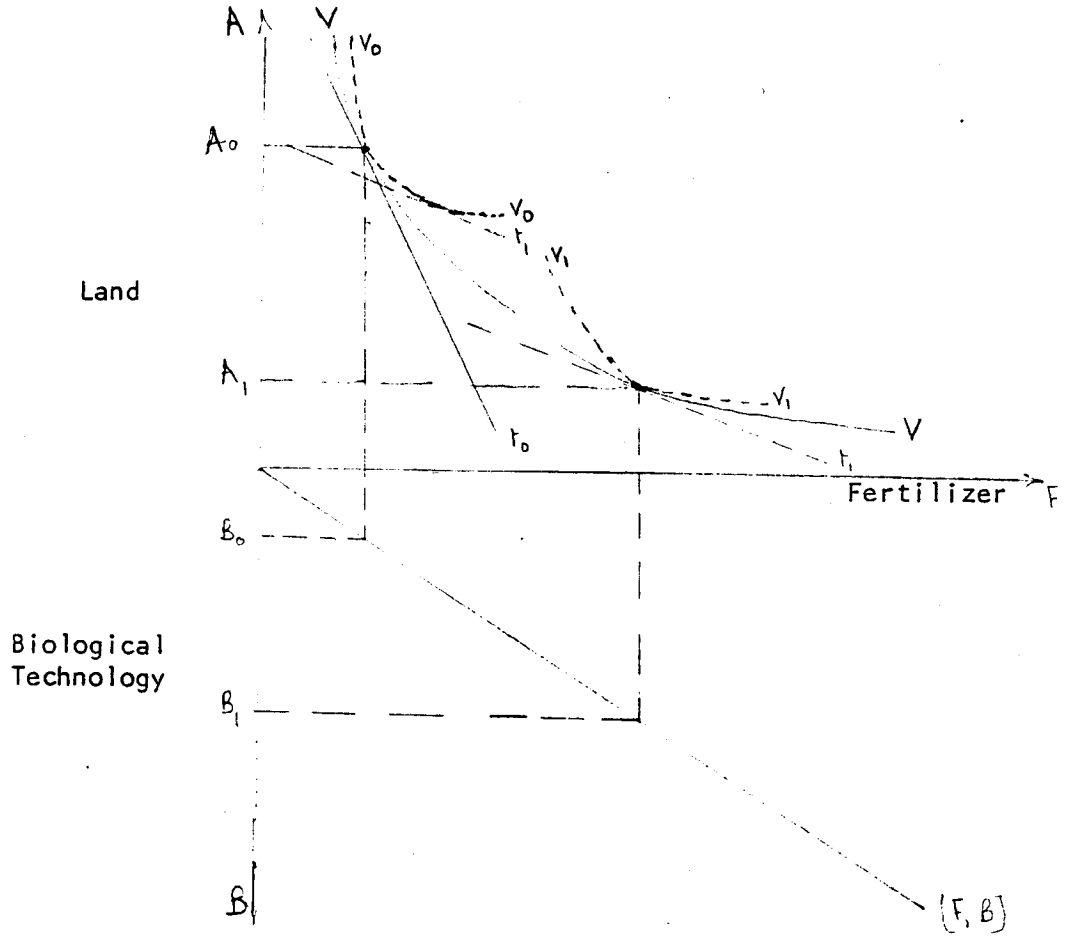

Figure 2. Factor Prices and Induced Technological Change

varieties described by isoquants to the right of V_o. The farmers also press for public research institutions to develop new varieties. Through a kind of dialectic process of interaction among farmers and experiment station workers, new varieties such as that represented by V_1 are developed (11, page 127).

Available information does not indicate a presence of a coherent

trade policy and policies to increase or maintain rural incomes at levels that do not place farmers at a disadvantage relative to urban incomes. are simply absent.

As indicated in the preceeding paragraph, agricultural price policy is by far the most important instrument that has been used to influence resource allocation as shown by movements in the producer prices of selected agricultural commodities in Table 5. To influence resource allocation within agriculture and among the different crops, the government sets producer prices. These are adjusted on an annual basis. They are announced in April or May for the next planting season which is November. The basis for this review is usually the cost of imports and since these inputs as we shall see later are handled by government controlled heavily subsidized parastatal organizations, the price of inputs in general are low and hence the producer prices tend to be depressed. Livestock pricing is done in a similar way and livestock prices are supposed to be reviewed every year. These prices are the legal prices at which the affected commodities are supposed to be traded within Zambia.

The dominance and power of state controlled trading is ensured through the control of marketing, processing, distribution and retail function of government controlled parastatals and cooperative unions.

As an illustration of the intensity and depth of government control, I will cite some of the functions of the National Agricultural Marketing Board (Namboard). Its functions include: a) to buy, store

Table 5. Agricultural Producer Prices (in kwacha)

Maize (a)	90 kg bag	4.30	4.30	4.50	5.00	6.50	6.30	6.80	9.00	11.70	13.50
Groundnuts	80 kg bag	10.20	12.60	17.00	17.00	25.00	25.00	28.60	32.00	32.70	32.70
Sunflower	59 kg bag	4.62	6.64	8.95	9.40	10.00	10.00	12.50	13.70	16.40	16.40
Soybean	90 kg bag	8.40	13.20	13.20	13.20	17.00	17.00	21.50	25.50	33.00	33.00
Wheat	90 kg bag	--	7.50	7.50	12.00	16.00	16.00	18.00	20.00	26.00	26.00
Milk (f)	litre	.10	.11	--	.15	.18	.18	.20	.21	.25	.25
Paddy rice	90 kg bag	--	--	--	13.50	16.20	16.20	16.20	18.00	18.60	18.60
Seed cotton (d)	kg	.18	.18	.25	.30	.40	.40	.46	.46	.46	.46
Tobacco: Virginia (b)		.89	.89	.29	.89	1.04	1.44	1.45	1.45	1.51	1.51
Barley		57	62	62	61	61	61	--	--	--	--
Cattle (e) kg (c.w.d.)		.49	.58	.58	.67	.67	.67	.71	1.09	--	--
Pigs (g) kg (c.w.d.)		56	59	63	.59	.62	.64	.94	.94	--	--

Source: Ministry of Agriculture and Water Development.

(a) Grade A maize at all depots.
(b) Average auction floor price from 1977 onwards. The 1973-1976 price includes subsidy.
(c) Chalimana and Makula Red Grade A; as from 1976.
(d) Grade A hand picked cotton.

and transport and sell at fixed prices a specified group of agricultural commodities. In 1974, the board was the monopoly buyer of only maize, but the buyer of last resort for sorghum, groundnuts, various dried beans, soybeans, sunflower seed, sunhemp and also for others not infact offered to it; b) to import and export designated proudcts; and c) to offer for sale to farmers various farm inputs ... principally fertilizer and seed in 1974, but including chicken feed, pesticides and sprayers and a wide range of hardware and farm tools, including wheelbarrows, shovels, rakes, hatchets, hoes, harrows, barbed wire, chicken wire and hard corn shellers (14, Annex 8, page 18). The foregoing has been an explanation of producer prices setting and extent of government intervention in the market for agricultural products. The government also controls consumer prices as outlined below.

Consumer prices are decided separtely. The government may adjust prices upwards due to worries about expanding subsidies or may fail to do so because of fear of consumer reaction (14, Annex 8, page 36). We now turn to international trade.

Success in international trade in agricultural commodities depends on the exchange rate policy being pursued by the government. In the Zambia case, the exchange rate has been established with a view to support an import substitution industrial strategy in the broad framework of modernizing the economy. Modernization has meant high level of imports of industrial machinery in other sectors of the economy and also in agriculture. In addition to the machinery has been a related growth in

Table 6. Value of Some Selected Imports by SITC Sections

Imports of principal items	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Food	48,193	37,138	24,344	43,801	35,747	25,706	28,672	31,544	37,138	45,962
Beverages and tobacco	1,417	1,250	973	1,130	1,018	884	879	678	1,299	801
Crude materials	7,629	7,943	5,420	10,363	9,892	7,198	8,807	9,027	11,048	12,400
Electricity and mineral fuels	32,235	26,523	33,285	61,095	81,115	726	81,010	86,978	106,411	192,430
Oils and fats	4,516	3,907	4,323	6,770	9,087	10,684	9,108	7,169	10,118	7,307
Chemicals	31,688	33,041	35,136	48,445	77,293	68,184	58,928	66,103	79,275	108,374
Manufacturers classified by materials	84,786	87,918	77,339	129,996	140,211	96,789	117,856	98,106	121,542	180,140
Machinery and transport equipment	160,115	168,009	138,911	165,795	211,300	166,904	205,102	175,672	204,906	304,392
Other manufactured articles	27,257	35,377	25,383	36,431	28,698	18,996	19,260	18,469	23,890	29,972
Miscellaneous transactions	1,448	1,365	1,753	2,809	3,250	783	347	401	1,494	654

Source: C.S.O.

the demand for spare parts imports. In view of this situation, especially in the face of foreign exchange problems, the government has sought to make machinery and imports of a long list of other items including oil cheaper by overvaluing the Zambian exchange rate relative to the exchange rate of our major suppliers and trading partners. Table 7 below summarizes the structure of Zambia's external trade while Table 8 provides some evidence of the overvalued exchange rate. The current exchange rate does make imports cheaper but it is clearly inconsistent with the objective of entering international trade. This is so because Zambian exports become more expensive and this makes them unattractive and uncompetitive in world markets. In addition, the food imports tend to depress the prices of local agricultural prices hence we have two pressures on agricultural prices. One being the government control and the other resulting from imports. This situation undermines Zambia's capacity to trade effectively and earn foreign exchange in international markets with which to settle her import bills. This translates into balance of payments problems. It is clear from the foregoing that there are undesireable impacts in the agricultural sector resulting from an exchange rate policy that was designed to maximize imports while minimizing cost. The first part of this section has attempted to outline the broad agricultural and rural development objectives and to demonstrate the degree and intensity of government intervention in the agricultural sector, price policy and the exchange rate policy in place. The second part of this section will be devoted to the consideration of the state

Table 7. Zambia's External Trade (K '000)

	1971	1977	1978	1979	1980
Value of exports (f.o.b.) of which	485,177	708,016	675,314	1,094,000	
EEC	148,403	276,035	222,439	345,125	--
Soviet bloc	1,279	2,998	6,905	9,314	--
U.K.	79,187	113,349	98,797	145,398	132,151
South Africa	10,447	1,735	8,000	4,171	5,668
China	32,061	22,908	14,832	34,819	28,086
U.S.A.	4,557	72,847	70,111	111,624	99,919
Japan	99,669	124,141	132,021	201,348	151,106
West Germany	45,520	102,406	79,285	100,338	7,689
East African countries	2,537	6,322	5,019	6,650	6,729
Exports of principal commodities					
Copper	450.2	644.9	596.7	907.9	
Zinc	11,507	17,920	17,630	29,400	
Lead	4,557	5,705	3,275	6,900	
Cobalt	4,125	16,226	36,679	135,300	
Tobacco	3,512	5,783	3,481	4,000	
Maize	77	2,517	7,823	--	
Value of imports (f.o.b.) of which	339,282	529,970	493,932	625,000	
EEC	57,570	114,826	102,029	98,302	--
Soviet bloc	3,358	1,646	2,136	4,063	96,647
U.K.	97,091	121,480	112,506	15,294	--
South Africa	60,091	38,524	32,411	64,650	139,377
China	4,085	6,697	6,286	2,288	5,678
Japan	36,833	25,401	21,906	24,392	43,851
West Germany	17,558	62,871	54,697	100,338	7,689
East African countries	14,173	9,139	8,251	11,441	10,696
U.S.A.	43,359	57,524	38,692	55,357	63,935

Source: Central Statistics Office, Zambia in Figures (1980 edition) and Monthly Digest of Statistics, Vol. XVII, Nos. 4 to 6 April/June 1981.

Table 8. The Structure of Exchange Rate Regimes and Percentage Imports with Major Trading Partners

	Currency	Exchange rate per US dollar	Exchange rate per kwacha	Percentage of total 1979 imports
German Democratic Republic	(DM)	2.2548	2.5542	16.05
European Economic Community (EEC) Block*	(EU$)	1	1.1328	15.72
South Africa	(rand)	1.0454	1.0836	10.34
United States*	($)	1	1.1328	8.86
Japan	(Yen)	219.90	249.10	3.90
United Kingdom	(£)	.5241	.5937	2.45
Subtotal				57.32
Rest of the World		K1 = SDR 0.97631		42.68
				100.00

Sources: Republic of Zambia, Central Statistical Office Monthly Digest of Statistics and Internal Monetary Fund, International Financial Statistics Yearbook, 1982.

*Note: Most of the trade with the EEC block is conducted in Euro-dollars. These are U.S. dollars in the European financial markets.

and roles of other factors that influence agricultural production and productivity. As pointed out elsewhere the factors identified in this paper do not exhaust the list of relevant factors. With this understanding we proceed to consider credit, extension services marketing, and transport in turn.

A. Credit

Credit plays an important role in the operation of many business ~~operations~~ enterprises and it is an equally important variable in the operation of the farm firm, to agriculture as a whole and to those industries that service the agricultural sector. It can be said therefore that credit is an important area supporting a wide range of economic activities.

Consistent with the foregoing role of credit, it is generally agreed that credit is an important input as it is a source of farm operating capital and also the basis of investments. This being the case in the Zambian situation, for example, there may be those who may argue for increasing credit to the agricultural sector. If credit is indeed a bottleneck to the growth of the agricultural sector, especially emphasizing the type of growth with distribution, then ways have to be found to attract investment into the agricultural sector. Agriculture is first thought to be a risky sector for purposes of investment especially due to the variability of weather conditions and problems associated with disease control especially in the livestock sector. For this reason, credit has tended to be accessible mostly to those persons that can offer some kind of firm recourse for financial institutions in the event

Table 9. Distribution of Loans Released to Farmers by Province: 1970-71 to 1979-80 (Percentages)

Province	1970-71	1971-72	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Central	51.7	49.2	55.3	46.2	24.0	24.8	18.1	17.8	30.7
Lusaka	Included in Central Province				51.1	42.2	45.0	21.6	23.0
Southern	41.1	43.1	35.1	35.6	17.9	21.6	25.0	41.5	30.1
Copperbelt	2.3	1.8	6.5	2.6	2.0	3.5	3.1	4.1	4.4
Eastern	1.9	2.8	1.8	14.5	3.8	6.1	5.2	13.6	7.4
Luapula	0.8	0.8	0.8	0.1	0.2	0.2	0.6	0.1	0.6
Northern	0.9	1.1	0.2	0.4	0.7	1.0	2.2	0.9	2.5
N. Western	0.8	0.8	0.2	neq	0.3	0.3	0.6	0.2	0.8
Western	0.5	0.4	0.1	0.6	0.1	0.1	0.2	0.2	0.5
ZAMBIA (Total)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Central Statistical Office.

Note: (1) This table excludes figures for 1972-73 year for which the survey was not carried out.

(2) Lusaka Province figures prior to 1978-79 may include loans given to NAMB (roughly 3 to 4 million kwacha/year) and some amount given to farmers of Southern and Central Province.

of a crisis situation facing a farmer. The usual form of this recourse is generally called collateral security. Since collateral security is not general in the Zambian farming community, agricultural credit has continued to be the privilege of those that have the collateral and sometimes has included those that are politically powerful. The result of this problem has been the distribution of credit as illustrated in Table 9 below, where credit has been concentrated in areas where commercial type farming has gone on for long periods of time and also where political clout is clearly present. This distribution is inconsistent with the approach to the development of agriculture which emphasizes growth with distribution or more specifically a strategy that can be characterized as unimodal.

The credit situation as it exists makes it more imperative to find ways to induce financial institutions to make credit available to a broader section of the farming community. It is clearly unjustifiable to coerce financial institutions to make credit available without offering them some kind of security. As for the inducement part, we recall the role of price in resource allocation. For the financial institutions to allocate significant portions of their portfolio to agriculture, the price has to be good and their price is measured in terms of interest rates. I would therefore state that interest on loans to the agricultural sector should be made competitive. However, I must hasten to add that the level of interest must be made consistent with or closely approximate the estimated increase in the earning capacity of the farming

unit resulting from additional credit. A failure to increase the earning capacity of the farming unit in the midst of increased credit can only lead to failure to meet repayments on loans and subsequent disruption of the credit system.

The problem regarding inducement could be handled as suggested in the foregoing paragraph but still the question of risk of non repayment and accessibility remains. This problem is and has engaged the minds of people concerned with improving the quality of life for masses of people in agriculture for a long time. In Zambia, one of the ways that should be considered with a view to providing security to lenders and accessibility to borrowers without security to offer is for the government to guarantee such credit. The mechanism for providing such guarantees would start with appropriate law reforms enabling the Central Bank of Zambia to directly provide these guarantees to financing agencies. There are other kinds of arrangements which would fall outside bank resources or jurisdiction but these would be taken care of by elaborating a complementary and/or supplementary structure with the relevant government ministries or agencies.

The categories of Zambian farmers eluded to earlier, also suggest the level of competence of the operators. Credit although indeed is a limiting factor, its availability cannot in itself ensure efficiency and success of a farming operation. As an illustration, for small scale farmers, "lenders must do more than simply provide the amount of loans needed if they are to adequately serve the credit needs of a dynamic

agriculture" as Enberg (9) argues. Enberg stresses the quality of a credit service and states that that quality includes competent and intelligent evaluation of prospects and risks in the operation to be financed, counselling on financial management when appropriate (this can be attained in part by including the condition in the loan packages), and adaptation of credit lines to individual requirements. This should include the schedule of advances and repayments. The quality aspect of credit serving links credit to extension services.

B. Extension Services

There are several functions that an extension service is supposed to perform. Some of these include:

(a) The creation of an awareness in farmers of research findings,

(b) Interpretation of findings and their applications,

(c) Identification of operations that are most efficient, problems on farms, and assisting in efforts to solve them,

(d) To encourage some simple bookkeeping practices and emphasizing the need for prudent financial management practices on farms.

The above cited functions do not constitute an exhaustive list of extension functions, however, they are the more basic and are of considerable importance.

Extension can take different forms and can be at different levels. For example, the extension services required by large scale commercial farmers is different for the most part from that required by small scale farmers. Usually, the level of sophistication is also different. Large

scale farmers in Zambia are fewer in number and demand less extension services because they generally are able to deal with most problems themselves. Small scale village farmers on the other hand are many in number; their levels of education in as far as interpretation of new procedures is lower and requires more extension services in general. This extension effort to be successful has to exhibit ability to be in fairly close contact with these groups. This translates into a need for a lower extension worker-farmer ratio. The extension worker to farmer ratio is presently estimated to vary between 1:350 to 1:700 farm families in different districts and regions of Zambia.

There are other questions pertaining to quality of extension work. There are recorded cases where extension services have simply been rejected because of their poor quality. In a rural-traditional setting, the quality of extension workers may be judged by the results on trial plots run by an extension worker. There are several reasons why a crop in a trial plot can fail but in order to eliminate the likelihood of such failure being linked to inadequacy of training one would be persuaded to argue for a more rigorous training curriculum and more intense supervision of extension workers. Further, to reduce the number of farmers or farm families per extension worker I would suggest a more rapid expansion of numbers of extension workers. These suggestions in a structure where extension services are provided by the government suggested stronger pressures on the government budget. However, depending on the pricing policies and levels of government intervention in marketing

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and other structures connected to the agricultural industry, the burden of finance need not fall on the government budget. As an illustration, if the government role is to guarantee a floor price only, then other private interests would conceivably enter the research processes and develop those inputs that are used in agriculture. These private interests would also provide their own extension systems so that their clients may benefit from using whatever seed or machinery they may have developed. This would then increase the number of extension workers and the government may not bear the pressure to increase the number of extension workers.

To facilitate coordination of research and extension with a view to enhancing the capabilities of extension officers and also assisting the research staff in the identification of urgent research needs, a reorganization in the government structure within the Ministry of Agriculture and Water Development would be in order. The current structure is as shown in the chart below and what is called for would be an integration of the extension and research branches under one department.

C. Marketing

The importance of an efficient marketing structure for a growing agriculture industry is of critical importance. The failure to market agriculture produce or the ability to market at a price that does not insure an adequate return to cover investment can be a great disincentive to farmers to increase agricultural production.

The Zambian marketing structure is going through an evolutionary

process and is characterized by a deep presence of government control as illustrated earlier in the section identifying types of farmers in Zambia. It is not the thesis of this paper to argue for complete elimination of some form of government intervention in the agricultural industries. However, it the contention of this paper that government intervention has to be appropriately gauged and must only be there to ensure availability of food and other agricultural products at prices that prevent worsening of commodity terms of trade for agricultural commodities relative to nonagricultural commodities and also to provide a market of last resort at what may be termed parity prices.

D. Transport

Zambia's transport infrastructure can be viewed from the internal and external standpoints. The justification for viewing the transport infrastructure from these two standpoints are that first, the internal view enables us to examine the general development of the internal communications and distribution system and second the external view is relevant in this discussion because of the high import content of Zambian agriculture which the Ministry of Agriculture and Water Development has estimated to lie between 60 and 80 percent for different crops. Further, where considerations are made for entering international trade ~~are being made~~, it is only consistent to determine the means by which the output is going to be moved. Given the foregoing justification, I now turn to the general discussion.

Internally, Zambia's transport infrastructure is relatively well

developed by African standards (14). This assertion is illustrated by the table below and Map 1 illustrates the geographic spread of these roads within Zambia.

Table 10. Structure of Zambian Roads (15)*

Type of road	Road length (kilometers) 1971	1976
Class I paved	3216	4848
Class II and II gravel roads	7221	7887
Unclassified roads	7222	6550
Total	17659	19279
Roads under rural council or local authority	16151	15908
Grand Total	33,813	351,876

Source: National Commission for Development Planning.

*See Map 1 for structure.

The assertion, figures and the map presented ~~above~~ may appear impressive. However, it remains important to remember that Zambia is a large country covering some 750,000 square kilometers (14) and the transport infrastructure remains inadequate for purposes of meeting the demands of the rural farming communities who continue to face serious difficulties in transporting first their farm requisites to the farm and second transporting whatever produce they have to the markets. The difficulties arising from the inadequacy of the general transport infra-

structure are compounded by the lack of or poor planning strategies for efficient operation of existing transport facilities. In general, it can be said that the transport situation in urban centers is fairly satisfactory and that between provincial capitals and some centers is fairly well developed. However, for the whole economy the internal transport situation can be characterized as sluggish. As a landlocked export and import oriented country whose exports are generally heavy and bulky while very large import volumes are usual, land transport assumes crucial importance for the country's development program. Zambia has long routes to the sea and before the Unilateral Declaration of Independence (U.D.I.) in Rhodesia (New Zimbabwe) her short routes to the ports of Beira and Maputo in Mozambique were approximately 1600 miles by rail from the Zambian Copperbelt. With UDI in 1965, Zambia turned to East African ports which are further away and less reliable. Considering that not only do these routes handle exports but also most of essential imports, inefficiency on or disruption of these routes has adverse effects on the economic development of Zambia in general and if the imports concern agricultural activities, timing assumes critical importance and can make a difference between a bumper crop and a serious contraction of agricultural output. It can be seen from the foregoing without even referring to a host of other problems, that transport is critical and remains a constraint in the development of agriculture.

Since the major road network is fairly well developed, it would appear that efforts should now be directed at development and strengthen-

ing the feeder road (small roads linking farms with the major highways) infrastructure.

VII. CONCLUDING REMARKS

Economic development is a complex process which demands efficiency and coordination of all sectors of the economy. Given the consensus regarding the need for the development of agriculture because of the renewable nature of the resources of this sector and the integrability of its inputs and outputs with other growing sectors of the economy, it becomes necessary to devise an appropriate strategy that would maximize returns from all investment and other efforts directed towards this sector. As we have seen, the sector has a complex mesh of intricate problems which would render most single or contain combinations of solutions inconclusive in resolving the problems of this vital sector.

However, despite these difficulties, on the basis for example of the findings of this paper regarding the role of capital formation in agricultural development, while not arguing for shutting out new and advanced technologies from adoption on Zambian farms, it is extremely important to evaluate the appropriateness of those technologies in terms of consistency with current environmental conditions, manpower skill limitation, means of repair, maintenance or application procedures and their side effects. In general, the finding of this paper is that capital accumulation alone cannot form the basis of a viable agriculture.

In recognizing the role of other factors, the role of price policy has been eluded to and the need for government to disengage from the control of agricultural institutions is important. The question of government

disengagement is a complex one and it is not the suggestion of the paper to encourage a rapid government disengagement because this would be very disruptive as a vacuum would be created in the present structure. It must be mentioned also, that a case for a complete elimination of government presence in the agricultural sector in the context of a less developed country like Zambia cannot be convincingly argued.

However, the role of price is clear and the degree of freedom of its determination can lead to increased investment and independent research and extension for the sector.

On questions pertaining to the desire to produce for the international market for purposes of earning foreign exchange, calls for an efficient management of the exchange rate policy.

In general, it is the conclusion of this paper that any strategy of agricultural development should embrace a combination of programs of institution building related to such activities as improving the planning capabilities of those persons involved in the planning of agricultural strategy, agricultural research, rural education and farmer training, programs of investment in infrastructure including dam projects, rural (feeder) roads, programs to improve product marketing systems of paying the farmers and distribution of inputs and also policies related to credit, prices, and land tenure systems; and finally, programs to strengthen all spheres of agricultural extension.

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APPENDIX A

```
SORT=4

1          DATA ONE;
2          INPUT Y L A K;
3          LOGY=LOG(Y); LOGL=LOG(L); LOGA=LOG(A);
4          LOGK=LOG(K);
5          CARDS;

NOTE: DATA SET WORK.ONE HAS 10 OBSERVATIONS AND 8 VARIABLES. 280 OBS/TRK.
NOTE: THE DATA STATEMENT USED 0.08 SECONDS AND 64K.

16         PROC PRINT;

NOTE: THE PROCEDURE PRINT USED 0.16 SECONDS AND 128K AND PRINTED PAGE 1.

17         PROC CORR;

NOTE: THE PROCEDURE CORR USED 0.21 SECONDS AND 116K AND PRINTED PAGE 2.

18         PROC GLM; MODEL Y=L A K/P;

NOTE: THE PROCEDURE GLM USED 0.25 SECONDS AND 202K AND PRINTED PAGE 3.

19         PROC GLM; MODEL LOGY= LOGL LOGA LOGK/P;

NOTE: THE PROCEDURE GLM USED 0.25 SECONDS AND 202K AND PRINTED PAGE 4.

20         PROC PLOT;
21         PLOT Y*L  Y*A  Y*K;

NOTE: THE PROCEDURE PLOT USED 0.29 SECONDS AND 136K AND PRINTED PAGES 5 TO 7.

NOTE: SAS USED 202K MEMORY.

NOTE: SAS INSTITUTE INC.
      SAS CIRCLE
      BOX 8000
      CARY, N.C. 27511-8000
```

		L	A	K	LOGY	LOGL	LOGA	LOGK
1	132.5	489500	812930	1693023	4.88658	13.1011	13.6084	14.3420
2	139.4	660500	870121	1730346	4.93735	13.4008	13.6764	14.3638
3	145.6	695940	740649	1864302	4.98086	13.4530	13.5153	14.4384
4	143.9	706830	682321	2428730	4.96912	13.4685	13.4333	14.7029
5	150.5	719210	957821	3917805	5.01396	13.4859	13.7724	15.1810
6	157.0	731900	941178	5409398	5.05625	13.5034	13.7549	15.5036
7	166.9	738700	932324	7192141	5.11739	13.5126	13.7454	15.7885
8	168.2	753000	798974	8847676	5.12515	13.5318	13.5911	15.9957
9	169.0	755390	813478	10039257	5.12990	13.5350	13.6091	16.1220
10	153.4	760590	799437	9196552	5.03305	13.5418	13.5917	16.0343

						MAXIMUM
Y	10	152.640000	12.667298	1526.40000	132.50000	169.00000
L	10	701156.000000	80521.076220	7011560.00000	489500.00000	760590.00000
A	10	834923.300000	89932.086589	8349233.00000	682321.00000	957821.00000
K	10	5231923.000000	3358023.361131	52319230.00000	1693023.00000	10039257.00000
LOGY	10	5.024962	0.083431	50.24962	4.88658	5.12990
LOGL	10	13.453407	0.131143	134.53407	13.10114	13.54185
LOGA	10	13.629789	0.109094	136.29789	13.43326	13.77242
LOGK	10	15.247234	0.734723	152.47234	14.34203	16.12201

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 10

	Y	L	A	K	LOGY	LOGL	LOGA	LOGK
Y	1.00000 0.0000	0.77976 0.0078	0.25616 0.4750	0.87585 0.0009	0.99934 0.0001	0.75429 0.0117	0.26186 0.4649	0.90628 0.0003
L	0.77976 0.0078	1.00000 0.0000	0.10520 0.7724	0.67071 0.0338	0.79990 0.0055	0.99836 0.0001	0.09463 0.7948	0.72998 0.0165
A	0.25616 0.4750	0.10520 0.7724	1.00000 0.0000	0.13773 0.7044	0.25878 0.4703	0.10354 0.7759	0.99854 0.0001	0.24613 0.4930
K	0.87585 0.0009	0.67071 0.0338	0.13773 0.7044	1.00000 0.0000	0.87311 0.0010	0.63040 0.0507	0.15767 0.6635	0.98051 0.0001
LOGY	0.99934 0.0001	0.79990 0.0055	0.25878 0.4703	0.87311 0.0010	1.00000 0.0000	0.77530 0.0084	0.26339 0.4622	0.90749 0.0003
LOGL	0.75429 0.0117	0.99836 0.0001	0.10354 0.7759	0.63040 0.0507	0.77530 0.0084	1.00000 0.0000	0.09159 0.8013	0.69174 0.0267
LOGA	0.26186 0.4649	0.09463 0.7948	0.99854 0.0001	0.15767 0.6635	0.26339 0.4622	0.09159 0.8013	1.00000 0.0000	0.25774 0.4722
LOGK	0.90628 0.0003	0.72998 0.0165	0.24613 0.4930	0.98051 0.0001	0.90749 0.0003	0.69174 0.0267	0.25774 0.4722	1.00000 0.0000

DEPENDENT VARIABLE: Y

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	1230.19225522	410.06408507	11.50	0.0067	0.851849	3.9121
ERROR	6	213.95174478	35.65862413		STD DEV		Y MEAN
CORRECTED TOTAL	9	1444.14400000			5.97148425		152.64000000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
L	1	878.07554367	24.62	0.0025	1	95.34221839	2.67	0.1531
A	1	44.27893533	1.24	0.3078	1	25.28815727	0.71	0.4320
K	1	307.83777622	8.63	0.0260	1	307.83777622	8.63	0.0260

PARAMETER	ESTIMATE	T FOR H0: PARAMETER=0	PR > |T|	STD ERROR OF ESTIMATE
INTERCEPT	86.37283539	3.14	0.0200	27.48440067
L	5.4505109E-05	1.64	0.1531	0.00003333
A	1.8821221E-05	0.84	0.4320	0.00002235
K	2.3578910E-06	2.94	0.0260	0.00000080

OBSERVATION	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL
1	132.50000000	132.34538526	0.15461474
2	139.40000000	142.83016698	-3.43016698
3	145.60000000	142.64086059	2.95913941
4	143.90000000	143.46747677	0.43252323
5	150.50000000	152.83857296	-2.33857296
6	157.00000000	156.73401497	0.26598503
7	166.90000000	161.14152035	5.75847965
8	168.20000000	163.31470472	4.88529528
9	169.00000000	166.52757307	2.47242693
10	153.40000000	164.55972432	-11.15972432

SUM OF RESIDUALS	0.00000000
SUM OF SQUARED RESIDUALS	213.95174478
SUM OF SQUARED RESIDUALS - ERROR SS	-0.00000000
FIRST ORDER AUTOCORRELATION	0.01456479
DURBIN-WATSON D	1.38866739

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGY

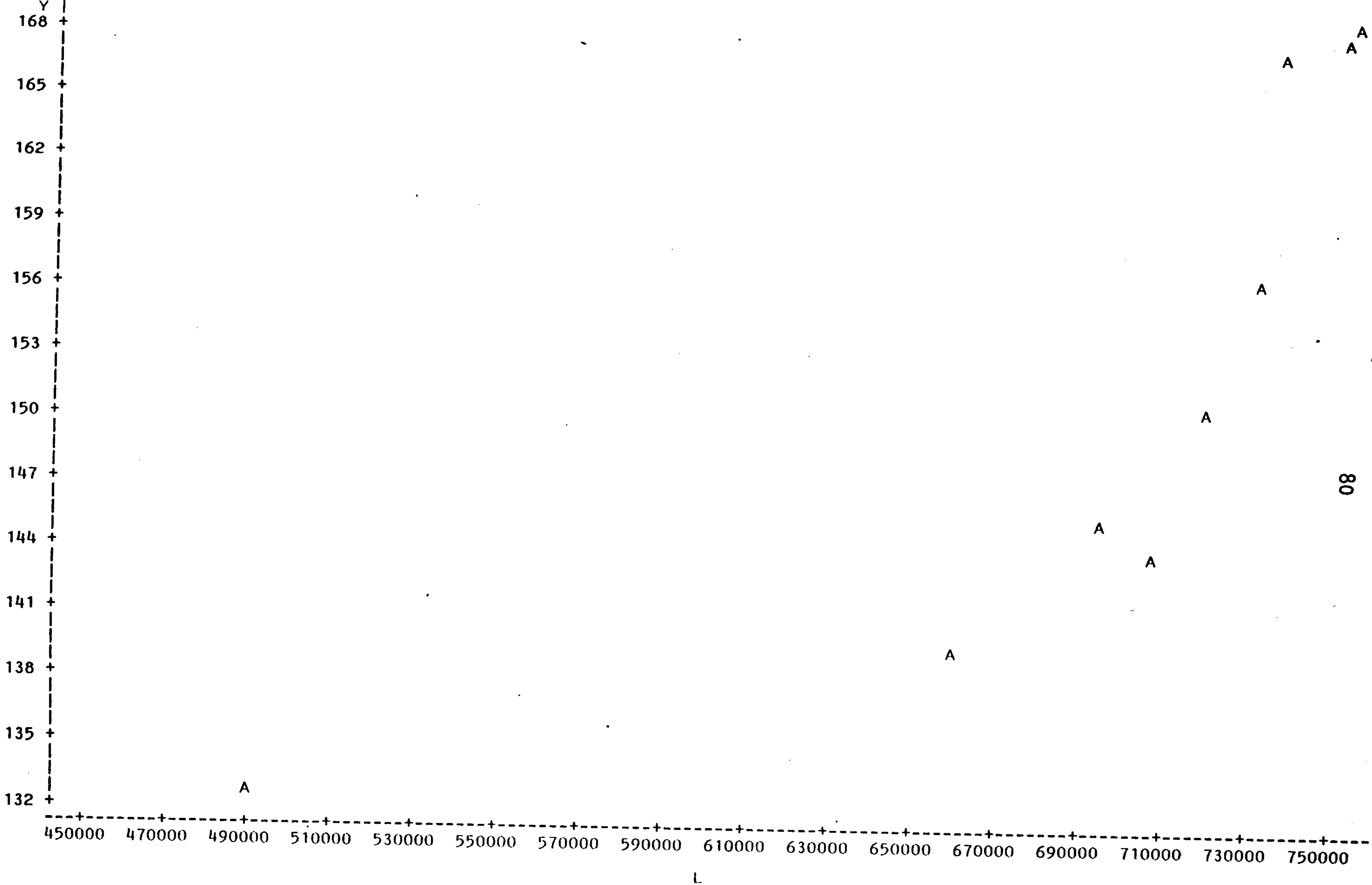
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	0.05440742	0.01813581	13.21	0.0047	0.868472	0.7375
ERROR	6	0.00823990	0.00137332		STD DEV		LOGY MEAN
CORRECTED TOTAL	9	0.06264732			0.03705829		5.02496170

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE IV SS	F VALUE	PR > F
LOGL	1	0.03765706	27.42	0.0019	1	0.00275604	2.01	0.2064
LOGA	1	0.00233815	1.70	0.2398	1	0.00019891	0.14	0.7166
LOGK	1	0.01441221	10.49	0.0177	1	0.01441221	10.49	0.0177

PARAMETER	ESTIMATE	T FOR HO: PARAMETER=0	PR > |T|	STD ERROR OF ESTIMATE
INTERCEPT	0.71258539	0.31	0.7681	2.30996730
LOGL	0.18622178	1.42	0.2064	0.13145366
LOGA	0.04494767	0.38	0.7166	0.11810521
LOGK	0.07833759	3.24	0.0177	0.02418189

OBSERVATION	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL
1	4.88658265	4.88748867	-0.00090603
2	4.93734750	4.94804715	-0.01069965
3	4.98086314	4.95638023	0.02448290
4	4.96911861	4.97630361	-0.00718499
5	5.01396308	5.03223964	-0.01827656
6	5.05624581	5.05998108	-0.00373527
7	5.11739483	5.08359297	0.03380186
8	5.12515375	5.09645458	0.02869917
9	5.12989871	5.10775115	0.02214756
10	5.03304889	5.10137789	-0.06832900

SUM OF RESIDUALS	0.00000000
SUM OF SQUARED RESIDUALS	0.00823990
SUM OF SQUARED RESIDUALS - ERROR SS	-0.00000000
FIRST ORDER AUTOCORRELATION	-0.03185316
DURBIN-WATSON D	1.49699154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165
162
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153
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132
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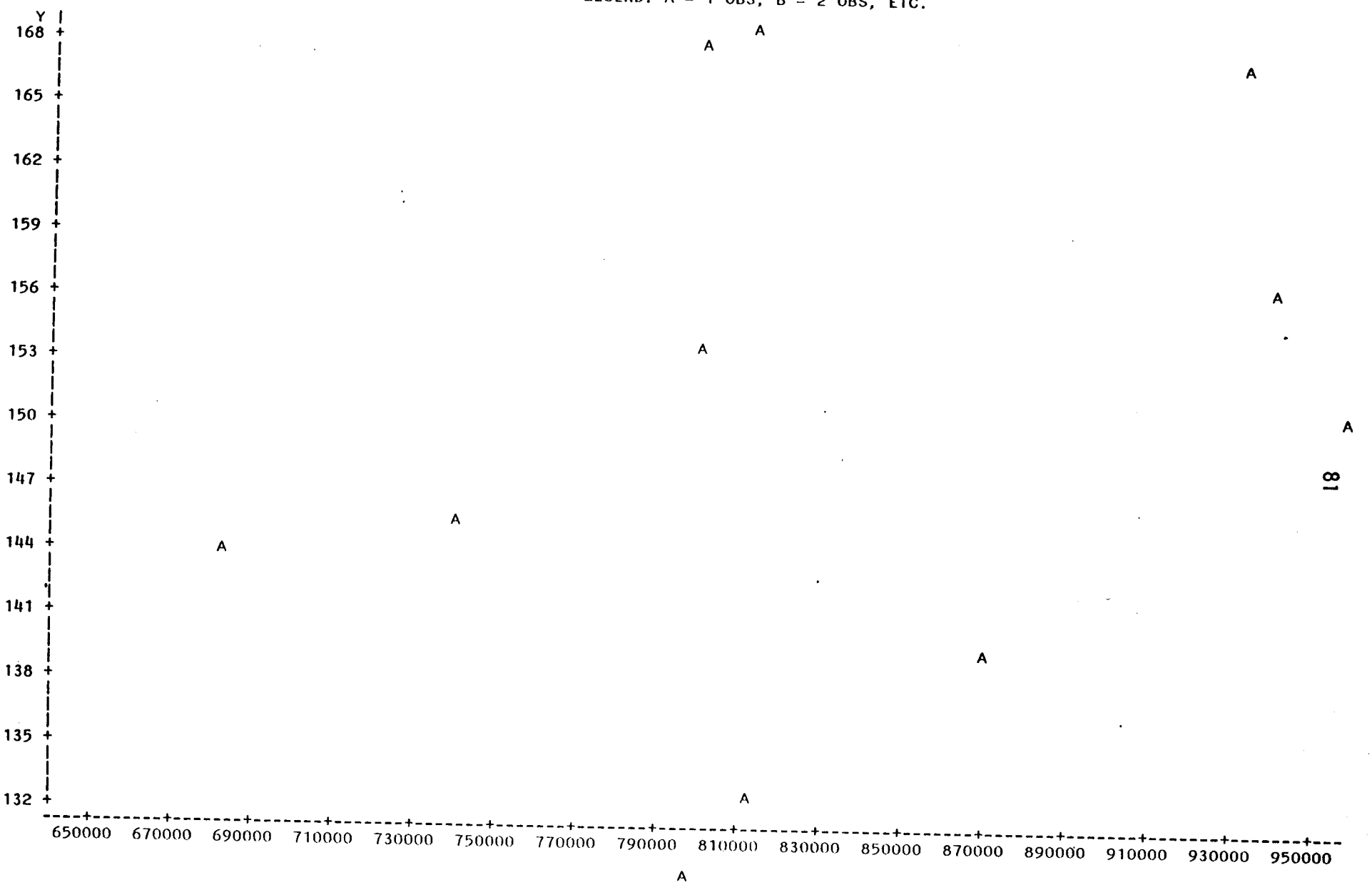
L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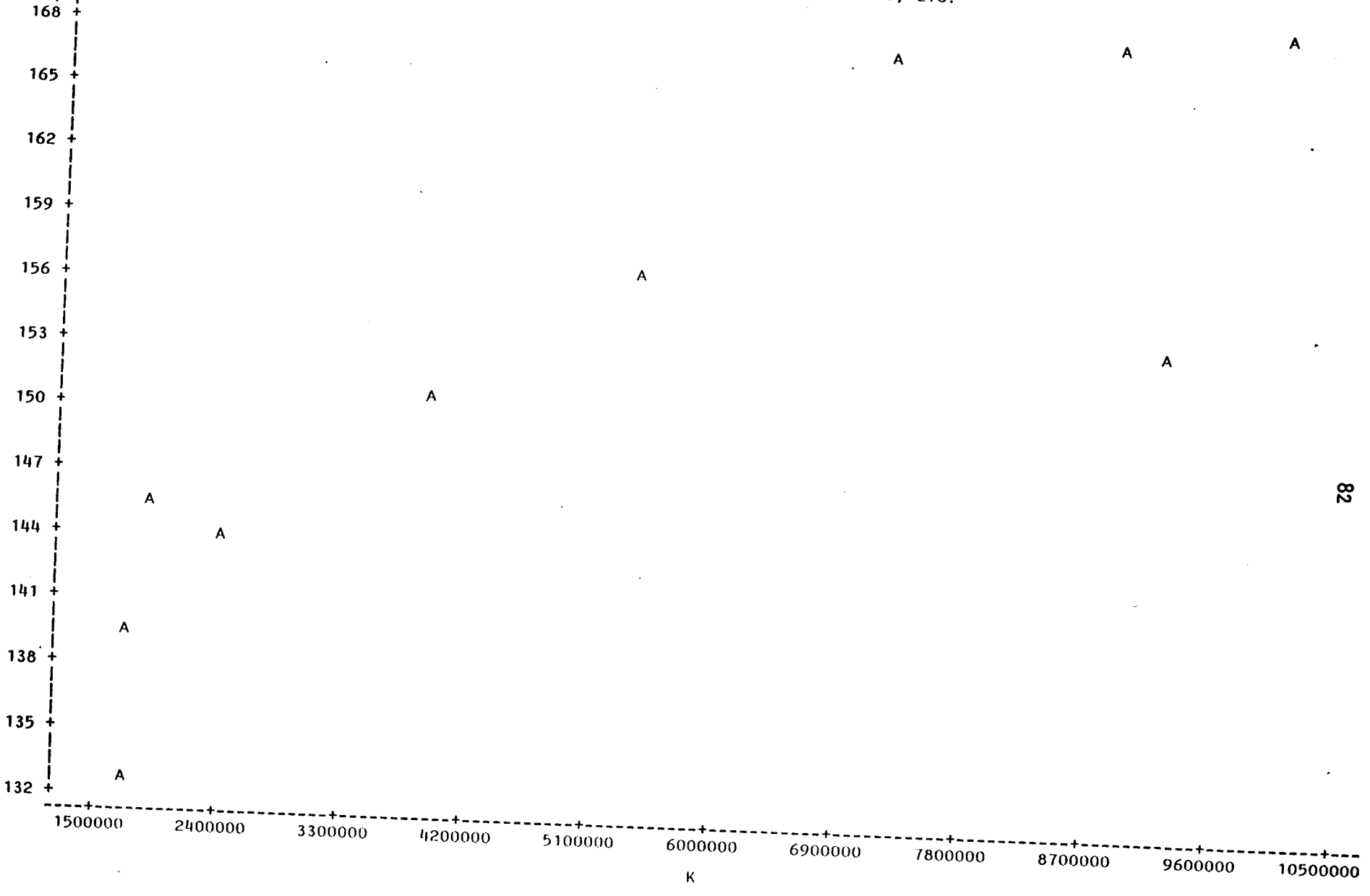
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A
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2400000
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4200000
5100000
6000000
6900000
7800000
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10500000
K

APPENDIX B

Table 11. Government Revenue, 1966-1980

	K'000		
	Total Revenue	Mineral	Other
1966-1967 (a)	384.3	245.8	138.5
1968 (a)	392.3	176.2	116.1
1969 (a)	389.5	235.1	154.4
1970	432.4	171.5	260.9
1971	309.0	27.2	281.8
1972	315.2	27.7	287.5
1973	385.1	91.3	293.8
1974	647.5	252.2	395.3
1975	448.3	59.4	388.9
1976	443.0	11.5	431.5
1977	499.0	-1.2	500.2
1978	550.0	62	488.0
1979	595.2	-9.0	504.2
1980	494.8	1	493.8

Source: Third National Development Plan (National Commission for Development Planning) - Monthly Digest of Statistics - Central Statistics Office (National Commission for Development Planning.

Note: (a) From Third National Plan and others from Monthly Digest of Statistics.

Table 12. Exports of Principal Commodities, 1971-1980

	K Million									
	1971	1972	1973	1974	1975	1976	1977	1978[a]	1979[a]	1980[a]
Copper	444.2	492.6	699.9	838.5	472.0	688.6	645.9	596.7	910.0	1008.2
Zinc	11.5	16.4	16.7	25.2	20.3	26.6	17.9	17.6	21.4	19.0
Lead	4.6	5.6	5.4	7.2	5.7	4.4	5.7	3.3	12.1	9.0
Cobalt	4.1	8.6	4.9	7.9	7.1	15.6	15.3	36.7	130.0	49.1
Tobacco	3.5	2.7	4.8	5.8	5.0	5.1	5.8	3.5	2.6	3.0
Maize	0.2	0.1	2.6	7.6	1.4	0.5	3.5	7.8	--	--
Timber	0.4	0.1	--	--	--	--	--	--	--	--
Other exports	5.5	11.6	5.3	8.2	6.5	7.7	12.3	9.0	12.9	14.0
Total domestic exports	474.0	537.7	739.5	900.4	518.0	748.8	705.4	674.6	1088.6	1102.3
Re exports	5.2	5.5	4.6	4.7	3.1	3.1	2.1	1.5	3.4	2.0
Total (b)	479.2	543.2	743.6	905.1	521.1	751.9	707.5	676.2	1092.4	1104.2

Source: Central Statistical Office and Bank of Zambia Annual Reports.

Note: (a) Preliminary

(b) Totals in this table do not take account of any adjustments and therefore from those appearing in balance of payment tables.

Table 13. Estimated Numbers of Workers Engaged in Agricultural Activities

	Non Commercial sector household	Average number employed in commercial sector	Total
1970-71	455.500	34,000	489,500
1971-72	651.300	39,200	660,500
1972-73	664,800	31,400	695,940
1973-74	675,100	31,730	706,800
1974-75	685,600	33,610	719,310
1975-76	695,800	36,100	731,900
1976-77	706,200	32,500	738,700
1977-78	722,200	30,850	753,000
1978-79	724,000*	31,320	755,320
1979-80	726,000*	34,520	760,520

Source: Central Statistics Office.

Note: *Estimated.

Table 14. Crop Yields and Total Land Area (hectares) (a)

(Noncommercial Sector)

Year/ Yield	Maize (b)	Sorghum (b)	Millet (b)	Cassava (b)	Beans (b)	Groundnuts (b)		Commercial Cultivated Crop Land	Total Land Area
(kg/ha)									
1970	1,363	1,120	74,482	1,883	1,212	1,136	750,000*	62,930	812,930
1971	407,054	37,336	74,482	187,033	15,460	61,176	782,541	87,580	870,121
1972	348,114	39,286	44,387	152,544	15,831	51,507	651,669	88,980	740,649
1973	409,589	20,330	25,463	49,534	12,572	37,133	554,621	127,700	682,321
1974	677,661	51,434	26,370	43,403	3,030	52,923	857,821	100,000	957,821
1975	654,451	28,816	25,055	26,749	7,671	100,436	843,178	98,000	941,178
1976	668,720	29,403	34,350	52,843	8,332	43,767	837,324	95,000	932,324
1977	587,073	30,680	18,170	40,472	6,223	26,176	708,974	80,000	798,974
1978	--	--	--	--	--	--	--	--	813,478*
1979	--	--	--	--	--	--	--	--	799,437*

Source: Central Statistical Office.

Note: (a) Crop yield figures are a summary of Crop Cutting Survey conducted in 1970/71.

(b) 1 bag = 90 kg.

(c) 1 bag = 80 kg.

* Projected.

Table 15. Trend of Expenditures on Capital Items (Capital Formation in Agriculture)

	(Kwacha)
1980/71	1,693,022.7
1972/73	1,864,302.7
1973/74	2,428,729.5
1974/75	3,917,805.4
1975/76	540,939.8
1976/77	7,192,141.3
1977/78	8,847,675.6
1978/79	10,039,257
1979/80	9,196,552.3

Source: Survey of agricultural loans issued by commercial banks and other financial institutions.

16. Net Foreign Assets (K'000)

	Assets							
			Foreign Exchange					
	Gold	SDRS*	B.OZ	Gov't	IMF Reserve Position	Gross Internal Reserves	Commercial Banks (a)	Total
	4,173	6,348	264,389	78,615	13,576	367,001	17,819	384,820
)	4,541	13,592	163,073	5,419	13,851	200,206	9,848	210,054
	4,552	130	110,210	2,759	--	117,651	7,636	125,189
)	4,563	14	117,999	1,226	--	123,802	5,801	129,603
	4,563	9,037	115,262	2,957	--	131,819	11,960	143,779
	4,563	11,914	77,225	2,259	--	95,961	4,861	100,822
	5,424	17,661	55,116	1,108	--	79,309	9,911	89,220
	5,424	10,481	38,751	1,131	--	55,787	8,138	63,925
	7,193	12,413	26,049	1,697	--	47,352	26,255	73,607
	8,358	4,320	56,329	1,671	--	70,678	75,226	145,904
	8,353	--	60,386	2,445	--	71,189	45,071	116,260

Bank of Zambia.

(a) Balances abroad, claims on nonresidents plus foreign notes and coins.
(b) This item includes all outstanding IMF drawing since December, 1971.
(c) Amounts owing abroad plus nonresident deposits.
(d) These data have been revised to include assets of nonresidents.
(e) In December, 1971, following the general realignment of parities, official assets revalued by K 13.2 million.
(f) In February, 1973, following the U.S. devaluation, official assets were devalued by K 3.2 million.

Table 16. continued

End of Period	Liabilities			Net Foreign Assets (c) New Series
	Monetary Authority (b)	Commerical Banks (c)	Total	
1970	164	3,026	3,190	381,630
1971 (e)	13,807	10,012	23,819	186,235
1972	28,391	18,336	46,727	78,562
1973 (f)	43,777	18,661	62,388	67,215
1974	43,547	23,647	67,194	76,585
1975	151,833	24,009	175,842	-75,020
1976	174,827	29,051	203,878	-114,658
1977	205,209	42,226	247,435	-183,510
1978	338,385	46,797	385,182	-311,575
1979	391,521	37,487	429,008	-283,104
1980	441,465	62,465	504,209	-387,949

Commodity	Unit	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980 (a)
Maize	Tonnes	39,950	616,554	460,480	495,000	558,865	746,426	693,000	657,000	331,255	381,150
Tobacco:											
Virginia		6,300	5,917	6,701	6,631	6,950	6,262	5,588	3,700	4,590	4,127
Barley		388	385	471	430	502	212	312	264	387	554
Sugar cane		34,000	397,400	488,000	570,243	768,153	860,000	71,203	73,450	102,148	110,601
Groundnuts		5,970	6,480	2,260	3,435	6,418	8,371	7,229	6,777	2,693	2,008
Sunflower		16	163	1,050	3,519	9,713	3,079	13,320	11,320	12,869	19,950
Seed Cotton	kg	11,919	8,453	8,368	3,874	3,100	3,891	8,929	10,200	15,000	23,824
Sorghum	Tonnes	90	212	34	350	92	23	--	--	--	--
Wheat	Tonnes	--	--	--	--	934	3,459	4,744	6,400	4,322	9,576
Paddy rice	Tonnes	--	293	506	726	990	2,224	2,090	2,970	1,686	2,208
Soybeans	Tonnes	--	--	24,000	400	683	944	2,400	2,844	1,294	3,510
Coffee	kg	22,300	16,300	5,000	21,000	23,750	33,100	--	--	--	--
Fruit	kg	5,600	5,900	20,000	5,700	6,500	6,850	--	--	--	--
Vegetables	Tonnes	24,100	27,700	--	25,000	27,400	2,800	--	--	--	--
Tea	Tonnes	--	--	90,000	--	--	--	64	85	--	--
Cattle	Head	67,000	72,443	15,734	80,654	84,000	77,000	79,700	80,000	84,000	87,000
Milk	1000 litre	865	15,865	35,700	13,227	11,200	10,500	10,300	9,000	7,130	10,512
Pigs	Head	34,000	32,000	1,230	44,280	52,800	55,440	46,300	42,000	48,416	47,814
Eggs	Millions	108	115	610	140	156	178	173	85.5	155	148.3
Chicken	Millions	414	515	1.25	9.67	9.60	11.0	13.0	12.5	12.2	13.1
Day-old chicks (Exports)	Millions	.570	1.10	1.73	1.11	1.33	1.40	1.43	1.3	.04	.04

Source: C.S.U. and Ministry of Agriculture and Water Development.

Notes: (a) Preliminary

(b) Year indicates end of harvesting season, e.g., 1979/80 = 1980

Table 18. Area Under Cultivation For Elected Crops (Hectares)

	1975	1976	1977	1978	1979 (a)	1980 (a)
Maize	212,194	268,078	485,000	595,000	335,800	540,000
Groundnuts	11,211	7,599	102,000	137,000	43,200	25,552
Sunflower	15,471	19,282	240,000	232,000	24,800	30,791
Soybean	732	825	1,200	2,200	2,200	37,000
Wheat	435	1,144	1,700	1,585	1,600	2,400
Tobacco	7,628	8,608	--	3,700	4,700	--
Rice	1,690	2,230	--	--	3,100	5,100
Sugar	7,019	8,709	9,600	10,300	10,000	10,000

Source: Planning Unit, Ministry of Agriculture and Water Development.

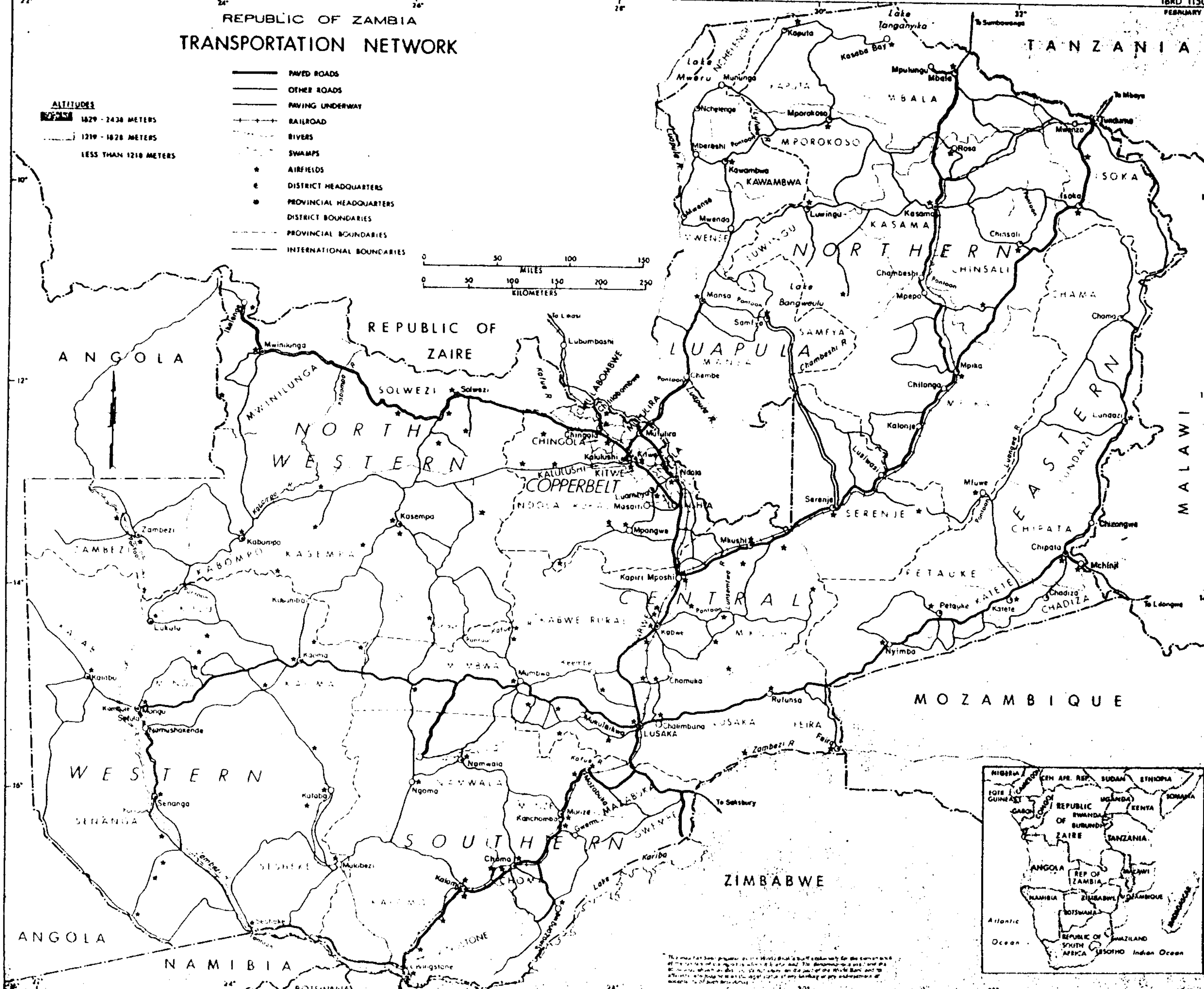
Note: (a) Estimates hectares.

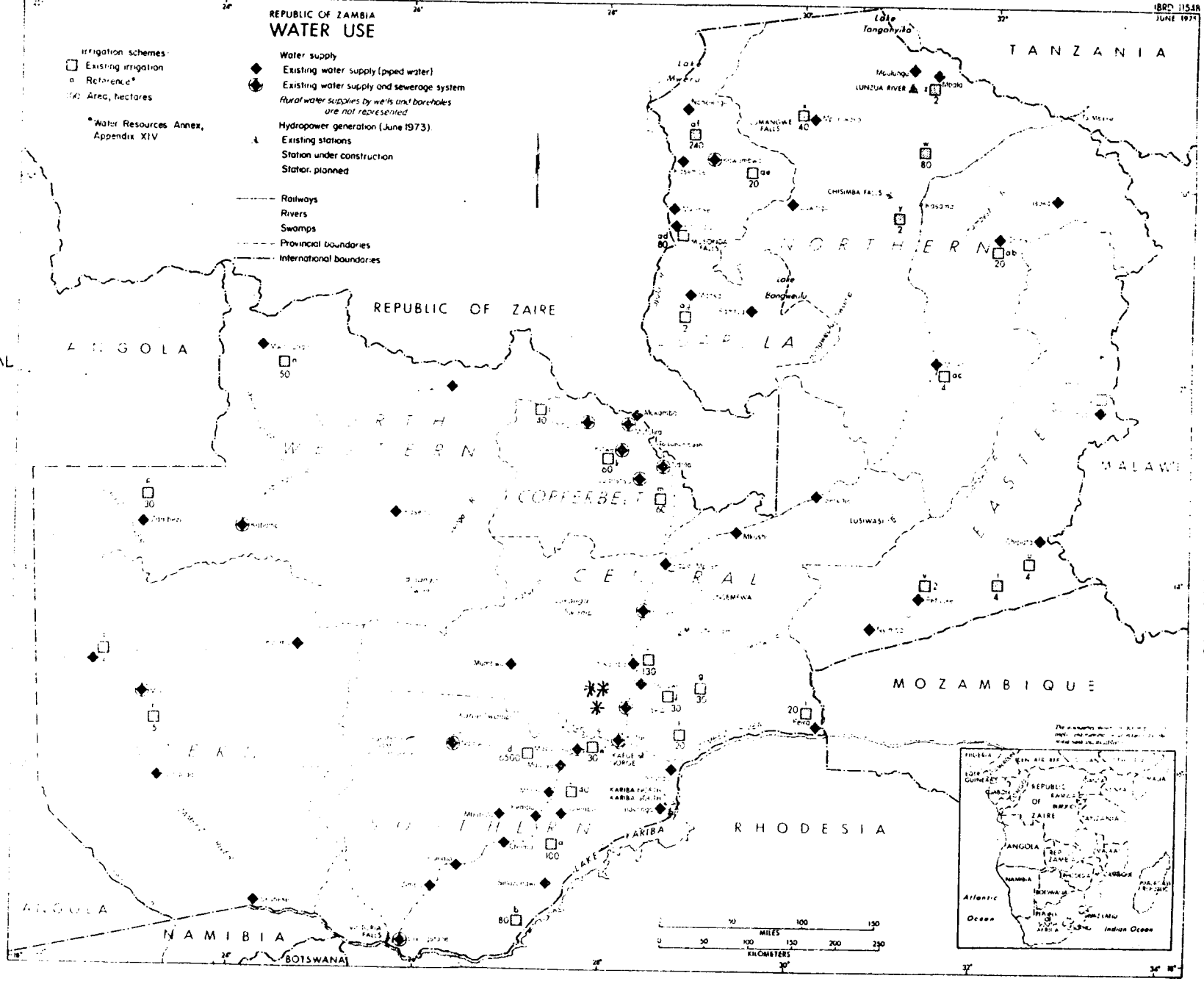
Table 19. Statistical Profile of Zambian Education 1964, 1970, and 1978

Class		1964	1970	1978
Primary:	Grade 1	74,643	127,359	158,786
	2	72,068	122,974	156,402
	3	70,847	119,962	152,160
	4	67,654	112,902	148,945
	5	33,602	75,741	118,796
	6	31,602	68,402	114,379
	7	14,781	67,222	114,379
	8	13,002	--	--
		378,417	694,670	964,475
Secondary Form:	I	4,693	15,175	23,237
	II	4,078	15,400	23,099
	III	2,176	8,578	22,536
	IV	1,720	7,792	10,988
	V	783	5,509	9,120
	VI	403	--	--
		13,853	37,208	88,980
Teacher Training			2,146	3,123
University of Zambia (Graduates)		--	113	538

Source: Ministry of Education.

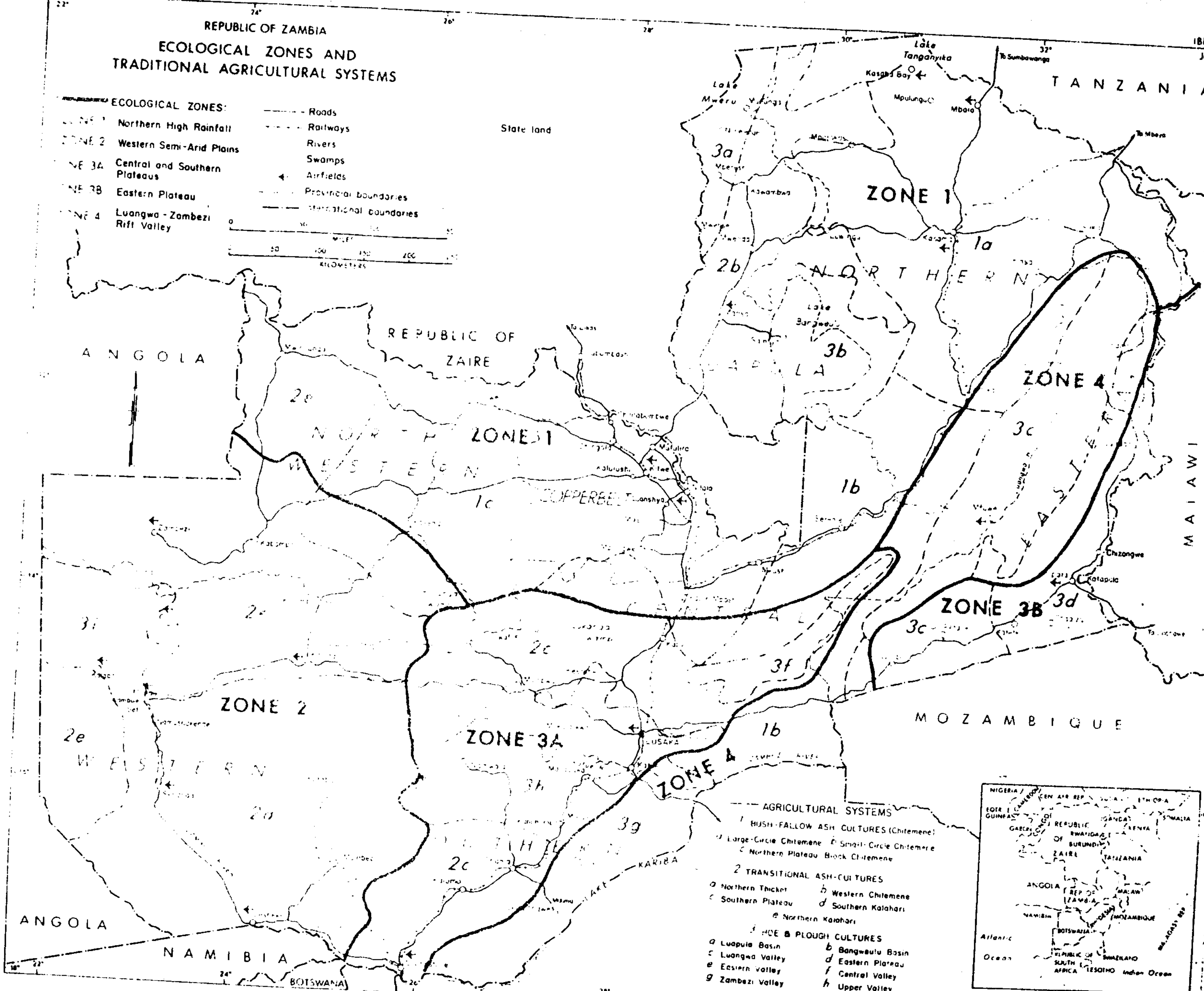
APPENDIX C


IBRD 11509R
FEBRUARY 1981
REPUBLIC OF ZAMBIA
TRANSPORTATION NETWORK
PAVED ROADS
OTHER ROADS
PAVING UNDERWAY
RAILROAD
RIVERS
SWAMPS
AIRFIELDS
DISTRICT HEADQUARTERS
PROVINCIAL HEADQUARTERS
DISTRICT BOUNDARIES
PROVINCIAL BOUNDARIES
INTERNATIONAL BOUNDARIES
ALTITUDES
1829 - 2438 METERS
1219 - 1828 METERS
LESS THAN 1218 METERS
MILES
KILOMETERS
TANZANIA
MALAWI
MOZAMBIQUE
ZIMBABWE
NAMIBIA
BOTSWANA
ANGOLA
REPUBLIC OF ZAIRE
NORTHERN
LUAPULA
NORTH WESTERN
COPPERBELT
CENTRAL
EASTERN
SOUTHERN
WESTERN
LUSAKA
Lake Tanganyika
Lake Mweru
Lake Bangweulu
Lake Kariba
Zambezi R.
Kafue R.
Luapula R.
Chambeshi R.
To Sumbawanga
To Mbeya
To Lilongwe
To Salisbury
To Likasi
Lubumbashi
Kitwe
Ndola
Chingola
Kabwe
Kapiri Mposhi
Livingstone
Mongu
Kasama
Chipata
Solwezi
Mansa
Mpika
Serenje
Mbala
Tunduma
Mpulungu
Choma
Kalomo
Senanga
Sesheke
Kabompo
Zambezi
Mwinilunga
Kasempa
Kaoma
Mumbwa
Mazabuka
Feira
Nyimba
Petauke
Katete
Chadiza
Mchinji
Lundazi
Chama
Isoka
Chinsali
Mporokoso
Kawambwa
Nchelenge
Samfya
Luwingu
Mkushi
Chamimbuna
Mufulira
Kalulushi
Luanshya
Mpongwe
Chililabombwe
Kaputa
Kaseba Bay
Nakonde
Mwenzo
Mungwi
Rosa
Chilonga
Kalonje
Lusiwasi
Mfuwe
Rufunsa
Chamuka
Namwala
Ngoma
Kalabo
Lukulu
Kaoma
Monze
Kanchomba
Gwembe
Mulobezi
Kazungula
Sioma
Mumbwa
Republic of Zaire
ZAMBEZI
KABOMPO
KASEMPA
MWINILUNGA
SOLWEZI
KASAMA
MBALA
MPOROKOSO
KAWAMBWA
CHINSALI
ISOKA
CHAMA
LUNDAZI
CHIPATA
CHADIZA
KATETE
PETAUKE
SERENJE
MKUSHI
KABWE RURAL
MUMBWA
LUSAKA
FEIRA
MAZABUKA
GWEMBE
CHOMA
KALOMO
LIVINGSTONE
NAMWALA
SESHEKE
SENANGA
KAOMA
LUKULU
CHINGOLA
KALULUSHI
NDOLA RURAL
MANSA
SAMFYA
LUWINGU
MWENSE
Atlantic Ocean
Indian Ocean
NIGERIA
CEN. AFR. REP.
SUDAN
ETHIOPIA
SOMALIA
COTE D'IVOIRE / GUINEA
GABON
CONGO
REPUBLIC OF ZAIRE
RWANDA
BURUNDI
UGANDA
KENYA
TANZANIA
ANGOLA
REP. OF ZAMBIA
MALAWI
NAMIBIA
ZIMBABWE
MOZAMBIQUE
BOTSWANA
REPUBLIC OF SOUTH AFRICA
SWAZILAND
LESOTHO
MADAGASCAR



** LUSAKA PROVINCE CONTAINED IN CENTRAL PROVINCE.

Location of Zambia's Provinces



REPUBLIC OF ZAMBIA
ECOLOGICAL ZONES AND
TRADITIONAL AGRICULTURAL SYSTEMS
IBRD 11631
June 1975
ECOLOGICAL ZONES:
Northern High Rainfall
Western Semi-Arid Plains
Central and Southern Plateaus
Eastern Plateau
Luangwa - Zambezi Rift Valley
Roads
Railways
Rivers
Swamps
Airfields
Provincial boundaries
International boundaries
MILES
KILOMETERS
State land
TANZANIA
MALAWI
MOZAMBIQUE
ANGOLA
NAMIBIA
BOTSWANA
REPUBLIC OF ZAIRE
ZONE 1
ZONE 2
ZONE 3A
ZONE 3B
ZONE 4
NORTHERN
NORTH-WESTERN
WESTERN
COPPERBELT
LUAPULA
EASTERN
KARIBA
Lake Tanganyika
Lake Mweru
Lake Bangweulu
Kasaba Bay
Mpulungu
Mbala
To Sumbawanga
To Mbeya
Chizongwe
Katapula
Lusaka
Kalulushi
Luanshya
1a
1b
1c
2b
2c
2d
2e
3a
3b
3c
3d
3f
3g
3h
AGRICULTURAL SYSTEMS
1 BUSH-FALLOW ASH CULTURES (Chitemene)
a Large-Circle Chitemene
b Small-Circle Chitemene
c Northern Plateau Block Chitemene
2 TRANSITIONAL ASH-CULTURES
a Northern Thicket
b Western Chitemene
c Southern Plateau
d Southern Kalahari
e Northern Kalahari
3 HOE & PLOUGH CULTURES
a Luapula Basin
b Bangweulu Basin
c Luangwa Valley
d Eastern Plateau
e Eastern Valley
f Central Valley
g Zambezi Valley
h Upper Valley
i Barotse Plain
NIGERIA
CAMEROON
CEN. AFR. REP.
SUDAN
ETHIOPIA
SOMALIA
IVORY COAST
GHANA
GABON
CONGO
REPUBLIC OF ZAIRE
UGANDA
KENYA
RWANDA
BURUNDI
TANZANIA
ANGOLA
REP. OF ZAMBIA
MALAWI
MOZAMBIQUE
NAMIBIA
BOTSWANA
REPUBLIC OF SOUTH AFRICA
SWAZILAND
LESOTHO
MALAGASY REP.
Atlantic Ocean
Indian Ocean

Map 4