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Maize Marketing In Zaire

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REPORT SUMMARY

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SUMMARY STATEMENT

Urban centers are expanding rapidly in Zaire, creating a need for expanded commercialization of cereal grains. Zaire imported 150,000 metric tons in 1974 but is striving for self-sufficiency in Maize. An improved marketing system will help to achieve this goal.

Urban consumption of maize is projected within an approximate range of 360,000 and 470,000 metric tons in 1985 which is nearly double the estimates for 1975.

The current maize marketing system is underdeveloped. Deficiencies exist in means of evacuating from villages and entry of maize into commercial channels. Storage facilities are minimal. Insect losses are high. Facilitating functions such as financing, providing marketing information, and determining market quality have had only rudimentary development.

The Government of Zaire established a national cereals agency (ONACER) in 1974 with responsibility for improving the marketing system for cereals. ONACER's responsibility also includes participation in formulation of national policy for cereal production and marketing, price stabilization, and control of cereal imports. In its early operations ONACER has involved private traders in marketing functions under close surveillance by the cereals office. It is recommended that involvement of private traders under regulatory control by ONACER be extended at a rate consistent with development of an orderly, disciplined marketing system.

A harvesting-storage-transportation strategy for maize is recommended in this report. Storage includes (1) crib-type facilities at village selling stations, (2) collection point facilities initially for transit storage of bagged grain with provision for expansion to bulk storage at a later time, and (3) facilities at major mills for storage of maize and flour stocks. It is recommended that a minimum of 10 collection station facilities be developed as soon as possible for operation by ONACER.

Insect infestation is a major problem at all points in production-marketing channels. Charcoal fires placed under village storages are used to dry

maize and to discourage insects. Chemical treatment is used in warehouses in some cases. However, control measures are not sufficient for effective elimination of distructive insects. Detailed recommendations for control of insect infestations and other forms of product losses are incorporated in this report.

A critical short-run objective of ONACER is the establishment of a means of purchasing maize at the villages and moving it through the marketing system to consumers. The urgency of this task justifies heavy short-run participation in marketing by ONACER where this is expedient. In the longer run it is recommended that the National Cereals Agency promote the development of private trading in anticipation of ONACER's marketing and handling a maximum 20 to 25 percent of market supply each year. ONACER stocks should be used to counter sharp price fluctuation. Purchasing and selling operations of ONACER should be geared to establishing announced minimum prices for producers and maximum market prices to consumers.

In the shorter run, increased official prices to producers are recommended to encourage expanded commercialization. Increases in marketing margins are recommended in some instances. A pattern of differential prices crudely reflecting transportation and storage costs is also recommended.

When self-sufficiency is achieved, ONACER should consider a buffer-stock policy to provide year-to-year minimum carryover of maize to offset major flucuations in domestic production and world market conditions.

Additional longer-run recommendations include; (1) improving transporation, especially the rural road system, (2) improving credit availability for private traders and processors, (3) systematically developing marketing information, and (4) providing a means of intermarket communication.

Facilities and equipment for handling and preserving maize in marketing channels are deficient in Zaire. However, the priority needs are in (1) developing operating and management skills in marketing personnel, (2) developing information inputs for sound policy decision, and (3) providing current supply, demand, and price information (along with a system for intermarket communication) for the effective operation of a national marketing system. Priority recommendations for international assistance include providing (1) technical and management consultants, (2) in-country training programs for ONACER personnel and private traders, (3) opportunities for attendance of selected Zairois at international short courses, and (4) longer-term graduate training of key personnel at foreign universities.

MAIZE MARKETING IN ZAIRE

Prepared by
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Prepared for
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UNITED STATES DEPARTMENT OF STATE
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and Agribusiness Development
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Citoyen Kungula Biantanqa - PNM - Kaniama/Kasese

Citoyen Tepatondele Zarnbite Pandosi - ONACER - Shaba

Citoyen Mukendi N'Kashoma - PNM - Kisanga

Citoyen Mukendi Mukala wa Shombuyi - Kalamie

Citoyen Kazadi Tshienda - PNM - Kongolo

Citoyen Kanku Mukanya wa Shambuyi - PNM - Kabalo

Citoyen Lubaki - USAID - Kinshasa

Dr. Thomas G. Hart - CIMMYT - Kisanga

Dr. Richard N. Wedderburn - CIMMYT - Kisanga

FOREWORD

This is a report of a study of maize marketing in Zaire conducted by Kansas State University under contract AID/ta-C-1162.

The request for the study originated with the Government of Zaire and USAID/ Kinshasa. Dr. Richard Phillips of Kansas State University, during a preliminary visit to Zaire in March, 1975, developed a "proposed scope of work" for the study (Appendix I-1) which was subsequently carried out by a University team consisting of Dr. L. Orlo Sorensen, Team Leader and Economist; Mr. John R. Pedersen, Entomologist, and Grain Quality Specialist; and Dr. Norton C. Ives, Engineer.

I. INTRODUCTION

A stable and efficient maize marketing system in Zaire will provide motivation for increased maize production. Marketing is not a passive element in economic development to be provided after surplus production has occurred but is a stimulant to increased output. National marketing systems do not develop spontaneously as need for marketing services occur. Positive action is necessary to provide rules to govern marketing procedures, develop uniform contracts, provide infrastructure and, in many cases, provide marketing services directly. The Government of Zaire is taking steps to provide better marketing services.

Marketing systems and marketing needs are different at various stages of development of an agricultural or food system. Kreisberg and Steele (6) provide a stage classification of agricultural economies that is useful in systematic identification of cereals marketing problems. The three stages of development identified are (1) traditional subsistence agriculture, (2) transitional production-oriented agriculture, and (3) market-oriented agriculture.

Countries with transitional, production-oriented agriculture (e.g. Zaire) have rapidly expanding urban populations. Production of food crops is a priority activity in development plans. As commercialization increases, marketing and distribution constraints emerge. Markets are no longer limited to local transfers from producers to consumers. With greater distance to market, additional exchange arrangements are required. Facilities for physical handling

and storage are required. Public policy is brought to bear in the further development of marketing systems.

Marketing problems in Zaire include obvious deficiencies in storage and transportation. Less obvious problems exist. Original sale and resale risks are high because marketing channels are not well developed. Marketing margins are high because many of the system's functions are not yet adequately performed.

Additional stress on a developing marketing system in Zaire has been created by removal of expatriates from ownership and management positions. Marketing and management expertise and at least a part of the capital investment developed by expatriates have left Zaire at a time when those resources are much in demand.

The Government of Zaire took positive action in the marketing of cereals with an executive order creating the National Office of Cereals in January 1974. One purpose in creation of this office was to provide an administrative force for the development and expansion of a marketing system for cereals. Development of recommendations concerning the many policy issues related to production, pricing, and marketing of cereals is included in the responsibility of the National Office of Cereals. Stabilization of prices and market channels are priority items in marketing system development. Although price risk may have been diminished by establishment of official prices in Zaire, many other dimensions of price must receive further consideration.

Facilities for storage are characteristically insufficient, especially when increased commercialization occurs. Management of storage stocks needs improvement at all market levels in Zaire as evidenced by almost universal insect infestation, rodent damage, existence of breeding places for insects and

lack of stacking techniques to facilitate inspection, inventory and insect control.

Problems exist in the development and communication of marketing information. This has great significance in developing a national marketing system. Financial credit for investment in trucks, warehouses and for inventory appear to be restraining factors in expansion of volume of maize commercialized.

Clearly and universally recognized deficiencies in road transport exist in Zaire. Substantial deterioration in the road system since national independence in 1960 is reported. Reports (for example, 4, Vol. II, Annex 4, p. 5) indicate greater impact of road deterioration on rural roads than on roads which connect major cities.

Transport charges on the river/rail system are not high, perhaps because of subsidy to the system. Rates are established on the basis of thirteen classifications of freight. Maize receives very favorable rates.

Estimated freight traffic on the rail system in 1974 of 2,276,000 metric tons is expected to increase to 3,478,000 tons by 1980. River traffic is expected to expand from 1,388,000 tons in 1974 to 2,336,000 tons in 1980 (8, p. 39). The river/rail system appears capable of handling increases in maize commercialization, assuming good management of the system and normal levels of maintenance and improvement in future years.

This report and the recommendations embodied in the report are concerned with marketing performance and marketing efficiency, and the application of public policy in the marketing of maize in Zaire.

II. PROJECTED NEED FOR MARKETING SERVICES

The projected need for marketing services for maize is based on several factors including population size and distribution, location of cereal grain production, and geographic differences in consumption patterns resulting from differences in food preferences. Each of the main factors determining need for marketing services (population, production, and consumption by area and major population centers) for Zaire is discussed here. Projected trends in relevant factors are related to probable growth in need for marketing services to 1985.

A. Population and Projected Growth

The last census of population in Zaire was made in 1970 by the Institut National de la Statistique (INS). Total population at that time was estimated at 21,637,876, of which 20,705,834 were nationals and 932,042 were foreigners. The effect of Zairianization on the total foreign population is not known. A reduction is expected, but the extent of reduction is uncertain. Another factor which could lead to an upward bias in the population estimates is population migration said to be occurring at the time of the census. As a result, concern for double counting has been expressed. However, no means for evaluating the above or other possible data errors were available. Official INS and Department of Agriculture estimates of population are used in this report.

The average population density in 1970 is variously estimated at between 8.4 and 11.0 persons per square kilometer (km^2). An average density of 7.26/km^2 was calculated for the rural population in 1970. Population density by district

is shown in Figure II-A. Total urban and rural population by province for 1970 is also shown in Table 1. An urban population of 4.7 million (21.5%) and rural population of 17.0 million (78.5%) were reported in 1970.

The total population in agriculture in 1970 was estimated at 16.1 million persons, or 74.5 percent of the total population. There were an estimated 2.9 million farms (exploitations) and 5.48 persons per farm reported for 1970 (see Appendix II-1). In 1980, a total population of 28.7 million is estimated by Institut National Statistique with urban population at 10.2 million (35.4%) and rural population at 18.5 million (64.6%). Projected population estimates assume an annual population growth rate of 2.81 percent from 1970 through 1975 and a growth rate of 2.91 percent from 1976 through 1980. Population estimates by province for 1980 are presented in Appendix II-2.

Table 1. TOTAL HUMAN POPULATION BY PROVINCE-REPUBLIC OF ZAIRE 1970

Province	Total Population	%	Urban[1] Population	%	Rural Population	%
Kinshasa	1,323,039	6.1	1,323,039	100	-----	
Bas-Zaire	1,504,361	7.0	292,554	19.4	1,211,807	80.6
Kasai Oriental	1,872,231	8.7	325,633	17.4	1,546,598	82.6
Equateur	2,431,812	11.2	242,488	10.0	2,189,424	90.0
Kasai Occidental	2,433,861	11.3	573,100	23.6	1,860,761	76.4
Bandundu	2,600,556	12.0	300,647	11.6	2,299,909	88.4
Shaba	2,753,714	12.7	814,842	29.6	1,938,872	70.4
Haut-Zaire	3,356,419	15.5	473,562	14.1	2,882,857	85.9
Kivu	3,361,883	15.5	312,657	9.3	3,049,226	90.7
Rep. of Zaire	21,637,876	(100.0)	4,658,522	(21.5)	16,979,354	(78.5)

Source: Republic du Zaire, Institut National de la Statistique, 1970.

[1] Urban population figures include 11 major cities and 68 secondary centers.

Using the indicated rates of population growth, estimates of the total, urban, and rural population in Zaire, 1970 through 1985 are calculated as shown in Table 2. These estimates indicate a relative growth in urban population from 21.5 percent of total population in 1970 to 46 percent in 1985.

Estimates of total, urban and rural population by province by year, 1970 through 1985, are shown in Appendix II-4 for provinces specifically involved in major maize production and consumption.

A general rate of population increase of 2.86 percent was reported in 1970. The migration from rural to urban centers has had a tremendous impact on the rate of increase in urban areas. After independence in 1960 and the removal of strict control regulating movement, expansion in urban areas was rapid. In 1958, Kinshasa had a population estimated at 380,000. The population increased to 1,280,000 by 1970. This yearly growth rate of nearly 11 percent is used by INS in projecting the 1980 population. The rate of growth is a combination of a high birth rate plus population migration.

Kinshasa is not unique in its rapid expansion. Estimates indicate that Kananga has increased at an annual rate of about 13 percent and Kikwit and Mbuji-Mayi at annual rates of 16 percent or more. Population increases for the five largest cities in Zaire between 1958 and 1970 are shown in Table 3.

TABLE 2 HUMAN POPULATION FOR ZAIRE 1970-1985

Year	Total Population[1)]	Urban Population[2)]	%	Rural Population[3)]	%
1970	21,638	4,659	21.5	16,979	78.5
1971	22,246	5,029	22.6	17,217	77.4
1972	22,871	5,431	23.7	17,440	76.3
1973	23,514	5,867	25.0	17,647	75.0
1974	24,174	6,340	26.2	17,835	73.8
1975	24,854	6,853	27.6	18,001	72.4
1976	25,577	7,410	29.0	18,167	71.0
1977	26,321	8,016	20.4	18,306	69.6
1978	27,087	8,673	32.0	18,414	68.0
1979	27,875	9,388	33.7	18,488	66.3
1980	28,680	10,267	35.4	18,414	64.6
1981	29,501	11,010	37.3	18,497	62.7
1982	30,344	11,928	39.3	18,416	60.7
1983	31,212	12,929	41.4	18,283	58.6
1984	32,105	14,018	43.6	18,087	56.4
1985	33,023	15,204	46.0	17,819	54.0

1) Population calculated with rates of increase as follows: 1970-1975 2.81%, 1976-1980 2.91%, 1981-1985 2.86%.

2) Urban population from Appendix II-2 using variable rates of increase.

3) Corrected to that reported in Appendix II-2.

TABLE 3 POPULATION INCREASE IN FIVE CITIES IN ZAIRE, 1958-1970

City	Population (x1000) 1958	1970	Percent 1970 over 1958
Kinshasa	368	1,323	359
Lubumbashi	169	318	188
Kisangani	110	230	209
Kananga	107	429	401
Mbuji-Mayi	40	256	640

Source: "Les Statistiques Démographiques en République Démocratique du Congo, Congo-Afrique, Nº 47, Aug-Sept. 1970.

With the exception of Kinshasa, urban rates of growth have diminished from that of the 1958 to 1970 period. Urban population distribution (1970) for cities by region is shown in Appendix II-3.

Projected annual rates of urban population growth by provinces (Shaba, 5.5 percent; Kasai Oriental, 6.7; Kasai Occidental, 8.23; Kinshasa 10.78 and others 7.036) result in urban population estimates in 1985 for Shaba, 1.819 million; Kasai Oriental, .865; Kasai Occidental, 1.877; Kinshasa 6.145 and for all other provinces, 4.498 million people. Estimated urban population for selected provinces by year 1970 through 1985 is reported in Appendix II-4.

B. Production of Maize

Maize is produced throughout Zaire largely on small farms by traditional hand-cultivation methods. Average yields are low, ranging from 325 to 1,000 Kg/ha. Data on yield and production are fragmented and, in some cases, contradictory. Production data reported in several sources were examined in an effort to build a consistent series of historical production data by province that would provide a basis for projecting maize production into the future. A historical data series for the 8-year period 1968 through 1975 by province is reported in Table 4, along with projections based on the reported 8-year series.

Projected production figures in Table 4 reflect a trend estimated from available data and do not consider possible new inputs either of capital or technology in the immediate future period for which maize production is projected. Production increases do not reflect increased price incentives or an improved marketing system. An effective program to introduce new seed, fertilization, market improvement and price incentives will expand production and commercialization at a faster rate than indicated in Table 4.

TABLE 4. REPORTED MAIZE PRODUCTION BY PROVINCE 1968-1972, ESTIMATE, 1973-75 AND PROJECTED 1976-80 AND 1985.

- 1,000 Metric Tons -

Province	1968[1]	1969[1]	1970[1]	1971[1]	1972[1]	1973[2]	1974[2]	1975[2]	1976[3]	1977[3]	1978[3]	1979[3]	1980[3]	1985[3]
Bas Zaire	50	45	38	35	42	35	33	31	29	27	24	22	20	11
Bandundu	65	64	54	66	72	68	69	70	72	73	74	76	77	84
Equateur	43	45	35	48	44	46	47	48	49	51	52	53	54	60
Haut-Zaire	40	45	45	45	39	43	43	43	43	43	43	43	43	43
Kivu	36	27	23	30	26	28	29	29	30	31	31	32	33	37
Shaba	50	51	54	56[4]	58[4]	60	62	64	66	68	70	72	74	84
Kasai Occidental	34	35	37	39	51	50	53	56	59	63	66	69	73	89
Kasai Oriental	43	45	44	55	64	62	66	69	73	77	80	84	88	108
TOTAL	361	357	330	374[4]	396[4]	392	402	410	421	433	440	451	462	516

Sources: 1) Les Superficies, la Production et le Rendement des Principales Cereales Cultivees au Zaire, 1968-1972, Rep. du Zaire, Dept. de l'Agriculture.

2) Estimates based on the following reports:

Republique Democratique Du Congo, Présidence de la République, Office National de la Recherche et du Développement. Annuaire Statistique 1958-1969 par L'Institute National de la Statistique Nouvelle Série No. 1. Kinshasa Septembre 1971 (Ministére de l'Agriculture.)

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Dept. de l'Economie Nationale, Conjoncture Economique Noll et No. 12. and Dept. des Finances Listing 1972 1972 des Importations, Direction des Douanes.

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Dept. of Agriculture, Republic of Zaire.

IRBD Agricultural Sector Survey PA-118a, Vol III Annex II

"Les Problemes de la Promotion de l'Agriculture". Conference Donnée par le Citoyen Kayinga Onsi N'Dal, Commissaire d'Etat à l'Agriculture, Institut "Makanda Kabobi", Session Mobutu Sese Seko, Septembre 1974.

Kamlanga Mulumba Kapuku Boya (1973): Le Mais au Zaire. Memoire Universite National du Zaire, Campus de Kinshasa, Faculté des Sciences Agronomiques, 153 p.

3) Projected from 1968-1975 trend

4) Adjusted by KSU team.

Zaire Department of Agriculture estimates of hectarage, production and yield by province of maize, rice, wheat and other cereals, 1968 to 1972 are reported in Appendix II-5. Small farms, scattered distribution, lack of communication and other estimating difficulties make the collection of reliable production information extremely difficult.

C. Consumption of Maize

Maize is used in Zaire primarily for human food in the form of maize flour, for seed, and for beer production (brewing grits). Since 1960 the quantity of maize consumed in Zaire has exceeded the quantity produced. The deficit has been made up by imports of maize, principally from the African countries to the south of Zaire (Rhodesia, South Africa, Zambia and others). The level of imports has increased over the past several years. It is estimated that it will be necessary to import between 125,000 and 155,000 metric tons of maize in 1975 to provide the estimated 530,000 to 560,000 tons to feed the people of Zaire. Information on consumption of maize in Zaire is virtually non-existent. Estimates of consumption are based on total disappearance (i.e. production plus imports). On the basis of this type of information, estimates have been made of average per capita consumption of cereals (Appendix II-6). Estimates of annual per capita consumption of cereals by various income groups in Kinshasa in 1970 is presented in Appendix II-7.

A recent IBRD report indicated that because of increased costs of living, failure of wages to keep pace and growing urban unemployment, increases in average per capita income in real terms will remain small or nil. As a result, the report concludes that urban demand for food will increase primarily in relation to population development.

In Kinshasa, the per capita consumption rate for maize is relatively low. Consumption of maize flour is low in relation to other carbohydrate sources (Appendix II-7). Cassava is the main carbohydrate source, although it is replaced by rice and wheat in higher income groups. Beer production (requiring 7.7 Kg. of maize per hectoliter) represents additional demand for maize. Based on apparent supply of maize entering Kinshasa (Appendix II-8) we estimate annual consumption for that city at 7.8 kg per person in 1968-70.

Again, using data from Appendix II-8 and II-9 the maize flowing out of Bandundu Province was determined. Subtracting the quantity of maize leaving Bandundu from the estimated production gave a basis for estimating a 14.8 kg. annual per capita consumption of maize for the region. In this case, no attempt was made to estimate separate per capita consumption rates for urban and rural populations. The relatively low per capita consumption was confirmed by interviews in the Kikwit area. Bandundu is not a heavy maize consuming region with the inhabitants blending approximately 20 percent maize with 80 percent Cassava to provide much of the carbohydrate for the diet. Maize is largely a cash crop.

The per capita consumption in Kasai Occidental appears to be approximately the same as for Bandundu, however, the region is somewhat of a transitional area. Kasai Occidental is also a surplus area shipping maize to both Kinshasa and Lubumbashi (Appendix II-8 and II-9). Also, some quantities are processed into flour and are flowing to Mbuji-Mayi in Kasai Oriental for consumption. Using the same procedure as for Bandundu region, an average per capita consumption of 14.6 kg was calculated.

Based on the flow of maize from Maniema (Kivu Province to Lubumbashi) (Appendix II-9) a per capita consumption of 3.9 kg was calculated for Kivu. Kivu is a surplus region.

Utilizing the estimated flow of imports into south Shaba region and the surplus domestic flows from Bandundu, and Kivu, total consumption for Shaba region was calculated. If the 144 kg/capita figure for consumption in the "Copper Belt" of Shaba is considered, a rural consumption of maize is estimated at 24 kg/capita. Shaba is a major deficit maize area.

The per capita consumption for Kasai Oriental was estimated at 50 kg by the International Bank for Reconstruction and Development (4). Based on balancing the total consumption of the major maize regions with the calculated consumption of the regions other than Kasai Oriental, the residual was an average annual per capita consumption for Kasai Oriental of 51.9 kg. This is consistent with information gathered in interviews regarding maize consumption in this region. Indications are that the ratio of maize flour to manioc in the diet is roughly 80-20, just the opposite of that in Kasai Occidental.

Alternative projections of annual maize consumption in urban areas, 1970 through 1985, have been calculated based on differing estimates of urban per capita consumption of maize in Shaba and in the Kasais. Lower levels of per capita consumption were 92 kg for Shaba, 44.5 for Kasai Oriental, 20 for Kasai Occidental, 7.6 for Kinshasa and 15.4 for urban areas in all other provinces. Higher levels of per capita consumption were 144 kg for Shaba, 50 kg in Kasai Oriental and 25 for Kasai Occidental with all other consumption rates unchanged. Projection of urban consumption by region to 1985 using low levels of per capita consumption are presented in Table 5. Higher levels of per capita consumption were used to develop the projection of urban consumption presented in Table 6. Urban consumption is projected in 1980 at a low figure of 258,420 metric tons

and a high of 340,551 metric tons. In 1985 the high and low figures are 357,359 and 468,096 metric tons, respectively. Based on field interviews and informal evaluation of related data, we place more confidence in the lower level estimates of per capita consumption than in the higher ones.

D. Surplus/Deficit Status of Major Maize Regions

Estimated production for five major maize producing regions have been combined with estimated consumption in the five regions and Kinshasa and the surplus/deficit status of each region calculated annually, 1970 through 1985. These data are presented in Table 7. Production estimates reflect estimates of trends in production by region for the 5-year period 1968 through 1975. Consumption increases are based on population projections by regions at estimated current per capita consumption rates. If strategies to increase production are successful, net deficits (line 23) will be reduced. If per capita consumption of maize increases, deficits will increase. Given the assumptions on which data in Table 7 are developed, net deficits (imports) will increase to 210.6 thousand tons by 1985.

Data in Table 7 indicate that surplus production in Bandundu, Kasai Occidental and Kivu will increase by 1985 to a total surplus in the three regions of 87,300 metric tons. Deficits will increase in Shaba and Kinshasa with a reduced deficit in Kasai Oriental. Large deficits occur in Shaba. The deficit is a result of high per capita consumption in population centers in southern Shaba. Within Shaba, commercialized maize moves southward from northern producing areas.

The magnitude of surplus/deficit status of regions estimated in Table 7 may be greatly modified in the future decade by strategies to increase production through improved marketing and application of improved cultural practices.

Major geographic flows of commercialized maize from surplus to deficit areas are illustrated in Figure II-B.

TABLE 7.

ESTIMATED MAIZE PRODUCTION, CONSUMPTION AND SURPLUS/DEFICIT STATUS
OF KINSHASA AND FIVE PROVINCES IN SOUTHERN ZAIRE, 1970-1985

- 1,000 Metric Tons -

Province	(line)	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Bandundu:																	
Production	(1)	54.0	66.0	72.1	67.5	69.0	70.0	71.5	73.0	74.0	75.0	77.0	78.0	79.5	81.0	82.5	84.0
Consumption	(2)	38.4	39.4	40.2	41.1	42.0	42.9	43.8	44.8	45.7	46.8	47.8	48.8	50.0	51.1	52.2	53.3
Surplus	(3)	15.6	26.6	31.9	26.4	27.0	27.1	27.7	28.2	28.3	28.2	29.2	29.2	29.5	29.9	30.3	30.7
Kasai Occidental:																	
Production	(4)	37.2	39.0	51.3	49.5	53.0	56.0	59.0	62.5	66.0	69.0	72.5	76.0	79.0	82.5	86.0	89.0
Consumption	(5)	35.6	36.4	37.3	38.2	38.9	39.8	40.8	41.7	42.7	43.6	44.7	46.1	46.8	47.9	49.0	50.1
Surplus	(6)	1.6	2.6	14.0	11.3	14.1	16.2	18.2	20.8	23.3	25.4	27.8	29.9	32.2	34.6	37.0	38.9
Kasai Oriental:																	
Production	(7)	43.9	55.0	63.5	61.5	65.5	69.0	73.0	76.5	80.0	84.0	88.0	92.0	96.0	100.0	103.5	107.5
Consumption	(8)	97.0	98.5	99.5	102.2	105.7	107.5	109.3	110.9	112.8	114.8	116.5	118.5	120.5	122.5	124.5	126.5
Deficit	(9)	-53.1	-43.5	-36.0	-40.7	-40.2	-38.5	-36.3	-34.4	-32.8	-30.8	-28.5	-26.5	-24.5	-22.5	-21.0	-19.0
Shaba:																	
Production	(10)	54.0	56.0	58.0	59.5	61.5	63.5	65.5	67.5	69.5	71.5	74.0	76.0	78.0	80.0	82.0	84.0
Consumption	(11)	171.4	171.0	178.5	186.4	194.5	203.2	212.2	221.6	231.6	241.9	252.9	264.4	276.4	289.1	302.3	316.2
Deficit	(12)	-109.9	-115.0	-120.5	-126.9	-133.0	-139.7	-146.7	-154.1	-162.1	-170.4	-178.9	-188.4	-198.4	-209.1	-220.3	-232.2
Kinshasa:																	
Production	(13)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumption	(14)	10.1	11.1	12.3	13.7	15.1	16.8	18.6	20.6	22.8	25.3	28.0	31.0	34.4	38.0	42.2	46.7
Deficit	(15)	-10.1	-11.1	-12.3	-13.7	-15.1	-16.8	-18.6	-20.6	-22.8	-25.3	-28.0	-31.0	-34.4	-38.0	-42.2	-46.7
Kivu:																	
Production	(16)	23.2	26.5	27.0	28.0	28.5	29.0	30.0	30.5	31.0	32.0	33.0	33.5	34.5	35.0	36.0	36.5
Consumption	(17)	13.1	13.4	13.8	14.1	14.4	14.8	15.2	15.5	15.9	16.3	16.7	17.1	17.5	17.9	18.4	18.8
Surplus	(18)	10.1	13.1	13.2	13.9	14.1	14.2	14.8	15.0	15.1	15.7	16.3	16.4	17.0	17.1	17.6	17.7
TOTAL:																	
Production	(19)	212.3	242.5	271.9	266.0	277.5	287.5	299.0	310.0	320.5	331.5	344.5	355.5	367.0	378.5	390.0	401.0
Consumption	(20)	358.1	369.8	381.6	395.7	410.6	425.0	439.9	455.1	471.5	488.7	506.6	525.9	545.6	566.5	588.6	611.6
Surplus	(21)	27.3	42.3	59.1	51.6	55.2	57.5	60.7	64.0	66.7	69.3	73.3	75.5	75.3	81.6	84.9	87.3
Deficit	(22)	-173.1	-169.6	-168.8	-181.3	-188.3	-195.0	-201.6	-209.1	-217.7	-226.5	-235.4	-245.9	-253.9	-269.6	-283.5	-297.9
Net Deficit	(23)	-145.8	-127.3	-109.7	-129.7	-133.1	-137.5	-140.9	-145.1	-151.0	-157.2	-162.1	-170.4	-178.6	-188.0	-198.6	-210.6

E. Summary

Data on which to develop and project the pattern and magnitude of market flows of maize have some limitations. Where data are incomplete, assumptions based on best available information have been used. Surplus and deficit areas have been identified. These data indicate market flows of maize as shown in Figure 2.

Projected production and consumption of maize (Table 7) indicate total deficits in three regions of nearly 300,000 tons at the end of the next 10 years. This suggests a need for a marketing system that will accomplish commercialization and movement of large quantities of maize by 1985.

Estimates of urban consumption of maize in 1980 and 1985 (Tables 5 and 6) also indicate a rapidly growing demand for marketing services in Zaire. Urban demands for maize will increase to a figure between 360,000 tons (Table 5) and 470,000 tons (Table 6) by 1985. This is almost double the range of estimated urban consumption of maize in 1975.

III. PRESENT HARVESTING, STORING AND HANDLING SYSTEM

A description of the present marketing, storing and handling system for maize in Zaire is presented here to provide a basis for the recommendations which follow.

The planting and harvesting dates for the main maize producing provinces are shown below:

PROVINCE	PLANTING PERIOD	HARVESTING PERIOD
Bandundu	Sept. - Oct.	Jan. - Feb.
Kasai Occidental	Sept. - Oct.	Jan. - Mar.
Kasai Oriental	Sept. - Nov.	Feb. - Mar.
Shaba	Oct. - Nov.	Mar. - April

A second crop is commonly planted by the traditional producers in January and February and harvested in June and July.

A. Harvesting

Maize is commonly left in the field to dry following maturity for a period of approximately one month. At this time maize, for family food or for seed, may be picked and taken to the producer's home for storage. Maize which will be marketed is often left in the field until sold. The buying campaign started in May 1975 in most areas and will continue through July. Some quantities of maize may be left in the fields for up to 5 months after maturity. Some may not be harvested at all because buyers are unable to reach the villages.

Quality deterioration begins in the field. We saw weevils (Sitophilus sp.) on ears in the field; especially those which had a loose husk or had been damaged by field insect pests. A commonly observed insect in field-stored maize is an unidentified

moth larva, probably Mussidia Nigrenevella. Damage by this insect is characterized by webbing near the tip of the ear, large quantities of white frass and a tunneling through the embryos of a series of kernels in a row. This insect is primarily a field pest; however, we saw adult moths in warehouses, also. Webbing and larvae were seen in shelled maize being offered for sale at villages.

Termites are a serious problem when maize is left in the field for extended periods of time. When stalks dry, termites sever the roots of the plant, causing it to fall. When the ears are in contact with the ground, termites invade the ears and consume the maize kernels. Termite damage appeared to be extensive, locally.

B. Village Storage and Marketing

The most common method used to store maize in the village is to store in homes above the cooking area. At Ikubi (Bandundu Province), the tassel end of ears (husks on) are placed under stick bracing for the thatched roofs. In another area, maize with husks is placed on a shelf-type support over the cooking area. Probably the most common home storage is on a stick or bamboo platform which forms a loft in the space beneath the peak of the thatched roof. Cooking fires dry the maize and discourage insect development. Maize stored in this manner is primarily for the producer's consumption and for seed. This form of storage was observed in the Kikwit, Kananga, Gandajika and Kaniama areas. In the Kaniama area and other areas in Shaba, maize is stored on platforms raised above the ground and covered with a thatched roof. Fires may be built beneath the storage platforms for drying and insect control. Maize from the field which may not be dry enough for storage is frequently sun-dried by placing unhusked ears on the ground, on platforms 5-6 feet above ground or laid on thatched roofs. Drying of shelled

maize is accomplished by placing maize a single layer deep on woven reed mats or directly on the ground.

Most of the maize we saw in storage over the cooking area in village homes was relatively free of infestation. On occasion weevils were noted crawling on ears of maize; however, no extensive damage was noticed. Moth damage due to the larva was probably more extensive than that of weevils. The ability of this moth to damage maize in storage has not been determined. However, whenever damage was observed, about one-third of the kernel, including the embryo, was lost.

Maize purchasing by ONACER was observed in the Kikwit area. Procedures observed are believed to be the same as those used by private dealers. Announcement of intent to buy is made at the village by the dealer or ONACER. When there are buyers (private dealers or ONACER), villagers harvest the maize from the fields, bring the maize to the village and shell it by hand. At Ikubi, fields were said to be as much as 8-10 kilometers from the village. Maize is carried from the field to the village by "head load." Other reports indicate maize may be carried by head load as much as 30km. for sale.

Shelled maize is brought to the buying point primarily in baskets which hold approximately 30-35 kg. Baskets of maize are weighed, one kilo deducted for the weight of the basket, and the producer paid in cash at the rate (in Bandundu Province) of three makuta (K) per kilo.

If the maize is excessively infested or in obviously poor condition, it may be refused until it is cleaned up by the producer. Otherwise, no discrimination is made on the basis of moisture, insect infestation, or foreign material. After purchase, bags of maize are either stored in a house-like structure in the village or left beside the road for pick up by ONACER or the dealer's truck.

A fear expressed in Kikwit and other areas was that no one would come to buy the maize. Road conditions have made some areas inaccessible. Dealers are reluctant to go beyond 60 km. in many cases because of the transportation costs involved. An estimated 13 to 16 makuta (K) per MT/KM for transportation to the collection point prohibits the economical movement of trucks beyond this distance. A general shortage of sacks appears to exist in all areas of the country. There is an apparent shortage of credit for private dealers.

C. Grain Dealers

An accurate assessment of the number of grain dealers operating in Zaire could not be made. In four provinces in which the team traveled, ONACER licensed dealers for purchase and shipment of maize. Other dealers who function in the market appear to operate on a local level, supplying local markets on a continuing basis.

In 1970, primary buying of agricultural produce was carried out by licensed dealers. In Kasai Occidental the total number of licensed dealers in 1970 was 128. Since dealers were required to be licensed by districts within the province, many dealers were licensed in more than one district. Estimates of average purchase per dealers in typical districts ranged from 25-60 MT (Appendix III-1).

With Zairianization, many of the dealers left Zaire. Reports on the number of dealers now operating varies and no reliable figure can be given. The lack of credit, deterioration of equipment, and change in licensing procedure probably decreased the number of licensed dealers. For example, in the Demba district, indications were that 3 or 4 dealers were licensed currently whereas in 1970 there were 54 licensed dealers. In Kananga, the manager of the Minoterie de Kasai said he is dealing with 40 to 60 sellers of maize.

In Kasai Oriental ONACER has licensed thirteen dealers and requires that records of purchase be submitted to ONACER. Before a license is granted, the dealer must indicate to ONACER the following information:

1. Number of trucks operated by dealer,
2. Amount and source of credit,
3. Participation in previous buying seasons,
4. Whether he has scales and tarpaulin for his trucks,
5. Knowledge of the official price (4K/kg.),
6. How much maize the dealer intends to buy and when.

Also in Kasai Oriental, dealers and ONACER buyers are required to maintain records of their purchases of maize and rice. The following information is required on a card form for each purchase:

1. Address of dealer,
2. Type of truck,
3. Type of grain purchased (maize or rice),
4. Quantity purchased,
5. Name of producer,
6. Location where purchased (sub-region and zone).

This is the beginning of an information-gathering system which would provide much valuable information for ONACER on commercialization of maize in Zaire. This system was encountered only in Kasai Oriental. It may be useful to consider similar procedures for other areas.

The form in which maize is sold to dealers, ONACER, or in the local markets varies among provinces. In Bandundu Province, maize is sold primarily as shelled

maize. In Kasai Occidental, shelled maize and unhusked ear maize are sold in the local markets. Dealers' agents working in the local markets buy maize by the ear, and pay to have it shelled (cost unknown). Dealers accumulate maize in local market places until sufficient quantity is available to send a truck to pick it up. In Kasai Oriental very little maize is sold as shelled maize. Nearly all is sold as unhusked ears of maize. Producers are said to prefer selling unhusked ear maize because they feel they are getting a better price. When supply is plentiful, each ear sells for 1 likuta. As maize becomes scarce, buyers may have to pay as much as 2 or 3 makuta per ear and higher. On the basis of observations made by the team, an average yield of shelled maize is approximately 0.17 kg./ear. At one likuta per ear the producer receives about 6K/kg. When the price is 3K per ear the price per kg. is roughly 18K. Official price to producers in Kasai Oriental in June, 1975 was 4K/kg.

In Shaba, maize purchased by dealers is commonly bought by the "sack". The producers consider a "sack" 100 kg. and accept payment for 100 kg./sack. Depending on the size of the sack the dealer may receive quantities from 80 kg. to as much as 130 kg. for the price of 100 kg.

Private dealers indicated that they are limited in their activities by: (1) poor roads, (2) lack of credit, (3) shortage of sacks and (4) low price margin.

The most common size truck used by dealers is in the 6 to 8 MT capacity range. Road conditions cause high maintenance cost. Trucks usually operate 50,000 km. before troubles develop. At 80,000 km. (2 to 4 years) trucks must usually be replaced.

Lack of credit was generally cited as a restriction on dealer operations. In some cases, lack of credit is probably due to irresponsibility on the part of individual dealers. Instances were cited where dealers have failed to repay loans or have "changed identity" to avoid collection of past loans and/or to gain new loans. Poor-risk dealers and inadequate means for loan evaluation and lending combine to create credit difficulties.

A shortage of sacks was evident across the southern maize producing provinces. The extent of shortage is not known; however, a shortage of sacks could seriously impede the flow of maize from producer storage into commercial channels. At present, prices quoted for sacks are as follows:

TYPE OF SACK	PRICE PER 70 KG. CAPACITY SACK
New Jute	40K to 46.5K
New Synthetic	50K
New Jute/Synthetic Combination	50K
Used Jute	28K to 30K

The purchase and selling price margin is, in part, said to be responsible for lack of movement of maize into commercial channels. Evidence of inadequate margins was most apparent in Kongolo and Nyunzu areas of north Shaba.

Depending on the size of the dealer's operation, maize may be stored in facilities ranging from small structures holding a dozen or so sacks to warehouses capable of holding 100-150 MT of bagged maize. Storage conditions and practices at dealer warehouses are not conducive to safe storage of maize.

In all dealer storage observed, bags of maize were improperly stacked for safe extended storage. Bags were placed directly on concrete floors, against

the walls and as high as possible. This practice of storage: (1) prevents proper stock rotation (first-in, first-out rotation), (2) does not allow inspection of the maize for insects and/or rodent activities, (3) does not allow treatment of grain with fumigants if infestation is detected, and (4) does not allow proper inventory control.

In all dealer storage facilities poor house-keeping practices were observed. Spillage of grain, cassava and palm kernels was noticed. Assorted pieces of equipment and other discarded items had not been removed. Conditions such as this provide food and harborage for rodents. Spilled maize, rice or cassava harboring insects can be sources of migratory infestation of clean maize.

In general, the dealer warehouses or stores were not designed or maintained to prevent rodents from entering the storage structure. Most of the warehouses had poorly fitted doors, open or unscreened windows and ventilation openings where rodents could enter. In some warehouses, holes in the roof and broken windows allowed water to enter. Although water damaged maize from this cause was not observed in warehouses, maize being delivered to the ONATRA warehouses in Kikwit for shipment had obviously deteriorated from water having contacted the bags of maize.

Maize stored by ONACER in Kikwit and Kananga was stored under similar conditions as reported for dealers. Moths, Probably Mussisia Nigrenevella and warehouse moths (Ephestia elutella), were seen flying over the surfaces of bags and several bags of maize had weevils on the exterior.

Available reports indicate grain losses of 8 to 30 percent by weight experienced in dealer storages where maize may have remained up to 4 months.

Samples taken from a feed mill in Kikwit averaged between 1 and 7 percent weight loss with 8 to 15 percent insect damaged kernels. This maize had been stored in bulk for approximately 3 months in a wood crib bin. Of twelve ears of maize selected from storage at Kaniama (Shaba Province), seven ears had no damage, two ears had 1 percent insect damaged kernels, one ear 4.5 percent, one ear 7.9 percent and one ear 90 percent. This represents an average of 6.8 percent insect damaged kernels. Maize of this condition represented 87.5 percent of the maize stored at this site. Unfortunately, the remaining 12.5 percent had about 80 percent damaged kernels. In rather crude estimations, a 12 percent insect damage level has averaged out at about 4 percent weight loss, (a weight loss of about 1/3 of the percentage insect damage level.) With this crude method of estimation, the maize with 80 percent infestation would have suffered about a 26 percent weight loss and the 6.8 percent insect damage about 2.2 percent weight loss. The heavily infested maize examined here had been in storage approximately 5 months and had an average moisture content of 14.8 percent. The lesser damaged maize had a shorter storage period and moisture of 17.6 percent.

D. Wholesale Distributors

We visited only one wholesale distributor. SEDEC was purchasing maize delivered in Kikwit at 4.5K/kg. in an area where 3K/kg. was the official village price. The maize being accumulated by SEDEC was destined for Kinshasa. Approximately 500 MT had been accumulated at the time of our visit. Total effective capacity of the warehouse was estimated at 1500 MT.

Storage practices were similar to practices of smaller dealers with minor exceptions. However, in contrast to the smaller dealers, SEDEC had a

platform scale holding 36 sacks which was used to weigh maize into the warehouse. Most small dealers are not so equipped. DDT dust is used to control insects by sprinkling the dust on the floor and over the surface of the stacks of bags. One kg/MT of maize is used over the top of bags if moths are noted. This type of treatment would not control insects within the stack of grain and did not appear to be effective in controlling the moths for which it was intended. Numerous moths, tentatively identified as Mussidia Nigrenevella and the warehouse moth (Ephestia elutella) were noted in considerable numbers flying over the surface of the stacks of bagged maize.

Rodent damage and contamination was observed. Bags were chewed and rodent droppings were present on several bags. No estimate of the quantity of grain damaged by rodents could be made.

The warehouse was structurally sound and with changes in grain management practices would provide excellent storage for bagged grains.

E. Grain Processors

Maize processing at the village level consists of hand pounding the maize in a wood mortar with a wood pole. The mortars vary in size from about 40 cm. in diameter and 60 cm. high to 30 cm. in diameter and 40 cm. high. They are cut from logs and may be variously cut to resemble flower urns. The wood pole is 6 to 8 cm. in diameter and usually over a meter long.

Shelled maize is placed in the mortar and pounded to produce flour. The pounded material is then sifted in a wooden box sieve with a screen about the size of window screen stretched sideways to form diamond shaped openings approximately 1 mm. by 2 mm. Flour is sifted from the pounded material into a container (usually a flat woven basket 45-50 cm. in diameter and 10-15 cm. deep)

and the overs (material left on the screen) placed back in the mortar for more pounding. When as much flour as possible has been recovered, the residue consisting of the pericarp (hulls) of the maize kernels are thrown to the chickens or goats. A 97 to 98 percent recovery of maize is estimated from this type processing. We estimated that it took about 1 hour to pound what appeared to be 5 to 6 kg.

Conditions existing at the market mills are conducive to insect and rodent build-up. The mills are housed in an assortment of very loosely constructed sheds, and there didn't appear to be any effort to remove spillage of maize or flour from the area. The same mills are used to grind cassava. The number of this type milling operations in Zaire is unknown. Inquiries at several small mills indicated the price for milling at market-place hammermills to be 1.3 to 2.0 K/kg.

One dealer operating in Kikwit, in addition to buying maize, was operating a hammermill to produce flour for local distribution and for delivery to Kinshasa. The dealer purchases and accumulates maize from February through May. Maize is milled on a Scotmag hammermill equipped with a 1 mm. screen and powered by a diesel engine. The mill operates two 5-hour shifts with three men each shift. The dealer indicated he mills 30 sacks (70 kg. each) of maize and produces 60 sacks (35 kg. each) of flour or 2.1 MT per day. The estimated annual volume was 10,000 sacks of maize or 700 MT.

The dealer indicated he owns five trucks. Two of the older trucks are used for maize collection. Two newer trucks are used to haul flour to Kinshasa. In the rainy season an average of two trips per month are made and in the dry season three to four trips per month. The fifth and oldest truck is used to

deliver flour to 22 shops in Kikwit and 17 more shops in the surrounding area. Flour sells to retailers for 10 K/kg. (June 1975). Only a small amount of flour is sold in the Kikwit area with the greatest volume being trucked to Kinshasa.

There are several maize roller mills in Zaire of varying capacities. They are primarily located in the industrial area of Shaba. Mills are also located in Kananga and Kinshasa. Table 8 indicates the production of maize flour in Zaire for 1970-1974. Data on capacities of the various larger mills are shown in Appendix III-2.

TABLE 8. MAIZE FLOUR PRODUCTION IN ZAIRE, 1970-1974

Year	G.C.M. MINOKA	CEROTEX	TARICA	Others[2/]	Total
			(metric tons)		
1970	70,000	10,915	10,500	5,000	96,415
1971	71,900	11,900	9,500	12,000	105,300
1972	104,000	12,597	12,000	13,000	141,597
1973	109,550	22,378	15,675	14,000	161,603
1974[1/]	27,478	4,000	5,400	500	37,378

Source: "Profiles of Zaire," issued by the President of the Republic of Zaire, 1974.

[1/] Three months' production

[2/] Only a partial estimate

As far as we could determine there were five large maize mills operating in Zaire in June, 1975. They were G.C.M. (GECAMINES) MINOKA mills at Likasi and Kolwezi; a CEROTEX mill at Kanaga; ONACER's mill, (Minoterie de Kasai) at Kananga; and the MEUNERIE DE KINSHASA in Kinshasa. There may have been other mills producing of which we were not aware.

We visited two mills in Kananga but were unable to get permission to visit the mills in the industrial area of Shaba (at Likasi and Kolwezi).

The Minoterie de Kasai was stockpiling maize for full scale operation. The capacity of the mill is 35 MT per day running three shifts of seven men each. Usually it makes 400-500 sacks of flour (24-30 MT) per day. Yield from the mill is:

Maize flour	90%
Animal Feed	4%
Shrink (moisture)	3%
Screenings	3%

Whereas some mills produce brewers grits, this mill processes flour only. All flour milled is sold in Mbuji-Mayi (Kasai Oriental). Flour is picked up by customers with their own trucks. The mill reported orders for 3,000 bags per month from customers.

Maize received at the mill between April and September comes from the area between Kananga and Ilebo and some from Kikwit. This mill deals with from 40 to 60 different intermediaries in purchasing maize. At the time of our visit, 100 MT had been received and the mill expects to buy 10,000 MT this season. Last year 1,250 MT of maize were processed.

Maize is received at the mill in trucks or rail cars. There is a rail dock where maize is unloaded and flour could be loaded. All maize is received in sacks and the mill has no bulk storage facilities. The miller indicated that bulk storage would not be warranted unless he was handling 30-40,000 MT per year. Maize sacks are reused for flour shipment.

The present mill warehouse has capacity for storing approximately 1,000 MT (20m X 50m X 6m). Immediately adjacent to the mill is a steel-beam supported

roof which at present could hold up to 6,000 MT (25m X 36m X 12m). This open space could easily be converted to good sound storage for sacked maize by pouring a concrete floor and enclosing the sides if the mill or ONACER needs additional storage space. The miller said he had four more storage warehouses where he could store an additional 3,000 MT.

Storage conditions were very similar to those observed at the SEDEC warehouse in Kikwit. Bags of maize were stored on wood pallets (off the floor) but were being stacked against the walls in an irregular manner eight bags high. An examination of bags of maize in the stack indicated numerous rice/maize weevils (50 per bag) crawling on the surface of bags.

Samples taken from three bags being unloaded from a rail car were relatively free of insect damage. One had no insect damage, one had 1 percent insect damaged kernels and the third had 2 percent insect damaged kernels. An average of 1 percent insect damaged kernels would represent roughly a 0.3 percent weight loss or less. (See Appendix III-3). About ten sacks of maize had gotten wet during shipment to the mill and maize was sprouting through the sacks. The door on the rail car from which the bags were removed was very poorly fitted and did not close completely. These bags were set aside to dry out. When dried, the maize would be blended into that going to the mill and any loss would be negligible.

OZAC (Office Zaire de Control) samples all shipments arriving at Minoterie de Kasai but according to the miller does not apply any discount schedule for foreign material, excess moisture or insect damage. Samples are sent to Kinshasa for analysis.

No pesticides are used to treat the maize at the mill. When operating at full capacity in the past, DDT dust was placed on bags of maize in storage. The SERVICE DU HYGIENE DU REPUBLIC fogs the mill and warehouse every 3 months or more at 28 Z per treatment. The pesticide used is not known.

The CEROTEX mill in Kananga is larger than the Minoterie de Kasai but mill personnel indicated that it has only 20 MT processing capacity per 24 hours. It is a much newer and more sophisticated processing plant. In addition to producing maize flour, the mill produces grits for brewing. Producing grits is preferred because of the higher price received (120 Z/MT compared to 80.80 Z/MT for flour). When producing flour, 12-18 MT per day are produced at a 90 percent yield.

Maize is received at the mill by truck and/or barge-rail. Local dealers supply 3-4,000 MT and 3,000 MT comes from Kikwit. Maize bags are stored in stacks on pallets. Stacks are formed by bags in layers as shown in Appendix III-4. Each layer of bags is 6 bag lengths and 9 bag widths and contains 54 bags. Width and length directions are changed with each layer to "tie" the stack together. Each layer contains 3.78 MT of maize. Stacks in the CEROTEX warehouse were 18 bags high giving roughly 75 MT per stack. There were several such stacks of maize in the warehouse with proper space between stacks to allow inspection and fumigation if necessary. Total bag storage capacity was estimated at roughly 6,000 MT.

DDT dust was being used to control insects. We did not observe large numbers of weevils or moths on or around the stored maize. Two samples taken from bags of maize ready to be fed into the mill each showed 2 percent insect damaged kernels.

In addition to bag storage, bulk storage was available in wooden bins with capacity estimated at 100 MT. This storage is installed to be used in "feeding" the mill. Provision is made for dumping bags of maize into a hopper on the rail-dock for filling bulk storage directly from rail cars.

After bags are emptied into the mill, CEROTEX uses machines to clean the bags and repair them. In contrast to the Minoterie de Kasai, CEROTEX does not use maize bags for flour but uses new cotton bags.

Both the mill managers (CEROTEX and Kasai) commented on the lack of credit and shortage of maize in their warehouses. The manager at the Kasai mill said that he had a shortage of credit until ONACER took over the mill again in January 1975. ONACER had controlled the mill from May through September and then gave up control. Problems, now that money was again available, were a shortage of sacks and an uncertain future. The manager at CEROTEX indicated a general lack of credit for all millers.

The G.C.M. MINOKA Mills (GECAMINES) are located in the industrial area of Shaba. G.C.M. Kakontwe mill at Likasi and the mill at Kolwezi were the only mills operating in the industrial area of Shaba. G.C.M. has a mill at Lubumbashi which was idle as were the CEROTEX and TARCIA mills at Lubumbashi.

Although the team was not able to visit the GECAMINES mills, information on certain aspects of the operation was available from other sources.

In the past the GECAMINES mills have processed both local and imported maize. Local maize (from Kasai and Kwilu) and imported maize were purchased as indicated in Table 9.

TABLE 9. MAIZE PURCHASE BY G.C.M. 1971-1974

YEAR	LOCAL MAIZE (metric tons)	IMPORTS	TOTAL
1971	2,506	85,643	88,149
1972	22,500	88,000	110,500
1973	16,500	104,000	120,500
1974	10,000 (est)	155,000 (est)	165,000

Source: Republic du Zaire Conjuneture Economique No. 14, 1974.
The actual needs of the mill in 1973 of 130,000 M.T. were not met.

GECAMINES is apparently supplying dealers with credit to purchase maize. The Belgian mechanized maize production project at Kasese is sending all of its production to the GECAMINES mills. To date (mid-June 1975) roughly 3,500 MT of maize have been shipped from Kasese to Lubumbashi. Shipment is in bulk in open-top gondola cars which are covered with tarpaulins. Cars used hold 30 to 32 MT each.

Bulk storage at the Likasi mill is in concrete silos with a total capacity roughly estimated at 5,000 to 6,000 MT. Facilities for fumigation with Phostoxin are probably available since the drying facility at Kasese indicated they borrow Phostoxin fumigation equipment from the mill in Lubumbashi.

Maize flour produced by GECAMINES is used to feed GECAMINES employees and excess is sold to the public.

The Meunerie de Kinshasa mill is located in Kinshasa and is a production unit of the Domaine de la N'sele. This mill specializes in the production of grits but also makes animal feed and a small quantity of maize flour. This

mill purchased 4,000 MT of maize from the Kwango-Kwilu (Bandundu) area in 1973 and estimated purchase of 13,000 MT in 1974. Maize flour produced at the mill is sold in Kinshasa. An increase in maize flour consumption in Kinshasa began in 1972 with increased migration of families from Kasai Oriental, Kasai Occidental and Bandundu. In 1971 needs were estimated at 50 MT/month. Needs in 1974 were about 100 MT/month.

Additional data on these and other maize mills in Zaire are included in Appendix III-2. Wheat flour milling in Zaire is discussed in Appendix III-5.

F. Office Zairois De Controle (OZAC)

The Office Zairois de Controle (OZAC) is a government organization with responsibility for providing chemical and physical analyses of agricultural products. In addition to the product inspection service, and in conjunction with this service, OZAC operates a 15,000 MT storage silo at Kinshasa. The silo is constructed of poured concrete and consists of approximately 54 square bins. The bins are equipped with aeration. All agricultural products received at Kinshasa by barge are unloaded at the OZAC silo.

The OZAC silo is located on the Zaire River and is designed to receive bulk commodities by barge. There are two pneumatic unloading units (German made) with combined unloading capacity of 10 MT/hour. Cereal grains are received in bags on barges. The bags are opened on the barges and the grain pneumatically conveyed into the elevator. The same equipment and procedure is used to receive maize, rice, millet, barley, malt, peanuts, palm, sesame and cacao.

When maize is received it is unloaded from the barge, weighed, and placed in an "uncleaned grain" bin. The buyer (receiver) owns the maize while it is in the silo. When cleaned, the foreign material is discarded and the broken kernels returned to the receiver (or client). Handling and storage charges at the silo are shown in the following table.

TABLE 10. OZAC SILO HANDLING AND STORAGE CHARGES

Service	Charge
Unloading	80 K/M.T. (Bulk)
	220 K/M.T. (In Bags)
Cleaning	200 K/M.T.
Storage	90 K/M.T./month
Transfer[1/]	70 K/M.T.
Loadout	70 K/M.T. (Bulk)
	220 K/M.T. (In Bags)[2/]

[1/] Charged if transferred between bins at owners request.

[2/] Does not include cost of bags.

According to the manager, grain can be removed from the silo at a rate of 6 MT/hour in bag or in bulk. Some top-loading metal rail cars are available for bulk loading.

The silo manager did not have records of last year's (1974) maize receipts, however, 5,000 MT had been cleaned. This is probably a good estimate of receipts. Maize arrives, primarily from Kikwit, from May through October. No maize arrives from November through February.

No pesticides are used at present. The manager said a powder formerly was mixed with the grain but now they have no insect problems.

OZAC performs a series of physical analyses on cereal grains and their products in laboratories located in Kinshasa and Lubumbashi. Procedures for physical analyses of grain are outlined in Appendix III-6. Chemical analyses of grain are performed only at Kinshasa.

At present, OZAC acts only in an inspection and analysis function. We heard that "discounts" are applied on the basis of OZAC analysis, however, were unable to determine who establishes the levels and amounts of discount. OZAC says other "agencies" establish rejection limits.

At Kikwit, ONACER indicated that the following discounts could be applied against the shippers' price of maize:

LIMIT	DISCOUNT
More than 4% Foreign Material	2% of price
More than 16% Moisture Content	2% of price
More than 10% Insect Damage	5% of price

Example:

Price of maize at mill	63.00 Z/M.T.
If 4% Foreign Material	-1.26
If 16% Moisture Content	-1.26
If 10% Insect Damage	-3.15
Price Paid Seller	57.33 Z/M.T.

We also heard various rejection levels for moisture content, i.e. above 14 percent rejected or above 13 percent rejected. At this time, it appears that the buyer may set the limits and that the limits are variable.

Records of all inspections are filed in Kinshasa at the main office of OZAC in the product section. The records are not summarized. Valuable information could be obtained by reviewing and summarizing the following information:

1. Quantities of maize arriving at mills by location and date (days, weeks or months).
2. Points of origin of maize shipments and time enroute to destination.
3. Moisture content of maize arriving at destination by month.
4. Amount of insect damaged maize in shipments. This information could be used to estimate the quantity of maize lost during the storage year.
5. Other information on maize quality, i.e. damaged grains, colored kernels, foreign material, etc.

G. Summary

Physical losses of maize occur at all stages of the harvesting, storing and handling system. Major field losses from lodging and subsequent insect attack occur in all areas. We did not see major insect loss in villages perhaps because maize to be marketed is not generally stored in villages for extended periods and maize for home consumption and seed was observed relatively early in its period of storage. Smoke from cooking fires appears effective in drying maize and discouraging insect development where maize is stored in village houses.

Infrastructure deficiencies in road transportation, communication networks and sources of credit seriously impede the development of a national marketing system. Facilities specific to maize marketing such as storage facilities and shelling and grinding equipment are needed at village and

country collection centers for improved quality maintenance and to reduce labor input into marketing functions.

Warehouses operated by maize wholesalers and mill operators are generally in good basic condition, however, maintenance and management practices result in avoidable insect and rodent losses. For maize mills, credit and material shortages and low operating margins were reported major sources of operating difficulties.

The absence of nationally standardized marketing and regulatory procedures is a serious difficulty in development of a national marketing system. Market information is not adequate or adequately transmitted for timely performance of many marketing functions.

OZAC provides a supervisory framework for improving a premium and discount system based on quality of maize delivered to mills. OZAC records contain information that may be useful in further specification of maize quality problems and their causes.

IV. THE NATIONAL OFFICE OF CEREALS

The President of the Republic, by Executive Order No. 74-011 (January 10, 1974) for the control of cereals, created a National Cereals Office known as ONACER (Office Nationale des Cereales) (Appendix IV-1). This Order gives the Commissaire d'Etat a l'Agriculture control of cereals cultivation, processing and marketing (interior and exterior trade). The National Cereals Office (ONACER) implements the cereal control program.

The purposes of ONACER are to (1) plan grain production, (2) give technical assistance to cereal producers and buy their production, (3) process cereals and sell them in the domestic and export markets, and (4) advise the Commissaire d'Etat a l'Agriculture on the economic and technical aspects of production and marketing of cereals.

A. Organization and Current Operation

A general organizational chart of ONACER is shown in Figure III-A. The main office is headed by a Delegué Général (Manager), assisted by a deputy. The Delegué Général has authority to manage the affairs of ONACER. This authority may be delegated to his deputy.

The Commissaire d'Etat a l'Agriculture determines what acts need prior authorization by him, but in all cases authorization is required for (1) purchase and ownership changes of real property, (2) loans of more than 1 year (3) starting, renewing or ending shareholding interests, and (4) establishment of branches of exploitation, agencies or offices.

The financial year is January 1 through December 31 of the same year.

ONACER is to establish a price stabilization fund intended to sustain prices paid to cereal producers. The fund is to be fed or supplied by a

monthly deduction on the revenues earned during the previous month's sale of cereals. The Commissaire d'Etat a l'Agriculture determines the lump sum percent to be deducted from the receipts and also fixes the maximum amount of the fund. The stabilization fund must be maintained in a separate account.

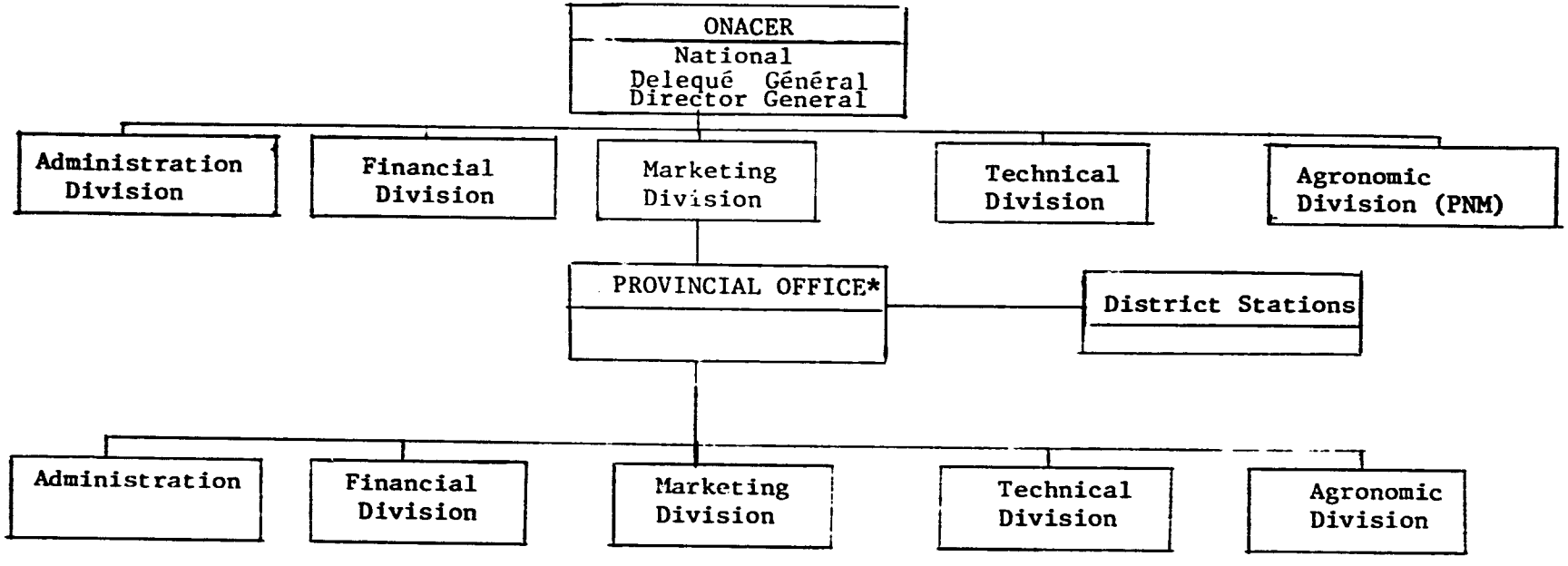
ONACER, both at the Central Office and in the regional offices, is staffed with young, energetic individuals. This is the first year for ONACER to function in the market and the task of starting a new enterprise plus inexperience has created some difficulties which should be overcome with time. Lack of vehicles at some of the stations and the general shortage of storage space and sacks in all regions has added to the first year problems.

At present there are seven regional offices; one in each of the provinces with the exception of Bas-Zaire which operates out of the Kinshasa Central Office. Each of the regional offices has an administrative organization patterned after the ONACER main office (Figure III-A). In the future a total of 32 agency offices attached to the various regional offices is anticipated. At present there are 18 agency offices functioning.

We visited the regional offices at Kikwit (Bandundu), Kananga (Kasai Occidental), Mbuji-Mayi (Kasai Oriental) and Lubumbashi (Shaba), and the agency office at Kalemie, as well as the central office in Kinshasa. Also included in the itinerary were visits to the Programme National du Mais (PMN) stations at Kisanga (Lubumbashi), Kongolo, Kaniama and Gandajika. Technical and agronomic capabilities of ONACER have been greatly enhanced by incorporation of the PMN program into the National Cereals Office.

At present ONACER has only limited storage space most of which consists of rented structures of various types including a section of a retail shop

FIGURE III-A General Organization Chart, ONACER



* Eight regional offices are functioning with district stations operating or planned as indicated on the following page.

PROPOSED ONACER REGIONAL OFFICES AND AGENCIES

Regions	Regional Office	Agencies
Kasai Occidental	Kananga	Mweka Luiza Dekese
Kasai Oriental	Mbuji Mayi	Gandajika (PNM) Lodja Mwene Ditu Laputa
Shaba	Lubumbashi	Kongolo Kalemie Manono Moba Sandoa
Bandundu	Kikwit	Gungu Idiofa
Bas-Zaire	Kinshasa	Mbanza-Ngung Luozi
Kivu	Kindu	Goma Lubutu Kasongo Shabunda Beni Uvira
Haute-Zaire	Kisangani	Kisangani Bafuasende Isangi Irumu Watsa Buta
Equateur	Bumba	Lisala Gemena Boende Basankusu

area and part of a restaurant in Kikwit and owned storage buildings in Luputa and Mwene Ditu. At Kananga, ONACER controls the Minoterie de Kasai which has enclosed warehouse space for 4,000 MT distributed in four warehouses. An additional 6,000 MT could be stored under a roofed area adjacent to the mill. In Nyunzu, ONACER uses the ONIFATEX warehouse platform for storage and rail car loading. ONACER has indicated a need for warehouses at the regional and agency offices. A facility investment program is recommended in Chapter V of this report.

Although the Executive Order creating the Agency indicated that ONACER should be the sole purchaser of cereals from producers, ONACER at present has neither the capability or facilities for the task.

B. A Proposed Marketing Role for ONACER

The position of ONACER in the marketing of maize is not fully determined either in the short-run or the long-run at this early stage of agency development. It is clear that ONACER will be a prominant force in the marketing of maize. However, operating policies have not been clearly defined by the National Office. Hence, regional directors exercise greater autonomy in defining objectives than appears desirable for the development of either a reasonably uniform national marketing system or uniform exercise of price policy objectives. In some areas maize is purchased by ONACER from producers at prices above official price without apparent guidance from the National Office. In other areas plans were developing at the regional level to market commodities other than cereals, simply because those activities would provide earning for the regional office. It is the purpose of this section to recommend both a short- and a long-run role in maize marketing for consideration by the Government of Zaire.

Initial emphasis by ONACER has been to provide a means of purchasing and evacuating maize from villages and entering it into commercial channels. There is urgent need for more marketing services of this kind. In the short-run, this objective must receive primary emphasis by ONACER.

ONACER has operated effectively and with dispatch in becoming a significant force in the marketing of maize in a short period of time. ONACER has not yet had time to bring an adequate supply of resources into marketing at the local level. In many areas there are not enough trucks or buyers to evacuate maize. Some areas cannot be reached because of inadequate roads, missing bridges or inoperative ferry boats. Persons of long experience in maize marketing told us that surplus production in parts of the Kasais has dropped by as much as 50 percent from the preindependence days because of unstable and inadequate marketing.

ONACER has licensed private dealers to purchase maize and resell in the marketing channel if they have enough financial resources to carry out their operations and a commercial integrity that will insure minimum improper exercise of bargaining power in dealing with producers. Use of private dealers, whether planned or as a short-run expediency, has been highly beneficial. The ability to market maize has been increased.

Longer term development of a force for moving maize into marketing channels should continue (and expand) the use of private dealers. Permitting dealers to enter the market under controlled conditions will retain ONACER's control over the integrity and stability of the marketing system. A stated policy of encouraging dealer participation on a long-term basis, provided standards set by ONACER are met, will aid potential dealers in

establishing credit and give them the incentive to invest in the necessary trucks and other equipment to become dealers.

Use of private dealers will reduce substantially the amount of investment required of the Government of Zaire in marketing facilities and operating funds for ONACER. Adjustments to changed supply and demand conditions occur more promptly when private dealers are employed than when marketing functions are carried out by Public Agencies. New, more effective, channels and techniques of marketing characteristically are discovered sooner in competitive markets than in non-competitive situations--an element that would likely contribute significantly to economic progress in Zaire over a period of years.

ONACER should, in the longer run, maintain a sufficiently dominant position in marketing of maize to insure:

A. A stable and continued functioning of the system for physical movement, preservation and processing of maize;

B. Reasonable limits on price levels and price level changes in the interests of producers and consumers alike, and

C. Commercial practices that will accomplish exchange transactions with minimum effort, encourage credit financing and reduce marketing risks hence facilitating a low cost, effective system.

In pursuit of these goals, ONACER should control a portion of the commercialized supply each year--probably 20 to 25 percent. Readiness to purchase at least that quantity will provide an alternative market for producers each year, and guarantee an established minimum price. Variations above or below this portion of the market will occur by regions depending on local conditions. For longer-run development of a marketing system, ONACER should give attention to the development and training of a cadre of private traders that will become of major importance in maize marketing in future years.

With a trading volume of 20 to 25 percent, ONACER policies would establish the pattern of marketing practices in each market. In addition, ONACER, in licensing private traders, is in a position to exercise the penalty of revocation of licenses of traders, not conforming to trade practices judged by ONACER to be fair or ethical. With facilities for handling 20 to 25 percent of the crop and general surveillance over private traders, sufficient control and flexibility would exist in the system to assure stable marketing.

A system of official prices for maize exists currently. It is expedient in the short-run to continue a system of official prices to reduce market price risks as much as possible. In the longer-run, maintaining limits within which prices are free to move will reduce the cost of administering a pricing system and allow for supply/demand and cost/price adjustments within the system and, at the same time, limit price fluctuations.

In a price stabilization role, ONACER should shift stocks among provinces in order that a relatively even maize price to consumers exists throughout the nation. Ideally, price differences among geographic points should reflect cost of transportation only. After self-sufficiency has been reached, it will be desirable for ONACER to develop year-to-year carryover (buffer stocks) for use in effective control of prices and to offset abrupt changes in annual production.

The stabilization role for ONACER casts the agency in a different role than that of an exclusive purchaser exercising ownership control over all surplus stocks but in a much more manageable role. With a clear stabilization objective, ONACER will not purchase maize in competition with local merchants at prices exceeding official stabilization prices as was the case in Kasai

Oriental in June 1975. ONACER purchases and sales of maize can be used to offset price fluctuations that are disruptive to overall goals for producers or consumers. Management of a national marketing system such as this requires knowledge of market characteristics and a system of market communication.

In a stabilization role, the "profit" objective of ONACER regional offices and agencies must be the secondary to other policy objectives. Regional directors indicated intentions to market palm nuts, vegetables and other products because of earnings available to ONACER in doing so. If marketing capabilities of ONACER can be used more fully in handling additional products where marketing functions are not already adequately performed, additional service may be justified. However, entering other commercial markets for the purpose of earning operating funds for ONACER will dilute the concentration of scarce resources on the establishment of a reliable cereals marketing system. Marketing expertise is a very scarce resource with ONACER and should, for the near future at least, be concentrated on developing a marketing system for the major cereal crops (i.e. maize and rice).

We recommend that ONACER assume a leading role in advancing and improving marketing practices at the local level. Currently, maize is weighed as purchased in many areas. In other areas, maize is bought on a sack basis of 100 kgs with no provision for variation in size of sacks. A uniform practice of weighing maize would appear to be more equitable practice. Leadership in establishing grain quality maintenance practices should be assumed by ONACER.

Introduction of equipment to improve local marketing should be undertaken by ONACER. Hand-operated corn shellers for use at the village appears immediately desirable. A second is the installation of moisture testers at regional and agency offices to determine when maize is dry enough to begin the campaign.

Pioneering in establishments of marketing policies and procedures should be undertaken by ONACER. Efforts to establish use of trade documents (sales contract, shipping letter or other documented evidence of inventory) as a basis for financial credit offers an opportunity for ONACER leadership. Local determination of the date for the beginning of the buying campaign is another example. Field losses were occurring at Kongolo this year allegedly because the start of the campaign was announced later than desirable.

It is our judgement that ONACER should not enter the milling business at this time. Milling is a complex operation requiring technical expertise which ONACER does not currently have available. The objective of developing and guiding a marketing system for maize in the public interest does not require ownership of processing facilities. We recommend a return to private operation of the two mills currently owned by ONACER in Kasai Occidental as soon as feasible.

ONACER is in current need of warehouse facilities for transit storage at several locations. After self-sufficiency and the development of buffer stocks, longer-term storage facilities will be required at collection stations in strategic locations for reserve stocks. Estimates of the longer term level of activities for ONACER is required as a guide to facility investment. We recommend that plans for transit storage anticipate handling of 20 to 25 percent of all maize commercialized with plans for expansion to serve a buffer stock program. Specific facility recommendations are presented in Chapter V.

C. Summary

The Executive Order creating the National Office of Cereals authorizes an administrative organization that appears appropriate for such a function.

The National Office of Cereals has registered achievements toward accomplishment of a very difficult task in a short period of time.

Operating objectives and policies of ONACER have not been clearly designated. We recommend that ONACER continue to develop and improve the marketing system, performing in the short-run those maize marketing functions required for rapid marketing system development. We recommend that system development include licensing of private dealers as rapidly as a stable, reliable contingent of private dealers can be developed.

We recommend that in the longer-run ONACER control only that portion of market supply required to achieve price stabilization, regulatory control and an efficient system of privately operated markets. We estimate this can be achieved with control of 20 to 25 percent of commercialized maize. Planning for longer-term facilities and staff should reflect that anticipated level of direct market participation by ONACER, including a reserve or buffer stock policy when self sufficiency is achieved.

Recommendations contained in the remainder of this report reflect an anticipated role for The National Office of Cereals as indicated above.

V. HARVESTING AND STORAGE TECHNIQUES FOR MARKETING IMPROVEMENT

The harvest-storage-transportation program herein described is designed to build on existing conditions for immediate improvement in critical areas and at the same time provide a basis for growth and expansion of the system. Storage and handling at villages and at collection centers are emphasized. Facilities of large dealers and facilities located at mill sites are more nearly adequate for current demands.

Village living centers are the selling and delivery points of small producers. Marketing functions of village centers begin when the corn is mature and ready for harvest. Field operations affect the quality and quantity of maize available for commercialization.

The major additional physical facilities required early in the program is a series of collection-storage-shipping centers. It is anticipated that facilities recommended for immediate installation at 10 designated collection centers will be operated by ONACER and will initially provide transit storage for bagged maize. Later expansion and design of these facilities for longer-term storage and for increased volume of grain handled through the facility will depend upon the amount of expansion in production and degree of participation in marketing by private traders in the area served by each collection center.

For discussion of an overall harvest-storage-transportation strategy, harvesting and marketing operations are categorized as (1) field,(2) village, and (3) collection center operations.

A. Field Operations

Objectives in selection of field operations are (1) harvesting of a maximum quantity and quality of maize and (2) minimizing labor requirements in field operations and transport to the villages.

Studies of present farming practices estimate that 60 percent of all labor requirements for production of maize on small (½ to 1 hectare) farms is expended in harvesting and post-harvest operations. This work is customarily done by women of the village and indicates there may be labor constraints for more maize production even though better cultural practices or planting of more hectares make increased production technically possible. Changes or assistance that can be introduced to decrease the harvesting, drying, head-load transporting and market preparation hand-labor processes can serve to encourage increased production and commercialization from small family farms.

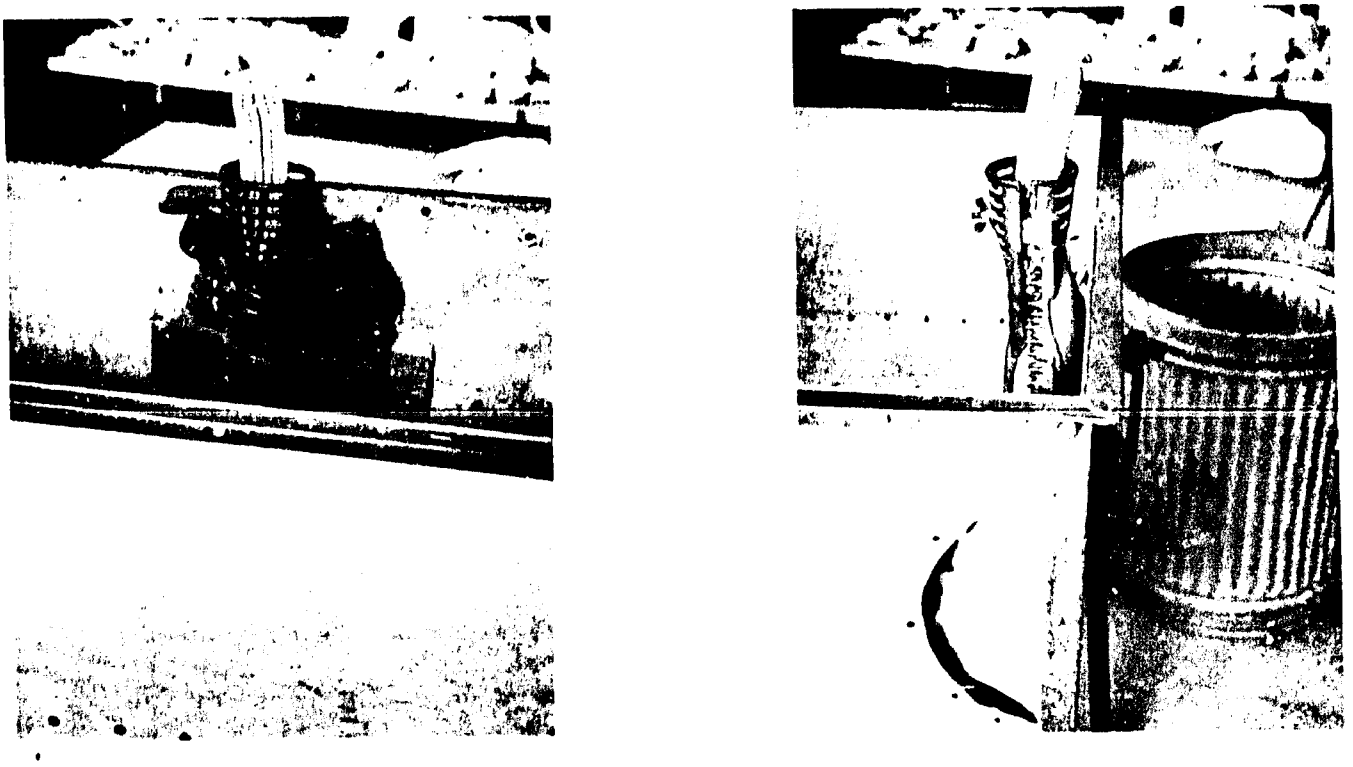
Alternative field operations are appropriate under various field conditions and various subsequent dispositions of the maize. In each general case, however, maize should be harvested approximately 1 month after maturity to permit field drying on stalks and to avoid field losses resulting when maize remains in the field for longer periods of time.

1. Field handling of maize for immediate sale. If maize is to be sold immediately when taken to the village, it may be shelled either in the field or at the village. In either case, husks may be removed when maize is picked from the stalks.

a. Field Shelling. Transport labor may be saved if maize is shelled in the field. If this is done, sun drying of husked ears of maize on field patios,

Figure V-A

SINGLE EAR MAIZE SHELLERS



V-A-1 Single ear hand cranked sheller mounted on hopper stand.

V-A-2 Fly wheel type single ear sheller - motor driven (can be hand cranked.)

mats or raised platforms in or near the field may be necessary to dry the ears to the point of easy shelling. Field shelling may be by hand or by small hand machines taken to the field (See Figure V-A). Only the shelled maize would then need to be transported to the village. Cobs and husks would be left in the field.

b. Village Shelling. An alternative to field shelling is transport of husked ears to the village for patio drying and shelling with mechanical shellers (See Figure V-B) or more extensive use of family labor. The more labor-efficient system will depend on distance transported, reduced labor requirements for shelling in the village and the value of the cobs for fuel or other use in the village. Comparative efficiencies of the two systems cannot be generalized.

2. Field handling of maize for subsequent sale. When maize will subsequently be marketed but not immediately, conditions must be provided for its storage and preservation during the period from harvest to evacuation from the field or in the village, depending on how transport/shelling operations are to be accomplished for minimum labor input.

a. Field or village crib storages will allow drying by maximum air circulation or by placing charcoal fires underneath the stored maize. The crib should be covered with a waterproof roof for protection from rain. A removeable section of the roof facilitates filling from the top. Small field storages observed in Zaire were filled from one end with ears stacked (corded) in rows. Cording of ears reduces the amount of air circulation through the maize that would occur if ears were dropped in from the top and allowed to fall in a random pattern in a crib. Objectives of drying by convection and maximizing air circulation can be achieved with alternative

COBMASTER

TWIN FEED MAIZE SHELLER

A new machine has been developed which can shell maize. It can be operated manually or can run on electricity. The machine was designed specifically for a successful small scale farmer.

The body of the machine is made of steel and this makes the machine rugged and long lasting.

Moving parts are designed such that they are self lubricating, to minimize maintenance.

This machine cannot easily go wrong.

The metal parts that are employed in shelling the grain work very accurately and satisfactorily. Dehusked ears are fed into two slots provided on the machine, and there are two rubber supports in each slot which enable big or small ears to be shelled.

There is a fan built in the body of the machine that blows air to clean the grain as it is shelled. The chaff is blown out through the front of the machine, together with the cobs.

The grain drops down through a spout underneath the machine, and can be collected in a suitable container placed under the machine.

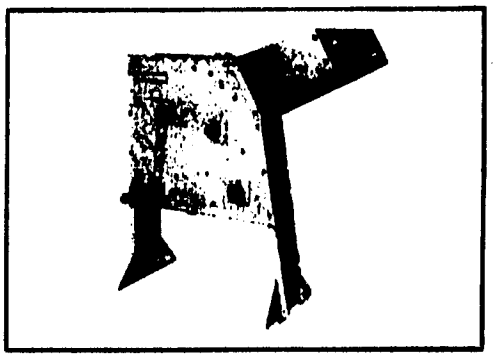
The container does not come with the sheller.

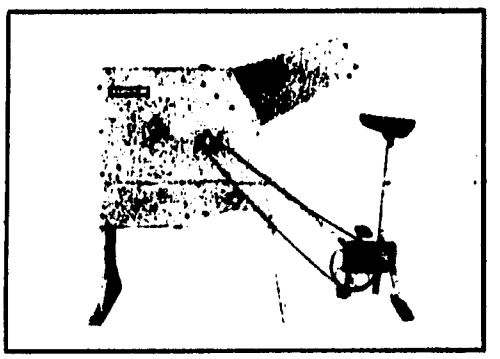
<u>There are three types (designs) of the maize sheller.</u>

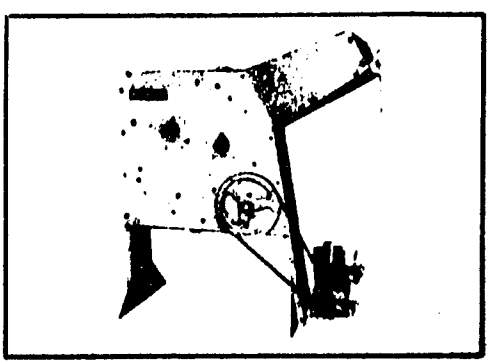
One type is hand operated. It has a handle attached to a wheel. The handle is common to all the designs.

Another important design is one that is operated by foot. There is an adjustable seat attached. In this design one man can drive and feed the machine at the same time.

The other design comes with a motor and belt, type 'A' Brammer. You can choose the type of pulley to use, like a 254 mm (10 inch) together with an engine that has 2800 revolutions per minute or a 152 mm (6 inch) pulley with an engine that has 1440 revolutions per minute. The positioning of the engine will tighten the belt automatically, because this is dependent on the engine weight. If a petrol (gasoline) engine whose capacity is 100 cc with a rating of 1/2 hp were to be used, it must have an 88 mm (3 1/2 inch) pulley.







NOTE:
Shelling rate 750-900 kilos per hour (1600-2000 lbs)
Weight 95 kg (210 lbs)
Machine speeds:
Hand operated 50 rpm
Foot operated 200 rpm
Electric 800-1000 rpm
Engine adapted for electric use 1/2 hp
A petrol (gasoline) engine 100 cc (please specify size of motor required)

DIMENSIONS
Height 1156 mm (45 1/2 inches)
Length 1073 mm (42 1/2 inches)
Width 616 mm (24 1/4 inches 1073 mm (42 1/2 inches)

designs which may be selected to make best use of indigenous materials. Appendix V-1 describes a crib for maize storage designed by FAO which makes maximum use of indigenous materials and can be constructed by farmers for use in the field or village.

B. Village Operations.

Marketing operations performed in the village include shelling of maize transported from the field in the ear, further sun-drying of ear or shelled maize, temporary storage of shelled maize for imminent sale, sale to ONACER or private dealers for delivery to a collecting station, warehouse or mill and longer term storage of ear or shelled maize for subsequent sale.

1. Village shelling of maize. Ear maize is transported to the village from the field for hand shelling prior to sale. Delivery of a maize sheller to the village prior to the buying campaign would greatly reduce village labor requirements for this operation. Total investment by ONACER or private dealers in small mechanical maize shellers as shown in Figure V-B would not be large, approximately ₹ 125-150. Provision of mechanical shellers would generate interest in the marketing of maize by small producers in addition to reducing labor requirements.

2. Further sun drying of ear or shelled maize. At present small quantities of ear maize requiring additional drying at the village are placed directly on the ground or on woven mats for added drying. With shelled maize this practice allows sand and stones to be mixed with the maize as impurities. These methods may be adequate for small quantities of maize, however, as production increases and maize with fewer impurities is demanded, other methods of sun drying may be necessary.

Large, open (not shaded) clean (no grass) patios suitable for sun-drying should be provided at villages. For dirt-patio drying of shelled maize the use of sheets of black polyethylene or polyvinyl chloride greatly facilitates collecting the shelled maize without soil contamination, and during any rainy or damp nighttime periods the thin layers of maize can be quickly and easily ricked and covered with the same sheets.

3. Temporary storage of shelled maize. After shelling in the village, maize may be held for short periods of time before sale. This is usually accomplished in small baskets or sacks stored in village huts. In some cases ONACER or private dealers may accumulate and store quantities of shelled maize in villages for short periods of time.

The limiting factor in moving maize from villages to the collecting centers is often lack of trucking capacity due to bad roads, too few trucks, and/or malfunctioning trucks. Good short-term village storage should be provided for sacked, dried maize. Temporary use of enclosed village huts with good roofs and removable, raised floor pallets to keep sacks off damp, earthen floors could serve very well for emergency short-term village storage. If necessary, ONACER or private dealers could construct good, sacked-grain storage warehouses of indigenous materials in the larger villages for short-term storage.

4. Sale of maize to ONACER and/or private dealers. The village is the point where ownership changes and it is at this point that a judiciously standardized set of differential prices can be used to promote:

a. more timely harvesting,

b. more adequate drying,

c. earlier marketing and,

d. removal of impurities.

Price discounting should be applied only where differences in grade characteristics affect the subsequent market values of maize. High moisture content affects the value per unit of weight because it results in increased weight purchased and, if above 14 percent, substantially increases the risk of spoilage. Portable moisture testers such as that shown in Figure V-C are highly valuable aids for buying early in the campaign when moisture contents tend to be high and for spot checking maize offered for sale at other times. Maize judged to be above 14 percent moisture content could be discounted at the village or rejected.

5. Longer term storage of ear maize for subsequent sale. As the marketing system in Zaire develops and small producers increase their production, longer term storage at the village will probably be needed. Individual farmers will produce maize in excess of amounts they can store in the spaces above living areas in their houses. Storage facilities will be needed if the maize is removed from the field as has been recommended.

a. Crib storage. The FAO crib design for unhusked ear maize storage shown in Appendix V-1 is recommended as an alternative for this purpose. The basic plans included in this report can be modified for use of a variety of construction materials. It is a structure that can be made by the farmer from indigenous materials at minimum cost. The crib can be made relatively rodent-proof but has no particular protection against insects. Husks of the ear offer some protection against insect attack and it is possible that the practice of drying and smoking stored maize with fires could be used with modifications of the crib base. Field testing will be required to determine the practicality of drying and smoking ear maize in the crib.

BURROWS Universal Moisture Tester

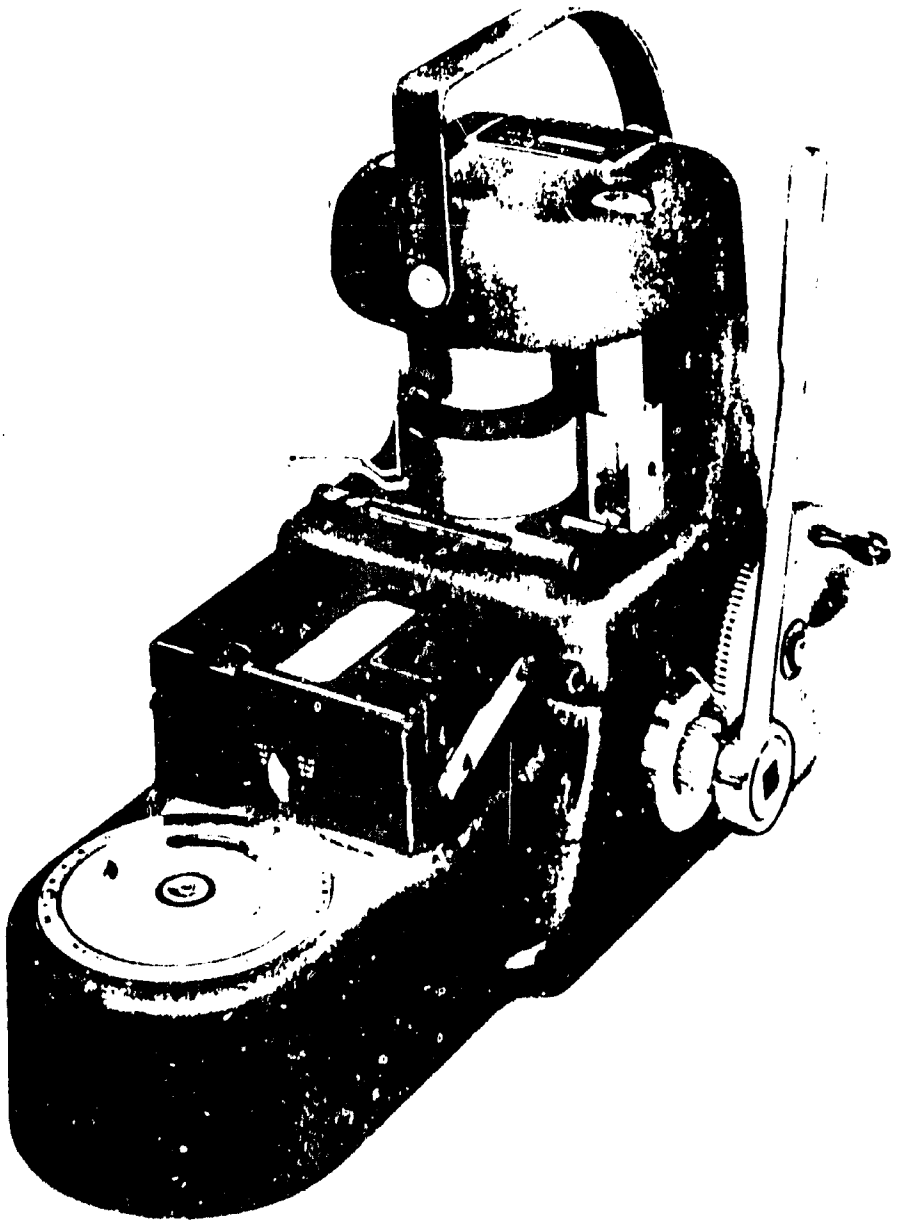


Figure V-C.

Designed and constructed upon a highly-perfected principle entirely different from that of other testers. Gives you consistently accurate and satisfactory moisture testing. The operation is based on the importance to you—of knowing the exact moisture content of your grain, seeds, fertilizers, meal and other commodities. Your business profits depend on the accuracy of your moisture tests. Overall dimensions: 12" high, 9" wide, and 19" deep. Portable. This compact instrument can be used for field testing—a practical feature saving you time and money over the years.

NOTE: Model EH can be used for testing oil-bearing grain or seed down to approximately 5 or 6% by using a factor.

HOW IT WORKS: The sample cup is removed from the instrument and filled. Next the sample is compressed to a pre-determined thickness setting as registered on a micrometer gauge. Different settings are used for various products. A built-in thermometer gives the temperature reading. The operator turns the crank on the ohmmeter-generator and obtains a reading. The final step is to rotate the upper plate of the correlator dial at the front of the instrument aligning the meter and temperature reading and the actual moisture percentage of the sample is read directly on the outer scale of the dial. To remove the sample, compression is released and sample cup is withdrawn from housing to be emptied.

b. Village Storage-shelter Design. With increasing grain volumes, or as more and better facilities are found necessa y, more permanent and secure village storage-shelters can be constructed and operated jointly or separately by the village unit and/or ONACER (or other grain buying or marketing group).

The storage-shelter should be simple and low cost in design and construction yet functionally versatile and adequate. It should also provide for sun-drying, manual handling and short-term holding or storage of both ear maize and shelled maize in bulk and in sacks. It should accommodate several alternative methods that may change during any one harvest season or with progress and expansion from year to year. It may be used for processing and storing maize for only a few months of the year. Initially it probably should not be intended or designed to be used for storing maize into the wet season or to replace household storage now in common use.

Appendix V-2 presents a suggested design for a common but highly versatile type of storehouse structure, which could be built in stages and used for many purposes. The minimum basic unit considered adequate initially is a pole-type building with a wood framed roof covered with galvanized, corrugated sheet steel or aluminum roofing. The function of permanent walls would be protection against animals or human theft, and if the building were located in a suitably enclosed or protected area, walls are unnecessary. Where walled-off sections are desired, walls can be provided with light-weight filler-sections, non-structural in nature.

Ear maize can be collected and held for large-batch power-machine shelling by use of a simple, slat-fencing material made of four or five horizontal double strands of twisted wire containing vertical wood slats about 1 m. long.

One or more rolls of this removable and reuseable slat-fencing can be joined and formed into a cylinder one tier high of the desired or necessary diameter to hold any quantity of ear maize from 1 to 100 tons. The table in Appendix V-2 gives the ear maize capacities in tons of dried, shelled maize of 1 m. high slat-fence, round cribs according to their diameter, assuming the ears to be piled to a crown slope of one vertical to two horizontal. Such single-tier cribs can be filled by baskets (also illustrated in Appendix V-2) and can be emptied by hand simply by opening the slat-fence and allowing the ear maize to flow through the opened area.

To collect and commingle ear maize from several small producers for larg batch shelling will require either the purchase of the ear maize or the devel ment of an acceptable or workable system in which the final shelled maize yie from a large, commingled batch of ear maize can be satisfactorily prorated to the several producers contributing to that crib of ear maize. More than one such temporary round holding crib may be desirable.

A concrete floor can be installed at any later date, but if provided ini· tially, mill-sawed columns can be used to advantage instead of poles. The butt-end of wood columns or poles should be treated with a wood preservative, especially when they are to be enclosed by a concrete slab.

Lining the slat-fencing with sackcloth or heavy paper could provide for temporary bulk storage of shelled maize. Sacked maize can be stacked directly on a good concrete floor briefly during the dry season, but wood pallets should always be placed on earthen floors for sacked grain piling and preferably on concrete floors.

Such large-mass crib storage should not be considered suitable for further or final drying of ear maize. Ear maize must be adequately dried before piled into the crib. Freshly harvested, cleanly husked ear maize dried to 16 percent or less kernel moisture before cribbing may be expected to store safely in ventilated crib storage for more than 2 months if free of insect infestation.

The large roof, pole-type structure suggested for village collection and holding stations can be built in a variety of ways and with many different materials. Adding a 14 by 28 meter concrete floor would nearly double the cost. Providing a concrete floor for only that part of the area to be used for shelled maize holding or storage would help minimize initial investment. The unit storage costs of almost any type of structure that provides a good roof and floor for ear maize usually will be considerably higher than that for shelled maize. The smaller the size or capacity of the structure, the higher the cost per ton of storage provided.

The wire-slat, fence-type cribbing could be locally made in the village at low cost. Four or five double strands of at least 16 gauge wire should be used to provide sufficient strength in tension for large diameter cribs or bins.

Estimated cost of constructing a village storage-shelter of the type illustrated in Appendix V-2 is shown in Table 11. Basic cost data from which Table 11 is developed are listed in Appendix V-7.

TABLE 11. COST ESTIMATES OF VILLAGE STORAGE-SHELTERS

Materials

Lumber -- 11.6 m^3 @ ₴ 50		₴ 580
Roof -- (Cor. Gal. sheet steel) - 448 m^2 @ ₴ 2		896
Cribbing-fencing (2-12 m. cribs) - 75 m. @ ₴ 1		75
Hardware and Miscellaneous		150
TOTAL MATERIALS		1,701
Labor @ 20% of materials - - -		340
Estimated total storage cost		₴ 2,041
Unit cost for ear maize per ton of shelled maize (2-12 m. cribs - 162 tons) - ₴ 12.60/ton		

Equipment

Small cylinder sheller with 16 HP gas engine		₴ 825
Platform scales		300
Misc. tools and equipment		50
	TOTAL	1,175
Plus 30% shipping cost		330
	Total	1,505
GRAND TOTAL		₴ 3,546
Grand unit cost for ear maize storage	₴ 21.89/ton	

C. Collection Centers

The following functions should be performed at collection centers when maize is handled in sacks:

(1) Maize is unloaded from trucks, sampled, weighed and classified on the basis of pertinent quality characteristics.

(2) If it is to be shipped immediately, maize is stored only until transport is available and sufficient quantity has been assembled to load a rail carload, barge, or other vehicle.

(3) If shipment to mills is delayed, sacks are stacked in the warehouse in the manner illustrated in Appendix III-4 and quality control measures applied as recommended in Chapter VI.

The following functions should be performed at collection centers when maize is handled in bulk:

(1) Sacked maize is unloaded, weighed, sampled, and classified.

(2) Sacks are emptied, cleaned, and returned to trucker or village buyer.

(3) Acceptable grade grain is conveyed to bulk storage via cleaner according to classification:

a. extra-dry high quality (13 percent moisture or below)
b. standard quality.

(4) Off-grade grain is conveyed via cleaner to a special bin for further drying or other treatment.

(5) Railcars are loaded in the case of immediate transhipment.

(6) All grain above 13 percent moisture, if stored for more than a few weeks, should be dried with low humidity natural air:

a. to 13 percent level for 1 to 2 months storage, or
b. to around 12 percent level for more than 2 months storage.

(7) All stored grain is inspected periodically and given insect control treatment as recommended in Chapter VI.

The need for orderly establishment of a series of collection centers cannot be over-emphasized. Good storage facilities are indispensible for the establishment of a viable national maize marketing system. But either too much or too little storage capacity can result in serious economic loss.

The most logical first step would be to use storage now available that is suitable or can be adapted or made suitable by repairing or remodeling. Caution needs to be exercised here since miscellaneous structures can become very expensive storage if they permit quantity or quality losses. The basic requirement of any storage structure or system is to handle and hold grain without loss of quality and to do this at the lowest possible overall cost.

Many factors need to be considered in the selection of facility sites. These include (1) past, present, and probable future patterns of maize production, (2) available transportation facilities, and (3) availability of electricity. In view of the present road conditions between the production areas and the mills, it is obviously desirable to locate as many of the collection centers as possible with access to rail or river transport.

A basic requirement considered in the proposed design layouts of these centers is provision for orderly and efficient expansion. Table 12 (Figure V-D) is a proposed list of possible sites and suggested first year storage capacities. Site selection for facilities should include land for possible expansion. It is recognized, however, that the incremental size of storage capacity expansion as well as the total final capacity at any site can best be determined by actual marketing records obtained as the program develops.

If the original structures are built by ONACER, subsequent expansion will depend upon the extent to which private dealers participate in marketing at collection centers and the manner in which their own facilities are provided. Decisions concerning development of buffer stock by ONACER will also have significant influence on ultimate size of facilities at collection points.

Collection point storage capacity must be increased over the next decade. If ONACER plans for 20 to 25 percent of current market and the operation of a storage/buffer stock program, it is conservatively estimated that total ONACER warehouse capacity for corn should be expanded to 100,000 tons by 1985. A portion of this expansion may be at milling points. Projected plans for ONACER to increase warehouse capacity by 10,000 tons per year over the ensuing 8 years after 1976 appears to be an appropriate objective.

TABLE 12. PROPOSED SITES AND CAPACITIES OF COUNTRY COLLECTION CENTERS FOR RECEIVING, STORING AND SHIPPING MAIZE

Site	1976 Capacity
	metric tons
Mweka	2,000
Luputa	2,000
Mbuji Mayi	2,000
Kongolo	2,000
Kaniama	2,000
Kananga	2,000
Nyunzu	2,000
Kikwit	2,000
Kamina	2,000
Idiofa	2,000
	20,000

The strategy of this program is to get commercial maize out of the villages before the onset of the wet season. Without significant improvement of storage facilities, 4 months is about the maximum safe harvest and storage period for large quantities of commercial maize in Zairian villages. The dry season, and therefore passable country roads, frequently exceeds 4 months; however, most of the maize is likely to be delivered in a 4-month period. The sooner maize can be moved to collection stations after harvest and field drying, the less will be the field and farm infestation and spoilage.

By 1980, movement of maize to urban consumption centers will be between 260,000 and 340,000 metric tons (Tables 5 and 6, Chapter II), with a projected urban average volume of 390,000 metric tons and assuming that one-third of the current year's production is consumed during the 4-month harvesting/marketing season, stocks of 200,000 tons from the current crop will be in warehouses at the end of the harvesting/marketing period in 1980.

At the rate of expansion in warehouse space projected, ONACER should operate warehouse space for 60,000 tons by 1980. This amount of space would be only slightly more than one-fourth the space required for storage of stocks from the 1980 maize crop. If by 1980 ONACER begins to plan for year-to-year carryover of buffer stocks of maize, a need to continue expansion of warehouse capacity at a rate of 10,000 tons annually at least through 1984 is likely. Conversion of existing warehouses to bulk storage may also begin by 1980.

1. Warehouse for sacked maize. A warehouse for sacked maize with a minimum capacity of 2,000 tons is recommended for each of 10 designated collection centers. It is anticipated that these warehouses will be used only for transit storage at this time. Capacity of a warehouse of this size will permit accumulation of up to 55 to 60 train carloads at local points during the campaign if rail cars were not available to load maize as rapidly as received. A proposed warehouse design is shown in Appendix V-3. The design of the proposed warehouse is such that it can later be converted to bulk storage by removing part of the wall sections and placing cylindrical bins beneath the warehouse roof.

The extra cost initially of building this warehouse to accommodate later conversion to silo type bulk storage is relatively small. The extra requirements are the sub-floor ducts, the split truss design and the additional enclosing walls. Special consideration is required in its location to provide for future bulk load-out into railcar and/or river barge.

Estimated cost of construction and equipment for the recommended design is presented in Table 13. Basic unit cost data from which Table 13 is developed is found in Appendix V-7.

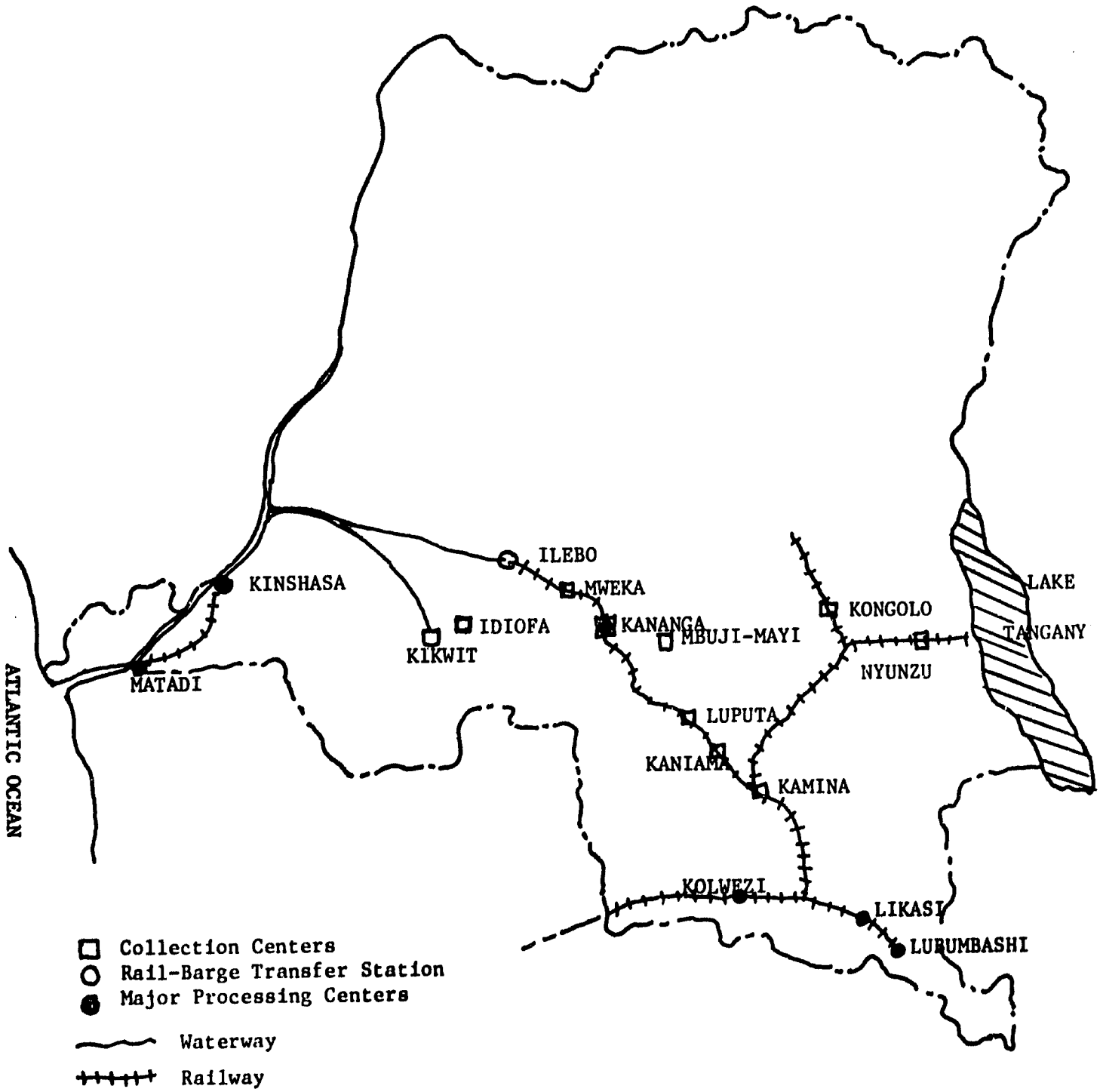


Figure V-D. PROPOSED SITES FOR 10 MAIZE COLLECTION CENTERS

Table 13. Cost Estimate for Country Collection Warehouse

Materials--	Estimated Cost
Warehouse	
Concrete--114 m^3 @Z25	Z 2,850
Rerod--900 Kg. @Z0.50	450
Lumber--34 m^3 @Z50	1,700
Roof--(28 g. gal. sheet steel) --840m^2 @Z2	1,680
Walls--(28 g. gal. sheet steel)--940m^2 @ Z2	1,880
Hardware and Miscellaneous	1,000
Materials Total	Z 9,560
Labor @ 30% of materials	2,868
Total estimated storage cost	Z 12,428

Capacity:
Warehouse (sacks)--Gross volume 4522m^3
Useable volume @ 72%=3256m^3
Capacity @ 1.8m^3/M.T.=1809 M.T.

Unit Storage capacity cost-- Z6.87/M.T.

Equipment Imported:

1 Bag conveyer (5m)	Z 500
1 Cylinder grain cleaner	250
1 Platform scale	300
1 Set grain laboratory equipment	504
Total imported equipment (FOB)	Z 1554
Plus 30% shipping cost	466
Total Equipment Cost	Z 2,020
Grand Total Estimated Cost	Z 14,448

Grand Total unit cost--Z7.99/M.T.

Expansion of collection point capacity may occur by adding to the basic warehouse for additional sack storage. Additions should extend along the rail track where the warehouse is served by a railroad for convenience in loading. Expansion of sack space may be desirable if storage at collection centers continues to be for only short periods and if maize must be shipped by sack. However, with expanded commercialization and longer-term storage in ONACER facilities, advantages accrue from bulk storage and handling.

2. Bulk Storage. When grain is handled and transported in bulk, substantial savings of investment in sacks occurs. Sacks in which maize is delivered from the village can be cleaned and repaired and subsequently are reuseable for delivery from the villages.

A second advantage of converting to bulk storage is that handling maize and loading on out-going vehicles can be mechanized through use of very simple machinery to reduce the amount of human labor required for moving grain.

If maize is to be stored for any extended period of time, as may be the case if ONACER operates a market regulatory function through control of critical supplies, one of the basic functions of the collection stations will be to clean, condition, and treat maize as necessary to prevent further quality deterioration. Maize may also need to be dried in preparation for long-term storage. These functions can be performed more effectively and efficiently when maize is handled in bulk.

Cereal grains are endowed by nature with properties favorable for long-term preservation in storage if they are properly dried soon after maturity and then kept dry. To better understand the functional basis for the system and designs proposed, it is helpful to have a basic understanding of how this

system can be made to work well to safely and economically preserve maize for long periods under Zairian conditions. Relationships between the moisture content of the grain and that of the interstitial air associated with the grain and the effects of the level of these moisture contents on the rates of development of grain molds and grain insects - the two major destructive agents of grain quality are basic to understanding good grain storage. For discussion of the functional operation of a bulk storage system see Appendix V-4.

3. Alternative designs for bulk handling at Collection Centers. The southern and eastern maize production regions of Zaire are favored with a dry season for harvesting and processing their crop of maize. With proper design and operation of storage structures, these periods of low relative humidity air can be utilized to great advantage to condition grain for safe storage into the wet season and even to carry over grain into the following dry season, if necessary, without serious loss of quality.

Bulk storage with aeration equipment is the most practical system to utilize these periods of low relative humidity air to advantage. Drying to low moisture content is the single most effective method of preserving grain quality in storage for long periods.

Two alternative designs or layouts are presented in Appendix V-5 and V-6 which provide for sack receiving and bulk storage, conditioning and delivery.

(a) The common-roof plan. The first plan, Appendix V-5, is designed to utilize materials normally available within the country, i.e. concrete, masonry, lumber, reinforcing and roofing steel, or as an alternative, the use of circular steel bins when space is converted to bulk storage. It is a type of structure that can be used entirely for sack handling and storage at first, then

converted to all bulk storage, with only sack receiving. The plan shows a common type of warehouse roof construction. It is supported entirely on columns with a split-truss arrangement to provide maximum head space or clearance down a central passageway between the two rows of bins. When converted to bulk handling and storage, this high-clearance center alleyway accommodates sufficient height and freedom of movement for a single portable auger elevator to serve all the bins. Sacks can be dumped directly into the auger boot or into a portable, cylinder-type cleaner which discharges directly into the auger boot.

Light weight, filler-wall sections between the columns are required only for that area to be used permanently for sack or general warehouse storage. One of the desirable features of starting with this common-roof system is that all the space or floor area can be used initially for only sack handling and storage, bulk bins and handling equipment to be added later. It is highly recommended that any new warehouse construction to be used initially for only sacks be planned for easy, efficient conversion to bulk handling and storage at any future time. The proposed layout in Appendix V-5 was designed with this specific objective in mind. Special provision for future conversion requires proper spacing of the columns, the twin-truss arrangement and the installation of the main sub-floor ducts into the original concrete floor and foundation design for future round bins. These large sub-floor ducts are then covered for sack storage.

Some suggested design details for round silo installations, methods and equipment for aeration-drying and bulk loading and unloading are presented in Appendix V-5.

The most efficient and economical structural shape for a bulk grain storage bin is a cylinder. Cylindrical bin walls can be made from pre-cast concrete staves, properly hooped with steel rods and plastered preferably both inside and outside for dry grain storage; brick and mortar properly reinforced with steel rods and plastered inside and outside; or prefabricated, corrugated, galvanized steel sheets that are well caulked as they are bolted in place. Good quality construction with any of these materials will provide excellent walls for round bins. The choice is largely one of availability, cost, and local know-how or preference.

As noted in Appendix V-5, all dimensions given are for a round bin size of 7.3 m diameter by 7.3 m height (24 feet by 24 feet). This size bin can store a little more than 200 tons of dry maize. These dimensions were somewhat arbitrarily selected for these suggested designs. However, increasing the bin diameter will require a larger and higher roof structure. Also, bins deeper than about 7.3 m would require vertical cup elevators and horizontal conveyors, which are very common equipment for moving grain into and out of bulk storage, but which are much more expensive in first cost than the portable auger recommended for smaller bins diagrammed in Appendix V-5. Also, bins deeper than 7.3 m are not as well suited for aeration-drying, i.e. much larger fans and motors would be necessary to force the required quantities of air through the deeper grain.

Relatively low cost and versatile equipment for loadout into rail cars is illustrated in the plan. If the rail siding is immediately adjacent the side of the warehouse for more convenient sack loading or unloading, then a

vertical auger elevator could be permanently installed for each pair of bins. Electric motors would then be required for the loadout augers in place of the single, portable, engine-driven auger illustrated in the plan.

If the site does not have suitable electric power, gas engines can serve well to operate the fans. Portable engine-fan units, designed especially for drying grain, are commercially available from several manufacturers. Sub-floor horizontal conveying augers probably should be powered with small, electric motors. A collection center should have at least some electric power available to provide light for small power equipment such as cleaners, and for laboratory equipment such as electric moisture testers. As a last resort, small 5 to 10 KW motor-generator sets could be provided. The Inga-Shaba transmission line is providing switching stations at Kikwit, Kananga and Kamina so abundant electric power can be anticipated at these locations at some future time.

Future expansion of this common-roof system is accomplished simply by increasing the length of the common-roof and installing more round bins, preferably in pairs. The common-roof design does not show any permanently constructed tops or covers for the individual bins. For bulk bin storage structures in tropical environments, the real functional need for tight covers over the top of each bin where they would have no utility as a roof is a subject of debate.

Numerous field observations and experiences have been reported and documented that metal bins with tightly sealed roof-to-wall joints located in humid, tropical regions permit development of severe moisture migration within the bin. But, apparently (and unfortunately) there has been little or no investigation or

experience with open-top metal bins provided with good cross-ventilation. There is little question but that good cross-ventilation of the space between the grain surface and roof would dissipate any moisture migration. The concern is that such free ventilation, especially during the wet season, would also permit reinfestation and rehumidification of the surface grain. There is good reason to believe that when there is daily sunshine for a few hours at least, such as occurs throughout the year in the maize growing regions of Zaire, that the small pickup of moisture by the surface kernels from the nighttime air would be re-evaporated each day by radiant heat transferred from the hot metal roof during the daily sunshine hours, and that this moisture would be carried away if there is good cross-ventilation. Maize dried to low moisture content and free from insects or disinfested after placement in storage would be subject to reinfestation at the surface. Frequent inspection and treatment for any surface infestation if and when it is detected would be required.

The only suitable method and materials readily available within the country to tightly cover these silos would be a steel beam or truss supported flat steel sheet deck or a reinforced concrete slab. Estimates indicate that the use of either of these would nearly double the construction costs for these relatively small silos, prevent cross-ventilation, and eliminate the head room provided by the common-roof above the bins. They could create more problems than they solve.

It would be desirable to use wire screening to isolate the space above the bins and beneath the roof to exclude birds, other animals and thieves. Although birds probably would not consume large quantities of grain from the storage, the over space provided numerous roosting areas and could lead to

contamination of the stored grain with bird excrement. Screening material has not been included in cost estimates.

In view of the above, it is recommended that at least one or two bulk units of this type design be constructed and put into operation at an early date. Careful observation will identify and allow correction for problems that may arise in use of this design in Zaire.

(b) The 4-bin cluster unit. The second type layout or design proposed, Appendix V-6, consists of a basic receiving area (or 2,000 ton sack storage warehouse) with bulk storage through use of standard-type round steel bins, handling equipment, and drying-aeration fans and equipment, all of which is commercially available from several manufacturers. It comprises the most modern methods of rural storage now being sold and employed in the temperate zone grain producing regions of the world. The warehouse for receiving and handling the sacked maize and other farm supplies could well be constructed with locally available materials, but the rest of the facilities probably would have to be imported.

Where a good sack warehouse already exists and the site can be made suitable for placement of bulk storage bins, remodeling of the sack warehouse to accomodate this type of bulk storage expansion would require only the installation of the receiving auger-elevator. The sack-dump pit may or may not be considered desirable. Without the dump pit, an above-floor hopper on the boot of the auger elevator could serve as the sack dump.

Where only a sack warehouse is desired initially, one end of the warehouse should adjoin the railroad track for a track siding arrangement for direct rail-

car loading of either sacked or bulk grain (the sacks to be emptied directly into an auger elevator hopper or dump pit). This would not substantially change the orientation of the round bin arrangement with the railroad siding as shown in Appendix V-6. The direction of any future bulk bin expansion would still parallel the rail siding, and a single overhead auger conveyor could be used to convey the grain to additional 4-bin cluster units.

Each bin has a prefabricated, cone-shaped, light-weight, self-supporting, sheet steel roof. To prevent moisture from accumulating at the grain surface, cross-ventilation can be provided by raising the roof above the upper edge of the metal wall about 5 cm by means of several small, metal clips. Each bin is also completely equipped with floor auger, roof auger, and a complete set of aeration-drying equipment. The aeration-drying equipment consists of the fan-motor unit and the air ducts or plenum system. Specially designed fan-motor units are available in a wide range of sizes - 1 hp to 20 hp or more for this purpose. There are two general types of air distribution systems: (1) a perforated-raised floor and (2) perforated ducts. For either type system, it is preferable to have a main sub-floor delivery duct built into the concrete floor foundation. This duct also accomodates the sub-floor delivery discharge augers. The desired size of the fan-motor unit and type of air distribution equipment depends primarily upon the amount of in-storage drying to be attempted. For the 7.3 m diameter bins shown in Appendix V-5 and V-6 a 2 hp fan-motor unit with ducts probably would be adequate for initial moisture contents of maize no higher than 15 percent, while a 3 or 5 hp motor-

fan unit with a raised, perforated floor would be desirable for initial moisture content maize above 15 percent.

Reliable and ample electric power must be available at any site where this system is to be installed, as several electric motors are necessary for handling and aerating the bulk-stored grain.

Use of the simple sweep auger mechanizes the removal of grain from flat-bottomed silos. These light-weight augers are removed from the bin after it is emptied and installed again through the access door after the grain ceases to flow by gravity to the center of the hopper when emptying the silos.

It is very important, especially for the duct system to effectively seal the bin-wall-floor joint, to prevent entrance of rainwater and to place a vapor barrier in the concrete floor. Methods to do this effectively and permanently are shown in the detailed sketches in Figure V-6.

Orientation of the bin arrangement with the railroad siding will depend upon whether both sack and bulk railcar loading is required or just bulk-grain loading into railcars. In the case of the former, the rail siding should be run along the top of the plan shown in Figure V-6 to permit loading sacks directly from the warehouse storage into railcars. Expansion of the unit by adding more bins should parallel the direction of the rail siding.

D. Cost Estimates for Country Collection Stations. As discussed above, two alternative approaches are suggested (1) the common-roof unit which can be used entirely for sack handling and storage initially, and (2) the 4-bin cluster

unit, for which a relatively small sack warehouse is required initially, but for which expansion consists entirely of groups or "clusters" of the common, standardized round steel grain bins, which are suitable only for bulk handling and storage.

As will be noted, the cost estimates for the common-roof unit apply only to the size of unit shown in Appendix V-5 (1,700 tons capacity sack and bulk), and that a reinforced, plastered brick and motar wall was somewhat arbitrarily selected for the six silos shown. Prefabricated steel bins (walls only - no roof or floor) might be imported and erected with much less labor and possibly at lower total cost.

Unit cost data for estimating cost of constructing and equipping facility are presented in Appendix V-7. Current FOB prices and other data of standardized, prefabricated round steel grain bins, both with and without the bin roofs, are given in Appendix V-8. FOB net costs listed in Appendix V-8 are the retail prices less 35 percent, which may be considered about the FOB factory price to a dealer-builder. As pointed out above, shipping costs for containerized, prefabricated and nested steel sheets would be calculated on the basis of weight and may be estimated at about 10 cents per pound. The current FOB dealer-builder cost is 40 cents per pound regardless of the size of bin as calculated from the data in Appendix V-8. Adding 10 cents per pound for shipping costs gives the CIF total costs and unit costs per metric ton of storage capacity tabulated in the last two columns of Appendix V-8. As shown

in Appendix V-8, these costs vary from around $6 to $12 per ton (Z 3 to 6). Expressed in makuta per 70 kg. sack of maize, this is 21 to 42 makuta per sack of storage capacity, which is less than the current cost of one set of new sacks.

As indicated in Table 14, estimated cost of reinforced, plastered brick and mortar silo walls, assuming erection labor to cost only 30 percent of materials cost, is Z 3.70 per ton capacity, or about the same as the larger diameter imported steel bin walls.

Storage capacities listed in Table 14 are based on a normal amount of crowing or center piling above the upper edge of the bin wall, and shelled maize with a pack factor of 5 percent or an average grain density of 0.753 ton per cubic meter.

CIF costs for imported steel bins with regularly equipped cone-shaped roofs (less floors and any equipment) per unit storage capacity calculated from data in Table 14 varies from around $10 to $15 (Z 5 to 7.50) per ton storage capacity.

TABLE 14. COST ESTIMATES OF COUNTRY COLLECTION STATIONS

1. Common Roof Unit (Appendix V-5)

Materials --

		Est. Cost
Warehouse		
Concrete -- 114 m^3@ Z 25	Z	2,850
Rerod -- 900 kg. @Z 0.50		450
Lumber -- 30 m^3 @Z 50		1,500
Roof -- (28 g. gal. sheet steel) -- 840 m^2@Z 2		1,680
Walls - (28 g. gal. sheet steel) -- 252 m^2@Z 2		504
6 Silos (walls only) 7.3 m. x 7.3 high		
Plastered brick and mortar -- 1000 m^2@Z 3		3,000
Rerod (hoop and vertical) 2670 kg. @Z 0.50		1,335
Hardware and Miscellaneous		1,000
Materials total	Z	12,319
Labor @30% of materials		3,695
Total estimated storage cost	Z	16,015

Capacity:

6 silos (bulk)	1300 tons
Warehouse (sacks)	400 tons
	1700 tons

Unit storage capacity cost -- ₴ 9.42/ton

Equipment --

3 sets of perforated, raised floor supports (cement block and lumber) @₴ 100		₴ 300
3 sets additional concrete floor slabs @₴ 100		300
Imported:		
3-perforated-raised floors @$555	$1,665	
3-sets of above floor ducts @ $210	630	
1-18 m. x 6" auger with engine & transport	1,550	
1-6 m. x 6" " " " "	235	
1-7 m. x 6" sub-floor auger, hopper & motor	355	
1-9 m. x 6" sub-floor auger, hopper & motor	486	
1- Sweep auger and motor	229	
2- Fan-engine units @$1820	3,640	
1- Cylinder grain cleaner	550	
1- Platform scales	600	
1 set- Grain laboratory equipment	1,007	
Total imported Equipment FOB	$10,947	
Plus 30% shipping cost	3,284	
	$14,231	--₴ 7,116
Total equipment costs		₴ 7,716
Grand total estimated cost		₴23,731
Grand total unit cost	₴ 13.96/ton	

2. 4-Bin Cluster-Unit (Appendix V-6)

Materials

Sack receiving-holding warehouse		
Concrete -- 37 m^3@₴ 25		925
Re-rod -- 250 kg.@₴ 0.50		125
Walls (plastered brick and mortar) 230 m^2@ ₴ 3		690
Lumber -- 4.33 m^3 @ ₴ 50		216
Roof -- 204 m^2 @ ₴ 2		408
Hardware and Miscellaneous		100
Material Total		₴ 2,464
Labor @30% of materials		739
Total		₴ 2,203

One 4-Bin Cluster-Unit			
Concrete (foundation & Floor) -- 47.6 m^3 @Z 25			Z 1,190
Steel bins (with roof) -- 4 bins -- FOB	$ 9,920		
Plus 30% for shipping	2,976		
Plus 10% for erection	992		
Total	$13,888	--	Z 6,944
Total estimated storage cost			Z11,337
Capacity 4 Bin Cluster Unit (Bulk) -- 880 M.T.			
Unit storage capacity cost -- Z 12.88/ton			
Equipment			
Common hopper unit for 4-bin cluster (upper & lower hopper, roof & supports)			Z 300
2 sets - Perforated, raised floor supports @ Z 100			200
2 sets - Concrete floor slabs added for ducts @Z 100			200
Imported:			
2-Perforated, raised floors @ $555	$ 1,110		
2 sets - 1/2-round ducts @$210	420		
1-14 m. x 6" Auger with motor	1,040		
1-11 m. x 6" Auger with motor	958		
4-6 m. Sub-floor augers with hoppers and motors	1,320		
1-Sweep auger with motor	$ 229		
2-1 hp Aeration-drying fan-motor units	594		
2-3 hp Aeration-drying fan-motor units	840		
2-Humidistat controls	50		
2-Time-clock controls	50		
1-Cylinder grain cleaner	550		
1-Platform scales	600		
1-set -Grain Laboratory equipment	1,007		
Total	$ 8,768		
Plus 30% shipping costs	2,630		
Total	$11,398	--	Z 5,699
Total equipment costs			Z 6,399
Grand total estimated cost			Z 17,736
Grand total unit cost Z 20.15/ton			

D. Terminal or mill-site stations

While accurate figures were not obtained on the total mill-site or terminal storage capacity available at the milling centers in Zaire, there were no reports or indications of any immediate future needs of increased terminal

storage capacity. Some improvement of the maize handling facilities at certain sites appeared justifiable, but we concluded that no additional terminal storage is required during the early stages of this program.

If and when more terminal storage becomes desirable or necessary, its design and construction could well be based on the successful use and experience of the larger capacity and most preferable type of country collection station units.

E. Summary

We recommend harvesting of maize approximately 1 month after maturity to reduce field losses. If maize is to be sold immediately, husk may be removed from the ear when picked from the stalk. Shelling may also be done in the field to reduce transport labor.

Maize stored by producers for later sale may be stored in the ear (husk on) in the field or in the village in crib-type storages made from indigenous materials. Mechanical shellers and provision of drying patios or platforms in fields or villages will improve market preparation techniques for maize. An alternative larger scale storage facility for the village to be operated by buyers is also illustrated.

We recommend immediate construction of collection center warehouses by ONACER at 10 locations totaling 20,000 MT capacity. Provision should be made for increasing ONACER warehouse capacity at a rate of 10,000 MT per year through 1984. Conversion to bulk handling of grain should be considered at a later date, especially if a buffer stock program is undertaken and if railroad transport can be converted to bulk handling.

Mill site storage facilities appear adequate at the present time.

VI. PRESERVATION OF GRAIN QUALITY IN THE MARKETING SYSTEM

Prior to presenting the team's recommendations for preservation of grain quality in the marketing system in Zaire, it is necessary to provide some background information on which the recommendations are based. Preservation of grain quality in the marketing system is aimed at economically preventing reduction of food quantity and quality caused by the several factors of deterioration. This is doubly important at a time when Zaire is short of maize and required to import substantial quantities. Unnecessary loss of food is wasteful through reduced food quantity and quality and also wasteful of basic resources used to produce the food. Losses, substituted by imports, increase the outflow of capital from Zaire.

A. Factors Which Result in Storage Loss

Several factors, independently or in combination with one another, are responsible for losses of food grains. Each of these factors is discussed separately, however, the reader should realize that, in most cases, the factors are interrelated. Causes of loss considered here include (1) insects, (2) rodents, (3) molds, (4) birds, and (5) spillage.

Insects. One of the most common causes of loss is insect infestation. Although there are some 50 to 75 different species of insects which infest and consume maize and other cereal grains, about 15 are commonly associated with serious losses.

Insects which infest and damage grain are generally cosmopolitan in distribution and those recognized and reported from other areas of the world are also found in Zaire. Table VI-1 lists several of the more common species of insects which infest cereal grains and grain products. Species which were observed in

TABLE VI-1

Alphabetical list of the major insect pests of stored grain

Scientific Name	Common Name
Acarus siro L.	Grain mite
Anagasta Kuhniella (Zeller)	Mediterranean flour moth
Cadra cautella (Walker)	Almond moth
Cryptolestes ferrugineus (Stephens)	Rusty grain beetle
Cryptolestes pusillus (Schonherr)	Flat grain beetle
Cryptolestes turcicus (Grouv.)	Flour-mill beetle
Ephestia elutella (Hübner)	Tobacco moth
Oryzaephilus surinamensis (L.)	Saw-toothed grain beetle
Oryzaephilus mercator (Fauv.)	Merchant grain beetle
Plodia interpunctella (Hübner)	Indian-meal moth
Rhyzopertha dominica (F.)	Lesser grain borer
Sitophilus granarius (L.)	Granary weevil
* Sitophilus oryzae (L.)	Rice weevil
Sitophilus zeamais Motschulsky	Maize weevil
Sitotroga cerealella (Olivier)	Angoumois grain moth
* Tenebroides mauritanicus (L.)	Cadelle
Tribolium castaneum (Herbst)	Red flour beetle
* Tribolium confusum Duval	Confused flour beetle
Trogoderma granarium Everts	Khapra beetle

Zaire are marked with an asterisk. No reference to specific insects in Zaire were found in literature reviewed in this study.

An ONACER employee indicated the most common insects were weevils (Sitophilus sp.), square necked grain beetle (Cathartus quadricollis Guér), and a moth (Mussidia nigrevenella Rag.) The moth is one of the insects which are not cosmopolitan and only reported from Africa.

Insects observed most frequently in maize during this study were Sitophilus oryzae (rice weevil) and a moth, probably Mussidia nigrevenella. Sitophilus species were commonly observed in all types of storage. Moths were more common in maize in the field and newly harvested maize being marketed. Moth infestations were also noted in warehouses.

A color print of principal stored grain insects with a brief description of each is included as Appendix VI-1.

Damage and loss caused by insects are increased by warm temperatures and by atmospheric humidities in the range of 70 percent and higher. These conditions are common in maize production and storage areas in Zaire.

Under temperature and humidity conditions prevalent in Zaire, especially at the lower altitudes, most of the insects infesting cereal grains will complete their development from egg to adult (life cycle) in about 1 month. Once insects become adults, they are capable of mating and laying eggs, usually within 1 week. Each female insect is capable of laying from 50 to over 400 eggs, depending on the species. Because of relatively short life cycles (1 month), short regeneration periods (less than 1 week), and large number of eggs laid per female (50 to 400+), insects can multiply in large numbers in a relatively short period of time. A mated pair of weevils, for example, could produce over 1,000,000 insects

in a period of approximately 5 months unless measures are taken to prevent their increase.

The most damaging insects are those which develop inside grain kernels. Included are the weevils (Sitophilus sp.), lesser grain borers, and the Angoumois grain moth. They are not detected until they have consumed the grain and are ready to produce the next generation. In maize, these insects cause a reduction of about one-fifth the weight of the infested kernel.

To add to the complexity of the storage problem, some species of insects which cause serious damage in storage (Sitophilus sp. and Sitotrogra cerealella) actually infest maize and other grains in the field before they are placed in storage.

Termites, not usually considered a pest of stored grains, are responsible for losses in Zaire while maize is stored in the field.

Insects cause direct damage to the grain by consuming large quantities. They contaminate grain with excrement, cast skins and webbing. Their metabolic activities (production of heat and moisture) can result in conditions favorable for development of molds and the loss of additional quantities of maize.

Rodents. In some countries, rodents are said to cause as much as 20 percent loss in quantity of stored grains. No estimates are known for Zaire. In addition to actually consuming grain in their diet, rodents damage grain by contaminating it with their excrement and urine. This contamination can be the cause of human and animal disease. Holes in bags created by rodents result in the spillage of grain and make the bags unusable or require their repair. Chewing can cause damage to storage structures also.

Rodent damage to grain at the farm level was not observed in Zaire. Some evidence of rodent activity was noted in dealer warehouses and at large mills, however, the damage did not appear extensive. Storage practices make it difficult to actually determine the extent of damage.

Molds (Fungi). High humidity can result in loss of grain due to molds. Molds can grow in grain with moisture content as low as 14.5 to 15.0 percent, however, most serious damage is done to grains at moisture contents above 16.0 percent. Like insects, molds are cosmopolitan in their distribution.

Molds produce heat in their metabolic processes. At relatively low humidities and low levels of mold development, loss of germination of seeds occurs. At higher levels of mold development, large amounts of heat are produced. Kernels turn dark and their nutritive value is severely reduced or completely destroyed. In large stacks of grain or grain stored in bulk, the heat generally cannot dissipate and may reach a point (50^{o}C.) where other processes will cause the temperature to increase until combustion occurs.

Evidence of mold damage to maize was observed in the field and in storage. Mold damage in the field was observed where ears of maize were in direct contact with the earth. Most of the maize observed in this condition was in the field after harvesting. A large pile of ear maize stored at the FEDS compaund in Kaniama was heating as a result of mold developing on maize with moisture content above that safe for storage. At the Minoterie du Kasai in Kananga bags of maize that had been wetted in rail car transport were set aside. The bags were rotted and broken and maize had sprouted. This maize was not placed in regular storage but would eventually be milled with good maize. At the Kikwit ONATRA

river terminal a private dealer delivered sacked maize, which had evidence of some mold damage, for shipment to Kananga. No attempt was made to identify the molds present in the maize nor was an attempt made to estimate loss due to mold.

In the past decade, the ability of molds to produce toxins or toxic materials in grains has become more important. Aflatoxin, produced by the mold, Aspergillus flavus, is one of the most deadly poisons known. Aspergillus flavus grows well on maize at moisture contents above 16 percent and may or may not produce the toxin depending on the "strain" or variety of Aspergillus flavus and the temperature and humidity conditions. There are a few documented cases of human deaths due to aflatoxin and large numbers of animal deaths recorded.

Birds. Damage is often caused to grains, especially maize, in the field by birds. Not only do birds feed on the maize in the ear, but their feeding also exposes the ear to insect and mold invasion. At storage sites and processing plants birds feed on spillage and may contaminate the grain with their excrement. It is possible to spread disease in the excrement of the birds. No particular problem with birds was noted during this study.

Spillage. Considerable loss of grain can be experienced due to incomplete harvesting (a form of spillage) in the fields. Ears of maize left in the field are lost as food and can become infested and serve as a source of infestation for the succeeding crop. Spillage because of improper handling and broken sacks can result in considerable loss also.

B. Points in Marketing System Where Losses Occur

Losses of maize and other grains cannot be isolated to any one part of the marketing system. Losses occur at all points in the flow of maize and other grains from the producer to the consumer.

We observed insect and mold losses occurring in the field before the grain is harvested and brought into storage or marketed. We saw losses due to insects and molds in producer storage facilities. In dealer warehouses, insects, rodents and molds were observed causing losses. We saw losses occurring in transport of grains from dealers to processors or other storage sites. Losses were also observed in processor storage. Processors, if they store the finished product for any length of time, can experience losses in flour, grits or other products also. Transport to the baker and consumer can also result in losses.

As the losses occur nearer the consumer in the marketing system, their value is greater since the cost of storing, handling, transporting and processing have been lost as well as resources required to produce the maize originally.

C. Extent of Losses in Zaire

A recent report (4), indicated losses at a minimum of 10 to 15 percent, but running up to 40 percent. Source of the estimates and their reliability is not known. If losses are in the range of 10 to 15 percent annually, the reduction in consumable maize is equivalent to that which would supply normal maize requirements for 300,000 to 450,000 persons per year in the Shaba urban areas. The numbers would be even greater in the Kasai and Kinshasa urban areas because of the lower per capita consumption levels. For each 1 percent reduction in loss, enough maize would be saved to supply normal annual requirements for 30,000 persons in the Shaba urban areas, 86,600 in the Kasai and 570,000 in Kinshasa.

Improvement in maize storage management practices and facilities can reduce the losses substantially and should be a main concern for Zaire.

A summary of observed insect damage reported in Appendix III-3 is as follows:

Location Sample Taken	Average % Insect damaged Kernels	Est. of % Weight loss
Local Market, Kananga	1.3	0.4
Maize Mill - 1, Kananga	1.0	0.3
Maize Mill - 2, Kananga	2.0	0.6
PNM Seed Storage, Gandajika	9.1	2.7
FED Seed Storage, Gandajika	36.0	11.6
Large Farm, Kaniama	0.3	0.1

Estimates in the above table are based on a limited number of observations, reflecting only losses due to insects and indicating losses which have occurred over the first 1 to 5 months in storage. The 10 to 15 percent losses may be meant to include all losses on an annual basis.

It is our opinion, however, that many loss estimates are made on the basis of mere observation and not actual measurements and that estimates made in this manner tend to exaggerate the losses. Measurements made and reported above, although not statistically defensible, indicate relatively low levels of damage in commercialized maize.

D. Methods to Preserve Grain Quality in Storage and Marketing

Just as there is a variety of ways in which grain quality may be reduced, there is also a variety of ways in which losses may be reduced. Unfortunately, no one method in itself is capable of preventing losses of grain quantity and quality in storage. Effective preservation of grain in storage requires an integrated approach using a combination of various methods. For discussion the

methods can be grouped into four major categories: (1) Inspection, (2) Housekeeping, (3) Physical and Mechanical, and (4) Chemical.

The primary objective should be to prevent deterioration from occurring rather than attempting to stop deterioration after it has started. Where deterioration has started, steps should be taken to minimize the loss by applying control methods as soon as possible. To this end we can use the following methods:

Inspection. Physical inspection of grains, storage and processing facilities and the environments in which grain is stored can make persons responsible for preservation of the grain aware of existing and potential deterioration. Inspection is a technique which, if properly applied, can result in the prevention of deterioration at a minimum of cost. Procedures for inspection are outlined in Appendixes VI-2, VI-3, VI-4 and VI-8

Housekeeping. Spillage and accumulation of grains in the field, in and around the storage facilities and in transport vehicles provide an attractant and food source for cereal-grain-infesting insects and rodents. Accumulations of spilled grains, cobs and husks provide situations in which large numbers of insects can multiply and then migrate to market grains. They also provide a readily available source of food and harborage for rodents from which they can move to and destroy market grains. Proper cleaning and disposition of accumulations of spillage, residues of cobs and husks and other debris is an effective way of eliminating sources of insects and rodents which cause deterioration.

Housekeeping also includes the orderly stacking and storage of grains to facilitate application of other major categories of pest control, i.e. inspection, chemical pesticide application and ventilation to prevent mold damage.

Physical and Mechanical. Altering the physical condition of grain by reducing the moisture content and/or temperature can produce conditions unfavorable for the development of insects and/or molds.

Mechanical or physical barriers to insect and rodent penetration of storage facilities and grains are effective means of reducing losses in storage. Included here are items such as leaving husks on ear-stored maize to inhibit insect attack, rodent-proofing storage facilities so that rodents are excluded from the market grains, and in general, providing sound storage structures.

Chemical. Insecticides, fumigants and rodenticides form the bulk of chemical agents used in the preservation of grains in storage.

Insecticides, as used in context here, refers to chemical materials which are toxic to insects and with which the insect must come in direct contact. This can be by walking over a treated surface, such as a warehouse floor, bags of grain, etc. or by flying through suspensions of insecticides in the atmosphere in the form of smokes or mists.

Fumigants are chemicals which, on exposure to the atmosphere, form toxic vapors. To obtain an effective fumigation of grain a toxic concentration of the gas (vapor) must be maintained for a sufficient time to kill the insects. This requires that fumigants be applied to grains in air-tight (or nearly so) environments, such as under gas-tight sheets of polyethylene or other materials or in reasonably tight bulk storage structures (metal or concrete bins and silos).

Rodenticides are chemicals which are usually consumed by rodents in especially prepared baits.

It should be re-emphasized that no one technique or method is, in itself, completely effective in preserving the quality of grain in storage. The proper

management of grain in storage requires an integrated application of all of the methods and techniques.

With this background the following recommendations should be more meaningful.

E. Specific Recommendations

Prevention of Deterioration in the Field. To reduce the potential for deterioration of maize in the field the following general recommendations are made:

- Encourage village producers to remove and dispose of all damaged ears and crop residues normally left in the field.

The effect here is to remove the sources of insects which are present in the field to infest the new crop. Damaged ears, remaining in the fields, provide a means by which stored grain insects can carry over from one crop to the next.

- Encourage village producers to harvest maize from the fields as soon as maize is dry enough for storage (approximately 1 month after maturity).

Damage and loss of maize occurs when maize is stored in the field for extended periods of time (the practice at present in most regions). Considerable damage due to termites was indicated in some regions. Termites invade stalks of maize plants when they dry after maturity and cause lodging. Ears in contact with the ground are soon invaded by termites and are subject to mold deterioration due to ground moisture. The longer maize remains in the field, the greater the opportunity for infestation from field sources.

Prevention of Deterioration in Village Storage. Present techniques of storing maize for seed and food at the village level appear quite satisfactory. Accumulating ears in the husk on platforms over the cooking area in homes provides for the drying and preservation of small quantities of maize. When

village producers are encouraged to remove maize from the field, this will undoubtedly over-burden the existing storage capacity at the village level. The following recommendations are made to preserve grain quality at the village level:

- New crop maize should be moved into central collection and/or buying points as soon after harvest as practical.

This will require ONACER and dealers to be active in village markets, as soon as maize can be removed from the field for storage rather than waiting for a decree to "start the campaign." Facilities and technology at central collecting stations should provide safeguards for maize if the following recommendations are implemented.

- Village producers should be encouraged to construct crib storage as described in the "facilities" section of this report if they choose to hold maize for later sale.

Crib storage for maize is being advocated throughout wide areas of Africa. Crib storage has certain disadvantages in that it accumulates large quantities of maize in a lot where infestation can spread rapidly from one ear to another. In addition, open storage does not prevent migration of pests from one crib to another. On the other hand, cribs have the advantage of being constructed of indigenous materials which the village producer can readily obtain. By using drying techniques now employed in the homes, i.e. building fires beneath the storage area, village producer should be able to maintain good quality maize in cribs for reasonably long periods of time. Developmental research is needed to determine the most efficient way in which to use heat in preserving the quality of ear maize in cribs.

- Use of pesticides for maize storage at the village level is not recommended at this time.

As production programs develop and an incentive for village producers to store maize at the village level materializes through price advantages, pesticides might be applied to economic advantage. A program for testing various pesticide formulations for future use under village level storage conditions in Zaire should be initiated by PNM/ONACER. Recommendation for such a program is included in Section IX, Training and Developmental Research, of this report.

- An extension program paralleling the production schemes should be initiated to advise village producers of losses caused by insects, rodents, etc. and to instruct producers on methods to minimize loss.

Prior to initiating such an extension program, it will be necessary to have PNM/ONACER personnel adequately advised on the various aspects of maize quality preservation (see Section X, Summary of Government Inputs for Marketing System Development).

Preservation of Grain in Dealer Storage. Grain management practices in dealer storage operations require considerable revision. Much of the revision or change in management practices can be effected without additional expense to the dealer and should be effective in substantially reducing the quantity of maize lost in dealer storage. The major impact should be felt at the large commercial dealer level. There is probably little that can be accomplished by way of improving the petty (local) dealer storage in local markets.

ONACER, through its licensing procedures, could enforce certain of the following recommendations making suggested storage practices mandatory for license approval.

- Warehouse stocks should be maintained in an orderly fashion so that inspection and inventory of the stored product can be made and so that pest control measures may be applied.

Appendix III-4 illustrates the proper stacking and storage of bagged maize in a typical dealer warehouse. There is a variety of stacking patterns that

can be used. Stacks of bags can be about 6 meters across and not exceeding 6 meters in height, with length of the stack depending on warehouse size and size of fumigation tarpaulins available. Stacks of bags should be at least 1 meter from all walls, other stacks of grain and overhead support structures. This is to facilitate periodic inspection of the grain and space to install fumigation tarpaulins when they are used. Bagged grains should be stored off the floor on wooden pallets or movable platforms to prevent condensation from wetting the bottom layer of bags.

- First-in, first-out stock rotation should be practiced.

At present, most dealers stack bags of grain on the floor, against walls and to the ceiling of storage structures. This storage practice does not allow the first grain received in the warehouse to be moved out first. For this reason, some grains received at the beginning of the season may remain in storage until the end of the season. The longer grain is in storage, the greater the opportunity for loss due to insects, rodents and molds.

- Storage facilities should be kept free of grain spillage and accumulations of grain by-products (cleanings, cobs, husks, etc.).

Daily removal of grain spillage should be a routine accomplishment. Grain free of infestation should be cleaned, sacked and added to grain stocks. Other materials removed from the storage area should be disposed of by burning or other means. If spillage and accumulations of other debris are allowed to remain for extended periods of time they can serve as attractant and breeding areas for insects and rodents.

- Controlled use of approved pesticides should be encouraged. Use of DDT should be discontinued.

At present most dealers do not make use of pesticides in their storage facilities. Those that do use insecticides have largely confined their use to DDT dust. DDT is not considered a desirable pesticide to use because of the accumulation of the toxic material in human and animal fat and milk. The use of DDT has been banned in many countries and is generally no longer used in association with grain storage. Zaire should also discontinue use of DDT.

Malathion dust or sprays, pyrethrin dusts or sprays and lindane (α isomer of BHC) dusts are contact insecticides which can be used with reasonable safety in and around grain storage warehouses. Dusts and/or sprays can be applied between layers of bags of grain when they are put in storage. This type of application acts as a protective or residual treatment and is usually effective over a period of several months. This type of treatment is generally not effective in killing insects which are developing inside of kernels of grain or within a given bag of grain. It does prevent migration of insects from infested to non-infested grain fairly effectively.

Quality Preservation at ONACER Collecting Stations. ONACER should set an example by taking the lead in establishing good grain management practices at it's collecting stations. Procedures and techniques used at ONACER grain collecting stations should be encouraged at dealer, distributor and mill storage facilities.

Specific recommendations for ONACER collecting stations parallel those given for dealer/distributor storage warehouses. In addition, specific recommendations made here for bulk storage of grains are applicable to bulk storage facilities at large flour mills.

Since ONACER will be assuming the lead in establishing improved grain management practices, a detailed explanation for implementing those practices will be given here. Reference will be made to the grain collecting stations (hereafter referred to as the "station") recommended for consideration in this report.

The following specific recommendations are suggested as a guide for maintaining the quality of grains in storage at ONACER collecting stations:

- Shipments of grain received at the station should be inspected using the procedure outlined in Appendix VI-2.

This inspection will include determination of (1) weight of shipment, (2) moisture content, (3) insect damage, (4) presence of live insects, and (5) amount of foreign material. On the basis of this inspection, the station manager should determine whether the shipment of grain requires drying, fumigation and/or cleaning before being placed in storage. A list and description of inspection equipment and procedures is given in Appendix VI-2.

- A storage record form (example in Appendix VI-3) should be completed in triplicate.

The original copy should be sent to ONACER's regional office, the first carbon retained in the agency office file and the second carbon (on heavy card) should be attached to the grain stack (for bagged storage) or held in a "bin file" if grain is stored in bulk. The stack/bin card will be used as a record of receiving condition and subsequent inspections and treatments.

- Bagged storage of grains should be maintained in a neat and orderly fashion to facilitate subsequent inspection, inventory, treatment and facility maintenance.

Appendix III-4 suggests a stacking diagram for storage of bagged maize at ONACER stations.

- Bagged grains in storage should be inspected monthly.

Ten percent of the total number of bags in the stack should be sampled and a composite made. A representative sample of the composite should be examined for (1) moisture content, (2) presence of live insects, and (3) any other obvious defects (molds, rodent contamination, etc.). The general condition of the stack and surrounding area should also be noted (i.e. evidence of water damage, rodent chewed bags, spillage, etc.). Results of the inspection should be recorded on the stack/bin card. Any corrective action required (i.e. cooling, drying, fumigation, etc.) should be taken by the manager.

- Bulk stored grain should be inspected monthly using the procedure outlined in Appendix VI-4.

Record should be made of (1) moisture content of the grain, (2) presence of live insects,and (3) any other obvious defects. Any corrective action necessary will be determined by the station manager.

- High moisture grain should be cooled and/or dried.

Procedures for handling high moisture grain are outlined in Chapter V.

- Grain containing live insects should be fumigated as judged appropriate by the station manager.

The station manager's decision should be based on the following criteria:

(1) Type of insect infestation. Weevils, lesser grain borer and Angoumois grain moths are exceptionally damaging and presence of these insects should demand immediate fumigation. Beetles and other moths may be tolerated at low levels, however, the manager should understand that these insects can migrate to other stacks and bins and infest additional quantities of grain.

(2) Length of storage anticipated. The reduction in loss to grains to be shipped immediately for processing would probably not justify the expense of fumigation, however, it should be recognized that any infestation in the grain can be spread to carriers and/or other storage sites.

- Storage facilities should be inspected on a monthly basis.

A suggested inspection format and record is shown in Appendix VI-8. The inspection should be made by the station manager or a responsible representative of the manager. Periodic unannounced inspections should be made by technical representatives from ONACER/Kinshasa. The same inspection format and record used by the station manager may be used.

- Stocks of grain should be rotated on a first-in, first-out basis.

The longer grain is held in storage, the greater is the opportunity for it to deteriorate and sustain losses. In general the oldest stocks should be shipped from the collecting station first. There may be instances where, because of condition of the grain, it may be desirable to ship grain out of rotation. The station manager will necessarily make this decision.

Quality Preservation at Grain Processing Facilities. Bagged grain storage at processing plants (mills, breweries, etc.) is essentially the same as that at ONACER and dealer storage facilities. The same general procedures used to maintain quality at ONACER and dealer warehouses should be used.

- Bulk grain stored in upright silos should be inspected regularly and proper treatment applied as necessary.

Techniques of inspection vary from those used in bagged grain warehouses. Inspection is usually accomplished by monitoring the temperature of the grain in storage. "Hot spots" or increases in temperature detected by thermocouple cables

suspended vertically in the silo indicate insect or mold activity. If "hot spots" are detected, corrective action should be initiated immediately.

Insect infestations can be controlled by fumigation with the same fumigants as used for bagged stored grain. Techniques for application will vary, however, and may require the movement of grain from one silo to another.

Heat produced by molds may be dissipated by moving grain from one silo to another, however, excessively damp grain will begin to reheat again and should either be processed immediately or dried for continued storage.

- Storage facilities should be kept free of grain spillage and accumulations of grain by-products (cleanings, cobs, husks, etc.)
- Storage facilities should be inspected on a monthly basis.
- Controlled use of approved pesticides should be encouraged.

Insecticides may be applied as residual sprays to walls, floors and interiors of storage silos primarily to prevent migration of insects. Fumigants should be used to control infestations which are detected in bulk stored grain.

Detailed procedures for treatment of bulk grain stored in silos are not included here, however, they can be supplied when bulk stored grain is more extensively used.

VII. PRICE POLICY

Every national government must select a cereals price policy. Alternative policies range from complete administrative specification of prices to allowing prices to be determined entirely by buyers and sellers. Historically, individual buyers and sellers have largely determined prices both in traditional and in market-oriented economies. However, free markets have not always performed as desired. Modifications in free market prices have been made to change resource allocation patterns, for example, when returns to farmers are increased to encourage expanded production. Equity considerations may precipitate price regulation, for example, when trade practices appear to injure excessively those participants with low levels of bargaining power. Price policy is used in the promotion of social policy, for example, to help provide adequate nutritional levels to low-income consumers at prices they can afford.

Price movements in cereals markets are often abrupt. Changes in market supply or changes in demand cause sharper changes in price of cereals than for many other commodities. These changes result in disadvantages to those least able to adjust to adverse prices, often those with incomes at substandard levels. Control over market supply has, on many occasions, resulted in manipulation of prices. Price level and price behavior for cereals are subject to some measure of control in nearly every country in the world. The nature of price policy depends upon the objectives to be achieved by price control.

A. Present Price Policy in Zaire

The Government of Zaire has undertaken a system of official prices for maize. The announced prices involve geographically nearly uniform prices and prices that remain constant throughout the marketing year. Prices are fixed at various levels of market movement, thus fixing margins available for performance of marketing services. Announced prices supplied by GOZ Department of Agriculture in June 1975 were as follows: (See also Appendix VII-1)

Maize (June 22, 1973)*

Minimum prices			
Producers:	Kasai Occ.	:	0.04 Z/kg.
	Kasai Or.	:	0.04 Z/kg.
	Shaba	:	0.04 Z/kg.
	Other regions	:	0.03 Z/kg.
Processor (at mill)		:	0.063 Z/kg.

Maize flour (April 27, 1974)*

Producers:	80.80 Z/ton
	4.85 Z/60 kg.
Distributors:	91.60 Z/ton
	5.50 Z/60 kg.
Consumers:	108.00 Z/ton
	6.50 Z/60 kg.
	0.11 Z/kg.

*Indicates dates on which prices became effective.

Source: GOZ Department of Agriculture.

NOTE: An increase in the price of maize flour to producers was reported to be imminent when the KSU team was in Zaire.

An explicit statement of the objectives of GOZ in establishing the above prices has not been discovered by the KSU team. The following appear to be the objectives: (1) avoidance of the affect of speculation by private dealers on producer and/or consumer prices for maize and maize flour, (2) maintenance of a stable, low-level of prices for consumers and (3) control of marketing margins at fixed levels and hence, stable prices throughout the system.

Current official prices for maize and maize flour are apparently below prices required to equalize supply and demand in major consuming areas, especially Kasai Oriental and south Shaba. Marketing margins are reported to have been below that required to cover milling costs for more than a year prior to June 1975. Dissatisfaction with the level of prices for maize to the producer was expressed in other areas of Zaire. Significant inflation in prices of goods purchased by farmers has occurred since June 1973 when current prices for maize to producers were established. A producer illustrated the change in price relationship when he said, "When I buy soap and when I buy sugar, the price is very high; but when I sell maize, the price is very low." Prices paid to farmers for maize in Zaire are reported to be substantially lower than in neighboring countries, for example, in Zambia.

Specification of prices at various levels of the marketing channel that accurately reflect the cost of performing marketing services is very difficult. For example, milling costs require very careful study to determine the margin required to adequately compensate for costs incurred at a single location with a given volume of output. Those costs will change, often abruptly, as prices of inputs change and as changes occur in volume of maize milled per month or per year. Mills located in Kananga may have costs that are quite different from the mill(s) at Likasi. Similar cost differences occur at all levels of marketing.

Reflecting all cost differences in an administrative cost structure becomes extremely complex and administratively, virtually impossible. Administered

prices must, therefore, give up some of the complex price structure and complex system of signals flowing between consumers and producers found in a trade-determined price system functioning under uniform competitive conditions. However, if the distortions in price structure become major, they seriously distort the functioning of a marketing system.

The present structure of official maize prices in Zaire appears to have major distortions (i.e. not reflecting costs of performing marketing services) in at least three ways. First, a uniform geographic price system (except for a lower producer price in Bandundu Province) does not incorporate a recognition of the cost of providing transport services. Private dealers licensed by ONACER are reported to limit their activities to a maximum range of 60 to 80 kilometers (in some cases a smaller range was reported) from collection centers to minimize cost of transportation for which they cannot recover specific costs. Likewise ONACER or private dealers shipping maize long distances to a mill receive the same price at the mill and pay the same price to producers as shippers located much closer to the mill. For example, ONACER offices in Kalemie must operate on a lower net margin after paying transportation to Lubumbashi than does the office in Kananga where much of the maize acquired is resold to mills within Kasai Occidental.

A second distortion in official price structure relates to the cost of storing stocks of maize. If maize or maize flour from domestic production is to be available in consumption centers in November, December and January, it must be stored from the previous harvest. Since the official price system does not compensate anyone for performing a storage service, maize will move through

the marketing system as rapidly as possible without major provision for storage at any level. Maize storage occurs at mills to accomodate maize received during the buying campaign but maize is milled rapidly and delivered to distributors. Net margins for milling are reduced in proportion to the amount of storage services the mills are required to perform.

The third area of distortion, already alluded to, is failure of prices to fully reflect processing costs. At the time of our field studies, the cost/price relationship for maize flour sold by a mill was reported as follows:

TABLE 15. Reported Evaluation of Cost/Price Relationship of Maize Flour[1)]

Operating Costs:	
Purchase price of maize (ton)	Ƶ 63.00
Cost of bags	7.00
Product loss (cleanings, shrinkage, weevils) 8%	5.04
ONACER taxes	2.00
Milling costs	11.26
OZAC taxes (Maize Ƶ0.30; Flour Ƶ0.20 per ton)	0.50
Depreciation	1.00
Total	Ƶ 89.80
Less sale of 50 kg. bran	.64
Net Cost of Flour	Ƶ 89.16
One ton of Maize yields:	
50 kgs. of cleanings	
30 kgs. shrinkage	
50 kgs. bran	
870 kgs. of flour @	Ƶ 89.16
Cost per 60 kg. flour	Ƶ 6.15
Official price for 60 kg. flour	Ƶ 4.85
Loss per 60 kg. of flour	Ƶ 1.30
Loss per ton of maize milled	Ƶ 18.85

1) Costs were reported by a mill manager in Kananga. They are not a result of a cost analysis by us. However, the costs appear consistent with related observations on costs and prices. We have no reason to doubt the validity of these data at this time.

Cost information for marketing services other than milling was not obtained in any detail. Informal evidence indicates very low margins for purchase and collection of maize in the North Shaba area (Nyunzu and Kongolo). ONACER offices appear to have greater difficulty in financing operating costs in the North Shaba area than in other areas and private dealers complained of inadequate margins. This is likely a reflection of higher transportation cost and related expense between collection point and mills.

B. Recommended Objectives of Price Policy

Three principal objectives appear most important in price policy for maize in Zaire: (1) relatively stable prices (in the short-run) to accompany stabilized market channels, (2) a level of prices to farmers that will encourage larger commercial production, and (3) maintaining retail food prices as low as possible with due consideration of production and marketing costs.

Stabilized prices and stabilized market channels appear to be a very essential element in orderly development of a system for marketing maize. Farmers and marketing participants need a reasonably stable economic environment within which to make business plans. Stability does not necessarily mean fixing exact prices but, perhaps more appropriately, establishing a specified range over which market forces may determine the exact price at a given location and at any point in time.

Stabilization of prices may mean a pricing scheme in which prices paid to farmers are supported at a minimum level but permitted to go above the minimum price if market forces dictate. Maximum prices to consumers may also be designated, with action by a public agency (ONACER) taken to increase market supply if market price approaches the maximum level. Control of price through purchase

at a minimum price when downward pressure on specified prices occurs and adding to market supply from stocks or by import when strong upward pressure occurs, implies a longer-run role for ONACER that is different than it's current, or perhaps anticipated, role. It is, however, a more manageable role than attempting to enforce exact, pre-announced prices at all levels of the marketing system.

Concurrent objectives of higher producer prices to stimulate production and low consumer prices for a basic food grain suggests a conflict of goals. To the extent that this is true, one must consider the relative merits of these goals and the trade-off that occurs as one objective is pursued at the expense of the other.

Maize is a basic food grain in the diets of many urban families in Zaire. This is especially true in south Shaba where annual per capita consumption in 1970 is reported to be 144 kg. (4, Vol. II, Annex 2). Very limited information exists on maize consumption by income group. A study of consumption patterns in 1969/70 in Kinshasa indicates that consumption of maize by income groups increased from 0.6 kgs. per adult per year in families with monthly incomes of less than Z 15 to 2.7 kgs. per adult in families with monthly incomes of Z 60 or more. These data suggest that consumption of maize increases when consumer income increases. In percentage terms, quantity of maize consumed increased at about the same rate as income increased (i.e., income elasticity of about 1.0). It is not known if the same relationship holds in cities with higher maize consumption rates, e.g., Mbuji-Mayi or Lubumbashi.

Existing evidence indicates that maize is a staple food for nearly all income groups in areas with high levels of maize consumption. Higher prices for maize will require adjustments by consumers through a combination of the following

actions: (1) lower levels of total food consumption, (2) higher expenditures for food and (3) substitution of other kinds of food for maize. Without doubt, increased retail prices for maize flour, if they occur, will cause inconvenience to low-income consumers.

In the case of producers, maize prices have remained constant while significant inflation has occurred. Zaire does not currently produce the quantity of maize demanded at the existing level of official prices. Recent study of the economics of fertilizer application for maize by the TVA team indicates a need to raise the price of maize relative to the price of fertilizer to make fertilizer use attractive to the traditional farmer. The draft report recommends "that a floor price of 5K/kg. for corn grain be established and supported by the Government." Numerous knowledgeable people with whom we have discussed farmer response to price have indicated that Zaire farmers will respond positively to price incentives to produce more maize.

A decisive argument for increased price of maize is that supply and demand for maize are not equal at present prices. Quantity demanded and quantity supplied can be brought together by (1) raising prices to increase quantity supplied and reduce quantity demanded or (2) increasing the supply through imports. The import alternative is inimical to the stated goal of the GOZ of self-sufficiency in maize within the next few years. Current production and consumption trends indicate maize deficit of 162,000 tons in 1980. That volume of imports valued at 70 Z/MT would require Z 11,340,000 in foreign exchange.

When demand exceeds supply at official prices, "parallel markets" at prices above official price arise which circumvent official channels. In those circum-

stances, further reduced volume of maize flour is available at the official price causing it to become more and more difficult for low-income consumers to obtain maize. Hence, an increase in price to producers that will increase production may be less damaging to consumers than would be anticipated, based solely on change in the official price to consumers. In inelastic demand markets where the ability to control prices at retail is limited (as with maize or maize flour at retail in Zaire) increased maize supply may be of substantial benefit to consumers.

In view of the preceding argument, it is recommended that maize prices continue to be controlled in the immediate future to provide assured markets and market prices to producers and that the price level to farmers be increased to encourage greater production. It is also recommended that the structure of prices (relationship of prices at various levels) be designed to compensate all marketing agencies for services rendered.

It is very important that GOZ, through ONACER, guarantees the official price. It is important that ONACER, through use of its own resources and through licensing of private dealers, is able to bring buyers to the villages with sufficient sacks and trucks to bring into the market channel all maize available for purchase from farmers. Inability to do so would damage the confidence of the producers in ONACER's ability to provide marketing services and have a negative effect on producers' willingness to produce maize in the future. For that reason, it is suggested that the initial increase in village price level be only of a magnitude that resulting production can be effectively handled by the marketing system, nevertheless, demonstrating a sincere official effort to increase the production of maize and a desire to aid small producers to respond positively to the expressed will of their government.

Under conditions of assured markets and higher prices, largest production increases may be expected in traditionally surplus areas that have experienced relative isolation from the demand forces operating in the maize-consuming centers. Especially significant increases may be expected in Bandundu Province, the Demba-Mweka area in Kasai Occidental and the Nyunzu-Kabalo-Kongolo triangle in North Shaba with improved producer price and marketing conditions.

In announcing new prices, it is also desirable that transportation costs be recognized in the structure of prices. One such structure might differentiate prices to collection centers based on assembly cost differentials. Basically, assembly cost varies based on distance but may also differ based on the quality of the road. Private dealers appear to be going out an average maximum distance of 60 Km. from collection centers under "typical" road conditions. Greater distances were reported in some cases where better than average road conditions were reported.

A higher price to producers for maize within 60 Km. of a collection point than beyond 60 Km. would compensate ONACER and private dealers for greater travel and bring in maize from the villages located at greater distances although it would not reflect transport cost differences within each zone. If the price to producers reflected differences in cost of average hauls, private dealers would be attracted to the outer zone and ONACER would also receive additional compensation for additional expense involved in longer hauls.

If the average distance to villages within the inner zone is 30 Km. and the average distance for the outer zone is 80 Km., the difference in average haul is 50 Km. Estimates of costs per MT/KM for transport of maize to collection points varied from 13K to 16K. At an assumed cost of 15K per MT/KM, the average distance differential is 7.50 Z/MT.

Additional differentiation of regional prices also appears appropriate. The major direction of flow from surplus production areas is to southern Shaba. In general, prices in other areas should reflect transportation costs to southern Shaba when production is for Lubumbashi, Likasi or Kolwezi markets. Kinshasa also is consuming an increasing amount of maize annually. Representative transport rates to Lubumbashi and to Kinshasa from maize collection points are reported in Table 16.

TABLE 16. Representative Rates for Transport of Maize on the Rail/Barge System, Zaire, June 1975

From:	To Kinshasa	Zaires per Metric Ton
Kikwit		4.50
Ilebo		4.10
Kananga		4.95
Luputa		5.65
	To Lubumbashi	
Ilebo		4.25
Mweka		4.62
Kananga		4.14
Luputa		3.62
Kaniama		3.42
Nyunzu		3.56
Kongolo		3.48
Kikwit*		7.00

*Estimated

C. Suggested Official Prices for 1976

We believe that marked increases in maize for commercialization can be achieved by assuring producers that buyers will appear to buy their maize when

they are ready to sell. Additional increases in production will result from increased producer prices.

The level to which prices of maize should be raised to increase maize production involves considerable subjective judgement concerning influence of monetary incentives on production. A recent report by a study team from TVA indicates a base price of 5K/kg. would be necessary to persuade producers to use fertilizer at anticipated fertilizer prices in 1976.

Another approach to establishing a level of official prices for maize is to maintain an established price relationship between cereal prices paid to producers and items the producer must buy. Data on rates of inflation in Zaire, especially in rural areas, were conflicting. However, based on a predominance of reported price increases, a price increase for maize to 50 Z/MT in major producing areas is within reason.

If the base price of 50 Z/MT is applied in major producing areas (for example, the Kasais and North Shaba), transport costs (transport rates plus related costs) would suggest a price of 54.5 Z/MT to producers located in southern Shaba near Lubumbashi, Likasi or Kolwezi (9°South latitude may be an appropriate dividing line).

Maize shipped from surplus producing areas in Bandundu Province goes to Kinshasa for consumption or to Ilebo for rail shipment to the south. Table 17 indicates quantities of maize arriving at Kinshasa and Ilebo by river shipment over a 4-year period.

TABLE 17. Maize Shipments on the Kinshasa-Ilebo Water Route 1969-1972

Year	To Kinshasa	To Ilebo	Total
	(Metric Tons)		
1969	8,428	21,565	29,993
1970	7,268	11,337	18,605
1971	11,266	12,701	23,967
1972	19,413	14,513	33,926

Source: ONATRA, Plan D'Action, 1973-80 et Programme de Investissements.

Transport cost from Bandundu Province (based on major collection at Kikwit) would indicate a producer price below Kananga by Z 5.5 per ton and below Lubumbashi by about Z 9. This suggests a producer price in Bandundu of 44.5 Z/MT. Current spread between producer price and mill price is 23Z/MT. Where delivery to the mill is from "local" producing territories within 60 Km., a margin of this size may not be required. Maize was delivered to Kikwit in June 1975 at 15 Z/MT over the village price. It is recommended that a margin of 20 Z/MT be maintained between village price and local mills. With a price spread as indicated, mill prices for maize in south Shaba would be 74.5 Z/MT and 70.0 Z/MT in the Kasais, north Shaba and Kinshasa.

Based on the above considerations, the following producer and mill prices for maize are offered for consideration for 1976:

South Shaba (south of 9°S latitude):

Producers (within 60 Km. of Collection Center)	54.5 Z/MT
Producers (beyond 60 Km. of Collection Center)	47.0 Z/MT
Mill	74.5 Z/MT

Kasais and North Shaba:

Producers (within 60 Km. of Collection Center)	50.0 Z/MT
Producers (beyond 60 Km. of Collection Center)	42.5 Z/MT
Mill	70.0 Z/MT

Bandundu:

Producers (within 60 Km. of Collection Center)	44.5 Z/MT
Producers (beyond 60 Km. of Collection Center)	37.5 Z/MT
Mill	65.0 Z/MT

Kinshasa:

Mill	70.0 Z/MT

Milling costs indicated in Table 15 plus (1) an anticipated increase in cost of milling in 1976 equivalent to Z 1 per ton of maize and (2) increases in cost of maize indicated above would result in total cost of flour produced at mills by location, in 1976 as follows:

South Shaba	116.85 Z/MT (7.01 Z per 60 Kg.)
Kasais and North Shaba	111.68 Z/MT (6.70 Z per 60 Kg.)
Bandundu	105.93 Z/MT (6.36 Z per 60 Kg.)
Kinshasa	111.68 Z/MT (6.70 Z per 60 Kg.)

These costs compare with an estimated cost of 102.5 Z/MT (Z 6.15 per 60 Kg.) in 1975. It would appear that these recommended margins would permit some restoration of mills where deterioration in physical capital has occurred in a period when margins have been below costs.

Official consumer price for maize flour at retail in June 1975 was Z 27.20 per ton above the producer (miller) price. We did not avaluate the cost basis for that margin. Assuming the cost basis on which that margin was established remains relevant, consumer prices for maize flour will vary from 13.3K/kg. in Bandundu to 14.4 K/kg. in south Shaba at harvest season with the above price structure. Seasonal price increases would raise prices in the latter months of the marketing year.

Storage cost should also be reflected in official prices. It is recommended that increases in prices begin on September 1 each year to reflect the cost of the first month of storage following completion of purchase of second-harvest maize from producers. It is recommended that the prices for maize increase at a rate of 90 K/MT per month in the period September through January and that the prices for maize flour increase at a rate of 1.0 Z/MT per month. Recommended rate of increase is based on a current charge of 90K/MT per month for storage of maize in bulk at OZAC silos in Kinshasa. Prices should return to base levels at the start of a new campaign.

We did not discover any studies of the cost of storing maize in Zaire. Storage rates (i.e. seasonal price increase) may need to be adjusted after storage cost studies are completed. Storage cost calculations should include the following elements of costs:

1. Labor and management costs involved in handling and managing storage stocks.

2. Interest cost on investment in inventory.

3. An allocated portion of all taxes and insurance related to ownership of storage facilities.

4. Cost of sacks and other supplies and equipment associated with storage.

5. Costs of shrinkage and quality deterioration occurring in storage.

6. Costs of insect and rodent control measures applied.

In the longer-run role anticipated for ONACER, it should not be necessary to specify prices at as many market levels as indicated above. In other countries it has been possible to control the level of consumer prices and avoid undue speculation by private dealers through controlled sale of stocks maintained by a national cereals office. When supply of maize in Zaire becomes more adequate and ONACER is able to maintain buffer stocks, those stocks may also be used to influence prices where required. Specification of prices is often limited to a guarantee of minimum prices to farm producers in circumstances where prices at other levels can be influenced through management of existing stocks.

D. Summary

Quantity of maize produced and quantity demanded were not in balance in Zaire at official prices in the 1975 producing season. We recommended a moderate increase in the price structure based on Z 50.0 per metric ton to producers within 60 Km. of collection centers in the Kasais and North Shaba.

We recommend differential prices throughout the system for rudimentary recognition at this time of transportation, storage and processing costs. Only moderate

price increases are recommended because the market system will have difficulty handling a large increase in supply in 1976[1].

In the longer run, we recommend control of prices largely through stock management by the National Office of Cereals and reduced administrative specification of prices at various market levels.

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[1] In August 1975, official price of maize to producers was increased to Z 75 per metric ton. In our judgement, an increase of this amount was not required to elicit a substantial increase in maize production. It is not likely that the marketing system will be prepared to evacuate the quantity of maize forthcoming in 1976 and hence, will not likely be able to sustain the established price. This will be especially true in Bandundu and the Nyunzu-Kongolo triangle and to a degree in Kasai Occidental where maize moves longer distances to market. Proportionately stronger effort by ONACER in these areas may be warranted.

VIII. TRANSPORTATION, CREDIT AND MARKETING INFORMATION

Problems associated with transportation, credit and marketing information are in part infrastructure problems and in part problems associated with development of techniques in performance of these functions in the marketing of maize. Infrastructure problems are severe in road transport, especially in rural roads, and in communications systems. In techniques areas, serious deficiencies exist in availability of development credit and in the generation of market information.

A. Transportation

Transport problems in Zaire provide especially severe restrictions for a national marketing system. The International Bank for Reconstruction and Development reports as follows:

> Many Zairan officials and foreign advisors tend to regard the poor state of transport as the major, ..., reason for the poor performance of agriculture and the decline of marketable surpluses. Undoubtedly, the poor state of roads is a disincentive to traders to penetrate much of the rural area.... (4, Vol. II, Annex 2, p. 32).

Reports indicate a deterioration of the road system since independence and substantial reduction in volume of traffic. The condition of rural roads makes collection of maize expensive and has isolated many areas because roads have become impassable. River crossings are an especially serious problem because of missing bridges and inoperative ferry service. For example, in the Kasais it is reported that there are 85 ferry points of which 80 have ceased to operate, thus isolating large areas from road transportation.

Although road transport problems exist at all levels the more severe impact of road deterioration in rural areas is indicated by data cited in an International Bank study. The ton/kilometer cost of secondary road transport was 5 percent above main road transport in 1959. In 1970 it was 46 percent above (Table 18). Costs on main roads increased 29 percent over the 1959 to 1970 period while transport cost on secondary roads increased by 80 percent.

TABLE 18 Transport Rates Per Ton/Kilometer.[1/]
(Makuta)

	1959	1970
Main Roads	5.80	7.50
Secondary Roads	6.10	11.00
Difference:		
Absolute	0.30	3.50
Relative (percent)	5.0	46.0

Source: International Bank for Reconstruction and Development, Agricultural Sector Survey, Republic of Zaire, Vol. II, Annex 4, page 5.

1/ These figures refer to the hire rates for transportation of seed cotton in the southern part of Kasai Oriental and Kasai Occidental, as reported by a cotton ginning company.

Estimates of current cost per ton/kilometer for transport of maize were difficult to obtain in Zaire. Depreciation and maintenance costs for vehicles are high because of the condition of the roads and the high cost of vehicles and repair parts. Size of truck varied from 6 to 8 tons capacity. Because of the condition of the road, trucks frequently were not loaded at rated capacity. A maximum load of 5 tons was common. Trucks were reported to operate only about 50,000

km before major repair was required and replacement required at about 80,000 km. Trucks last from 2 to 4 years before being replaced.

In cases where transport costs for maize collection were reported, costs ranged from 13 to 16 K per ton/kilometer, apparently increased from 11 K reported for cotton seed in 1970. In Bandundu Province where the price of maize at the village is 3K/kg, transportation of maize 60 kms at 15 K per T/km is equal to one-fourth the value of maize at the village. In relative terms, this is an extremely high transport cost. High cost of rural road transport relates directly to the condition of rural roads. Minor economies can be achieved aside from road improvement (such as greater use of diesel trucks instead of gasoline fueled vehicles) but the major difficulty lies in condition of the roadways.

The isolation of formerly surplus areas with deterioration of the road system has undoubtedly resulted in a decline in marketable surplus of maize. A mill manager in Kananga with more than 30 years experience in the area reported a decline of more than 50 percent in marketed surplus of maize from nothern areas of Kasai Occidental from the pre-1960 period, which he attributed to a lack of transpor and marketing facilities. Lack of transport and marketing facilities for maize collection were reported in all regions but such reports were especially prevalent in Bandundu and Kasai Occidental provinces.

The River-Rail System:

The major transport system in Zaire is a river system that is supplemented by rail where rivers are not navigable or major rivers are not available. For maize transport, in the areas in which this study is concerned, rail is the principal mode of transport. Major transport routes in Zaire are shown in Figure VIII-A. Maize is transported by barge on the Kwilu River (Kikwit) and on

the Kasai-Zaire Rivers (Ilebo-Kinshasa). Rail transport is used for other major movements of maize to mills and consumption centers in southern Zaire other than those served by local production.

Maize is transported in sacks, except for maize transported from the plantation project at Kasese to mills in Lubumbashi and Likasi, in which case it is transported in bulk. Cases were observed where maize arriving by rail had become wet because of leaky rail cars. Damage of this type was reported to be minor.

Quantity loss in transit was reported by shippers ranging from a 4 percent loss over a period of years reported by a private dealer at Kikwit upward to occasional very large losses resulting from apparent pilferage (reduced number of sacks on arrival) reported by shippers in the Kongolo/Nyunzu area. The loss is apparently fairly high. Five percent loss valued at 6.3 K/kg is equivalent to 3.15 Z/ton of maize shipped, which is nearly the equivalent of the rate charged by the carrier on shipments from Kongolo to Lubumbashi.

Carrier rates for maize are low by nearly every standard by which they may be measured. Within the rate structure for commodities carried by the river rail system in Zaire, rates on maize (and other agricultural and food products) are low. Rates on maize are about one-sixth the rate for fertilizer when compared on a rate per ton/km basis. Rates on maize reported to the KSU team average slightly over 0.5k per ton/km. based on rail and water distances.

Rail car and barge equipment were generally reported as satisfactory by shippers of maize. In one area (Nyunzu-Kabalo-Kongolo) shortage of available rail cars for shipment of maize was reported. Rail cars observed appeared to be in good condition although reported by ONATRA not to be in sufficiently good condition to transport maize in bulk without substantial loss from car

leakage unless major repair and upgrading were undertaken. Problems associated with loss of maize in transit and potential transit loss if maize is transported in bulk will need investigation before installation of facilities for bulk handling of grain merchandised from collection centers is undertaken. In the Kasese area, maize is carried in bulk in open-top hopper cars, covered by tarpaulins. Cars of this type may not be satisfactory for an extensive system of transport of maize. Weather damage to maize is more likely with tarpaulin coverage than in a sealed car. Opportunities for pilferage are obvious with open-top cars. A bulk delivery system may, therefore, require improvement or substantial replacement of rail cars suited to bulk transport.

Transport deficiencies are largely infrastructure deficiencies in both local and intercity transport. Infrastructure problems, in this case, cannot be remedied by ONACER or by marketing firms but must await increased public effort to improve the system. However, it is important in the structure of prices for maize to recognize transport costs to be overcome. Price structure recommended earlier (Chapter VII) includes price differences in zones (at different distances) from collection centers. This represents transport costs in only a very rudimentary way. Any other system of price differentials that can be handled administratively, which thoroughly represents transport costs, would improve the recommended pricing system.

ONACER should also begin early discussions with ONATRA concerning rail car requirements to facilitate movement of maize in bulk at a future time.

B. Financial Credit

Shortage of financial credit was reported to be a limiting factor in operation and expansion of business by private traders and processors. Problems in obtaining loans appear to arise from lack of loan collateral or other ability to establish a reliable, credit-worthy position by potential borrowers.

Reported interest rates paid when loans were obtained were from 5 to 6 percent annually. Indications are that supply of loanable funds is not a limiting factor in financial credit in Zaire with either the commercial banking system or with the Government's development bank (SOFIDE). Historical attitudes toward loan repayment, unstable policies toward private trade and unstable political/economic conditions have caused lenders to be very cautious in extension of loans, especially long-term loans.

Grain dealers and processors require large amounts of commercial credit in market-oriented economies. Capital investment, frequently obtained largely through borrowing, is needed to provide trucks, sacks, and facilities, to pay operating costs and to finance inventories. For grain dealers in Zaire, much of the financial need is for short-term credit. Investments in sacks and in inventory are short-term. Even investment in trucks (the major capital investment) is a relatively short-term investment (2 to 4 years).

Ability to provide collateral provides some assurance of recovery of loan funds if earnings are not sufficient to repay the loan. However, the more basic criteria for a sound lending policy by credit institutions is the expectation of a source of income to the borrower from which he can repay the loan.

In the case of grain dealers a critical question is, what is the basis for an expectation that a stream of income will develop from which the loan will be repaid? One important criteria is the integrity and capability of the individual making application for a loan. In this regard ONACER offices can be helpful in identifying persons with past experience in buying maize (possibly as ONACER employees) who understand maize markets and marketing techniques; who have demonstrated reliable performance of duties; and have an understanding of the obligation to repay a loan. A policy of careful identification of persons whom ONACER is willing to license as dealers if capital needs are met (ownership of a truck and auxilliary equipment, for example) would assist those persons in obtaining loans from private sources. It is not suggested that ONACER guarantee loans to private dealers but only that they assist private lenders (banks or individuals) in identifying persons who are credit-worthy on the basis of personal traits and capacity to function successfully as grain dealers.

Even with thorough indentification of responsible borrowers and a projected stream of earnings from which loans may be repaid, private sources may still consider loan applications to be unsatisfactory if significant collateral is not available. Since there is national interest in development of a national maize marketing system, development financing by a government agency where financing from private sources is not available may be an alternative. According to the International Bank Report (4 Vol. III, Annex 9, p. 3):

> "The only institution devoted to development finance is the Societé Financiére du Developpment (SOFIDE), which was established in January, 1970. Its purpose is to provide medium and long-term finance for private enterprise in all processing industries, but also commercially oriented

agriculture, forestry, fishing and tourism. It has mixed public and private ownership (national and foreign)."

SOFIDE loan policies currently include loan duration of 3 to 15 years; loan limits from 10,000 minimum to 1,200,000 Z maximum and an annual interest rate of 10.5 percent. SOFIDE participation in a development project cannot exceed 50 percent of total cost for new investments and cannot exceed 75 percent for extension or modernization of an existing business. SOFIDE currently has offices only in Kinshasa but will soon open offices inside the country at Lubumbashi and Kisangani. Supply of loanable funds was indicated to exceed the demand for loans meeting SOFIDE credit criteria.

SOFIDE organization and credit policies appear directed toward large projects requiring substantial investment in fixed plants. With present organization and credit policies SOFIDE could be a source of credit for financing construction or renovation of a mill or for construction of a warehouse or bulk storage facility. SOFIDE does not have credit terms that would be required to finance a minimum-size dealership thus facilitating entry of private dealers into the maize marketing system at rural locations. Organization for handling small, low-collateral, supervised credit throughout the maize producing area does not exist in Zaire.

A supervised credit system would require offices at collection center with lending officers with the authority and expertise to make short-term loans on inventory of maize, sacks and trucks and oversee the collection of loan proceeds when income from sale of maize is obtained by the borrower. For development purposes, loan limits will likely need to go beyond the current

50 percent limit on new investment perhaps to 75 or 80 percent. SOFIDE cannot currently provide supervision for loans of this type from its office in Kinshasa. Additional offices in Lubumbashi and Kisangoni will not be sufficient to provide small-scale, supervised credit.

The alternatives for a supervised credit plan for small dealers are (1) for a credit system to operate through a non-financial organization with sufficient local offices to provide supervision or (2) to operate through the private banking system through a system of loan guarantees. Each would require substantial time to develop institutional relationships and procedures. Neither alternative appears to be a feasible short-term solution to financial requirements of potential maize dealers wishing to enter the market.

Inventory financing presents a credit problem of a different nature than that of providing funds for investment in trucks or facilities. Elements of a system of inventory financing that allowed credit upon evidence of ownership of grain stocks or evidence of sale of stock were discovered. It was reported that dealers shipping maize to the GECAMINES mill in Likasi are receiving credit in the following manner. An initial loan is received from GECAMINES for purchase of maize. As dealers deliver maize to the railroad, they receive a certificate (shipping letter) which may be presented to the mill for advance payment at a rate of 65 percent of basic mill price of the maize. The balance is paid after the OZAC inspection at the mill and the determination of discounts for foreign material, moisture and insect damage. The 65 percent provides short-term operating capital for the dealer.

Another dealer reported use of a contract with a mill to deliver maize as evidence of forthcoming revenues to obtain bank credit. A private bank

would loan 65 percent (75 percent in 1974) of the purchase price of maize upon presentation of a valid contract.

Supervised development credit does not appear to be a feasible short-run solution to improved credit in the marketing system. Access to credit could be improved through improved identification of low risk borrowers who may wish to expand or others who may become dealers if credit is available (local petty dealers or ONACER employees.) This is a function that could be performed by ONACER. ONACER may also help to enforce a responsibility for repayment through possible revocation of license if credit terms are not met satisfactorily.

Improving means of getting inventory credit through wide spread use of contracts for delivery or shipping letters as a basis for credit would be helpful. Use of such documents in obtaining credit from local private banks would provide a broadly based credit system more capable of dealing with local situations than a trade credit system operated through the mills.

Development of a financial credit system is an essential ingredient in the development of an integrated marketing system. It is an element of the system that needs additional intensive study in Zaire.

C. Marketing Information and Its Communication

Market information at the disposal of persons making decisions is the basis for management of a marketing system whether the system is centrally controlled in total or in part or if management decisions of individual participants provide organization and structure for the total system. It is the purpose of this section to indicate the types of economic information specific to maize that are useful in management of a marketing system

and to suggest procedure by which ONACER may begin to assemble and communicate relevant information. Five types of information are designated as follows: (1) production and market supply information, (2) consumption information, (3) price, (4) quality and quantity of stocks and (5) other parameters of maize markets.

Production and Market Supply:

Production estimates are a characteristic part of statistical information gathered by departments of agriculture. To be useful in marketing a current crop, such information must be timely and accurate. Production information aids in estimating market supply of maize in any region but is not sufficient for that purpose. Estimates of the portion of increased production by regions that will be commercialized also is very relevant as is the market supply effect of a less-than-normal crop. Production variations resulting from weather conditions occur in Zaire but the extent of variation is not known. PNM CIMMYT reports indicate yield below expectations on some test plots because rains were not timely. ONACER employees in North Shaba report an estimated 13,500 tons of maize to be commercialized from Nyunzu this year which is 1,500 tons below 1974 because unfavorable weather conditions have lowered production from a year earlier.

As weather conditions change, it is useful to supplement routinely reported statistics. This can be done by field sampling and on-site observations by experienced observers.

When size of crop varies, the portion (percentage) of the crop commercialized will vary also. PNM/CIMMYT estimates that 80 percent of increased production resulting from improved seed and fertilizer would be commercialized in

the Gandajika area. Development of data series reporting production and commercialization, uniformly prepared at all ONACER regional and agency offices will provide a basis for more accurate estimates of quantity of maize to be commercialized.

Consumption and Demand Information:

Data on demand for maize in Zaire and the patterns of consumption are very limited. It is reasonable to estimate that consumers will not change appreciably the quantity of maize consumed except with major changes in price. This is suggested by scattered evidence of price variation (both seasonal and annual) and from parallel circumstances in other countries. An evaluation of demand characteristics (elasticities), although not precisely measured in quantitative terms, will aid substantially in estimating the behavior of markets under various supply conditions. Important policy decisions may be determined by demand characteristics. For example, if an estimated short-fall in production of 10 percent is likely to increase consumer prices by 50 percent, it may be desirable to offset that short-fall with imported maize. If, under the same short-fall conditions, consumer prices would rise 10 percent or less in order to bring supply and demand into balance, no import action may be required. Systematic collection of supply and price information at major consumer markets will permit such analysis. Data series of this kind become more valuable in understanding market characteristics and market changes as the length of the series grows. Accuracy and uniformity are again very important. ONACER can develop the capability of collecting such statistics.

Patterns of maize consumption for food such as quantity consumed by various income groups is also important information for policy purposes. Current consideration of the merits of increase in the price of maize to increase incomes to

producers and processors emphasizes this informational need. With current data it is not possible to know whether increased price for maize flour will have relatively greater impact on high-income or low-income families.

Price Information:

Under strictly controlled price conditions there is no need to collect price information. However, in very few situations are prices so strictly controlled that they do not deviate from official prices. Control is not that complete in Zaire. Occasional reports of purchases from producers at less than (or more than) official prices were encountered. Reports of retail prices above official prices were reported and confirmed by observations in retail markets. Prices to producers that were below the official prices occurred where the capability of buyers to move maize from the villages was low. Where local demand for maize is high, producers were receiving prices above the official price (Kasai Oriental and south Shaba). Consumer prices were significantly above official prices in Mbuji-Mayi and in Lubumbashi.

Prices provide the signals concerning supply/demand conditions. Current and accurate reports on producer and consumer prices provides the barometer of short-run market conditions in various market segments. If maize marketing is to be managed on a national basis so that surplus supply areas send maize to areas of greatest demand, price information can provide the necessary informational base to make possible good short-run supply management. Information on seasonal price movements obtained by regularly recording price information (daily or weekly) will enable evaluation of incentives to store maize until the latter part of the marketing year. ONACER has offices in major producer and consumer markets from which price information could be assembled.

Maize Stocks:

Appropriate management of current supplies within a marketing year requires knowledge of the size, location and condition of existing supplies within the country. After development of a marketing system as proposed here, it is likely that maize in commercial channels at any time will be owned by local petty dealers, ONACER, dealers licensed by ONACER, or mills who manufacture maize flour. ONACER, therefore, will have fairly ready access to figures that will provide a basis for estimating available commercial supply. Periodic estimates of existing stocks will be useful in appraising market conditions. Additional supply may exist at any time in the hands of producers and as flour owned by distributors. Development of procedures for estimating those stocks will also be useful.

Additional Information:

Data for description of market flows of maize are reported to exist in the office of OZAC in Kinshasa (Chapter III). These data could be useful in determining needed improvements in transportation; aid in determining appropriate storage locations; aid in assessing degree of damage to maize in storage other than in mills; reveal the seasonal pattern of flows of maize to mills and indicate changes that occur in the above characteristics of commercialization over a period of years.

To provide management and policy related data,it is recommended that ONACER establish a division of Information and Statistics in the Kinshasa office and that similar divisions be established in each regional office and in agency offices as required for the purpose of assembling and disseminating information as described above.

For information to be most useful, it must be communicated promptly. Management of a national cereals office also requires easy communication among various offices within the organization.

The communications infrastructure is extremely inadequate for the needs of ONACER if maize marketing management is to be coordinated throughout Zaire. It is recommended, therefore, that ONACER explore immediately the establishment of a communication system that will permit daily communication among the Director's office in Kinshasa and all regional and appropriate area offices. This is of primary importance in the development of a coordinated marketing system.

D. Summary

Significant improvements in transportation must await greater public investment in the transportation system. Rail cars are not adequate for bulk transportation of maize. If bulk handling is to be undertaken, discussion with ONATRA concerning need for improved rail cars should precede initiating such a system.

Shortage of financial credit in marketing is in part the absence of lending techniques suited to the needs of marketing firms and in part inability of potential lenders to assure repayment of loans. Systems of providing inventory credit based on documented evidence of inventory (shipping letter or other documents) needs to be expanded. Cooperative effort of ONACER and lenders could help identify credit-worthy potential dealers.

Information on market supply, consumption characteristics, prices, quality and quantity of stocks and movement patterns for maize should be

developed. ONACER should begin to develop needed market data. A system of inter-market communications is badly needed.

IX. TRAINING AND DEVELOPMENTAL RESEARCH

A. Training

The Government of Zaire has a core of well-educated, energetic young persons in positions of responsibility in the National Office of Cereals. In general, however, these individuals lack the managerial and technical training and experience required for effectively operating a grain storage, processing and marketing operation of the magnitude proposed for ONACER.

To provide managerial and technical skills a program of planned training is recommended. The Programme National Mais has a program to train qualified individuals in the technical aspects of maize production. A parallel program should be undertaken to train the storage and marketing staff of ONACER. The four levels of training suggested are: (1) in-country training provided by grain storage and marketing specialists, (2) an in-country seminar on grain storage and marketing, (3) participation in grain storage and marketing short courses, and (4) degree programs at foreign universities in specialized areas of study related to grain storage and marketing.

- On-the-job training in Zaire under the direction of contract grain storage and marketing specialists. Two specialists, one each in grain marketing and in grain storage, handling and preservation are recommended for a 2-year period. The function of the two specialists would be to act as advisors to ONACER in the areas of marketing and storage of cereal grains at national and regional levels. The specialists would be expected to provide on-the-job advice and training to ONACER personnel and private dealers until a core of trained personnel has gained the experience necessary to assume full operation of the grain storage and marketing program in Zaire.

The description of specialists needed for the purposes outlined here are as follows:

A. Grain Storage Preservation and Handling Specialist.

The grain storage specialist should be qualified to:

1. appraise the appropriateness of alternative storage structure installations at specific locations and provide advice on storage design.

2. provide assistance in selection and operation of maize handling methods and equipment.

3. provide assistance in selecting, locating, and operating shelling, cleaning, drying and processing equipment and facilities.

4. define and analyze field and storage losses due to insects, molds, rodents, birds and other causes.

5. recommend effective maize preservation techniques under conditions existing in Zaire including, but not limited to, management practices and chemicals.

6. provide assistance in the development of a quality identification or grading system in cooperation with the grain marketing management and systems specialist.

7. provide assistance in developing and maintaining transportation systems and equipment within the available infrastructure components.

B. Grain Marketing Management and Systems Specialist.

The systems and management analyst should be qualified to:

1. appraise and diagnose an entire marketing sub-system to determine what elements (or linkages) are missing or require strengthening.

2. appraise, on a continuing basis, the consequences of alternative Government of Zaire price and marketing policies on the producers, consumers and the marketing system.

3. estimate costs and benefits of alternative improvements in the marketing system and in the infrastructure from which it draws its support.

4. make recommendations concerning the design of a market information system.

5. provide assistance in the development of a quality identification or grading system in cooperation with the grain storage and handling specialist.

6. provide assistance in organization and business management techniques at ONACER installations at all marketing levels.

7. provide assistance in financial and credit management of ONACER operations.

Provision of technical advisors should have a very high priority because of the immediate need to deal with technical and policy problems on a daily basis for which indigenous background, experience and expertise is in short supply. Because of the need to develop private dealer participation, services of technical advisors also should be available to private dealers whenever possible.

• In-country seminar on grain storage and marketing. The purpose of this training would be to provide individuals now in positions of responsibility with knowledge of the basic elements of the various aspects of grain storage and marketing. Such a seminar would provide a foundation on which current operations could be improved and on which more specialized training could be based.

This in-country seminar should be attended by the members of the National Cereals Board (staff members of the National ONACER office) and the eight regional ONACER directors and their deputies. The seminar should be two (2) weeks in duration and cover the following subject areas:

- Fundamentals of Grain Storage (causes of grain losses, moisture measurement, structure of cereal grains, etc.)
- Methods of Storing and Handling Grain (Grain handling equipment, storage facilities construction and sizing)

- Grain Quality Preservation (Control of insects, rodents, birds and micro-organisms

  Grain Marketing Economics (Principles of management and operation, storage costs and alternatives, price stabilization, transportation, facilitating grain marketing).

Participation in Grain Storage and Marketing Short Courses. Short courses in grain storage and grain preservation techniques are held frequently in Africa, and elsewhere, under the supervision of various International Organizations. Short courses of this kind, with which we are familiar, provide very useful technical information. Regional directors of ONACER, their deputies and marketing section heads should gain in technical competence by attendance.

A similar short course in grain storage, but also emphasizing economic aspects of grain marketing and market organization, is presented in the U.S. each year under contract support from USAID. This short course is designed to examine grain marketing problems in developing countries and possible solutions. Subject materials and times devoted to various core, economic and technical areas of grain storage and marketing in this short ocurse are shown in Appendix IX-1.

- Degree programs. It is recommended that at least one individual in each of the areas of grain marketing and grain storage and quality preservation be sent to a foreign university each year for advanced training to the Master's level. Training in this category should be provided for promising individuals who would, subsequent to their training, assume positions in the National Cereals office and act as advisors to regional offices.

Degree programs should emphasize specialized areas for which training is not available in Zaire. Various U.S. universities offer advanced training

in basic areas of engineering, entomology, cereal chemistry, business management, accounting and economics with specific applications to unique problems encountered in storage and marketing of cereals. Universities elsewhere may provide similar opportunities.

Training to the Master's degree in U. S. universities commonly requires a period of 24 months with the student taking regular university courses in his area of specialization plus conducting a research problem related to his specialization. Proficiency in speaking, reading and writing English are required.

Candidates for advanced training should be those with potential for top level management as well as those expected to supervise specialized programs. Specialized program personnel may include persons expected to direct a statistics gathering and analysis program or persons responsible for management of an insect control program. Several other specialized areas can be identified.

Upon their return to Zaire, these individuals should be qualified to provide training for other ONACER personnel as well as functioning in an advisory capacity.

B. Research

The most immediate need in maize marketing is application of present knowledge to the development of a marketing system in Zaire. However, research needed to relate known principles to specific conditions in Zaire should not be totally neglected. ONACER has an excellent opportunity to

conduct research on improved storage and preservation of grains under conditions in Zaire utilizing the established research and training facilities at PNM stations throughout Zaire. Studies of application of management, credit and transportation techniques for efficient, low-cost operation of a marketing system in Zaire also offers potential for greater benefit.

The fact that losses do occur in the storage of grains at all levels of storage is evident from the discussion in preceding sections of this report. To safely store anticipated increases in production from current and subsequent programs will require improved storage methods and facilities at field and village levels. Not only increased production but effective preservation of that grain produced will help to overcome the current and future grain deficits.

Areas of research that should seriously be considered include:

1. Conduction of a survey to determine the extent of grain losses under various methods of storage at the farm and village level.

2. Development or modification of farm/village level storage units that can be effectively and economically used to store surplus grains until they can be moved into the commercial marketing channels.

3. Investigation of farm/village level drying techniques so that grain can be removed from the field at maturity for safe storage.

4. Development of techniques of financing ownership of stocks of commercialized grain during the course of marketing and processing.

5. Application of computerized systems to minimize total storage-transportation-processing costs in maize marketing in Zaire.

6. Evaluation of insecticide formulations for use under farm/village level storage conditions with emphasis on safety and effectiveness.

X. SUMMARY OF GOVERNMENT INPUTS FOR MARKETING SYSTEM DEVELOPMENT

We have referred to necessary inputs for the Government of Zaire in development of a maize marketing system throughout this report. It is our purpose in this chapter to summarize those inputs as we visualized and to suggest areas of possible international technical assistance. In specifying estimates we assume that ONACER will facilitate growing involvement of private traders with ONACER handling 20 to 25 percent of total volume after 5 to 10 years. We also assume that in the developed system ONACER will manage its maize stocks to achieve price objectives and conditions of relatively stable supply.

A. Warehouses and Equipment

Based on warehouse and equipment requirements for collection stations outlined in Chapter V, establishment of 10 warehouses (2,000 tons per site) in 1976 can be achieved at an estimated cost of Z 13,500 per warehouse (exclusive of land). Additions or expansions of warehouse space from 1977 through 1980 of 10,000 tons annually is projected at an annual cost of Z 67,500. From 1980 through 1984 additional expansion, at a rate of 10,000 tons annually plus conversion of some facilities to bulk handling, will require annual investment of an estimated Z 87,500. Warehouse and warehouse equipment investment, 1976 through 1984, for completion of 100,000 tons of warehouse space is summarized in table 19.

TABLE 19 Costs for Projected ONACER Warehouses, 1976 through 1984

Year	Investment	Capacity Increment	Total Capacity
	(Zaires)	(Metric tons)	(Metric tons)
1976	135,000	20,000	20,000
1977	67,500	10,000	30,000
1978	67,500	10,000	40,000
1979	67,500	10,000	50,000
1980	67,500	10,000	60,000
1981	87,500	10,000	70,000
1982	87,500	10,000	80,000
1983	87,500	10,000	90,000
1984	87,500	10,000	100,000

Included in the equipment requirements for each of the above sites is a sheller with engine, a moisture tester, a grain cleaner, scales, sack probes, and other miscellaneous equipment. Equipment costs at each site constructed in 1976 will be about Z 1,370. Equipment cost is included in the above estimates.

We recommend the distribution of hand-operated twin feed maize shellers to villages during the buying campaign. We estimate an average of 10 shellers for each of 10 collection stations initially at a total cost Z 15,000.

B. Trucks

A large element of cost for ONACER is the provision of vehicles at each of the collection stations and sub-stations. ONACER had a reported 39 trucks during the buying campaign in 1975. Some trucks were not in good condition and likely could not be used in the 1976 campaign. We estimate that ONACER will need an additional 80 trucks in 1976 to provide a total of 100 trucks for evacuating maize from villages. One truck loading an average of 35 tons per week (5 loads of 7 tons each) will deliver 630 tons in 18 weeks. One hundred trucks provide

capacity for 63,000 tons delivered to ONACER on their own trucks in a 4-month campaign. Eighty new trucks at an estimated Z 8,000 per vehicle will cost ONACER Z 640,000. Additional vehicles must be supplied by private dealers to facilitate movement of additional market volume in 1976 and subsequent years.

C. Bags

Adequate supply of bags was a problem for ONACER in the 1975 campaign. We do not know what the total supply of bags was for the 1975 campaign or the portion of those bags that will be returned to collection centers or villages to be reused. It is, therefore, impossible to estimate the need for bags for the 1976 campaign. Investment in bags is substantial. New jute bags (100 kg. capacity) cost approximately 50 K each in 1975. A supply of new bags for 100,000 tons of maize would require an investment of Z 50,000.

D. Personnel Training

Training of personnel is a continuing process within ONACER. However, because of the very large job to be accomplished in a very short time period, certain specific training functions are recommended. We recommend (Chapter IX) (1) In-country training provided by grain storage and marketing specialists, (2) An in-country seminar on grain storage and marketing,(3) Participation in the grain storage and marketing short courses, and (4) Degree programs of study at U.S. universities emphasizing management, grain marketing and grain storage.

We recommend a 3-week seminar on marketing and storage techniques held for a maximum of 30 key people in ONACER. Estimated cost of a seminar conducted by three specialists is Z 8,500.

Continued participation in the annual KSU Short Course with attendance of two persons annually would cost an estimated Z 4,600.

Participation in degree programs at U.S. universities with two people in training would cost an estimated ₴ 8,000 annually.

Providing in-country specialists in grain storage and marketing will require approximately ₴ 30,000 per man annually. Two specialists for 2 years each will require an estimated ₴ 120,000. Training costs based on the above estimates are indicated in table 20.

TABLE 20. Estimated Training Costs By Years, 1976-1980

Year	Training Cost
1976	₴ 81,100
1977	72,600
1978	12,600
1979	12,600
1980	12,600
Total	₴ 191,500

E. Extension and Research

One area of extension activity is stressed in this report. That area is working with villagers in construction of storages and instructing farmers in harvesting and care of maize for maximum preservation until it leaves the village. This is an extension function that could be carried out through ONACER offices. This should be an extensive effort. It is not possible for the KSU team to estimate a cost of this effort at this time.

The suggested research program (Chapter IX) is similar to the extension program. Large potential benefits in preservation of maize have been indicated. Other areas of research also hold potential gain. However, the magnitude of research undertaking can not be realistically estimated by us at this time.

F. Areas of Potential Technical Assistance

If further technical assistance for development of a maize marketing system in Zaire is available through USAID and sought by the Government of Zaire, appropriate areas of assistance appear to be the following in order of priority.

A. Technical assistance in development of a training program for ONACER personnel. Most urgent is provision of grain storage and marketing specialists, as specified in Chapter IX, for in-country participation in training and problem solving, primarily with ONACER, for a minimum period of 2 years. The other aspects of training are also important and are high priority items for technical assistance.

B. Development of a Research Program also described in Chapter IX. Research effort to be assisted by grain storage and marketing specialists as indicated in A. (above) and by U.S. research agencies.

C. Technical assistance in the establishment of a radio communications system to link markets together and to establish communications among ONACER offices throughout the country.

D. Technical assistance in development of a system of credit that would aid all dealers in financing grain inventories and providing maximum opportunity for new dealers to enter the marketing system.

E. Assistance in training of extension agents to promote proper handling and care of maize on farms and in villages, including design and construction of appropriate village storage units.

F. Technical aid in construction of warehouse facilities at a minimum of 10 points as specified in Chapter V of this report.

G. Technical Assistance in providing trucks, sacks, and miscellaneous equipment (shellers, moisture testers, cleaners, etc.) for marketing

system development. If a policy of increased use of private dealers is accepted by the Government of Zaire, it will be as important to aid private dealers to gain control of trucks and other necessary equipment as for ONACER.

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APPENDIX

Revised Draft
March 14, 1975

ZAIRE MAIZE STORAGE AND MARKETING STUDY

Proposed Scope of Work

Richard Phillips

Revised Draft
March 14, 1975

ZAIRE MAIZE STORAGE AND MARKETING STUDY

Proposed Scope of Work

SUMMARY OF CURRENT SITUATION

* Importance of Maize

Maize has been an important crop to Zaire for many years. Since 1950 annual production has averaged slightly more than 300,000 metric tons, and in recent years has exceeded 400,000 MT. Production is concentrated in the Kasai and Shaba Provinces in the southeastern one-third of the country. Employees of the copper mines and other industries in this section of the country are the major consumers of maize flour.

In spite of major efforts to increase production in recent years, growing demands continue to outstrip available domestic supplies. Annual imports reached nearly 150,000 metric tons in 1974, and represented a major drain on Zaire's foreign exchange. The population effect alone represents an estimated increase in demand of 4,500 to 5,000 metric tons of maize per year.

* Production Potentials

The total undeveloped hectarage of suitable maize soils has not been determined, but appears to be substantial. Climatic conditions are favorable, and yields of 8.0 MT/ha (nearly 150 bushels/acre) have been demonstrated under controlled conditions on village peasant farms. The current fertilizer recommendations of 50 to 60 units of N and 50 units of P_2O_5 per hectare alone are believed to increase average yields by 2.0 MT/ha.

* National Programs to Improve Supply/Demand Balance

The Government of Zaire has active programs to improve the supply/demand balances of maize. The National Cereals Office (ONACER) has responsibility for implementing both production and price support

programs for farmers. The production program is carried out through the National Maize Program (PNM), with direct support from CIMMYT. In addition, ONACER is implementing direct procurement activities as well as educational programs with existing petty traders and corn mills to improve and stabilize farmers' markets.

The most important buyer and processor of maize (both domestic and imported), is Kakoutwe Mills (subsidiary of GECAMINES, the largest copper mining company). The company's mills are located in Likasi and Lubumbashi. Recent sale of maize flour included 36 percent to the large copper plants and 23 percent to other large industries for direct distribution to their employees. As further effort to reduce the need for imports, GOZ is encouraging large mining companies and S.N.C.Z.* to go into plantation production of maize to meet the requirements of employees.

* Producer Marketing Problems

The marketing problems of maize producers (and the procurement problems of ONACER to support producer prices) are challenging indeed. Areas of surplus and potential surplus production are concentrated in large "pockets" in (1) the Mweka-Demba area of Kasai Occidental, (2) the Gandajika area of Kasai Oriental, (3) the Kongolo-Kabolo-Nyunzu triangle of North Shaba, and to a lesser extent in (4) the Kaniama, (5) the Likasi-Kolwezi, and (6) the Kasodji areas of Shaba. The major mills (and therefore the markets) are located in Likasi, Lubumbashi and Kananga, several days' travel time from most of the production areas. Roads exist but they are badly eroded. The primary and secondary roads are rough and nearly impassable in the rainy season.

Existing facilities for collection, storage, shelling and loading maize are not adequate to serve the surplus and potentially surplus production areas. Production and market intelligence is unreliable and prices in private trade are volatile.

Transport and marketing costs are very high--often in excess of 85 percent of the consumer price.

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*Société Nationale de Chemin de Fer Zairois, (National Society of Zairian Railroads).

The present farm support price of 4 makuta per kilogram for maize, and the official selling price for maize flour of about 5.5 makuta per kilogram in 60-kilogram bags mean that a large percentage of the extremely high marketing and transport costs must be subsidized. This subsidy is much less than that currently required on imported maize, but still represents a substantial cost.

The development of an effective collection system is difficult. Transport from the field to the village (often several kilometers) is done by head load. Shelling is done by hand. Village storage usually is done in stilted hutches, typically less than one-half ton, in unhusked form. Losses from insects, rodents and birds are high. Many of the villages are not accessible by any type of truck, and animal power is not used. Once collected, shelled and brought to the rail head, the national railroad appears to be the most effective way of transporting to the distant mills for processing.

OBJECTIVES OF THE STUDY

* Overall Objective

The overall objective of the study is to analyze the marketing system for maize in Zaire and formulate recommendations for balanced development of the system, with emphasis on the specific needs of small peasant maize producers. For purposes of the study, the marketing system is defined to include maize harvesting, gathering and hauling from the field, handling, shelling, assembly, storage, transporting, milling, and the transport and distribution of maize flour. The study will address the physical, institutional and financial infrastructure to support marketing as well as the marketing functions involved. It is expected that the study will produce a proposed time-phased implementation program to achieve balanced development of the marketing system to match the maize production development program.

The study will focus upon improvements in the marketing system needed to serve the needs of small peasant producers and the women who harvest and carry

the maize from the fields. Needed and proposed marketing system developments to serve the large commercial farms and proposed integrated poultry enterprises will be evaluated in terms of potential complementary marketing services to these small producers.

* Team Reports

Before leaving Zaire the team will prepare a complete draft report summarizing (1) the methods and results of the analyses, (2) the consequences, costs and benefits of the viable alternatives, (3) recommended priorities for development, and (4) specific recommendations for the marketing component of maize development programs to be implemented by the GOZ and donor agencies. The report will be presented to AID/Zaire for review and interaction with the team members before their departure from Kinshasa.

Upon review and acceptance of the report, analysis and recommendations by AID and GOZ, Kansas State University will publish the results in its regular country report series for distribution through established channels by AID/W and USAID/Zaire.

In addition to the written report, oral reports will be presented by the team while in Zaire to the Director General of the Department of Agriculture, to the Director General of the National Cereals Office, and to such other officials as may be designated. The oral reports will emphasize the methods of analysis used, the data sources, all underlying assumptions, the resulting impacts, benefits and costs of the viable alternatives, and the team recommendations for priority implementation.

* Seminars in Zaire

In order to maximize the benefits of the team's presence in Zaire, it is anticipated that the team members will participate in one or more one or two-day seminars on maize marketing and related activities. Anticipated seminar participants include representatives of the Department of Agriculture, ONACER and other Zaire agencies, as well as representatives of CIMMYT, USAID, World Bank and other donor agencies.

QUALIFICATIONS OF STUDY TEAM

The study team will consist of three members, including (1) a grain marketing economist, (2) a grain sanitation specialist, and (3) a grain storage and handling engineer. The team members will be familiar with the unique problems of maize production and marketing, and have substantial experience in developing countries. One of the members will be designated as team leader, with management responsibilities for the team and the team report.

* Grain Marketing Economist

The grain marketing economist will be qualified to analyze the impacts and the costs and benefits of alternative (1) maize policies and price stabilization programs, (2) maize production, assembly, storage, shelling, handling and shipping facilities and systems, (3) road development and transport systems, (4) inventory financing programs and (5) programs for increasing the effectiveness of public and private marketing institutions.

* Grain Sanitation Specialist

The grain sanitation specialist will be qualified to analyze and diagnose the existing problems causing losses in the handling and storage of maize from insects, rodents, birds, molds and other pests. He will be qualified to assess the effectiveness of sanitation in existing storage structures and to suggest modifications in existing structures and/or management practices to make them more effective. He will be qualified to assess the benefits and costs of alternative methods of reducing maize losses, and to recommend effective maize preservation programs for conditions in the different maize producing regions of Zaire.

* Grain Storage and Handling Engineer

The grain storage and handling engineer will be able to appraise the requirements for, and the effectiveness of, alternative (1) storage structures for ear corn and shelled maize, (2) shelling methods and equipment, (3) handling methods and equipment, (4) transport methods and equipment and (5) processing methods and equipment. He also will be able to assess the requirements for and effectiveness of alternative materials

handling systems as applied to the assembly, movement and loading of maize, both in the ear and in shelled form.

PROBLEM AREAS TO BE STUDIED

The maize marketing study team will analyze the problems in Zaire from the viewpoint of a total food commodity system, the components of which must be properly balanced and coordinated if the system is to effectively serve both maize producers and the consumers of maize products. The team will visit each of the major maize production areas and address the specific needs in each area within the context of a coordinated national maize production, marketing and storage program.

Upon arrival in Kinshasa, the team will assemble the latest available maize production and market data for the major production zones from the Department of Agriculture, ONACER, USAID and other donor agencies (including CIMMYT, World Bank, FAO). The projections of maize production and consumption to be developed by the Fertilizer Team, CIMMYT and others will be reviewed in detail and modified to the extent that further analysis warrants doing so. The maize production budgets and analyses being developed by Mr. Mwamufiya (AID-sponsored Ph.D candidate in agricultural economics at Oregon State University) will be reviewed in detail. The results will be compared to those of similiar analyses of maize production, marketing and storage in other developing countries from the KSU files. The latest statements and interpretations of GOZ political and economic policies affecting maize production and marketing will be reviewed and analyzed. On the basis of these reviews and analyses, field research outlines and questionnaires will be developed for use by the team for the collection of primary data during the field trips to the production areas.

A number of specific problem areas will be analyzed in sufficient depth to measure the impacts of alternatives and formulate sound and workable recommendations. These include the following:

- Field Harvesting and Gathering

The methods of field harvesting and gathering can be an important source of loss, contamination and excess-

ive cost or effort to producers. These functions will be analyzed in relation to the magnitudes of existing problems, costs and benefits of alternative solutions, and their importance in the total maize marketing system. Particular attention will be given to the identification and measurement of limiting factors, such as the availability of woman power and production and price uncertainties as viewed by producers.

* Transport from Field to First Assembly Point

It seems clear that with the bad state of farm-to-market roads, the absence of farm animal carts, and the dependence on farm women to perform this function, field transport of maize is one of the limiting factors to rapid development of production by small farmers. This problem will be addressed in the specific context of each production area, alternative solutions will be formulated, and the costs and benefits of each alternative will be analyzed.

* Village Storage of Maize for Food

Some information has been assembled by PNM, CIMMYT and others on the costs and effectiveness of existing village storage units and practices. This information will be supplemented as necessary and analyzed to determine the seriousness of losses under existing conditions. Based upon successful types of village storage developed under similar conditions around the world, alternatives will be formulated and analyzed in a pro forma sense. Promising alternatives will be recommended for experimental development at the PNM stations, and in the case of those which show promise, for demonstration under village conditions.

* Village Storage of Maize for Seed

Because of the much smaller quantities, and the higher per unit costs involved from contamination and loss of germination, the handling and storage of seed maize at the village level must be addressed separately. Alternatives such as the sealed metal cans used in Northeast Brazil will be specified, and the costs and benefits analyzed. Those that show promise will be recommended for experimental development at the PNM stations and demonstration at cooperating villages.

* Assembly Point Functions

The assembly point functions of receiving from farmers, weighing, grading, financial settlement, storage in ear, shelling, shelled corn storage, arranging transport, loading, etc., appear to be in great need of development to serve surplus production areas of small maize producers. These "country-elevator" functions, and the alternative schemes for developing them, must be analyzed carefully. Many alternatives, including portable shellers with hopper scales and storage holding bins need to be evaluated as possible answers. In analyzing the alternatives, attention will be given to the costs and effectiveness of strengthening and motivating private marketing institutions and channels versus expanding the role of ONACER and other GOZ marketing institutions for maize. Possible development of assembly point facilities by ONACER for later lease or sale to private entrepreneurs will be included among the alternatives to be evaluated.

* Shipping Point Functions

The next important point in the marketing system to serve the increasing surplus maize production of small farmers is that of the rail head or shipping point. The functions of receiving, cleaning and conditionaing, storage, handling, blending, selecting and arranging transport and loading, need to be addressed in a context comparable to that for the assembly point functions. More complete facilities for this function may be justified at some specific locations. The team will formulate and analyze alternatives and make recommendations for shipping point facilities as integral parts of the total marketing system. Alternative mixes of functions between the public and the private marketing sectors will be analyzed from the point of view of relative cost-effectiveness at this level in the marketing system also.

* Roads and Transportation Networks

Anyone who has traveled over them in a four-wheel drive vehicle is conscious of the need for local road development and improvement as an integral part of the total maize production and marketing development program. Yet, there are many alternatives as to number of kilometers, types, grade, location, etc., for the roads,

and the potential traffic and cost savings must be demonstrated if alternative road developments are to be feasible. The road and transportation network studies as part of marketing system development clearly must be specific to the unique needs in each production area. In some cases, as has happened already, it is more economic to bring the surplus production areas to the roads than to bring the roads to the surplus production areas.

The KSU maize marketing and storage team will (1) identify the priority needs for road improvement and development in each major maize production area, (2) review all available cost-benefit studies of such roads, (3) formulate alternative levels for improvement of the roads, (4) conduct pre-feasibility analysis of the alternatives, and (5) on the basis of the findings, make specific recommendations for feasibility study of the most promising road improvement and development program to serve the maize areas.

* Marketing and Merchandising Logistics

The many dimensions of marketing and merchandising logistics--getting the needed materials at the right time at the right place in the right form--must seem almost overwhelming to ONACER. The logistics problems for everything from maize bags to transport vehicles must be addressed in the context of the total marketing system. This requires dependable intelligence information on supplies, markets and prices. It involves major tasks of institution building--trained people, organization, communications, etc. All of these things are difficult to acquire under present conditions in Zaire. The team will be expected to take an inquiring, understanding and sympathetic look at the alternative ways of building the necessary logistical system, and to formulate recommendations to facilitate doing so. The alternatives to be analyzed for cost-effectiveness will include varying relative roles of ONACER and the private trade in performing these logistical functions.

* Price Policies

Maize price policies, both for producer price supports and consumer price ceilings, as related to relative prices of other commodities, are crucial for

motivating balanced development of the maize program. Although price policy questions are complex and difficult to analyze, especially when so little basic data exist from which to measure demand and supply coefficients, the team will be expected to bring experience and expertise to bear on the policy questions. As a minimum, the team is expected to project the probable consequences of existing price policies in Zaire, and to suggest alternative policies which may be more effective in achieving national goals.

The team will analyze (1) the production (income) effects, (2) the foreign exchange effects, and (3) the income distribution (equity) effects of the alternative price policies. Farmers' responses to alternative levels and methods of incentive pricing for maize will be analyzed, and the resulting production and income effects evaluated. The resulting impacts on the country's foreign exchange position will be projected. The net incidence of impacts and the income distribution effects of the alternatives will be projected and evaluated. In this analysis of the impacts of alternative price policies for maize, the KSU team will take full advantage of the related analyses to be made by the TVA fertilizer team.

* Other Factors

A number of related factors and marketing functions, while not the central focus of the terms of reference for the team, will be studied as they bear on the above problems and the effective functioning of the total marketing system for maize. The list of such other factors include:

(1) Maize milling, including storage, handling and distribution functions of the mills;

(2) Marketing and distribution of maize flour;

(3) Comparative advantages of maize production to producers in the different production areas, particularly as related to the production of other food crops;

(4) Infrastructure development to support economic development of the maize production areas in the broader context;

(5) Related policies and programs of the GOZ and donor agencies, particularly those discussed in the next section.

COORDINATION WITH RELATED STUDIES AND PROGRAMS

The team will coordinate the field studies, analysis of alternatives and formulation of recommendations with related programs and studies in Zaire. These include in particular (1) the CIMMYT/ONACER/PNM program for maize production, (2) the pending North Shaba Project, (3) the TVA fertilizer study, (4) Mwamufiya's Analysis of Maize Production and Marketing, and (5) road development programs supported by the World Bank and other donor agencies.

* CIMMYT/ONACER/PNM Program

The efforts of the team in focusing on maize storage and marketing will be fully complementary with the on-going CIMMYT/ONACER/PNM Program. The CIMMYT specialists are anxious to cooperate fully, and have agreed to accompany the team in its field studies, and to make all information and findings available to the team. The two PNM Zairians in training at Kansas State University will brief the team in depth prior to its departure for Zaire. The Food and Feed Grain Institute at Kansas State University has been placed on the July/August study tour of USA and Mexico by Director General Makoko, Shaba Regional Director Tepatondela, and CIMMYT team leader Thomas G. Hart. It is hoped that one or more ONACER technicians will be able to participate in the International Grain Storage and Marketing Short Course to be held at Kansas State University June/August 1975.

* The North Shaba Project

The Kongolo-Kabolo-Nyunzu maize production area in North Shaba is to be included for first-hand field study by the team. In addition to the above areas to be studied, special attention will be given to developing any additional information and analyses which may be needed regarding the pending AID support of this project.

* TVA Fertilizer Study

The arrival of the grain storage and marketing team in Zaire is timed to follow immediately upon completion of the fertilizer study by the TVA team. The Kansas

State University team will take full advantage of the analysis and recommendations of the fertilizer study report. One or more members of the grain storage and marketing team will have a full personal briefing by one or more members of the fertilizer team upon completion of that study. The briefing will be held either in Kinshasa or in the USA, depending upon the exact departure dates of the fertilizer team and the exact arrival dates of the grain storage and marketing team.

- Mwamufiya's Analysis of Maize Production and Marketing

The budget analyses being conducted by Mwamufiya as part of his AID-sponsored training as a Ph.D. candidate at Oregon State University will represent valuable information to the KSU team, and full advantage will be made of his work. A formal request is being made to have Mr. Mwamufiya stop over at Kansas State University en route to Corvallis upon completion of the field work in Zaire for his study.

- Road Development Programs

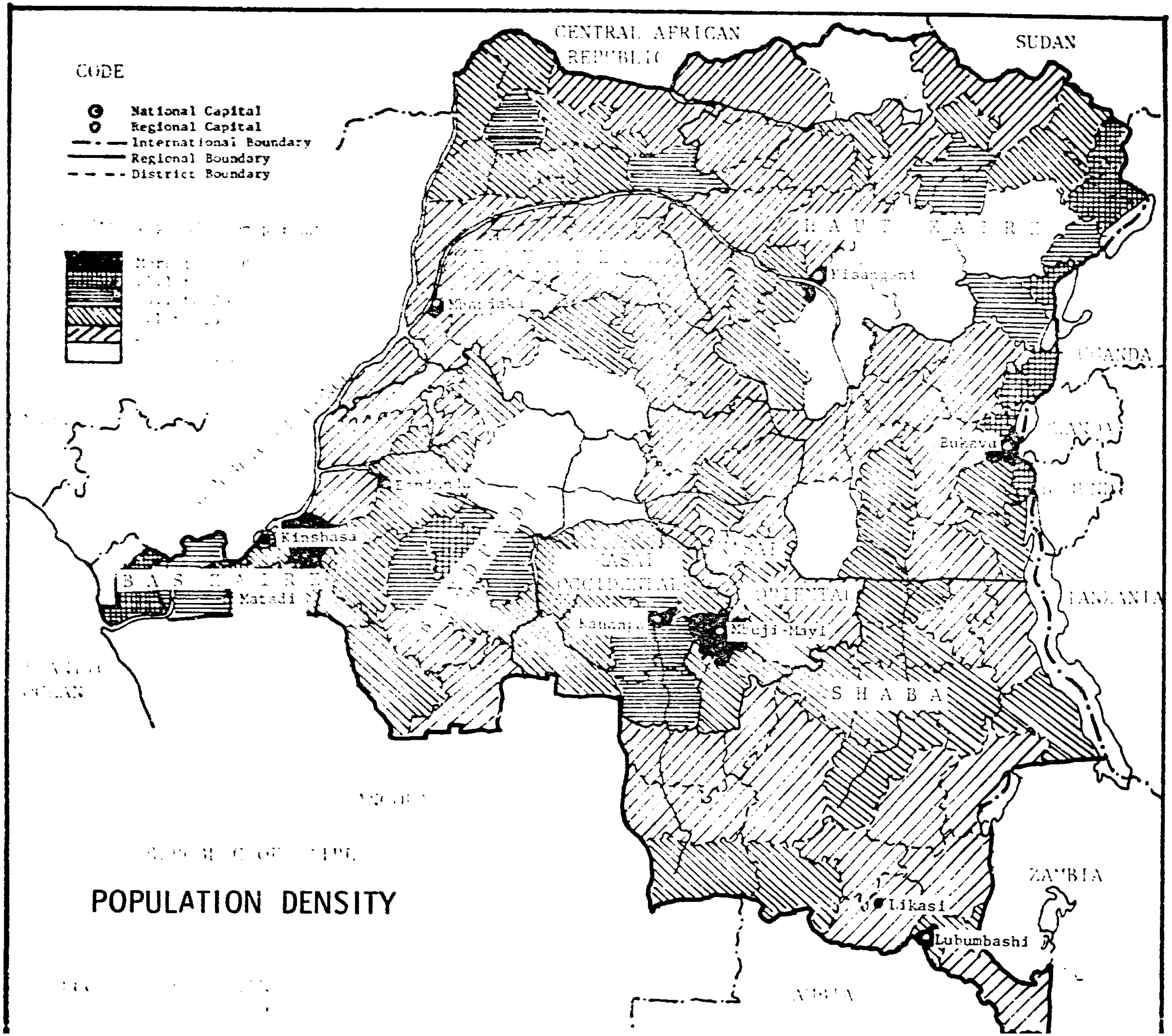
The grain storage and marketing team will reflect in its analyses all approved and pending road development projects within and serving the maize production areas. Such projects include those supported by the World Bank and other donor agencies as well as those supported solely by the GOZ.

PROPOSED ITINERARY FOR THE TEAM

The maize storage and marketing team should be programmed to arrive in Zaire in May, 1975 and remain in country for six to eight weeks. Approximately three weeks of this time should be spent in the maize production areas for first-hand study of existing storage and marketing problems.

In order for USAID/Zaire and ONACER to make advanced preparations for the team, and to contact CIMMYT officials so that they can meet the team in the field, it is essential that USAID be informed of the membership and exact ETA of the team no less than two weeks in advance of arrival in Zaire.

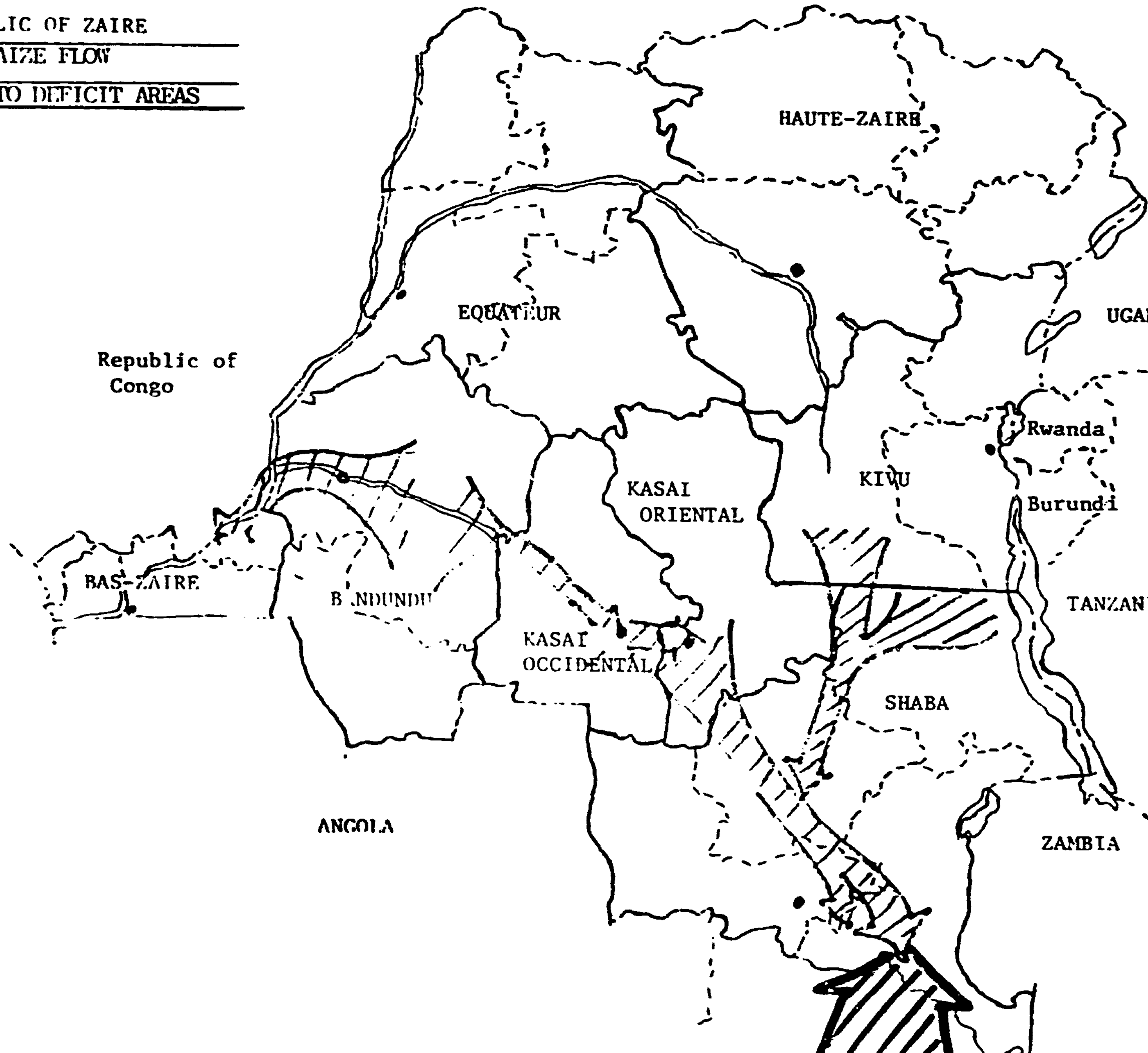
Appendix II
Figure II-A



REPUBLIC OF ZAIRE

MAIZE FLOW

SURPLUS TO DEFICIT AREAS



Appendix II
Figure II-B

Appendix II-1

ESTIMATED NUMBER OF FARMS
AND PERSONS PER FARM -1970

Region	Rural Population	Population in Agriculture	Number of Farms	Number of Persons/Farm
Bas-Zaire	1,211,807	1,151,217	215,584	5.34
Bandundu	2,295,112	2,180,356	387,964	5.62
Equateur	2,189,324	2,079,858	366,172	5.68
Haut-Zaire	2,882,857	2,738,714	570,565	4.80
Kivu	3,049,226	2,896,765	445,656	6.50
Shaba	1,938,872	1,841,928	368,386	5.00
Kasai Oriental	1,546,598	1,469,268	290,369	5.06
Kasai Occidental	1,860,761	1,767,723	296,598	5.96
Zaire	16,974,557	16,125,829	2,941,294	5.48

Source: Department de l'Agriculture (1974) Les Problemes de la Promotion de l'Agriculture. Conferénce Donnée par le Citoyen Kayinga Onsi N'Dal Commissaire d'Etat à l'Agriculture. Institut "Makanda Kabobi," Session Mobutu Sese Seko, Septembre 1974, 114 p.

ESTIMATED TOTAL HUMAN POPULATION BY PROVINCE
REPUBLIC OF ZAIRE 1980

Province	Total Population	%	Urban Population	%	Rural Population	%
Kinshasa	3,682,497	12.84	3,682,497	100	--	-
Bas-Zaire	1,914,788	6.67	559,827	29.2	1,354,961	70.8
Kasai Oriental	2,206,301	7.70	624,663	28.3	1,581,638	71.7
Equateur	2,926,153	10.20	499,074	17.1	2,427,079	82.9
Kasai Occidental	3,078,855	10.73	1,263,698	41.0	1,815,157	59.0
Bandundu	3,229,491	11.26	593,570	18.4	2,635,921	81.6
Shaba	3,580,011	12.48	1,391,417	38.9	2,188,594	61.1
Haute-Zaire	3,783,532	13.70	940,451	24.9	2,843,081	75.1
Kivu	4,278,795	14.92	711,311	16.6	3,567,484	83.4
Rep. of Zaire	28,680,423	100	10,266,508	35.8	18,413,915	64.2

NOTE: Population Growth Rate 1971-1980

Total	(1971-75)	2.81%
	(1976-80)	2.91%
Urban		8.15%
Rural		0.847%

Source: Republic of Zaire, Institut National Statistique, 1970.

URBAN POPULATION DISTRIBUTION BY REGION AND CITY, 1970

Region/City	Population
Kinshasa	1,323,039
Bas-Zaire	
Matadi	110,436
Boma	61,054
Mbanza-Ngungu	55,838
Kintanu	15,859
Kimpese	12,000
Kasangulu	11,923
Lukula	11,000
Moanda	7,440
Luozi	7,004
Bandundu	
Kikwit	111,960
Bandundu	74,467
Mangai	15,232
Inogo	14,823
Bulungu	14,658
Kenge	14,351
Mushie	13,732
Bolobo	10,256
Yumbi	10,181
Kutu	10,026
Dibaya Lubwe	7,879
Kwamouth	3,082
Kivu	
Bukavu	134,861
Goma	48,728
Kindu	42,799
Kasongo	37,782
Butembo	27,933
Uvira	15,851
Beni	4,703

Region/City	Population
Equateur	
Mbandaka	107,910
Gemena	36,767
Bumba	34,705
Lisala	28,653
Boende	12,758
Businga	10,987
Basankusu	10,708
Haut-Zaire	
Kisangani	229,596
Isiro	49,279
Bunia	28,842
Yangambi	22,632
Watsa	21,298
Buta	19,753
Lokutu	18,651
Aketi	17,225
Faradje	10,359
Niangara	9,165
Basoko	9,120
Durungu	9,116
Wamba	9,081
Mangwalu	8,847
Ubundu	6,276
Mosite	4,322
Kasai Oriental	
Mbuji-Mayi	256,154
Lusambo	13,140
Mwene-Ditu	-
Gandajika	-
Lodja	56,339
Kabinda	-
Lomela	-
Lubao	-

-Continued

Region/City	Population	Region/City	Population
Shaba		Kasai Occidental	
Lubumbashi	318,000	Kananga	428,960
Likasi	146,394	Ilebo	32,126
Kolwezi	107,276	Mweka	24,792
Kalemie	63,179	Luebo	21,749
Kamina	59,026	Demba	-
Manono	44,394	Dibaya	-
Kipushi	24,384	Luiza	-
Kabalo	22,280	Tshikapa	-
Kongolo	14,710		
Kadongo	9,044		
Lubudi	6,155		

Source: Department de l'Agriculture (1974) Les Problemes de la Promotion de l'Agriculture. Conferénce Donnée par le Citoyen Kayinga Onsi N'Dal Commissaire d'Etat à l'Agriculture. Institut "Makanda Kabobi," Session Mobutu Sese Seko, Septembre 1974, 114 p.

PROJECTED URBAN POPULATION IN PROVINCES OF SHABA, KASAI ORIENTAL, KASAI OCCIDENTAL, KINSHASA AND OTHERS 1970-1985

Year	Shaba[1]	Kasai Oriental[2]	Kasai Occidental[3]	Kinshasa[4]	Other[5]
			(X 1,000)		
1970	815	326	573	1,323	1,622
1971	860	348	620	1,466	1,736
1972	907	371	671	1,624	1,858
1973	957	396	727	1,799	1,969
1974	1,010	423	786	1,993	2,129
1975	1,065	451	851	2,207	2,279
1976	1,123	481	921	2,445	2,439
1977	1,185	514	997	2,709	2,611
1978	1,251	548	1,079	3,001	2,794
1979	1,319	585	1,168	3,324	2,991
1980	1,392	625	1,264	3,683	3,202
1981	1,468	667	1,368	4,080	3,427
1982	1,549	711	1,480	4,520	3,668
1983	1,634	759	1,602	5,007	3,926
1984	1,724	810	1,734	5,547	4,202
1985	1,819	865	1,877	6,145	4,498

[1] Annual Rate of Increase = 5.5% Based on 1970 and 1980 population estimates, INS & Dept. Agriculture

[2] Annual Rate of Increase = 6.75% Based on 1970 and 1980 population estimates, INS & Dept. Agriculture

[3] Annual Rate of Increase = 8.23% Based on 1970 and 1980 population estimates, INS & Dept. Agriculture

[4] Annual Rate of Increase =10.78% Based on 1970 and 1980 population estimates, INS & Dept. Agriculture

[5] Amount Rate of Increase =7.036% Based on 1970 and 1980 population estimates, INS & Dept. Agriculture

AREAS PLANTED, PRODUCTION AND YIELD OF THE PRINCIPLE CEREALS CULTIVATED IN ZAIRE 1968-1972

Year and Region	MAIZE			PADDY RICE		
	Area Planted Ha.	Production M.T.	Yield Kg/Ha	Area Planted Ha.	Production M.T.	Yield Kg/Ha
	x1000	x1000		x1000	x1000	
Republic of Zaire						
1968	548.4	361.4	659	236.1	140.4	594
1969	545.1	357.8	656	266.9	187.9	704
1970	429.0	329.6	768	265.7	172.1	648
1971	593.1	409.0	689	242.8	194.8	734
1972	653.6	433.2	663	275.8	206.3	748
1968						
Bas-Zaire	56.5	50.0	850	9.5	10.7	802
Bandundu	86.5	65.0	752	7.6	5.6	734
Equateur	72.6	43.0	592	37.2	28.0	752
Haut-Zaire	77.9	40.0	534	67.6	36.0	533
Kivu	54.2	36.4	670	63.1	33.0	523
Shaba	66.3	49.5	747	1.9	1.5	781
Kasai Occidental	81.1	34.3	422	27.7	8.6	310
Kasai Oriental	56.3	43.3	768	21.5	17.0	790
1969						
Bas-Zaire	51.1	45.0	881	14.9	14.8	994
Bandundu	98.3	64.0	651	8.5	7.4	868
Equateur	71.7	45.0	628	37.9	30.0	792
Haut-Zaire	71.7	45.0	627	82.9	53.0	640
Kivu	71.7	27.3	518	79.5	45.0	566
Shaba	61.2	51.1	834	2.3	4.7	207
Kasai Occidental	81.1	35.1	432	19.8	17.0	859
Kasai Oriental	57.5	45.4	790	21.3	16.0	753

Appendix 11-5
Continued p.2

Year and Region	MAIZE			PADDY RICE		
	Area Planted Ha.	Production M.T.	Yield Kg/Ha	Area Planted Ha.	Production M.T.	Yield Kg/Ha
	x1000	x1000		x1000	x1000	
1970						
Bas-Zaire	37.9	37.9	994	18.4	13.1	713
Bandundu	74.6	54.0	724	11.7	6.7	573
Equateur	55.7(e)	35.0	628(e)	30.5	28.0	919
Haut-Zaire	75.6	44.5	508	82.9	50.0	603
Kivu	44.7(e)	23.2	518(e)	48.3(e)	35.0	724(e)
Shaba	59.3	54.0	910	5.8	2.9	499
Kasai Occidental	37.2	37.2	999	46.4	23.0	495
Kasai Oriental	44.0	43.9	998	21.8	13.4	615
1971						
Bas-Zaire	46.2	35.0	757	9.2	7.0	764
Bandundu	83.1	66.0	795	10.0	8.3	834
Equateur	72.4	48.0	663	43.4	29.2	722
Haut-Zaire	67.9	45.0	663	87.0	57.8	664
Kivu	69.3	30.0	433	56.9	49.7	872
Shaba	117.9	91.0	772	12.1	13.0	1,077
Kasai Occidental	83.0	55.0	663	13.1	10.7	814
Kasai Oriental	53.4	39.0	731	14.2	19.2	1,348
1972						
Bas-Zaire	49.1	41.6	848	7.3	5.9	811
Bandundu	89.2	72.1	809	11.0	9.2	833
Equateur	66.1	43.8	663	42.0	32.7	778
Haut-Zaire	118.5	38.5	325	90.6	62.8	693
Kivu	56.7	25.5	450	61.3	57.3	935
Shaba	125.8	96.9	770	14.4	9.0	623
Kasai Occidental	50.3	51.3	1,006	9.0	6.8	756
Kasai Oriental	96.6	63.5	657	40.3	22.8	565

Appendix II-5
Continued p. 3

Year and Region	WHEAT			BARLEY			SECONDARY CEREALS		
	Area Planted Ha.	Production M.T.	Yield Kg/Ha	Area Planted Ha.	Production M.T.	Yield Kg/Ha	Area Planted Ha.	Production M.T.	Yield Kg/Ha
	x1000	x1000		x1000	x1000		x1000	x1000	
Republic of Zaire									
1968	5.5	2.8	510	4.0	2.0	504	56.1	34.6	616
1969	7.2	3.4	472	3.2	2.1	666	88.6	53.7	606
1970	6.9	3.3	472	3.0	2.0	666	69.2	49.7	718
1971	4.6	2.0	434	.041	.034	829	79.9	49.2	615
1972	3.8	1.7	434	.067	.086	1,300	70.7	56.6	815
1968									
Bas-Zaire	-	-	-	-	-	-	-	-	-
Bandundu	-	-	-	-	-	-	12.4	9.8	794
Equateur	-	-	-	-	-	-	.9	.7	800
Haut-Zaire	-	-	-	-	-	-	-	-	-
Kivu	5.5	2.8	510	4.0	2.0	504	33.4	18.7	560
Shaba	-	-	-	-	-	-	3.6	2.6	716
Kasai Occidental	-	-	-	-	-	-	2.1	1.0	475
Kasai Oriental	-	-	-	-	-	-	3.7	1.7	460
1969									
Bas-Zaire	-	-	-	-	-	-	-	-	-
Bandundu	-	-	-	-	-	-	25.6	20.8	810
Equateur	-	-	-	-	-	-	-	-	-
Haut-Zaire	-	-	-	-	-	-	41.7	22.2	532
Kivu	7.2	3.4	472	3.2	2.1	666	9.7	5.5	570
Shaba	-	-	-	-	-	-	4.2	2.7	634
Kasai Occidental	-	-	-	-	-	-	2.8	1.4	500
Kasai Oriental	-	-	-	-	-	-	4.6	1.2	254
1970									
Bas-Zaire	-	-	-	-	-	-	-	-	-
Bandundu	-	-	-	-	-	-	28.1	25.9	921
Equateur	-	-	-	-	-	-	-	-	-
Haut-Zaire	-	-	-	-	-	-	14.1	8.4	596
Kivu	6.9	3.3	472	3.0	2.0	666	9.5	5.2	552
Shaba	-	-	-	-	-	-	3.6	2.7	747
Kasai Occidental	-	-	-	-	-	-	1.4	.9	600
Kasai Oriental	-	-	-	-	-	-	12.5	6.6	528

Year and Region	WHEAT			BARLEY			SECONDARY CEREALS		
	Area Planted Ha.	Production M.T.	Yield Kg/Ha.	Area Planted Ha.	Production M.T.	Yield Kg/Ha.	Area Planted Ha.	Production M.T.	Yield Kg/Ha
	x1000	x1000		x1000	x1000		x1000	x1000	
1971									
Bas-Zaire	-	-	-	-	-	-	-	-	-
Bandundu	-	-	-	-	-	-	26.9	18.6	690
Equateur	-	-	-	-	-	-	-	-	-
Haut-Zaire	-	-	-	-	-	-	33.5	20.1	600
Kivu	4.6	2.0	434	.041	.034	829	4.1	2.3	567
Shaba	-	-	-	-	-	-	4.7	3.3	716
Kasai Occidental	-	-	-	-	-	-	.473	.189	399
Kasai Oriental	-	-	-	-	-	-	10.3	4.6	456
1972									
Bas-Zaire	-	-	-	-	-	-	-	-	-
Bandundu	-	-	-	-	-	-	26.1	19.7	755
Equateur	-	-	-	-	-	-	1.8	1.4	802
Haut-Zaire	-	-	-	-	-	-	-	-	-
Kivu	3.8	1.7	434	.067	.086	1,300	27.9	26.4	946
Shaba	-	-	-	-	-	-	8.7	6.6	762
Kasai Occidental	-	-	-	-	-	-	1.3	.5	400
Kasai Oriental	-	-	-	-	-	-	4.9	3.0	600

Source: Mouvement Populaire de la Revolution Republique Du Zaire, Departement De l'Agriculture, Direction Des Services Generaux Et Etudes, Division d'Etudes Et Programmation Agricole.

AVERAGE PER CAPITA CONSUMPTION OF CEREALS IN ZAIRE

A. Apparent and Projected Average Consumption

Source	Year	Kg/Capita Maize	Rice	Wheat	Cereals Total
FAO[1)]	1965	15.0	5.0	3.4	30
	1970	15.3	7.7	3.5	30
	1975	16.0-16.7	8.3- 9.1	3.9	31-32
	1980	16.8-17.8	9.3-10.4	4.3	33-40
TVA[2)] Apparent	1970	19.3	9.1	5.5	35.1
	1971	20.5	8.6	5.8	36.0
	1972	20.6	8.7	6.2	36.6
	1973	22.0	11.9	6.0	41.0
	1974	22.3	10.8	6.2	40.4
TVA Projected	1980-Low	22	11.0	6.4	40.6
	1980-Med	24	11.5	6.7	43.5
	1980-High	26	12.0	7.0	46.4
	1985-Low	24	11.5	6.7	43.5
	1985-Med	26	12.0	7.0	46.4
	1985-High	28	12.5	7.3	49.3

Source:

1) TVA Fertilizer Study for Zaire, USAID/Kinshasa, 1975. (FAO date as quoted).

2) TVA Fertilizer Study for Zaire, USAID/Kinshasa, 1975.

APPARENT CONSUMPTION OF CEREAL FOODS FOR KINSHASA
(BY INCOME GROUPS 1969/1970)

Commodity	Income Groups in Z Per Month Per Household[1] <15.0	15.1-20.0	20.1-25.0	25.1-35.0	35.1-60.0	60.1+
	(Consumption in Kg./Adult/Year)					
Cereals	18.0	28.0	37.4	48.7	67.3	76.6
of which:						
Maize Flour	0.6	1.1	0.7	1.3	2.2	2.7
Rice	3.3	4.7	6.8	9.7	15.6	23.1
Bread	13.6	21.4	27.7	35.0	46.6	43.8
Tubers and Plantain	68.7	103.0	118.3	136.5	148.8	112.6
of which:						
Cassava[2]	65.9	99.6	114.0	130.7	135.9	91.4
Legumes	8.1	9.6	11.2	13.4	13.6	10.3
of which:						
Groundnuts	2.5	3.1	3.5	5.3	4.5	2.9
Haricot Beans	4.9	5.5	7.0	7.4	8.6	7.1
Beer	7.5	12.1	20.7	35.8	45.4	72.4

1) Population having up to 20 Z/Month income is about 65% of total.

2) Includes cassava roots, cassava flour and cassava paste.

Source: IRES, Résultats de l'Enquête sur les Conditions de vie à Kinshasa, May 1971

KINSHASA APPARENT MAJOR SUPPLY AREAS FOR FOOD
AVERAGE 1968-1970

Region	Cassava		Maize		Rice		Groundnut	
	%	M.T.	%	M.T.	%	M.T.	%	M.T.
Bas-Zaire	88.7	99,987	-	-	-	-	6.1	246
Kwilu River	8.0	9,018	44.9	3,482	-	-	69.6	2,802
Kasai River	2.2	2,480	3.4	264	1.1	123	10.4	419
Kasai Occident	0.1	113	20.6	1,599	6.4	717	-	-
Kwango-Wamba Rivers	0.6	676	0.2	16	-	-	12.5	503
Sankuru River	-	-	-	-	1.7	190	0.5	20
Fimi-Lukenie River	0.4	451	2.2	171	2.4	269	0.5	20
Mongala River	-	-	26.3	2,041	3.6	403	0.2	8
Bumba	-	-	1.1	85	44.6	4,995	-	-
Bumba-Mbandaka	-	-	0.4	31	12.8	1,434	-	-
Vicicongo Railway	-	-	0.6	47	16.4	1,837	-	-
Lulonga River	-	-	0.2	16	5.0	560	-	-
Ruki River	-	-	0.1	8	3.6	403	-	-
Kisangani Region	-	-	-	-	2.4	269	0.2	8
Totals		112,725		7,760		11,220		4,026

NOTE: This table excludes supplies transported by road from the Kikwit-Kenge Region. No clear indications of the importance of this marketing channel are available but will undoubtedly develop with new road.

Source: OTRACO Transport data and mission estimates of supplies from Bas-Zaire (From IBRD Report PA118a)

MAJOR FOOD SUPPLY AREAS FOR LUBUMBASHI
(1970 data)

Region	Maize		Maize Flour		Cassava Root		Cassava Flour	
	%	M.T.	%	M.T.	%	M.T.	%	M.T.
N. Shaba & Kasai	7.2	2,002	2.1	326	3.0	454	11.5	463
Bandundu	42.0	11,676	-	-	10.6	1,603	-	-
W. Shaba	5.8	1,612	0.8	124	76.3	11,540	57.0	2,294
Maniema	36.3	10,091	-	-	0.8	121	-	-
Haut Shaba	8.7	2,419	97.1[1)]	15,060	9.3	1,407	31.5	1,268
Total		27,800		15,510		15,125		4,025

Region	Beans		Groundnut		Rice		Millet	
	%	M.T.	%	M.T.	%	M.T.	%	M.T.
N. Shaba & Kasai	1.4	26	0.9	30	9.4	189	-	-
Bandundu	-	-	1.2	40	0.5	10	-	-
Maniema	84.4	1,557	1.1	37	67.3	1,349	-	-
Haut Shaba	13.9	256	12.5	421	20.6	413	41.1	458
Total		1,845		3,365		2,005		1,115

1) Includes maize flour produced from imported maize.

SOURCE: From IBRD report No. PA118a, 1972.

LICENSED DEALER ACTIVITY KASAI OCCIDENTAL, 1970[1/]

A. Primary Trader Licenses, Kasai Occidental

(1) Number of Licensed Buyers per District

District	Buyers
Mweka	78
Demba	53
Luiza	45
Luebo	34
Ilebo	33
Kazumba	24
Tshikapa	21
Dimbelenge	17
Dibaya	6
Dekese	3

(2) Number of Districts per Licensed Buyer

Number of Districts	Number of Buyers
1	30
2	31
3	54
4	10
5 and over	3

B. Average Purchase by Dealers in Typical Districts

Commodity in M.T./Dealer

District	Maize	Cassava
Mweka	25	540
Luiza	40	500
Dimbelenge	60	550

C. Purchase of Largest Buyers, Kasai Occidental, 1970

Trader	Maize (M.T.)	Cassava (M.T.)
1	-	-
2	2,780	-
3	-	-
4	1,900	-
5	1,230	130
6	1,013	-
7	635	180
8	400	120
9	170	290
10	-	15
11	5	15
12	5	5

Source: Abstracted from "Agricultural Sector Survey, Republic of Zaire, Vol II IBRD Report No. PA-118a, June 19, 1972.

MAIZE MILLING CAPACITIES OF MAJOR MILLS

GECAMINES - MINOTERIE DE KAKONTWE - MINOKA

Likasi Mill	-	250 M.T./day (3 shifts)
Lubumbashi Mill	-	200 M.T./day (3 shifts)
Kolwezi Mill	-	70 M.T./day (3 shifts)

EX/TARICA FRÊRES

Lubumbashi Mill	-	80 M.T./day (3 shifts)

CEROTEX

Lubumbashi Mill	-	unknown	1973 Production was
Kananga Mill	-	unknown	22,378 M.T. flour

MEUNERKIN - MEUNERIE DE KINSHASA

Kinshasa Mill	-	Grits	4,800 M.T./Year (2 shifts)
		Flour	2,000 M.T./Year (2 shifts)

DETERMINATION OF PERCENT DAMAGED KERNELS AND PERCENT WEIGHT LOSS[2)]

Sample	Number of Kernels Sound	Number of Kernels Damaged	Total	Percent Kernels Damaged	Sound Kernels to Equal Weight of Sample	Percent[1)] Weight Loss
1	43	7	50	14	47	6
2	45	5	50	10	46	8
3	47	3	50	6	49	2
4	45	5	50	10	47	6
5	44	6	50	12	48	4
6	41	9	50	18	51	-2
				Av-11.7		Av-4
Pooled Samples						
1-2	88	12	100	12	93	7
3-4	92	8	100	8	96	4
5-6	85	15	100	15	99	1
				Av-11.7		Av-4

1)To determine the percent weight loss in sample use the following equation:

$$\text{Percent Weight Loss} = 100 - \frac{\text{Number of Sound Kernels to Equal Sample Weight}}{\text{Number of Kernels in Sample}} \times 100 \qquad (1)$$

2)Sampling Procedure to Determine Percent Damaged Kernels and Percent Weight Loss of Cereal Grains and Legumes on next page.

SAMPLING PROCEDURE TO DETERMINE PERCENT DAMAGED KERNELS AND PERCENT WEIGHT LOSS OF CEREAL GRAINS AND LEGUMES

1. Obtain a representative sample of seeds from container.

2. At random, select 100 kernels from the sample and visually examine each individual kernel for evidence of insect, rodent and/or extensive germ damage.

3. The number of damaged kernels is recorded as the percentage damaged kernels.

4. Place the 100 kernel sub-sample (sound and damaged kernels) on one pan of a balance or otherwise weight the sub-sample.

5. Select, at random, an additional 100 sound kernels and place on the pan opposite the sub-sample. Remove sound kernels from the pan opposite the sub-sample until the pans balance. If a balance is used where the actual weight of the sub-sample is determined, weigh an equivalent amount of sound kernels.

6. Determine the number of sound kernels equivalant in weight to the sub-sample by counting.

7. The number of sound kernels determined in this manner, subtracted from 100 (the number of kernels in the sub-sample) should be recorded as the percent weight loss.

8. Smaller sub-samples may be used to estimate the percent damage and weight loss.

   a. Percent damaged kernels is determined by dividing the number of damaged kernels by the total number of kernels in the sub-sample and multiplying by 100.

   b. Percent weight loss is determined using formula (1).

Appendix III-3
Continued

DAMAGE SURVEY SAMPLES

Sample	Number of Kernels/Ear: Rows	Kernels /Row	Total Kernels	Insect Damaged Kernels	% Insect Damaged Kernels	Est. % Weight Loss	Remarks
Sample Purchased in Local Market, Kananga (Kasai Occidental) June 12							
Ear-1	Shelled Sample		100	28	28.0	-	Ear infested-MW, CAD, FB and moth.
Ear-2	17	31	527	0	0	-	15 kernels mold damaged = 2.8%
Ear-3	Scattered			0	0	-	Ear not fully developed.
Ear-4	18	34	612	0	0	-	Good ear.
Ear-5	15	26	390	0	0	-	
Ear-6	17	18	306	0	0	-	
Ear-7	13	18	234	2	0.8	-	
Ear-8	16	20	320	25	7.8	4.7	Borer/moth damage.
Ear-9	18	25	450	0	0	-	Live weevil on ear; Penetration hole in husk
Ear-10	16	29	464	0	0	-	Small amount of webbing at tip.
Ear-11	14	28	392	0	0	-	
Ear-12	20	29	580	1	0.1	-	
Total			4,375	56	1.3	-	
Samples from Railcar, Minoterie de Kasai, Kananga, June 13							
1	shelled sample		100	1	1		
2	"	"	100	2	2		
3	"	"	100	0	0		Musty Odor
Total			300	3	1		
Sample from Feed-in Conveyor, CEROTEX Mill, Kananga, June 13							
1	shelled sample		100	2	2		

Sample	Number of Kernels/Ear: Rows	Kernels /Row	Total Kernels	Insect Damaged Kernels	% Insect Damaged Kernels	Est. % Weight Loss	Remarks
Samples from PNM (Gandajika) Seed Storage, FED Compound							
A. Ears without Husks							
Ear-1	16	37	592	80	13.5		1) Ears of maize stored in pile 6'x20'x30' in warehouse. 2) Moisture content 16.0-18.9%
Ear-2	14	37	518	42	8.1		
Ear-3	16	40	640	64	10.0		
Ear-4	12	48	576	0	0		
Ear-5	16	40	640	32	5.0		
Ear-6	20	40	800	3	0.38		
Total -A			3,766	221	5.87		
B. Ears with Husks							
Ear-7	12	26	312	84	26.9		
Ear-8	14	38	532	4	0.8		
Ear-9	14	30	420	4	1.0		
Ear-10	16	45	720	128	17.8		
Ear-11	14	33	462	154	33.3		
Ear-12	14	38	532	42	7.9		
Ear-13	21	33	693	42	6.1		
Total -B			3,671	458	12.5		
Total A & B			7,437	679	9.1		
Tabazaire Farmer (500 Ha. Farm) Storage, Kaniama (Shaba Region)							
Ear-1	20	26	520	0	0		Ears with Husks.
Ear-2	12	30	360	0	0		
Ear-3	14	30	420	2	0.5		
Ear-4	16	36	576	6	1.0		
Ear-5	14	31	434	0	0		
Ear-6	14	26	364	2	0.6		
Ear-7	12	36	432	0	0		Webbing & Frass at tip.
Total			3,106	10	0.3		

Sample	Number of Kernels/Ear: Rows	Kernels /Row	Total Kernels	Insect Damaged Kernels	% Insect Damaged Kernels	Est. % Weight Loss	Remarks
Seed Storage at FED Station, Gandajika Area							
Ear-1	14	46	644	0	0		Adult weevils on ear
Ear-2	17	39	663	0	0		
Ear-3	13	38	494	0	0		
Ear-4	18	39	702	0	0		
Ear-5	13	30	390	0	0		
Ear-6	17	33	561	6	1.0		10 weevils on surface of ear
Ear-7	16	34	544	0	0		
Ear-8	14	40	560	5	0.9		3 weevils on surface of ear
Ear-9	16	40	640	0	0		
Ear-10	12	44	528	24	4.5		
Ear-11	18	38	684	54	7.9		25 adult weevils on ear
Ear-12	12	35	420	378	90.0		weevil & mold damage
Total			6,830	467	5.5		

NOTE: Above sampled maize was representative of that occupying approximately 7/10 of thatched roof shed 10m x 100m. Maize was stored to a peak height of 1.7m. Volume of available maize storage = $855m^3$.

Approximately 1/10 of the available storage space had maize with 80-90% insect damaged kernels per ear.

Average percent damage

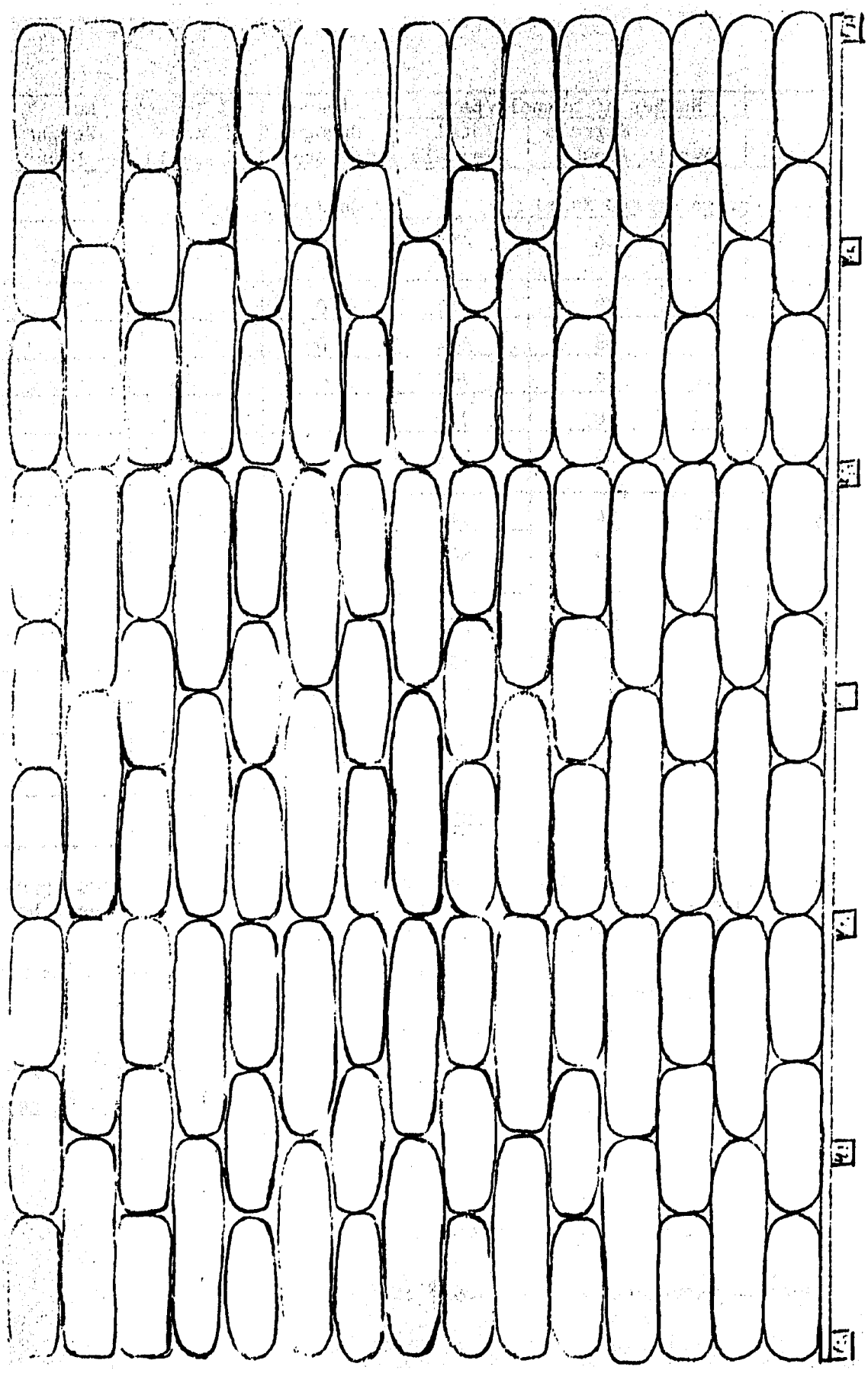
0.7 of storage: $600m^3$ x $450Kg/m^3$ x 0.675 shelled maize[1] = 182,250 Kg.

0.1 of storage: $85.5m^3$ x $450Kg/m^3$ x 0.675 shelled maize[1] = 25,970 Kg.

182,250 Kg x 0.055% damage = 11,452.1 Kg Damage
25,970 x 0.85 = 31,808.8
203,220 Kg Total 43,269.9 Kg Damage
Equivalent to 36.0% damaged kernels

[1] Shelled maize estimated at 0.675 of ear weight.

STANDARD STACKING DIAGRAM FOR BAGGED GRAINS



WHEAT FLOUR MILLING IN ZAIRE

Two wheat flour mills exist in Zaire. The most important wheat flour mill is located at Matadi in Bas-Zaire Province. This mill, the MINOTERIE DE MATADI (MIDEMA), has a capacity of 80,000 MT per year (1,760,000 cwt/year.) At present the mill is operating at 60 to 70 percent of capacity producing 113,000 sacks (cwt) of flour per month. A yield of 76 percent flour is obtained.

All of the wheat processed at the mill is imported and the supply guaranteed by Continental Grain International.

The port of Matadi is restricted to receiving only small ships (4,000-5,000 MT capacity). The mill receiving equipment consists of four portable pneumatic unloaders which are placed on board the ship. Receiving capacity is 2,000 MT/24 hours total.

Bulk storage at MIDEMA consists of 13,000 M.T. in metal silos. An additional bulk flat storage of 5,000 M.T. is planned. Flour storage consists of warehouse space for 25,000 to 30,000 bags of flour.

Flour produced is packed in high quality cotton bags (39.6K each). Because of the bag quality the railroad guarantees delivery to the customers without damage claims against the mill. About 60 percent of the flour sales are in Kinshasa and 40 percent in areas in the interior of the country. Sales are made to about five large distributors in Kinshasa including SEDEC (a food distributor with 14 branches) and large bakeries (those receiving 10,000 bags per month). Flour produced is, at present, all bakery flour. Small package family flour may be produced and sold later.

Approximately 50 percent of the flour is shipped to Kinshasa by truck and 50 percent by rail. Rail rates are 70 K/bag or 15 Z/M.T. A preferential rate is given for shipments to Shaba which go by rail (Matadi to Kinshasa), barge (Kinshasa to Ilebo) and rail (Ilebo to Lubumbashi). Shipment to Lubumbashi can take as long as 2 to 3 months.

Mill byproducts (used for animal feed) are pelleted for export to Europe (80 percent). Twenty percent of the byproduct is distributed locally in jute bags.

Insect control for grain quality preservation is generally not practiced. Imported wheat is commonly held for short periods and fumigation is not necessa The mill is fumigated periodically with methyl bromide for insect control.

A second wheat flour mill MINOKA, is located in Likasi and is operated by GECAMINES. Past production is shown below. Whether this mill is operating at present is not known.

PRODUCTION OF WHEAT FLOUR IN ZAIRE, 1972-74

- In M. T. -

Year	Midema	Minoka	Total
1972	-	5,400	5,400
1973	16,626	5,553	22,179
1974 (3 mos)	10,383	1,094	11,477
1974 p.	65,000	5,000	70,000 p.

Source: Rep. du Zaire Conjuncture Economique No. 14, 1974.

OZAC Analysis Procedures

Physical analysis of maize consists of the following procedure:

1. Ten percent of the bags of a shipment (truck load) of maize arriving at mills or the silo are sampled using a bag probe.

2. The sample is mixed and reduced to approximately 4-5 Kg., placed in a polyethylene bag, labeled and taken to the laboratory for analysis.
   a. mixing is done in a large bag.
   b. label includes:
      (1) date
      (2) point of sampling
      (3) shipper and consignee
      (4) number of bags
      (5) type of commodity
   c. A report of the inspector's observations also accompanies or is sent to the laboratory and includes the following information:
      (1) Condition and type of bags
         (a) number of new bags
         (b) number of used bags
         (c) number of damaged bags
      (2) Amount of spillage (in Kg.)
      (3) Total weight in Kg.

3. At the laboratory the sample is poured on a table and mixed by hand in the following manner:
   a. sample is quartered and opposite quarters mixed
   b. the sample is "cut-down" in this manner until approximately 200 grams remain (quartered 4 times)

4. A 200 gram sample is weighed on a balance and the sample hand picked into the following categories:
   a. foreign material (insect webbing, pieces of cob, silks, chaff, etc.)
   b. immature (shriveled or underdeveloped) kernels
   c. damaged kernels (dull, molded, etc.)
   d. insect damaged kernels (any type) of insect and probably rodent feeding

e colored kernels are separated as:

(1) red

(2) blue

(3) yellow

f. sound kernels. (If broken kernels are present in large numbers, a separate category is added, otherwise they are included in sound kernels.)

g. If live insects or worms or webbing with "eggs" (frass) are found, a note to this effect is made on the record sheet.

5. Each category is weighed on a balance and the percentage by weight determined and recorded.

6. Moisture content of the maize is determined by grinding the sample on a laboratory mill and testing the flour for moisture content using a MESS KUHNE (FRANKFURT) METER. Percent moisture is recorded on the analysis report.

Reports of analysis are sent to the "requesting" party, i.e. mill, dealer, etc. All shipments of maize arriving at mills and at the OZAC silo are inspected by OZAC. There is a fee charged for each analysis. Although OZAC did not supply the information, indications are that the charge for maize is 30 K/MT and 20 K/MT for flour.

EXECUTIVE ORDER No. 74-011 of JANUARY 10, 1974
FOR THE CONTROL OF CEREALS AND CREATION OF
NATIONAL CEREALS BOARD.

THE PRESIDENT OF THE REPUBLIC,
Considering the Constitution, and more particularly Section 46,
Condisering the law No. 74-001 of January 2, 1974 entitling the President of the Republic to take measures in the law field, by application of Section 52 of the Constitution;

On the proposal of the "Commissaire d'Etat à l'Agriculture":

O R D E R S :

CHAPTER 1. CONTROL ON CEREALS

Part 1 - Cultivation and Processing.

Section 1:
The Commissaire d'Etat à l'Agriculture may, for economical reasons, prevent the cultivation of some cereals in determined areas and order the destroying of plantations concerned by the interdiction.

The loss resulting from the destroying will be set up by a subsidy not exceeding two third of the destroyed vegetables' value. The subsidy is granted by decision of the Commissaire d'Etat à l'Agriculture.

Section 2:
The Commissaire d'Etat à l'Agriculture may, in the Public Health interest, prevent sowing of cereal seeds other than the ones he determines.

Section 3:
Every person cultivating cereals must tell the Commissaire of the area, the place and surface of his sowings. This must be done within the 30 days following the sowing or the transplanting.

Section 4:
When a cereals plantation is admitted diseased, the Commissaire d'Etat à l'Agriculture may prescribe the owner or his representative all treatments or measures necessary to check the spreading of the disease. If need be he may order the total or part of the plantation.

The loss resulting from the destroying is set up by a subsidy not exceeding two third of the same, non-destroyed vegetables. The subsidy is granted by the Commissaire d'Etat à l'Agriculture.

In case the owner or his representative refuses or fails to cooperate, the necessary measures of protection, processing or destruction, one executed automatically by the Commissaire d'Etat à l'Agriculture without prejudice of lawsuits. The cost of the works is collected by the government; if the payment is not done within 3 months starting from the receipt of the registered letter asking repayment, the sum owed by the person concerned will be increased to 25 percent.

Section 5:

Agents from the Department of Agriculture and persons appointed for this effect by the Commissaire d'Etat à l'Agriculture are allowed to visit, between sunrise and sunset the lands sown with cereals in order to check the sanitary conditions of the plantations.

Section 6:

Creation, extension, or transfer of a cereals processing factory is submitted to the authorization of the Commissaire d'Etat à l'Agriculture.

The claim for creation or extension must indicate the power and equipment the manufacturer will dispose of, the amount of cereals to be processed in 8 hours work and the capacity of storage of the plants.

SECTION II : MARKETING

Sub-part - 1. Interior trade

Section 7:

The National Cereals Board alone anticipated in Section 16 below is allowed to make purchases of cereals from the producers in an industrial or commercial purpose.

Section 8:

Places where and periods during which the National Cereals Board purchases cereals and producers are determined by the Commissaire d'Etat à l'Agriculture.

Prices of these purchases are fixed by a decree from the Commissaire d'Etat à l'Agriculture decided after notice from the National Cereals Board.

For a consideration of its purchasing monopoly, the Board must buy at the legal price all the cereals that are offered to him by the producers.

Section 9:

The Commissaire d'Etat à l'Agriculture fixes the maximim prices at which the Board may sell the cereals on the interior market. He May determine the conditions in which the cereals delivered must be packed.

Sub-part II - Extension Trade

Section 10: The National Cereals Board alone is allowed to export cereals produced in Zaire.

Section 11:

To be able to be exported the cereals must:

1) answer to the conditions of quality and packing fixed by the Commissaire d'Etat à l'Agriculture.
2) be covered with a certificate of origin and quality delivered by an institution certified for this purpose by the Commissaire d'Etat à l'Agriculture.

Section 12: To satisfy the needs of interior consumption, the Commissaire d'Etat au Commerce may, by a joint decree, limit and even prevent the export of some cereals.

Part III - Various dispositions

Section 13: In consideration of the previous authorization of the Commissaire d'Etat à l'Agriculture, the Board may, by contract, charge individuals or body corporates (legal entities) living in Zaire to make, for his own account, purchases of cereals from the producers and process for his own account, the cereals purchased in this way.

The conditions of payment of these persons are fixed by the Commissaire d'Etat à l'Agriculture.

Section 14:

By departure from Section 10, the individuals or legal entities who exported cereals before the day of the present executive order becoming operative, will be able to export the cereals they had in stock at the submentioned date, provided that you are given the authorization of the Commissaire d'Etat à l'Agriculture.

To this effect -hey (individuals and legal entities) will have to declare to the Commissaire d'Etat à l'Agriculture, before the last day of the month following the date of the present executive order becoming operative, the amounts of cereals they had in stock at this date.

Section 15:

All transgressions to the dispositions of the present chapter or to the measures taken for their execution will be punished with a penal charge of 3 months maximum and a fine that will not exceed Z1,000 without the addition of charges or of one of these penalties only.

CHAPTER II : NATIONAL CEREALS BOARD

Part I - General Dispositions

Section 16:

It has been created under the name of "ONACER" a public industrial and commercial institution endowed with legal status and placed under the control of the Commissaire d'Etat à l'Agriculture.

Section 17:

The head office is established in Kinshasa; it may be transferred to another place in the Republic by decision of the Commissaire d'Etat à l'Agriculture. Branches of exploitation, agencies and offices can be created everywhere.

Section 18:

The Board's purpose is:

1) to cultivate cereals
2) to give a technical assistance to cereals producers and buy the yields of their harvest:
3) to process the cereals and sell them on the interior and exterior markets:
4) to propose to the Commissaire d'Etat à l'Agriculture all economical or technical measures concerning production and marketing of the cereals.

It may make every operation directly or indirectly connected to it objective.

Section 19:

The properties that the Zairian Government transfers to the Board will be determined by an order from the President of the Republic.

Section 20: The Government grants to the Board, as funds for starting its establishment, an appropriation in money whose amount will be determined by an order of the President of the Republic.

Section 21:

The initial capital of the Board is equal to the value of transferred properties in application of Section 19, with the amount of the appropriation in money anticipated in Section 20 added to it.

The capital increases with the value of the amounts of money granted later by the Government and some reserves that will be incorporated by it. It eventually reduces the value of the sums given back.

Part II: Administrative Organization

Section 22:

The Board is managed by a Head Manager who may be helped by an Assistant Manager.

Section 23: The Head Manager and the Assistant Manager are named and are revocable anytime by the President of the Republic. Their salaries and additional advantages are fixed by the President of the Republic.

Section 24:

On condition of the authorization anticipated by the present executive order, the Head Manager has all the necessary powers to manage the Board affairs.

He may delegate his powers to the Assistant Manager or agents from the Board. He may also grant special instructions to everybody.

In case he is missing or detained by something he is temporarily replaced in all his functions by the Assistant Manager or if this one is missing, by the Head of Department named by him.

Section 25:

The Commissaire d'Etat à l'Agriculture determines the acts that need to be previously authorized by him. This is always required for the purchase and/or alteration of real properties, loans with more than a one year term, when you obtain, renew or terminate shareholding interests, for the estab lishment of branches of exploitation, agencies and bureaus.

Section 26:

Bargains for works and equipment are entered either with competitive biddings or by private treaty in the cases anticipated in the third paragraph of the present section.

The competitive bidding is general or restricted, as the Board chooses. The general competitive bidding has a bidding for competition published in one or several newspapers of the Republic. The restricted competitive bidding has a bidding for competition limited to the contractors or suppliers the Board decides to consult. In both cases, the Board chooses freely the bidding he thinks is the most interesting, taking into account the prices of the allowances, their cost of utilization, their technical value, the security of supplyings, professional and financial guarantees given by every candidate, the time of execution, and any other consideration that would be anticipated in the conditions of the contract or in the competitive bidding, as well as any suggestion made in the bidding.

The Board may negotiate by prive treaty for works whose presumed value does not exceed Z 25,000 for current equipment and generally speaking, in all the cases where the government has a right to negotiate by private treaty to conclude its own bargains. Negotiating by private treaty is done, either by an engagement subscribed on the basis of a price bidding, that may be modified after a discussion between both the parties concerned, or by the agreement signed by the parties or by the correspondence according to the trade practices; negotiation by private treaty whose amount does not exceed Z 10,000 may be done by a simple accepted bill.

Section 27:

All the acts that involve the Board, are signed, either by the Head Manager, or the one who has taken his place, either by a delegate or a special mandatory agent from the Head Manager. Legal proceedings, either for request or for defense, are instituted or held by the Board authority, either by the Head Manager, or the one who replaces him, either by a delegate or a special agent of the Head Manager.

Section 28:

The personnel of the Board is engaged, paid and disbanded in the private law conditions.

The Head Manager fixes, by written decisions submitted to the approval of the Commissaire d'Etat à l'Agriculture: 1) the list of employments and maximum force of men for each of them, 2) the tariffs of payments (salaries and other money advantages).

Part III - Financial Organization

Section 29:

The financial year of the Board begins on January 1st and ends on December 31st of the same year.

As an exception, the first financial year will start the day when the present executive order becomes operative.

Section 30:

Every year the Board prepares a statement of the estimates of all the incomings and outgoings that may be effected in the coming financial year.

This statement is submitted to the approval of the Commissaire d'Etat à l'Agriculture on December 1st of the year preceding the years it concerns, at the latest. Its registrations have an estimating and not a limitating character.

Section 31:

Accountancy is organized and kept in order to permit:

1) to follow the execution of the statement of estimation of incomings and outgoings;
2) to determine the amount of production and charges of the exploitations;
3) to evaluate any time, assets and liabilities of the Board.

Section 32:

The Board constitutes a price stabilization fund, intended to sustain the prices to be paid to the cereals producers.

The fund is fed or supplied by a monthly deduction on the revenues earned during the previous one month, by cereals sales. The Commissaire d'Etat à l'Agriculture fixes the lump sum to be deducted in percantage of the revenues. He also fixes the maximum amount of the fund.

The cash attached to the fund cannot be mixed with the other cash belonging to the Board. It is deposited in a bank in a special account.

Section 33:

At the end of each financial year, the Head Manager, after inventory:

1) gets out a balance sheet, a trading account (operating income statement), a profit and loss account;
2) sets an account of execution of the statement of estimates of incomings and outgoings. Presented in the same shape as the statement of estimates, this account establishes the amounts of the incomings and outgoings actually effected, as well as the difference between the estimates and the mentioned incomings and outgoings.

All these documents are submitted to the approval of the Commissaire d'Etat à l'Agriculture on March 31st of the year following the year which they concern, at the latest. A report from the Head Manager on the running of the Board during the past financial year, is joined to them.

Section 34:

The net profit of the financial year is constituted by the difference between, on one hand, the gross profit, and on the other hand the overhead expenses, charges and depreciations.

From the gross profit, it is deducted, if need be, the necessary sum to cover the past losses brought forward.

From the balance, it is deducted 5% for the constitution of a fund for general reserve; this deduction ceases to be compulsory when the fund mentioned has reached an amount equal to one tenth of the capital.

From the new balance, the Commissaire d'Etat à l'Agriculture, when it is proposed by the Head Manager, is allowed to decide the deduction of the sums he thinks fit to fix and have them brought to one or several special reserve funds.

What is left is given to the government.

Section 35:

When the gross profit does not cover the total amount of general expenses, charges and depreciations, the wantage is covered by a deduction from the general reserve fund. If this deduction does not entirely cover the wantage, the excess is inscribed as an amount carried forward, on an account which groups the passive results.

Section 36:

The Board may revalue the elements appearing in its balance-sheet and constitute a special revaluation reserve.

This operation is submitted to the approval of the Commissaire d'Etat à l'Agriculture.

The incorporation of any reserve to the capital is submitted to the same approval.

Section 37:

The Board is submitted to common law for fiscal matters.

Part IV - Control

Section 38:

The Commissaire d'Etat à l'Agriculture exercises his power of general control on the acts of the Board through a delegate he has chosen among the officials of his department.

The delegate named by the Commissaire d'Etat à l'Agriculture has all the necessary powers to fulfill his mission normally. He may put his knowledge, on the field, on the documents, files or records; make all the verifications he wants and have all the information he finds useful, communicated to him.

PART III - FINAL DISPOSITIONS

Section 39:

The 112/AGRI executive order of April 11th, 1942 regulating rice industry and trade as well as all the measures taken for its execution are repealed.

Section 40:

The present executive order will become operative when signed.

ONACER Estimates of Resource Needs

(June, 1975)

ESTIMATES ON CEREALS AND OTHER FOOD CROPS

MARKETING IN ZAIRE

1. Grain production areas.

In each region, we mean to establish ONACER agencies in the areas with a high yield of cereals and other food crops.

If you read the annexed table, you will see that 32 agencies need to be opened to join the 8 main region offices already functionning.

2. Essential proceedings for a rational marketing organization.

a. Packing

Total amount of cereals to be packed: 365,950 t. If we use 50 kg bags we'll need 365,950 t x 20 bags/t = 7,319,000 bags. The office has only 130,000 bags at present. Cost of the bags: 7,319,000 bags x k.39/bag = Z 2,195,700.

b. Transport

With an average amount of 15 vehicles for each Region, we need: 15 x 8 = 120 7 ton trucks. The office has only 39 trucks available. Taking into account the present conditions of the market, we may agree with an average price of Z 9,000 per truck. Total: 120 x 9,000 = Z 1,080,000.

c. Transit Storage

We need one warehouse for each agency or main Region Office, i.e. 40 warehouses. At an average price of Z 15,000 for each warehouse, the total storage cost is: 40 x 15,000 = Z 600,000. The office has not a single warehouse at the moment.

From what we mentioned above, one can conclude that the needed equipments for cereals and other food crops marketing being very deficient, we could not rationally organize the markets.

It is obvious indeed that the office will have to dispose of ₴ 3,500,000 to organize the marketing well. The funds necessary to the purchase of the products are not included in this sum. They will come from short term bank credits.

In order to make our presence sure in the main centers of production, we have still 35 more agencies to open inside the country. This operation will start as soon as we shall be able to know the operating budget that will be granted to us for the experiment in progress.

FAO
AFRICAN RURAL STORAGE CENTRE
(Worksheet for the building of a drying/storage crib)

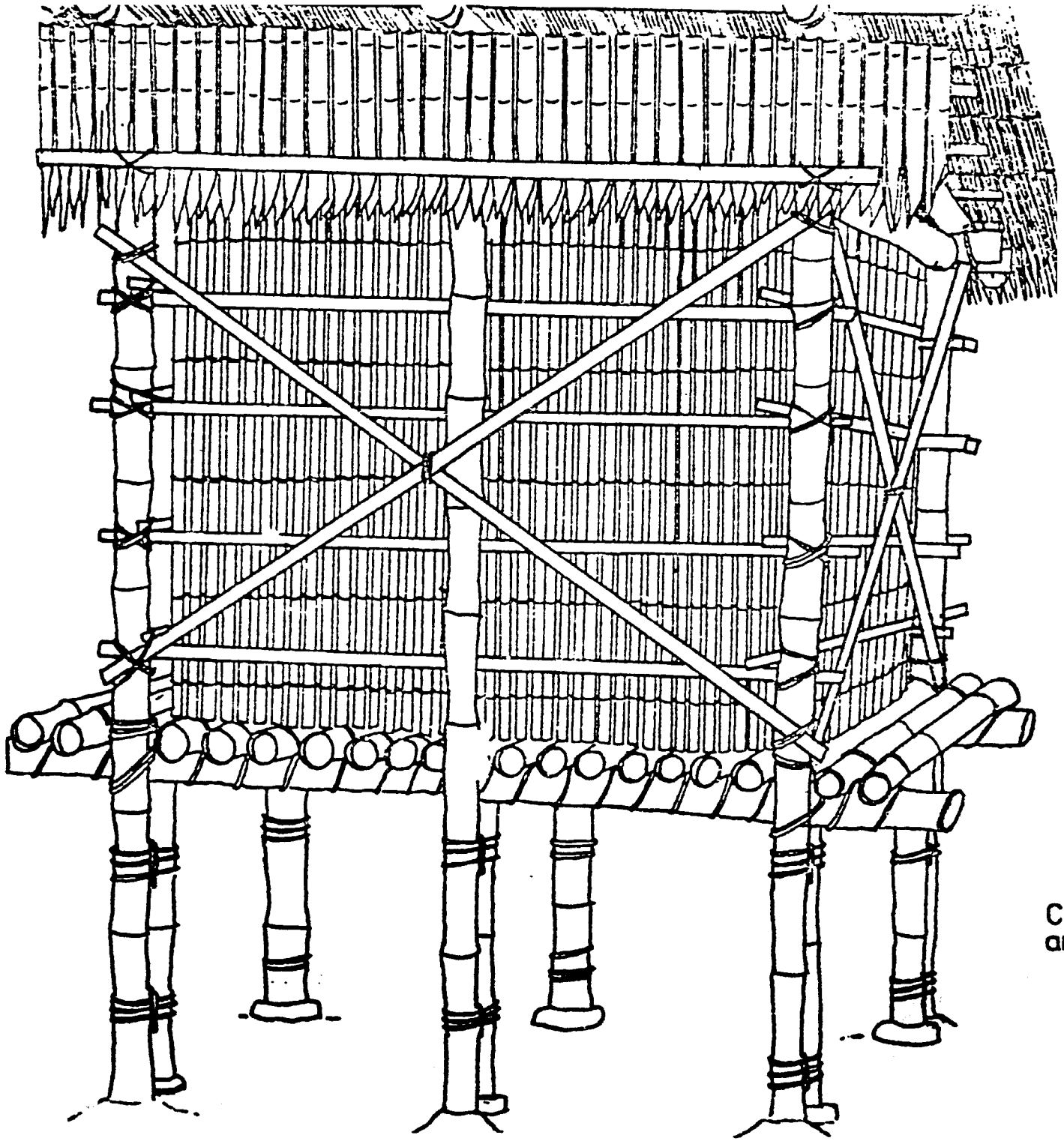
NOTE:

1. The crib illustrated is a modified version of the NSPRI crib.

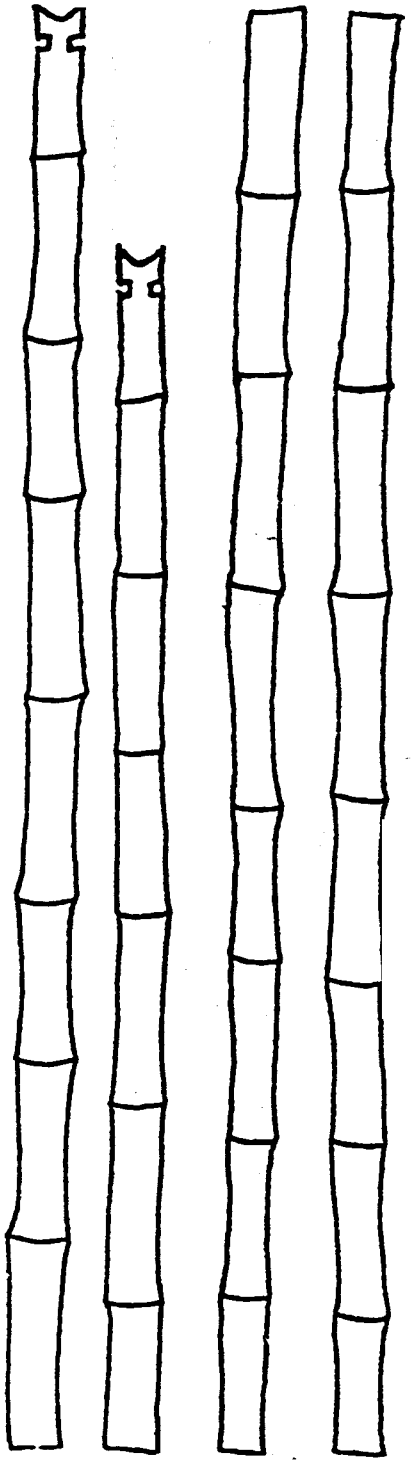
2. There is no reason to use exactly the same materials as is shown in the illustrations, but users may choose whatever is most convenient.

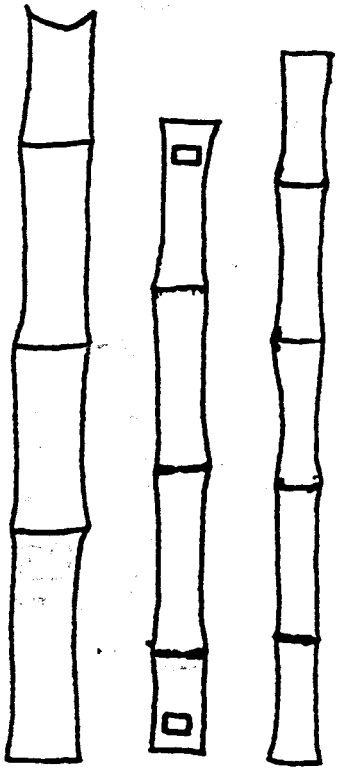
3. Users are advised though to adopt the dimensions shown as much as possible as this will facilitate building, avoid structural failures, prevent rodent damage and ensure maximum drying efficiency.

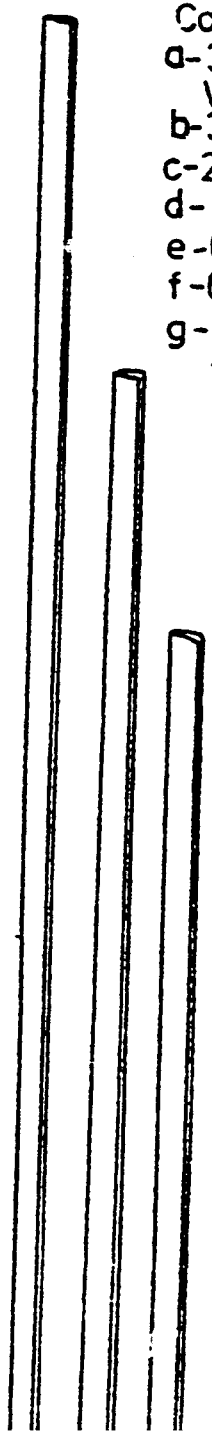
4. In building of the Roof (step 9 onwards) the materials should match the basic crib (step 8). Since each crib is likely to be somewhat different, in practice no dimensions are given for the roof materials, but the easiest would be to build the roof straight onto the basic building.

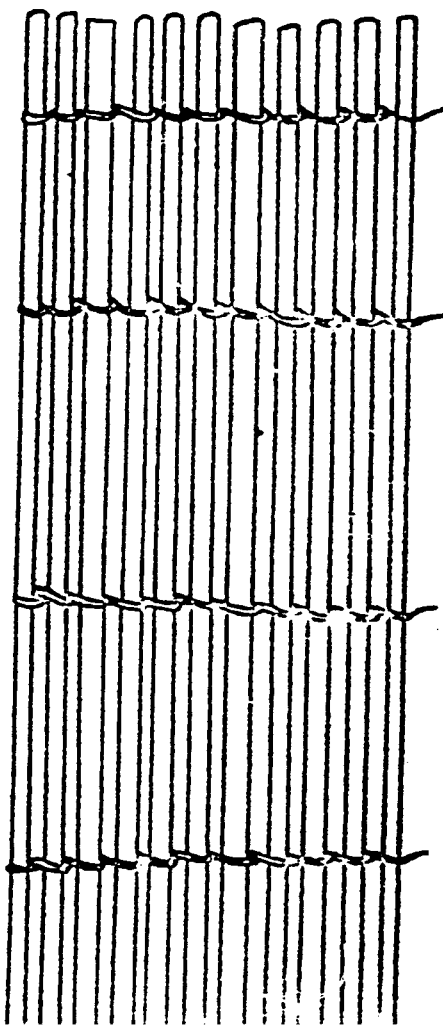


Crib with front loading cover and roof in position-complete









STEP 1

Collect materials, cut to length and notch where required.

a-3 vertical supports (notched at nodes at one end with V cut above node) 3·5m long

b-3 vertical supports (same as above) 3·0m. long

c-2 horizontal roof supports 2·5m long

d-2 horizontal platform supports 2·5m long

e-6 vertical platform supports 1m long

f-6 horizontal spacers (notched at nodes both ends) 1m lor

g-20 25 bamboo or poles (straight and uniform in size) 1·25m long

h- 8 braces (raffia or small bamboo) 2·5m long

i - 8 side wall supports same as h above 2·25r

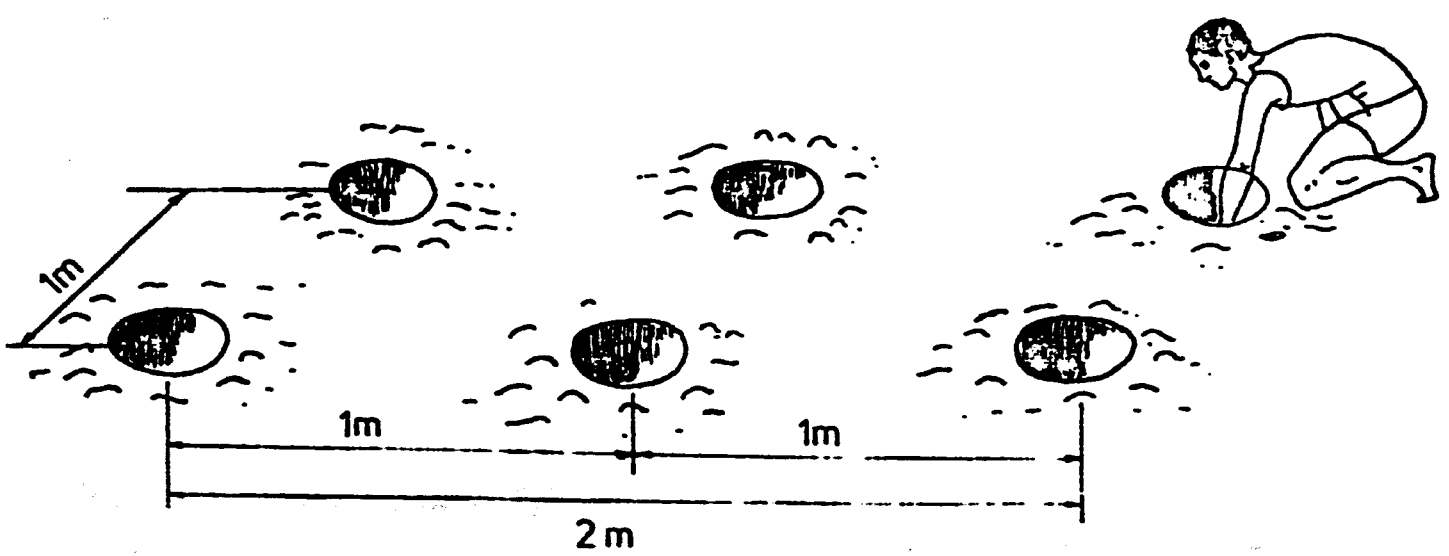
j 8 end wall supports same as h & i above 1·25m long

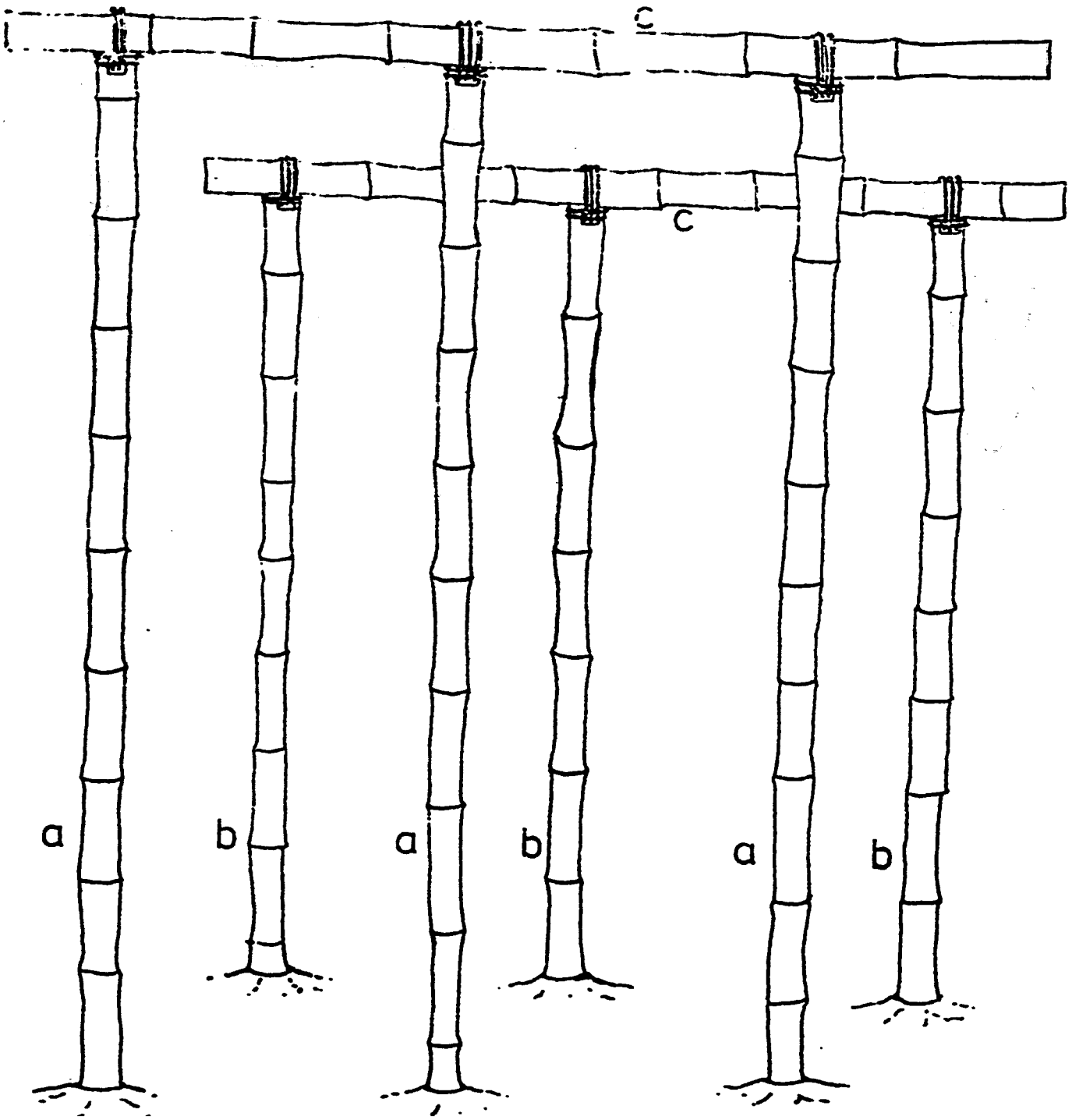
k Raffia or other strong slats (tie as pickets for crib walls) approx 6m long by 1·5m high

l. Rattan or other tie vine for lashing

STEP 2

Dig holes for vertical supports 6 holes .5 m deep

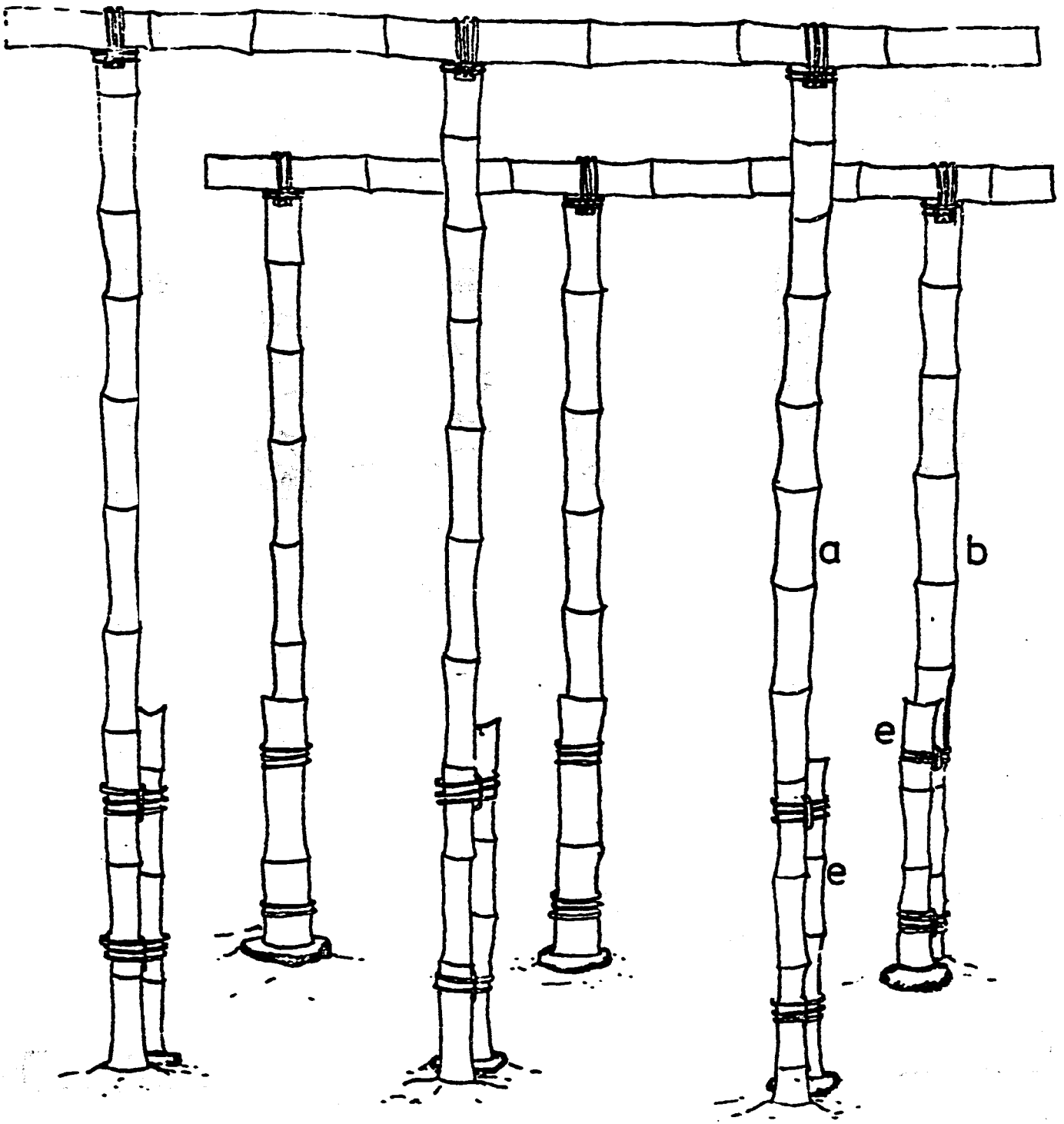




STEP 3

1 Lash horizontal roof supports c to vertical supports a & b - position opposite holes

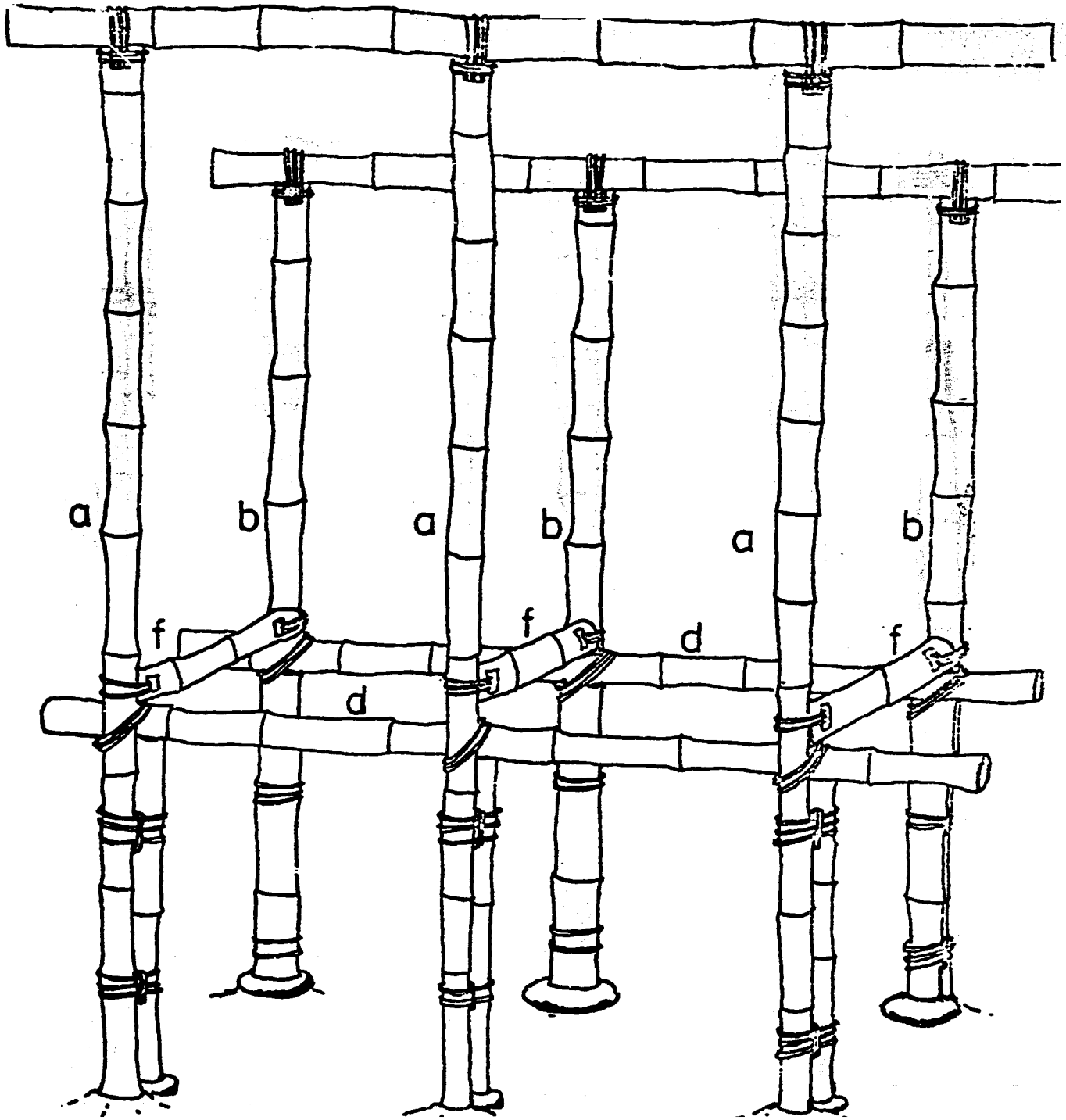
2 Place into holes and tamp fill around supports a & b after placing spacer f between vertical supports - temporarily.



STEP 4

1 Lash vertical platform supports e to vertical supports a & b

2 Position flat stone under each platform support

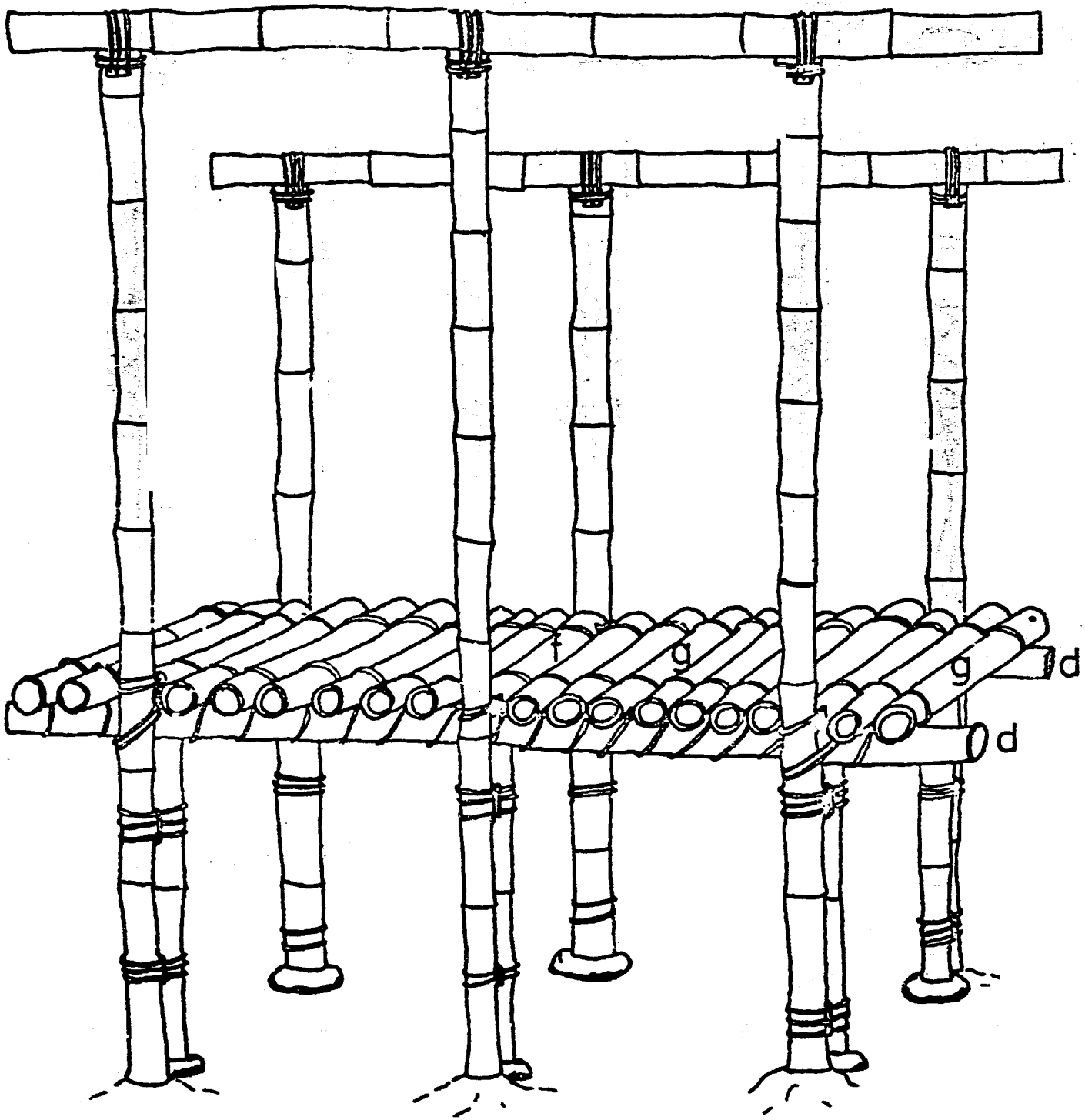


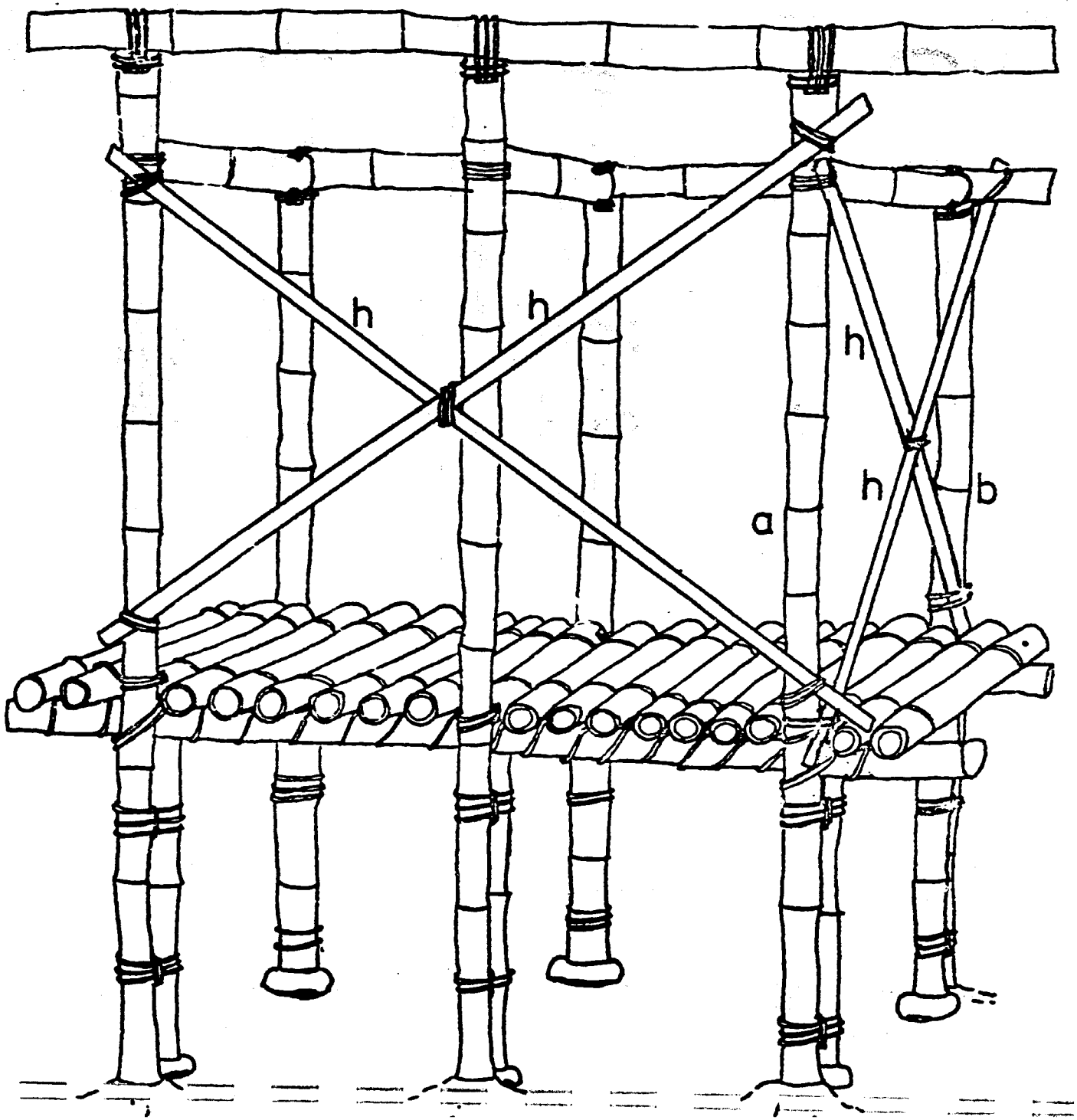
STEP 5

Lash horizontal platform supports d and spacers f to vertical supports a & b

STEP 6

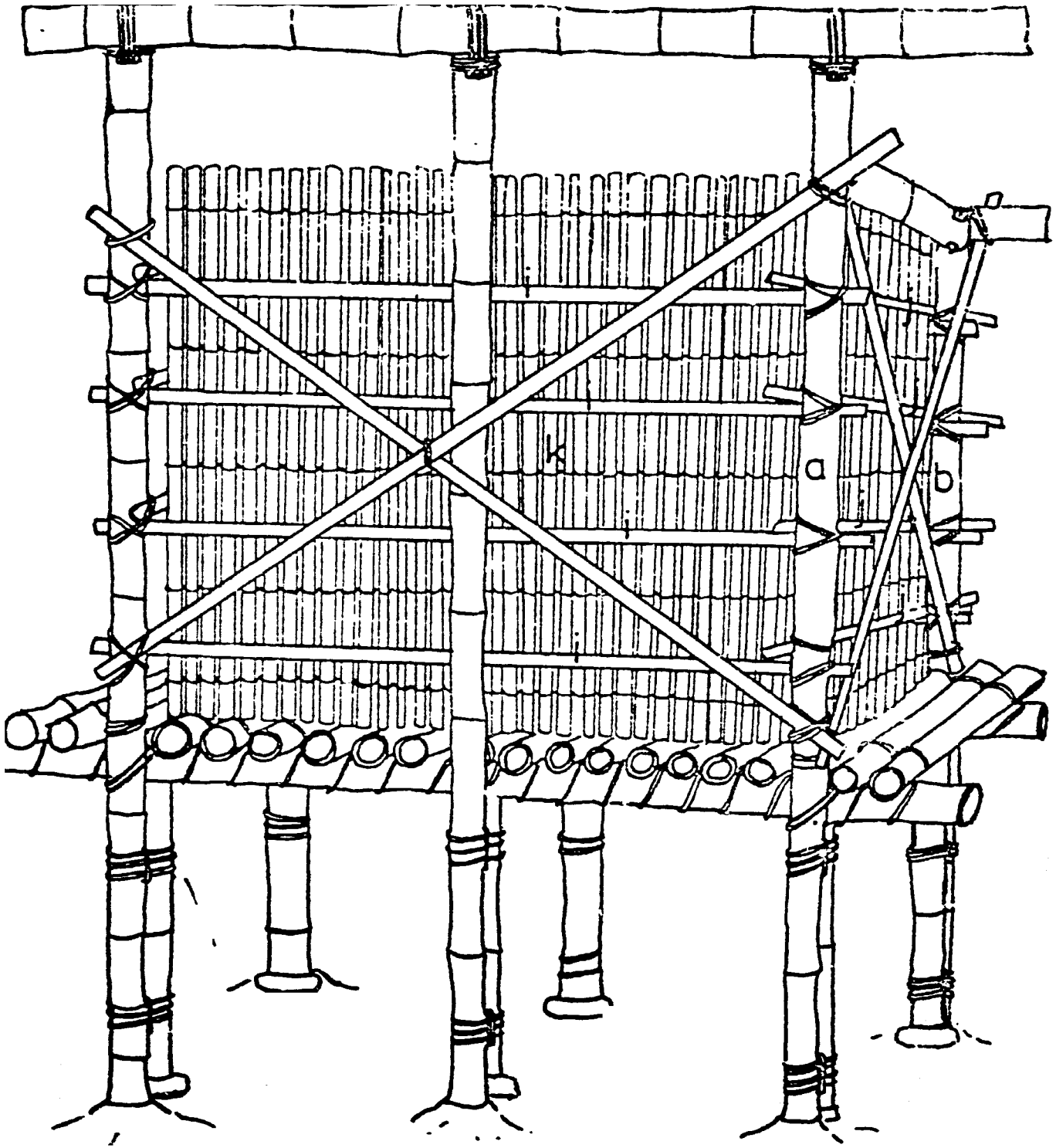
Lash platform pieces g to horizontal supports d





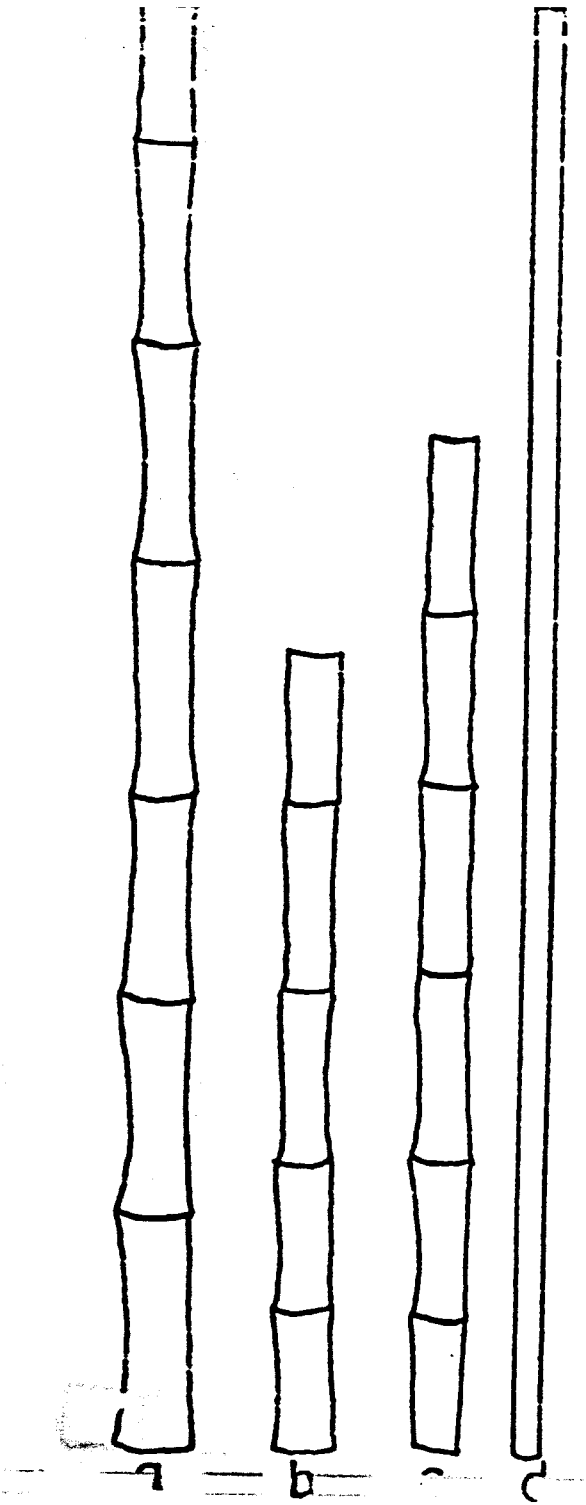
STEP 7

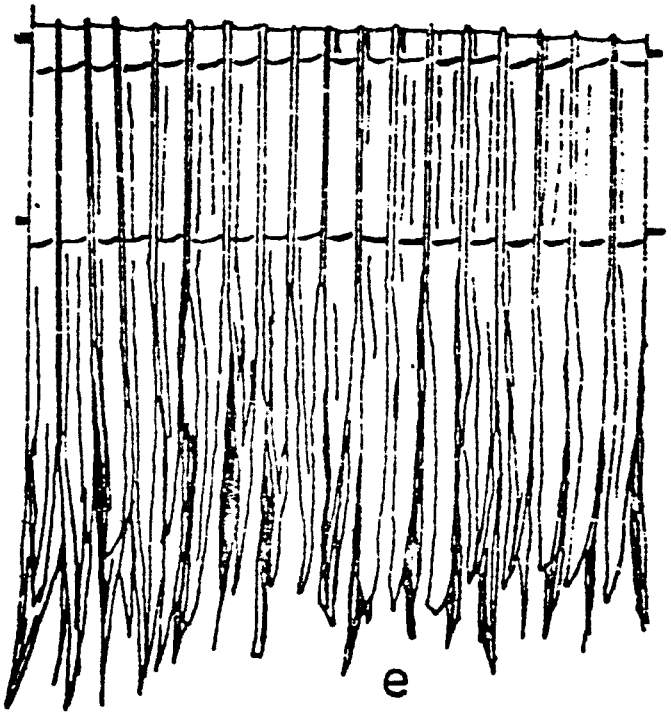
Lash X braces h to vertical supports a & b square frame before securing



STEP 8

1. Lash wall supports i & j to vertical supports a & b
2. Lash side wall k to wall supports i & j





STEP 9 - ROOF

Collect material and cut to length

a 3 horizontal roof members

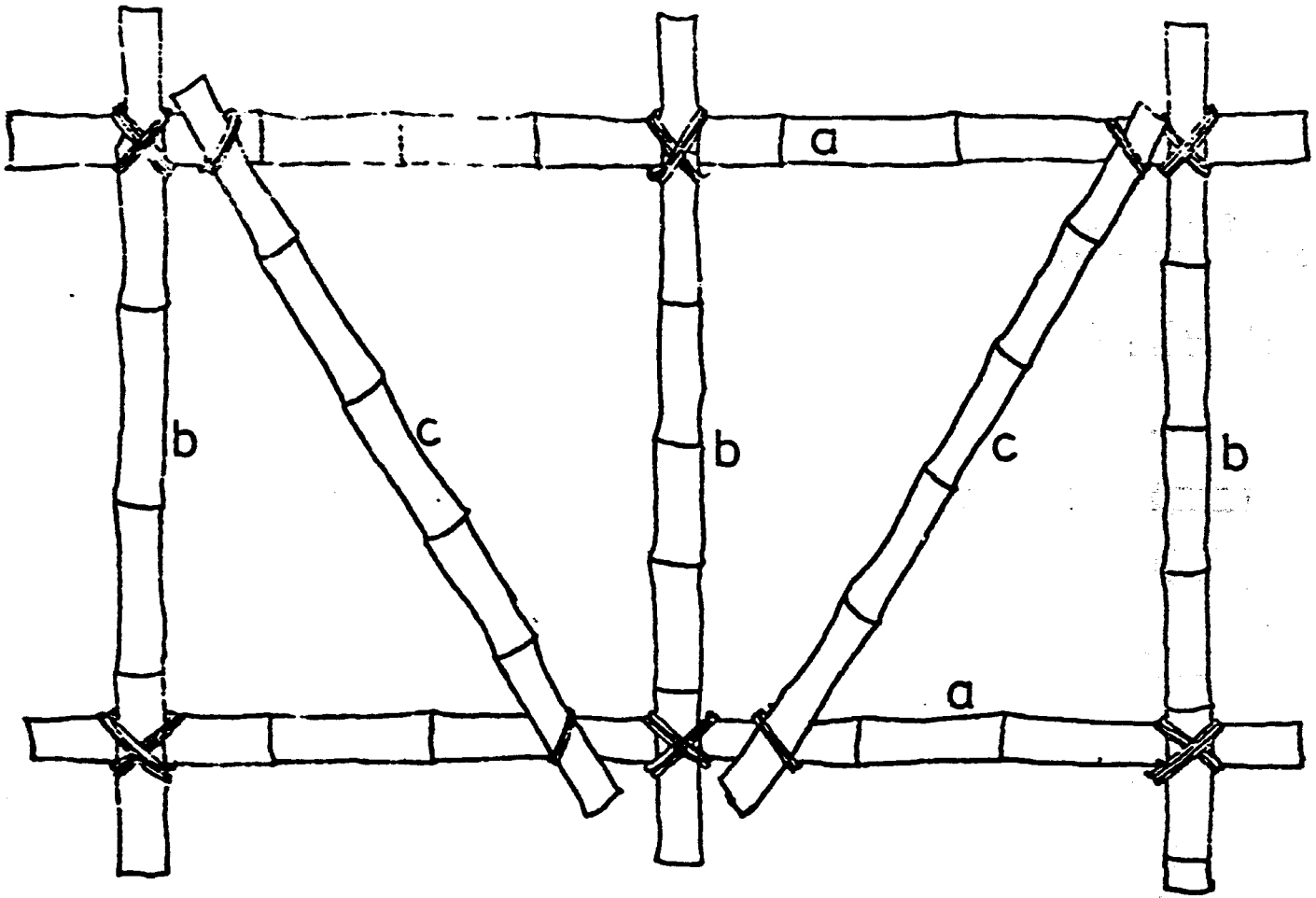
b 3 cross roof members

c 2 braces

d 7 purlins

e raffia mats or grass for thatch and front loading cover

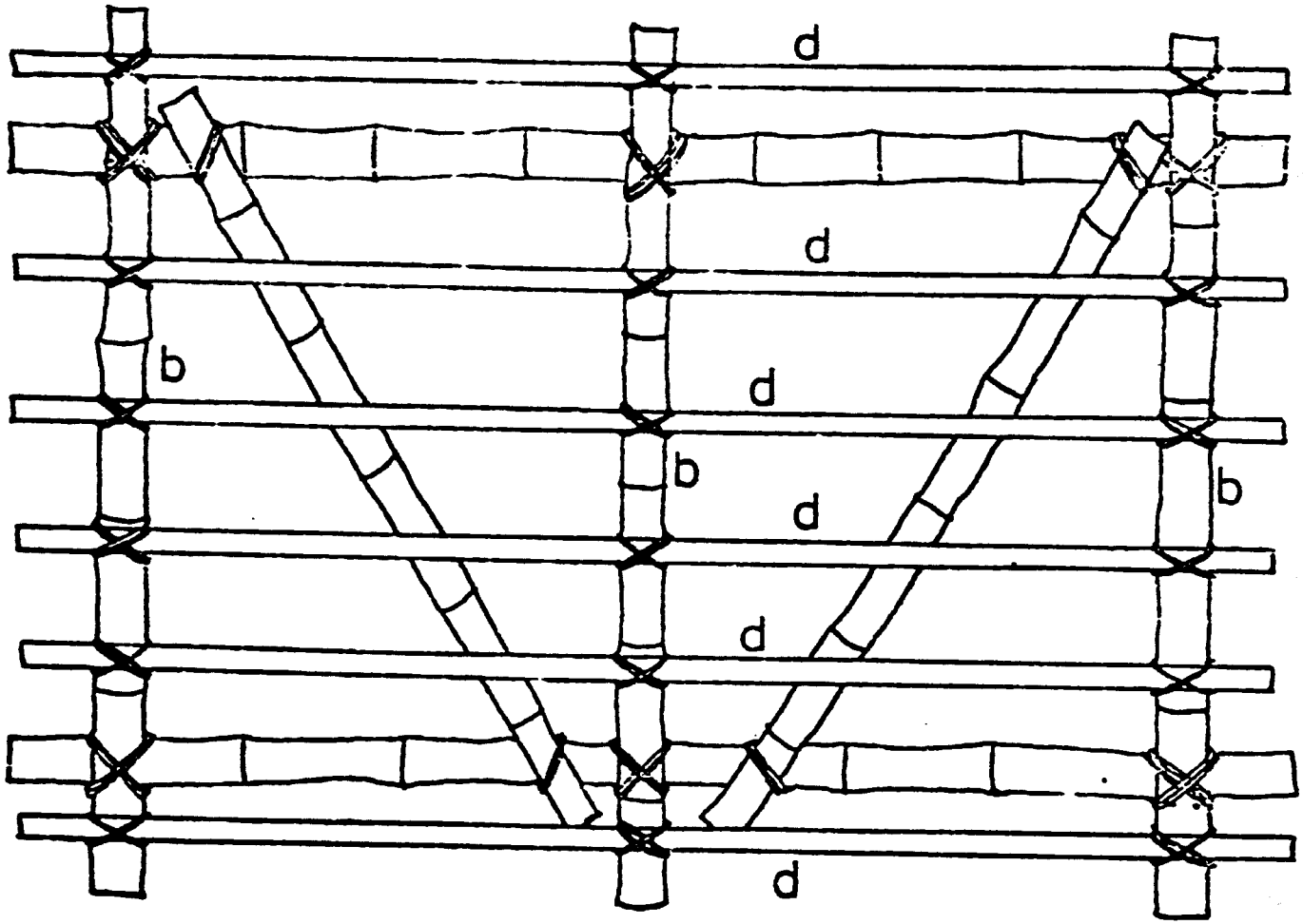
f tie vine



STEP 10

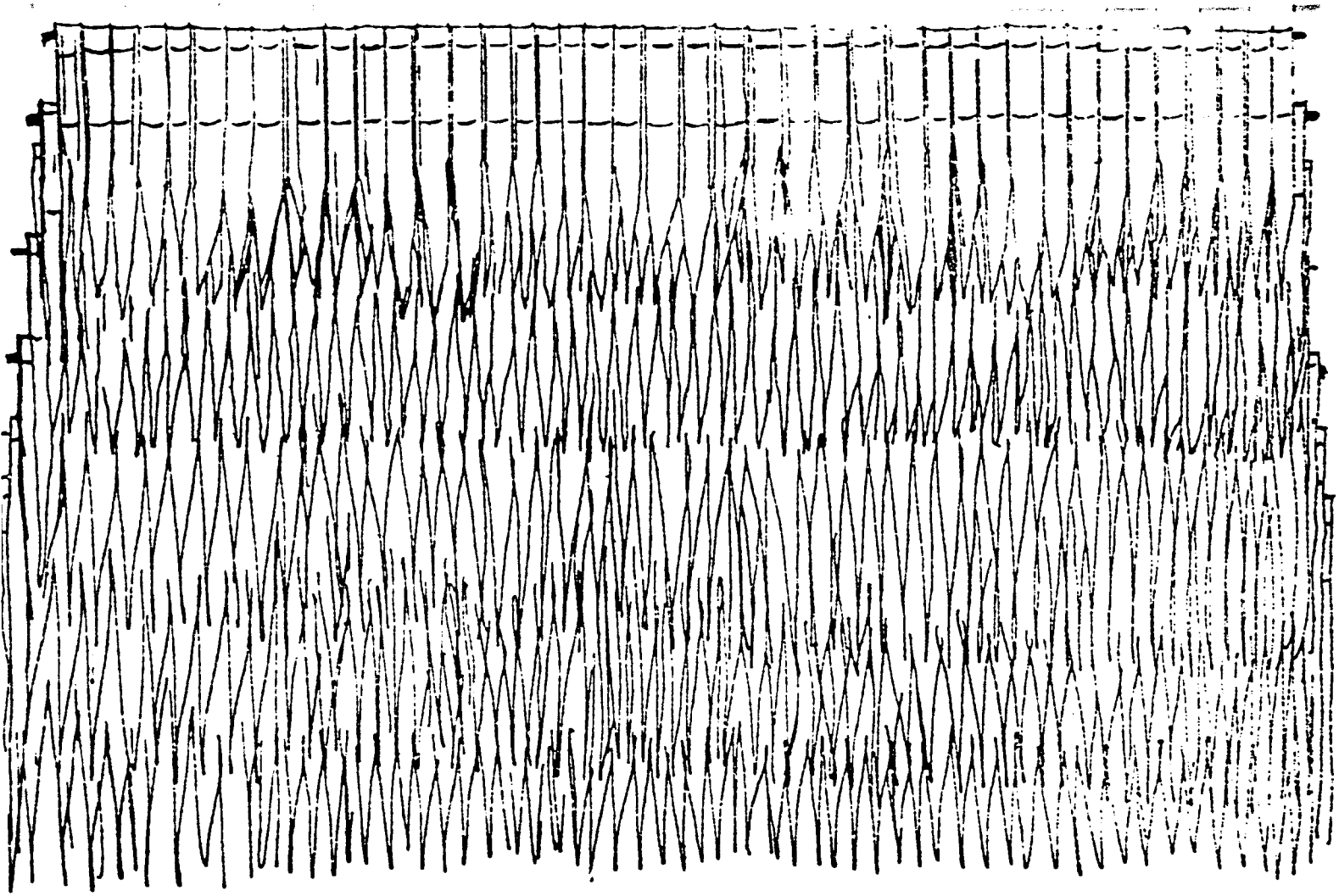
1 Lash cross roof members b to 2 of horizontal roof members a.

2 Lash braces c to horizontal roof members a.



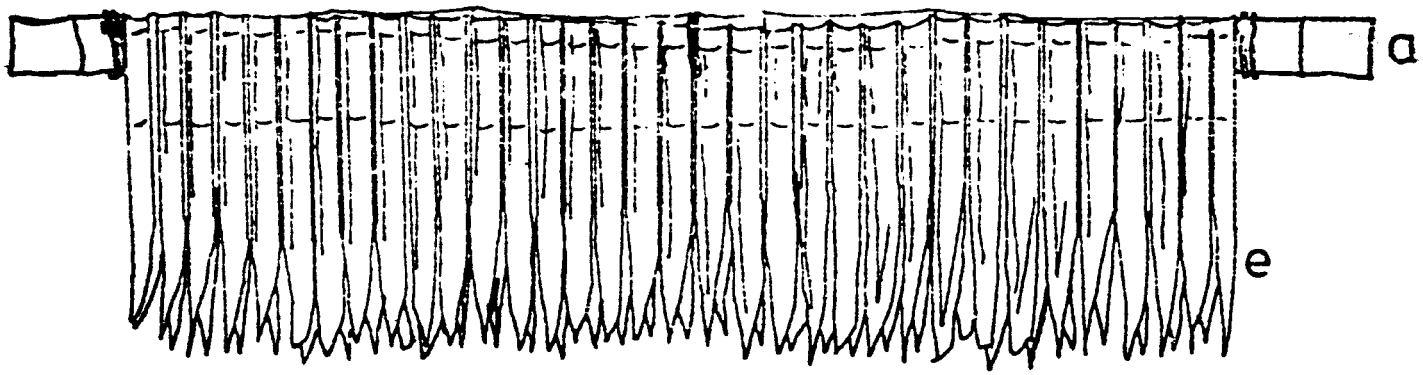
STEP 11

Lash 6 purlins d to cross roof members b



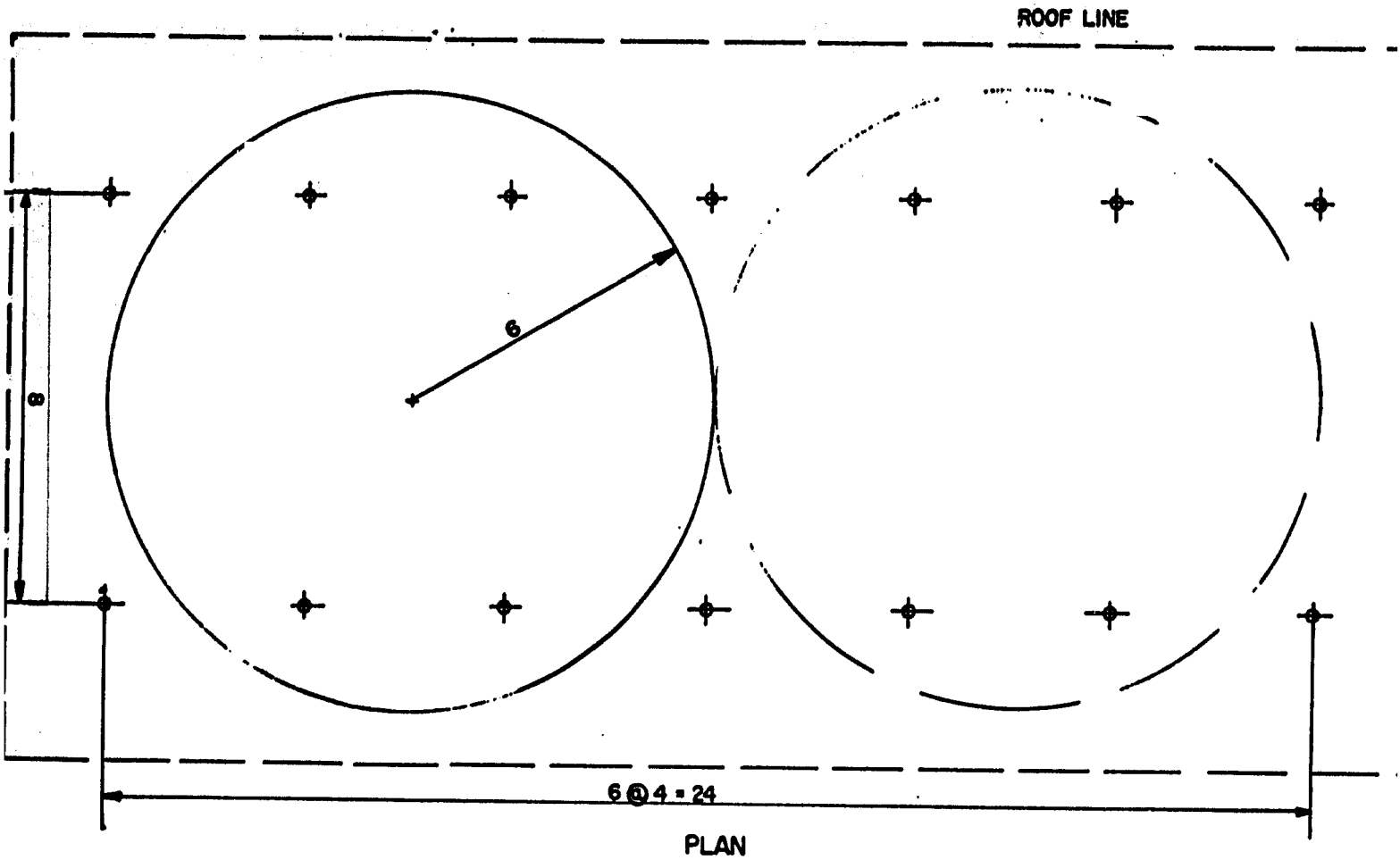
STEP 12

Lash raffia mat in overlapping layers to roof frame



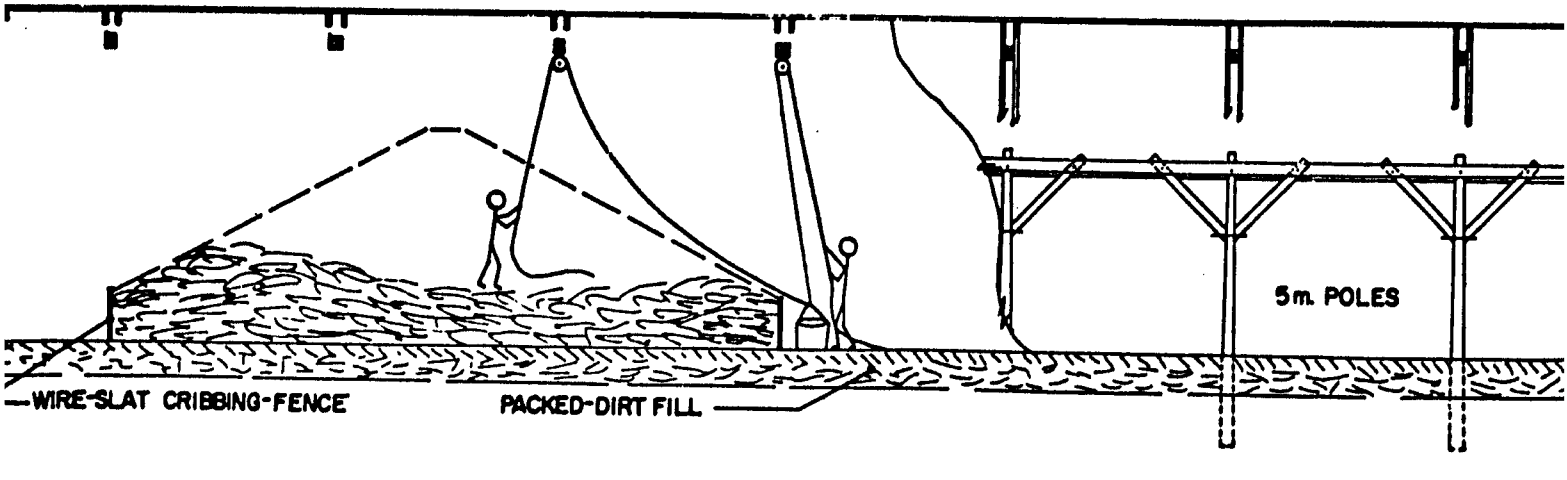
STEP 13

Lash raffia mat e to horizontal roof member a to form front loading cover



PLAN

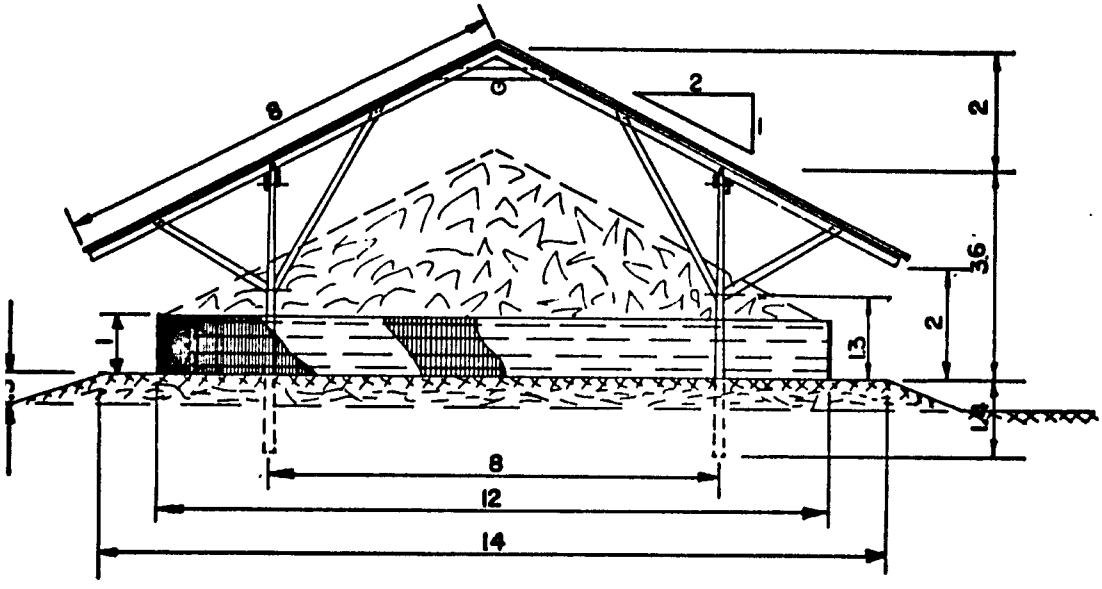
ALL SCALES:-- 1:80 (0.0125)
ALL DIMENSIONS IN METERS



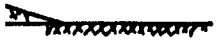
SECTION VIEW THRU A-A ELEVATION

VILLAGE STORAGE-SHELTER
FOR
EAR-MAIZE
AND/OR
SHELLED-MAIZE
IN
SACKS OR BULK

KINSHASA, ZAIRE 7-29-75 HCI

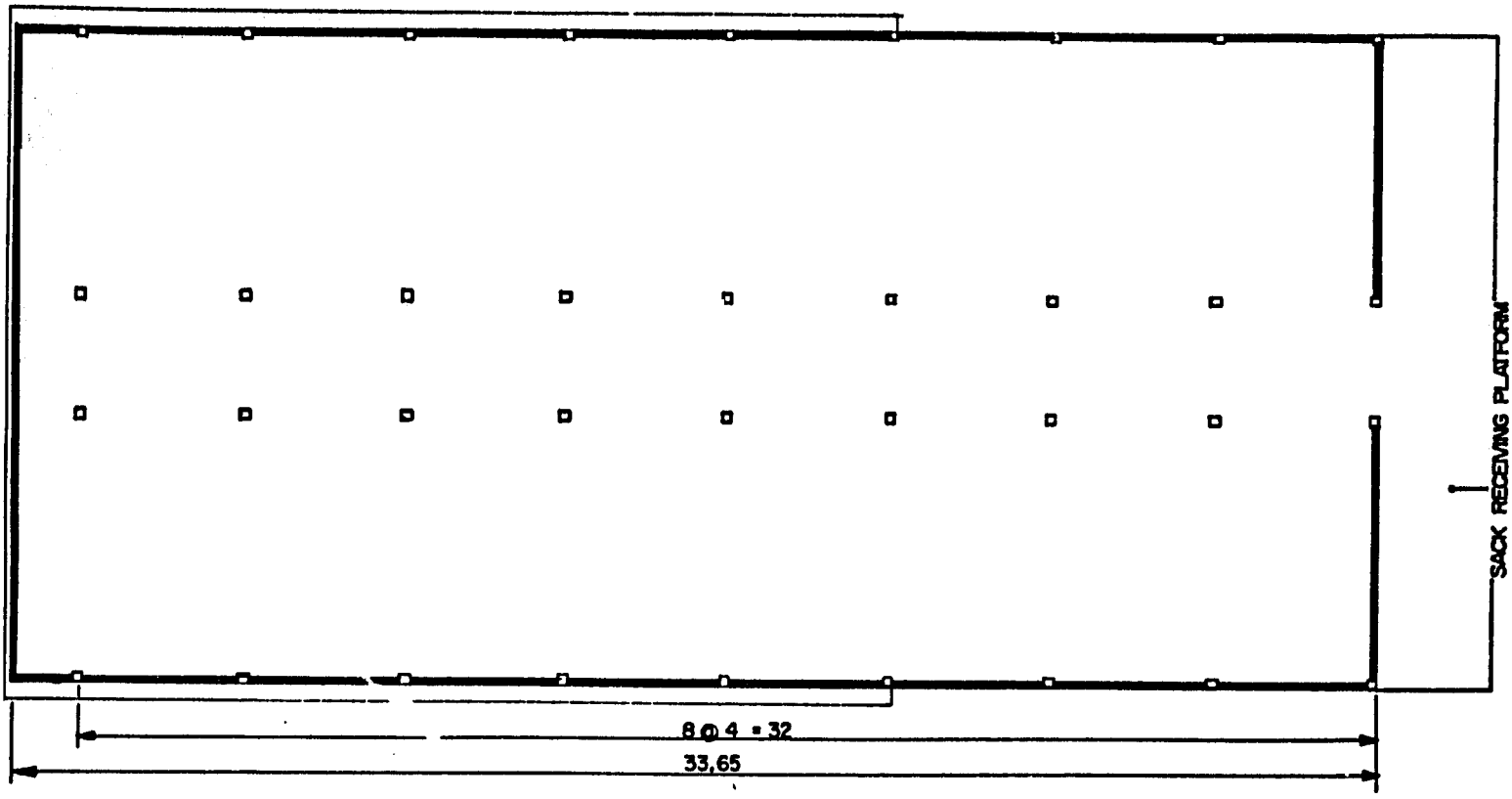


CROSS-SECTION

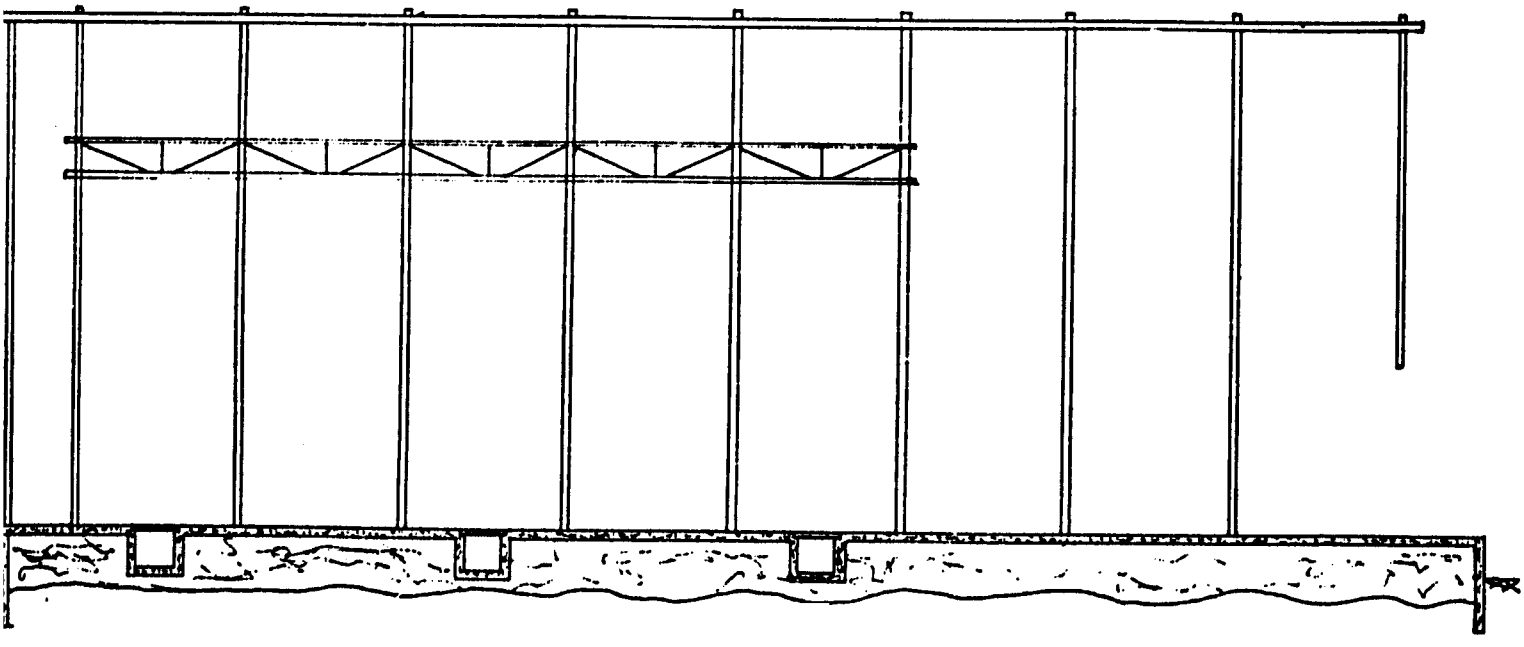


CRIB CAPACITIES
(1M. HEIGHT & 1:2 CROWN SLOPE)

DIAMETER METER	CAPACITY METRIC TON	
	EAR-MAIZE	SHELLED-MAIZE
2	1.3	2.6
4	6	12
6	15	30
8	30	60
10	51	100
12	81	162
14	120	240
16	168	335



PLAN

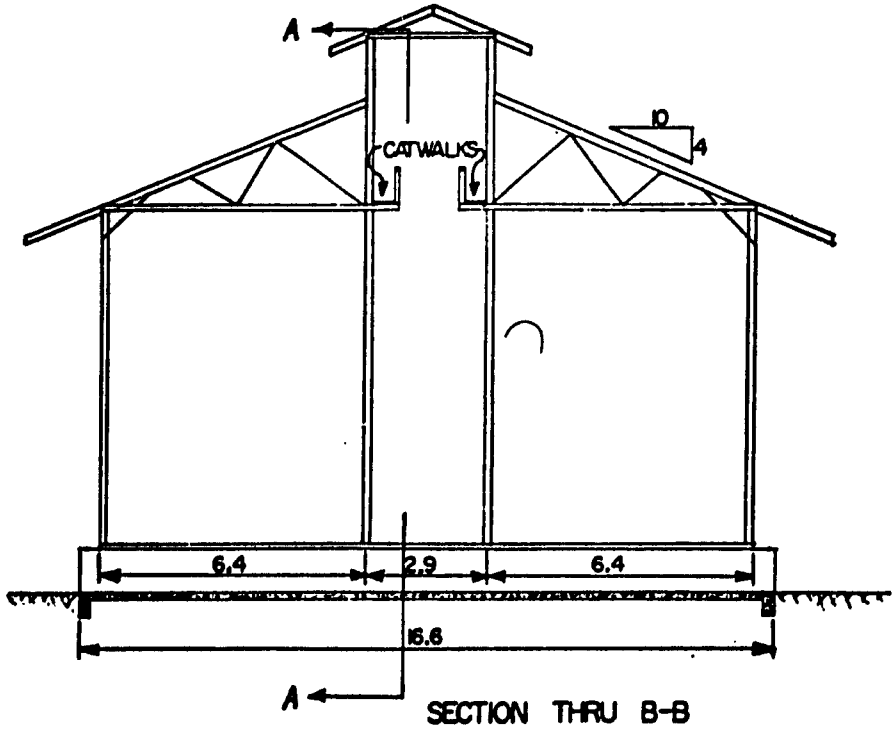


SECTION THRU A-A

COUNTRY COLLECTION CENTER

SACK STORAGE WAREHOUSE

(CONVERTIBLE TO BULK STORAGE SEE APPENDIX V-5)



SECTION THRU B-B

Functional Operation of a Bulk Storage System

A bin of stored grain contains essentially only two materials with which we are concerned here - grain and air. About 40 percent of the space in a bin or grain is interstitial air, and the humidity content of this air plays a vital role in maintaining grain quality. The relationships between the grain moisture and air humidity may be considered first qualitatively and then quantitatively.

(a) Qualitatively. For any given grain moisture content there is a corresponding interstitial air relative humidity value at equilibrium conditions. These natural equilibrium values have been determined experimentally for most grains. When these moisture values are not in equilibrium, there will always be a transfer of moisture between the air and the grain until they come to equilibrium. The direction and amount of transfer depends upon which predominates, the moisture in the grain or the humidity in the air and how much change must occur to establish equilibrium.

(b) Quantitatively. In regard to the amount of transfer required to attain equilibrium there are essentially two distinct cases - the case of storage and the case of drying.

In a bin of stored grain containing 500 tons of 13 percent moisture content maize there are 435 tons of grain dry matter, 65 tons of grain moisture, and about 280 cubic meters of interstitial air, which at 20°C temperature and in moisture equilibrium with 13 percent maize will contain only about 2.3 kilograms of water vapor in the entire bin. This is a quantitative ratio of about 28,000 to 1. Obviously the moisture in the grain greatly predominates in the case of storage and small amounts of air entry even if saturated can produce only slight changes in the average moisture content of the bin of grain. Initially dry grain placed in reasonably tight storage that prevents entrance of any liquid water can keep the grain dry for many months or years, almost

regardless of the outside air humidity conditions during this storage period. This, of course, assumes there will be no movement of the moisture within the bin due to moisture migration, which will be discussed briefly in a later section.

Now let us assume, for example, that this 500 tons of maize had an average moisture content of 18 percent (wet basis*) when placed into a bulk storage bin during the month of June located, say in Kananga; that this bin was equipped with a perforated, raised floor and fan-motor unit; and that it will be slowly dried simply by running the fan continuously, 24 hours per day. According to long time weather records (Figures V-4-a and V-4-d), the average or mean June values of temperature and relative humidity in Kananga are 24°C and 70 percent relative humidity (R.H.). Damp maize continually exposed to such air will lose moisture until it dries to about 13.5 percent - the equilibrium maize moisture condition for this air. To dry maize from 18 to 13.5 percent moisture requires the evaporation and removal of 52 kilograms of water per metric ton of the initially 18 percent maize. For 500 tons of maize this is a total of 26 tons of water to be removed. Unheated or atmospheric air averaging 24°C and 70 percent R.H., when forced to pass through 18 percent moisture maize will evaporate and absorb only about 1.2 grams of water per kilogram of air change. To evaporate and remove 26 tons of water with such air would require passing 26,000/0.0012 or 21,666,666 kilograms of air through the maize at a velocity slow enough to permit full utilization of the moisture pickup capacity of the air and to minimize fan power requirements. The volume of this mass of air is about 20 million cubic meters. The only feasible way to force such huge quantities of air throug

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*Percent Moisture Content (Wet Basis)=

$$\frac{\text{Weight of Moisture in Grain}}{\text{Weight of Moisture + Weight of Dry Material in Grain}} \times 100$$

such large masses of grain is to use a power-driven fan designed for such operation and to provide for the use of a long period of time for the process. About the only practical approach is to place the grain into bulk storage bins equipped with air ducts or plenums for proper distribution of the air into the mass of grain, and then ventilate it slowly.

If the 500 tons were placed in a bin equipped with a raised, perforated floor with 100 square meters floor area, the bin would be filled to about 7.3 meters depth. One 5 hp motor-fan unit connected to this bin would provide a steady air flow rate of about 260 cubic meters of air flow per minute. At this rate of air supply, about 50 days of continuous fan operation would be required to force 20 million cubic meters of air through the grain, which would dry all the grain in the bin to about 13.5 percent moisture content.

The cost per horsepower hour to operate electric motors approximately equals the cost per KWH of the electricity. For an electricity cost of, say, 2 K/KWH x 5 hp x 50 days x 24 hr/day or ≅ 120 -- about 24 K/ton, or 2.4 K per 100 kilograms.

If, however, the initial moisture content were 16 percent, only about one-half as much fan operating time would be required. Or if the rate of air flow were reduced to one-half, a fan-motor unit with less than one-third as much horsepower would be adequate and a corresponding reduction of electricity costs would be possible.

b. The Suitability of Natural Air for Conditioning Maize in Bulk Storage in Zaire. The annual weather pattern in the maize growing regions in Zaire consists of two fairly distinct seasons, a wet and a dry season. While there are only slight fluctuations of the monthly average temperatures throughout the year - less than plus or minus one degree in those regions below 700 meters' elevation - the monthly average values of relative humidity vary greatly. Figures V-4-a,b,c and

d describe data obtained from the National Meteorological Service for the period 1951 to 1960 for several locations in the maize growing regions. As shown in graph Figure V-4-a there is great variation in the amount of change of mean monthly relative humidity values during the year according to locality, (north to south) and elevation. The port of Ilebo, to the north of the corn growing region, has high relative humidities throughout the year. Kikwit experiences some drop during July, August, and September. Moving east and south it becomes drier and for longer periods. The average relative humidity for June in Mbuji-Mayi is 62 percent. The southern, higher elevation regions - Kamina, Lubumbashi, Kolwezi, (all above 1,000 meters) have several months with exceptionally dry air, and all experience monthly means of less than 20 percent midway during the dry season.

Bulk maize exposed to average relative humidities greater than 75 percent will spoil after a period of time from mold development, and it cannot be piled up in storage at these conditions for more than a few weeks without beginning to spoil rapidly. The horizontal line at 75 percent relative humidity in Figure V-4-a depicts graphically the highest level of average relative humidity for safe storage of any grain. It will be noted that all locations for which data were plotted have higher than 75 percent average relative humidities for 6 to 7 months of the year, and a couple of them for the entire year. The only practical, sure way to store grains through such periods is to dry them to levels below 70 percent relative humidity equilibrium values (approximately 13.5 percent moisture content for maize) and then keep them in tight storage.

While maize that is dried to the 70 percent level or slightly below will be safe from mold development, it will not be safe from insect development if it has been infested before placement into storage or after it is stored. In-

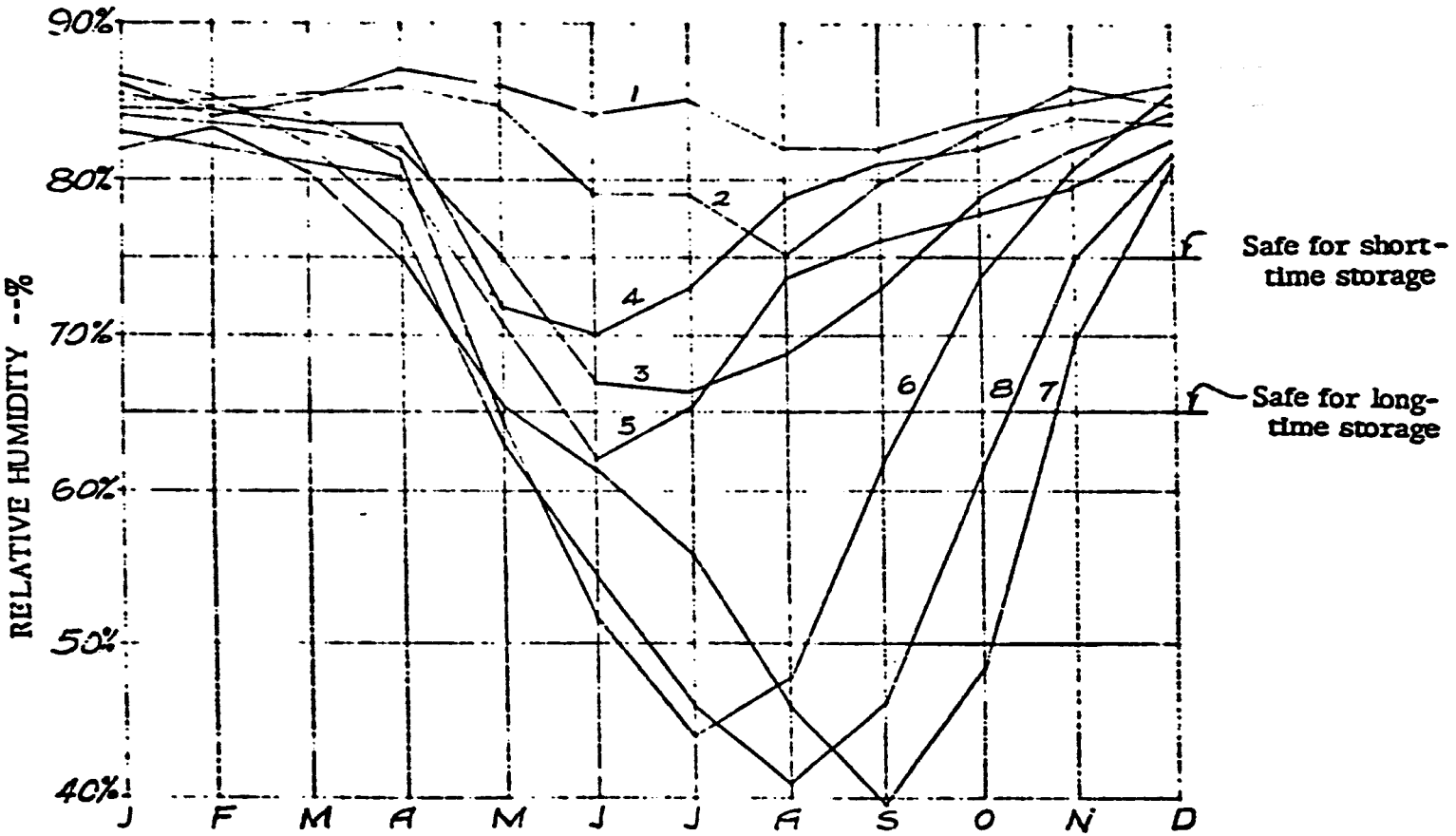
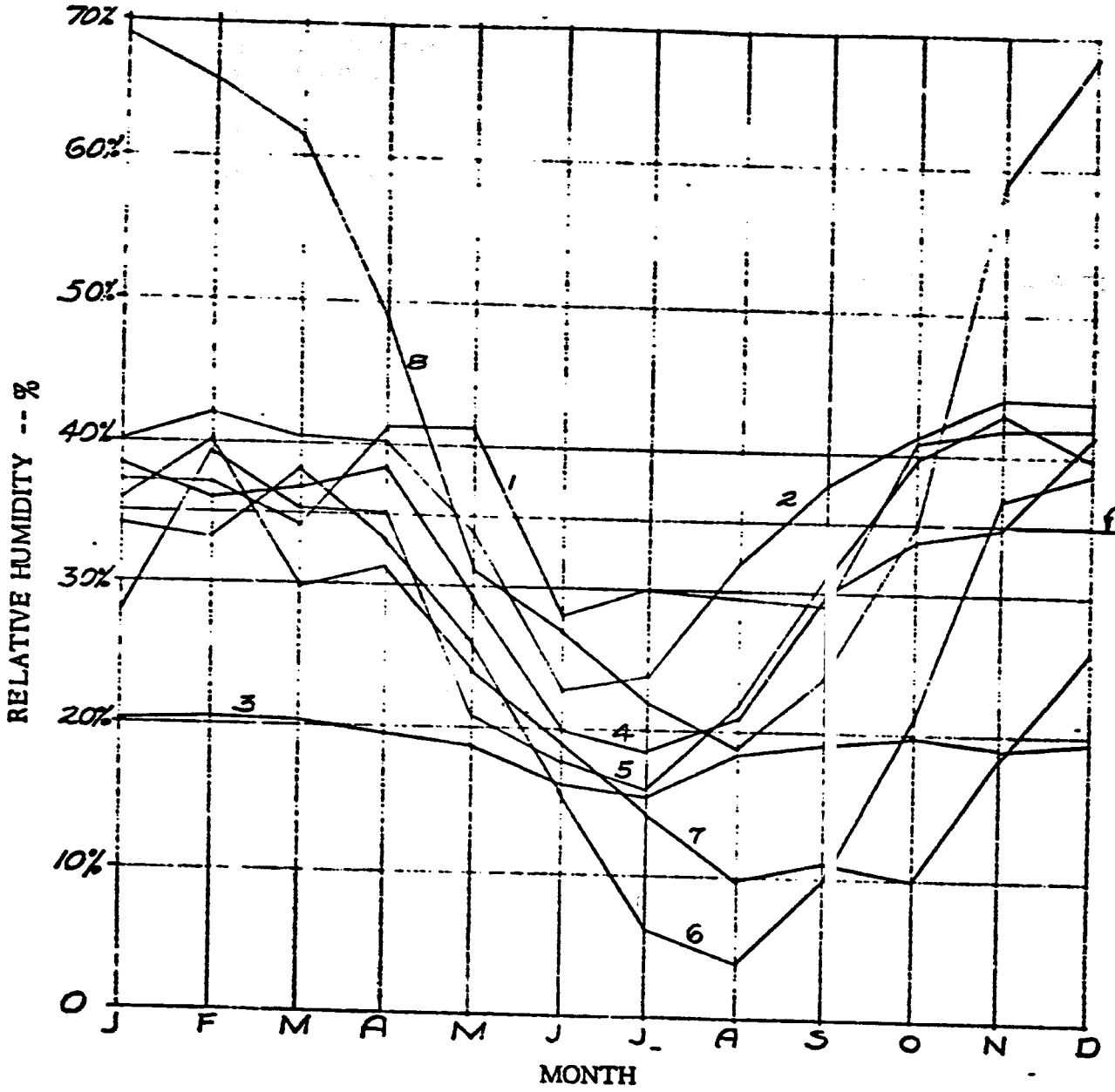


Figure V-4-a MONTHLY MEAN RELATIVE HUMIDITIES

No.	STATION	ELEVATION
1	Ilebo	420 m.
2	Kikwit	449
3	Kongolo	561
4	Kananga	657
5	Mbuji-Mayi	677
6	Kamina	1117
7	Lubumbashi	1298
8	Kolwezi	1526

WEATHER DATA
for
ZAIRE MAIZE REGIONS
from
National Meteorological Service
1951-1960

Kinshasa, Zaire 7-18-75 NCI

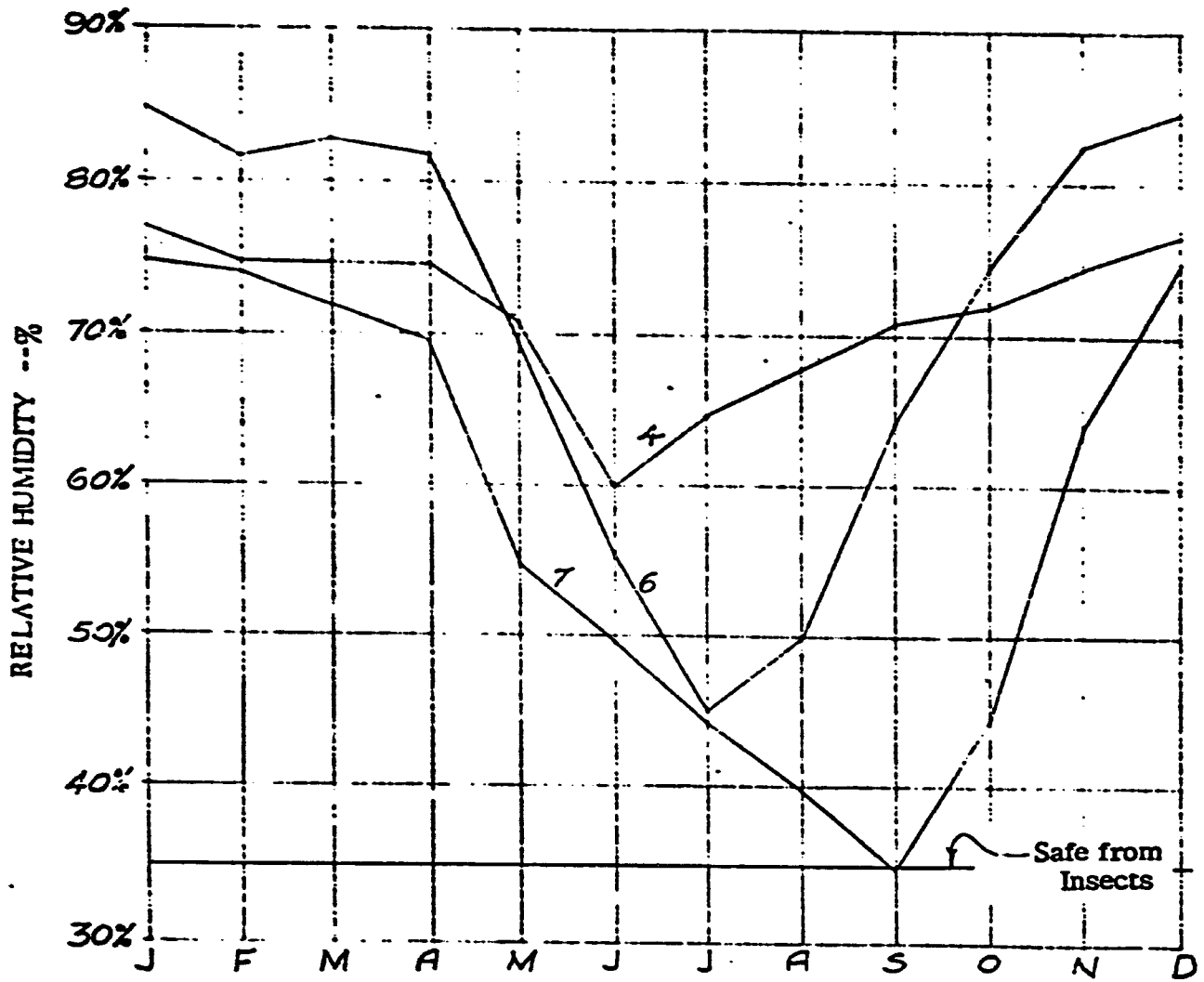


No.	STATION	ELEVATION
1	Ilebo	420 m.
2	Kikwit	449
3	Kongolo	561
4	Kananga	657
5	Mbuji-Mayi	677
6	Kamina	1117
7	Lubumbashi	1298
8	Kolwezi	1526

EATHER DATA
for
ZAIRE MAIZE REGIONS
from
National Meteorological Service
1951-1960

Figure V-4-b MONTHLY AVERAGE DAILY MINIMUM RELATIVE HUMIDITY

Kinshasa, Zaire 7-18-75 NCI



No.	STATION	ELEVATION
1	Ilebo	420 m.
2	Kikwit	449
3	Kongolo	561
4	Kananga	657
5	Mbuji-Mayi	677
6	Kamina	1117
7	Lubumbashi	1298
8	Kolwezi	1526

WEATHER DATA
for
ZAIRE MAIZE REGIONS
from
National Meteorological Service
1951-1960

Figure V-4-c DAYTIME MONTHLY AVERAGE RELATIVE HUMIDITIES

Kinshasa, Zaire 7-18-75 NCI

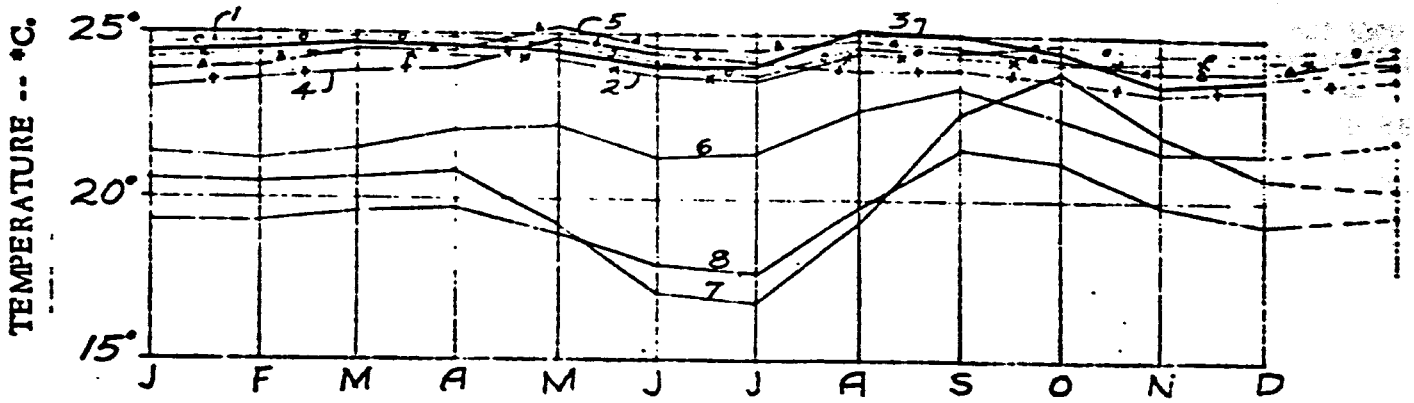


Figure V-4-d MONTHLY MEAN TEMPERATURES

No.	STATION	ELEVATION
1	Ilebo	420 m.
2	Kikwit	449
3	Kongolo	561
4	Kananga	657
5	Mbuji-Mayi	677
6	Kamina	1117
7	Lubumbashi	1298
8	Kolwezi	1526

WEATHER DATA
for
ZAIRE MAIZE REGIONS
from
National Meteorological Service
1951-1960

Kinshasa, Zaire 7-18-75 NCI

sects develop rapidly at 70 to 75 percent relative humidity levels. But as storage moisture relative humidities are decreased to 50 percent and below, insect activity becomes greatly retarded and at 35 percent relative humidity insects usually will not survive. Figure V-4-b is a plot of the monthly minimum values of relative humidity for the stations listed in Figure V-4-a with the safe level for insect control plotted at the 35 percent relative humidity value. The lowest annual observation reported was a reading of 4 percent relative humidity at Kamina. It becomes obvious from Figure V-4-b that low relative humidities are available sometime during each day at nearly all the stations for all months of the year. This is a result of the relatively high percentage of sunshine. Even during the rainy season the lowest monthly average of daily sunshine hours was reported to be 4.7 for Ilebo and 4.6 for Kikwit which is nearly one-half of the maximum possible values.

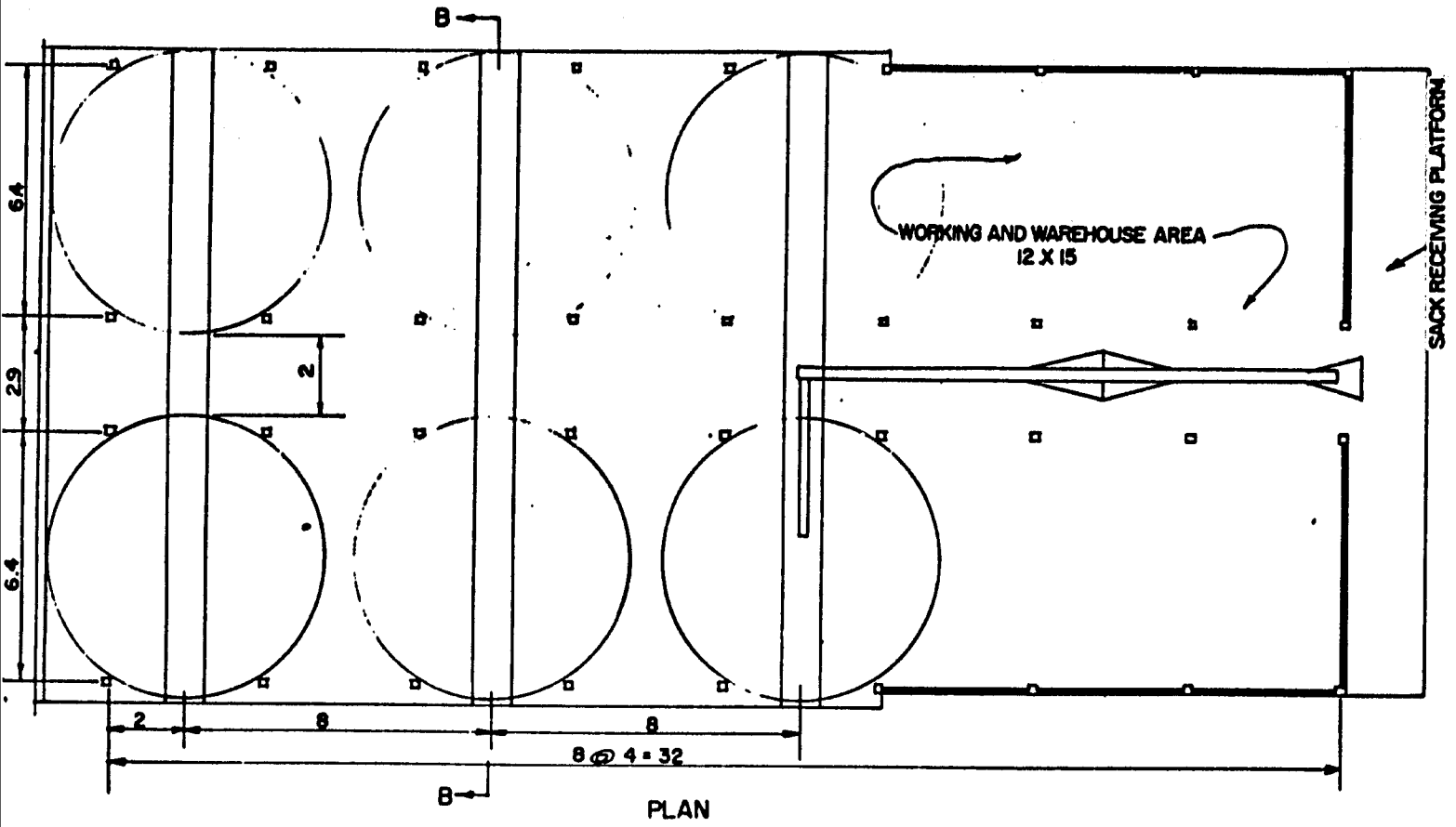
Some daytime average relative humidity values were obtained from a weather atlas for Zaire entitled, Atlas Climatique du Bassin Congolais (INEAC) authored by Franz Bultat, that is available in the library of the National Meteorological Service. Figure V-4-c presents a graphic plot of these data for three selected stations. These data describe only the best 10 or 12 hours of the day. There was insufficient time to search out or find the basic data that would give the best 3-hour, 6-hour, 9-hour, etc. daily average relative humidity values. The pen-line graphs from recording thermohumidgraph instruments can be analyzed for such information, and this type of information would be most valuable and useful to determine the drying potential and capacity of the natural or unheated air according to location and time of year.

It is clear from the previous data that the natural atmosphere in the southern maize growing regions of Zaire for selected months of the year and selected hours of the day is favorable for drying grain to safe moisture levels for long-time storage. At several of the locations, it should be possible to dry the maize to extra-low moistures with only natural air, which would greatly inhibit any insect infestation.

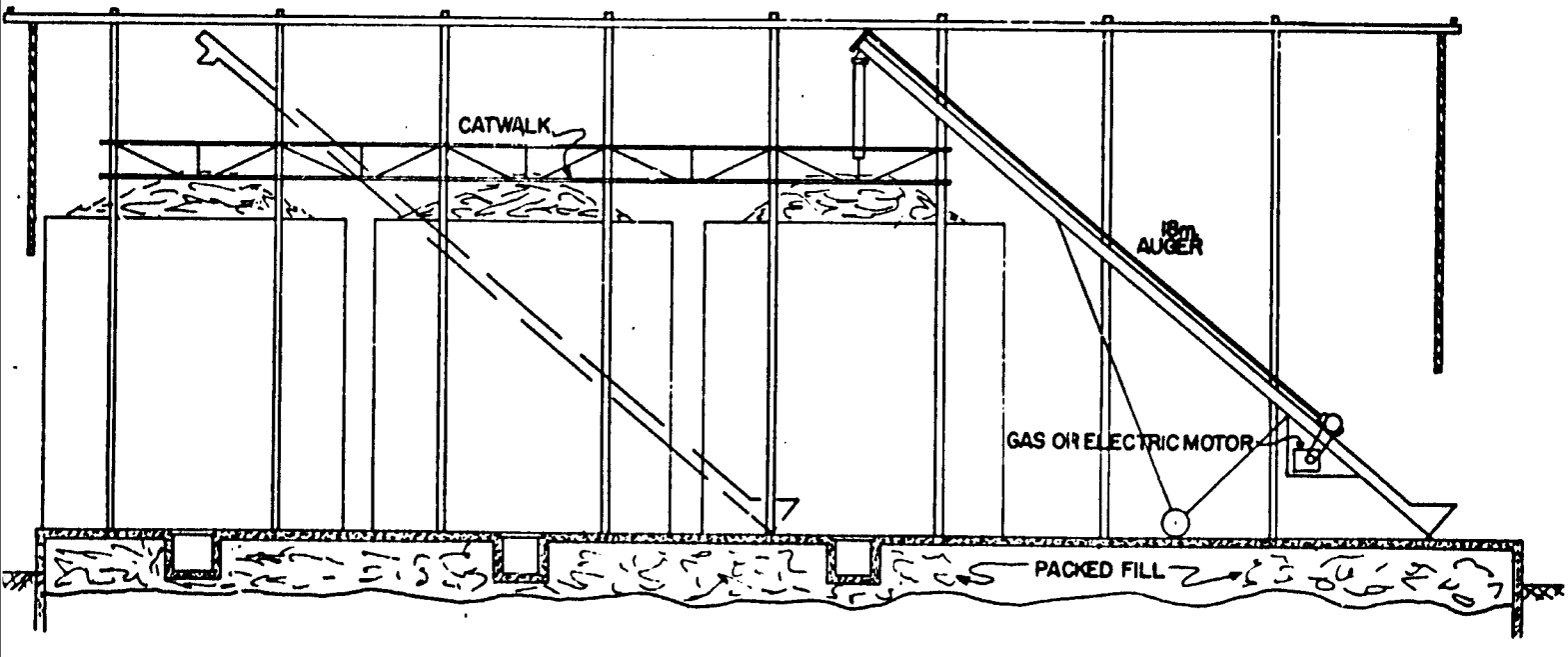
Returning to our illustrative example, let us now assume that the relative humidity of the best 8 hours at Kananga during the June, July, and August period averages 50 percent relative humidity and 28°C, and let us further assume that the maize contains 16 percent moisture content when placed into the bin. Drying air averaging 28°C and 50 percent relative humidity will dry maize to about 10.5 percent and will pick up about 2.4 grams of moisture per kg.of air flow. The drying load from 16 to 10.5 percent is 61.5 kg/ton which for 500 tons is 30,800 kg. of water to be evaporated and carried out. The total amount of air required at 2.4 grams/kg. calculates to be about 11 million cubic meters. With a fan delivery of 260 CMM, 705 hours of fan operation time would be required, which at 8 hours/day would require an operation period of 88 calendar days or about 3 months. The cost of electricity at 2 K/KWH would be 14 K/ton.

During this 3 month aeration period, the grain would be heated as it is dried to an average temperature of 28°C but the 16 percent undried grain in the bin (that grain remaining above the drying zone during the drying process) would be maintained at a temperature averaging 21°C. After the entire bin is dried, it could be cooled to within a few degrees of the lowest diurnal prevailing temperatures simply by running the fan two or more nighttime periods. Cooling grain with aeration will tend to further dry it even when the cooling air is very high in humidity. So long as the aeration air is accomplishing

some cooling, the grain will not be rehumidified. Therefore, limited use of the coolest nighttime air can accomplish at least partial cooling with practically no re-wetting. Then after cooling as much as possible, the bin should be closed and kept closed during humid weather.



PLAN



SECTION THRU A-A

COUNTRY COLLECTION CENTER

COMMON ROOF

EXPANSIBLE SILO-BANK-UNIT

KINSHASA, ZAIRE 6-28-75 NCI

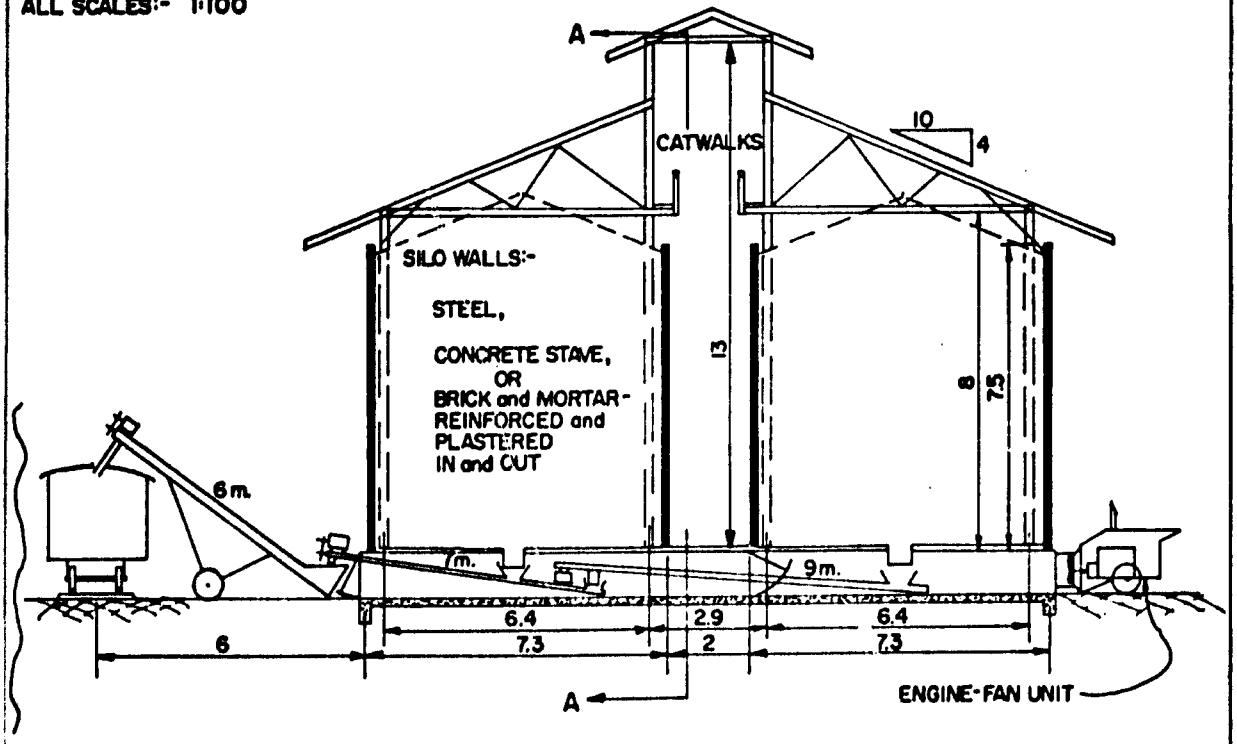
SILO CAPACITIES

DIAMETER Ft.	M.	CAPACITY METRIC TON 16' HEIGHT (4.9M.)	24' HEIGHT (7.3M.)
18	5.5	82	124
21	6.4	112	168
24	7.3	146	220
27	8.2	186	279
30	9.1	244	366
36	11.0	330	495
42	12.8	450	675
48	14.6	587	881

NOTES-

DIMENSIONS FOR 7.3ϕ X 7.3 SILOS

ALL SCALES:- 1:100



SECTION THRU B-B

COST ESTIMATES

Table V-7 lists current prices for grain storage construction materials and manufactured or prefabricated steel bins and associated grain handling and conditioning equipment. Materials normally available within the country were priced at different locations. However, it was found that prices for some materials were increasing almost monthly. For this reason unit prices, selected as currently typical, are listed for locally available materials, which will serve as reference for adjustments for any future price fluctuations.

Current FOB (central United States) retail prices for the 24 foot by 24 foot height prefabricated steel bin and the necessary auxiliary handling and conditioning equipment are listed in dollars along with the shipping weight. With this information the cost per pound is readily calculated, which figures is useful as an index to indicate cost for the different kinds or types of equipment. FOB retail prices for such equipment typically contain a 25 to 35 percent markup above the authorized or franchized salesman-dealer-builder costs. The erection or assembly labor costs of steel bins and equipment (concrete work excluded) are commonly estimated at 10 to 15 percent of the retail price, which leaves a dealer margin of 20 to 25 percent.

Labor costs are estimated as a percentage of the material costs, somewhat according to the type or nature of the construction work involved. These percentage figures may vary greatly according to local conditions and the method of labor employment or management - whether direct hire, contract, full time, part time, etc.

Shipping costs for the items requiring importation are usually calculated on the basis of volume or weight, whichever is the higher. Present shipping costs to central Africa from central USA for containerized, prefabricated steel sheets and equipment such as listed above, figures to be around 10 cents (U.S.)

per pound where weight determines the shipping charges, and for the more bulky fabricated equipment such as fan units, elevators and laboratory equipment, where volume determines the shipping charges, the cost for typical items when converted to a weight basis varies from 15 to 40 cents per pound. Figuring these shipping charges as a percentage of the FOB price, the percentage figures vary from around 20 to 40 percent of the FOB costs. For the following preliminary estimates, the shipping costs are 30 percent of the FOB list price.

TABLE V-7 PRICES ASSUMED FOR COST ESTIMATES

Locally Available Materials

	Unit Price
Lumber-structural grade	50 Z/m^3
Concrete--ready mixed - less delivery	25 Z/m^3
Reinforcing and structural steel	50 K/kg.
Corrugated, galvanized steel roofing, 28 g.	2 Z/m^2
12 cm. Brick & motar wall--cement plastered both faces	3 Z/m^2

Prefabricated, round steel grain bins and equipment
(Current U.S. FOB retail prices--for Conversion, 1Z=$2)

Item	Weight lbs	FOB Price (U.S. Dollars)
Round steel bin with 1 ring door, with cone roof but no floor --7.3 m. x 7.3 m. height (24' x 24')	6913	$2480
Perforated raised floor--7.3 m.	827	555
Perforated raised floor steel supports	1109	615
Above floor lateral ducts--8" radius - ½ round -- per foot length	2	2
*Sub-floor auger & hopper--6"x16' (5 m)	104	147
*Sub-floor auger & hopper--6"x24' (7 m)	144	183
*Sub-floor auger & hopper--6"x30' (9 m)	174	231
*Sweep auger for 24' bin	82	129
*Roof auger-- 6" x 18' (6 m)	108	138

*Less motors

-continued

TABLE V-7 continued

Portable auger elevators with two-wheel transport, drive and winch--less motor

	HP Rqd.	Weight (lbs)	FOB Price (U.S. Dollars)
6" x 16' (5m)	1	180	$125
6" x 20' (6m)	1-1/2	240	160
6" x 30' (9m)	2	500	450
6" x 36' (11m)	3	680	700
6" x 42' (13m)	5	760	760
6" x 52' (16m)	5	990	990
6" x 60' (18m)	7-1/2	1170	1200
8" x 52' (16m)	7-1/2	1281	1366
8" x 62' (19m)	10	1950	2000
10" x 62' (19m)	20	2500	2900

Maximum delivery capacities @30° slope and dry grain:--
6" -- 25 MT/hr
8" -- 40 MT/hr
10" -- 80 MT/hr

Chain-flight, portable elevator (21"x7" trough) with drive and hopper

	HP Rqd.	Weight (lbs)	FOB Price (U.S. Dollars)
37' (11m) long	10	2089	$1549
42' (13m) long	12	2216	1758
52' (16m) long	15	2470	1844
Electric motors			
3/4 hp (S. Ph.)		25	100
1 hp (S. Ph.)		35	147
1-1/2 (S. Ph.)		40	172
2 hp (S. Ph.)		46	205
3 hp (S. Ph.)		66	258
5 hp (S. Ph.)		91	280
7-1/2 (3 Ph.)		135	325
10 hp (3 Ph.)		175	388
20 hp (3 Ph.)		300	617

-continued

TABLE V-7 continued

Item	Weight (lbs)	FOB Price (U.S. Dollars)
Gas engines		
2 hp (@ 3600 rpm)*	30	$ 75
4 hp (@ 3600 rpm)*	36	96
8 hp (@ 3600 rpm)*	60	150
12 hp (@ 3600 rpm)*	100	275
16 hp (@ 3600 rpm)*	120	350
*Recommended continuous duty hp is about 1/2 of that rated @ 3600 rpm		
Aeration-drying fan motor units		
1 hp (S. Ph.)	60	$247
1-1/2 hp (S. Ph.)	80	302
3 hp (S. Ph.)	110	420
5 hp (S. Ph.)	215	540
7-1/2 hp (S. Ph.)	225	678
10 hp (S. Ph.)	280	801
Humidistat control for magnetic starter		25
Time-clock control for magnetic starter		25
Enclosed fan-engine drying unit	1300	1820
Shelling and cleaning equipment		
Hand-crank bench type sheller- 1/5MT/hr	15	35
Hand-crank floor stand with flywheel-- 1/2 MT/hr	100	250
Small cylinder sheller - 10 MT/hr, 10 hp	700	1300
Large cylinder sheller - 50 MT/hr, 50 hp	4000	6660
Rotating cylinder grain cleaner	280	550
Portable platform scales - 1 MT cap.	150	600
Portable bag conveyor - 5M	500	1000
Grain laboratory equipment		
Electric moisture tester		$ 700
Grain scales - 500 grams capacity		78
Glass stem thermometers - each		3
Dial bimetalic thermometers		33
Maize dockage sieve with pan		20
Set of grain probes for sacks and bin		103
Dial humidity indicator		50
Sling psychrometer		20
TOTAL		$1,007

STANDARD SIZE ROUND STEEL GRAIN BIN DATA
(WITH AND WITHOUT CONE ROOF)

Diameter		Wall Height		Storage Capacity	With cone roof		Walls Only			
		No.			Weight	FOB net	Weight	FOB net	CIF costs $	
Ft.	meter	rings	meter	metric ton	lbs	cost $	lbs	cost $	Total	per MT
18	5.5	4	3.25	67.3	2184	864	1411	607	748	11.1
18	5.5	5	4.06	81.7	2730	976	1935	806	999	12.3
18	5.5	6	4.87	96.0	3154	1134	2359	968	1204	12.5
18	5.5	7	5.69	110.3	3665	1316	2870	1164	1451	13.1
18	5.5	8	6.50	124.7	4244	1524	3449	1383	1728	13.8
18	5.5	9	7.3	139.0	4805	1725	4020	1598	2000	14.4
24	7.3	4	3.25	127.5	3659	1446	2212	917	1138	8.9
24	7.3	5	4.06	152.7	4282	1537	2835	1155	1438	9.4
24	7.3	6	4.87	177.9	4852	1742	3405	1372	1712	9.6
24	7.3	7	5.69	203.0	5619	2015	4172	1663	2080	10.2
24	7.3	8	6.50	228.0	6046	2168	4699	1865	2335	10.2
24	7.3	9	7.3	253.4	6913	2480	5466	2156	2703	10.7
30	9.1	4	3.25	202.8	5581	2083	3237	1305	1629	8.0
30	9.1	5	4.06	243.2	6071	2180	3727	1483	1856	7.6
30	9.1	6	4.87	283.7	7003	2512	4669	1855	2322	8.2
30	9.1	7	5.69	324.2	7968	2857	5624	2218	2780	8.6
30	9.1	8	6.50	364.6	9320	3341	6976	2747	3445	9.4
30	9.1	9	7.3	405.1	10030	3594	7686	3018	3787	9.3
36	11.0	4	3.25	308.4	7260	2710	3842	1553	1937	6.3
36	11.0	5	4.06	365.8	8108	3026	4689	1875	2344	6.4
36	11.0	6	4.87	423.1	8672	3234	5265	2101	2627	6.2
36	11.0	7	5.69	480.7	10213	3809	6787	2692	3371	6.3
36	11.0	8	6.50	538.0	11739	4378	8329	3288	4121	7.7
36	11.0	9	7.3	595.4	12661	4719	9246	3641	4566	7.7

MOTOMCO MOISTURE METER

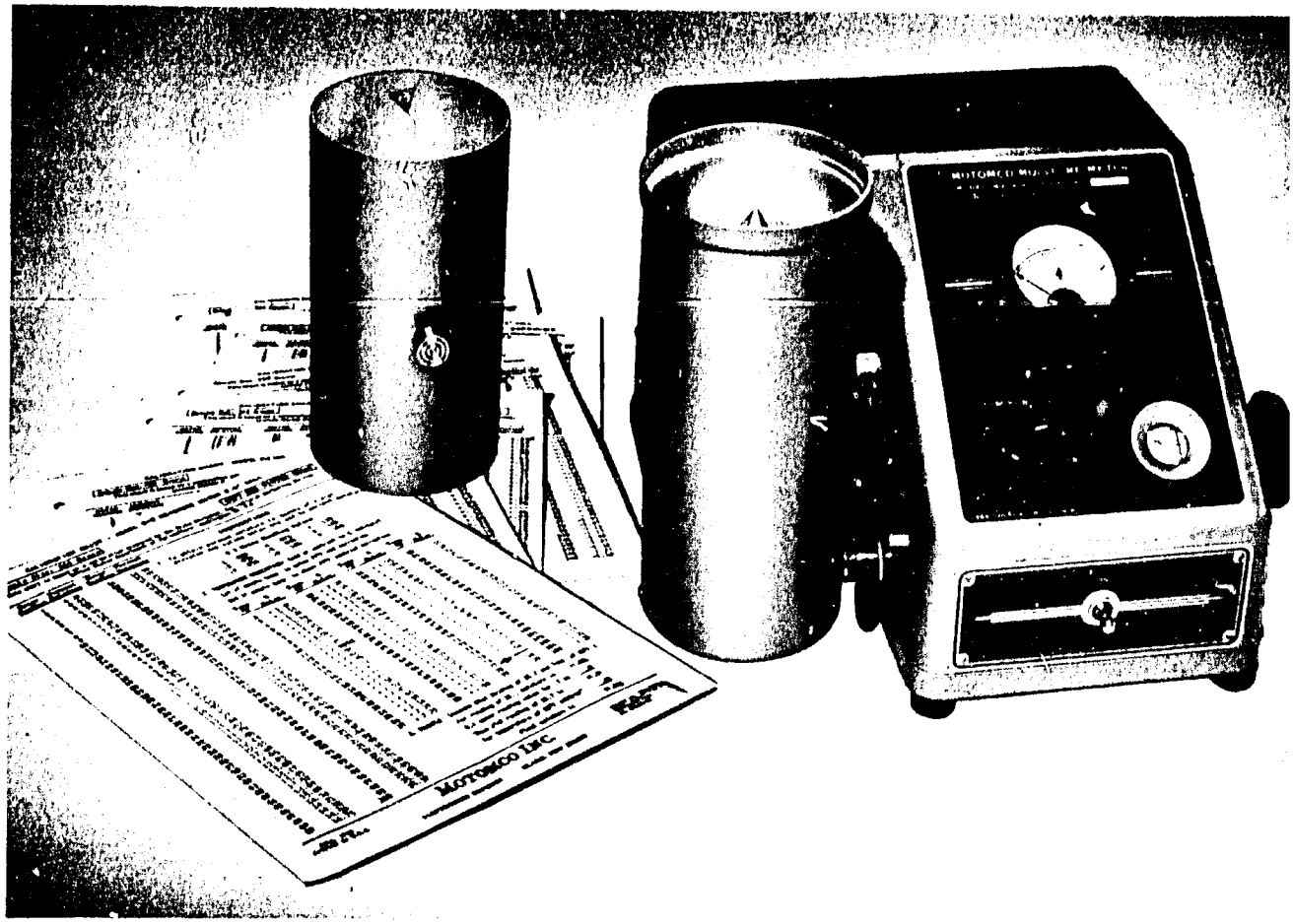
MODEL 919

For all Grain Seeds and other ranular commodities

Less than one inute required test sample

Moisture Tests with repeated ccuracy within /10ths of one per cent

No Bushel Weight orrection Required



Make Rapid "INSPECTOR-ACCURATE" Tests Anywhere

for

GRAIN INSPECTORS

ELEVATOR OPERATORS

GRAIN MERCHANTS

GRAIN DRIERS

MILLERS

SEED PRODUCERS

CHEMICAL MANUFACTURERS

Designed specifically to meet the requirements of the grain trade, the Model 919 Moisture Meter achieves a fine balance between cost, simplicity, and speed of moisture determination without sacrificing accuracy and reproducibility.

The electronic measuring circuits are the ultimate in simplicity and are so designed that battery or line voltages, ageing of components and variable climatic conditions do not affect their accuracy.

Precision built parts and rugged construction provides a quality instrument which is remarkably trouble-free over years of service and under rigorous field conditions. Fast factory service is always available at minimum charges.

The instrument is calibrated to indicate the moisture content of a wide variety of materials including wheat, oats, barley, rye, flax, corn, rice, beans, sorghums, flax meal, etc.*

*Charts furnished for cereal grains are based on calibrations prepared by the Grain Division, Agricultural Marketing Service, U. S. Department of Agriculture.

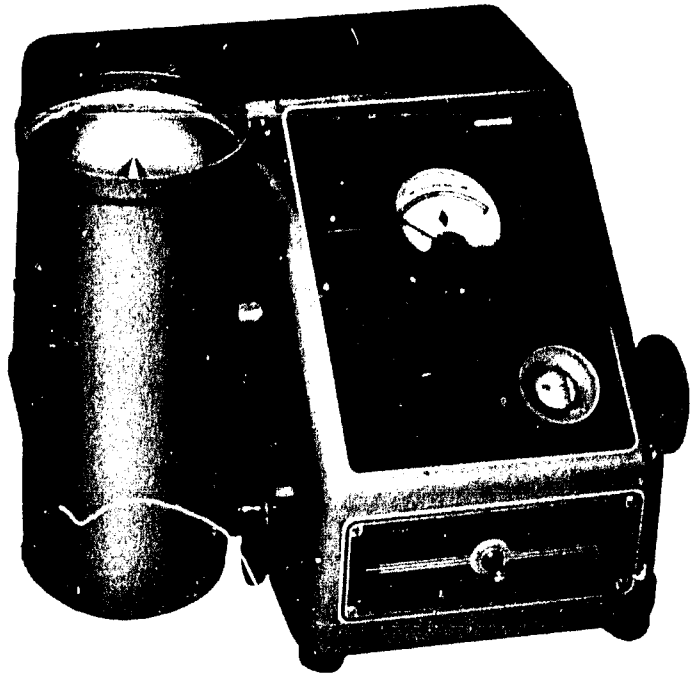
Printed in U.S.A.

Some of the Leading Features of the 919 Moisture Meter

PRECISION INDICATING METER WITH JEWELLED BEARINGS

TAPERED CENTRE POST COMPENSATES FOR PACKING AND SERVES TO PROPERLY DISTRIBUTE THE GRAIN SAMPLE

LIGHTWEIGHT ALUMINUM DIECAST HOUSING PROVIDES PROTECTION FOR THE SENSITIVE MEASURING CIRCUIT UNDER MOST RIGOROUS TESTING CONDITIONS



PIVOTED MEASURING CELL FOR RAPID AND CONVENIENT REMOVAL OF SAMPLE

INSTANTANEOUS OPERATION— NO WARM-UP REQUIRED. TOTAL POWER CONSUMPTION LESS THAN 5 WATTS

ENTIRE UNIT SEALED AGAINST ENTRANCE OF MOISTURE, DIRT AND FOREIGN MATERIAL

PRECISION DRUM DIAL WITH LARGE EASY-GRIP CONTROL

ONLY THE MOTOMCO MOISTURE METER

HAS ALL THESE ESSENTIAL FEATURES

FAST—No warm-up period required. Average time of determination, less than one minute per sample. Tests can be made by inexperienced personnel.

ACCURATE—Laboratory and field tests on most cereal grains show standard estimate of error to be less than two-tenths of one per cent.

INEXPENSIVE—The best moisture meter value at any price.

BLENDED SAMPLES—Accurate determination of moisture in newly blended samples.

FRESHLY DRIED SAMPLES—outstanding in accurate moisture determination of samples taken directly from grain driers. No overnight "equilibrium" required.

SAMPLE NOT DESTROYED—Grinding or crushing of sample is not necessary. The method of measurement enables the determination of moisture without injury to sample. Permits repeated tests on same sample.

PORTABLE—Rugged, die-cast aluminum case encloses sensitive measuring elements, assuring the ultimate in serviceability with a minimum weight (17 lbs.).

EXCELLENT STABILITY—No internal heating due to hot tubes, transformers, etc.

PATENTED TAPERED CENTRE POST IN CELL—Minimizes errors due to bushel weight variations, packing and levelling of sample.

LIGHTWEIGHT—Portable, Compact and Rugged. Battery models available on special order.

FULLY GUARANTEED

MOTOMCO INC. Electronics Division • CLARK, N. J.

GRAIN STORAGE RECORD

Date Shipment received _____ Shipment Number _____

Shipper _____ Dealer License No. _____

Address _____ Type of Grain _____

Source of grain: Producer _____ Location _____

Quantity in shipment: _____ Weight _____

Total Number of Bags _____ Comment on Load Condition:

Good Bags _____

Damaged Bags _____

Condition of Grain: Comment on grain condition:

Sound grain _____ %

Insect damage _____ %

Foreign Material _____ %

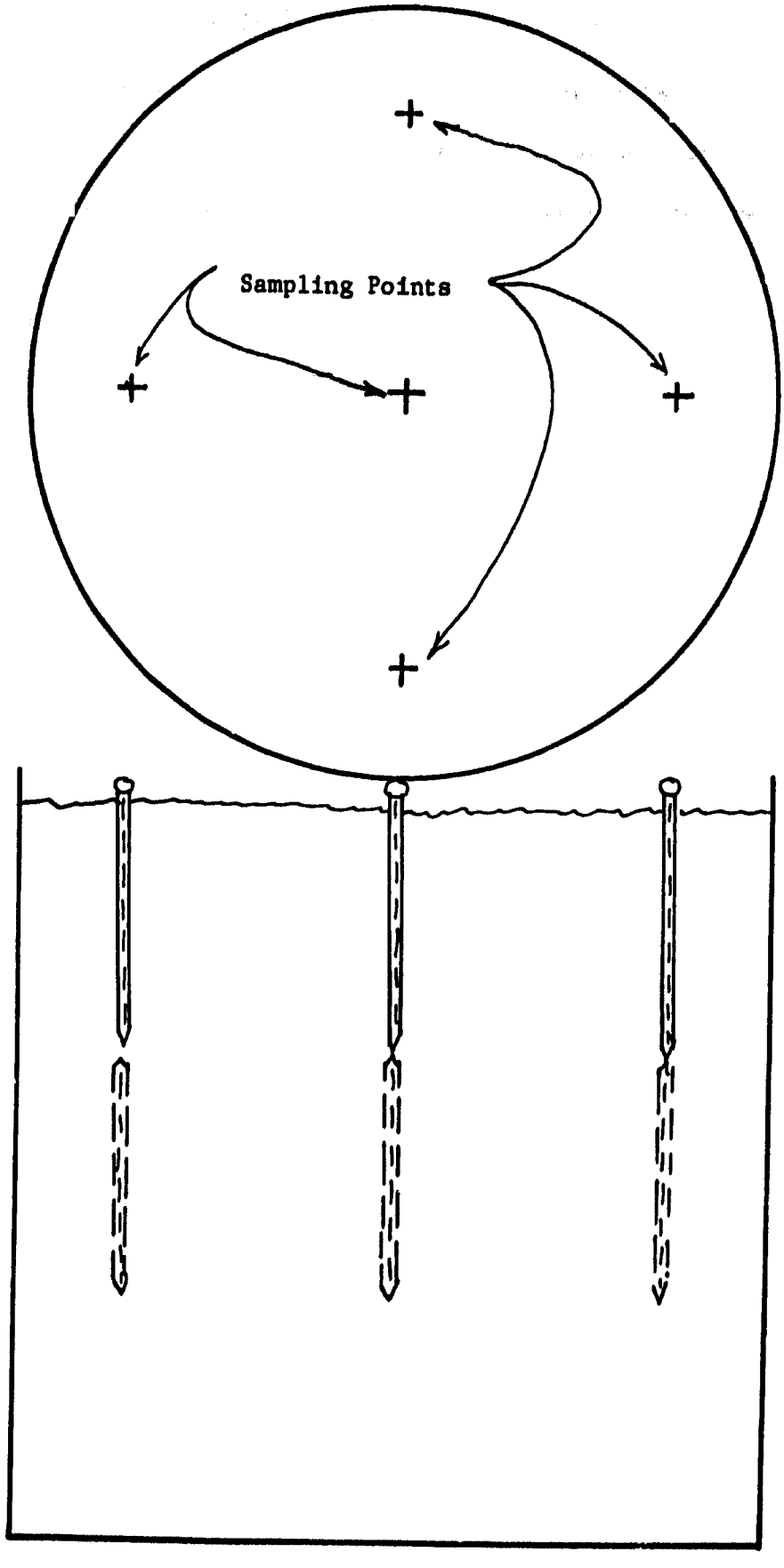
Inspection Record

Date	% M.C.	Remarks		Corrective Action
		Live Insects	Mold damage	

Sampling and Inspection Procedure for Grain in Storage

1. Sampling and inspection of bag stored grain.
   a. Lots of grain should be inspected on a monthly basis.
   b. Samples should be obtained from a number of bags equal to 10 percent of the exposed bags using a bag probe.
   c. Samples should be composited and blended as indicated in receipt sampling procedure.
   d. Samples should be examined for:
      (1) presence of live insects
      (2) moisture content
      (3) mold damage
   e. Results of the inspection should be recorded on the grain storage record form.
   f. Corrective action taken should be noted on the storage record.
2. Sampling and inspection of bulk stored grain.
   a. Bulk stored grain should be inspected on a monthly basis.
   b. Samples should be obtained from the grain bulk by probing the bin as indicated (See Figure 1) using a five foot grain probe (See Appendix VI-2, Figure 1) with extensions. Probing of deep bulks of maize is difficult. Temperature cables would provide a workable alternative.
   c. Probe samples should be placed in a probe tray and visually examined for live insects.
   d. Samples should be taken to the laboratory for moisture testing.
3. Appropriate action should be taken by the station manager to correct infestation and/or high moisture conditions. This may require fumigation and/or aeration.
   a. See Appendix VI-5 for bag grain fumigation procedures.
   b. See Appendix VI-6 for bulk grain fumigation procedures.

FIGURE 1 PROBE SAMPLING OF BULK STORED GRAIN



Appendix VI-5

Procedure for Fumigation of Bagged Stored Grain

In event that it should be necessary to fumigate bag stored grain, the following procedure should be followed:

1. Determine the quantity of grain to be fumigated and the required amount of fumigant.
   a. The quantity of grain should be known by grain storage record.
   b. The amount of fumigant required may be determined by consulting the attached schedule for Phostoxin.
   c. If the quantity of grain is not known it can be estimated by calculating the volume of the grain stack and fumigating at the level indicated in the attached schedule.
2. Assemble the following equipment and materials necessary to conduct the fumigation:
   a. Equipment
      (1) Gas-tight fumigation tarpaulin
      (2) Sand-snakes
      (3) Ladders
      (4) Respiratory protective equipment
   b. Materials
      (1) Fumigant
3. Apply the fumigant to the grain stack as follows:
   a. Position the gas-tight tarpaulin across the stack so that it is easily pulled into position to cover the stack as Phostoxin is applied.
   b. Apply Phostoxin tablets between the bags and across the surface of the stack to distribute the tablets as uniformly as possible over the grain.
   c. As the tablets are applied, the gas-tight tarpaulin should be pulled in place to cover the treated sections of the stack.

d. As the tarpaulin covers the stack it should be sealed to the floor using the "sand snakes", (sand or other flexible weights).

4. The required exposure period is indicated in Appendix VI-7.

5. Following the required exposure period individuals equipped with the proper respiratory protective equipment should remove the tarpaulin for storage and later reuse.

6. Following fumigation, it may be desireable to surface treat the bags of grain using insecticide dust or spray treatment to prevent reinfestation.

Procedure for Fumigation of Bulk Stored Grain

1. Determine the quantity of grain to be fumigated. The quantity of grain in round storage bins can be estimated from the formula in figure 1.
2. Diagram the application of Phostoxin tablets to give a uniform distribution of fumigant gas. See the examples in figure 2.
3. Assemble the following equipment and materials necessary for fumigation.

    a. Equipment
        (1) Phostoxin probe
        (2) Gloves
        (3) Plastic cover sheet

    b. Materials
        (1) Phostoxin tablets

4. Apply the Phostoxin tablets according to the diagrammed schedule.
5. Cover the surface of the grain with the plastic cover sheet to prevent unnecessary loss of gas from the surface of the grain. This is especially necessary if the bin is not nearly full. If a plastic cover sheet is not available the fumigant dosage will need to be increased to compensate for surface loss.

NOTE: It may be desireable to surface treat the grain in the bin prior to fumigation to prevent immediate reinfestation of the surface grain.

FIGURE 1 FORMULA TO CALCULATE THE QUANTITY OF MAIZE IN ROUND STORAGE SILOS

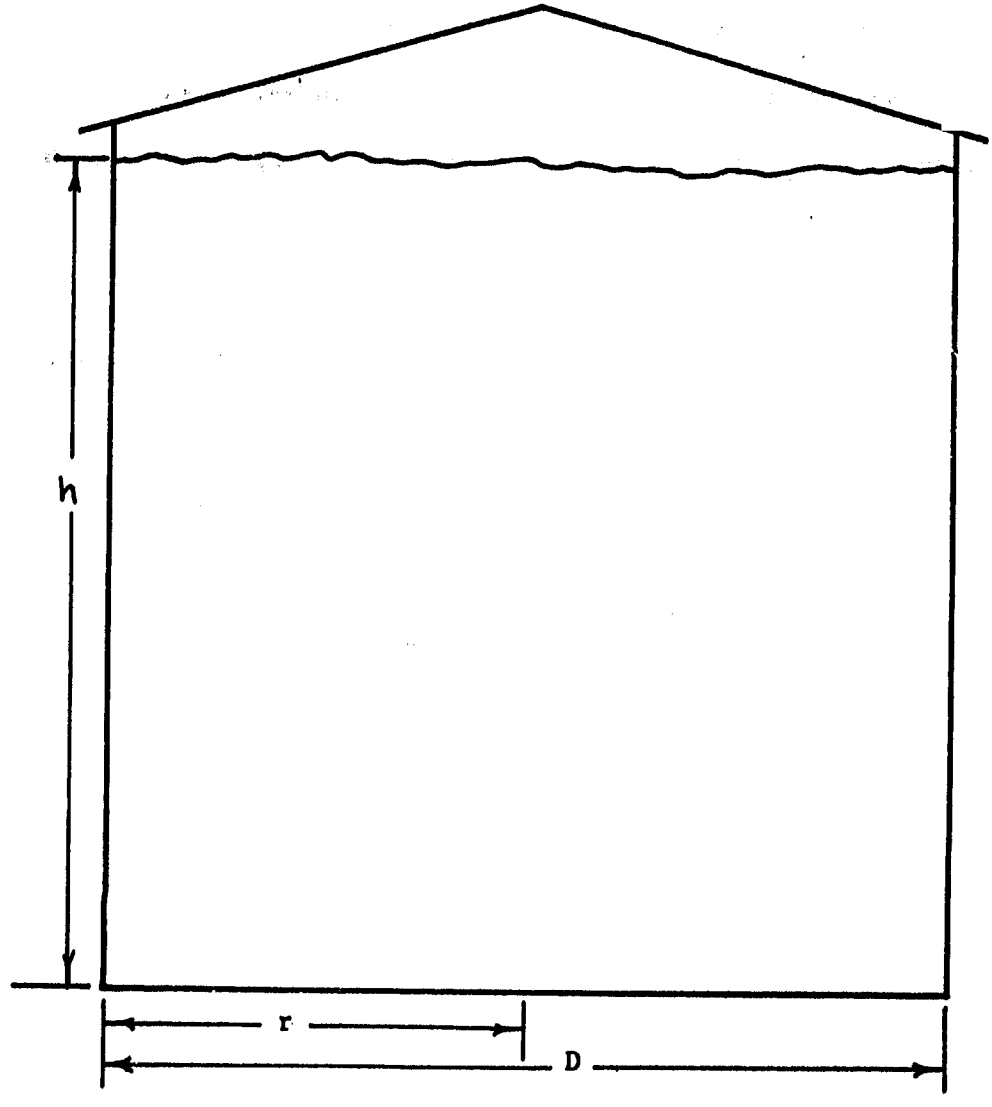


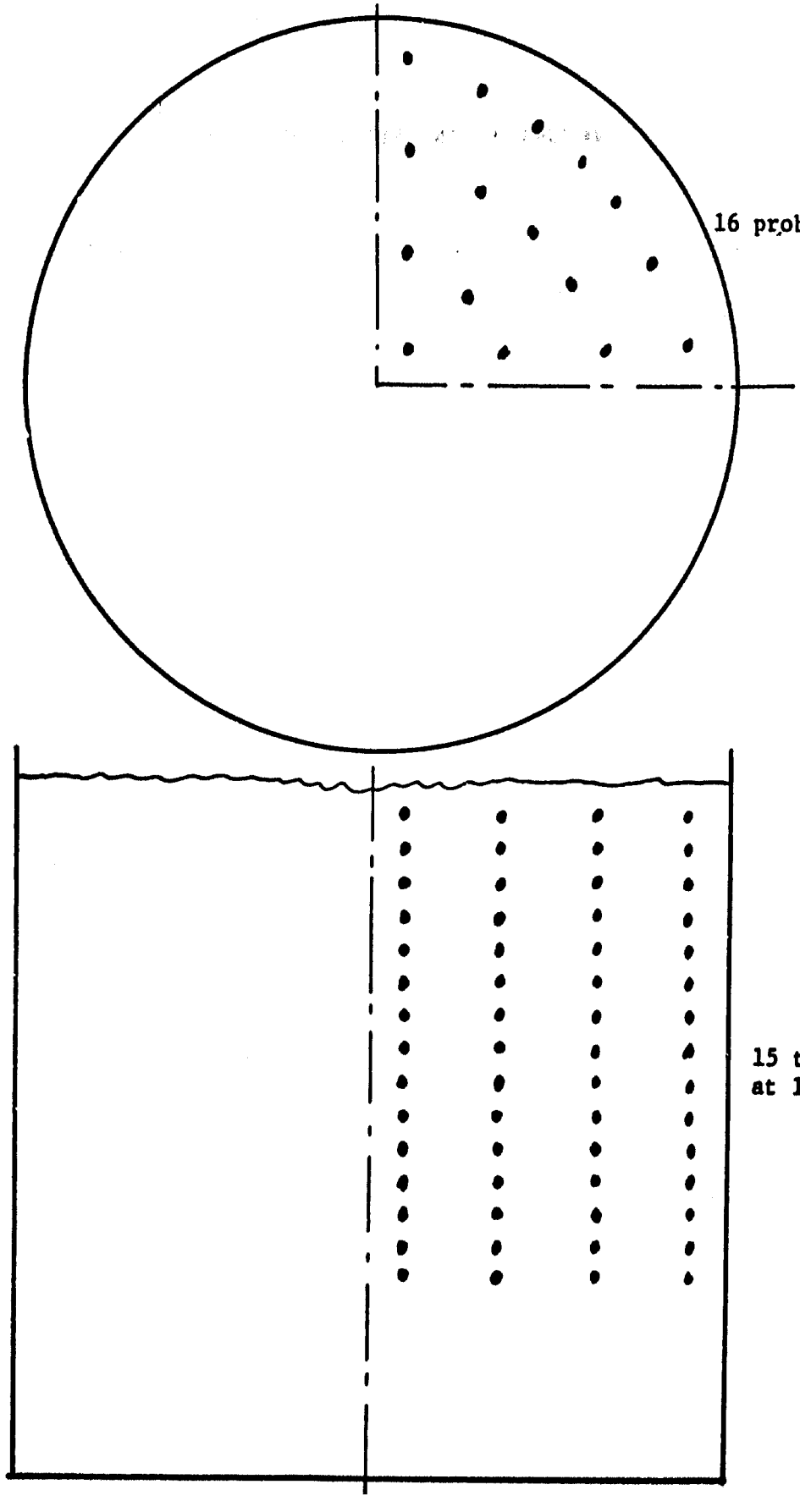
FIGURE 2 DOSAGE AND DISTRIBUTION OF PHOSTOXIN FOR BULK STORED MAIZE

The quantity of grain to be fumigated should be determined as indicated in figure 1 and the type and condition of the storage structure determined. The fumigant dosage based on type of storage and temperature is obtained from Appendix VI-7.

The total amount of fumigant to be applied is determined by multiplying the the quantity of maize (metric tons) by the number of tablets per metric ton.

Assume (as in the example in figure 1) that 198 MT of maize are stored in a cylindrical metal bin (Batter-type) with a grain temperature of 18°C. These conditions would indicate a dosage rate of 5 tablets per MT and a total need for 990 tablets. Further assume that the infestation is uniformly distributed throughout the grain mass. To obtain an effective fumigation the tablets should be as uniformly distributed throughout the grain mass as possible. In the example, distribution pattern as follows.

1) Divide the bin into ¼ sections.
2) Use 16 probes per ¼ section.
3) Dispense 15 tablets per probing at 15 cm. intervals.
4) Four sections with 16 probes each and 15 tablets per probe would dispense 960 tablets. The remaining 30 tablets should be scattered over the surface covered with a polyetheylene sheet.


16 probes per ¼ of bin
15 tablets per probe
at 15 cm. intervals

Appendix VI-7

WAREHOUSE SANITATION CHECK LIST

Name of Warehouse_____ Date_____

Location_____

Warehouse manager_____ Inspector_____

WAREHOUSE UTILIZATION

1. Products stored_____

2. Storage space: Capacity_____ Area_____

CONDITION OF WAREHOUSE PERIMETER

	Yes	No
1. Loading and unloading areas		
a. Accumulations of grain or grain products_____	___	___
b. Accumulations of debris	___	___
2. Weeds or tall grass present	___	___
3. Trash piles and junk present	___	___
4. Evidence of rodents (Burrows, etc.)	___	___
5. Birds nesting or roosting under canopies_____	___	___

MAINTENANCE OF WAREHOUSE EXTERIOR

	Yes	No
1. Canopies in need of repair	___	___
2. Holes in walls where bird can enter	___	___
3. Holes in walls at ground level to admit rodents	___	___
4. Do doors fit tightly when closed?	___	___
5. Broken windows present	___	___
6. Windows (open) without screens	___	___
7. Does roof leak?		

MAINTENANCE OF WAREHOUSE

	Yes	No
1. Do floor areas need cleaning?	___	___
2. Accumulations of debris, equipment or junk in warehouse	___	___
3. Do walls and/or overhead areas require cleaning?	___	___
4. Is rodent bait or broken glass on floors?	___	___

GRAIN STORAGE PRACTICES

1. Are grains stacked against walls?	___	___
2. Are grains stacked on floors?	___	___
3. Are stacks of grain less than 1 meter apart?	___	___
4. Are fertilizers, chemicals, pesticides or materials with strong odors stored next to grains?	___	___
5. Are broken bags of grain in stacks?		

INSECT CONDITIONS

1. Moths seen flying in warehouse	___	___
2. Insects or worms:	___	___
a. Crawling on floors	___	___
b. On outside of bags	___	___
c. In bags of grain	___	___
3. Insect tracks seen in dust	___	___
4. Explain any "YES" above.	___	___

_____

_____

_____

RODENT AND/OR BIRD CONDITIONS

1. Rodent pellets seen on floor or on bags	___	___

	Yes	No
2. Rodent chewed bags in stacks	___	___
3. Rodents seen in warehouse	___	___
4. Rodent tracks in dust	___	___
5. Bird droppings on floor or bags	___	___
6. Birds seen in warehouse	___	___
7. Explain any "YES" above.	___	___

_____

_____

_____

GRAIN HANDLING PRACTICES

1. Are all grains inspected when received at the warehouse?	___	___
2. Can warehouse personnel identify grain infesting insects?	___	___
3. Is grain fumigated when insects found?	___	___
4. Is grain fumigated when received for storage?	___	___
5. Do warehouse personnel report evidence of rodents, insects, and birds?	___	___

PEST CONTROL

1. Who performs pest control?_____

RECOMMENDATIONS

Republic of Zaire
National Economy Department

INTERDEPARTMENTAL DECREE NO. 0015/74
TO FIX THE PRICE OF CORN FLOUR

Commissaire d'Etat à l'Economie Nationale,
and
Commissaire d'Etat à l'Agriculture,

Considering the Constitution,

Considering the Executive order of March 20th 1961 concerning prices,

Considering the AE/13 decree of January 14th, 1964 concerning wholesale and retail cost price fixing for locally produced goods;

Considering the AE/023 decree of March 6th concerning fixing of cost prices for the industrial producer;

Considering the AE/422/0024 decree of October 7th, 1967 fixing the maximum purchase prices from producers of the harvested and cultivated products in Republic of Zaire;

Considering the AEI/422/0053 decree of March 18th, 1968 fixing maximum prices for imported and local products;

Considering the CAB/EN/0027/75 interdepartmental decree of June 22nd,1973 fixing minimum purchase prices from corn producer and peanut producer in the Republic of Zaire;

Reconsidering AEI/422/0054 decree of March 31st, 1968 concerning the wholesale selling price of corn flour coming from Zambia to Shaba region.

D E C R E E

Section 1 : The selling price of corn flour when leaving the flour mill is fixed as follows:

- Z. 80.80/ton

- Z. 4.65/60 kg in sack

Section 2 : Wholesale selling price is fixed to:

- Z. 91.60/ton
- Z. 5.50/60 kg in sack

Section 3 : Detail sale price is fixed to :

- Z. 108/ton
- Z. 0.11/kg.

Section 4 : AEI/422/0054 decree of March 31st, 1968 is repealed.

Section 5 : The present decree will be in force when signed.

Kinshasa, April 27th, 1974