worked out in the fourth five-year development plan (1979 - 1983) has aimed at securing the food self-sufficiency in the premise of the considerably high rate of population growth through the production increase by land improvement, expansion of arable lands, sufficient supply of fertilizers and quality seeds, and encouragement of intermitted cropping together with improvement and expansion of the storage facilities of the grains as staple food.

During the period of the third five-year development plan (1974 - 1978) the maize production had been increased sufficiently to enable the country to export; however, shortage in grain storage capacity had impelled the farmers to hold the crops in considerable amount in their own storages. Such increase in the grain stockpiles on the farms resulted in the farmers' reluctancy in grain production and furthered to decrease in growing acreages. To make the situation worse, the unfavourable weather gave another blow to the farmers in poor harvest to result in failure to attain the target in the former half of the fourth five-year development plan.

The agriculture of Kenya, as mentioned in Chapter 2, has been supported by three mainstays of maize, wheat, etc. as self-sufficient food, the industrial cash crops such as coffee, tea and pyrethrum and the animal husbandry.

The grain silos are proposed to be constructed at three major cities of marketing centers of the farm products in the west highlands, the granary of grains and industrial crops.

The major maize producing districts in the highlands are tabulated according to the average production for five years from 1977/78 to 1981/82.

	District		
1.	Trans Nzoia	1,928,000 bags	79%
2.	Nandi	1,662,000 bags	
3.	Kericho	1,527,000 bags	
4.	Bungoma	1,484,000 bags	
5.	Kakamega	1,184,000 bags	
6.	Uasin Gishu	1,160,000 bags	
7.	Kisii	1,129,000 bags	
8.	Nakuru	964,000 bags	
	Others	2,978,000 bags	21%
	Total	14,016,000 bags	100%

As learned from the above, almost 80 percent of the national maize production is covered by the highlands with these districts of Nakuru, Kisumu, Bungoma, Kericho and Kakamega.

The present maize yield per hectare is as low as about one ton. Although such poor yield is considered to be caused from insufficient fertilization and the recent unseasonable weather, the import of maize to Kenya will be required up to 1984 according to Table D-12 in Appendix D that was prepared as the forecast of the national demand and production by the Ministry of Agriculture.

Table D-12 in the Appendix D, however, indicates that the Government will take a policy to increase the maize production by yield increase from 1981 in learning the fact that the expansion of growing acreage is out of consideration.

The west highlands, being the granary of wheat as well, include Nakuru and Uasin Gishu district which produce about 66 percent of the national total wheat. The five-year averages of wheat production from 1976 in the highlands districts are tabulated as follows;

District		
Nakuru	567,586 bags	66%
Uasin Gishu	671,398 bags	
Narok	205,092 bags	34%
Central Kenya	204,711 bags	
Trans Nzoia	129,710 bags	
Nayandara	100,467 bags	
Total	1,878,964 bags	100%

(See Table D-2 in Appendix D)

3-4. Marketing Mechanism

3-4-1. Grain marketing

The handled amount in the market in the past bumper year, although largely exceeding two million tons per annum, had been only about 20 percent of the total production. The Government has decided every year the maize and wheat prices of procuring from the farmers and selling to the millers. The procurement and sales of these grains are exclusively made by the NCPB, the governmental organization, and therefore, the amount of the grains dealt with by the NCPB is the amount of the grain marketed.

Table D-4 in Appendix D indicates that the amount dealt by the NCPB in the bumper year of 1975/76 and 1976/77 was about 550,000 tons in purchase, while that in 1977/78 and 1978/79 was 230,000 tons, almost less than half of the former.

The decrease in handling amount by the NCPB had resulted from hesitancy in procurement due to shortage in storage capacity of the NCPB, and the NCPB's hesitancy caused an increase in large stockpiles on the farms to give a serious damage to the farmers. And the farmers, decreasing the maize production in the acreage in the following year, suffered again from very poor harvest by bad weather, and since 1978/79, both the productioin and the farmers' stockpiles of maize had been decreased gradually. On the other hand, the NCPB had been urgently requested to supply maize not only to the market but to the farmers and such a kind of demand allowed the NCPB to decrease the considerable amount of its stockpiles.

Increase in market demand by poor harvest and decrease in the NCPB's stockpiles have driven the country into the maize import country because the NCPB has had no further capacity to control the market to meet the increasing demand. This fact suggests that the maize market in Kenya has not been firmly established yet and the shortage in storage capacity of the NCPB is considered as one of the reason of this difficulty.

3-4-2. Storage capacity of the NCPB

The estimated storage capacity of the NCPB is about 7.57 million bags in total, including about 6.31 million bags for maize and about 1.26 million bags for wheat and the effective storage spaces will be available for about 6.81 milion bags, approximately 90 percent of the above estimated capacity.

The maize storage facilities are provided at 36 sites, where maize is sold to the millers, and there are three types of facilities specified by the uses; about 50 percent of the facilities for exclusive use for collecting the grains, about 20 percent for dual uses for collecting and selling, and 30 percent for exclusive use for selling. In Kenya, maize is grown once a year in the highlands extending with 1,000 m difference in elevation, and the different temperature and rainfall by elevations, in addition to the particular equatorial climate, have caused staggering in its harvest season, the peak of which has fallen in October to December, although harvestable throughout the year somewhere in the highlands. The staggering harvest of maize has permitted the storage facilities to have the turnover rate of 1.37 per year on an average by adjusting the stored maize from one storage to the other to meet the facilities' conditions. (See Table D-9 in Appendix D)

The estimation of the maize demand by non-farmer population (based on the previously quoted population growth rate) can be forecasted by about 8.16 million bags in 1985. For those years from now on, the expected expansion of marketing economic sphere will increase the NCPBs' handling amount by more than that the above estimation. However, since the turnover rate of the facilities is not expected to be raised more than 1.5 per year in taking into account the current situation, the expansion and increase in storage capacity is the prerequisites for staple supply of these grains in future.

3-4-3. Marketing system

When maize is stored in the farmers' own storages, the poorly provided facilities seemingly give losses or damages by 15 to 30 percent due to degradation in quality by rodents, insects and moisture whereas the storage in the NCPB's facilities has assumed to cause the losses and damages by about two percent. The current study, however, has found that even the NCPB's facilities, almost of them, have some defects in quality control to protect of damages by rodents and moisture.

Collection and sales of maize are the exclusive deal of the NCPB, but the KFA as the agency of the NCPB has been handling 50 percent of maize and 60 percent of wheat in collecting services.

The delivery of the grains has been made at the collecting depots of the NCPB properly, and transportation between the depots and the storage have been carried out by the NCPB. One collecting depot covers the farms located within about 20 km from the depot and transportation distance between the depot and the storage closest thereto is about 50 km. Commonly, trucks are used for transportation between the farms and the depots and between the depots and the storages, because most of all the collecting depots are located far from the railways, but not because the trucks are advantageous in the transportation rates. (Actually, the railway rates are relatively lower than those of the trucks).

The grains collected by the KFA are delivered to the NCPB at the commission of K.sh 3.5 per bag. The payment to the farmers, however, is made directly by the NCPB. Among 36 maize storage, more than 20 percent of them in number are not available in railway transportation, while the storage sites that are not available in railway transportation do not exceed 10 percent in capacity. Transportation between the storages or between a storage at growing area and a storage at consuming area, has been commonly made by railways. The grains are sold to the millers on the terms of delivery at the NCPB's storage and the freight is borne by buyers in principle. The milling

factories are concentrated in and around the urban areas and the capacity of factories around Nairobi and Nakuru is totaled to about 55 percent of the national capacity and reaches 70 percent, if adding the capacity available around Mombasa. The NCPB has transported the grains to the storages possibly close to the milling factories to meet their requirement in hauling about 80 km on an average by railways in most cases.

As mentioned previously, the Government has decided the prices for purchase from the farmers and sales to the millers involving the necessary cost of the NCPB, and furthermore, fix the standard selling price of the millers. The wholesale prices and the retail prices of flour, however, vary from one place to another due to difference in transportation cost from each other.

3-5. Storage and Milling Facilities

The NCPB possesses its own storages at 46 sites, of which those located at the large consuming cities like Mombasa and Nairobi have the capacity of 1.04 million bags in total, while other storages are located in the producting areas. Several storages located in the producing areas has been built almost 30 years ago and time-worn. These facilities, covering about 800,000 bags capacity, are planned to be converted to the storages for temporary storage of fertilizers and miscellaneous cereals. The use of these old storages for maize is uneconomical and loss-ridden in stored grains, although regular maintenance and repair have been made every year. These storages are mostly made in steel structure with galvanized-iron sheet roofing; some are built of wood. Those built around 1970 are made with reinforced concrete frame and slate roofing.

The concrete silo is provided at Nakuru, having capacity of 550,000 bags and another concrete silo for maize with 440,000 bags capacity is now under construction at Eldoret by Danish financial aid.

The grain storages are commonly used separately for maize or wheat, respectively, but in emergency, these storage are adequately converted to maize storage and/or wheat storage.

The present turnover rate of a storage is 1.37 per year on an average in the normal harvest years, while 1.5 in the bumper harvest years, respectively. The turnover rate of the storage in the consuming areas has become relatively high; for instance, the storages in Nairobi have been utilized five to six times a year. Most storage, which are conventional storage, should keep the paths and spaces for handling the bags. Consequently, the net storage spaces available are estimated at about 90 percent of the nominal capacity.

The present storage held by the NCPB are illustrated in details in Appendix and the summary is shown as follows:

	Maize and Miscellaneous Cereals	Wheat
Location	36 sites	10 sites
Nominal Capacity	6,309,000 bags	1,260,000 bags
Net Capacity (90%)	5,678,000 bags	1,134,000 bags

Among the above storages 16 storage (11 sites) are time-worn over 30 years, totaling their capacity to 831,000 bags. the breakdown of which is shown below.

Location	Stores No.	Capacity
Kitui	1	13,000
Kibwezi	1	40,000
Kipkelion	1	42,000
Kericho	1	14,000
Kisumu	2, 3 & 4	257,000
Mombasa	1 & 2	90,000
Meru	1	20,000
Kipkarren	1	45,000
Eldoret (Saporet)	1	100,000
Sagana	1	100,000
Bungoma	1, 2 & 3	110,000
Total		831,000

A greater part of maize and wheat stored by the NCPB has been sold to the private milling firms, and the milled products have been distributed on the markets. The major millers who are dealing with the NCPB have the milling capacity for wheat by 3.0 million bags in annual total (45.4 tons/hr) and for maize by 12 million bags in annual total (120 tons/hr). Therefore, the milling capacity for maize and wheat is considered sufficient in comparing with their consumption. Table D-11 in Appendix D shows the district-wise distribution of the maize warehouses and the millers, indicating the most of the millers concentrate around Nairobi.

CHAPTER 4. THE PROJECT

4-1. Purpose and General Plan of the Project

The rapid population growth and long-lasting unfavourable weather since 1976, had triggered to shake the food self-sufficiency system to result in being prone to social unstability. The agricultural production, however, has been gradually increasing since early 1981 by recovery of the weather conditions. Under the circumstances, it has become vitally important to formulate a project for expanding and constructing the grain storage facilities and for securing smooth and efficient marketing of the grain products so that the losses and damages of the staple food can be minimized. Such a grain storage project, although having been proposed by the NCPB since 10 years ago, has been given the top priority for implementation for the purpose of stabilizing the social security that has been disturbed these few years by collapse of the staple food self-sufficiency system.

First of all, the demand forecast for maize and wheat in Kenya has been made on the basis of the population predication prepared by Mr. Roushdi A. Henin, and the target years for the long-term and the short-term programmes are set up at 1990 and 1985, respectively. The summary of the forecast is illustrated as follows:

(Maize)		1977/78	1985/86	1989/90
Maize Production	(1,000 bags)	25,000	33,000	39,000
Population	(1,000)	14,596	20,400	24,506
Maize Consumer Ratio to Population		24%	30%	35%
Consumption	(1,000 bags)	4,593	8,160	11,436

(Wheat)		1977	1985	1990
Wheat Production	(1,000 bags)	1,900	3,500	5,000
Consumption	(1,000 bags)	2,131	3,060	3,465
Import		364	(Stockpile)	(Export)

(See Table D-12 and 13, Fig. D-1 in Appendix D)

At 1977, the actual handling amount of the NCPB was totally 6.8 million bags of grains, 4.6 million bags of maize and 2.1 million bags of wheat. The maize amount handled by the NCPB in 1980/81 was total to 7.27 million bags which is 2.4 million bags procured from the farmers plus about 4.87 million bags imported (see Table A-5 in Appendix A). In general the NCPB's handling amount has been increasing

year by year since 1975. The records on the maize production in the past suggests that maize was grown in the area of about 5.5 million hectares with average yield of about 1.0 ton/ha at 1976, and the cultivation area of maize has been decreased since 1976. In recent years, the cultivation area is increasing and the average yield is expected to raise up to 2.0 ton/ha. Therefore, the country is deemed to provide a considerably high potential in maize production.

Furthermore, the storage capacity increase will allow the NCPB to purchase a sufficient amount of maize from the farmers even in bumber cropping year, and this will give an incentive to the farmers for their maize growing. The procured maize in surplus will also serve as stockpile for emergency in poor harvest by unfavourable weather, etc.

Based on the above forecast, the NCPB can have the prospect to deal the grains of about 11.22 million bags including 8.16 million bags of maize and 3.06 million bags of wheat, respectively in approximation. Besides the above handling, the NCPB has planned to secure stockpile of maize by 2.0 million bags for stable staple food supply. The said stockpile is equivalent to thirty percent of the amount handled by the NCPB per annum. In future, the population increase will require to increase the stockpile amount of maize.

In taking the turn-over rate of the NCPB's storage by 1.37 at present, the necessary storage capacity is obtained by 11.22 million bags ÷ 1.37 = 8.20 million bags, and the above necessary capacity for routine handling plus that for stockpile will result in 11.0 million bags as the total necessary storage capacity to be held by the NCPB.

The Kenyan Government, setting the target year of the short-term programme at 1985, has endeavoured to make a plan to cope with the increasing food demand by means of the capacity increase as shown in the following table. The details are illustrated in Table D-14 in Appendix D.

Table 4-1 Capacity Increase Plan by Kenyan Government

A.	Present Capacity	
1.	Maize and other produce (including 750,000 bags for other produce)	6,309,000 bags
2.	Wheat	1,260,000 bags
	Total	7,569,000 bags
	Net Capacity (90%)	6,812,000 bags

B. Storage Requirement

1.	Maize		10,229,000 bags
	Dilapidated stores		831,000 bags
	Net Capacity (90%)		8,458,000 bags
2.	Wheat		1,815,000 bags
3.	Other produce		1,000,000 bags
	Sub-total		2,815,000 bags
	Net Capacity		2,534,000 bags
	Total of Net Capacity		10,992,000 bags
		say ≒	11,000,000 bags

C. Shortfall in Storage (Net)

1.	Total needed capacity	11,000,000 bags
2.	Present capacity	6,800,000 bags
3.	Shortfall	4,200,000 bags

In other words, the necessary storage capacity in 1985 was estimated at 11.0 million bags for maize, wheat and other cereals based on the forecasted population of the target year in 1985. These figures computed by the Kenyan Authorities concerned are considered reasonable.

The Government of Kenya has made a three-staged development plan to provide the storage capacity of 4.2 million bags; the first stage and the second stage aim at construction of facilities in the grain producing areas, while the third in the consuming areas.

Securing the staple food supply and smooth transportation of the grains will require to provided the storage facilities in the producing areas, while holding a good amount of stockpiles will require to provide them in the consuming areas.

A grain silo and storage are now under construction in Eldoret, the producing area, as the first stage plan, while the construction plan in this study covers the second stage of construction in the producing area as well. In the third stage, a plan has been contemplated to provide the facilities in Nairobi and Mombasa, the consuming urban areas, so as to consolidate the effective system for stockpiling the staple food and its smooth marketing.

As least from Table 4-1, the first stage plan covers the construction of storage with capacity of 40,000 bags and 50,000 bags respectively in Nwingi district and Loitokitok district both of which will be completed within 1981 and one silo and storages with capacity of 640,000 bags are now being constructed in Eldoret to be completed in 1982.

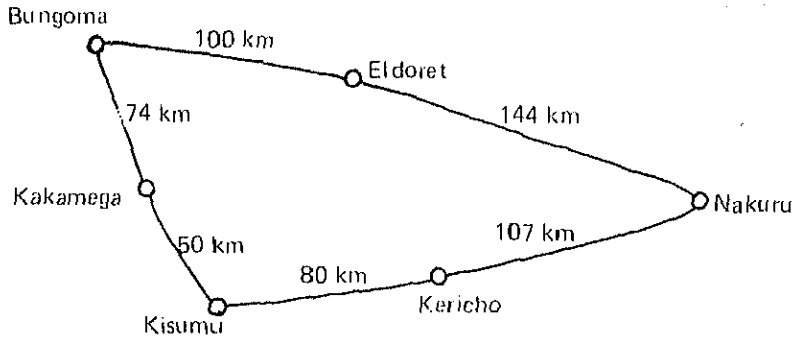
The second stage plan includes the silos construction at Bungoma, Nakuru and Kisumu, and the storage construction at Kakamega and Kericho. These facilities, which have been studied in this survey, will be completed by the middle of 1985. The details of the storage capacity of the above facilities are shown as follows:

Bungoma Silo	330,000 bags
Nakuru Silo	550,000 bags
Kisumu Silo	330,000 bags
Kakamega Storage	200,000 bags
Kericho Storage	200,000 bags
Total	1,610,000 bags

The third stage aims at providing the storage capacity of about 2,135 million bags by silos and storage, of which the silos will be constructed at Nairobi and Mombasa, the consuming area, with capacity of 950,000 bags in total and the storages in other 17 districts. The construction of these facilities will be completed in 1985.

The five sites proposed in this study are in the large municipalities surrounded by the granary of Kenya, and these municipalities are the trading centers of the farm products and other commercial goods in the rural areas. The above sites, excepting Kakamega which functions only as the grain collecting center, have been playing the vital roles as collecting and forwarding centers with necessary storage facilities provided. Nakuru, Bungoma and Kisumu are located in the eastern part, northwestern part and southwestern part of the granary, respectively. Kisumu has the third largest population of the country and Nakuru the fifth largest. And these two cities, where the national railways and the trunk highways are available, function as the commercial centers of the areas in trading the daily necessities, other consumers goods, farming materials and equipment such as fertilizers and seeds, etc.

On the other hand, Kakamega and Kericho, located in the middle between Bungoma and Kisumu and between Kisumu and Nakuru, have geographical relation ship shown as follows:



These storage facilities located in the granary the functional relations with one another for effective storage. Specifically, the facilities at Bungoma, Kisumu and Kakamega function organically, while those at Nakuru and Kericho do as well. The study on the capacity of these facilities in the above two blocks has required to obtain the grain production in the respective blocks. The data prepared by the NCPB carry the five-year national average of maize production from 1977/78 to 1981/82 by 14.0 million bags. The NCPB's estimate is considered to exclude those amounts of maize which have been harvested by the small-scale farmers and those of maize growers cum animal breeders, who have not been marketing their surplus.

On the other hand, the production indicated in the report of the National Food Policy, which was prepared by Ministry of Agriculture are 20.2 million bags in the same period as above. However, since the district-wise production has not been illustrated, the said figures were obtained by applying the district-wise ratios, being derived from the NCPB's figures, to these figures of the Ministry of Agriculture to tabulate as follows:

(Bungoma-Kakamega-Kisumu Area)

	NCPB Statistics	Estimates by Food Policy
Bungoma District	1,484,000 bags	2,141,000 bags
Brea District	276,400 bags	399,000 bags
Kisumu District	179,200 bags	259,000 bags
South Nyanza District	483,200 bags	697,000 bags
Kisii District	1,129,100 bags	1,629,000 bags
Kakamega District	1,185,600 bags	1,711,000 bags
Total	4,737,500 bags	6,836,000 bags

(Kericho-Nakuru Area)	NCPB Statistics	Estimated by Food Policy
Nakuru District	964,000 bags	1,391,000 bags
Baringo District	169,800 bags	245,000 bags
Narok District	202,920 bags	293,000 bags
South of Uasin Gishu District	580,000 bags	837,000 bags
Kericho District	1,527,440 bags	2,204,000 bags
Total	3,444,160 bags	4,970,000 bags

The population of the Bungoma Area is estimated at 4,420 thousand in 1980 as shown in Table B-1 in Appendix B, and that of the Nakuru Area at 1,730 thousand. When taking the maize growers population by 70 percent of the above total populations, field losses of maize by five percent, and annual consumption of per head by 120 kg/head, the family consumption of maize is estimated at 4,353 thousand bags for the Bungoma Area and at 1,695 thousand bags for the Nakuru Area.

Consequently, the amount of maize available in handling by the NCPB is estimated at 2,257 thousand bags in the Bungoma Area and at 2,977 bags in the Nakuru Area, when taking the total losses by 10 percent including losses at the fields and in marketing. Therefore, the necessary capacity for maize storage in the above areas is estimated at 1,647 thousand bags and 2,173 thousand bags, respectively, providing that the turn-over rate is 1.37 1/ per year.

The NCPB's storage capacity is absolutely short in availability in taking into account the present capacity of 567 thousand bags in the Bungoma Area and 429 thousand bags in the Nakuru Area.

Under such critical situation, the NCPB has planned to increase the storage capacity by 1.61 million bags in these areas to total 2,606 thousand bags. The district-wise planned capacity is tabulated as follows:

	Bungoma Area	Nakuru Area
Amount available in Marketing	2,257,000 bags	2,977,000 bags
Present capacity	567,000 bags	429,000 bags
Planned capacity	1,427,000 bags	1,179,000 bags
NCPB's Handling Amount (turn-over rate = 1.37) 1/	1,955,000 bags	1,615,000 bags

Note: 1/ The turn-over rate 1.37 is estimated from present condition of Nakuru, Bungoma and Kisumu silos, but the mean turn-over rate in Kenya whole storage is 1.5.

The NCPB has designed to increase the turn-over rate of the storage facilities by annual average 1.6 in the Bungoma Area and 2.5 in the Nakuru Area close to the large consuming area of Nairobi, through providing the silos in the consuming areas.

When the above target rate is realized, the handling amount will be increased to about 2.2 million bags in the Bungoma Area and about 3.0 million bags in the Nakuru Area, while the field losses and damages will be decreased to a large extent.

The proposed storage sites are characterized by specific features as follows.

a) Nakuru

Although Nakuru, located in granary of maize and wheat, played as the storage for collected products, it has recently its characters into storage for consumption and/or buffer stocking. The transportation facilities available in Nakuru are the trunk road connecting Nairobi and the western districts and the industry side-track which provide a favourable condition for handling the products. Nakuru, the five largest city in Kenya, is one of the biggest trading center of maize and wheat, and will require to increase the storage capacity of maize with demand increase in future.

b) Bungoma

Bungoma, playing a role as a maize granary in the western districts, has been a developing city, and characterized as storage site for collecting products. The transportation facilities available are the trunk road leading to Nairobi and Mombasa as well as the industry side track. Bungoma has experienced to handle a larger amount of grains than its capacity and is now required to increase the storage capacity to meet growing handling amount.

c) Kisumu

Kisumu, located on the shore of Lake Victoria in the Nyanza district, has the dual characteristics as storage for collecting and consumption. Kisumu, being the third largest city in Kenya to Mombasa and Nairobi, has a large potential of grain consumption judging from the activities of the local millers. The transportation facilities available are the trunk roads connecting Kisumu, one of the cover stone of the transportation networks, with the central districts (Nakuru, Nairobi), the western district (Bungoma) and the area on the shore of Lake Victoria, and the industry side-track. Kisumu, as well as the above cities, is required to increase the handling capacity, in the Nyanza district and the southern part of the western district.

d) Kakamega

Kakamega, located between Bungoma and Kisumu, the center of grain producing area, is expected to play a role as the storage for collecting the products, although no storage are provided therearound at present. The transportation facilities available are the trunk road leading to Nyanza and the western districts only, but no railways available.

e) Kericho

Kericho is located at the crossing point to Kisii between Kisumu and Nakuru, and expected to serve as the storage for collecting grains, since being in the middle of the granary. The transportation facilities available are the trunk road linking with the central district, but no railways available at present. A plan is made to construct a industry side-track for the grain transportation.

The above description is the outline of the conditions the proposed sites, which suggests that the availability of well-functioning transportation facilities or the railways will be essential for securing the stable forwarding the large consuming districts like Nairobi, Mombasa, etc. and the smooth receiving the grain cargoes sent out of the storage in the producing areas. Furthermore, Kenya, having hundred percent dependency of oil on import, would have to reduce dependency of long-distant transportation or trucks which mean large oil consumers. Under the circumstances, three proposed silo construction sites, Bungoma, Nakuru and Kisumu, out of the five, are most suitable to provide the modern large capacity storage facilities in due consideration of their availability of railway facilities.

4-2. Storage

4-2-1. Determination of Type of Storage Facilities

The storage capacity of the proposed three silos has been decided as follows in the previous paragraph.

Location	Capacity
Bungoma	330,000 bags
Nakuru	550,000 bags
Kisumu	330,000 bags

The Project has taken up two types of facilities, conventional storage and silo, among many, and these two have been compared with each other in various respects and summarized as follows:

Item	Silo	Conventional storage
Necessary Lot	small	large
Foundation Treatment	required	little required
Air-tightness	favourable	unfavourable
Storage efficiency	large (100%)	small (90%)
Operation/management	easy	relatively difficult
Workability	easy	difficult
Losses & damages in Storage	small	large
Fumigation	easy	difficult
Construction cost	large	small
Quality control	easy	a little difficult

The comparison indicates that the silos, excepting only for expensiveness in construction cost, are recommendable as the grain storages, but the construction cost ratio to the unit amount of the stored grains is higher in the small-scale silos than in the large-scale silos, even the said ratio is higher in the small-scale silos than in the conventional storages with the same capacity that the silos have.

Therefore, silos are used for long storage of a considerably large amount of grains, while conventional storages for short storage of a relatively small amount.

The proposed facilities in the Project, which require a long storage of a considerable amount of grains, are planned with the silos.

4-2-2. Determination of Capacity of Silo Bins

The net content of the silos should be estimated in taking into consideration the weight per unit volume of the grains and the space to be kept in the upper part of the storage bin. The grains to be stored in the proposed silos are maize which has the estimated specific weight in bulk of 0.73 ton/cu.m with moisture content of 12.5 percent. The grains thrown into the upper mouth of silos will be piled up in the form of circular cone. Consequently, the some space should be kept in the upper part of the bins to maintain the conish pile-up of the grains. The clearance between the grain surface and the ceiling of silos varies with the diameters of the silos.

For circular bottle type silos, the clearance should be over a third of the silo diameter. The following table shows the net storage capacity of the proposed silos.

Location	Capacity			
	Bag	Weight 1/	Volume 2/	Total Capacity
Bungom	330,000	30,000 tons	41,100 cu.m	46,500 cu.m
Nakuru	550,000	50,000 tons	68,500 cu.m	77,300 cu.m
Kisumu	330,000	30,000 tons	41,100 cu.m	46,500 cu.m

Note:- 1/ Capacity by weight ≒ Capacity by bags x 0.09 ton/bag
2/ Capacity by volume ≒ Capacity by weight ÷ 0.73 ton/cu.m

On the other hand, the net receiving period of harvested grain was estimated at 150 days for six months from October to March. According to the above estimation, the average receiving amount of grains at the respective silos was computed as follows.

Silo	Daily Average Receiving Weight	Daily Average Receiving Volume
Bungoma	300 ton/day	411 cu.m/day
Nakuru	500 ton/day	685 cu.m/day
Kisumu	300 ton/day	411 cu.m/day

The aggregate of circular bins type is recommended in the Project considering its advantage in the structure and the construction cost. The aggregated circular bins type has an advantage in using the spaces as storage, which are provided among the contacted bins. The numbers of the space bins created in the aggregated circular bottles type silos can be computed by the following equation with the total number of the bins and the number of the row.

$$N = \frac{n - 1}{n} (m - n)$$

where,

N = number of space bins
m = total number of bins
n = number of rows of bins

On the other hand, the ratio of the area of the circular bins and the area of the space storage is, although varies from the diameter of one bottle to that of another, approximately three to one (3 : 1)

The capacity of circular bin type should be determined on the following factors.

i) Relationship between circular bottles and the space bins,
ii) Daily average receiving amount,
iii) The total capacity of silos
iv) Areal size of construction site, and
v) Construction method

According to the following reasons, however, the Project has determined the capacity of the respective silos by 3,600 cu.m (about 2,630 tons equivalent) with the silo diameter of 12.0 m.

i) There will be some difficulty in the construction site of Nakuru in long strip shape which will not permit a large diameter silo bins, although no problem with other two sites.

ii) The sliding form construction method is commonly used in Kenya for high-rise structure; hence, the use of the same sliding forms for the same diameter silo bin has a great advantage.

The above factors have result in determing the dimensions of the respective silos as follows:

				Circular Bottle	
Silo	Total Capacity	Bin Dia.	Height	Total No.	No. of Row
Bungoma	46,500 cu.m	12.0 m	40 m	10	2
Nakuru	77,300 cu.m	12.0 m	41 m	16	2
Kisumu	46,500 cu.m	12.0 m	40 m	10	2

And the circular bins and the space bins will have their own capacity as follows:

Silo	Total Capacity	Capacity per Circular Bin	No. of Row	Capacity per Space Bin	No. of Space Bins
Bungoma	46,500 cu.m	3,600 cu.m	10	1,300 cu.m	4
Nakuru	77,300 cu.m	3,720 cu.m	16	1,330 cu.m	7
Kisumu	46,500 cu.m	3,600 cu.m	10	1,300 cu.m	4

4-2-3. Wet Bins

The wet bins function to temporarily store the high moisture content maize immediately after receiving from the farmers and running stocks for proceeding to the drying process. The capacity of the wet bins in the Project was proposed as follows:

Silo	Capacity	
	Weight	Volume
Bungoma	60 ton x 6 bottles	82 cu.m x 6
Nakuru	100 ton x 6 bottles	137 cu.m x 6
Kisumu	60 ton x 6 bottles	82 cu.m x 6

The wet bin capacity was estimated on the basis of the average grain amount to be received per day plus one bin in surplus.

One type of sliding forms should be used for constructing all the wet bins that will have the same cross-section as each other. The bins' diameter will be 3.8 m. And the dimensions of the wet bins are shown below.

Silo	Bin Dia.	No. of Bins	Bin Height	Capacity per Bin
Bungoma	3.8 m	6	12.5 m	86 cu.m
Nakuru	3.8 m	6	17.0 m	137 cu.m
Kisumu	3.8 m	6	12.5 m	86 cu.m

4-2-4. Construction Materials of Proposed Silos

The construction materials of the main bins of the circular type silos and the wet bins were determined by alternative study of the cast-in-place reinforced concrete and the steel plate in taking the height, size, etc. of the silos into account. The results of the comparative study on the merits and the demerits of the respective materials are tabulated as follows:

	Cast-in Place	Steel Plate
Weight:	Heavy	Light
Cost of Foundation Treatment	Expensive	Economical
Purchase Availability	Local purchase available for most materials	Import
Moisture Absorption	Provided	Not Provided
Thermal Insulation	High	Low
Air-tightness	Relatively low	High
Corrosion	Least corrosive	corrosive
Operation & Maintenance (O & M)	Less needed	Needed
O & M cost	Unexpensive	Expensive

Purchase availability and O & M among the above items should be noted in particular. Except the reinforcing bars and the forms which may have to be imported, the necessary materials are locally available for the cost-in-place reinforced concrete, whereas purchase is fully dependent upon the import for the steel plate silo.

In the respect to the O & M, the intensive O & M services is essentially required for corrosion prevention for the steel plate silo which will cost huge amount of money, whereas the least O & M services are necessary for corrosion prevention for the cost-in-place reinforced concrete silo which will require little cost.

The above comparative study has resulted in adopting the reinforced concrete for the proposed silo construction, which will be carried out in the cast-in-place method.

The structure of the main bins and storage bins are illustrated in the drawings attached hereto.

4-2-5. Foundation

The expected load per square meter to the reinforced concrete silo with the designed full amount of maize would be about 30 tons, which the foundation piles should be provided to bear on the firm foundation. Further geological study is required to determine the diameter, length and strength of the piles, and depths of firm foundation at the proposed sites, which is essential for the preliminary design of the structures, have been estimated as follows from the topographical conditions and the foundation treatment observed on the buildings around the sites.

Silo	Depth of Firm Foundation
Bungoma	Approx. 10 m
Nakuru	Approx. 10 m
Kisumu	Approx. 25 m

The foundation piles are recommended with the following three kinds;

1. Cast in place reinforced concrete pile
2. Pre-cast concrete pile (PC pile, RC pile)
3. Steel pile

Among the above, the pre-cast concrete piles cannot be adopted in the Project because the said piles will have to be imported since no manufactures are available in Kenya and the imported piles are more costly than the cast-in-place reinforced piles.

And then, comparison of the cast-in-place reinforced concrete piles with the steel piles has resulted in that the former is suitable for piling shorter than 20 m, while the latter for longer piling than 20 m, although the steel piles are unfavourable in driving through the gravel layers for reaching the firm foundation. Therefore, the cast-in-place reinforced concrete piles are to be employed for the sites of Bungoma and Nakuru, while the steel piles for the site of Kisumu.

Permanent allowable bearing capacity of a pile can be computed by the following equation in considering the bearing capacity only in the negligence of the friction of the pipe,

$$Ra = 1/3 \times 30 \times N \times Ap$$

When taking N-value by 40 and pile diameter by 800 mm,

$$Ra = 1/3 \times 30 \times 40 \times \left(\frac{0.8}{2}\right)^2 \times \pi = 201.0 \fallingdotseq 200 \text{ ton/p'ce.}$$

The total load of a silo should be taken as the sum of the weights of construction materials by reinforced concrete and the maize stored in silo. The total weight in the respective silos is tabulated as follows;

Silo	W't of Reinforced Concrete	W't of maize Stored	Total W't
Bungoma	7,500 cu.m x 2.4 = 18,000	30,000	48,000 ton
Nakuru	12,200 cu.m x 2.4 = 29,280	50,000	79,280
Kisumu	7,500 cu.m x 2.4 = 18,000	30,000	48,000

The necessary number of piles for each silo can be computed by dividing the total weight of a silo by permanent allowable bearing capacity of one piece of pile. And the computation results for the respective silos are shown as below.

Bungoma Silo	48,000 ÷ 200 = 240 pieces ≒ 250 pieces
Nakuru Silo	79,280 ÷ 200 = 397 pieces ≒ 400 pieces
Kisumu Silo	48,000 ÷ 200 = 240 pieces ≒ 250 pieces

As a result, the cast-in-place concrete piles with 800 mm diameter are to be used for the sites of Bungoma and Nakuru, while the steel piles with 800 mm diameter and 12 mm thickness for the site of Kisumu.

4-2-6. Aseismatic Structures

There were no data and information on earthquake in Kenya available. The proposed silos, however, should have the aseismatic structures in taking into account

the fact that the Rift Valley runs through the African continent and many dead/dormant volcanos exist around the proposed sites. The data for driving the necessary seismic coefficient for designing of the aseismatic structures were not available in Kenya; consequently, the coefficient of the shear strength for seismic zones, which has been employed in the revised law of building standards in Japan. was used in the following computation.

$$Ci = Z \cdot Rt \cdot Ai \cdot Co$$

Z = Coefficient the seismic zone ..... 0.7 (Okinawa Pref.)

Rt = Coefficient of tremor charachteristics .... $\frac{1.6 \times 0.6}{1.2} = 0.8$

T = 40m x (0.02 + 0.01 x 100) = 1.2

The firm foundation in the Project to be taken as the second rank in the classification. Tc = 0.6

Ai = Distribution coefficient of shearing coefficient in the seismic zone... 1

Co = Standard shearing coefficient 0.2

Ci = 0.7 x 0.8 x 1.0 x 0.2 = 0.112

Japanese laws and regulations on the aseismatic structures for the buildings are known well as one of the most stringent laws, because Japanese archipelago lies on one of the world famous earthquake belt. The above value can be said by the minimum that the Japanese laws require.

As mentioned previously, since no data were available on the earthquakes in the Project sites, the minimum volues of Ci = 0.11 that the Japanese laws of building standards requires, is adopted in taking into account the local conditions.

In the detailed design stage, not only the data on the local earthquakes should be collected as many as possible but also the computer-aided thorough calculation should be carried out for securing technical soundness of the silos.

4-3. Facilities

4-3-1. Basic Conditions

As a result of the site surveys on various matters, the following basic conditions have been established for the definite project plan.

(a)	Location	Bungoma Silo	Nakuru Silo	Kisumu Silo
(b)	Variety	Maize	Maize	Maize
(c)	Quantity of storage	30,000 ton	50,000 ton	30,000 ton
(d)	Total quantity to be processed	45,000 ton	75,000 ton	45,000 ton
(e)	Harvesting period	Oct. – Mar. (180 days)	Oct. – Mar. (180 days)	Oct. – Mar. (180 days)
(f)	Receiving period	Oct. – Mar. (180 days).	Oct. – Mar. (180 days)	Oct. – Mar. (180 days)
(g)	Actual receiving day	180days x 0.8 1/ ≒ 150 days	180days x 0.8 1/ ≒ 150 days	180days x 0.8 1/ ≒ 150 days
(h)	Moisture raw	15%	15%	15%
	processed	12.5%	12.5%	12.5%
(i)	Forwarding days	250 days	250 days	250 days

Note) 1/ 0.8 is efficiency due to rainy day, sunday, etc.

4-3-2. Equipment Capacity

(a) Receiving capacity

(i) Receiving quantity per day

Bungoma & Kisumu silo: 45,000 ton/150 days = 300 ton/day

Nakuru silo: 75,000 ton/150 days = 500 ton/day

(ii) Receiving quantity per hour

Working hours = 8 hr, working efficiency = 0.8

Bungoma & Kisumu silo: 300 ton/8 hr/0.8 ≒ 50 ton/hr

Nakuru silo: 500 ton/8 hr/0.8 ≒ 80 ton/hr (40ton/hr x 2 lines)

(iii) Pre-cleaner capacity

Bungoma & Kisumu silo: 50 ton/hr x 1 set

Nakuru silo: 40 ton/hr x 2 sets = 80 ton/hr

(b) Drying capacity

Pre-cleaned maize is to be received in wet bin

(i) Type of dryer: Vertical continuous flowing type

(ii) Basic drying process

Reducing moisture 15% - 12.5% = 2.5%

Working hours 10 hr

Receiving and emptying 2 hr

Total 12 hr

Dryer capacity

Bungoma & Kisumu silo: 300 ton/10 hr = 30 ton/hr

Nakuru silo: 500 ton/10 hr = 50 ton/hr

(c) Forwarding capacity

(i) Forwarding quantity per day

Bungoma & Kisumu silo: 45,000 ton/250 days = 180 ton/day

Nakuru silo: 75,000 ton/250 days = 300 ton/day

(ii) Forwarding quantity per hour

Working hours = 8 hr, working efficiency = 0.8

Bungoma & Kisumu silo: 180 ton/8 hr/0.8 ≒30 ton/hr

Nakuru silo: 300 ton/8 hr/0.8 ≒50 ton/hr

(iii) Cleaner and scale capacity

Bungoma & Kisumu Silo: 30 ton/hr x 1 set

(Bag-forwarding capacity = 150 Bags/hr x 2 sets = 300 Bags/hr)

Nakuru silo: 50 ton/hr x 1 set

(Bag-forwarding capacity = 150 Bags/hr x 2 sets = 300 Bags/hr)

(These data are shown in Table 4 - 2)

Note: The two or three shift can be employed to cover the peak time requirements for handling of the grain through increase in daily processing capacity as following estimation.

i) Forwarding quantities per day at maximum

Bungoma & Kisumu silo: 50 ton/hr x 12 hr = 600 ton/day

Nakuru silo: 80 ton/hr x 12 hr = 960 ton/day

ii) Drying quantities per day at maximum

Bungoma & Kisumu silo: 30 ton/hr x 20 hr = 600 ton/day

Nakuru silo: 50 ton/hr x 20 hr = 1,000 ton/day

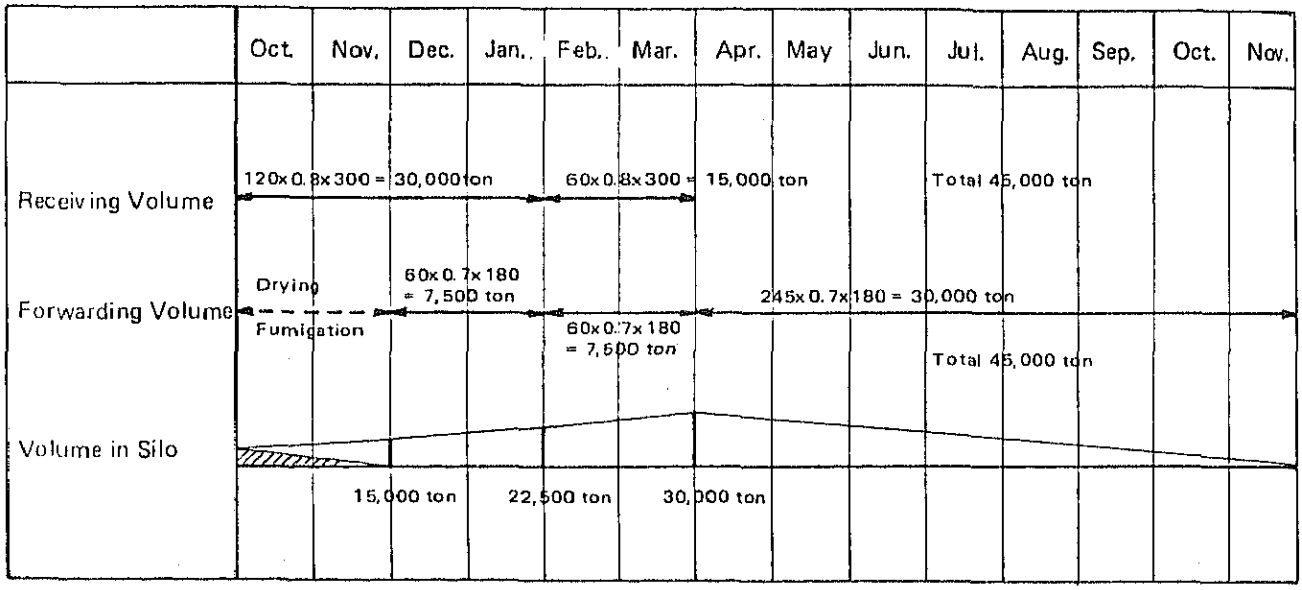
iii) Forwarding quantities per day at maximum

Bungoma & Kisumu silo: 30 ton/hr x 12 hr = 360 ton/day

Nakuru silo: 50 ton/hr x 12 hr = 600 ton/day

(d) Working Process

(i) Bungoma & Kisumu Silos



(ii) Nakuru Silo

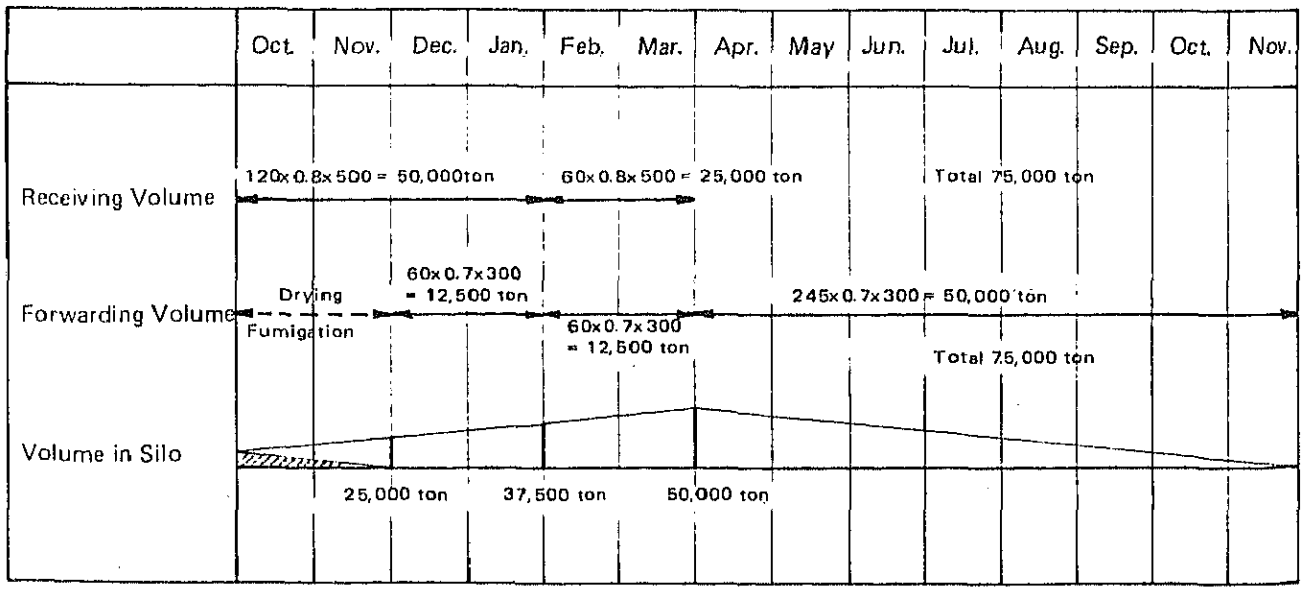


Table 4 - 2 Basic Data and Capacity of Equipment

	Location	Bungoma Silo	Nakuru Silo	Kisumu Silo
(a)	Crop	Maize	Maize	Maize
(b)	Quantity of storage	30,000 ton	50,000 ton	30,000 ton
(c)	Total quantity to be processed	45,000 ton	75,000 ton	45,000 ton
(d)	Harvesting period	Oct. - Mar. (180 days)	Oct. – Mar. (180 days)	Oct. – Mar. (180 days)
(e)	Receiving period	Oct. – Mar. (180 days)	Oct. – Mar. (180 days)	Oct. – Mar. (180 days)
(f)	Actual receiving days	180days x 0.8 ≒ 150 days	180days x 0.8 ≒ 150 days	180days x 0.8 ≒ 150 days
(g)	Moisture raw	15%	15%	15%
	final	12.5%	12.5%	12.5%
(h)	Forwarding days	250 days	250 days	250 days
(i)	Receiving quantity per day	300 ton/day (600 ton/day	500 ton/day 960 ton/day	300 ton/day 600 ton/day max.)
(j)	Receiving quantity per hour	50 ton/hr	40 ton/hr x 2sets = 80 ton/hr	50 ton/hr
(k)	Drying capacity	30 ton/hr	50 ton/hr	30 ton/hr
(l)	Forwarding quantity per day	180 ton/day (360 ton/day	300 ton/day 600 ton/day	180 ton/day 360 ton/day max.)
(m)	Forwarding quantity per hour	30 ton/hr	50 ton/hr	30 ton/hr
(n)	Bags-forwarding quantity per hour	150 Bags/hr x 2sets = 300 Bags/hr	150 Bags/hr x 2sets = 300 Bags/hr	150 Bags/hr x 2sets = 300 Bags/hr

4-3-3. Measurement Equipment for Receiving Grains

The measurement equipment is required for weighing the lots delivered from the individual farmers. For weighing materials with such a large amount as in grain storage two methods are considered.

(a) Weighing by Truck Scale

(b) Weighing by Hopper Scale

In Truck Scale, a loaded truck is weighed at first before receiving and then, the empty truck is weighed after unloading. The difference will be the net delivered weight of the materials accordingly. The advantage of this method is the simplicity in handling when traffic is congested for receiving, because the scale is installed outside the buildings. This method, however, has a disadvantage in rather inferior accuracy to that of Hopper Scale on account of heavier weight in each measuring.

On the other hand, in Hopper Scale, the total net weight is obtained by adding up each lot of 500 kg to 1,000 kg, which is weighed separately on each lot after cleaned. This method keeps more strict accuracy than that of Truck Scale, but requires much time and complicate in handling, because the scale is required to be installed inside the buildings and moreover, each lot must be checked separately into the scale upon receiving. In view of the above, the truck scale of 60 ton capacity with automatic printer is recommended for the project.

4-3-4. Receiving Equipment

(a) Receiving hopper

The hopper is equipped for receiving maize weighed by truck scale. The underground hopper is recommended in order to facilitate the receiving work. It is also desirable that a dust collecting equipment is installed to keep the working environment clean and hygienic.

Since the receiving capacity of Bungoma and Kisumu silos is 50 ton/hour, one receiving line will do enough for the purpose. In this case, however, the receiving hopper should have two cells so that two trucks may discharge maize into the hopper simultaneously for increasing the working efficiency. Each cell of the hopper is required having 15 ton capacity to a truck load, so that the hopper capacity may hold 30 tons. (15 tons x 2 = 30 tons)

The receiving capacity of Nakuru silo is as large 80 ton/hour and some receiving congestion is expected to cause trucks idling in a row, due to small scale receiving sections.

Accordingly, the project plans to install two lines with two hoppers to secure high working efficiency that facilitates the successive works with the separate receiving of dry grains and wet grains. Each hopper is required having 15 ton capacity so that the four hoppers may hold 60 tons in total. (15 tons x 4 = 60tons)

(b) Cleaner

The cleaner is for removing foreign matters included in grain received. Such foreign matters usually are corncob, chaff, dust, etc. and it is an essential process to remove them from the received grain in order to clean the grains for marketing. To remove the foreign matters, corncob is separated by scalper and then lighter matters such as chaff, dust, etc. are blown off by aspirator. The project plans to use provide such cleaning devices for the purpose.

4-3-5. Wet Bin Equipment

Wet bin is used for temporary storage of received grain and running stocks for drying process. The project plans to install receiving bin separately in consideration of sub bin being intended also for storage.

The moisture content of received grain usually varies widely from one lot to another. In order to avoid the storage of grains in mixture with different moisture content, it is necessary to provided many small bins for separate storage by extents of moisture arranged about three percent difference. The project plans to install six bins of 60 tons for Bungoma and Kisumu-silos and six bins of 100 tons for Nakuru silo.

4-3-6. Drying Equipment

The drying equipment, which plays most important role in the Project, is essential to keep the longer life of the grains (maize) in the storage. For such dryers as requiring a large capacity, continuous flow type dryer is recommended, although various types of dryers are available. The continuous flow type dryer is classified into the following three types according to its structure.

(a) Vertical screen columns type
(b) Baffled columns type
(c) Inverted troughs type

Any of the above three types of dryers is used for large drying and storing facilities in Japan, having their own advantages and disadvantages, respectively. In most cases under the Project, one pass of the dryer will permit to reduce the grain moisture contents to the required level because the moisture content of the received grains is expected to be as low as 15 percent, whereas two passes of the dryer may be necessary for the grains harvested in the rainy weather. Accordingly, the Project adopts the Inverted Troughs Type Dryer, which is expected to assure the uniform drying even by one pass of the dryer.

Diesel light oil may be used as the fuel for the equipment and the fuel tank of 10 kℓ capacity will be installed. The existing receiving and drying equipment in Bungoma will be used for the grains to be stored in conventional storage available at present. Therefore, the project require to provide such new facilities as receiving, drying and forwarding in addition to the silo.

4-3-7. Cleaning and Weighing Equipment

The foreign matters in the grains, which have their own moisture to some extent, cannot be removed completely only by the precleaner. As the drying and the rotation works proceed, the moisture content of the foreign matters will be removed considerably. At the same time, however, another matters and dust will be mixed in. Before weighing and forwarding, therefore, the grain must be cleaned grains again after these processes. In this case, the cleaner of the same kind as used in receiving section will serve for the purpose. However, another cleaner will be required independently from the pre-cleaner in view of working efficiency and reduce in complexity of handling. Weighing before forwarding is absolutely necessary for ascertaining the quantity to be forwarded and stored. A simple manually weighing equipment may be considered, which, however, an operator will be exclusively occupied. Although such a manual weighing equipment may be enough for the time being, the automatic hopper scale with auto-sampler is highly recommended in due consideration of the future development. Samples taken from the grains by auto-sampler will be inspected in various respects.

As for the weighing and the forwarding equipment, it is recommendable that two sets of 90 kg weighing scale, packing machine and conveyer for loading be also installed for forwarding in bags.

4-3-8. Temperature Measurement Device in Silo

The grain moisture content and storage temperature are the important factors for quality control of the grains. The high temperature and high moisture content accelerate breathing of grains of cause occurrence of microbes and harmful insects. Such phenomenon, if remarkable, may result in high temperature in silos and grain fermentation, which deteriorate the quality of the grains. Thermometers should be provided in silos so that the silo temperature can be observed from time to time, and when the temperature rises, the rotational operation of the silos should be made for moving the grains to the other silos for lowering the grain temperature. The eight observation points should be set up along the vertical center line of the silo with a transfer device controlled by a centralized control panel.

4-3-9. Fumigation Equipment

Most of the losses during the storage may be caused by vermin, which must be exterminated by any of the following methods.

(a) Methyl bromide Fumigation
(b) Malathion Spraying
(c) Phostoxin Tablet

Fumigation by methyl bromide is most efficacious of the above three.

4-3-10. Remote Control Device

The following three operating systems are available for such large scale drying and storing facilities as in the Project.

(a) Manual control - The device is operated locally by operators' discretion.

(b) Semi-automatic control - Operation is carried out by operators' discretion with the remote control system which indicates the process on the control panel.

(c) Automatic control - The fully computerized system with the necessary data input all operation as well as discretion is automatically carried out. In this case, only a few operators will be enough for the purpose.

The main purpose of adopting automatic or semi-automatic control system is to save personnel expenses as well as to minimize the possible operators' errors.

The manual control system will serve enough for the present so far as it is rather easy to employ the necessary operators. However, it would be recommendable to adopt the semi-automatic or the full automatic control systems in view of the general trend of labour shortage with the economy growth in Kenya and also for the effective measure for reducing possible human errors in operation. In any case, a thorough investigation should be made before implementation stage to select the system most suitable to the local conditions in various aspects.

4-3-11. Inspection

Inspection before receiving, which is carried out by sampling and testing in various aspects for the grains hauled by farmers into the receiving hopper, plays a vitally important role to grade the grains for pricing for purchase from the farmers.

The following equipment or instrument are required for successful inspection.

(a) Moisture meter
(b) Weighing scale
(c) Divider
(d) Sieve
(e) Grain cleaner

4-3-12. Dust Collecting Equipment

The received grain contains various dust and moreover, drying process may raise much dust. Accordingly, collecting dust is necessary at all stages of processing from the hygienic viewpoint of the operators as well as of good maintenance of the machinery, especially from the following facilities.

(a) Receiving Hopper
(b) Bucket Elevator
(c) Chain Conveyor
(d) Pre-cleaner and Cleaner
(e) Scale
(f) Flow Control Tank

4-3-13. Maintenance Equipment

Proper maintenance is indispensable for successful operations and due performance of the machinery. A machine is sometimes subject to mechanical trouble, for which quick repares are needed. For such maintenance, main instruments required are enumerated as follows:-

(a) Electric Welder
(b) Gas Cutter
(c) Grinder and Baby Sander
(d) Vise
(e) Tools and Tool Box
(f) Shelf for Tools
(g) Charing Box of Parts
(h) Working Table
(i) Stock Yard
(j) Others

A regular training for the operators as well as the manager of the silo is also essential. The major training items are as shown below, along which a sufficient study is required.

(a) The Theory of Grain Drying
(b) The Management of Grain Storing
(c) Controls on Poisonous Substances
(Such as Methylbromide, Phostoxin, etc.)
(d) The Handling of Dangerous Objects
(e) Operation of Machines and Maintenance Methods
(f) Countermeasures of Mechanical Trouble and its Repairs
(g) Prevention of dust explosion

4-4. Project Cost Estimate

The total investment cost, not including the interest to be generated during the construction period, is estimated at 433,274 thousand Kenya shillings, equivalent to 11,468.8 million Japanese yen, of which 324,912 thousand Kenya shillings (8,600 million Japanese yen) will be foreign currency component. Table 4-3 shows the breakdown of the investment cost by major items and their details are given in Table E-1 in Appendix E. The annual disbursement schedule for the investment cost is shown in Table 5-4.

The Project cost estimates were made in the following manners;

i) Foreign and Local Currency Component

(a) Materials

The cost of the following materials is devided into two portions of foreign and local currency as shown below:

Percentage of Foreign and Local Currency

Materials	Foreign Currency	Local Currency
Cement (FOR)	50%	50%
Deformed Bar (CIF)	100%	0%
Steel Pile (CIF)	100%	0%

(b) Formworks of Silos

The sliding form will be used for formworks of the silos. The foreign currency will fully cover the cost for the sliding form, since the sliding form will be imported.

(c) *Depreciation of Construction Equipment*

The depreciation cost for construction equipment was considered to be

disbursed totally from the foreign currency; however, the depreciation cost is computed on the basis of working hours only.

(d) Expenses of the Contractor, Other than the Direct Cost

Since the foreign contractor might be employed the relevant expenses were estimated by foreign currency in 100 percent.

(e) Silo Facilities

The cost of the silo facilities will be covered totally by foreign currency because those facilities will be imported.

ii) Civil, Building Work and Silo Facilities

The Project cost estimate was made based on as follows;

(a) The unit cost of local materials is based on the price of materials in Kenya as of July of 1981.

(b) For materials and depreciation of construction equipment to be imported, the cost in Tokyo, Japan, as of July of 1981 was adopted. Inland transportation rate is included; however, custom duty and import tax are to be exempted.

iii) Administration Cost

This is the cost of Project operation by the NCPB; including the following expenses:

(a) The management expenses for Contractor & Consultants,

(b) The expenses for importation of material, equipment, silo facilities, etc.

(c) The expenses for disbursement (openning fee of Letter of Credit, direct satury of officers in charge, etc.), and

(d) Other expenses related to the Project implementation.

iv) Consulting Services

Engineering fee for consulting services covers the implementation of final design, tendering, supervising of the Project and training for management, operation and maintenance of the silos after completion.(See Appendix F)

v) Contingency

Contingency is included on the total basis to cover minor differences in actual and estimated quantities, unforeseeable difficulties in construction, possible deviation

in planning due to site conditions or uncertainties of foundation conditions. The adopted percentage of contingencies on civil work for the Project is 10 percent.

vi) Price Escalation

Price escalation is estimated by the basis of the following international price index of the World Bank and the rate reported by the Kenyan Government;

Price Escalation Index

(Unit: %)

	1981	1982	1983	1984	1985	1986
Foreign Component	9.0	8.0	7.0	6.7	6.5	6.3
Local Component	12.0	12.0	12.0	12.0	12.0	12.0

vii) Expenses of the Contractor not including Direct Cost

This expenses is including following expenses:

(a) expenses of main office,
(b) expenses of site offices,
(c) expenses of engineers, clerks working in the site offices, and
(d) other expenses related to the construction works.

Table 4-3 Project Cost

Description	Foreign Currency			Local Currency		Total	
	Million yen	K.sh '000	%	K.sh '000	%	K.sh'000	%
1-1. Civil Works	3,163	119,472		50,907		170,379	
1-2. Investigation Cost				2,000		2,000	
Sub-total	3,163	119,472	36.8	52,907	48.8	172,379	39.8
(%)		(69.3%)		(30.7%)		(100%)	
2. Building Works	780	29,450	9.1	6,200	5.7	35,650	8.2
(%)		(82.6%)		(17.4%)		(100%)	
3. Silo Facilities	1,917	72,430	22.3	8,090	7.5	80,520	18.6
(%)		(90.0%)		(10.0%)		(100%)	
4. Administration Cost	0	0	0	3,550	3.3	3,550	0.8
5. Consulting Services	582	22,000	6.8	3,000	2.8	25,000	5.8
Sub-total	6,442	243,352	76.0	73,747	68.1	317,099	73.2
(%)		(76.7%)		(23.3%)		(100%)	
6. Contingency	644	24,335	7.5	7,374	6.8	31,709	7.3
Sub-total (1 to 6)	7,086	267,687	82.5	81,121	74.9	348,808	80.5
(%)		(76.7%)		(23.3%)		(100%)	
7. Price Escalation	1,514	57,225	17.5	27,243	25.1	84,468	19.5
Total	8,600	324,912	100.0	108,364	100.0	433,276	100.0
(%)		(75.0%)		(25.0%)		(100%)	

Note: Convertion Rate of Currency: 1 Kenya shilling = 26.47 J. Yen

CHAPTER 5. PLAN OF PROJECT EXECUTION AND MAINTENANCE

5-1. Coordination of Concerned Agencies

The NCPB is an executing body of the Project under administration of the Ministry of Agriculture which is fully responsible for realization of the Project and coordination with the Ministty of Finance which is the borrower of the loan to the Project. The Ministry of Agriculture, whose organization chart is presented as Fig. 5-1, will have the responsibility to control the NCPB and has assigned the Parliament Secretary to the supervisor of the NCPB. The Director General of the NCPB has kept a close contact with the Parliament Secretary of the Ministry of Agriculture to receive the necessary instructions from time to time, while the detailed matters have been discussed by the director of Agriculture Bureau and the officials concerned and the personnel in charge in the NCPB for smooth execution. Especially, the Ministry of Agriculture has decided the prices of the grains which the NCPB purchases from the farmers and the selling prices to the market. And the NCPB has been sure to deal with these grains. When the purchase prices and the selling prices are brought about unbalance to result in shortage in the NCPB's operation funds, the Ministry of Finance supplies the funds out of the general budget to support the NCPB.

The Agriculture Bureau, the largest bureau in its scale in the Ministry of Agriculture, has played a main role in the Ministry's of service. And the Planning Division, which was established last year, in an important division to make plans for positive agricultural development of the country, and the Project is contemplated and operated under the cooperation of the Planning Division and the NCPB.

As learnt from the organization chart, the Ministry of Agriculture has executed the whole administrative works, and a variety of Bureaus have been responsible for consolidation planning of infrastructures such as irrigation facilities.

5-2. Executing Body

The NCPB is in charge of execution and operation and maintenance of the Project. The NCPB, having about 1,500 staff, has operated and mained 36 maize storages and 10 wheat storages throughout the country. Currently, a cereal's silo with 40,000 ton storage capacity and a storage with 20,000 ton capacity are under construction by Danish aid in Eldoret, and another storages are underconstruction in other two sites.

As shown in Fig. 5-2, the NCPB has assigned the Storage Manager to the services of planning and management of the storage facilities and the Technical Manager to controlling of the related machinery equipment. Design, tender and supervision of the construction works have been performed by the consultants registered at the NCPB. Consequently, the Project will be executed in the same procedures as above. As far as the consultants are concerned, the Japanese consultants registered at Japanese Government will be employed, when the Project is aided by Japanese funds. It is desirable that the Kenyan consultants will be assigned by the Kenyan Government as counterparts to the Japanese consultants and the collaboration of both consultants will enable to implement the Project smoothly.

For executing the Project, the Ministry of Finance of Kenya should prepare the necessary funds in both local and foreign currencies to meet the requirements of the Ministry of Agriculture, and supply these funds to the NCPB.

The Ministry of Finance (Kenya) expects to have a Japanese aid for foreign currency portion, and yet wishes to increase the foreign currency portion as much as possible due to the fact that the critical financial situation in Kenya has resulted from emergency import of foods and oil price soar. Under the circumstances, the NCPB is eager to have the Project completed as early as possible by foreign consultants and contractors so as to meet the national policy.

After completion of the Project, the silos will be under the control of the Technical Division, while the storage under the control of the Storage Division, and the stockpile adjustment and arrangement will be made by the Storage Division.

5-3. Implementation Programme

5-3-1. Methods of contractor employment

The Project includes construction of those silos located at Bungoma, Nakuru, and Kisumu. These construction works can be carried out in two ways: one is to employ two individual contractors for civil works and for mechanical works, and the other is to employ one contractor to carry out both of the civil works and mechanical works.

In due considerations as follows, the Project will adopt the latter method to employ only one contractor for all works.

i) The civil works and mechanical installation should be carried out in parallel, and
ii) The same kind and type of the equipment are installed at three silos.

Although the Kenyan Government shall be the consignee of the imported materials and equipment for exempting the import duty, full responsibility shall be imposed on the contractor to be appointed for the works from construction to manufacturing, transportation and installation of the equipment.

The project in Eldoret has been proceeded by individual contractors for the civil works and for the mechanical works. This method, however, has brought about several problems such as taking long time for detailed design of civil works, increase in total construction cost and difficulty in coordination between the civil works and the mechanical works.

5-3-2. Implementation programme

Construction of the proposed silos may be planned to start implementation simultaneously in all, although the construction sites are some tens kilometers apart from each other. The 3-month staggering start, however, for the two silos, respectively, is recommended in terms of economy, although the total construction period will be prolonged six months as compared with the fullscale start of implementation. Consequently, the implementation programme is prepared on the basis of the staggering method taking two years (24 months) for the total completion. The staggering method is advantageous in the following points;

i) Foundation treatment at Bungoma and Nakuru can be made by the same method, and hence, 3-month staggering will permit the one set of construction machines to complete the foundation works.

ii) Since the concrete silos at Bungoma and Kisumu have the same structure, the sliding forms and other materials for temporary works and the one set of construction machinery can be dually used.

On the premise that the loan agreement and the consultanting services contract are concluded by the end of June, 1982, four years in total are proposed as the Project period in taking into account the staggering method mentioned above. The said Project period includes the following three stages;

i)	Detailed design	6 months	(July, 1982 - December, 1982)
ii)	Tendering	6 months	(January, 1983 - June, 1983)
iii)	Implementation	24 months	(July, 1983 - June, 1985)
	For Bungoma Silo	14 months	(July, 1983 - August, 1984)
	Nakuru Silo	15 months	(October, 1983 - December, 1984)
	Kisumu Silo	18 months	(January, 1984 - June 1985)

iv) Consulting services 48 months (July, 1982 - June, 1986)
(including 21 months for consulting services for O & M of the Project)

The respective silo operations will be started one-month preparation period after completion of construction works, and the start of the operation at each silo is scheduled as follows;

Bungoma Silo	From October, 1984
Nakuru Silo	February, 1985
Kisumu Silo	August, 1985

The timetable of the Project is illustrated in Fig. 5-3.

5-4. Disbursement Schedule

The disbursement schedule for the Project was prepared as Table 5-4 according to the estimated Project cost (See table 4-3) and the timetable of the Project (See Fig. 5-3).

The proposed disbursement programme was made up based on the Kenya's fiscal year (August to July in the following year).

The payment for the necessary machinery and equipment to be procured from the foreign countries is planned to be made on the CIF basis against shipment from the ports of the suppliers' countries, while the payments for the other items are estimated on the monthly installation basis.

5-5. Project Execution

The execution of the Project is planned on the basis of the long-term loan under Japanese economic assistance.

The NCPB is very eager to have quick breakthroughs of various technical barriers lying ahead in the Project execution under the cooperation of the registered Japanese consultants who will be registered by the Government of Japan. In other words, the selected consultants will carry out the design, preparation of the necessary specifications and tender documents, evaluation of the tender, construction supervision, and guidance of operation and maintenance of the Project after completion under the control of the NCPB.

The consultants will prepare the tender documents that can meet the requirements of the international tender which has been defined by the FIDIC for the contracts of the civil construction works, and the qualified contractors will be selected with approval of the Ministry of Agriculture (Kenya) and the Japanese authorities concerned.

The consultants are fully responsible for making a good coordination for smooth Project execution among the Ministry of Agriculture and the NCPB of Kenya and the Ministry of Agriculture, Forestry and Fisheries and the Overseas Economic Cooperation Fund (OECF) of Japan, and also will assign the representative in charge of coordination to Kenya, while appoint the coordinator so as to keep close contract with those Project related authorities on the both sides for smoothening the works of construction and financing.

Accordingly, the consultants will assign the following experts to successfully carry out the respective works.

1. Coordinator
2. Team Leader/Project Engineer
3. Supervisor for Survey and Boring
4. Soil Expert
5. Design Engineer (Foundation)
6. Design Engineers (Structure) (2 persons)
7. Mechanical Engineers (Equipment) (2 persons)
8. Architect
9. Electrical Engineer
10. Marketing Expert
11. Cost Estimator (Implementation planning and cost estimate)
12. Expert for Preparation of Tender Documents
13. Specifications Writer

On the other hand, the consultants should appoint the well-qualified advisor(s) to render field services, for one year after the Project completion, in operation and management of the silos. The detailed consultants' services to be rendered are tabulated in Appendix F-1. The consultants' representative stationed in Kenya will make the monthly progress report of the Project and submitted to the Japanese authorities concerned through the consultants' coordinatorwho will give explanation of the Project to the officials concerned.

The international tendering will be made on the full turn-key basis for construction of the silos and their appurtenant structures, and procurement of the necessary machines and equipment together with their installation.

Under the conditions, the tenderers may have to form a consortium with the firms of machinery manufacturers, foreign contractors, and local contractors for participating the tender. The tenderers' technical level and experiences in home and alroad are the essential factors for evaluation as well as their quotations. The NCPB will make a final decision in evaluation.

The Project Manager to be appointed by the NCPB, supported by the selected consultants, will supervise the construction works at the respective sites where the field offices are provided.

The contractor should give the technical guarantee for the silos, appurtenant structures and machinery installed for one year after Project completion, while the consultants should supply the expert of operation and management to stay the sites one year for avoiding any accidents and securing successful operation.

5-6. Operation and Maintenance Cost (O & M Cost)

5-6-1. Number of personnel required

The number of the personnel required, although should vary from one silo to another by scales, was estimated by the same for each silo proposed, since the personnel required does not need to increase in number when the silos provide a considerably large holding such as those proposed for the Project by 30,000 - 50,000 tons. And three-shift system is taken into account for the 24-hour operation.

	Personnel Require	Bungoma silo, Nakuru silo, Kisumu silo
(a)	Manager	The manager of each station serves concurrently
(b)	Sub-Manager	2 (persons)
	For Facilities	1
	For Field and Forwarding	1
(c)	Personnel for operation	18 (persons)
	Chief operators	1 (person) x 3 shift = 3 (persons)
	Personnel for receiving	1 (person) x 2 shift = 2 (persons)
	Personnel for drying	1 (person) x 3 shift = 3 (persons)
	Personnel for rotating grains between silos	1 (person) x 3 shift = 3 (persons)

	Personnel for forwarding	1 (person) x 1 shift = 1 (person)
	Personnel for checking machines	1 (person) x 3 shift = 3 (persons)
	Extra. operators (for sickness, urgent business etc.)	1 (person) x 3 shift = 3 (persons)
(d)	Personnel for weighting at receiving	2 (persons)
(e)	Personnel for testing grain	5 (persons)
	Personnel for grading	3
	Personnel for sampling	2
(f)	Tractor operators	2 (persons)
(g)	Personnel for maintenance	6 (persons)
	Personnel for machinery	2
	Personnel for electric equipment	2
	Personnel for maintenance of silo and other structures	1
	Personnel for painting	1
(h)	Office clerks	3 (persons)
(i)	Workers	14 (persons)
	Workers for maintenance	4
	Workers for receiving, Forwarding and sweeping	10
	Total	52 (persons)

5-6-2. Fuel Consumption

Diesel light oil is used for the furnace of the dryer.

Item	Bungoma Silo Kisumu Silo	Nakuru Silo
Fuel consumption per hour	112.5 ℓ	198 ℓ
	10 hr	10 hr
Working days per year	144 days	144 days
Total fuel consumption	162,000 ℓ/year	285,000 ℓ/year

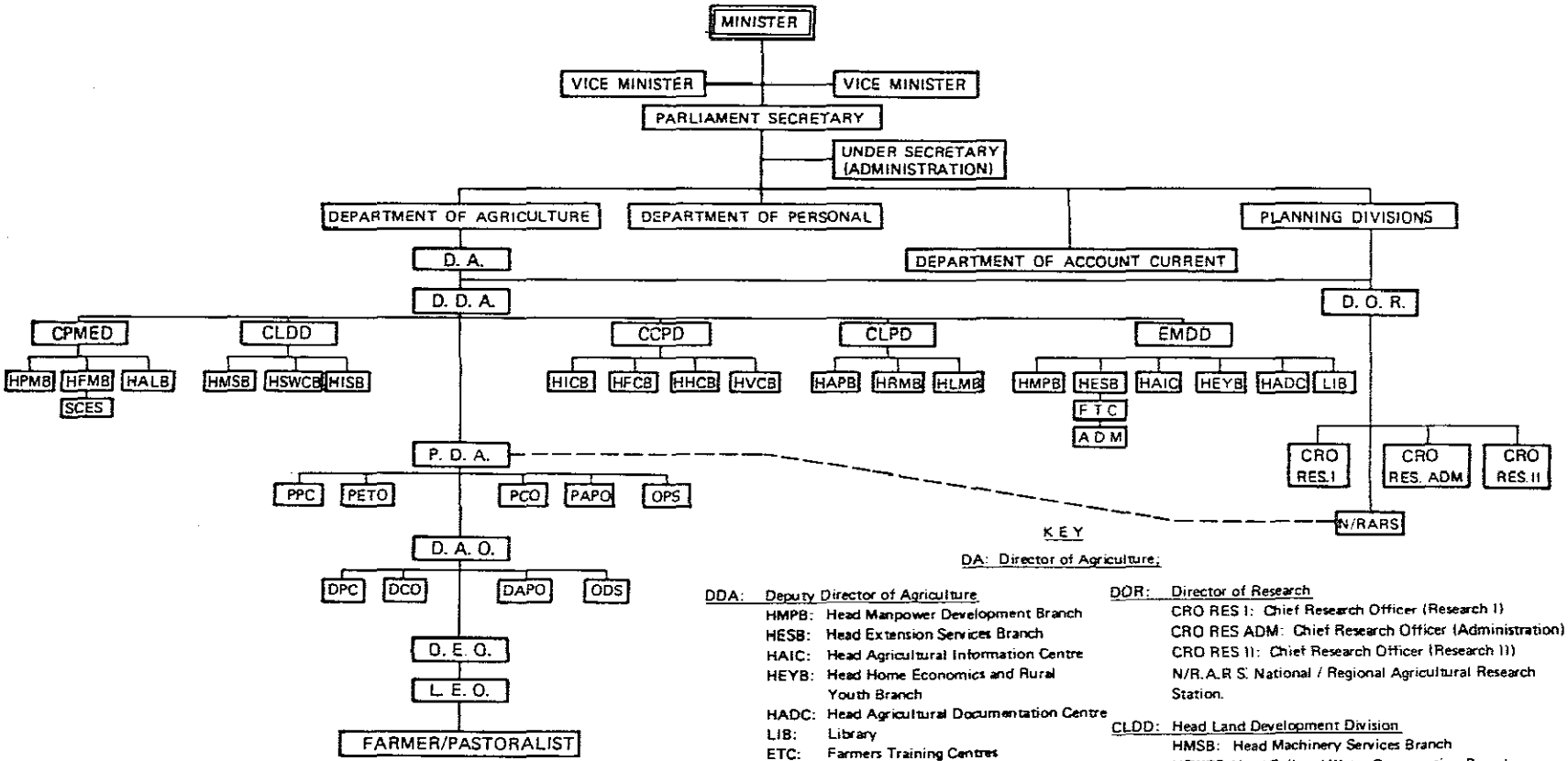
5-6-3. Operation and Maintenance Cost (Per Year)

	Item	Bungoma Silo, Kisumu Silo	Nakuru Silo
(a)	Salary and wage		
	Sub-Manager	2 (persons) x 3,500 ksh/mon x 12 mon = 84,000 ksh	2 (persons) x 3,500 ksh/mon x 12 mon = 84,000 ksh
	Personnel for operating, maintenance and others	36 (persons) x 1,200 ksh/mon x 12 mon x 1.3 = 673,920 ksh	36 (persons) x 1,200 ksh/mon x 12 mon x 1.3 = 673,920 ksh
	Workers	14 (persons) x 700 ksh/mon x 10 mon = 98,000 ksh	14 (persons) x 700 ksh/mon x 10 mon = 98,000 ksh
	Others	4,080 ksh	4,080 ksh
	Sub-total	860,000 ksh	860,000 ksh
(b)	Fuel cost	162,000 ℓ/year x 3.96 ksh/ℓ ≒ 642,000 ksh	285,000 ℓ/year x 3.96 ksh/ℓ ≒ 1,130,000 ksh
(c)	Electric fee	22,000 ksh/mon x 12 mon = 264,000 ksh	33,000 ksh/mon x 12 mon = 396,000 ksh
(d)	Water charges, fuel and light expenses	500 ksh/mon x 12 mon = 6,000 ksh	500 ksh/mon x 12 mon = 6,000 ksh
(e)	Fumigation charge	62,500 m^3 x 30 g/m^3 = 1,875 kg 1,875 kg x 48 ksh ≒ 90,000 ksh	104,100 m^3 x 30 g/m^3 = 3,123 kg 3,123 kg x 48 ksh ≒ 150,000 ksh
(f)	Repair charges	76,000 ksh	102,000 ksh
(g)	Insurance	38,000 ksh	51,000 ksh
(h)	Miscellaneous overhead cost	60,000 ksh	81,000 ksh
	Total	2,036,000 ksh	2,776,000 ksh

Table 5-1 DISBURSEMENT SCHEDULE OF THE PROJECT

Description	Total			1st Year (Aug. 1981 - Jul. 1982)			2nd Year (Aug. 1982 - Jul. 1983)			3rd Year (Aug. 1983 - Jul. 1984)			4th Year (Aug. 1984 - Jul. 1985)			5th Year (Aug. 1985 - Jul. 1986)		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. Civil Works																		
1-1 Bungoma Silo	30,090	14,203	44,293	-	-	-	-	-	-	30,090	14,203	44,293	-	-	-	-	-	-
1-2 Nakuru Silo	47,518	22,062	69,580	-	-	-	-	-	-	45,779	21,276	67,055	1,739	786	2,525	-	-	-
1-3 Kisumu Silo	41,864	14,642	56,506	-	-	-	-	-	-	7,796	410	8,206	34,068	14,232	48,300	-	-	-
1-4 Pre-Engineering	-	2,000	2,000	0	2,000	2,000	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	119,472	52,907	172,379	0	2,000	2,000	0	0	0	83,665	35,889	119,554	35,807	15,018	50,825	0	0	0
2. Building (Facilities Room)																		
2-1 Bungoma Silo	8,550	1,800	10,350	-	-	-	-	-	-	8,550	1,800	10,350	-	-	-	-	-	-
2-2 Nakuru Silo	12,350	2,600	14,950	-	-	-	-	-	-	6,175	1,300	7,475	6,175	1,300	7,475	-	-	-
2-3 Kisumu Silo	8,550	1,800	10,350	-	-	-	-	-	-	-	-	-	8,550	1,800	10,350	-	-	-
Sub-total	29,450	6,200	35,650	0	0	0	0	0	0	14,725	3,100	17,825	14,725	3,100	17,825	0	0	0
3. Facilities																		
3-1 Bungoma Silo	21,448	2,650	24,098	-	-	-	-	-	-	21,218	2,120	23,338	230	530	760	-	-	-
3-2 Nakuru Silo	29,433	2,790	32,223	-	-	-	-	-	-	28,403	279	28,682	1,030	2,511	3,541	-	-	-
3-3 Kisumu Silo	21,549	2,650	24,199	-	-	-	-	-	-	-	-	-	21,549	2,650	24,199	-	-	-
Sub-total	72,430	8,090	80,520	0	0	0	0	0	0	49,621	2,399	52,020	22,809	5,691	28,500	0	0	0
4. Administration Cost	-	3,550	3,550	0	25	25	0	0	0	0	2,330	2,330	0	1,195	1,195	0	0	0
5. Consultancy Services	22,000	3,000	25,000	450	48	498	6,390	840	7,230	6,038	840	6,878	6,328	888	7,216	2,794	384	3,178
Sub-total (1 to 5)	243,352	73,747	317,099	450	2,073	2,523	6,390	840	7,230	154,049	44,558	198,607	79,669	25,892	105,561	2,794	384	3,178
6. Contingency	24,335	7,374	31,709	45	207	252	639	84	723	15,405	4,456	19,861	7,967	2,589	10,556	279	38	317
Sub-total (1 to 6)	267,687	81,121	348,808	495	2,280	2,775	7,029	924	7,953	169,454	49,014	218,468	87,636	28,481	116,117	3,073	422	3,495
7. Price Escalation	57,225	27,243	84,468	30	194	224	853	116	1,016	32,603	14,704	47,307	22,742	11,962	34,704	997	217	1,214
Total	324,912	108,364	433,276	525	2,474	2,999	7,882	1,090	8,972	202,057	63,718	265,775	110,378	40,443	150,821	4,070	639	4,709

FIG. 5-1 ORGANIZATION CHART OF MINISTRY OF AGRICULTURE



KEY

DA: Director of Agriculture;

DDA: Deputy Director of Agriculture
- HMPB: Head Manpower Development Branch
- HESB: Head Extension Services Branch
- HAIC: Head Agricultural Information Centre
- HEYB: Head Home Economics and Rural Youth Branch
- HADC: Head Agricultural Documentation Centre
- LIB: Library
- ETC: Farmers Training Centres
- ADM: Administration

CPMED: Chief Project Management & Evaluation Division
- HPMB: Head Programme Management Branch
- HFMB: Head Farm Management Branch
- Head Arid/Semi Arid Land Branch
- SCES: Soil Conservation Extension Service Section

PDA: Provincial Director of Agriculture
- PPC: Provincial Programme Co-ordinator
- PETO: Provincial Extension & Training Officer
- PCO: Provincial Crops Officer
- PAPO: Provincial Animal Production Officer
- OPS: Other Provincial Specialist

DOR: Director of Research
- CRO RES I: Chief Research Officer (Research I)
- CRO RES ADM: Chief Research Officer (Administration)
- CRO RES II: Chief Research Officer (Research II)
- N/R.A.R.S. National / Regional Agricultural Research Station.

CLDD: Head Land Development Division
- HMSB: Head Machinery Services Branch
- HSWCB: Head Soil and Water Conservation Branch
- HISB: Head Irrigation Services Branch

CCPD: Chief Crop Production Division
- HICB: Head Industrial Crops Branch
- HFCB: Head Food Crops Branch
- HHCB: Head Horticultural Crops Branch
- HVCB: Head Crops Pests & Vermin Control Branch

CLPD: Chief Livestock Production Division
- HAPB: Head Animal Production Branch
- HRMB: Head Range Management Branch
- HLMB: Head Livestock Marketing Branch

DAO: District Agricultural Officer
- DPC: District Programme Co-ordinator
- DCO: District Crops Officer
- DAPO: District Animal Production Officer
- ODS: Other District Specialist
- DEO: Divisional Extension Office
- LEO: Locational Extension Officer

FIG. 5-2 ORGANIZATION CHART OF THE NCPB

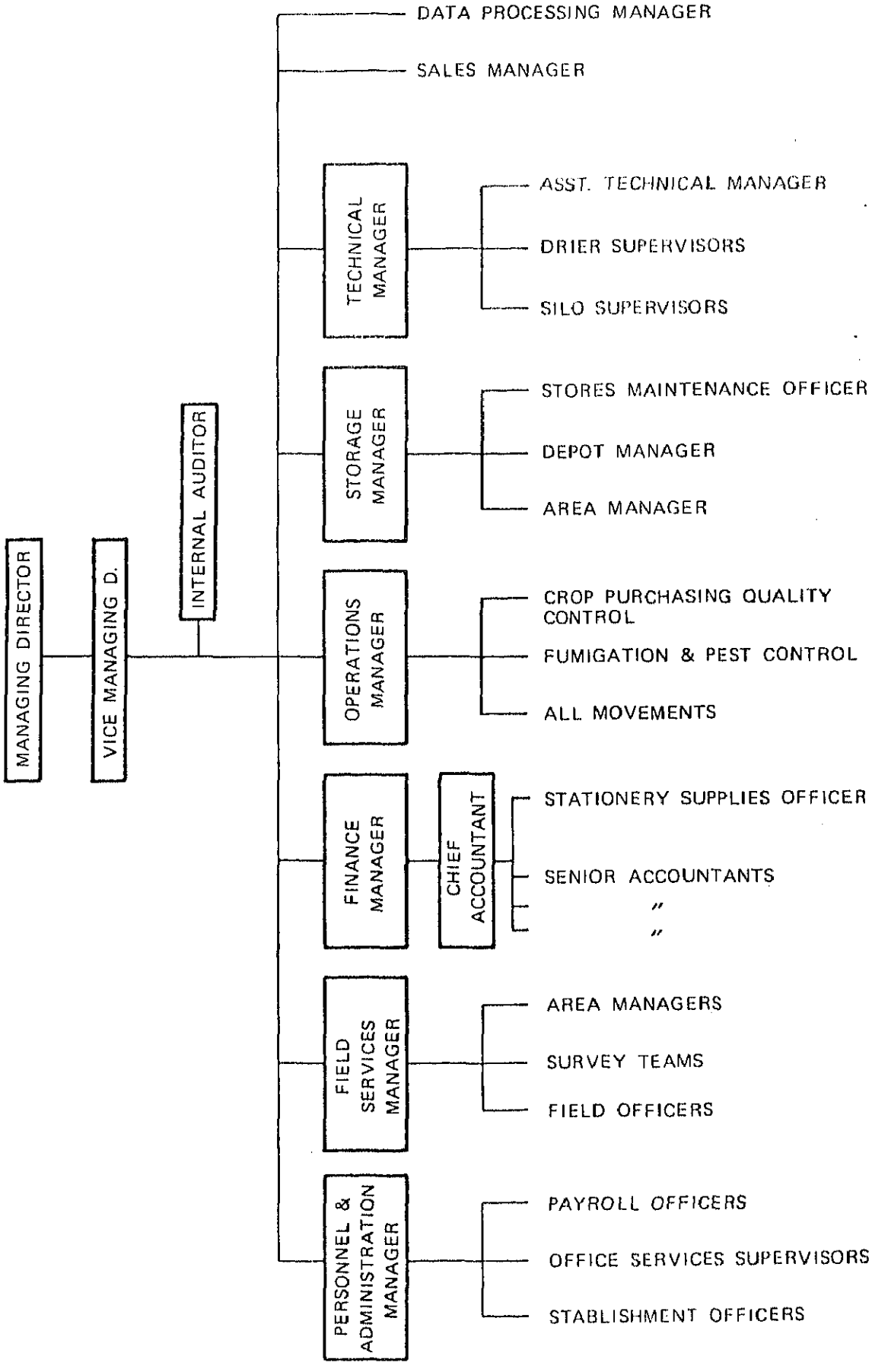
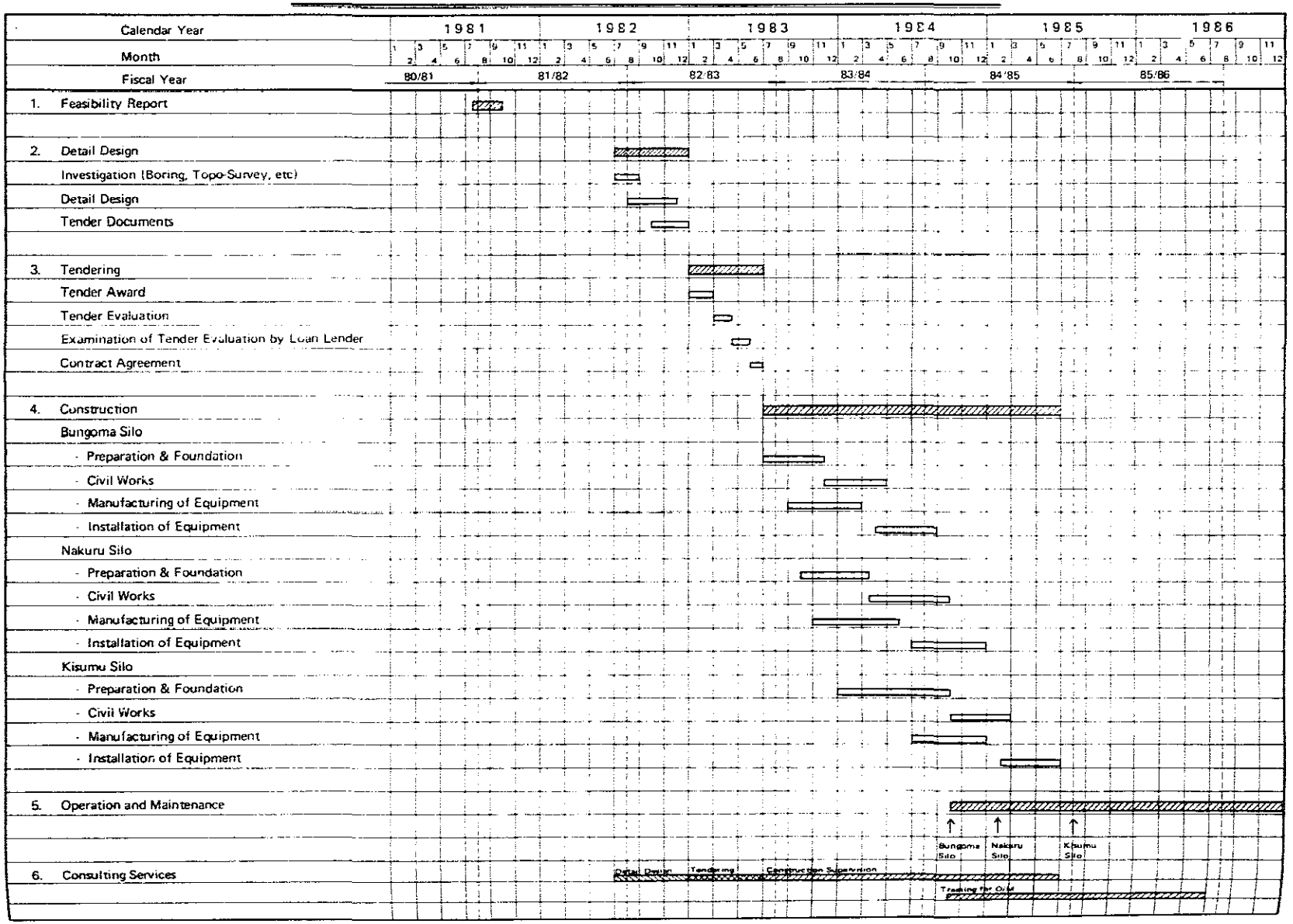


FIG. 5-3 IMPLEMENTATION SCHEDULE OF THE PROJECT



CHAPTER 6. ECONOMIC AND FINANCIAL ANALYSIS OF PROJECT

This chapter discusses the internal rate of return (IRR) of the Project which has been computed by economical benefit of the Project and Project cost as well as the economic and financial feasibility of the Project obtained through financial analysis.

6-1. Economic Benefit

Economic benefits created from any projects involve the tangibles and the intagibles. This is not an exception, and yet, the Project, under the administration of the Government of Kenya and the NCPB, aims at increasing the amount of grains handled in the domestic market as well as serving for easing the food crisis through grain stockpiles by expansion of the storage capacity. It is natural, therefore, that the benefits to be created from the Project consist of a variety of those benefits which, largely affecting the national economy, will be intangible.

6-1-1. *Tangible Benefit*

One of the tangible benefits which the Project can accrue is the economic benefit that is expected to accrue from reducing farm losses of maize by storage capacity increase by the Project. According to the NCPB, the farm losses of maize reach about 30 percent of the harvest for the small farmers, while 15 to 16 percent even for the large farmers due to poor storage facilities. The economic benefit will be ensured to accrue from the NCPB's purchase and storage of these would-be-loss grains. The above expected economic benefits were estimated on the gross basis as follows.

Estimated Gross Benefits

(Unit: Million K. sh)

	Expected Benefit by Minimizing Field Losses
1984/85	23.9
1985/86	53.4
1986/87	53.4
1987/88	53.4
1988/89	53.4
1989/90	53.4
1990/91	53.4
1991/92	534.0
2000/2001	
Total	878.3

The details can be referred to in Table G-1 in Appendix G. The amount of the expected benefits will vary with how to evaluate the farm losses. In this study, the maize market share of the large farmers and the small farmers was estimated by 65 percent and 35 percent, respectively, and the weighted average of these, two values, 20 percent was adopted.

The benefit accurance was designed to last the period from the beginning of the silos operation to the last target year of 2000/2001 grain year. The price of the maize imported in 1981 was adopted as the shadow price in this study. The expected economic gross benefit will amount to about 898 million Kenya shillings for the project period (¥ 23,771 billing equivalent ¥ 1.2 billion per annum).

6-1-2. Other Tangible Economic Benefits

One of the other tangible economic benefits is the increase in processing margin that will result from the increase in the storage capacity and in handling amount.

The expected increase in handling amount in the market was estimated at 150 thousand bags in case of the storage turn-over rate taken by 1.37, and at 165 thousand bags in future when the above rate taken by 1.5.

The economic benefits to be created from such an expansion of handling were estimated as follows on the basis of the necessary rates of margin which is officially determined by the Kenyan Government. The breakdown of the major price fixed by the Government is illustrated in Table D-10 in Appendix D.

(Unit: Million K. sh)

	Turn-over Rate 1.37	Turn-over Rate 1.5
1984/85	7.8	8.5
1985/86	17.4	19.0
1986/87	17.4	19.0
1991/92	17.4	19.0

According to the NCPB Officer in charge of grain collection, however, the small farmers have recently come to increase the market share.

6-1-3. Intagible Benefits

Several important intangible economic benefit will accrue from the Project. One of them is the economic incentive given to the maize growers.

In Kenya, the NCPB has controlled the market of the major grains and its purchasing power has seriously affected the production of the grain surplus. The country, from 1975 to 1977, had produced a considerable amount of the surplus, for which the NCPB had to hesitate its procurement due to shortage in the storage capacity. The hesitancy of the NCPB had resulted in not only leaving much surplus grains intact on the farms but discouraging the grain producers in their wishes for production. The maize growing areas have tended to decrease gradually since 1978, in particular in the major maize producing area in the Rift Valley. The direct effects given to deareas in maize growing areas and the production by shortage in storage capacity of the NCPB cannot be measured substantially, but it cannot be denyed that the negative effect was given to the maize growers for thin production effort.

Under the situation, the proposed silo construction in the Project will no doubt give a strong incentive to the farmers, not only the maize growers in the Project area but throughout the nation, as an economic benefit.

On top of the above, the following various project impact will be given the fields of society and economy of Kenya.

(1) The Project will play a role in the strategic grain stockpiles planned by the Government as a part of food policy, and greatly contribute to freedom from hunger and security of the society.

(2) The strategic stockpiles of the grains will allow the Government to avoid the emergency food import that had been inevitable in the poor harvesting years due to bad weather conditions and other natural disasters, and such food self-sufficiency will enable the Government to stabilize the financial standing, especially to minimize the foreign currency expenses.

(3) The Government will be able to distribute the food fairly and sufficiently together with securing a long-term food price stabilization.

(4) And furthermore, the Project will provide the opportunities to 120 engineers and technicians for O & M of the facilities and also the opportunities of 400,000 man-day during the construction period. Therefore, the Project will stimulate the labor market filled with unemployments.

The Project will a vitally important role not only to give a considerable economical benefit to the national economy but also to give the socio-pyschological effects in securing the social stability and freedom from hunger, and so on.

6-2. Project Cost

6-2-1. Investment

The Project cost, neglecting the price escalation, will be K. sh 267.68 million (about ¥ 7,100 million equivalent) for the foreign currency portion, while K. sh 81.12 million for the local currency portion. The breakdown of the relevant cost is tabulated as follows after subtracting 50 percent of those costs of imported materials and equipment, overhead, compensation, and labor wages which are treated in shadow prices.

Investment

(K. sh '000)

	Item	1981/82	1982/83	1983/84	1984/85	1985/86	Total
1.	Civil Works	2,000	-	111,658	47,521	-	161,179
2.	Building Works	-	-	17,825	17,825	-	35,650
3.	Plant Works	-	-	52,020	28,500	-	80,520
4.	Engineering Fee	498	7,230	6,878	7,216	3,178	25,000
5.	Contingency	252	723	19,861	10,556	317	31,709
	Total	2,750	7,953	208,242	111,618	3,495	334,058

6-2-2. Operation and Maintenance (O & M) Cost and Processing Margin

As discussed in Chapter 5, the O & M costs of the respective silos are shown as follows:

Bungoma silo	K. sh 2,036,000/year
Nakuru silo	2,776,000
Kisumu silo	2,036,000
Total	K. sh 6,848,000/year

Furthermore, the processers' margin of profit in the course of marketing, being deemed as indirect benefit, was estimated by K. sh 1.88 per bag, which will amount to K. sh 3,384,000 in taking the total estimated number of bags by 1.8 million bags.

6-3. Internal Rate of Return (IRR) and Sensitivity Analysis

The internal rate of return (IRR) of the Project was estimated at 16.8 percent based on the above estimation of economic benefit and investment. (See Table G-4 in Appendix G). The said IRR computation was made in taking the Project period by 20 years from the commencement of the Project. Although the salvage values are considered for these facilities of silos, this analysis has not taken them into account as a result of discussion with NCPB's Financial Manager in charge. The IRR, however, includes some salvage values.

The IRR of the Project was computed in taking the farm losses of maize by 20 percent, the unskilled laborers' wages by 50 percent of the standard wages, and the shadow price of maize by the imported maize price in 1981. Changes in these basic values will result in fluctuation of the IRR. When the farm losses are raised by five percent to 25 percent, the benefit increases by nine percent, and when the shadow price is not applied to, the total benefit decreases by 25 percent. The IRR, therefore, changes in corresponding to fluctuation of the total value of the benefit. The cost of the unskilled laborers' wages, however, was counted up in the construction cost by 400,000 persons x K.sh 28 = K.sh 11,200,000, whereas the O & M cost of the silos, costing by K.sh 25,000 per annum for the respective silos, has not been subtracted in considering it as comparatively small amount. In any case, the unskilled laborers' wages will not seriously affect the result of the IRR.

The sensitively analysis was made on the following items:

1) The benefit excluding the marketing margin of profit, ... 11.3%
2) Increase in benefit by 10 percent, ... 19 %
3) Decrease in benefit by 10 percent, ... 14 %
4) Cost runover by 10 percent, ... 14 %
5) One year delay in commencement of the Project, ... 15 %

6-4. Financial Analysis of the Project

The operation and management of the facilities will be carried out by the NCPB under the administrative guidance of the Government. The NCPB, the public corporation, does not consider the financial analysis not to be so important as the economic analysis. The following table is the balance sheet of the proposed silos.

	1984/85		1985/86		1986/87		1987/88 – 2000/01		Total	
	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
Purchase	135.0	180.0	165.0	219.9	165.0	219.9	2,310.0	3,079.2	2,775.0	3,699.0
Loss (0.3%)	0.4		0.5		0.5		6.9		8.3	
Sales	134.6	220.6	164.5	269.6	164.5	269.6	2,303.1	3,774.8	2,766.7	4,534.6
Gross Profit		40.6		49.7		49.7		695.6		835.6
Cost		20.9		26.6		26.6		372.3		446.4
O & M Cost		6.2		6.5		6.5		91.3		110.5
Transport		14.5		19.9		19.9		278.2		332.5
Miscellaneous		0.2		0.2		0.2		2.8		3.4
Balance		19.7		23.1		23.1		323.3		389.2
Depreciation		32.6		16.3		16.3		228.9		294.2

The margin of profit accruing by purchase and sales of maize is the product in multiplying the prices of input and output by amount to be handled, while the cost consists of the O & M cost of the silos included in the Project cost, and the transportation cost obtained by multiplying the NCPB's handling amount by the unit cost specified in the breakdown of the selling price by K.sh 11 per 90 kg bag. Estimation indicates that the gross profit created by the proposed silos will be about K.sh 802.3 million, whereas the necessary cost will be about 446 million. Therefore, the balance can be estimated at K.sh 376 million, and the difference between the gross profit and the depreciation cost for the new facilities will be counted up in black although most so much. Comparison of the balance sheets of the above with the currently operated NCPB's storage facilities (See Table G-5, Appendix G) will clarify that the proposed silo project is financially sound and profitable to the same extent as the current storage operation. Therefore, the Project can be said to be financially feasible.

APPENDIX

Appendix A Economical Background

Table A-1 Annual Growth Rate of National Economy

	Average growth rate of production 1976 - 85	Actuals 1975	Actuals 1976	Provisional 1977	Forecast 1978	Target 1979	Target 1980	Target 1981	Target 1982	Target 1983
Semi-Monetary products	2.6	1.1	-1.3	3.4	1.9	1.3	3.1	2.8	2.8	2.8
Real Monetary GDP	7.1	1.2	8.0	8.3	5.8	5.2	8.0	7.4	7.6	7.7
Real GDP (at factor cost)	6.3	1.2	6.1	7.3	5.0	4.5	7.0	6.5	6.7	6.9
Real out put per capita	2.8	-2.5	2.7	3.7	1.5	1.0	3.5	3.0	3.2	3.4

Source: Development Plan 1979 - 83, Part 1, Republic of Kenya

Table A-2 Gross Domestic Product

	K sh million in 1976 price		Annual Growth percent		Share of Total percent	
	1976	1984	Actual 1972-76	Targets 1976-83	1976	1983
Institutions Enterprises and non-profit	812.90	1,320.20	4.2	7.2	64.4	68.3
Agriculture	219.64	341.30	1.5	6.5	17.4	17.6
Forestry	6.33	10.70	5.9	7.8	0.5	0.6
Fishing	2.36	3.20	0.2	4.5	0.2	0.2
Mining and Quarring	4.15	7.10	11.2	8.0	0.3	0.4
Manufacturing	167.41	306.20	9.4	9.0	13.3	15.8
Electricity and water supply	14.20	24.30	10.1	8.0	1.1	1.3
Building and construction	46.20	84.50	-4.7	9.0	3.7	4.4
Wholsale Retail Trade, etc.	144.46	211.50	2.0	5.6	11.4	10.9
Transport, storage and communication	69.15	109.60	4.1	6.8	5.5	5.7
Finance Insurance, Realestate etc.	68.03	114.30	9.9	7.7	5.4	5.9
Ownership of dwelling	46.13	69.40	2.4	6.0	3.7	3.6
Other services	24.84	38.10	5.1	6.3	2.0	2.0
Private Household	10.93	21.30	13.6	10.1	0.9	1.1
Producers of Government services	178.91	281.20	6.7	6.7	14.2	14.5
Total monetary sector	1,002.74	1,622.70	4.8	7.1	79.4	83.9
Semi-monetary sector	260.11	311.30	0.8	2.6	20.6	16.1
Total DGP at Factor cost	1,262.85	1,934.00	4.0	6.3	100.8	100.0
Indirect Business takes Less subsidies	166.23	259.70	-4.1	7.0	13.2	13.8
GDP at Market prices	1,429.08	2,193.70	2.9	6.3	113.2	113.4

Table A-5 Gross Marketed Production

	Large farms		Small farms		Total		
	K sh million	Annual percent change	K sh million	Annual percent change	K sh million	Annual percent change	Percentage share of small farms
1975	71.8	-2.2	90.1	20.1	162.0	9.2	55.6
1976	122.1	70.1	128.0	42.1	250.0	54.3	51.2
1977	206.0	68.7	208.5	62.9	414.6	65.8	50.3
1978	147.2	-28.5	186.2	-10.7	333.4	-19.6	55.8
1979[1/]	143.3	-2.6	177.0	-4.9	320.2	-4.0	55.3

Note: 1/ Tentative Figure

Source: "Economic Survey 1980" Central of Economic Planning and Development

Table A-4 Marketed Production of Major Crops

	1975 ton	1976 ton	1977 ton	1978 ton	1979 ton
Wheat	145,459	186,774	169,880	165,941	200,968
Maize	487,826	564,748	423,964	236,268	241,717
Rice Paddy	32,113	39,299	41,415	35,816	37,466
Pyrethrum	203.9	166.1	131.1	114.0	113.7
Sugar-cane	1,654,583	1,652,597	1,888,140	2,349,206	3,147,580
Cotton	16,121	15,803	16,257	27,190	27,597
Coffee	66,152	80,303	97,066	84,328	75,082
Sisal	43,639	33,555	33,196	31,456	36,457
Tea	56,730	61,984	86,291	93,373	99,275

Source: Economic Survey 1980

	1974/75 ton	1975/76 ton	1976/77 ton	1977/78 ton	1978/79 ton	1979/80 ton
Wheat	161,912	180,716	165,969	154,612	155,186	189,949
Maize	450,704	555,667	542,822	244,205	236,610	222,693

Source: Annual Report of NCPB

Table A-5 Monthly Imported and Exported Maize

Imported Maize

1979/80 Financial Year

		Yellow Bags	White Bags	Total
March	1980	285,144	-	285,144
April	1980	41,956	302,221	344,177
May	1980	261,398	424,016	685,414
June	1980	462,919	59,653	522,572
		1,051,417	785,890	1,837,307

1980/81 Financial Year

July	1980	459,621	182,812	642,433
August	1980	673,711	19,841	693,552
September	1980	426,924	-	426,924
October	1980	491,593	-	491,593
November	1980	139,477	-	139,477
December	1980	407,436	-	407,436
January	1981	87,526	-	87,526
February	1981	47,396	-	47,396
March	1981	379,286	-	379,286
April	1981	864,260	-	864,260
May	1981	218,676	-	218,676
June	1981	468,479	-	468,479
		4,664,385	202,653	4,867,038

1981/82 Financial Year

July	1981	11,207	336,122	347,329
Grand Total		5,727,009	1,324,665	7,051,674

White Maize Exports - 1979/80 Financial Year

August	1979	177,889
Septemger	1979	49,684
Total		227,573

Appendix B Population

Table B-1 Population in Kenya

(Unit: 1,000 Persons)

Years/	1978	1979	1980	1981	1982	1983	1984	1989
1. Central Province	2,359	2,476	2,585	2,698	2,817	2,941	3,081	3,882
2. Coast Province	1,284	1,342	1,390	1,440	1,492	1,546	1,616	1,936
3. Eastern Province	2,657	2,756	2,869	2,987	3,109	3,237	3,403	4,261
4. N. Eastern Province	312	323	339	357	375	394	417	502
5. Nyanza Province	2,745	2,863	2,977	3,096	3,220	3,349	3,500	4,335
6. Nairobi Province	818	863	913	963	1,016	1,072	1,054	1,286
7. Rift Valley Province	3,236	3,415	3,568	3,729	3,897	4,072	4,269	5,289
8. Western Province	1,820	1,896	1,981	2,070	2,162	2,261	2,362	3,015
9. Whole Kenya	15,221	15,934	16,622	17,340	18,088	18,872	19,702	24,506

Population of the Project related districts

Kisii	858	895	931	968	1,007	1,047	1,095	1,356
*Kisumu	534	557	579	602	626	651	680	842
S. Nayaza	877	915	951	989	1,029	1,071	1,119	1,386
*Kericho	803	848	886	926	967	1,011	1,060	1,313
*Nakuru	445	470	491	513	536	560	587	727
Narok	162	171	179	187	195	204	214	265
Uasin Gishu	316	333	348	357	380	397	417	516

Appendix C Climate

Table C-1 Climate of Busia

STATION NAME BUSIA COTTON EXPERIMENTAL STATION — STATION NUMBER 89,34/105

LATITUDE 00° 28 N — LONGITUDE 34° 07 E — ALTITUDE 4000 FEET (1220 METRES)

MONTH	ATMOSPHERIC PRESSURE ( )		TEMPERATURE (1959–70)									RELATIVE HUMIDITY			RAINFALL (1957–70)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX 24 HOUR FALL
	mb.	mb.	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January			29.4	15.5	13.9	37.8	10.6	20.4	27.4	14.6	15.2		69	47	71	146	10	55.6
February			29.3	15.9	13.4	34.4	11.5	20.7	27.3	15.4	16.1		73	51	85	236	23	61.7
March			29.1	16.6	12.5	34.4	11.7	21.3	27.2	16.5	17.1		74*	54	158	245	95	44.2
April			28.0	16.8	11.2	32.5	14.4	21.0	26.2	17.4	18.3		80	62	280	394	97	112.8
May			27.4	16.5	10.9	30.0	11.0	20.7	25.9	17.4	18.2		82	61	240	343	184	54.6
June			27.2	15.7	11.5	31.1	9.0	19.8	25.9	16.4	16.6		81	56	106	161	63	52.3
July			26.8	15.7	11.1	29.5	12.2	19.2	25.2	15.9	16.0		81	56	81	208	22	90.7
August			26.9	15.5	11.4	30.0	11.5	19.5	25.6	16.0	16.3		80	56	138	256	71	77.5
September			27.5	15.6	11.9	32.2	12.0	20.0	26.3	16.1	16.8		78	56	159	266	43	51.3
October			28.1	16.4	11.7	32.5	13.9	20.9	26.2	16.5	17.0		76	57	183	333	129	62.2
November			27.7	16.2	11.5	31.5	12.2	20.8	25.7	16.1	16.8		75	58	170	302	79	69.1
December			28.3	15.8	12.5	31.7	10.0	20.4	26.5	15.6	16.2		73	50	104	232	58	69.3
Year			28.0	16.0	12.0	37.8	9.0	20.4	26.3	16.2	16.7		77	55	1775	2176	1639	112.8

*1962–70

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1966–70)			DAILY RADIATION (1965–70) INSTRUMENT GB			MONTHLY EVAPORATION (1960–70) PAN TYPE A			CLOUD AMOUNT ( ) TOTAL		LOW		DAILY WIND RUN (1963–70)	WIND SPEED ( )		CALMS ( )		VISIBILITY ( ) FOG		MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX. MEAN	MIN. MEAN	MEAN	MAX. MEAN	MIN. MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	7		7.7	8.4	6.7	591	649	499	199	270	142					95.4								
February	10		8.1	9.3	5.9	572	607	513	181	229	144					90.5								
March	14		7.3	8.3	6.3	555	615	504	198	254	148					84.5								
April	19		7.5	8.6	5.9	557	610	525	172	200	122					76.6								
May	19		8.4	9.6	7.7	561	590	525	167	200	133					68.4								
June	13		8.5	9.2	8.1	547	567	512	148	164	128					62.6								
July	9		6.8	7.0	6.6	505	535	483	133	179	125					64.3								
August	13		7.5	8.3	6.1	538	587	477	159	187	143					69.5								
September	16		7.9	8.3	7.5	596	623	550	180	209	150					75.4								
October	19		8.6	9.0	8.3	592	664	542	196	248	155					78.5								
November	15		8.2	9.1	7.6	553	626	471	166	206	126					74.6								
December	10		9.4	9.6	9.2	600	634	569	198	243	151					75.2								
Year	164		8.0	–	–	564	575	553	2097	2289	1881					76.3								

Table C-2 Climate of Kericho

STATION NAME KERICHO, TIMILIL T.R.I. STATION NUMBER 90.35/244

LATITUDE 00°22'S LONGITUDE 35°21'E ALTITUDE 7000 FEET (2134 METRES)

MONTH	ATMOSPHERIC PRESSURE ( ) 0600 GMT	ATMOSPHERIC PRESSURE ( ) 1200 GMT	TEMPERATURE (1963–70) MEANS MAX.	MEANS MIN	MEANS RANGE	EXTREMES HIGHEST	EXTREMES LOWEST	DRY BULB 0600 GMT	DRY BULB 1200 GMT	DEW POINT 0600 GMT	DEW POINT 1200 GMT	RELATIVE HUMIDITY 0300 GMT	RELATIVE HUMIDITY 0600 GMT	RELATIVE HUMIDITY 1200 GMT	RAINFALL (1964–70) MEAN	RAINFALL HIGHEST	RAINFALL LOWEST	RAINFALL MAX 24 HOUR FALL
	mb.	mb.	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January			24.0	8.7	15.3	27.5	2.5	17.0	21.7	9.2	9.7		60	47	78	289	14	47.8
February			23.8	9.1	14.7	29.0	2.8	16.7	21.1	10.4	10.7		67	51	114	226	10	41.4
March			23.6	9.5	14.1	27.7	5.6	16.7	20.8	11.2	11.5		70	56	188	321	120	58.9
April			22.3	10.1	12.2	26.2	6.1	16.5	18.7	12.2	13.5		77	73	275	482	114	79.3
May			22.1	9.6	12.5	28.5	6.0	16.5	18.2	12.3	13.6		77	74	262	455	120	70.0
June			21.3	8.7	12.6	27.8	4.5	15.5	18.3	11.4	12.5		77	68	202	282	128	53.4
July			20.5	9.1	11.4	24.0	5.5	14.7	17.7	11.3	12.0		81	70	199	334	118	62.7
August			20.7	8.9	11.8	25.0	5.6	15.4	17.3	11.1	11.9		76	71	212	340	45	57.2
September			21.9	8.4	13.5	26.6	5.4	16.9	18.5	10.9	11.4		68	63	172	223	107	57.1
October			22.1	8.8	13.3	26.3	4.2	17.3	18.6	11.1	12.0		66	65	168	208	119	30.4
November			21.9	9.5	12.4	25.6	5.6	17.1	18.6	11.4	12.2		69	67	131	222	70	37.2
December			22.7	8.6	14.1	27.3	5.0	17.0	20.1	10.5	10.7		65	53	80	129	8	42.6
Year			22.2	9.1	13.1	29.0	2.5	16.4	19.1	11.1	11.8		71	63	2081	2555	1583	79.3

MONTH	NUMBER OF DAYS OF RAIN ≥1mm	NUMBER OF DAYS OF THUNDER	DAILY SUNSHINE (1963–70) MEAN	DAILY SUNSHINE MAX. MEAN	DAILY SUNSHINE MIN. MEAN	DAILY RADIATION (1958–70) INSTRUMENT GB MEAN	DAILY RADIATION MAX. MEAN	DAILY RADIATION MIN. MEAN	MONTHLY EVAPORATION (1963–70) PAN TYPE A MEAN	MONTHLY EVAPORATION HIGHEST	MONTHLY EVAPORATION LOWEST	CLOUD AMOUNT TOTAL 0600 GMT	CLOUD AMOUNT TOTAL 1200 GMT	CLOUD AMOUNT LOW 0600 GMT	CLOUD AMOUNT LOW 1200 GMT	DAILY WIND RUN (1964–70)	WIND SPEED 0600 GMT	WIND SPEED 1200 GMT	CALMS 0600 GMT	CALMS 1200 GMT	VISIBILITY FOG 0600 GMT	VISIBILITY FOG 1200 GMT	VISIBILITY MIST, HAZE 0600 GMT	VISIBILITY MIST, HAZE 1200 GMT
		days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	8		8.3	9.8	5.7	551	638	428	151	176	112					91.8								
February	11		7.5	9.5	4.9	551	664	417	131	161	101					84.8								
March	15		7.2	8.7	5.1	538	625	450	144	169	116					81.6								
April	21		5.6	8.0	4.2	443	505	362	136	167	76					67.7								
May	22		6.3	7.6	4.0	440	534	366	105	124	87					70.2								
June	20		7.0	8.3	4.9	458	544	385	106	121	82					81.2								
July	20		5.8	6.7	4.9	414	478	370	100	113	88					78.3								
August	21		5.7	6.7	4.1	418	480	344	100	121	87					84.7								
September	19		6.5	7.5	5.0	454	492	389	116	130	93					87.6								
October	21		6.3	7.1	5.2	439	504	375	111	127	96					81.3								
November	15		5.9	6.7	5.1	431	517	356	101	118	87					80.9								
December	11		7.5	8.9	5.0	498	583	414	123	141	108					90.7								
Year	204		6.6	7.2	6.2	470	492	438	1376	1668	1324					81.0								

Table C-3 Climate of Kisumu

STATION NAME KISUMU AIRPORT MET. STATION. STATION NUMBER 90.34/025

LATITUDE 00°06'S LONGITUDE 34°45'E ALTITUDE 3795 FEET (1157 METRES)

MONTH	ATMOSPHERIC PRESSURE (1931–70)		TEMPERATURE (1931–70)									RELATIVE HUMIDITY			RAINFALL (1938–70)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	886.7	883.1	30.6	17.0	13.6	36.0	11.0	22.3	29.3	14.3	14.6	78	60	41	63	186	0	77.5
February	886.5	882.8	30.8	17.4	13.4	36.9	12.8	22.3	29.4	14.9	14.9	80	62	42	87	258	0	81.1
March	886.5	882.9	30.3	17.8	12.5	36.6	13.0	22.5	29.1	16.2	15.8	83	68	45	162	334	25	81.5
April	886.9	883.7	28.8	17.9	10.9	35.5	13.3	22.0	27.6	17.4	17.3	91	76	53	206	405	93	154.9
May	887.7	884.8	28.2	17.4	10.8	32.2	14.1	21.6	26.9	17.3	17.3	92	77	55	171	358	77	105.0
June	888.5	886.0	28.0	16.4	11.6	31.4	12.4	20.7	26.8	15.9	16.1	90	74	52	95	192	14	78.7
July	888.5	886.1	27.7	16.2	11.5	31.4	11.9	20.0	26.6	15.3	15.2	88	74	49	63	147	27	90.2
August	888.2	885.4	28.2	16.1	12.1	33.1	11.4	20.4	27.0	15.1	15.3	87	72	49	88	220	17	101.6
September	887.8	884.5	29.4	16.3	13.1	34.3	12.4	21.5	28.0	14.7	15.3	85	65	46	79	151	2	69.3
October	887.3	883.5	30.5	17.1	13.4	34.7	13.1	22.6	29.1	14.8	14.9	82	62	42	72	195	9	69.3
November	886.9	883.0	30.2	17.3	12.9	34.4	12.8	22.8	28.6	15.4	15.3	81	63	45	116	449	6	128.3
December	886.9	883.2	29.9	17.1	12.8	35.7	12.0	22.4	28.6	15.2	15.3	80	64	45	104	301	1	84.1
Year	887.4	884.1	29.4	17.0	12.4	36.9	11.0	21.7	28.1	15.5	15.6	85	68	47	1306	1884	942	154.9

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1958–70)			DAILY RADIATION (1967–70) INSTRUMENT GB			MONTHLY EVAPORATION (1958–70) PAN TYPE A			CLOUD AMOUNT (1931–70)				DAILY WIND RUN ( )	WIND SPEED (1939–70)		CALMS (1966–70)		VISIBILITY (1961–70)			
												TOTAL		LOW							FOG		MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX MEAN	MIN MEAN	MEAN	MAX. MEAN	MIN. MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm		hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	7	10	9.1	10.5	7.4	530	537	522	236	325	176	4.4	4.9	1.2	2.5		3	12	9	1	0	0	1	0
February	10	12	9.2	10.6	7.1	554	602	527	218	248	178	4.5	5.0	1.4	2.5		3	13	9	1	0	0	1	0
March	12	16	8.7	9.6	6.4	504	570	407	227	272	158	5.2	5.5	1.6	2.8		3	11	9	1	0	0	0	1
April	17	21	7.9	9.9	5.5	509	559	420	193	243	134	5.9	5.9	2.0	3.3		3	10	10	1	0	0	1	1
May	13	23	8.0	9.0	7.0	502	527	470	186	211	146	4.9	5.4	1.6	3.3		3	8	8	1	0	0	1	1
June	8	18	8.4	9.3	7.3	497	523	461	178	228	137	4.8	4.9	1.2	2.7		4	8	5	0	0	0	0	0
July	6	14	7.7	8.7	6.0	468	495	446	174	217	136	5.3	5.3	1.8	2.5		4	8	6	1	0	0	1	1
August	8	18	7.7	8.6	6.2	496	536	464	181	229	145	5.1	5.2	1.7	2.9		4	9	4	1	0	0	1	1
September	8	20	7.9	9.3	7.1	529	555	489	202	256	166	4.3	5.3	1.2	3.3		4	10	4	0	0	0	0	1
October	10	19	8.2	9.1	6.4	533	569	495	215	274	181	4.9	5.7	1.2	3.5		4	10	5	1	0	0	0	1
November	13	18	7.8	9.0	5.0	524	555	492	200	239	154	5.2	6.0	1.8	3.6		3	10	8	0	0	0	1	1
December	9	13	8.9	9.8	6.8	557	569	543	211	292	173	4.6	5.1	1.3	3.0		3	10	6	0	0	0	0	1
Year	121	202	8.3	8.8	7.8	517	542	501	2421	2759	2015	4.9	5.3	1.5	3.0		3	10	83	8	0	0	7	9

Table C-4 Climate of Nakuru (Lanet Airfield)

STATION NAME NAKURU LANET AIRFIELD MET. STATION — STATION NUMBER 90.36/236

LATITUDE 00°18 S — LONGITUDE 36°09 E — ALTITUDE 6200 FEET (1890 METRES)

MONTH	ATMOSPHERIC PRESSURE (1958–62)		TEMPERATURE (1957–82)									RELATIVE HUMIDITY			RAINFALL (1956–70)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX. 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	814.0	810.0	27.1	7.4	19.7	30.8	2.4	16.4	25.3	11.0	9.1	93	70	36	35	114	0	66.0
February	814.1	810.0	28.1	6.8	21.2	30.6	1.3	16.3	26.1	10.5	8.1	91	68	32	35	127	0	30.5
March	813.6	809.6	27.8	8.2	19.6	31.7	2.2	16.7	25.5	11.8	9.7	90	74	39	63	138	18	40.1
April	813.4	810.1	25.7	9.5	16.2	30.8	4.6	16.7	22.5	13.4	12.6	94	81	54	133	232	41	65.5
May	814.3	811.1	25.1	9.9	15.2	27.8	4.5	16.6	22.4	13.6	12.9	96	82	55	106	184	44	48.1
June	814.9	811.8	24.9	7.7	17.2	28.2	2.7	15.4	23.2	11.9	11.6	95	80	49	67	110	12	38.9
July	814.8	811.9	23.9	8.5	15.4	27.5	1.0	14.9	22.4	11.2	11.2	93	76	50	74	188	31	62.5
August	814.7	811.5	24.1	8.5	15.6	27.0	3.0	15.3	22.3	11.5	11.6	93	77	51	92	172	33	51.1
September	814.2	810.8	25.3	6.9	18.4	29.1	2.0	16.0	22.5	11.5	10.9	94	75	48	74	157	10	29.7
October	814.3	810.6	25.3	7.7	17.6	28.9	2.5	16.9	22.1	12.0	11.2	95	73	50	86	132	23	32.0
November	813.9	810.2	24.4	8.6	15.8	28.0	3.4	16.4	21.5	12.5	12.0	96	78	55	95	307	31	54.1
December	813.9	810.2	25.2	8.2	17.0	29.0	2.7	16.8	23.1	12.0	11.0	94	75	47	49	156	1	35.6
Year	814.2	810.7	25.6	8.2	17.4	31.7	1.0	16.2	23.2	11.9	11.0	94	76	47	909	1089	654	66.0

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1959–63)			DAILY RADIATION ( ) INSTRUMENT ____			MONTHLY EVAPORATION (1958–63) PAN TYPE A			CLOUD AMOUNT (1957–62) TOTAL		CLOUD AMOUNT (1957–62) LOW		DAILY WIND RUN ( )	WIND SPEED (1957–62)		CALMS (1958–62)		VISIBILITY (1957–62) FOG		VISIBILITY (1957–62) MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX. MEAN	MIN. MEAN	MEAN	MAX. MEAN	MIN. MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	5	4	7.9	9.1	7.3				190	227	167	4.1	6.1	2.0	5.5		1	11	22	1	1	0	1	1
February	6	4	8.4	9.6	7.9				199	237	168	3.8	5.7	1.4	5.3		2	12	19	1	1	0	1	1
March	9	9	7.2	8.1	5.9				193	237	162	4.7	6.4	2.2	5.9		2	11	21	2	1	1	2	1
April	17	13	6.0	6.6	5.2				128	166	102	5.4	6.9	3.4	6.8		3	8	15	4	1	0	2	2
May	13	18	6.7	7.3	6.1				136	156	121	5.6	6.5	3.4	5.9		4	10	13	3	1	0	3	2
June	8	14	7.9	8.6	7.5				139	172	114	4.5	5.9	2.6	5.4		5	9	9	2	1	0	3	1
July	11	12	7.5	7.7	7.2				148	212	93	5.5	6.3	3.7	5.5		7	10	7	2	1	0	4	2
August	12	17	6.9	7.9	5.9				148	157	128	5.0	6.4	3.5	5.9		7	9	8	2	0	0	3	2
September	11	15	7.2	8.0	6.3				150	163	139	4.2	6.5	2.2	6.3		7	10	7	1	0	0	1	3
October	15	11	6.3	6.8	5.0				138	149	122	5.0	7.0	2.8	6.6		4	9	12	3	0	0	2	3
November	14	12	5.5	7.0	3.9				117	138	99	5.3	7.0	3.7	6.5		2	7	17	3	1	0	3	3
December	6	5	7.5	7.9	6.6				147	175	121	5.0	6.4	3.0	6.1		2	11	21	2	1	0	2	1
Year	127	134	7.1	7.2	6.9				1833	2082	1773	4.8	6.4	2.8	6.0		4	10	171	26	9	1	27	22

Table C-5 Climate of Nakuru (showground)

STATION NAME NAKURU - SHOWGROUND MET. STATION — STATION NUMBER 90.36/261

LATITUDE 00°16'S — LONGITUDE 36°04'E — ALTITUDE 6139 FEET (1871 METRES)

MONTH	ATMOSPHERIC PRESSURE (1966–70)		TEMPERATURE (1964–70)									RELATIVE HUMIDITY			RAINFALL (1964–70)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX. 24 HOUR FALL
	mb.	mb.	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	815.9	812.4	27.0	7.8	19.2	31.5	1.5	16.0	25.4	10.4	8.9	90	69	36	33	105	0	36.0
February	815.6	812.1	27.2	9.2	18.0	30.8	2.2	16.5	25.9	11.1	8.9	91	71	35	43	130	0	42.1
March	815.6	812.0	27.1	10.1	17.0	31.2	5.0	16.5	25.2	12.3	10.1	92	77	40	105	191	33	51.6
April	815.9	812.8	25.2	11.3	13.9	29.5	6.0	16.4	23.0	13.5	12.9	95	83	54	164	264	28	67.8
May	816.6	813.7	24.7	10.8	13.9	27.7	5.5	16.1	23.0	13.4	12.7	96	84	52	113	172	34	36.4
June	817.3	814.5	24.5	9.3	15.2	28.0	3.8	14.8	23.1	11.8	11.5	94	82	48	57	128	24	31.4
July	817.3	814.7	23.8	10.1	13.7	27.2	5.0	14.6	22.4	11.7	11.7	92	82	51	100	180	36	33.3
August	817.0	814.1	24.3	9.4	14.9	28.4	4.4	14.7	22.7	11.2	11.2	92	80	48	87	178	52	36.2
September	816.7	813.4	25.5	8.3	17.2	29.3	4.4	15.2	23.6	11.3	10.7	93	77	45	94	196	23	32.3
October	816.4	812.9	25.1	8.8	16.3	28.8	4.7	16.3	22.0	11.9	11.8	94	76	52	65	115	33	25.3
November	816.0	812.5	24.0	9.6	14.4	27.6	4.6	16.2	21.7	12.5	12.5	95	78	56	68	104	47	20.5
December	815.9	812.5	25.7	8.0	17.7	29.3	3.4	16.3	24.3	10.9	9.1	91	70	39	28	56	4	26.2
Year	816.3	813.1	25.3	9.4	15.9	31.5	1.5	15.8	23.5	11.8	11.0	93	77	46	956	1167	614	47.8

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1964–70)			DAILY RADIATION (1967–70) INSTRUMENT GB			MONTHLY EVAPORATION (1965–70) PAN TYPE A			CLOUD AMOUNT (1965–70)				DAILY WIND RUN	WIND SPEED (1964–70)		CALMS (1966-70)		VISIBILITY (1964–70)			
												TOTAL		LOW							FOG		MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX. MEAN	MIN. MEAN	MEAN	MAX. MEAN	MIN MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	5	3	8.6	10.3	5.9	556	600	503	198	220	165	3.2	5.4	1.5	4.8		2	11	9	0	0	0	1	1
February	6	5	8.3	10.3	6.2	532	627	450	183	230	127	4.0	5.9	1.8	5.1		2	11	9	1	1	0	1	1
March	11	9	7.0	8.4	5.9	491	556	427	177	236	142	5.1	6.4	2.5	5.7		2	10	12	1	1	0	1	1
April	18	14	5.9	8.3	4.8	470	541	382	135	170	102	5.9	6.8	3.9	6.1		2	9	10	1	1	0	1	1
May	13	14	7.5	8.6	6.4	473	508	433	138	152	113	5.0	6.3	3.7	5.8		3	8	5	1	1	0	1	1
June	9	7	7.9	8.8	7.2	488	518	462	131	150	115	4.3	6.1	2.8	5.4		3	8	6	2	1	0	1	1
July	12	10	6.9	7.7	6.1	463	485	450	129	150	108	5.6	6.2	3.8	5.4		4	8	5	2	0	0	1	1
August	13	11	7.0	8.0	5.7	486	524	458	134	163	106	4.7	6.2	3.2	5.5		4	8	4	1	0	0	1	1
September	12	12	7.5	8.5	6.2	513	536	492	139	170	110	3.6	6.3	2.0	5.9		3	8	7	1	1	0	1	1
October	14	13	6.4	7.5	5.0	500	539	451	132	159	105	4.8	6.8	2.5	6.3		3	9	5	1	1	0	1	2
November	14	6	5.8	6.9	4.9	450	492	399	120	139	95	5.2	6.8	3.5	6.4		3	9	8	1	1	0	1	1
December	4	2	7.8	9.2	4.8	555	605	517	175	200	161	3.5	5.8	1.8	5.2		2	10	11	1	1	0	1	1
Year	131	106	7.2	7.5	6.7	498	513	464	1791	1935	1546	4.6	6.3	2.7	5.6		3	9	91	13	9	0	12	13

Table C-6 Climate of Nairobi (Dagoretti E.A.M.D.)

STATION NAME NAIROBI, DAGORETTI E.A.M.D. HEADQUARTERS — STATION NUMBER 91.36/164

LATITUDE 01°18'S — LONGITUDE 36°45 E — ALTITUDE 5900 FEET (1798 METRES)

MONTH	ATMOSPHERIC PRESSURE (1955–70) 0600 GMT	ATMOSPHERIC PRESSURE (1955–70) 1200 GMT	TEMPERATURE (1955–70) MEANS MAX	MEANS MIN	MEANS RANGE	EXTREMES HIGHEST	EXTREMES LOWEST	DRY BULB 0600 GMT	DRY BULB 1200 GMT	DEW POINT 0600 GMT	DEW POINT 1200 GMT	RELATIVE HUMIDITY 0300 GMT	RELATIVE HUMIDITY 0600 GMT	RELATIVE HUMIDITY 1200 GMT	RAINFALL (1954–70) MEAN	RAINFALL HIGHEST	RAINFALL LOWEST	RAINFALL MAX. 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	822.7	819.5	24.5	11.3	13.2	29.7	3.3	17.2	23.6	12.9	11.8	94	77	48	82	253	0	77.0
February	822.5	819.1	25.6	11.2	14.4	29.7	4.7	17.7	24.6	12.9	11.1	93	74	44	65	201	4	104.6
March	822.6	819.3	25.4	13.0	12.4	30.0	6.7	17.4	24.4	14.3	12.2	95	81	47	103	207	23	66.3
April	822.7	819.7	23.9	13.9	10.0	28.8	7.8	16.9	22.7	14.6	13.8	95	86	58	211	428	20	76.5
May	823.9	821.1	22.5	13.1	9.4	26.2	7.2	16.1	21.4	13.9	13.8	96	89	62	198	478	85	64.6
June	824.7	822.1	21.7	10.7	11.0	26.2	4.4	14.6	20.7	12.2	12.1	94	86	59	33	82	2	31.5
July	824.8	822.4	20.6	9.7	10.9	25.8	2.5	13.5	19.5	11.2	11.5	92	87	60	15	85	1	46.7
August	824.6	821.9	21.4	9.9	11.5	27.9	2.9	13.7	20.3	11.2	11.2	93	85	56	29	67	1	53.7
September	824.3	821.0	23.7	10.3	13.4	29.1	3.9	14.8	22.6	11.8	10.8	94	85	48	24	62	2	54.4
October	824.0	820.3	24.7	12.5	12.2	28.3	5.0	16.3	23.6	13.0	11.3	94	81	46	53	164	12	45.2
November	823.4	819.9	23.0	13.1	9.9	27.8	6.7	16.2	21.9	13.9	13.1	93	87	58	167	623	41	70.4
December	822.9	819.6	23.3	12.5	10.8	27.4	5.3	16.9	22.5	13.5	12.6	95	81	54	103	379	8	112.3
Year	823.6	820.5	23.3	11.6	11.5	30.0	2.5	15.9	22.3	12.9	12.1	94	83	53	1079	1632	653	112.3

MONTH	NUMBER OF DAYS OF RAIN ≥1mm	NUMBER OF DAYS OF THUNDER	DAILY SUNSHINE (1955–70) MEAN	DAILY SUNSHINE MAX MEAN	DAILY SUNSHINE MIN MEAN	DAILY RADIATION (1957–70) INSTRUMENT E MEAN	DAILY RADIATION MAX MEAN	DAILY RADIATION MIN MEAN	MONTHLY EVAPORATION (1964–70) PAN TYPE A MEAN	MONTHLY EVAPORATION HIGHEST	MONTHLY EVAPORATION LOWEST	CLOUD AMOUNT (1955–70) TOTAL 0600 GMT	CLOUD AMOUNT TOTAL 1200 GMT	CLOUD AMOUNT LOW 0600 GMT	CLOUD AMOUNT LOW 1200 GMT	DAILY WIND RUN (1964–70)	WIND SPEED (1955–70) 0600 GMT	WIND SPEED 1200 GMT	CALMS (1966–70) 0600 GMT	CALMS 1200 GMT	VISIBILITY (1961–70) FOG 0600 GMT	VISIBILITY FOG 1200 GMT	VISIBILITY MIST, HAZE 0600 GMT	VISIBILITY MIST, HAZE 1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	5	2	9.1	11.0	6.8	545	624	457	205	247	163	4.8	4.5	3.0	3.3	112.9	7	11	2	1	1	0	5	1
February	5	3	9.3	10.5	7.6	568	608	497	191	242	139	4.6	4.6	3.1	3.6	108.7	6	11	1	1	1	1	5	1
March	11	3	8.4	9.6	6.2	534	584	476	192	255	143	6.1	5.1	5.3	4.2	107.5	6	12	2	1	1	0	11	1
April	16	5	7.1	8.9	5.7	460	531	398	148	171	129	6.9	6.0	6.0	5.2	91.5	5	9	4	1	1	1	13	1
May	15	4	6.1	7.9	4.4	404	464	354	129	173	111	6.7	6.1	6.0	5.4	68.3	4	6	6	1	1	1	11	1
June	5	1	5.8	7.5	3.6	383	427	341	105	150	90	6.4	5.7	5.6	5.3	61.0	3	6	6	1	2	0	11	1
July	2	1	4.2	6.2	2.3	325	388	241	90	104	72	6.9	6.5	6.1	5.9	54.2	3	6	8	1	2	0	14	2
August	4	1	4.3	5.3	2.4	345	423	267	101	125	78	6.9	6.2	6.4	5.8	62.3	3	7	6	1	2	1	12	1
September	3	1	6.2	7.6	4.3	451	529	319	147	176	103	6.4	5.4	5.9	5.0	90.7	6	8	6	1	1	1	10	1
October	6	1	7.3	9.0	5.7	479	526	374	172	211	139	6.4	5.5	6.1	5.0	102.2	7	10	1	0	1	0	11	1
November	16	3	7.0	8.5	5.1	456	532	379	142	165	123	6.8	5.6	6.4	4.8	113.5	7	10	1	0	2	0	13	1
December	7	3	8.5	10.2	5.7	516	587	388	178	197	139	5.6	4.8	4.5	3.9	121.1	7	11	1	1	1	1	8	1
Year	95	28	6.9	7.5	6.2	455	477	394	1800	1951	1605	6.2	5.5	5.4	4.8	91.2	5	9	44	10	16	6	124	13

Table C-7 Climate of Nairobi (Eastleigh Airport)

STATION NAME NAIROBI, EASTLEIGH AIRPORT MET. STATION — STATION NUMBER 91.36/087

LATITUDE 01°17'S — LONGITUDE 36°50'E — ALTITUDE 5371 FEET (1637 METRES)

MONTH	ATMOSPHERIC PRESSURE (1942–57)		TEMPERATURE (1942–57)									RELATIVE HUMIDITY			RAINFALL (1943–58)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX 24 HOUR FALL
	mb	mb.	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	839.2	836.0	26.6	13.2	13.4	30.6	8.1	17.9	25.6	13.2	11.0	88	74	41	43	166	1	54.4
February	839.3	835.9	27.8	13.3	14.5	31.8	9.2	18.1	26.7	13.2	10.1	86	73	35	29	257	0	67.3
March	839.3	836.2	27.3	14.5	12.8	31.6	9.8	18.0	26.0	14.6	13.4	90	80	41	78	214	0	116.3
April	839.8	836.8	25.7	15.4	10.3	30.8	10.3	17.8	24.4	15.4	13.7	94	86	52	182	406	105	76.7
May	840.7	838.0	24.4	14.8	9.6	28.7	9.2	17.1	23.1	14.7	13.9	95	85	57	108	254	33	73.7
June	841.6	839.2	23.4	13.1	10.3	29.2	7.6	15.4	22.2	12.7	12.4	91	84	54	39	170	0	74.7
July	841.7	839.5	22.5	11.8	10.7	28.1	6.1	14.3	21.2	11.7	11.3	90	84	53	14	27	1	27.2
August	841.5	839.1	22.9	12.2	10.7	29.7	7.3	14.6	21.6	11.8	11.2	90	84	52	27	59	1	30.0
September	841.4	838.1	25.4	12.6	12.8	30.0	6.4	15.6	23.9	12.2	10.5	90	81	43	32	74	1	55.9
October	841.0	837.3	26.3	13.8	12.5	29.9	7.9	17.0	25.1	13.3	10.3	91	79	40	50	197	4	80.8
November	840.2	836.9	24.6	14.6	10.0	30.0	10.6	17.1	23.4	14.7	12.9	94	85	52	117	223	64	63.5
December	839.7	836.7	24.8	14.0	10.8	29.7	9.1	17.4	23.7	14.4	12.7	94	82	51	70	230	7	97.0
Year	840.5	837.5	25.2	13.6	11.6	31.8	6.1	16.7	23.9	13.5	11.8	91	81	48	783	1436	482	116.3

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE			DAILY RADIATION ( ) INSTRUMENT ____			MONTHLY EVAPORATION ( ) PAN TYPE ____			CLOUD AMOUNT (1942–57) TOTAL		LOW		DAILY WIND RUN	WIND SPEED (1942–57)		CALMS (1953–57)		VISIBILITY (1949–57) FOG			MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX. MEAN	MIN. MEAN	MEAN	MAX MEAN	MIN. MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	5	1										4.3	4.0	2.8	3.2		5	11	1	3	1	0	1	1
February	3	1										4.2	4.0	2.7	3.1		5	12	1	3	1	0	2	1
March	6	2										5.8	5.1	4.5	3.7		5	12	0	0	1	0	1	1
April	13	5										6.8	5.9	5.7	5.1		4	10	1	0	1	0	1	1
May	13	3										6.6	6.0	5.9	5.3		4	7	0	0	0	0	2	1
June	3	1										6.5	6.1	5.9	5.7		4	7	1	0	0	0	2	0
July	2	0										6.6	6.6	6.1	6.3		4	7	1	0	1	0	2	0
August	4	1										6.7	6.6	5.7	6.1		4	7	1	0	1	0	2	1
September	3	1										6.3	5.6	5.9	5.4		4	7	0	0	0	0	1	1
October	4	1										6.4	5.4	5.9	4.7		5	10	0	0	1	0	1	0
November	14	1										6.8	5.7	6.5	5.2		7	11	0	0	0	0	3	1
December	7	1										6.1	5.5	5.1	4.0		5	9	0	0	1	0	1	1
Year	77	18										6.1	5.5	5.2	4.8		5	9	6	0	8	0	19	9

Table C-8 Climate of Nairobi (Embakasi Airport)

STATION NAME NAIROBI EMBAKASI AIRPORT MET STATION — STATION NUMBER 91.36/168

LATITUDE 01°19'S — LONGITUDE 36°55'E — ALTITUDE 5327 FEET (1624 METRES)

MONTH	ATMOSPHERIC PRESSURE (1959–70)		TEMPERATURE (1959–70)									RELATIVE HUMIDITY			RAINFALL (1958–70)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX. 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	840.4	836.8	26.7	12.3	14.4	32.2	4.7	18.3	25.6	14.2	12.4	94	77	44	56	151	0	60.2
February	840.1	836.4	27.9	12.6	15.3	31.4	7.4	18.7	26.8	14.5	12.1	93	78	40	48	305	3	69.9
March	840.2	836.6	27.5	13.6	13.9	32.1	7.9	18.6	26.3	15.7	13.2	95	84	45	79	178	7	66.3
April	840.3	837.0	26.0	14.4	11.6	31.5	9.8	18.2	24.6	15.9	14.7	98	87	55	144	251	9	101.9
May	841.3	838.3	24.7	13.6	11.1	28.8	6.3	17.4	23.5	15.0	14.5	97	85	57	124	373	12	71.9
June	842.3	839.5	24.0	11.4	12.6	28.9	6.1	15.8	22.9	13.3	12.8	96	85	53	22	85	0	30.0
July	842.5	839.9	22.5	10.7	11.8	27.5	4.6	14.8	21.4	12.2	12.0	94	85	55	6	58	0	19.8
August	842.4	839.4	23.1	10.8	12.3	28.9	4.4	14.9	21.9	12.3	12.2	94	85	54	15	40	0	38.0
September	842.1	838.7	25.6	11.1	14.5	31.1	4.2	16.2	24.4	12.7	11.9	94	79	46	13	33	0	26.9
October	841.6	837.5	26.7	12.6	14.1	30.4	5.4	18.0	25.3	14.0	12.0	96	77	44	45	159	1	32.3
November	840.9	837.1	25.1	13.4	11.7	30.2	9.0	17.7	23.7	15.2	13.9	98	85	54	152	484	28	54.4
December	840.5	836.9	25.6	12.9	12.7	29.6	7.9	18.1	24.5	14.8	13.3	97	81	50	81	276	12	112.3
Year	841.2	837.8	25.5	12.5	13.0	32.2	4.2	17.2	24.2	14.1	12.9	95	82	50	785	1285	487	112.3

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1960–70)			DAILY RADIATION (INSTRUMENT ____)			MONTHLY EVAPORATION (1968–70) (PAN TYPE A)			CLOUD AMOUNT (1959–70)				DAILY WIND RUN (1963–70)	WIND SPEED (1959–70)		CALMS (1966–70)		VISIBILITY (1961–70)			
												TOTAL		LOW							FOG		MIST, HAZE	
	RAIN ≥1mm	THUNDER	MEAN	MAX MEAN	MIN MEAN	MEAN	MAX MEAN	MIN MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	days	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	4	2	9.5	11.1	6.4				226	292	171	4.6	4.5	2.9	3.2	161.3	7	11	2	1	1	0	1	1
February	4	2	9.5	10.9	7.5				199	226	164	4.4	4.6	3.0	3.5	168.4	5	12	3	0	1	0	1	1
March	9	5	8.3	9.9	6.0				177	219	144	5.9	5.0	4.8	4.2	163.5	6	12	3	1	1	0	1	1
April	13	4	7.2	8.9	5.8				154	192	135	6.5	5.7	5.6	5.0	127.3	5	10	4	1	0	0	1	1
May	12	3	6.1	7.7	4.8				125	141	116	6.2	5.8	5.2	5.2	140.0	4	7	11	2	0	0	1	1
June	3	1	5.7	7.2	4.6				108	123	95	5.9	5.5	4.9	4.9	106.1	4	7	7	3	1	0	3	1
July	1	1	4.2	6.1	2.4				107	123	87	6.4	6.3	5.5	5.7	107.0	5	6	5	2	1	0	4	1
August	3	1	4.1	5.5	2.4				109	133	89	6.5	6.3	5.9	5.8	110.8	4	7	8	1	1	0	5	1
September	1	1	5.9	7.7	4.1				168	175	158	6.0	5.5	5.4	5.1	140.8	4	7	6	1	0	0	2	1
October	4	1	7.1	8.9	5.7				214	230	204	6.1	5.6	5.7	5.1	161.8	5	10	4	1	1	0	1	1
November	11	2	7.0	8.1	4.7				166	188	129	6.6	5.6	6.2	4.9	182.0	7	11	2	0	1	1	3	1
December	7	1	8.7	10.2	5.9				206	232	185	5.3	4.7	4.5	3.9	183.4	7	12	2	0	1	0	2	1
Year	72	24	6.9	7.6	6.1				1955	2042	1894	5.9	5.4	5.0	4.7	146.4	5	9	57	13	9	1	25	12

STATION NAME NAIROBI, KABETE OBSERVATORY

STATION NUMBER 91.36/30

LATITUDE 01°16'S LONGITUDE 36°45'E

ALTITUDE 5971 FEET (1820 METRES)

MONTH	ATMOSPHERIC PRESSURE (1931–54) 0600 GMT	ATMOSPHERIC PRESSURE (1931–54) 1200 GMT	TEMPERATURE (1931–54) MEANS MAX	MEANS MIN	MEANS RANGE	EXTREMES HIGHEST	EXTREMES LOWEST	DRY BULB 0600 GMT	DRY BULB 1200 GMT	DEW POINT 0600 GMT	DEW POINT 1200 GMT	RELATIVE HUMIDITY 0300 GMT	RELATIVE HUMIDITY 0600 GMT	RELATIVE HUMIDITY 1200 GMT	RAINFALL (1929–63) MEAN	RAINFALL HIGHEST	RAINFALL LOWEST	RAINFALL MAX 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	821.9	818.6	25.1	12.2	12.9	28.9	8.2	16.9	23.9	12.3	10.3	84	76	43	47	218	0	72.1
February	821.8	818.5	26.3	12.7	13.6	30.3	8.9	17.3	25.2	12.6	9.2	80	75	37	51	190	0	71.9
March	821.7	818.6	25.6	13.7	11.9	29.9	9.6	17.1	24.3	13.9	11.1	84	81	44	100	279	2	68.6
April	822.3	819.3	23.8	14.3	9.5	29.6	11.1	16.6	22.6	14.6	13.3	90	90	56	210	436	40	99.1
May	823.0	820.4	22.3	13.6	8.7	27.8	8.7	15.8	21.1	13.9	13.7	90	90	62	171	486	47	79.8
June	823.9	821.5	21.2	11.9	9.3	26.7	6.9	14.3	20.1	12.3	12.2	86	89	60	44	183	0	56.1
July	823.9	821.7	20.6	10.9	9.7	26.4	5.7	13.3	19.6	11.1	11.1	86	87	58	19	131	0	87.9
August	823.8	821.4	21.1	11.1	10.0	27.6	6.6	13.3	19.7	11.1	10.9	86	87	57	26	77	0	62.2
September	823.7	820.5	23.7	11.4	12.3	27.8	5.1	14.4	22.3	11.6	10.1	86	83	46	29	127	1	40.9
October	823.2	819.7	24.6	12.7	11.9	30.0	7.2	15.6	23.2	12.6	10.1	87	83	44	60	203	2	67.3
November	822.4	819.2	23.1	13.4	9.7	27.9	9.2	15.9	21.9	13.7	12.1	88	88	54	127	642	30	56.6
December	822.1	819.0	23.2	12.9	10.3	27.8	8.3	16.4	21.9	13.2	12.0	88	81	53	93	385	6	102.9
Year	822.8	819.9	23.4	12.6	10.8	30.3	5.1	15.6	22.1	12.7	11.3	86	84	51	977	1716	543	102.9

MONTH	NUMBER OF DAYS OF RAIN ≥1mm	NUMBER OF DAYS OF THUNDER	DAILY SUNSHINE (1931–55) MEAN	DAILY SUNSHINE MAX MEAN	DAILY SUNSHINE MIN MEAN	DAILY RADIATION (1938–43) INSTRUMENT KIPP MEAN	DAILY RADIATION MAX MEAN	DAILY RADIATION MIN MEAN	MONTHLY EVAPORATION PAN TYPE MEAN	EVAPORATION HIGHEST	EVAPORATION LOWEST	CLOUD AMOUNT (1931–54) TOTAL 0600 GMT	CLOUD AMOUNT TOTAL 1200 GMT	CLOUD AMOUNT LOW 0600 GMT	CLOUD AMOUNT LOW 1200 GMT	DAILY WIND RUN	WIND SPEED (1934–54) 0600 GMT	WIND SPEED 1200 GMT	CALMS (1959–54) 0600 GMT	CALMS 1200 GMT	VISIBILITY (1949–55) FOG 0600 GMT	FOG 1200 GMT	MIST, HAZE 0600 GMT	MIST, HAZE 1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	7	1	9.7	11.2	6.8	628	694	580				4.4	4.5	3.1	3.3		5	11	4	0	1	0	1	0
February	4	2	9.6	11.0	6.8	627	640	602				4.6	4.5	2.8	3.5		4	12	2	0	1	0	1	0
March	9	4	8.6	10.1	6.7	595	662	537				6.0	5.3	4.7	4.0		4	11	1	0	0	0	1	0
April	13	7	7.1	8.7	4.5	525	573	485				6.9	5.9	6.2	5.2		4	9	3	0	1	0	2	0
May	13	3	6.1	8.3	4.0	446	482	414				6.9	6.0	5.9	5.5		3	8	3	0	1	0	4	0
June	5	2	4.8	7.3	2.8	372	477	321				6.9	6.3	6.1	5.6		3	7	5	0	1	0	4	1
July	4	1	4.2	5.9	2.9	350	383	299				6.9	6.5	6.3	6.1		3	6	3	0	1	0	5	1
August	4	1	4.0	5.5	2.6	373	411	344				7.0	6.6	5.8	5.9		3	7	2	0	1	0	8	1
September	4	1	6.1	8.1	4.3	518	584	407				6.5	5.4	6.0	5.0		3	9	2	0	1	0	4	1
October	6	1	7.2	8.9	5.2	547	583	485				6.7	5.5	6.3	4.6		5	10	1	0	1	0	3	0
November	14	2	7.2	8.9	5.4	522	556	476				7.0	5.7	6.5	4.3		6	10	1	0	1	0	3	1
December	7	2	8.5	10.1	6.2	575	628	518				5.9	5.2	5.1	3.2		6	11	2	0	0	0	2	0
Year	90	27	6.9	7.7	5.9	506	532	439				6.3	5.6	5.4	4.7		4	9	28	0	10	0	38	5

Table C-10 Climate of Nairobi (National Laboratories)

STATION NAME NAIROBI NATIONAL LABORATORIES — STATION NUMBER 91.36/025

LATITUDE 01°15'S — LONGITUDE 36°45'E — ALTITUDE 5700 FEET (1737 METRES)

MONTH	ATMOSPHERIC PRESSURE ( )		TEMPERATURE (1921–70)									RELATIVE HUMIDITY			RAINFALL (1923–70)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX. 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January			25.3	12.4	12.9	30.8	3.3	18.3	24.3	12.8	10.9		70	43	52	230	0	77.3
February			26.5	12.8	13.7	33.3	3.9	18.9	25.6	13.1	10.2		69	39	46	169	0	122.4
March			25.9	13.7	12.2	32.2	3.9	18.5	25.1	14.5	11.7		78	44	106	291	3	73.7
April			24.2	14.3	9.9	30.6	7.8	17.7	23.0	15.3	13.6		86	55	223	493	26	99.2
May			22.9	13.3	9.6	27.8	3.9	16.9	21.7	14.4	13.8		85	60	168	415	34	96.8
June			21.9	11.8	10.1	28.9	2.8	15.3	21.0	12.6	12.4		84	58	42	199	0	61.5
July			21.0	10.8	10.2	27.1	2.2	14.4	19.9	11.8	11.2		84	58	15	103	0	75.7
August			21.6	11.0	10.6	29.4	1.7	14.3	20.2	11.7	11.1		84	57	27	85	1	80.3
September			23.9	11.5	12.4	30.0	2.2	15.7	22.7	11.9	10.3		78	45	22	111	1	44.2
October			24.8	12.7	12.1	30.6	2.2	17.1	23.6	13.2	10.9		78	45	54	187	3	58.4
November			23.3	13.4	9.9	29.4	5.0	17.1	22.0	14.2	13.1		82	57	133	587	33	71.1
December			23.6	13.0	10.6	31.4	2.8	17.1	22.4	13.8	13.0		78	55	85	348	4	110.2
Year			23.7	12.6	11.1	33.3	1.7	16.8	22.6	13.3	11.9		80	51	973	1829	511	122.4

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1939–70)			DAILY RADIATION (1963–70) INSTRUMENT GB			MONTHLY EVAPORATION ( ) PAN TYPE			CLOUD AMOUNT ( )				DAILY WIND RUN (1963–70)	WIND SPEED ( )		CALMS ( )		VISIBILITY ( )			
												TOTAL		LOW							FOG		MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX. MEAN	MIN. MEAN	MEAN	MAX. MEAN	MIN. MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	6		9.2	11.1	6.2	510	620	392								75.6								
February	5		9.4	10.6	6.4	503	600	355								74.5								
March	10		8.3	9.8	6.4	469	594	366								72.7								
April	17		6.5	8.5	4.1	386	444	308								62.4								
May	16		5.7	8.0	3.6	358	447	261								52.3								
June	4		4.9	7.5	2.0	341	459	270								46.8								
July	3		4.1	5.3	2.4	301	394	196								45.2								
August	5		4.1	5.3	2.4	335	391	264								47.6								
September	2		6.1	8.3	4.2	432	491	308								59.8								
October	6		7.1	9.1	5.8	452	524	324								70.1								
November	15		6.5	8.3	3.7	389	455	254								70.2								
December	7		8.1	10.1	4.9	471	567	380								73.6								
Year	96		6.7	7.4	5.7	412	458	366								62.6								

Table C-11 Climate of Nairobi (Wilson Airport)

STATION NAME NAIROBI WILSON AIRPORT MET. STATION — STATION NUMBER [illegible]

LATITUDE 01°19 S — LONGITUDE 36°49 E — ALTITUDE 5545 FEET 1689 METRES

MONTH	ATMOSPHERIC PRESSURE (1965–70)		TEMPERATURE (1961–70)							DEW POINT		RELATIVE HUMIDITY			RAINFALL (1951–70)			
			MEANS			EXTREMES		DRY BULB										
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	835.1	831.7	26.4	12.5	13.9	31.1	7.2	18.1	25.3	13.1	10.1	90	72	39	69	251	0	64.0
February	834.8	831.4	27.3	12.9	14.4	30.4	7.7	18.7	26.0	13.5	10.1	89	72	39	51	185	0	70.6
March	834.9	831.6	26.9	14.3	12.6	31.5	10.3	18.2	25.3	14.9	11.5	93	81	43	83	197	0	74.7
April	835.2	832.2	25.2	14.6	10.6	28.9	10.9	17.7	23.6	15.4	13.8	95	86	55	188	462	19	109.2
May	836.3	833.5	23.8	13.7	10.1	28.1	8.3	16.9	22.5	14.6	13.9	96	86	68	170	437	43	116.7
June	837.2	834.8	23.1	11.6	11.5	28.0	7.2	15.4	21.1	12.9	12.0	93	85	54	33	-	-	37.4
July	837.5	835.1	22.0	10.8	11.2	27.0	5.4	14.4	20.7	11.7	10.9	93	83	54	33	68	-	27.4
August	837.2	834.4	22.6	10.9	11.7	28.8	5.9	14.4	21.2	11.8	10.6	93	84	51	2	127	-	82.4
September	836.8	833.3	25.2	11.4	13.8	31.1	5.9	15.7	24.4	12.1	9.9	91	79	40	20	67	-	31.1
October	836.3	832.4	26.1	13.3	12.8	29.6	6.9	17.3	24.9	13.5	10.6	93	78	41	45	143	-	47
November	835.6	832.2	24.3	14.0	10.3	28.4	9.6	17.1	22.7	14.6	13.1	95	84	55	146	521	19	82.0
December	835.2	831.8	24.9	13.5	11.4	28.6	8.4	17.7	24.6	14.1	11.5	92	79	44	70	244	9	72.4
Year	836.0	832.9	24.8	12.8	12.0	31.5	5.4	16.8	23.6	13.5	11.5	93	81	48	909	1944	581	109.2

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1961–70)			DAILY RADIATION (1961–70) INSTRUMENT ____			MONTHLY EVAPORATION (1961–70) PAN TYPE ____			CLOUD AMOUNT (1961–70) TOTAL		LOW		DAILY WIND RUN	WIND SPEED (1961–70)		CALMS (1966–70)		VISIBILITY (1961–70) FOG		MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX. MEAN	MIN. MEAN	MEAN	MAX MEAN	MIN. MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	3	2										4.5	4.2	3.1	3.6		7	11	3	1	0	0	1	1
February	5	2										4.5	4.8	3.1	3.9		6	11	3	0	1	0	1	1
March	11	3										6.2	5.5	5.9	4.8		7	12	5	1	0	0	2	1
April	16	4										6.8	6.1	6.0	5.5		5	10	6	1	1	0	1	1
May	14	3										6.4	5.9	5.8	5.5		4	7	11	2	1	0	1	1
June	3	1										6.1	6.0	5.3	5.5		3	7	11	2	1	0	3	1
July	2	0										6.7	6.7	5.9	5.9		4	7	11	3	-	0	3	1
August	4	0										6.9	6.5	6.3	6.1		3	7	11	1	1	0	3	1
September	7	1										6.4	5.7	5.8	5.5		4	8	8	1	0	-	2	1
October	5	1										6.6	6.1	6.2	5.6		5	10	6	-	1	0	1	-
November	15	1										7.0	6.0	6.4	5.1		3	11	2	-	-	1	3	-
December	7	1										5.5	4.1	4.7	1.8		4	11	3	0	1	0	1	1
Year	87	19										6.1	5.6	5.3	5		5	9	80	14	7	2	25	12

Table C-12 Climate of Mombasa

STATION NAME MOMBASA, PORT REITZ AIRPORT MET. STATION — STATION NUMBER 94.35/021

LATITUDE 04°02'S — LONGITUDE 39°37'E — ALTITUDE 186 FEET (57 METRES)

MONTH	ATMOSPHERIC PRESSURE (1946–70)		TEMPERATURE (1946–70)									RELATIVE HUMIDITY			RAINFALL (1946–70)			
			MEANS			EXTREMES		DRY BULB		DEW POINT								
	0600 GMT	1200 GMT	MAX	MIN	RANGE	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0300 GMT	0600 GMT	1200 GMT	MEAN	HIGHEST	LOWEST	MAX 24 HOUR FALL
	mb	mb	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	%	%	mm	mm	mm	mm
January	1006.2	1002.3	32.1	23.2	8.9	36.9	18.4	26.8	30.4	22.6	22.5	92	78	63	35	130	0	49.0
February	1005.8	1001.9	32.4	23.6	8.8	36.1	20.6	27.1	30.9	22.8	22.5	92	77	61	19	90	0	49.9
March	1005.6	1001.9	32.7	24.2	8.5	37.3	20.8	27.6	31.4	23.9	23.3	92	80	63	64	253	1	105.7
April	1006.0	1002.9	31.2	23.8	7.4	35.1	21.1	26.7	29.9	23.8	23.3	94	85	68	171	601	23	119.7
May	1008.2	1005.6	29.2	22.6	6.6	33.8	18.9	25.3	28.0	23.0	22.4	94	87	72	234	772	36	138.9
June	1010.5	1008.1	28.5	21.2	7.3	31.5	17.5	24.1	27.3	21.7	20.7	93	86	68	68	335	6	43.4
July	1011.2	1008.9	27.7	20.3	7.4	31.1	17.6	23.1	26.4	20.8	20.1	94	87	68	66	205	5	37.1
August	1011.2	1008.7	28.0	20.3	7.7	30.9	14.1	23.3	26.7	21.0	21.1	94	87	67	69	216	10	74.5
September	1010.5	1007.6	28.9	20.8	8.1	32.0	17.6	24.3	27.6	21.3	20.4	94	83	65	80	356	10	149.9
October	1009.2	1005.7	29.7	22.0	7.7	32.8	17.7	25.5	28.5	22.3	21.5	94	82	66	98	279	13	103.4
November	1007.5	1003.7	30.6	23.0	7.6	35.7	20.0	26.6	29.4	23.2	22.8	94	81	68	100	316	9	105.4
December	1006.4	1002.7	31.6	23.3	8.3	35.7	19.4	27.0	30.0	23.3	23.1	94	80	67	69	172	2	68.8
Year	1008.2	1005.0	30.2	22.4	7.8	37.3	14.1	25.6	28.8	22.5	21.9	93	83	66	1073	1784	585	149.9

MONTH	NUMBER OF DAYS OF		DAILY SUNSHINE (1949–70)			DAILY RADIATION (1963–70) INSTRUMENT GB			MONTHLY EVAPORATION (1958–70) PAN TYPE A			CLOUD AMOUNT (1946–70) TOTAL		LOW		DAILY WIND RUN	WIND SPEED (1946–70)		CALMS (1946–70)		VISIBILITY (1961–70) FOG		MIST, HAZE	
	RAIN	THUNDER	MEAN	MAX. MEAN	MIN. MEAN	MEAN	MAX MEAN	MIN MEAN	MEAN	HIGHEST	LOWEST	0600 GMT	1200 GMT	0600 GMT	1200 GMT		0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT	0600 GMT	1200 GMT
	≥1mm	days	hours	hours	hours	langleys	langleys	langleys	mm	mm	mm	oktas	oktas	oktas	oktas	miles	knots	knots	days	days	days	days	days	days
January	4	2	8.6	9.6	6.7	530	580	444	220	244	201	5.6	4.1	4.7	2.9		6	12	2	0	0	0	1	1
February	2	1	9.1	10.2	7.5	535	609	423	211	238	173	5.5	3.4	4.3	2.3		5	13	3	1	0	0	1	1
March	6	5	9.0	9.9	7.3	544	618	445	225	261	162	5.3	3.9	4.0	2.5		4	12	9	1	0	0	1	1
April	11	6	7.5	9.8	6.0	453	509	405	184	221	154	5.7	5.2	3.7	3.1		5	12	6	1	1	0	1	1
May	13	1	6.5	9.2	4.4	387	451	326	159	211	129	5.8	5.7	4.1	3.6		7	13	3	1	0	0	2	2
June	9	0	7.5	9.5	5.5	390	450	327	148	187	119	5.2	5.3	3.8	3.8		7	13	3	1	0	0	2	1
July	11	0	7.0	7.9	5.8	386	431	340	144	171	111	5.5	5.6	4.2	4.1		6	13	3	0	0	0	2	1
August	9	0	7.9	9.2	6.4	420	471	352	164	192	136	5.4	5.4	4.4	4.2		6	13	2	1	0	0	1	1
September	9	0	8.5	9.6	7.0	489	550	402	187	218	162	5.5	4.7	5.2	3.7		6	13	2	0	1	0	1	1
October	11	0	8.7	10.0	7.3	506	564	413	200	243	155	5.8	3.9	5.5	3.3		5	12	5	1	0	0	2	1
November	10	2	9.0	10.0	7.0	529	647	433	195	242	148	5.5	3.9	4.9	3.2		3	12	10	1	0	1	2	1
December	6	4	8.8	10.1	7.0	520	589	462	197	213	185	5.5	4.2	4.4	3.2		5	11	3	1	0	0	1	1
Year	101	21	8.2	8.7	7.4	474	517	422	2234	2454	1976	5.5	4.6	4.4	3.3		5	12	51	9	2	1	17	13

Appendix D Present Grain Production and Marketing

Table D-1 Maize Production

(Unit: Bag)

Year	Kisumu	Kisii	Nandi	Kericho	Uasin Gishu
1977/78	226,000	1,207,000	1,632,700	1,487,200	1,070,500
1978/79	194,000	1,038,000	1,567,000	1,380,000	1,020,000
1979/80	146,000	1,000,500	1,580,000	1,470,000	750,000
1980/81	130,000	1,200,000	1,732,000	1,600,000	1,359,000
1981/82	200,000	1,200,000	1,800,000	1,700,000	1,600,000
Average	179,200	1,129,100	1,662,340	1,527,440	1,159,900

Year	Trans Nzoia	South Nyanza	Bungoma	Kakamega	Nakuru
1977/78	2,100,000	600,000	1,650,000	1,600,000	1,050,000
1978/79	1,700,000	516,000	1,370,000	1,330,000	1,270,000
1979/80	1,050,000	300,000	850,000	1,248,000	700,000
1980/81	2,390,000	500,000	1,750,000	750,000	600,000
1981/82	2,400,000	500,000	1,800,000	1,000,000	1,200,000
Average	1,928,000	483,200	1,484,000	1,185,600	964,000

Year	Coast Province	Busia	Narok	Meru	Embu
1977/78	617,000	536,000	169,600	731,000	248,000
1978/79	543,000	200,000	140,000	694,000	235,000
1979/80	541,000	196,000	180,000	679,000	209,000
1980/81	500,000	200,000	225,000	600,000	200,000
1981/82	600,000	250,000	300,000	650,000	240,000
Average	560,200	276,400	202,920	670,800	226,400

Year	Kitui	Baringo	Kirinyaga	Total
1977/78	255,000	133,000	-	15,313,000
1978/79	242,000	106,000	-	13,545,000
1979/80	250,000	160,000	310,000	11,619,000
1980/81	200,000	200,000	250,000	13,363,000
1981/82	250,000	250,000	300,000	16,240,000
Average	239,400	169,800	286,700	14,016,000

Source: NCPB

Table D-2 Wheat Production

(Unit: Bag = 90 kg)

Zone	Year of Planting					Average
	1976	1977	1978	1979	1980	
Nakuru	607,255	616,242	535,289	443,060	636,085	567,586
Narok	293,371	305,179	114,605	82,937	229,366	205,092
Central Kenya	204,057	284,472	217,282	245,869	81,876	204,711
Nyandarua	151,290	101,614	105,135	57,552	86,746	100,467
Uasin Gishu	631,752	441,212	629,334	753,467	901,224	671,398
Trans-Nzoia	120,233	95,388	116,272	141,407	175,248	129,710
Total	2,007,958	1,844,106	1,717,917	1,724,292	2,110,547	1,878,964

Notes: (i) Figures for 1980 Planted crop are those as at 31st March, 1981. Total production however stands at 2,130,000 bags.

(ii) Uasin Gishu, Trans-Nzoia had poor harvest because of the heavy rains which fell at harvesting time. There were no drying facilities to salvage the crop.

(iii) Preliminary estimate for 1981 planted crop - 2,200,000 Bags.

Table D-3 Wheat Production and Flour Consumption

Year	Hectares	Net Wheat Production (Tonnes)	Wheat Imports (Tonnes)	Wheat Flour Consumption (Tonnes)
1970	128,004	176,871	Nil	94,092
1971	115,099	170,316	Nil	117,618
1972	104,859	149,586	64,826	113,489
1973	104,344	137,884	77,084	131,905
1974	105,101	157,833	13,744	128,673
1975	117,242	161,918	83,758	112,057
1976	119,653	180,716	Nil	136,478
1977	137,764	165,950	32,808	158,121
1978	118,970	157,500	90,980	184,733
1979	87,224	155,160	25,500	158,050
1980	99,914	190,681	92,386	225,242

Table D-4 Maize Handling Volume of the NCPB

Unit: 1 bag = 90 kg

Fiscal Year	Cultivated Area of Maize ha	Purchase bags	Export bags	Import bags	Domestic Consumption bags
1975/76	427,995	6,174,087	2,495,051	-	4,193,173
1976/77	488,959	6,031,336	162,009	-	4,252,341
1977/87	436,892	2,713,391	306,426	-	1,442,729
1978/79	367,696	2,648,070	1,545,784	-	4,149,422
1979/89	522,930	-	227,573	1,837,307	-

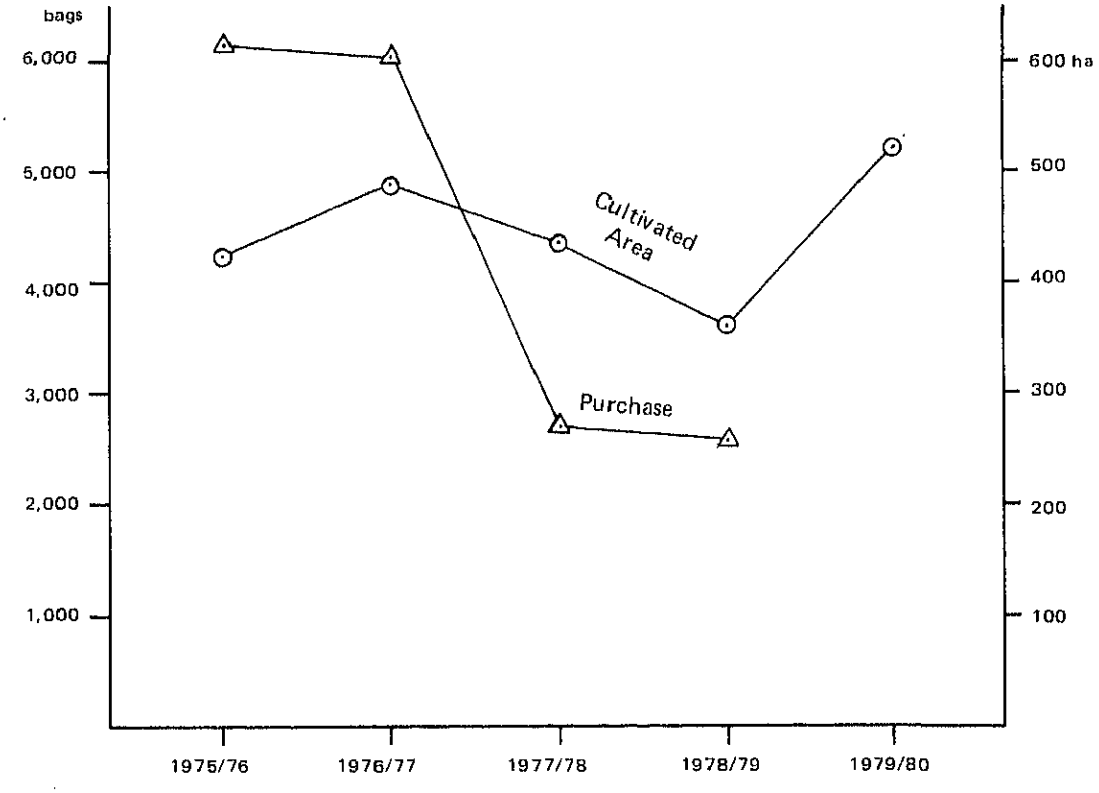


Table D-5 Monthly Movement of Grain

Unit: %

Month	NAKURU		BUNGOMA		KISUMU		Average in Kenya		
	77/78	78/79	77/78	78/79	77/78	78/79	77/78	78/79	Mean
8	0.1	-	0.3	-	-	6.4	1.4	0.5	0.9
9	-	2.9	2.1	-	-	27.8	3.0	2.6	2.8
10	-	3.0	6.6	1.2	-	13.4	6.0	2.3	4.2
11	-	1.3	10.1	-	1.4	20.4	8.4	3.9	6.1
12	-	3.2	6.8	-	8.5	9.7	6.5	6.0	6.2
1	3.2	1.4	14.7	29.8	43.1	13.4	16.0	10.9	13.5
2	13.1	12.9	15.9	37.0	12.0	8.6	15.6	21.6	18.6
3	38.3	30.2	13.8	22.4	24.7	0.1	14.5	21.9	18.2
4	17.4	21.6	16.8	7.8	5.2	0.1	13.6	13.1	13.3
5	16.1	20.2	10.4	1.8	2.4	0.1	9.6	9.2	9.4
6	8.7	3.3	2.5	0.1	1.8	-	4.8	5.1	5.0
7	3.1	-	-	-	0.9	-	0.6	2.9	1.8
Total	100	100	100	100	100	100	100	100	100

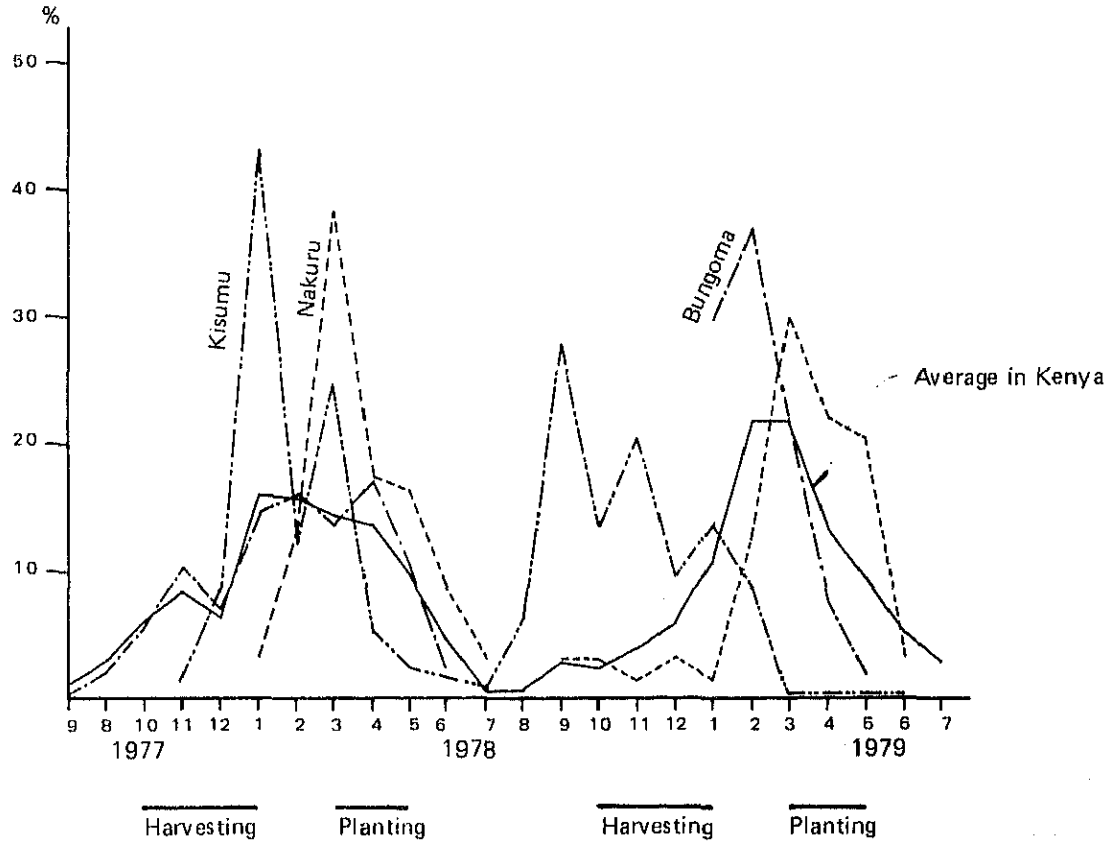


Table D-6 Operation of Storage (1975/76 - 1978/79)

Storage	Capacity 1,000 bags	Train	Purchasing %	Transfer in %	Local Sale %	Transfer out %	Note		Mill Capacity 1,000bags
Butere	180	o	61	-	23	45	C	-	
Myunga	70	o	177	-	14	68	C	-	
Malaba	40	o	68	-	2	53	C	-	
Bungoma	310	o	97	-	31	63	C	-	
Webuye	330	o	96	-	22	88	C	-	
Kipharren	95	o	58	-	7	49	C	-	
Lugari	80	o	152	15	3	105	C	-	
Jurbo	120	o	161	-	20	134	C	-	
Kitale	1,100	o	71	-	15	55	C	-	970.32
Eldoret	300	o	192	1	112	76	C	S	962.00
Moi's Bridge	155	o	200	-	18	190	C	-	
Nakuru	465	o	62	1	35	25	C	S	1,550.88
Kericho	64	x	79	-	3	30	C	-	
Kipkelon	142	o	112	3	45	73	C	-	21.60
Nyahururo	125	o	86	-	50	49	C	S	
Kilgoris	4	x	193	-	10	200	C	-	
Kisii	50	x	37	-	9	21	C	-	
Kendu Bay	125	x	149	2	46	102	C	-	
Homa Bay	65	x	164	3	20	122	C	-	72.00
Kisumu	257	o	96	1	56	48	C	S	950.40
Yala	74	o	54	-	27	30	C	S	
Machakos	60	x	20	49	99	44	-	S	84.00
Konza	120	o	10	111	62	-	-	S	
Kibwezi	90	o	115	109	71	40	C	S	
Kitui	33	x	49	189	220	-	-	S	
Nanyuki	100	o	17	39	41	21	-	S	28.80
Meru	70	x	63	30	38	-	-	S	480.00
Thika	140	o	11	26	33	-	-	S	86.40
Sagann	392	o	24	12	23	8	-	S	768.72
Voi	13	o	0.4	144	189	94	-	S	
Mombasa	290	o	3	67	223	49	-	S	1,739.20
Nairobi	750	o	18	54	74	31	-	S	4,181.38
Total	6,209		71	19	41	53			

Note: C means storage for purchasing, S means storage for selling.

Table D-7 Operation of Maize Storage

Each storage capacity = 100%

Storage Location	Transportation	Capacity Unit 1,000bag	Purchases 77/76	76/77	77/78	78/79	Local Sales 75/76	76/77	77/78	78/79	Stock Transfer 75/76	76/77	77/78	78/79
Butere	R	180	112.4	101.3	20.1	9.8	45.7	1.6	0.7	42.2	100.8	37.0	9.2	35.0
Myanga	R	70	173.9	88.5	26.2	18.1	4.2	-	0.2	53.2	190.9	52.2	-	30.8
Malaba	R	40	113.7	66.3	91.0	-	2.3	0.4	0.5	3.7	115.1	31.3	25.0	40.4
Bungoma	R	310	146.6	108.8	89.5	44.2	21.8	19.7	0.4	82.8	184.3	44.0	39.3	83.9
Webuye	R	330	138.0	125.5	51.8	68.7	14.7	23.2	0.2	49.9	168.5	27.8	37.5	116.7
Kipkarren	R	95	54.0	116.3	19.5	44.1	-	-	-	29.1	50.8	16.3	35.1	93.9
Lugari	R	80	140.5	168.0	143.5	154.8	2.9	0.1	-	10.0	Δ58.2 114.2	167.0	-	139.9
Turbo	R	120	170.8	213.5	157.7	103.2	0.3	40.6	0.3	38.8	134.8	89.5	112.1	199.5
Kitale	R	1,100	95.0	87.6	45.9	54.4	22.4	9.5	7.8	22.0	74.8	59.5	22.1	64.8
Eldoret	R	300	304.8	224.4	127.1	113.9	78.8	E151.8 -	65.4	151.3	Δ3.4 223.2	44.1	3.8	32.3
Moi's Bridge	R	155	239.0	238.9	180.0	143.2	13.6	27.5	7.0	23.0	213.0	149.4	137.4	261.3
Nakuru	R	465	90.2	59.7	49.0	49.5	23.1	43.4	13.4	58.5	Δ4.0 69.4	Δ0.2 17.3	- 1.7	10.8
Kericho	T	64	49.9	106.6	65.8	94.4	1.8	1.0	1.7	5.6	38.9	48.5	0.8	32.3
Kipkelion	R	142	222.3	153.3	29.6	42.6	77.0	78.1	2.1	22.5	Δ12.6 178.4	45.8	Δ0.4 28.8	41.0
Nyahururo	R	125	143.2	72.4	32.1	96.9	37.9	27.0	2.0	134.1	96.5	64.8	-	33.0
Kilgoris	T	4	278.2	332.0	149.4	12.0	35.4	0.8	-	4.0	280.0	224.0	210.5	86.3
Kissi	T	50	30.2	48.5	58.5	10.9	20.6	1.8	3.6	9.7	3.0	25.4	55.4	-
Kendu Bay	T	125	224.7	244.3	71.7	53.6	6.8	32.1	130.8	14.7	Δ9.8 225.2	163.4	18.0	-
Homa Bay	T	65	240.4	307.7	81.4	24.5	17.3	8.1	30.9	24.7	Δ0.1 200.3	232.4	Δ12.?	53.4
Kisumu	R	257	141.3	163.4	45.9	34.6	50.0	88.2	11.2	75.1	Δ2.5 105.0	- 42.0	Δ2.5 36.7	10.2
Yala	R	74	89.4	71.3	33.7	19.6	31.9	13.9	8.4	52.0	59.5	55.0	3.6	-
Machakos	T	60	5.7	53.7	-	19.5	198.7	189.4	5.9	3.0	Δ197.4 -	- 175.0	- -	- -
Konza	R	120	1.6	-	-	36.4	124.7	70.4	10.3	39.6	Δ243.3 101.1	202.5 -	- -	- -
Kibwezi	R	90	-	154.1	129.7	175.5	170.6	66.9	3.9	45.5	Δ281.0 81.2	Δ154.3 70.8	- 8.4	- -
Kitui	T	33	-	-	24.3	172.0	265.7	E441.1 138.1	33.7	0.4	Δ268.5 -	Δ463.3 -	Δ22.9 -	- -
Nanyuki	R	100	33.9	32.9	-	-	34.3	76.1	9.9	42.5	Δ11.8 16.6	Δ143.1 67.8	- -	- -
Meru	T	70	101.9	104.5	0.4	44.4	39.4	100.5	3.4	10.4	Δ21.4 -	Δ96.9 -	- -	- -
Thika	R	140	12.6	12.6	0.4	16.5	56.1	55.0	2.1	18.9	Δ54.0 0.5	Δ48.4 0.1	- -	- -
Sagann	R	392	44.5	44.6	4.8	2.6	30.4	9.1	16.0	35.2	Δ22.6 4.0	- -	Δ25.3 27.1	- -
Voi	R	13	-	1.6	0.1	-	482.6	234.4	29.8	8.9	Δ551.8 59.1	- 255.1	Δ22.6 -	- 61.5
Mombasa	R	290	0.3	9.3	0.5	-	117.8	103.0	E62.7 21.1	E535.5 51.9	Δ165.0 197.1	Δ99.3 -	Δ3.6 -	- -
Nairobi	R	750	19.3	39.0	2.2	10.3	81.3	94.0	29.1	92.6	Δ139.5 100.5	Δ1.4 2.5	Δ76.7 14.4	- 6.9
Total		6,209	102.3	95.7	43.7	42.0	E9.7 47.4	E2.9 50.2	E25.0 15.5	Δ42.9 52.3	Δ19.9 107.9	Δ11.4 41.6	- 21.5	42.0

Note: T: Truck, R: Rail, E: Export, Δ: Stock transfer in

Table D-8 Maize Losses in the Storage

Shortage	1977/78 Handling Volume	1977/78 Shortage Volume	1977/78 Shortage Percent	1978/79 Handling Volume	1978/79 Shortage Volume	1978/79 Shortage Percent
	bag	bag	%	bag	bag	%
Kisumu	134,492	+573	-	224,159	9	-
Nakuru Cyprus Bins	12,978	4,604	35.5	159,741	3,891	2.43
Nakuru M. Store	104,851	+302	-	171,222	7,778	4.54
Bungoma	122,931	5,415	4.4	510,949	13,831	2.70
Webye	124,265	+29	-	538,083	1,247	0.23
Moi's Bridge	217,354	1,000	0.46	466,088	2,583	0.55
Kitale	218,193	2,507	1.15	115,533	8,717	7.54
Mombasa	94,706	591	0.62	30,679	428	1.40
Eldoret	241,319	6,610	2.74	547,201	11,336	2.07
Total	2,411,207	50,088	2.07	8,838,078	182,613	2.07

Note: In Nakuru Cypras bins at 1977/78, sweat and head damages are included.

Table D-9 Monthly Movement of Maize

1. Summary of Whole NCPB's Storage

Month	Stock at Beginning	Arrival of Goods			Consignment of Goods			Arrangement
		Purchasing	Transfer in	Sub-total	Sale	Transfer out	Sub-total	
	bag	bag	bag	bag	bag	bag	bag	bag
1978								
8	5,321,352	12,527	19,846	32,373	249,308	20,701	270,009	36
9	5,083,752	68,149	50,178	118,327	254,902	58,455	313,357	-2,505
10	4,886,217	59,346	149,179	208,525	366,185	195,009	561,194	-14,225
11	4,519,323	99,786	163,656	263,442	452,470	114,632	547,102	-1,950
12	4,235,733	155,554	134,153	289,707	308,545	157,925	466,470	-6,669
1979								
1	4,050,301	282,692	238,771	521,463	351,480	291,489	642,969	+1,266
2	3,930,061	558,550	360,001	918,551	348,297	344,722	693,019	-5,404
3	4,150,189	566,062	393,759	959,821	608,140	436,101	1,044,241	-3,208
4	4,062,561	338,694	438,882	777,576	485,020	398,283	883,303	-39,560
5	3,917,274	238,078	569,481	807,559	804,125	654,712	1,458,837	-2,314
6	3,263,682	133,241	446,968	580,209	586,779	420,397	1,007,176	-10,665
7	2,826,050	74,974	392,252	467,226	649,424	300,986	950,410	-97,435
Total	end 2,245,431	2,587,653	3,357,126	5,944,779	5,444,675	3,393,412	8,838,087	-182,613

Note: Turn-over rate of storage 1977/78 = 1.30 1978/79 = 1.78 Mean: 1.54

(Table D-9 con't)

2. Bungoma Storage

Month	Stock at Beginning	Arrival of Goods			Consignment of Goods			Arrangement
		Purchasing	Transfer in	Sub-total	Sale	Transfer out	Sub-total	
	bag	bag	bag	bag	bag	bag	bag	bag
1977								
8	241,025	746	-	746	52	-	52	-
9	241,719	5,893	-	5,893	300	30,528	30,828	+50
10	216,834	18,011	-	18,011	-	59,337	59,337	+372
11	175,880	27,843	-	27,843	-	24,740	24,740	-1,605
12	177,378	18,637	-	18,637	-	7,071	7,071	-962
1978								
1	187,982	40,555	-	40,555	2	-	2	-48
2	228,487	43,627	-	43,627	-	-	-	+295
3	272,409	37,966	-	37,966	98	-	98	-1,973
4	308,304	46,313	-	46,313	107	-	107	-
5	354,510	28,684	-	28,684	66	-	66	+475
6	383,603	6,797	-	6,797	150	-	150	-2,060
7	388,190	0	-	0	480	-	480	+41
Total		275,072	-	275,072	1,255	121,676	122,931	-5,415
1978								
8	387,751	-	-	-	206	-	206	-
9	387,545	-	-	-	100	10,173	10,273	-
10	377,272	1,590	-	1,590	24,822	25,157	49,979	+4
11	328,887	-	-	-	17,826	35,298	53,124	+320
12	276,083	-	-	-	18,837	23,986	42,823	-1,000
1979								
1	232,260	40,901	-	40,901	15,593	13,015	28,608	-998
2	243,555	50,692	-	50,692	37,255	1,591	38,846	+824
3	256,225	30,703	-	30,703	16,277	29,904	46,181	-3,188
4	237,559	10,741	-	10,741	1,446	25,499	26,945	-3,428
5	217,927	2,408	-	2,408	40,199	64,137	104,336	+149
6	116,148	90	-	90	59,368	37,667	97,035	-3
7	19,200	-	-	-	12,593	-	12,593	-6,607
(8	96)							
Total		137,125		137,125	244,522	266,427	510,949	-13,927

Note: Turn-over rate of storage 1977/78 = 1.30, 1978/79 = 1.78, mean = 1.54

(Table D-9 con't)

3. Nakuru Storage

Month	Stock at Beginning bag	Arrival of Goods: Purchasing bag	Arrival of Goods: Transfer in bag	Arrival of Goods: Sub-total bag	Consignment of Goods: Sale bag	Consignment of Goods: Transfer out bag	Consignment of Goods: Sub-total bag	Arrangement bag
1977								
8	365,934	160	-	160	3,721	130	3,851	+9
9	362,252	-	-	-	1,830	9,770	11,600	+92
10	350,744	-	328	328	1,025	-	1,025	-600
11	349,447	-	-	-	640	25,606	26,246	3,244
12	326,445	-	204	204	6,330	204	6,534	-
1978								
1	320,115	7,386	-	7,386	3,220	-	3,220	-
2	324,281	29,734	-	29,734	-	272	272	-8,716
3	345,027	87,309	-	87,309	1,868	2,948	4,816	+6,000
4	433,520	39,696	-	39,696	5,957	2,007	7,964	-
5	465,252	36,800	-	36,800	4,933	-	4,933	+20
6	497,139	19,925	-	19,925	15,487	-	15,487	-20
7	501,557	6,900	-	6,900	19,790	-	19,790	-4,311
Total		227,910	532	228,442	64,801	40,937	105,738	-4,282
1978								
8	484,356	-	-	-	17,513	-	17,513	-
9	466,843	6,689	-	6,689	18,774	-	18,774	-
10	454,758	6,928	-	6,928	16,065	-	16,065	-366
11	445,255	3,066	-	3,066	10,174	-	10,174	+994
12	439,141	7,229	-	7,229	28,478	-	28,478	-1,913
1979								
1	415,979	3,148	-	3,148	33,451	-	33,451	-
2	385,676	29,347	-	29,347	34,716	-	34,716	-33
3	380,274	68,969	1,328	70,297	22,691	10,257	32,948	-1,105
4	416,518	49,132	1,248	50,380	23,182	8,939	32,121	-884
5	433,893	46,044	1,378	47,422	23,125	16,684	39,809	-1,140
6	440,366	7,552	6,091	13,643	52,598	14,324	66,922	-7,234
7	379,253	-	-	-	-	-	-	-
(8	379,853)							
Total		228,104	10,045	238,149	280,767	50,204	330,971	-11,681

Note: Turn-over rate of storage 1977/78 = 1.28, 1978/79 = 1.55, mean = 1.42

(Table D-9 con't)

4. Kisumu Storage

Month	Stock at Beginning bag	Arrival of Goods: Purchasing bag	Arrival of Goods: Transfer in bag	Arrival of Goods: Sub-total bag	Consignment of Goods: Sale bag	Consignment of Goods: Transfer out bag	Consignment of Goods: Sub-total bag	Arrangement bag
1977								
8	151,560	-	-	-	15,514	4,282	19,796	+184
9	131,948	-	-	-	18,163	3,031	21,194	-
10	110,754	-	-	-	640	4,950	5,590	+366
11	105,530	1,657	-	1,657	49	64,809	64,858	-
12	42,329	10,005	-	10,005	155	15,946	16,101	+33
1978								
1	36,266	50,899	6,400	57,299	524	670	1,194	-
2	92,371	14,164	-	14,164	381	505	886	-
3	105,649	29,187	-	29,187	787	-	787	-
4	134,049	6,161	-	6,161	918	-	918	-
5	139,292	2,817	-	2,817	1,500	-	1,500	-10
6	140,599	2,165	-	2,165	735	-	735	-
7	142,029	999	-	999	933	-	933	-
Total		118,054	6,400	124,454	40,299	94,193	134,492	+573
1978								
8	142,095	5,826	-	5,826	701	-	701	-
9	147,220	25,242	-	25,242	868	-	868	-
10	171,594	12,188	-	12,188	908	-	908	-
11	182,874	18,546	-	18,546	9,103	-	9,103	-
12	192,317	8,820	-	8,820	4,234	-	4,234	-
1979								
1	196,903	12,224	-	12,224	18,166	4,155	32,321	+23
2	186,829	7,832	-	7,832	28,385	5,241	33,626	-23
3	161,012	80	-	80	35,993	-	35,993	-
4	125,099	80	-	80	38,498	573	39,071	+20
5	86,128	81	-	81	19,951	10,075	30,026	+17
6	56,200	-	18,576	18,576	41,152	6,149	47,301	-46
7	27,429	-	-	-	-	-	-	-
(8	27,429)	-	-	-	-	-	-	-
Total		90,919	18,576	109,495	197,959	26,193	224,152	-9

Note: Turn-over rate of storage 1977/78 = 1.07, 1978/79 = 0.98, mean = 1.03

Table D-10 Breakdown of Maize & Wheat Price

A. Maize

Purchasing price at buying center	(90 kg)	95.0 K.sh
Transportation rate to storage	(90 ")	8.5 "
(Sub-total)	(90 ")	103.5 "
Agent commission	(90 ")	4.6 "
Cost of bag	(90 ")	11.9 "
Sub-total (Price at storage)	(90 ")	120.0 "
Fumigation charge	(90 ")	0.35 "
Losses	(90 ")	1.2 "
Handling charge	(90 ")	5.0 "
Miscellaneous	(90 ")	10.0 "
Transportation rate	(90 ")	11.0 "
Sub-total (Sale price of the NCPB)	(90 ")	147.55 "
Milling cost	(90 ")	17.0 "
Price of maize flour	(72 ")	164.55 "
Ex-factory of maize flour	(24 ")	54.85 "
Whole saler's margine	(24 ")	1.05 "
Whole sale price	(24 ")	55.9 "
Retailer's margine	(24 ")	2.9 "
Retail price	(2 ")	4.9 "

B. Wheat

Price of producer including bag cost	(90 kg)	160.7 K.sh
Margine of the NCPB	(90 ")	29.0 "
Transportation rate	(90 ")	12.0 "
Sale price of the NCPB	(90 ")	201.7 "
Milling cost	(90 ")	23.37 "

Table D-11 Maize Storage and Mill

Depot	Capacity	Mill	Capacity
Nairobi and its vicinity			
Nairobi	750,000	Nairobi	3,340,000
Sagana	392,000	Sagana	594,000
Thika	140,000	Kiambu	252,000
Kenza	120,000	Kangundo	209,560
Machakos	60,000	Limuru	162,000
		Ruiru	135,120
		Muranga	174,720
		Tala	98,400
		Thika	86,400
		Ngong	72,000
		Narok	10,800
		Machakos	84,000
Sub-total	1,462,000		5,217,000
Nakuru its vicinity			
Nakuru	465,000	Nakuru	1,489,680
Kipkalion	142,000	Rongai	36,000
Nyahururu	125,000	Molo	21,600
		Naivasha	25,200
Sub-total	732,000		1,572,480
Mombasa and its vicinity			
Mombasa	290,000	Mombasa	1,685,200
		Kwale	54,000
Sub-total	290,000		1,739,200

Depot	Capacity	Mill	Capacity
Kisumu and its vicinity			
Kisumu	257,000	Kisumu	816,000
Betere	180,000	Luanda	36,000
Yala	74,000	Homa Bay	72,000
Kericho	64,000		
Kenpu Bay	125,000		
Homa Bay	65,000		
Kisii	50,000		
Sub-total	815,000		924,000
Eldoret-Kitale			
Eldoret	300,000	Eldoret	962,000
Moi's Bridge	155,000	Kitale	851,520
Kitale	1,100,000	Kapenguria	118,800
Sub-total	1,555,000		1,932,320
Northern Mt. Kenya			
Nanyuki	100,000	Isiolo	28,800
Meru	70,000	Meru	480,000
Sub-total	170,000		580,000
Bungoma and its vicinity			
Bungoma	*310,000*		
Webuya	330,000		
Malaba	40,000		
Myanga	70,000		
Lugari	80,000		
Kipkarren	95,000		
Turbo	120,000		
Sub-total	1,045,000		

Nairobi

Depot $\frac{1,462}{6,309}$ = 23.2% Mill $\frac{5,217}{11,967.8}$ = 43.6%

Nakuru

Depot 11.6% Mill 13.1%

Mombasa

Depot 4.6% Mill 14.5%

Total in abobe three

Depot 39.4% Mill 71.2%

Kitale (large-farmer) Eldoret

Depot 24.6% Mill 16.1%

Kisumu

Depot 12.9% Mill 7.7%

Total in above five Mill 96%

Table D-12 Actual Storage Capacity and its Forecast of Maize

	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1983/84	1985/86	1989/90
1. Maize Production	(Bags) 25,000,000[1]	25,000,000	25,000,000	20,000,000	16,000,000	18,000,000	22,000,000[1]	30,000,000[1]	33,000,000[1]	39,000,000[1]
2. Purchases by NCPB	(Bags) 6,324,935	5,864,871	5,460,000 (2,713,000)	4,500,000 (2,629,000)	2,474,367	2,400,000	-	-	-	-
3. Population in Kenya	Δ13,400,000	13,971,000	14,596,000	15,221,000[2]	15,934,000[2]	16,622,000[2]	17,340,000[2]	18,872,000[2]	Δ20,400,000	24,506,000[2]
4. Farmer's Population										
Rate of Urban	Δ12%	12.6%	Δ13.8%	15%	Δ16%	Δ17%	Δ18%	19%	Δ20%	25%
Rate of Non farmer	Δ10	10.4	10.2	10	10	10	10	10	10	10
Rate of Farmer	78	77	76	75	74	73	72	71	70	65
No. of Farmer	10,452,000	10,758,000	11,093,000	11,416,000	11,971,000	12,134,000	12,485,000	15,399,000	14,280,000	15,929,000
5. Demand in Kenya	(Bags) 17,659,000 (118kg)	18,318,000 (118kg)	19,137,000 (118kg)	19,956,000 (118kg)	20,891,000 (118kg)	21,793,000 (118kg)	22,735,000 (118kg)	25,163,000 (120kg)	27,200,000 (120kg)	32,675,000 (120kg)
6. Required Demand for Non farmer	(Bags) 3,865,000	4,213,000	4,593,000	4,989,000	5,196,000	5,884,000	6,365,000	7,297,000	8,160,000	11,436,000
(2) - (6) =	(Bags) +2,470,000	+1,652,000	-1,880,000	-2,360,000	-2,722,000					
7. Loss of Demand (4%)	155,000	169,000	184,000	200,000	208,000	235,000	255,000	292,000	326,000	457,000
8. Storage for Emergency	(Bags) 2,000,000	(2,000,000)	(2,000,000)	(2,000,000)	-	-	2,000,000	2,000,000	2,040,000	2,860,000
9. Required Storage (6) + (7) + (8)	(Bags) -	-	-	-	-	6,119,000	8,620,000	9,589,000	10,526,000	14,753,000
10. (-) Import (+) Export +	495,051	+162,009	+306,426	+1,545,784	-1,837,307	-4,867,038				

Note: 1/ from Sessional Paper No.4 of 1981 on National Food Policy

2/ from District Population Profiles by Roushdi A Henin

Δ Estimate by Consultant

Maize 90kg → Flour 72kg (80%)

Table D-13 Actual Storage Capacity and its Forecast of Wheat

	1976	1977	1978	1979	1980	1981	1985	1985	1989
1. Wheat Production	Bags 2,100,000	1,900,000	1,800,000	1,800,000	2,200,000	2,500,000	3,000,000	3,500,000	5,000,000
2. Wheat Flour	ton 135,000	124,100	115,600	116,000	142,000	169,000	202,500	236,000	337,500
3. Population in Kenya	13,971,000	14,596,000	15,221,000	15,934,000	16,622,000	17,340,000	18,872,000 2/	20,400,000 2/	23,100,000 2/
4. Demand in Kenya	Bags 2,040,000 (9.8kg/capita) (0.146 Bag)	2,131,000	2,222,000	2,326,000	2,427,000	2,532,000	2,831,000 (10kg =0.15 Bag)	3,060,000 (10kg)	3,465,000 (10kg)
5. Balance (-) Import	-32,042	-286,894	-504,083	-601,708	-316,453	-32,000	+171,000	+440,000	+1,535,000
6. Purchases by NCPB	2,007,958	1,844,106	1,717,917	1,724,294	2,110,547	-	-	-	-
7. Actual Import	Nil	364,500	1,010,900	283,000	1,305,000	-	-	-	-
8. Storage Capacity	1,305,000	1,305,000	1,305,000	1,305,000	Bags 1,305,000	----------	—	1,860,000	

Note: Wheat 90kg → Flour 67.5kg (75%)

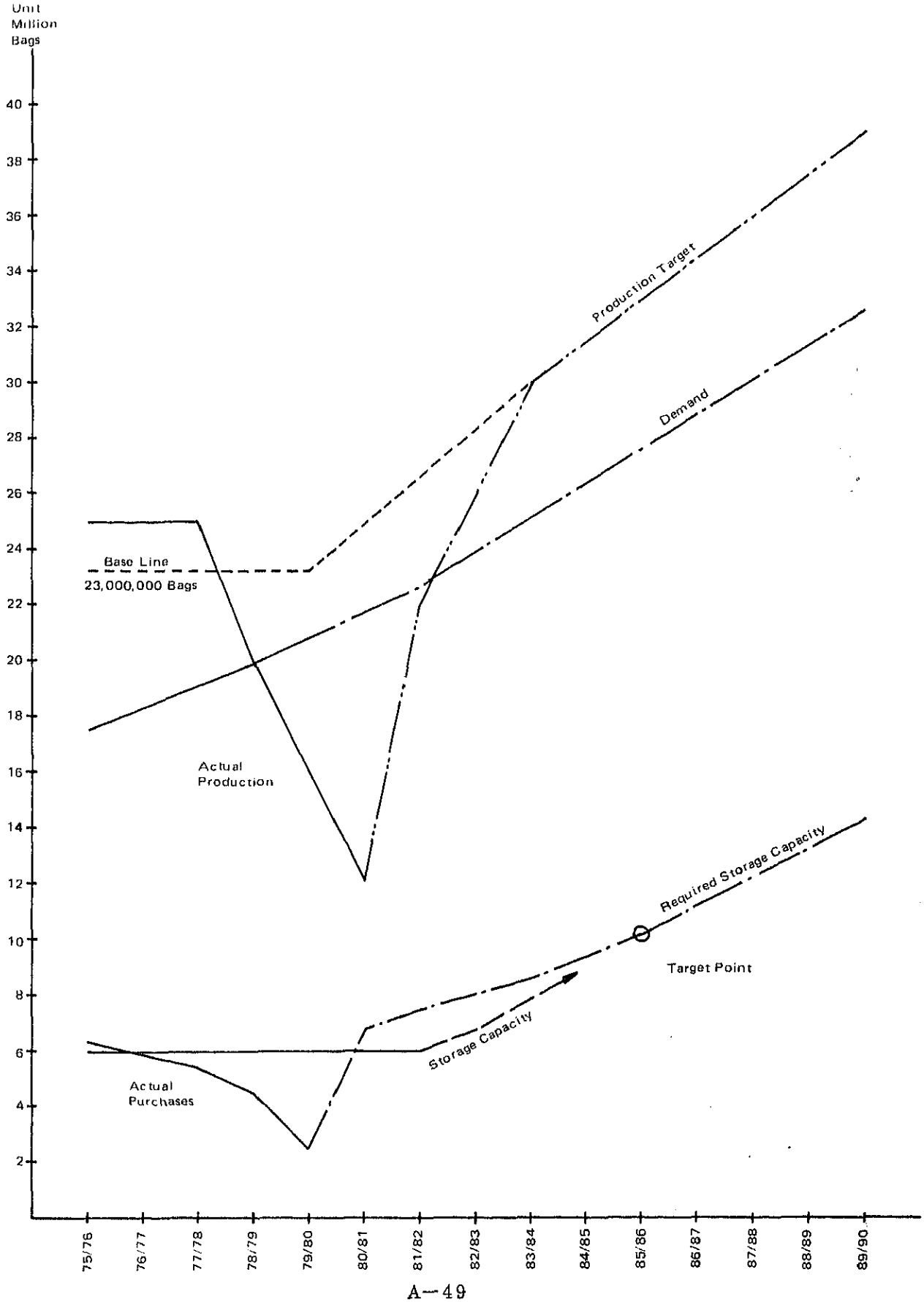
Table D-14 Present Storage Capacity and Extra Capacity Need

	Code Depot	Present Capacity	Extra Capacity Needed
A. Maize	1. Moi's Bridge	155,000	150,000 bags
	2. Kitale	560,000	-
	3. Kitale Cyprus Bins	540,000	-
	4. Nyahururu	125,000	-
	5. Kipkelion	142,000	50,000
	6. Kisumu	257,000	330,000
	7. Yala	74,000	-
	8. Kendu Bay	125,000	50,000
	9. Kisii	50,000	-
	10. Kilgoris	4,000	50,000
	11. Homa Bay	65,000	50,000
	12. Kericho	64,000	200,000
	13. Webuye	330,000	-
	14. Butere	180,000	-
	15. Malaba	40,000	-
	16. Myanga	70,000	-
	17. Bungoma	310,000	330,000
	18. Kinancha	50,000	-
	19. Mombasa	290,000	200,000
	20. Voi	13,000	100,000
	21. Kitui	33,000	-
	22. Konza	120,000	-
	23. Meru	70,000	150,000
	24. Kibwezi	90,000	-
	25. Machakos	60,000	40,000
	26. Kipkarren	95,000	80,000
	27. Turbo	120,000	-
	28. Lugari	80,000	70,000
	29. Thika	140,000	110,000
	30. Nanyuki	100,000	50,000
	31. Sagana	392,000	150,000

(Table D-14 Con't)

	Code Depot	Present Capacity	Extra Capacity Needed
	32. Nairobi	750,000	250,000
	33. Nakuru	125,000	550,000 bulk
	34. Nakuru Cyprus Bins	340,000	-
	35. Eldoret	300,000	200,000
	Eldoret silo	-	440,000
	36. Migori	-	100,000 bags
	37. Kakamega	-	200,000
	38. Maralal/Lodwar	-	10,000
	39. Marsabit	-	10,000
	40. Kabarnet	-	10,000
	41. Musoriot	50,000	-
	Total:	6,309,000	3,920,000 = 10,229,000
B. Wheat	42. Kitale	55,000	-
	43. Eldoret	260,000	-
	44. Nakuru Silo	550,000	
	45. Nakuru Store	100,000	-
	46. Njoro KFA	-	-
	47. Enangipiri	55,000	-
	48. Narok	55,000	-
	49. Naivasha	60,000	-
	50. Olkalou	45,000	-
	51. Kiganjo	50,000	-
	52. Nanyuki	30,000	55,000 bulk
	53. Nairobi	-	500,000 bulk
	Total:	1,260,000	555,000 = 1,815,000
	Grand Total:	7,569,000	4,475,000 bags

Fig. D-1 Required Storage Capacity of Maize



Appendix E Project Cost

Table E-1 Construction Cost for the Project

Item	Description	Quantities	Unit	Rate (sh)	Total Cost (sh'000)	Foreign Currency (F.C) Depreciation (sh'000)	Material (sh'000)	Total (sh'000)	Local Currency (L.C) Fuel & Material (sh'000)	Labor (sh'000)	Total (sh'000)
1. Civil Works											
1-1.	Bungoma Silo										
a)	Reinforced Concrete	7,700	cu.m	935	7,200	1,185	2,750	3,935	2,843	422	3,265
b)	Formworks	51,000	sq.m	100	5,100	2,040	1,020	3,060	969	1,071	2,040
c)	Reinforcing Bar	1,500	ton	10,700	16,050	2,250	10,800	13,050	975	2,025	3,000
d)	Concrete Pile	250	No.	12,250	3,063	638	1,442	2,080	679	304	983
e)	Truck-scale, Office and Others				2,300	-	300	300	1,800	200	2,000
f)	Miscellaneous Works				10,580	2,555	5,110	7,665	1,945	970	2,915
	Sub-total				44,293	8,668	21,422	30,090	9,211	4,992	14,203
1-2.	Nakuru Silo										
a)	Reinforced Concrete	12,500	cu.m	935	11,688	1,924	4,464	6,388	4,615	685	5,300
b)	Formworks	82,800	sq.m	100	8,280	3,312	1,656	4,968	1,573	1,739	3,312
c)	Reinforcing Bar	2,500	ton	10,700	26,750	3,750	18,000	21,750	1,625	3,375	5,000
d)	Concrete Pile	400	No.	12,250	4,900	1,020	2,307	3,327	1,086	487	1,573
e)	Truck-scale, Office and Others				2,300	-	300	300	1,800	200	2,000
f)	Miscellaneous Works				15,662	3,595	7,190	10,785	3,252	1,625	4,877
	Sub-total				69,580	13,601	33,917	47,518	13,951	8,111	22,062
1-3.	Kisumu Silo										
a)	Reinforced Concrete	7,700	cu.m	935	7,200	1,185	2,750	3,935	2,843	422	3,265
b)	Formworks	51,000	sq.m	100	5,100	2,040	1,020	3,060	969	1,071	2,040
c)	Reinforcing Bar	1,500	ton	10,700	16,050	2,250	10,800	13,050	975	2,025	3,000
d)	Steel Pile	250	No.	54,700	13,676	1,636	11,357	12,993	515	168	683
e)	Truck-scale, Office and Others				2,300	-	300	300	1,800	200	2,000
f)	Miscellaneous Works				12,180	2,842	5,684	8,526	2,444	1,210	3,654
	Sub-total				56,506	9,953	31,911	41,864	9,546	5,096	14,642
	Total				170,379	32,222	87,250	119,472	32,708	18,199	50,907
2. Building of Facilities Room											
a)	Bungoma Silo				10,350	1,080	7,470	8,550	1,080	720	1,800
b)	Nakuru Silo				14,950	1,560	10,790	12,350	1,560	1,040	2,600
c)	Kisumu Silo				10,350	1,080	7,470	8,550	1,080	720	1,800
	Total				35,650	3,720	25,730	29,450	3,720	2,480	6,200
3. Facilities											
a)	Bungoma Silo				24,098	500	20,948	21,448	1,700	950	2,650
b)	Nakuru Silo				32,223	500	28,933	29,433	1,800	990	2,790
c)	Kisumu Silo				24,199	500	21,049	21,549	1,700	950	2,650
	Total				80,520	1,500	70,930	72,430	5,200	2,890	8,090

Table E-2 Summary of Unit Cost

Unit: K.Sh (Kenya Shilling)

Description	Unit	Total Unit Cost (Contract Works)	Foreign Currency (F.C.)			Local Currency (L.C.)		
			Description	Materials	Sub-Total	Materials	Labor	Sub-Total
Reinforced Concrete	cu.m	935	153.9	357.1	511	369.2	54.8	424.0
Formwork	sq.m	100	40	20	60	19	21	40
Reinforcing Bar	ton	10,700	1,500	7,200	8,700	650	1,350	2,000
Concrete Pile (ø800)	No.	12,250	2,550	5,768	8,318	2,715	1,217	3,932
Steel Pile (ø800)	No.	54,700	6,543	45,427	51,970	2,060	670	2,730
Building	cu.m	1,150	120	830	950	120	80	200

Table E-3 Manufacturing and Installation Cost of Silo Facilities

	Bungoma Silo		Nakuru Silo		Kisumu Silo	
	F.C. Yen (1,000)	L.C. sh. (1,000)	F.C. Yen (1,000)	L.C. sh. (1,000)	F.C. Yen (1,000)	L.C. sh. (1,000)
1. Receiving Equipment	7,480		7,480		7,480	
2. Measurement Equipment	44,250		79,200		45,200	
3. Dryer	83,830		117,020		84,450	
4. Conveyer	38,930		54,000		38,930	
5. Rotation Equipment	40,300		56,480		40,300	
6. Attachment of Silo	16,800		27,370		16,800	
7. Cleaning Equipment	72,980		96,540		73,900	
8. Electric Equipment	27,100		35,350		27,100	
9. Remote Control Device	740		820		740	
10. Temperature Measurement Equipment	5,530		8,450		5,530	
11. Fumigation Equipment	32,000		39,150		32,000	
12. Testing Equipment	4,360		4,360		4,360	
13. Dust Collector	11,170		12,200		11,170	
14. Maintenance Equipment	7,600		7,600		7,600	
15. Packing	49,040		67,620		49,090	
16. Sub-total (F.O.B.)	442,110		613,640		444,650	
17. Ocean Freight & Insurance	95,330		136,160		95,440	
18. Sub-total (16 + 17) (C.I.F.)	537,440		748,800		540,090	
19. Inland Transportation		1,000		1,140		1,000
20. Installation	30,300	1,650	30,300	1,650	30,300	1,650
Sub-total (19 + 20)	30,300	2,650	30,300	2,790	30,300	2,650
Total (Yen)	567,740	2,650	779,100	2,790	570,390	2,650
Total (K.sh'000)	(21,448)		(29,433)		(21,549)	

Note: 1 Japanese Yen = 26.47 Kenya Shilling

Appendix F Consulting Services

APPENDIX F-1. Detailed Consultants' Services for the Project

General

In order to implement the Project successfully and attain its full benefit, it is required to execute the final detailed design, tendering to select contractors inclusive of that for procurement of equipment, supervision for construction works and training for silo management.

It would be, therefore, necessary for the Kenyan Government to employ Consultants who are capable to achieve the said objectives of the Project and who shall be approved by the Loan Lender.

The Kenyan Government will select, for good performance of the Project, one consulting firm which has sufficient experience in construction of structures and agricultural development of Works.

The Consulting Services could be divided into four stages, that is, the final detailed design stage, tendering stage, supervision stage and training stage for silo management.

The final detailed design will take about six (6) months. In this stage, the selected Consultants shall prepare the final detailed design for the Project on the basis of additional surveys and investigations as recommended in the Feasibility Study Report as well as on supplemental data and topographic maps, and shall propose the detail of the Project works and a required budget for it for approval of the Government and the Loan Lender.

The Consultants shall prepare specifications of construction works inclusive of these for procurement of machinery, materials, equipment, and shall prepare tender documents for approval of the Government and the Loan Lender.

The Consultants shall prepare and submit a final detailed design report of the Project to the Government.

Within about six (6) months of the tendering stage, tasks from tender announcement to opening the letter of credit shall be completed inclusive of receiving approval of the Loan Lender on the tasks. These tasks will be carried out under the name of the Government, however, the Consultants shall assist the Government in carrying out all of these tasks.

In the supervision stage the Consultants shall supervise construction works based on the Contract Drawing and the Final Detailed Design Report reviewing construction drawings to be prepared and submitted by the Contractor.

The Consultants shall also watch and direct the entire progress of the Project works and report it to the Government and the Loan Lender.

In the final stage, that is, in the training stage, the Consultants shall prepare a guidebook necessary for operation and maintenance of the Project facilities.

In the training stage the Consultants shall give necessary advice to the Kenyan staff in charge as required in the operation and management of constructed silos for one-year period for each silo under the cooperation of the Contractor who shall guarantee his performance.

During this period the Consultants shall advise the Government and make the Contractor repair any damages, mis-constructions, errors or defects in the Contractor's performance if found.

Terms of Reference for Final Detailed Design Stage

The Consultants will be retained to carry out the sound implementation of the Project under the cooperation of selected local counterpart personnels.

In addition to handling detailed technical requirements, the training of local engineers will be a basic objectives of the Consultants' services.

Project Engineer cum Team Leader - should be a graduate engineer with more than 20 years' experience, and should be competent to undertake the following tasks;

a) To review the Feasibility Study Report and to establish a time table for the final design based on additional investigation and data collection;

b) To formulate a plan which can assure of the Project to create its full benefit and to be operated and maintained smoothly and effectively;

c) To formulate an implementation plan of the Project so that the Project could be implemented based on the final design without undue revision of the original Project plan;

d) To arrange and prepare the Final Detailed Report;

e) To review specifications and tender documents for civil works and for procurement of silo facilities and equipment;

f) To secure coordination among the Government, the Loan Lender and the Executing Agency (Agencies) for the Project implementation;

g) To evaluate the Project benefit and effects as created by modifications of the Project components and plan, if any; and,

h) To explain the Final Detailed Design Report and tender documents inclusive of specifications to the Executing Agency (Agencies) and the Loan Lender, if required.

Supervisor for Investigation: - should be a graduate engineer with experience over 10 years, specially in soil investigation for silos with a large capacity or high buildings, and should be competent to undertake the following tasks;

a) To prepare specifications for soil investigation and field survey of the proposed sites taking into consideration the proposed structures and the existing conditions;

b) To supervise the investigation works; and,

c) To review and submit reports on the investigation works.

Soil Expert: - should be a graduate engineer having more than 15 years' experience, specially in analysis of building foundation, and should be competent to undertake the following tasks;

a) To examine specifications for soil investigation to be prepared by the Supervisor for Investigation;

b) To analyse soil foundations based on the investigation report;

c) To advise the Design Engineer for Foundation of the conditions of soil foundations; and,

d) To advise of the seismic coefficient for structures.

Design Engineer for Foundation: - should be a graduate engineer with experience over 15 years, and should be competent to undertake the following tasks;

a) To be fully acquainted with the silo structures and soil conditions;

b) To determine a type of piles by comparing vaious piles inclusive of analysis against earthquakes;

c) To design the foundations;

d) To prepare a final detailed drawing for the foundations;

e) To estimate construction quantities and to select construction machines for foundation works;

f) To assist the Cost Estimator cum Construction Planner in preparation of construction plans and schedules, and also in cost estimate; and,

g) To assist the Specification Writer in preparation of specifications for foundation works.

Design Engineer for Structure (1): - should be a graduate engineer having more than 15 years' experience, and should be competent to undertake the following tasks;

a) To conduct a survey on existing silos in Kenya and to recommend the points to improvement for the existing silos under the cooperation of Mechanical Engineer;

b) To make structural analysis for silos with or without aseismatic structures and to design the most suitable structures of silos;

c) To prepare final design drawings, to estimate the construction volume and to select construction machines;

d) To arrange all final design drawings for good tender drawings and contract drawings;

e) To assist the Cost Estimator cum Construction Planner in preparation of construction plans and schedules, and in cost estimate; and,

f) To assist the Specification Writers in preparation of specifications for civil works.

Design Engineer for Structure (2): - should be a graduate engineer with more than eight years' experience, and should be competent to undertake the following tasks;

a) To assist the Design Eenginner (1); and,

b) To assist the Cost Estimator cum Construction Planner.

Mechanical Engineers (1) and (2): - should graduate engineers. Mechanical Engineer (1) should have experience more than 15 years, and Mechanical Engineer (2) experience more than eight years. They should be competent to undertake the following tasks;

a) To make surveys on the existing silos in Kenya and recommend the points of improvement under the cooperation of Design Engineer;

b) To conduct a study for selection of silo facilities based on handling capacity per hour, operation program and other related information;

c) To design silo facilities in consideration of earthquakes;

d) To prepare technical specifications for manufacturing and installation of silo facilities to be incorporated in the tender documents; and,

f) To assist the Cost Estimator cum Construction Planner in preparation of construction plans and schedules, and in cost estimate.

Architect: - should be a graduate architect with more than 15 years' experience, and should be competent to undertake the following tasks;

a) To conduct surveys on high buildings in Kenya specially on aseismatic structure and on construction materials for buildings for machine rooms;

b) To layout of buildings in cooperation with the Design Engineer (1) and the Mechanical Engineer (1);

c) To make structural analysis of buildings with or without aseimatic structures and to design the most suitable structure of buildings to the local conditions;

d) To prepare the final design drawings and to estimate the construction quantity;

e) To assist the Cost Estimator cum Construction Planner in preparation of construction plans and schedules and in cost estimate; and,

f) To assist the Specification Writer in preparation of specifications for building.

Electric Engineer: - should be a graduate engineer with more than 15 years' experience, and should be competent to undertake the following tasks;

a) To conduct surveys on the conditions of power supply in Kenya specially standardized ways of electric power supply;

b) To prepare the electric design in cooperation with the Mechanical and Design Engineer for Structure (1);

c) To prepare the final detailed drawings and to estimate the construction quantity;

d) To assist the Cost Estimator cum Construction Planner in cost estimate and in preparation of construction schedules; and,

e) To prepare the technical specifications for materials and for installation of electric devices.

Marketing Expert: - should be a graduate economist with more than 10 years' experiences specially in marketing research, and should be competent to undertake the following tasks;

a) To review the Feasibility Study Report and to make survey on present systems for collecting and forwarding;

b) To establish a marketing program for the proposed silos;

c) To prepare a manual for the collecting program of the NCPB;

d) To advise managing staff of the NCPB of the collecting system; and,

e) To assist the Team Leader in study on the marketing and collecting system for the proposed silos, and to make proposal on equipment and facilities for collecting centers, if necessary.

Cost Estimator cum Construction Planner: - should be a graduate engineer with more than 15 years' experience specially in cost estimate and construction planning, and should be competent to undertake the following tasks;

a) To make surveys on construction materials available in Kenya and on prices of them;

b) To make surveys on labor efficiency per unit works in Kenya;

c) To prepare construction plans and schedules for construction works in cooperation with the Design Engineer for Foundation, Design Engineer for Structure (1), Mechanical Engineer (1), Architect, Electrical Engineer and Team Leader.

d) To arrange the estimated quantities prepared by the Engineers and the Architect

e) To estimate construction costs together with engineers, Architect and Team Leader; and,

f) To examine the construction cost estimated within a budget of the Agency concerned and the Loan, and to explain results of the examination to the Agency and the Loan Lender, together with the Team Leader.

Expert for Tender Documents: - should be a graduate specialist with more than 15 years' experience specially in preparation of tender documents, and should be competent to undertake the following tasks;

a) To make surveys on the laws and regulations on contracts in Kenya;

b) To prepare the tender documents on full turn-key basis in cooperation with Team Leader and the Governmental officials of

the Agency (Agencies) in accordance with the standard procedure of the Loan Lender and the Executing Agency concerned;

c) To explain, together with Team Leader, the tender documents to the Agency and Loan Lender for their approval;

Note: Tender documents shall consist of the following;

i) Invitation to Tender
ii) Instructions to Tenderers
iii) General Conditions of Contract

iv) Special Conditions of Contract
v) General Technical Specifications
vi) Special Technical Specifications
vii) Form of Technical Sheet
viii) Form of Bill of Quantities
ix) Local Conditions (if necessary)
x) Drawings

Specification Writer: - should be a graduate engineer with more than 15 years experience specially in specification writing and should be competent to undertake the following tasks;

a) To make surveys and collect data on local conditions for civil works and the manufacturing standard of local materials;

b) To prepare specifications for civil works, building works in cooperation with the Design Engineers, Architect, Electric Engineers and Team Leader;

c) To arrange specifications for manufacturing and installing silo facilities, prepared by the Mechanical Engineer; and,

d) To arrange all specifications to be incorporated in the tender documents.

Terms of Reference for Tendering Stage

In the tendering stage, all of the announcement of tender, opening of tenders, tender evaluation, approval on the tender evaluation by the Loan Lender, negotiation with successful tenderer, agreement with the successful tenderer, approval of the agreement by the Loan Lender and opening of the letter of credit shall be carried out based upon the tender documents having been approved by the Loan Lender. These procedures shall be followed by or under the name of the Executing Agency concerned, however, in order to shorten the period, to make smooth negotiations with the Loan Lender, and to carry out the fair adjudication, the Consultants shall carry out or assist the Agency in executing a part or all of the above-mentioned works;

Team Leader: - should be a graduate engineer with more than 20 years' experience. Furthermore, the Project Engineer in the final detailed design stage should be assigned to Team Leader of the Consultants in the Tendering stage. He should be competent to undertake the following tasks;

a) To prepare, together with the Agency concerned, necessary information to be given to tenderers in filling the questionnaires during the tender period.

b) To participate in the opening of tender;

c) To prepare the Tender Evaluation Report for approval of the Executing Agency;

d) To explain the Loan Lender of the tender evaluation report for its approval;

e) To assist the Agency in negotiating with the successful tenderer; and,

f) To assist the Agency in opening the letter of credit.

Assistant: - should be a graduate engineer with more than 10 years experience, and should be competent to undertake the following tasks;

a) To assist the Team Leader in administrative works during the tendering period;

Terms of Reference for Construction Supervision Stage

It is desirable that the same engineers and experts who engaged in the final detailed design will be assigned to the consultants' services in the construction supervision stage. In case of replacing such engineers and experts because of unavoidable circumstances of them,
the engineers and experts newly assigned shall be of higher grade than the engineers or experts to be replaced.

Project Engineer cum Team Leader: - shall undertake the following tasks;

a) To prepare the monthly disbursement schedule in accordance with the construction schedule having been agreed by the the Contractor;

b) To supervise the progress of construction works and performance of the works;

c) To make necessary arrangement for execution of consulting services and to secure coordination between the Agency and the Consultants;

d) To prepare and submit the monthly progress reports to the

Agency concerned and to the loan lender; and,

e) To make recommendations as regards the monthly payment to the Contractor from the Executing Agency.

Supervisor: - shall be a graduate engineer with more than 10 years' experience, and shall be competent to undertake the following tasks;

a) To supervise construction works of each silo in cooperation with the Civil Engineer, Mechanical Engineer, Electrical Engineer and Soil Expert;

b) To assist Team Leader in implementation of the construction works;

c) To prepare the plan for modernization of construction works;

d) To assist Team Leader in preparation of monthly progress reports;

e) To approve the construction drawings and schedules to be prepared by the Contractor; and,

f) To check the progress in construction works for controlling monthly invoices.

Terms of Reference for the Training Stage of Silo Management

The consulting services in the training stage shall consist of guidances in operation and maintenance inclusive of collecting grains from fields, inspection and quality control of grain and operation and maintenance of silos.

The Consultants will carry out these tasks in cooperation of the field staff and silo managment staff at each silo.

Mechanical Engineer: - shall be a graduate engineer with more than 15 years' experience in operation of silos, and shall be competent to undertake the following tasks;

a) To conduct training the Kenyan staff in silo management, operation and maintenance as described below;

i) Drying cereals
ii) Storage management of cereals
iii) Handling and storage of toxic chemicals
iv) Handling method of dangerous materials
v) Operation of each silo equipment, and,
vi) Maintenance and repair of each silo equipment

b) To find out the mis-installation, error or other defects due to the poor performance of the Contractor, and to instruct the Contractor to repair them for one year from the completion of each silo; and,

c) To prepare a guidebook needed for the operation and maintenance.

Civil Engineer: - shall be a graduate engineer with 15 years experience, and shall be competent to undertake the following tasks;

a) To assist the Mechanical Engineer in executing training;

b) To supervise and observe the maintenance in conformity with the general conditions of contract; and

c) To assist the Mechanical Engineer in preparation of the guidebook.

Table F-1 Consulting Services Fee

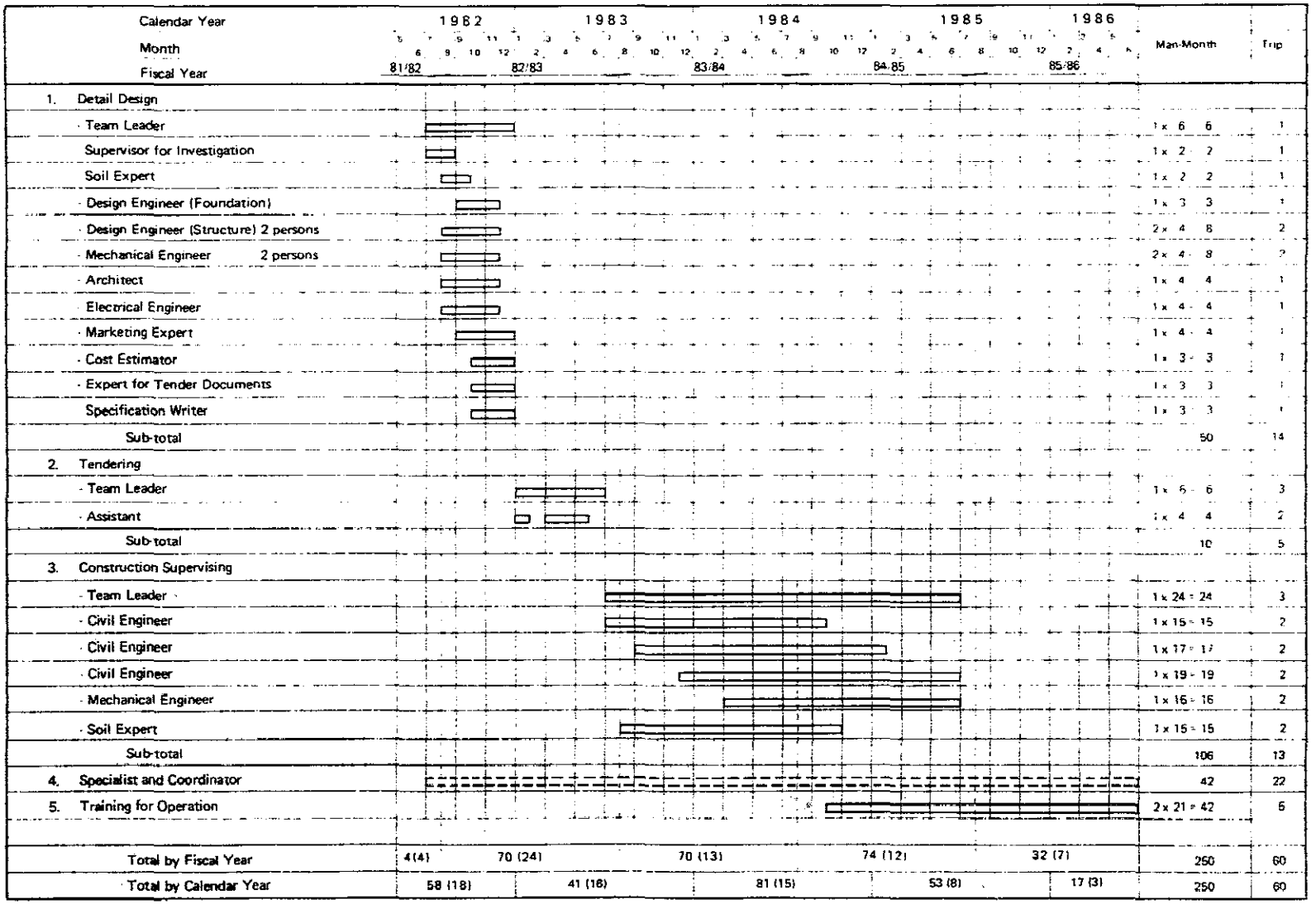
(Unit: sh'000)

Item	Description	Quantity	Unit	Rate	Amount
1.	1. Foreign Currency Cost				
	a) Final Design				
	Consultants remuneration	50	man-month	70	3,500
	International travel expenses	14	trip	32	448
	Miscellaneous & communication		L.S.		516
	Sub-total				4,464
	b) Tendering				
	Consultants remuneration	10	man-month	70	700
	International travel expenses	5	trip	32	160
	Miscellaneous & communication		L.S.		100
	Sub-total				960
	c) Construction Supervision				
	Consultants remuneration	106	man-month	70	7,420
	International travel expenses	13	trip	32	416
	Miscellaneous & communication		L.S.		1,098
	Sub-total				8,934
	d) Specialist and Co-ordinator				
	Consultants remuneration	42	man-month	70	2,940
	International travel expenses	22	trip	32	704
	Miscellaneous & communication		L.S.		433
	Sub-total				4,077
	e) Training for Operation				
	Consultants remuneration	42	man-month	70	2,940
	International travel expenses	6	trip	32	192
	Miscellaneous & communication		L.S.		433
	Sub-total				3,565
	Total of Foreign Currency				22,000

(Table F-1 Con't)

Item	Description	Quantity	Unit	Rate	Amount
2.	Local Currency Cost				
	a) Final Design				
	Consultant per diem	1,500	day	0.4	600
	b) Tendering				
	Consultant per diem	300	day	0.4	120
	c) Construction Supervision				
	Consultant per diem	3,180	day	0.4	1,272
	d) Specialist and Co-ordinator				
	Consultant per diem	1,260	day	0.4	504
	e) Training for Operation				
	Consultant per diem	1,260	day	0.4	504
	Total of Local Currency				3,000
	Grand Total				25,000

Fig. F-1 Consulting Services Schedule



Appendix G Economic Evaluation

Table G-1 Profit by Losses

Units: 1,000 ton, 1,000 shilling

Year	Incremental Amount of Marketing Maize	Reduction of Losses				Value of Reduction Losses					
						With Domestic Price			With Importing Price		
		16%	18%	20%	25%	18%	20%	25%	18%	20%	25%
1984/85	74.0	11.8	13.3	14.8	18.5	14,031	15,614	19,517	21,520	23,947	29,934
1985/86	165.0	26.4	29.7	30.0	41.3	31,351	34,835	43,596	48,055	53,394	66,823
1986/87	165.0	26.4	29.7	33.0	41.3	31,351	34,835	43,596	48,055	53,394	66,823
1987/88	165.0	26.4	29.7	33.0	41.3	31,351	34,835	43,596	48,055	53,394	66,823
1988/89	165.0	26.4	29.7	33.0	41.3	31,351	34,835	43,596	48,055	53,394	66,823
1989/90	165.0	26.4	29.7	33.0	41.3	31,351	34,835	43,596	48,055	53,394	66,823
1990/91	165.0	26.4	29.7	33.0	41.3	31,351	34,835	43,596	48,055	53,394	66,823
1991/92	165.0	26.4	29.7	33.0	41.3	31,351	34,835	43,596	48,055	53,394	66,823
⋮											
2000/2001	1,650.0	264.0	297.0	330.0	413.0	313,510	348,350	435,960	480,550	533,940	668,230
Total	2,714.0	434.2	488.5	542.8	679.3	515,647	572,974	717,053	790,400	878,251	1,099,102

Notes: Domestic price .... 1 bag (90 kg) = 95 shilling ≒ 1,055.6 shilling per ton.

Importing period .. 1 ton ... 180 M$ = 1,618 shilling.

Exchange rate of US$ and Kenya shilling ... 1 US$ = 8.9891 shilling rate of 31st July, 1981.

Table G-2

*** PRESENT WORTH OF BENEFIT ***

(UNIT: 1000 SHILLING)

YEAR	B.STREAM	12.00 %	13.00 %	14.00 %	15.00 %	16.00 %	17.00 %	18.00 %	19.00 %
1	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	32400.	20591.	19872.	19183.	18525.	17894.	17290.	16712.	16157.
5	72400.	41082.	39296.	37602.	35996.	34471.	33023.	31647.	30339.
6	72400.	36680.	34775.	32985.	31301.	29716.	28224.	26819.	25495.
7	72400.	32750.	30775.	28934.	27218.	25617.	24123.	22728.	21425.
8	72400.	29241.	27234.	25381.	23668.	22084.	20618.	19261.	18004.
9	72400.	26108.	24101.	22264.	20581.	19038.	17623.	16323.	15129.
10	72400.	23311.	21328.	19530.	17896.	16412.	15062.	13833.	12714.
11	72400.	20813.	18875.	17131.	15562.	14148.	12874.	11723.	10684.
12	72400.	18583.	16703.	15027.	13532.	12197.	11003.	9935.	8978.
13	72400.	16592.	14782.	13182.	11767.	10514.	9404.	8419.	7544.
14	72400.	14814.	13081.	11563.	10232.	9064.	8038.	7135.	6340.
15	72400.	13227.	11576.	10143.	8898.	7814.	6870.	6047.	5328.
16	72400.	11810.	10244.	8897.	7737.	6736.	5872.	5124.	4477.
17	72400.	10545.	9066.	7805.	6728.	5807.	5019.	4343.	3762.
18	72400.	9415.	8023.	6846.	5850.	5006.	4289.	3680.	3161.
19	72400.	8406.	7100.	6006.	5087.	4316.	3666.	3119.	2657.
20	72400.	7505.	6283.	5268.	4424.	3720.	3133.	2643.	2233.
TOTAL	1190800.	341474.	313114.	287746.	265000.	244554.	226131.	209490.	194426.

Table G-3

*** PRESENT WORTH OF COST ***

(UNIT: 1000 [illegible])

YEAR	C.STREAM	12.00 %	13.00 %	14.00 %	15.00 %	16.00 %	17.00 %	18.00 %	[illegible] %
1	275.	246.	243.	241.	239.	237.	235.	233.	231.
2	7953.	6340.	6228.	6120.	6014.	5910.	5810.	5712.	[illegible].
3	208242.	148223.	144323.	140558.	136923.	133412.	130020.	126743.	[illegible].
4	114662.	72870.	70325.	67889.	65558.	63327.	61190.	59147.	[illegible].
5	13732.	7792.	7453.	7132.	6827.	6538.	6263.	6001.	[illegible].
6	10237.	5186.	4917.	4664.	4426.	4202.	3991.	3792.	[illegible].
7	10237.	4631.	4351.	4091.	3848.	3622.	3411.	3214.	[illegible].
8	10237.	4135.	3851.	3589.	3347.	3123.	2915.	2721.	2546.
9	10237.	3692.	3408.	3148.	2910.	2692.	2492.	2308.	2139.
10	10237.	3296.	3016.	2761.	2530.	2321.	2130.	1956.	1798.
11	10237.	2943.	2669.	2422.	2200.	2000.	1820.	1658.	1511.
12	10237.	2628.	2362.	2125.	1913.	1725.	1556.	1405.	1269.
13	10237.	2346.	2090.	1864.	1664.	1487.	1330.	1190.	1067.
14	10237.	2095.	1850.	1635.	1447.	1282.	1137.	1009.	896.
15	10237.	1870.	1637.	1434.	1258.	1105.	971.	855.	753.
16	10237.	1670.	1449.	1258.	1094.	952.	830.	725.	633.
17	10237.	1491.	1282.	1104.	951.	821.	710.	614.	532.
18	10237.	1331.	1134.	968.	827.	708.	607.	520.	447.
19	10237.	1189.	1004.	849.	719.	610.	518.	441.	376.
20	10237.	1061.	888.	745.	625.	526.	443.	374.	316.
TOTAL	498419.	275032.	264478.	254596.	245321.	236598.	228378.	220614.	213270.

Table G-4

***** CALCULATION OF INTERNAL RATE OF RETURN *****

(UNIT: 1000 SHILLING)

DISCOUNT RATE	+++++ PRESENT WORTH +++++ BENEFIT	COST	B/C RATIO
12.00 %	341474.	275032.	1.24
13.00 %	313114.	264478.	1.18
14.00 %	287746.	254596.	1.13
15.00 %	265000.	245321.	1.08
16.00 %	244554.	236598.	1.03
17.00 %	226131.	228378.	0.99
18.00 %	209490.	220614.	0.95
19.00 %	194426.	213270.	0.91

INTERNAL RATE OF RETURN ---------- 16.8 %

Table G-5 Statement of Income and Expenses for Maize Storage

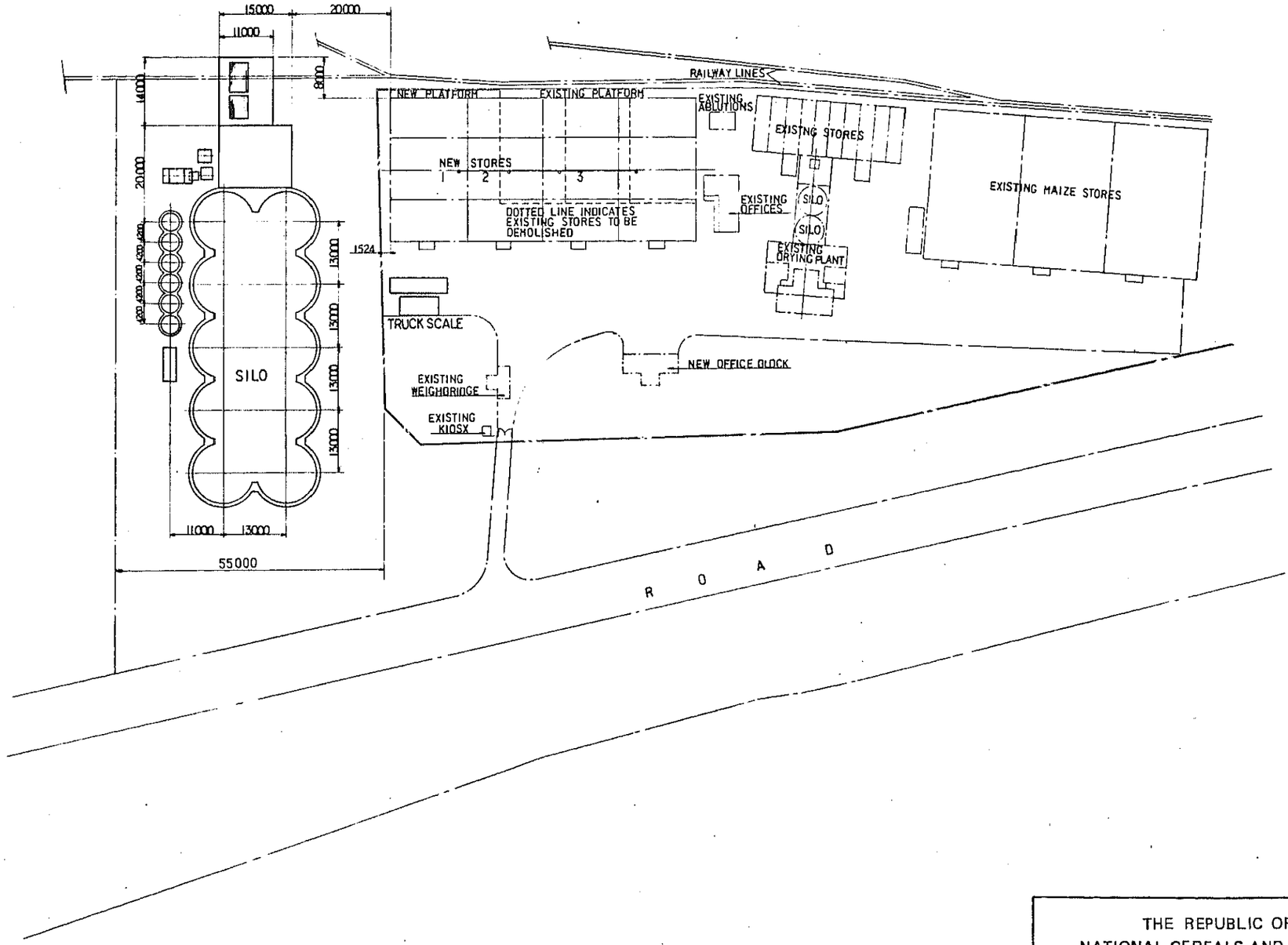
Unit: 1,000 ton, 1,000 K.Ł

	1974/75		1975/76		1976/77		1977/78		1978/79		1979/80	
	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
Selling												
Maize	339.5	13,330	377.4	16,604	382.7	17,914	129.8	7,323	373.4	17,602	409.6	17,458
(-) Losses	0.2	-	0.8	-	1.0	-	-	-	1.2	-	-	-
Sub-total	339.7	13,330	378.2	16,604	383.7	17,914	192.8	7,323	374.6	17,602	409.6	17,458
Selling Cost												
Stock at beginning	187.2	4,175	184.0	6,060	251.5	8,517	396.2	18,337	482.1	22,299	206.7	7,803
Maize parchased	458.0	16,068	555.7	22,119	542.9	26,035	244.2	11,654	238.3	10,253	205.1	6,657
(-) Transfer to import account	184.0	6,060	251.5	8,517	396.2	18,337	482.1	22,299	206.7	7,803	1.9	121
(-) Stock at end	114.7	4,497	109.9	4,362	14.6	698	27.6	1,321	139.1	6,666	20.4	819
Selling cost	339.7	9,686	378.2	15,301	383.7	15,516	129.8	6,371	374.6	18,083	389.5	13,520
Gross Income	-	3,644	-	1,303	-	2,398	-	951	-	481	-	3,938
Transportation cost	-	908	-	2,326	-	1,638	-	736	-	2,079	-	1,350
Transportation loss	-	151	-	55	-	2	-	-	-	-	-	-
Administration cost	-	1,314	-	1,375	-	2,558	-	3,203	-	2,845	-	2,735
Net Income	-	1,269	-	2,453	-	1,800	-	2,988	-	5,405	-	147

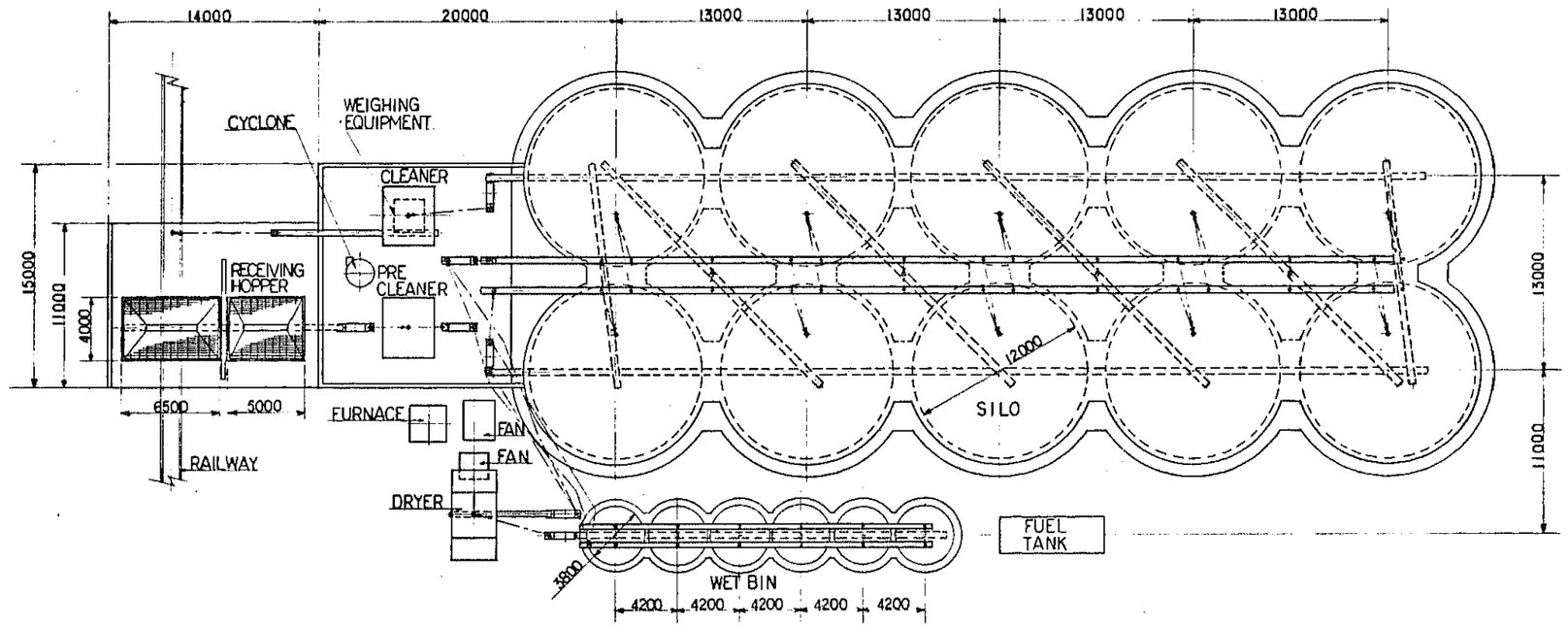
Source: NCPB Anuual Reports

LIST OF DRAWINGS

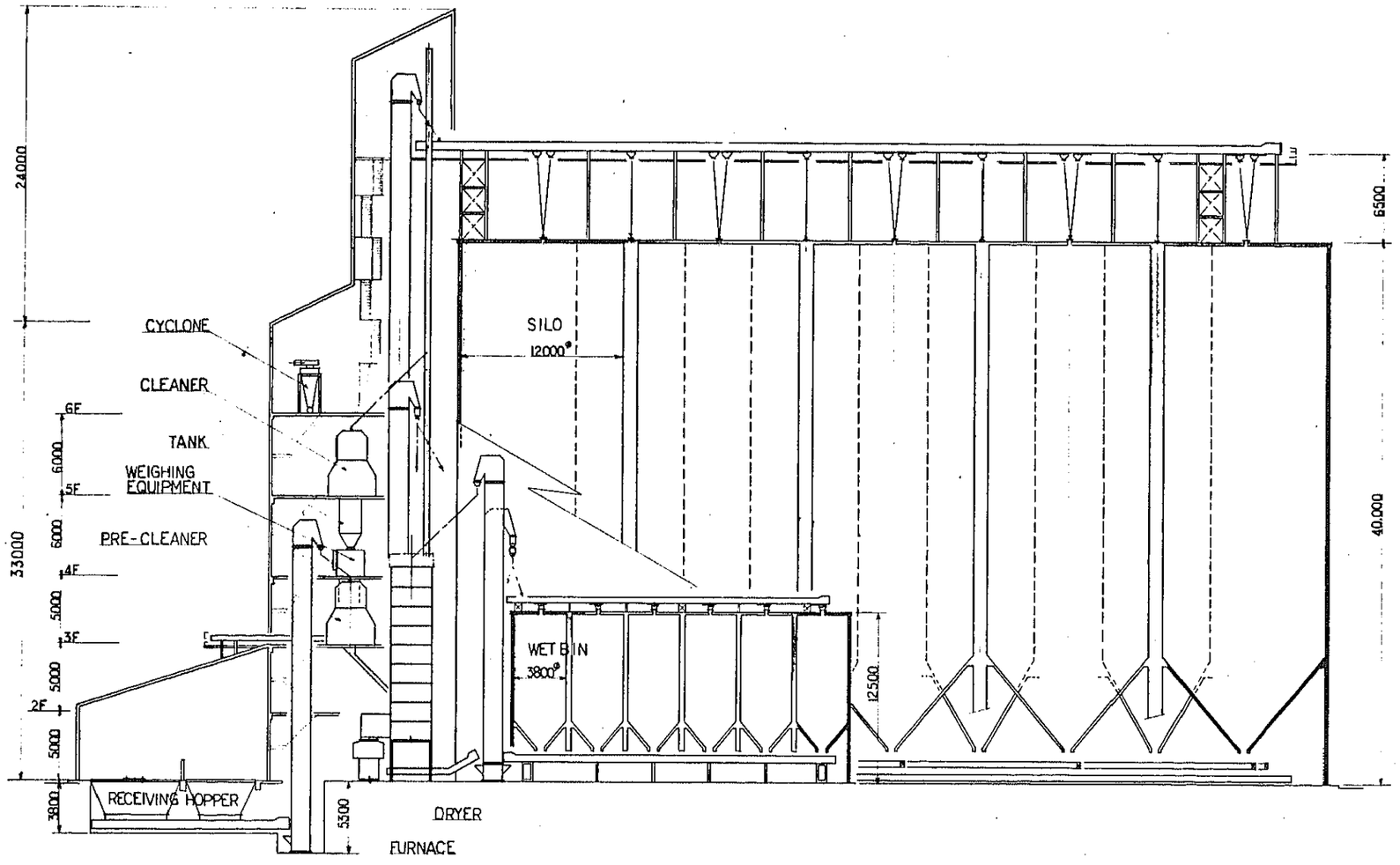
DWG. No.	TITLE
KGSP - B - 1	BUNGOMA SILO : GENERAL LAYOUT
KGSP - B - 2	BUNGOMA SILO : PLAN
KGSP - B - 3	BUNGOMA SILO : ELEVATION (1)
KGSP - B - 4	BUNGOMA SILO : ELEVATION (2)
KGSP - B - 5	BUNGOMA SILO : FLOW CHART
KGSP - N - 1	NAKURU SILO : GENERAL LAYOUT
KGSP - N - 2	NAKURU SILO : PLAN
KGSP - N - 3	NAKURU SILO : ELEVATION (1)
KGSP - N - 4	NAKURU SILO : ELEVATION (2)
KGSP - N - 5	NAKURU SILO : FLOW CHART
KGSP - K - 1	KISUMU SILO : GENERAL LAYOUT
KGSP - K - 2	KISUMU SILO : PLAN
KGSP - K - 3	KISUMU SILO : ELEVATION (1)
KGSP - K - 4	KISUMU SILO : ELEVATION (2)
KGSP - K - 5	KISUMU SILO : FLOW CHART



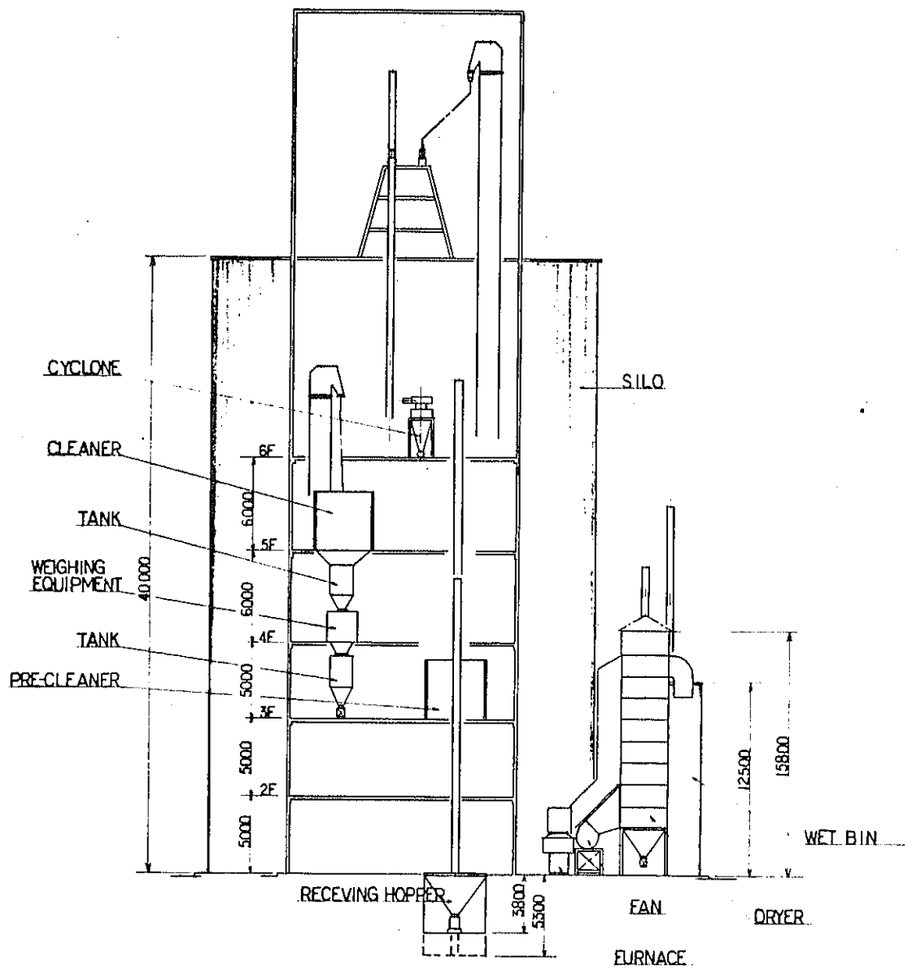
THE REPUBLIC OF KENYA NATIONAL CEREALS AND PRODUCE BOARD
KGSP BUNGOMA SILO: GENERAL LAYOUT
DWG NO. KGSP–B–1
JAPAN INTERNATIONAL COOPERATION AGENCY



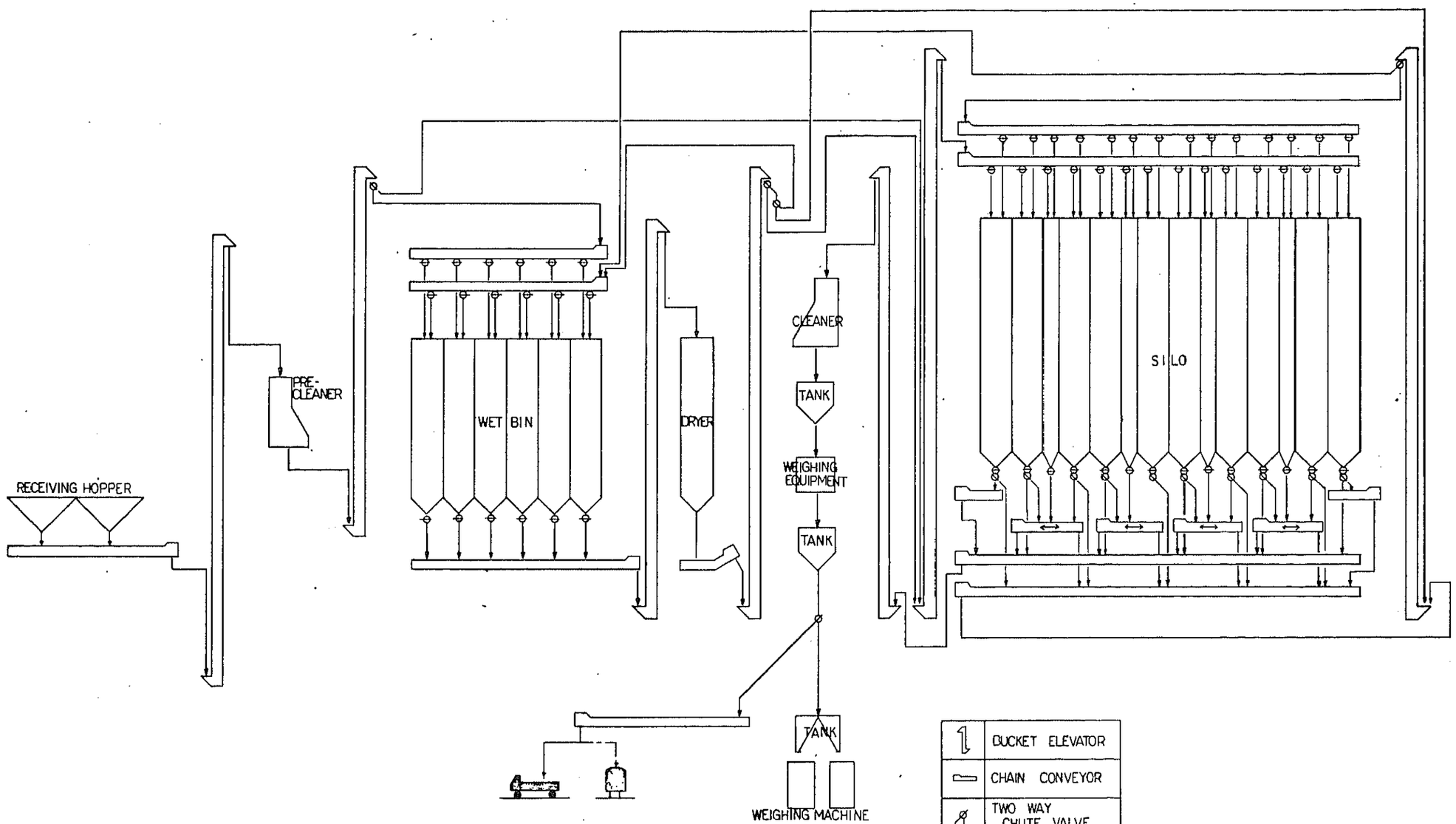
THE REPUBLIC OF KENYA NATIONAL CEREALS AND PRODUCE BOARD
KGSP BUNGOMA SILO: PLAN
DWG NO. KGSP--B--2
JAPAN INTERNATIONAL COOPERATION AGENCY



THE REPUBLIC OF KENYA NATIONAL CEREALS AND PRODUCE BOARD
KGSP BUNGOMA SILO: ELEVATION (1)
DWG NO. KGSP–B–3
JAPAN INTERNATIONAL COOPERATION AGENCY



THE REPUBLIC OF KENYA NATIONAL CEREALS AND PRODUCE BOARD
KGSP BUNGOMA SILO: ELEVATION (2)
DWG NO. KGSP–B–4
JAPAN INTERNATIONAL COOPERATION AGENCY



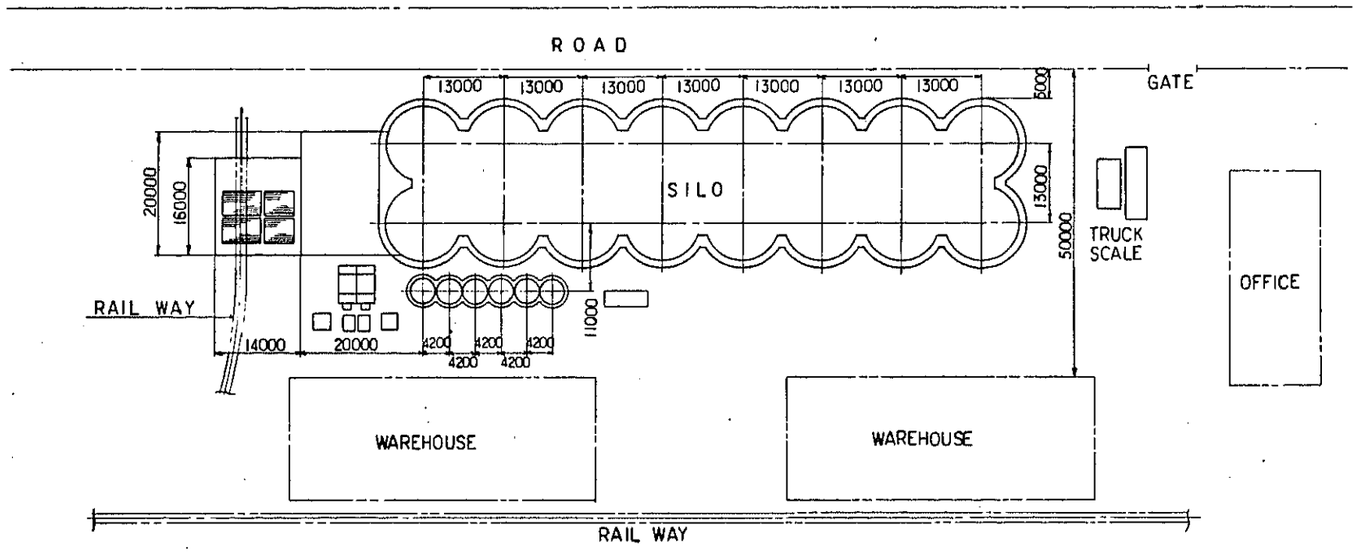
	BUCKET ELEVATOR
	CHAIN CONVEYOR
	TWO WAY CHUTE VALVE
	SLIDE GATE

THE REPUBLIC OF KENYA
NATIONAL CEREALS AND PRODUCE BOARD

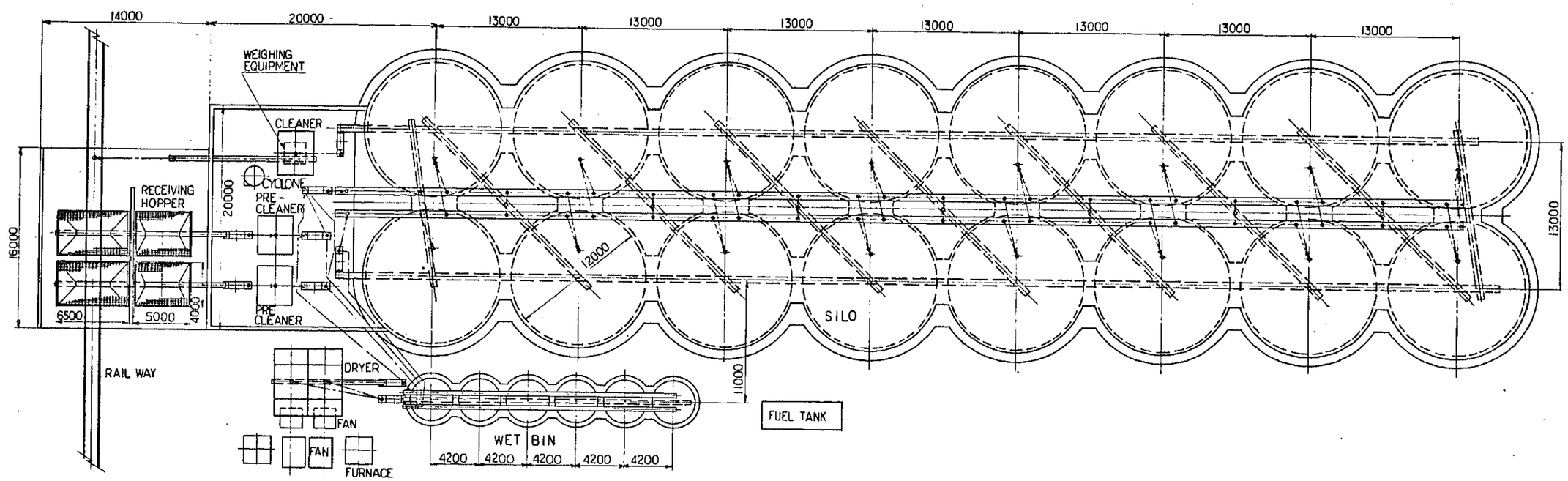
KGSP
BUNGOMA SILO: FLOW CHART

DWG NO. KGSP–B–5

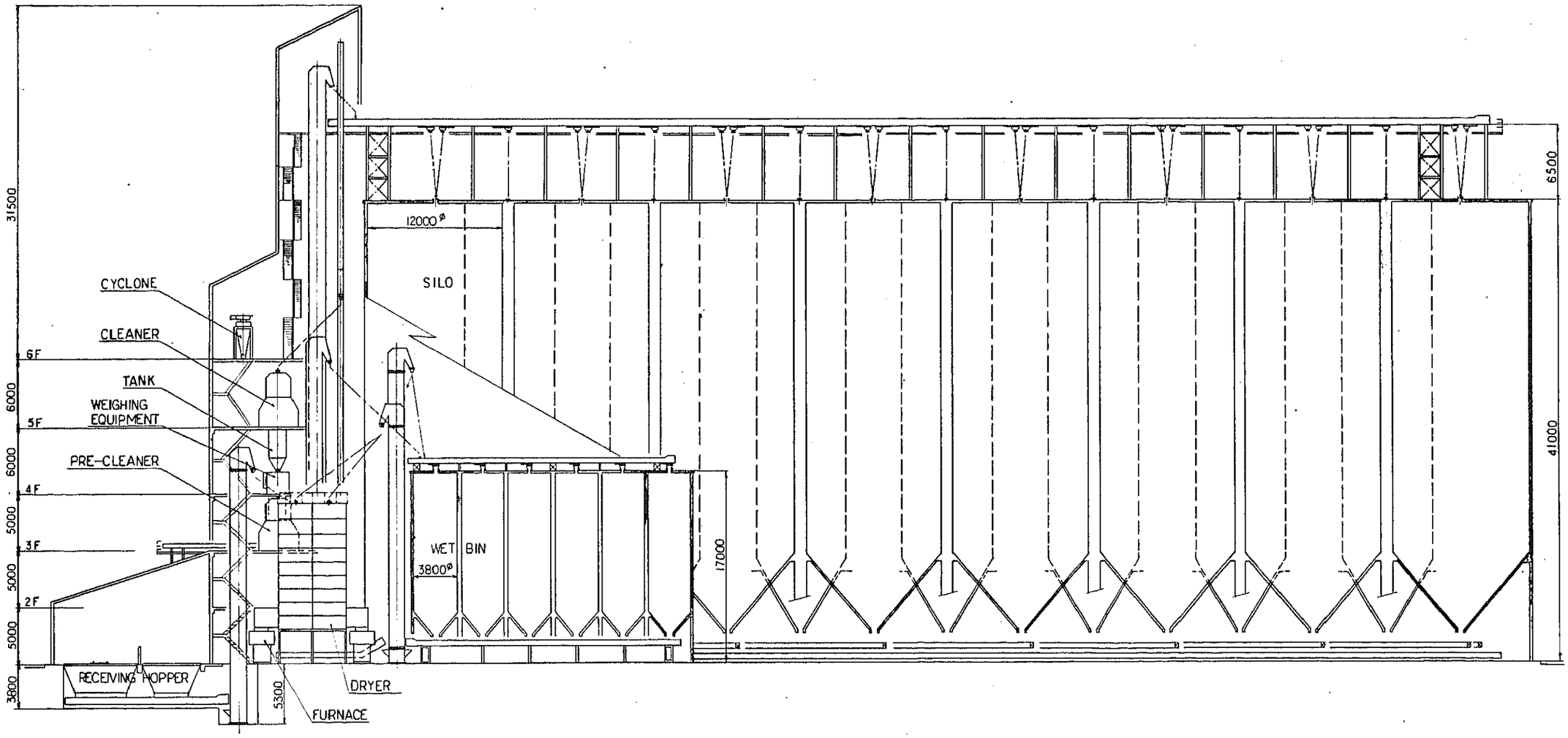
JAPAN INTERNATIONAL COOPERATION AGENCY



THE REPUBLIC OF KENYA NATIONAL CEREALS AND PRODUCE BOARD
KGSP NAKURU SILO: GENERAL LAYOUT
DWG NO. KGSP–N–1
JAPAN INTERNATIONAL COOPERATION AGENCY



THE REPUBLIC OF KENYA NATIONAL CEREALS AND PRODUCE BOARD
KGSP NAKURU SILO: PLAN
DWG NO. KGSP–N–2
JAPAN INTERNATIONAL COOPERATION AGENCY



THE REPUBLIC OF KENYA NATIONAL CEREALS AND PRODUCE BOARD
KGSP NAKURU SILO: ELEVATION (1)
DWG NO. KGSP–N–3
JAPAN INTERNATIONAL COOPERATION AGENCY