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REVIEW OF GRAIN STORAGE, HANDLING, PROCESSING, AND DISTRIBUTION PROBLEMS AND PROPOSALS IN THE REPUBLIC OF KOREA

KANSAS STATE UNIVERSITY
DEPARTMENT OF GRAIN SCIENCE AND INDUSTRY

U. S. AGENCY FOR INTERNATIONAL DEVELOPMENT

SEOUL, KOREA

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PREFACE

The review team is grateful for the assistance given to it by so many people in Korea. Without their help this report could not have been written. Of special, and constant help were:

Mr. John L. Cooper, Chief, Rural Development Division, USAID/Korea
Mr. Paul Bedard, Deputy Chief, Rural Development Division, USAID/Korea
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REVIEW OF GRAIN STORAGE, HANDLING, PROCESSING, AND DISTRIBUTION PROBLEMS AND PROPOSALS IN THE REPUBLIC OF KOREA

Introduction

In keeping with its contract to provide technical assistance to the United States Agency for International Development, Kansas State University was requested to provide a team to study the problems of the grain food supply of Korea from the farm and port to market. A statement of the objectives and scope of work for the study was prepared and presented to the study team by Mr. William F. Johnson of the East Asia Technical Advisory Staff, Bureau for East Asia, Agency for International Development, Washington, D. C.

This report is the result of that study. It is intended that the report represent investigations into each of the subjects included in the "scope of work" requested. It will either present conclusions reached from the study for a course of action, or recommendations for further studies.

In the belief that the AID and the Republic of Korea Government (hereinafter ROKG) will require further work before loans for facilities will be granted, the study team has prepared this report in the general format of Manual Order 1221.2 entitled "Feasibility Studies, Economic and Technical Soundness Analysis, Capital Projects. That manual order requires a depth of study, verification of data, engineering planning of "project budget" depth, and accurate economic analysis of cost versus benefits that is beyond the scope of the services to be provided under the applicable contract and the manning schedule of this study. Nevertheless, the team has approached this study in a manner designed to establish the additional work needed to meet the manual requirements and to make the work useful to those who may prepare a detailed feasibility study without retracing the same ground.

Time limitations have precluded verification of available data offered by the ROKG or USAID/K except in those instances where obvious inconsistencies could be discerned. We have reason to doubt the validity of much of the available data but we have no measurement of the significance of the deviations that may exist.

USAID/K requested that the units of measurement employed in reporting the study be the metric system for mensuration, and the United States dollar for currency. The study generally adheres to that request. A conversion chart is included in this report covering those units found necessary in its preparation.

For those who are not intimately familiar with Korea, some background data on the nation is needed to understand its grain economy and technology.

Geographically, the Republic of Korea (South Korea) is the southerly portion of a mountainous peninsula extending southeasterly from the Asian mainland in the North Temperate Zone lying mainly between 126° and 130° East Longitude and 33° and 38° North Latitude. There are several thousand generally small, adjacent islands. The Westerly boundary is the shallow Yellow Sea - the Easterly boundary, the Sea of Japan. The land area is reported to be about 98,477 square kilometers.

Tillable land is generally located along the valleys of the watercourses of the country and the gently rolling uplands contiguous thereto. There are no significant upland agricultural plains. However, the tillable lands are rather well distributed throughout the country. It is estimated that over 500,000 hectares of present forest land can be reclaimed into cultivated upland, increasing total cultivated area by about 25 percent.

The north temperate climate is greatly affected by its water borders to the West, East, and South and the Asian land mass in the North. Summer temperatures are high with a mean in the magnitude of 25°C to 30°C and a high in the magnitude of 40°C. Winter temperatures are cold with a mean in the magnitude of (-)5°C to 5°C and a low in the magnitude of (-)30°C. The southerly coastal areas, tempered by their sea boundaries are relatively warm compared to the northerly high plateau affected both by altitude and proximity to the Asian land mass. Average relative humidity over the year approximates 68% to 75% depending on location. Summer averages are high at 78% to 91%. Winter averages range from a low of 44% to a high of about 73% depending on location with a national average probably in the low 60's.

The population are deemed to be descendents of Shantung Chinese, Mongol, and Tungus peoples. The latest, October 1, 1966 census, counted 29,207,856 people, an increase of 17% since the last census in 1960. Population density is about 297 people per square kilometer - a very high density, further complicated by the large mountainous areas unsuitable for agriculture. The present annual net rate of

increase in population is 2.7%, among the highest in the world, which, if unchecked by the serious effort being made in birth control, will result in double the present population in about twenty-five years. In 1966 there were some 5,118,000 households of which 2,498,550 were farm and 2,619,500 were urban. There were thus about an average of 5.7 people per household. Data available indicates the farm component to be higher than urban at about 6.21 people per household in 1966.

Of the total land area of 98,477 square kilometers only 22,934 (23%) are cultivated. 12,871 square kilometers, 12.9% of the total area and 56.1% of the cultivated area are paddy lands. 10,060 square kilometers, 10.1% of the total area and 43.9% of the cultivated area, are cultivated uplands. The problems of feeding the population from the small per capita resource of tillable land are apparent. It is clear that success depends primarily on the factors of cultural technology, population control and enlarging the land base. The tillable land per capita is only 0.0785 hectares (0.247 acres). The total population density per hectare of cultivated land is thus 12.7 people (4.05 per acre).) Obviously, the farmer must be efficient and the land highly productive to feed the existing 12.7 people from each hectare of cultivated land. To the extent that he does not do so now, and increase his productivity in the future to meet the needs of the expanding population, the nation must meet its food deficit by importation.

The farm economy is now and probably will continue to be a labor intensive industry. The high farm population on small areas would seem to preclude heavy mechanization. The 2,540,274 farm households totalling 15,780,706 people, or 6.21 people per household, have a land area of 0.9025 hectares for each family on which to produce and live (equal to 2.23 acres per family). Each farmer thus must feed his own family of 6.21 people and 5.25 urban people from 0.9025 hectares of land for the present food economy to be self sufficient. In addition, there will be a demand for competing materials such as non-food industrial raw materials, tobacco, fibre and flowers that are bound to divert some area and increase the food productivity demand from the remainder.

In 1966 there were $31,091,000 more imports of food products than were exported. Included in that total figure, though, were $54,454,000 more imports of grain and grain products than were exported. This probably represents the net demand over production for foods, and indicates the relative attractiveness of grain and grain products as importation materials when due weight is given to the basis of payment for grains and grain products imported under U.S. Public Law 480.

The structure of government in Korea somewhat resembles the United States form of Government. A constitution provides the basic law. A President with powers similar to those of the U.S. President is the Chief Executive. He administers through an appointed Prime Minister and a State Council of Ministers similar to the U.S. Cabinet. There are fourteen ministries, one of which is the Ministry of Agriculture and Forestry, with whom this team has been associated in the development of this report.

The National Assembly is the law making legislative body for the Republic. It is unicameral with a present membership of 175, part of whom are elected by vote and part of whom are appointed by their political parties in proportion to their membership.

An independent Judiciary administers the laws through a system composed of a Supreme Court, Appellate Courts, District Courts, and Family Courts.

The nation is divided into eleven provinces, including "Special Cities" Seoul and Pusan as political entities with provincial status. The provinces are further divided into counties, cities, towns, villages, wards, etc. according to the organization needs and wants of the people, apparently decided in considerable measure by the historical organizations of the people. The constitution provides for local autonomy in the organization and administration of local matters that have not been preempted by National Law.

The Ministry of Agriculture and Forestry, with which this study is concerned, is headed by a Minister, a Vice Minister, and then, starting down the line in which our interests lie; an Assistant Vice Minister for Agricultural Administration, a Food Administration Bureau, and the Food Management Section of that Bureau, with which we have worked directly.

The Korean economy has grown rapidly in recent years. It is estimated that the real rate of growth per year in the period 1962-1966 was 8.3%. This was an increase over the 5.0% per year increase during 1957-1961. Rapid growth has continued to the present time.

The Agriculture-Forestry-Fishing sector of the economy grew at 5.5 percent per year during 1962-1966 (up from 4.9 percent per year during 1957-1961). The rest of the economy grew at 10.6 percent per year during 1962-1966 (up from 5.2 percent per year during 1957-1961). Industrial production has grown especially rapidly in recent years. Manufactured output doubled in the four-year period beginning in February 1964.

The high rate of growth of the Korean economy brought about an increase in per capita income of approximately 5.6 percent per year during 1962-1966 (up from 2.1 percent per year during 1957-1961).

Inflation has been severe in Korea. The wholesale price index increased an average 7.2 percent per year in the period 1957-1961, and 16.5 percent per year during 1962-1966. The consumer price index increased 7.8 percent per year in the period 1957-1961, and 16.6 percent per year in the period 1962-1966. There is indication that the rate has declined in 1967-68.

Exports have grown very rapidly in recent years, from only $33 million in 1960 to $320 million in 1967. But imports have grown rapidly also. Commercial imports grew from $98 million in 1960 to $674 million in 1967. "Official Aid" imports were $232 million in 1960, stayed at about that level until 1963, and have since declined to $119 million in 1967. Imports financed by foreign loans grew from zero in 1960 to $167 million in 1967.

The Korean economy has been using more resources in recent years than it has produced domestically. The gap represents resources made available to Korea by foreigners, either as grants or loans. These additional resources, if well used, allow the economy to grow faster than it would in their absence. As the Korean economy grows it should be possible for it to support from its own resources the investment required to sustain a high growth rate. The need for grants, and loans on non-market terms, would cease.

In spite of the growth of the economy high unemployment persists. Of the economically active population of 9,325,000 in 1966, 7.1% or 666,000 were unemployed. Under-employment is probably of greater consequence.

As a result of the very high growth rate of the economy and the continuing demand for investment money, interest rates are high. Commercial bank "official" rates quoted in May 1968 were, for example:

1. 27.6% per annum for time deposits.
2. 24% discount on commercial bills.

Government restrains inflation by regulating credit availability and interest rates through the operations and rules of the central Bank of Korea.

It is within that framework of a nation that the study has considered the grain supply problem, and formulated recommendations.

Section I

The Study

The stated objective of the study is to provide assistance in assessing the adequacy of existing facilities and determining the economic and technical feasibility of improving the grain storage, handling, processing, and distribution system in the ROK. The end goal is a rational system of grain supply management by the ROKG that will achieve a proper balance of supplies for the people with stabilization of prices for the producer and the consumer at levels that will result in incentives for the domestic producer.

The scope of work outlined is in two parts:

1. Survey the needs for an overall grain storage, processing, and distribution system. Based on those findings, recommend the further feasibility studies and engineering design needed.

2. In the context of the overall needs of the nation, review the preliminary loan application proposal of the ROKG for funds to build thirty insulated grain storage warehouses, with total space for 108,000 metric tons.

The only requirement for the study, as outlined for the team, that is in addition to the requirements of Manual Order 1221.2 is that the resulting recommendations must be reviewed by ROKG and U.N. Military authorities for National Security, and their alternative suggestions evaluated.

The scope of work provides that the economic analysis shall "use internal rate of return analysis, or other techniques approved in advance by ROKG and USAID/K."

Section II

Information

It is intended that this section shall contain the principal data on which analysis and recommendations are based.

Conversations with Korean and USAID/K experts on many of the pertinent subjects have been kept in note form, but are not generally included in this section. Such information influenced the findings of the team.

Mensuration Equivalents of Use in the Study

Volume

1 U.S. (Winchester) bushell = 1.2445 cubic feet
1 cubic foot = 0.8036 U.S. bushel
1 U.S. bushel = 35.2379 liters
1 cubic foot = 28.316 liters
1 liter = 0.03532 cubic feet
1 liter = 0.02838 U.S. bushels
1 Korean market bag = 100 liters of polished grain
1 Korean farm bag = 100 liters of unhulled grain
1 suk (seok) = 5.119 U.S. bushels
1 suk = 6.37037 cubic feet
1 suk = 180.39 liters
1 suk = 0.18039 cubic meters
1 hop = 0.001 suk

Area

1 hectare = 2.47104 acres
1 hectare = 0.01 square kilometer
1 acre = 0.40469 hectares
1 chongbo (cheongbo) = 0.99174 hectares
1 cheongbo = 2.4506 acres
1 tanbo = 0.099174 hectares
1 tanbo = 0.24506 acres
1 tanbo = 0.1 cheongbo
1 pyong = 3.3058 square meters
1 pyong = 35.5704 square feet
1 square meter = 10.76387 square feet
1 square foot = 0.0929 square meters

Weight

1 kilogram = 2.20462 pounds
1 metric ton = 1,000 kilograms
1 metric ton = 2,204.62 pounds
1 metric ton = 1.10231 U.S. (short) tons
1 metric ton = 266.67 kwan
1 pound = 0.45359 kilograms
1 U.S. (short) ton = 0.90719 metric tons
1 kwan = 0.00375 metric tons
1 kwan = 8.2672 pounds
1 kwan = 3.75 kilograms
1 doo = 8.0 kilograms
1 keun = 0.16 kwan = 0.6 kg

Standard weights per unit volume

1 standard straw bag polished rice = 80 kg
1 standard straw bag paddy rice = 54 kg
1 standard straw bag barley = 50 kg
1 standard straw bag naked barley = 60 kg
1 standard straw bag wheat = 60 kg
1 standard straw bag polished barley = 60 kg
1 barrel of flour = 196 lbs.
1 barrel of flour = 88.905 kg
1 bag of wheat flour = 22 kg
1 seok (suk) paddy rice = 100 kg
1 suk polished rice = 144 kg
1 suk barley = 99 kg
1 suk naked barley = 138 kg
1 suk wheat = 138 kg
1 liter paddy rice = 0.55435 kg
1 liter polished rice = 0.79827 kg
1 liter barley = 0.54881 kg
1 liter naked barley = 0.765 kg
1 liter wheat = 0.765 kg

Currency

1 U.S. dollar = 274 won
1 won = $0.00361 U.S.

Population projection

Procedure followed to obtain the 1971 population of Korea by province. The 1966 population of Korea by province (farm and non-farm) was used as the base. The farm population is assumed to grow at 1.7 percent per year from 1966 to 1971 and the non-farm population is assumed to grow at 3.7 percent per year from 1966 to 1971. After obtaining the farm and non-farm populations in 1971 by province they were summed to give total population for each province in 1971. The rate of growth for farm population (1.7%) and the rate of growth for non-farm population (3.7) were used by USAID in "Food Grain Gap Analysis".

Population in 1971, Projected from 1966 Base, in Million Persons. Growth Rate Farm Population 1.7% per Year, Non-Farm Population 3.7%

	1966			1971		
	Total(1)	Farm(2)	Non-Farm(3)	Total(4)	Farm(5)	Non-Farm(6)
Seoul	3.805	.108	3.697	4.551	.117	4.434
Pusan	1.430	.060	1.370	1.708	.065	1.643
Kyonggi	3.107	1.603	1.504	3.548	1.744	1.804
Kangwon	1.832	.934	.898	2.093	1.016	1.077
Chung-Puk	1.550	1.111	.439	1.735	1.209	.526
Chung-Nam	2.913	2.026	.887	3.268	2.204	1.064
Chon-Puk	2.524	1.773	.751	2.830	1.929	.901
Chon-Nam	4.052	2.884	1.168	4.537	3.136	1.401
Kyong-Puk	4.479	2.762	1.717	5.064	3.005	2.059
Kyong-Nam	3.178	2.263	.915	3.559	2.462	1.097
Cheju	0.337	.255	.082	.375	.277	.098
Total	29.208	15.781	13.427	33.268	17.164	16.104

1971 Farm Population = 1.0879 X 1966
Non-Farm Population = 1.1993 X 1966

1971 Total = Farm + Non-Farm

Columns (1) and (2) from MAF, Yearbook of Agriculture and Forestry Statistics 1967, pp. 22-23, 38-39.
Column (3) = (1) - (2)
Column (5) = (2) projected at 1.7% per year
Column (6) = (3) projected at 3.7% per year
Column (4) = (5) + (6)

Projected 1971 Population by Area

	1971 Pop.	%
Seoul	4,551	13.7
Pusan	1,708	5.1
Kyonggi	3,548	10.7
Kangwon	2,093	6.3
Chungchong-Pukto	1,735	5.2
Chungchong-Namdo	3,268	9.8
Cholla-Pukto	2,830	8.5
Cholla-Namdo	4,537	13.6
Kyongsang-Pukto	5,064	15.2
Kyongsang-Namdo	3,559	10.7
Cheju	375	1.1
Total	33,268	100.0

(Paddy) Rice Production Projection, by Area, 1965-1971

(Mil. MT)

	Base 1965	1967	1968	1969	1970	Polished 1971
Seoul	.022	.025	.025	.025	.025	.026
Pusan	.013	.015	.016	.016	.017	.017
Kyonggi	.467	.618	.642	.665	.680	.701
Kangwon	.119	.149	.155	.161	.165	.169
Chung-Puk	.202	.251	.260	.268	.274	.280
Chung-Nam	.483	.606	.628	.648	.663	.682
Chon-Puk	.481	.586	.604	.620	.632	.648
Chon-Nam	.603	.747	.773	.796	.814	.835
Kyong-Puk	.584	.696	.715	.732	.747	.764
Kyong-Nam	.489	.587	.611	.634	.653	.675
Cheju	.003	.004	.004	.004	.004	.005
Total	3.464	4.285	4.434	4.568	4.673	4.802

This "total" figure same as in 1967 Yearbook of A&F Statistics, p. 199, but province breakdown not same.

MAF, Second Five-Year Economic Development Plan, Food Grain Statistic (in Korea), pp. 18-27.

(Upland) Rice Production Projection, by Area, 1965-1971

(Mil. MT)

Polished

	Base 1965	1967	1968	1969	1970	1971
Seoul	.000	.000	.000	.000	.000	.000
Pusan	.000	.000	.000	.000	.000	.000
Kyonggi	.003	.006	.006	.006	.006	.006
Kangwon	.001	.003	.003	.003	.003	.003
Chung-Puk	.003	.003	.004	.004	.004	.004
Chung-Nam	.004	.004	.004	.004	.004	.004
Chon-Puk	.009	.013	.013	.014	.014	.014
Chon-Nam	.006	.008	.009	.009	.010	.010
Kyong-Puk	.003	.003	.003	.003	.003	.003
Kyong-Nam	.005	.005	.006	.006	.006	.006
Cheju	.003	.004	.004	.004	.004	.004
Total	.037	.050	.052	.053	.055	.056

1965 data same as in 1967 Yearbook of Agriculture and Forestry Statistics, p. 201.

MAF, Second Five-Year Economic Development Plan, Food Grain Production (in Korea), pp. 31-35.

Rice (Paddy + Upland) Production Projection by Area, 1965-1971

Polished Mil. MT

	Base 1965	1967	1968	1969	1970	1971
Seoul	.022	.025	.025	.025	.025	.026
Pusan	.013	.015	.016	.016	.017	.017
Kyonggi	.470	.624	.648	.671	.686	707
Kangwon	.120	.152	.158	.164	.168	.172
Chung-Puk	.205	.254	.264	.272	.278	.284
Chung-Nam	.487	.610	.632	.652	.667	.686
Chon-Puk	.490	.599	.617	.634	.646	.662
Chon-Nam	.609	.755	.782	.805	.824	.845
Kyong-Puk	.587	.699	.718	.735	.750	.767
Kyong-Nam	.494	.592	.617	.640	.659	.681
Cheju	.006	.008	.008	.008	.008	.009
Total	3.501	4.335	4.485	4.622	4.728	4.858

This table computed by adding table for paddy rice and table for upland rice.

Paddy Rice Production Increase - (Polished) The Sources of the Extra Output

Base	1965	3.464 MT (Mil.)
Target	1971	4.802 MT
Total increase		1.338 MT

	Mil. MT	%
New variety	.062	4.6
Seed improvement	.071	5.3
Early planting	.086	6.4
Deep plowing & fertilizer improvement	.144	10.8
Soil improvement	.080	6.0
Better timing and scheduling of farming	.213	15.9
Disease - insect control	.171	12.8
Paddy rice direct seeding on dry land	.057	4.3
Opening new paddy land	.087	6.5
Irrigation	.399	29.8
Land lost to other uses	-.030	-2.2
Total	+1.338	100.0

MAF, Second Five-Year Economic Development Plan, (Food Grain Production) (in Korean), pp. 26-27.

"Causes" of rice production increase as given in Ministry of Agriculture and Forestry, An Overall Agricultural Development Plan (Draft 1967-1971, January 1967.

Soils	(1)	Add 10,000 power plows for deep plowing
	(2)	Add 440 tractors
	(3)	Add 250,000 tons of soil improvement agents
Disease	(1)	Add 6,600 sprayers
	(2)	Disease forecast
Others	(1)	Irrigation expansion
	(2)	Reclamation
	(3)	Farmland "rezoning" p. 60

Upland Rice Production Increase
1965-1971
(Mil. MT)

The sources of the extra output

1965 (base)	.037
1971 (target)	.056
	.019

	Mil. MT	%
Seed improvement	.002	10.5
New land	.015	78.9
Better timing of activities	.001	5.3
Insect-disease control	.001	5.3
	.019	100.0

MAF, Second Five-Year EDP (Food Grain Production) p. 35

Rice Consumption Projection, by Province
1971
(Mil. MT) (Polished)

	Mil. MT	%
Seoul	.634	13.7
Pusan	.236	5.1
Kyonggi	.495	10.7
Kangwon	.291	6.3
Chungchong-Pukto	.240	5.2
Chungchong-Namdo	.453	9.8
Cholla-Pukto	.393	8.5
Cholla-Namdo	.629	13.6
Kyongsang-Pukto	.703	15.2
Kyongsang-Namdo	.495	10.7
Cheju	.051	1.1
Total	4.624	100.0

The figure for total rice consumption (4.624) is taken from "Food Grain Gap Analysis", Table 3.

It is assumed that rice consumption is proportional to population. The allocation of consumption by province is based on the 1971 population projection for each province.

Computation of Rice "Surplus" and "Deficit" Provinces

(1) Production Target MAF for 1970

(2) Consumption Estimate for RY 1971 following USAID "Food Grain Gap Analysis"

	(Mil. MT) Production	(Mil. MT) Consumption	Surplus(+) Deficit(-)
Seoul	.025	.634	-.609
Pusan	.017	.236	-.219
Kyonggi	.686	.495	+.191
Kangwon	.168	.291	-.123
Chungchong-Pukto	.278	.240	+.038
Chungchong-Namdo	.667	.453	+.214
Cholla-Pukto	.646	.393	+.253
Cholla-Namdo	.824	.629	+.197
Kyongsang-Pukto	.750	.703	+.047
Kyongsang-Namdo	.659	.495	+.164
Cheju	.008	.051	-.043
Total	4.728	4.624*	+.104

* Column does not add due to rounding.

Barley Production Projection, by Area
1965-1971
(Mil. MT)

	Base 1965	1967	1968	1969	1970	1971
Seoul	.002	.002	.002	.002	.002	.002
Pusan	.002	.001	.001	.001	.001	.001
Kyonggi	.079	.084	.094	.101	.108	.112
Kangwon	.018	.019	.022	.023	.025	.026
Chungchong-Pukto	.069	.072	.085	.090	.094	.096
Chungchong-Namdo	.082	.057	.047	.046	.045	.043
Cholla-Pukto	.012	.013	.004	.004	.004	.046
Cholla-Namdo	.001	.008	.010	.011	.011	.012
Kyongsang-Pukto	.258	.234	.210	.208	.202	.192
Kyongsang-Namdo	.184	.136	.182	.186	.190	.192
Cheju	.009	.012	.012	.013	.014	.015
Total	.718	.639	.669	.686	.696	.696

MAF, Second Five-Year Economic Development Plan, Food Grain Production (in Korean), pp 42-51.

Barley Production Increase 1965-1971 (Mil. MT)

1965 (base)	.718
1971 (target)	.696
	-.022

Sources of the output increase

	Mil. MT	%
Seed improvement	.019	
Lime	.021	
Transplanting cultivation	.018	
Better spacing of seed	.046	
New variety (shifting land to wheat)	-.227	
Paddy land - increased double cropping	+.039	
Reclaimed land	+.062	
Total	-.022	100.0

MAF, Second Five Year EDP (Food Grain Production), pp 50-51

Naked Barley Production Projection, by Area
1965-1971
(Mil. MT)

	Base 1965	1967	1968	1969	1970	1971
Seoul	.000	.000	.000	.000	.000	.000
Pusan	.003	.007	.007	.007	.007	.007
Kyonggi	.001	.000	.000	.000	.000	.000
Kangwon	.000	.000	.000	.000	.000	.000
Chungchong-Pukto	.002	.002	.003	.004	.004	.004
Chungchong-Namdo	.075	.128	.168	.66	.181	.184
Cholla-Pukto	.208	.224	.252	.250	.244	.235
Cholla-Namdo	.452	.466	.478	.477	.474	.465
Kyongsang-Pukto	.007	.052	.086	.094	.099	.101
Kyongsang-Namdo	.135	.243	.191	.184	.176	.166
Cheju	.044	.041	.047	.050	.052	.053
Total	.928	1.162	1.232	1.230	1.237	1.215

MAF, Second Five-Year EDP, Food Grain Production, pp 52-61
(in Korean)

Naked Barley Production Increase
1965-1971
(Mil. MT)

(Cause)

1965 (base)	.928
1971 (target)	1.215
	.287

	Mil. MT	%
Seed improvement	.030	10.5
Lime	.035	12.2
Transplanting cultivation	.035	12.2
Better spacing	.077	26.8
Shifting to wheat	-.041	-14.3
Paddy field - increased double cropping	.089	31.0
Reclaimed land	.063	22.0
Total	.287	100.0

MAF, Second Five-Year Economic Development Plan (Food Grain Production) pp 60-61

Wheat Production Projections, by Area
1965-1971
(Mil. MT)

	Base 1965	1967	1968	1969	1970	1971
Seoul	.000	.000	.000	.000	.000	.000
Pusan	.001	.001	.001	.001	.001	.001
Kyonggi	.019	.021	.023	.025	.026	.028
Kangwon	.009	.008	.010	.010	.011	.011
Chungchong-Pukto	.021	.021	.026	.026	.027	.027
Chungchong-Namdo	.019	.026	.033	.039	.046	.052
Cholla-Pukto	.014	.025	.034	.045	.057	.068
Cholla-Namdo	.034	.041	.063	.087	.112	.138
Kyongsang-Pukto	.046	.068	.077	.092	.107	.121
Kyongsang-Namdo	.027	.034	.043	.059	.075	.092
Cheju	.000	.000	.000	.000	.000	.000
Total	.191	.239	.308	.384	.402	.536

MAF, Second Five-Year Plan, Food Grain Production (in Korean)
pp 62-71

Wheat Production Increase
1965-1971
(Mil. MT)

(Cause)

1965 (base)	.191
1971 (target)	.535
Increase	.345

	Mil. MT	%
Seed improvement	.005	2.0
Lime	.014	4.1
Transplanting	.023	6.7
Better spacing	.059	17.1
Shift from barley and naked barley	.235	68.1
Paddy land	.003	1.0
Reclamation land	.007	2.0
Total	.345	100.0

MAF, Second Five-Year Economic Development Plan (Food Grain Production pp 70-71.

"Causes" of barley-wheat production increase as given in Ministry of Agriculture and Forestry, An Overall Agricultural Development Plan (Draft) 1967-1971. January 1967

(1) Improve seeds
(2) two million tons of lime to neutralize acidity
(3) Promote cultivation by transplanting
(4) Increase sowing intervals
(5) Expand farmland (a) by getting second crop
(b) reclamation p.61

Soybean Production Projection, by Area
1965-1971
(Mil. MT)

	Base 1965	1967	1968	1969	1970	1971
Seoul	.000	.000	.000	.000	.000	.000
Pusan	.000	.000	.000	.000	.000	.000
Kyonggi	.025	.033	.036	.039	.041	.044
Kangwon	.017	.021	.022	.024	.024	.027
Chungchong-Pukto	.019	.022	.024	.025	.025	.026
Chungchong-Namdo	.030	.037	.040	.041	.042	.043
Cholla-Pukto	.012	.017	.018	.030	.020	.020
Cholla-Namdo	.020	.030	.034	.025	.042	.046
Kyongsang-Pukto	.035	.043	.047	.049	.051	.053
Kyongsang-Namdo	.014	.016	.017	.018	.019	.020
Cheju	.002	.002	.004	.002	.002	.002
Total	.174	.222	.242	.253	.267	.281

MAF, Second Five-Year Economic Development Plan, Food Grain Production (in Korean) pp 162-171

Soybean Production Increase
(Mil. MT)

		Source of the output increase
1965 (base)	.174	
1971 (target)	.281	
Increase	.107	

		Mil. MT	%
Seed improvement		.008	7.5
Better timing of farm operation		.029	27.4
Fertilizer		.005	4.7
Lime		.000	0.0
Upland	Land expansion	.029	27.4
Reclamation		.035	33.0
Total		.106	100.0

MAF, Second Five-Year Economic Development Plan, Food Grain Production (in Korean), pp 170-171

Imports of Grain
1957-1968
(Mil. MT)

Year	Total grain import	Rice	Barley (1)	Wheat (2)	Wheat flour
1957	.966	.202	.290	.360	.044
1958	.968	.023	.323	.428	.051
1959	.267	.004	.032	.133	.039
1960	.468	-	-	.350	.032
1961	.603	-	.190	.330	.018
1962	.499	-	.047	.377	.021
1963	1.318	.118	.263	.789	.027
1964	.916	-	.226	.545	.062
1965	.669	-	.106	.441	.055
1966	.525	.032	-	.340	.119
1967	Not avail.	.139	.003	.636	.014
1st 3 months 1968	"	.020	.062	.334	.014

1957-1966 from MAF, Yearbook of Agriculture and Forestry Statistics: Grain Statistics 1967, pp 90-91

1967-68 from Bank of Korea, Monthly Statistical Review (June 1968), pp 102-103

(1) Barley imports are shown at "unpolished weight" for 1957-1966. The Bank of Korea publication does not state if its figures for 1967-1968 are on same basis.

(2) Wheat on this chart is quoted in grain form.

Exports of Grain, 1959-1967
(Mil. MT)

Year	Total grain export	Rice
1959	.005	.005
1960	.025	.024
1961	.008	.006
1962	.064	.062
1963	.006	.006
1964	.014	.014
1965	.026	.019
1966	.050	.044
1967	Not available	.000

1959-1966 MAF, Yearbook of Agriculture and Forestry Statistics: Grain Statistics 1967, pp 90-91

1967 Bank of Korea, Monthly Statistical Review (June 1968), p 92

Korean Yearly per Capita Consumption
1965

	Kilograms	Metric tons
Rice	130.3	0.1303
Barley	31.9	0.0319
Naked barley	23.3	0.0233
Wheat	24.5	0.0245
Rye	1.0	0.0010
Miscellaneous cereals	5.8	0.0058
Soybeans, millet, etc.	5.9	0.0059
Total	222.7	0.2227

Reference: pp 132, 1967 MAF Yearbook

Warehouse Capacity by Provinces - 70% of Capacity Utilized

Province	Class A			Class B			Class C			Low temperature			Total		
	No.of whses	Area in pyong	Capac. in straw bag	No.of whses	Area in pyong	Capac. in straw bag	No.of whses	Area in pyong	Capac.in straw bag	No. of whses	Area in pyong	Capac. in straw bag	No.of whses	Area in pyong	Capac. in straw bag
Seoul	17	2,368	142,080	19	2,198	118,692	34	4,825	202,650	2	800	104,000	72	10,191	567,422
Pusan	22	6,943	416,580	16	3,351	180,954	1	117	4,914	2	400	52,000	41	10,811	654,448
Kyonggi	50	6,054	318,900	133	13,094	665,146	196	8,886	373,212	-	-	-	379	28,034	1,357,258
Kangwon	-	-	-	50	6,616	357,264	114	10,106	424,452	-	-	-	164	16,722	781,716
Chung-Puk	2	240	14,400	150	9,626	530,604	84	2,580	108,360	-	-	-	236	12,446	653,364
Chung-Nam	8	1,378	82,680	70	5,464	295,056	8	352	14,784	-	-	-	86	7,194	392,520
Chon-Puk	70	13,162	353,880	52	5,102	275,508	162	9,086	381,612	-	-	-	284	27,350	1,011,000
Chon-Nam	38	4,618	277,080	158	19,528	1,246,211	352	18,600	656,340	-	-	-	548	42,746	2,179,631
Kyong-Puk	64	7,942	476,520	148	12,162	656,748	204	9,350	392,698	-	-	-	416	29,454	1,525,966
Kyong-Nam	20	4,284	276,600	91	8,444	266,652	94	4,926	206,892	-	-	-	205	17,654	750,144
Cheju	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	291	46,989	2,358,720	887	85,585	4,592,835	1,249	68,828	2,765,914	4	1,200	156,000	2,431	202,602	9,873,469

Grain Warehousing

Grain storage warehouses in Korea fall into four classes: (1) low temperature warehouses, (2) class "A", (3) class "B", and (4) class "C".

At the present time there are two low temperature warehouses completed and in use; one at Seoul with a rated storage capacity of 6,000 metric tons, the other at Pusan with a capacity of 3,000 metric tons. Four more such warehouses are scheduled for completion this year with a rated storage capacity of 10,000 metric tons each. Their locations are: Seoul, Pusan, Taegu and Kwangju.

These warehouses are of brick and concrete construction with the walls and roof insulated. They have double doors covered with metal sheathing. The floors are concrete. The temperature in each of five compartments is maintained at 15° centigrade. Each compartment has its own cooling unit equipped with a 10.8 kilowatt compressor and a three kilowatt fan.

We inspected the warehouse at Seoul which was empty at the time; however, each of the five compartments had a definite musty odor.

Class "A" warehouses are those of not less than 18 feet in height with reinforced concrete, brick or cement block walls. The floors are of concrete or lime clay mortar. The roof is of concrete, earth roofing tiles; slate, or galvanized iron sheeting The doors are solid with metal sheathing and should be tight. The windows should have wire mesh covering to prevent birds from entering the building when the windows are open. These warehouses should also be equipped with good ventilators.

The equipment in these warehouses consists of scales, fire extinguishers, ladders, stools, and adequate dunnage.

In the Seoul TOAID A-1253 report dated April 1, 1965 which was prepared by Forest Mariner, Grain Storage Consultant the following comments are noted concerning Class "A" warehouses: 75% of the floors are concrete. Remainder of the floors are dirt, gravel, or wood. These floors should be paved to prevent rodent entry.

Doors do not fit well enough to prevent rodent entry. The sheet metal is rusted. The sliding doors do not fit tightly.

Some holes in the side walls. Wooden structures should be sheathed to make them weather and rodent proof. Broken windows should be replaced and have outer screens.

Mr. Mariner recommended exhaust fans to lower the inside temperatures.

Class "B" warehouses are those whose construction materials and equipment are the same as Class "A". The height of this class of warehouse may not be less than 16 feet.

Class "C" warehouses are those which do not meet the specifications of Class "A" or "B" warehouses.

The classification of grain storage facilities determines to what height the number of straw bags may be stored. Class "A" warehouses may store straw bags 12 to 15 high; Class "B" from 9 to 11 bags high and Class "C" seven to eight bags high. The height of the building is the principal determining factor for classification, to provide more air space between the tops of the piles and the roof of the building.

Further storage comments by Mr. Mariner are as follows:

"Suchon, Seoul and Suwon - very few warehouses rodent proof. No shortage in space area.

Kangwon (Chunchon) - Few warehouses required as it is a food deficit province close to the demilitarized zone.

N. Chungchong (Chongju, Chungju and Tanyang) - Class "A" warehouses in very bad shape, rice deficit province.

S. Chungchong (Taejon, Nonsan and Changhang) - Warehouses need repairs. Managers state that storage rate too low. Repairs cannot be made because of lack of funds.

N. Kyongsang (Taegu, Pohang and Kyungju) - Class "A" and "B" warehouses in Taegu in good repair.

S. Kyongsang and Pusan Special City (Ulsan and Pusan) - Many private warehouses in Pusan. Dock warehouses in need of repairs. Warehousesmen suggested relocation of some ICA-type warehouses.

S. Cholla (Kwangju, Mokpo and Yosu) - Mokpo facilities in excellent condition. Yosu warehouses in very bad shape. Cooperative warehouses in Sengju were best visited in Korea. Kwangju which is the fourth largest city is short of warehouse space.

Cheju warehouses in fair condition. This province imports rice. Island is very rocky. Additional warehouse space, when required, could be constructed of stone.

The provinces of S. Cholla (Chonnam) and N. Kyongsang (Kyongpuk) rank first and second respectively as the largest grain producing provinces in the country. They also rank in the same order for grain storage capacities. S. Kyongsang (Kyongnam) which ranks third in production is sixth in warehouse storage capacity. S. Kyongsang lies in the south eastern section of the country near the Special City of Pusan.

The greatest inequality of grain production warehouse capacity ratio is in the province of Kyonggi. This province ranks sixth in grain production and third in total warehouse capacity.

The Special City of Pusan ranks seventh in grain warehouse capacity and the Special City of Seoul ranks ninth."

Modern warehouses should reduce the loss of rice and other grains now experienced through spoilage, rain, pests, theft, and fire reported as follows:

Losses in Gov't Contrclled Rice in 1966 (MT)

	Total handled	Unexplained disappearance	Spoilage loss	Ground storage loss	Theft	Fire	Total losses
Weight	290,063	9,907	8,231	6,250	3,722	1,680	29,790
% of total	100.0	3.4	2.8	2.2	1.3	0.6	10.3
% of loss	-	33.4	27.6	21.0	12.5	5.6	100.0

Grain Polishing and Milling

Korean Rice Milling Capacities by Provinces (Polished)
(Includes all types of mills: small scale, National Agricultural Cooperative Federation, and large scale mills)

Province	Number of mills	Daily Grind Capacity (10 hr./day) Straw bags*	Metric tons
Seoul	162	6,435	386.1
Pusan	100	6,917	415.0
Kyonggi-Do	2,736	55,552	3,333.1
Kangwon-Do	1,149	21,071	1,264.3
Chungchong-Pukto	1,981	35,190	2,101.4
Chungchong-Namdo	2,741	53,753	3,225.2
Cholla-Pukto	1,856	43,092	2,585.5
Cholla-Namdo	3,245	66,920	4,015.2
Kyongsang-Pukto	3,879	76,499	4,589.9
Kyongsang-Namdo	2,708	65,135	3,908.1
Cheju	0	0	0
Total	20,557	430,564	25,823.8

* Straw bag: 60 kilos.

Korean Barley Processing by Provinces - Daily Grind (10 hr./day) Capacity Includes all Types of Mills (Polished)

Province	No. of Plants	Straw Bags	Metric Tons
Seoul	15	7,353	441.2
Pusan	136	17,737	1,064.2
Kyonggi-Do	2,728	22,893	1,373.6
Kangwon-Do	1,308	5,458	327.5
Chungchong-Pukto	2,063	5,935	356.1
Chungchong-Namdo	2,841	15,074	904.4
Cholla-Pukto	1,870	15,854	951.2
Cholla-Namdo	3,227	28,702	1,722.1
Kyongsang-Pukto	3,898	21,267	1,276.0
Kyongsang-Namdo	3,187	14,716	883.0
Cheju	391	932	0.9
Total	21,664	155,921	9,300.2

Daily Flour Milling Capacity in Commercial Mills Authorized by Korean Government (See Footnote)

Province	Name and location of mill		24 hr. grind-permitted capacity in barrels
Seoul	Daesun Mlg. Co. -	Seoul	2,377
	Han Ill Mlg. Co. -	Seoul	2,568
	Tongbang Youliang Co. -	Seoul	1,579
Pusan	Don Ah Mlg. Co. -	Pusan	4,926
	Taemang Mlg. Co. -	Pusan	1,205
	Taesong Sanob Co. -	Pusan	896
	Shin Keudong Mlg. Co. -	Pusan	2,282
	Shinhan Mlg. Co. -	Pusan	2,916
	Han Ill Mlg. Co. -	Pusan	1,579
	Chae-il Sugar Co. -	Pusan	5,453
	Keumsung Koopo Co. -	Pusan	1,207
	Namsun Kiksan Co. -	Pusan	1,025
	Yungnam Mlg. Co. -	Pusan	1,239
Kyonggi	Taehan Mlg. Co. -	Inchon	10,005
	Samhwa Mlg. Co. -	Inchon	2,237
	Don Ah Mlg. Co. -	Inchon	3,338
Kyongsang-Pukto	Hando Mlg. Co. -	Taegu	1,138
	Poonggook Sanob Mlg. Co. -	Taegu	1,013
	Daedong Sanob Kongsa		1,185
Cholla-Pukto	Honam Mlg. Co. -	Kunsan	1,503
Chungchong-Pukto	Shinheung Mlg. Co. -	Chungju	2,308
Chungchong-Namdo	Shinheung Mlg. Co. -	Taejon	1,132
	Total		53,111

Footnote: Capacity stated is not full capacity or potential grind for all the mills. Some are capable of higher amounts.

Daily Flour Milling Capacity in Gristmills in Korea by Provinces

Province	No. of Plants	24 hr. day grind total grind capacity in barrels
Seoul	529	801
Pusan	57	81
Kyonggi-Do	1,557	1,655
Kangwon-Do	1,158	1,281
Chungchong-Pukto	1,822	1,920
Chungchong-Namdo	2,568	1,132
Cholla-Pukto	1,400	1,422
Cholla-Namdo	1,898	1,977
Kyongsang-Pukto	3,547	3,803
Kyongsang-Namdo	2,619	2,676
Cheju-Do	0	0
Total	7,155	16,748

Daily Total Flour Milling Stated Capacity by Provinces Commercial and Grist Mills

Province	Number of barrels
Seoul	7,325
Pusan	22,809
Kyonggi-Do	17,235
Kangwon-Do	1,281
Chungchong-Pukto	4,228
Chungchong-Namdo	2,264
Cholla-Pukto	2,925
Cholla-Namdo	1,977
Kyongsang-Pukto	7,139
Kyongsang-Namdo	2,676
Cheju-Do	0
Total	69,859

Imports of Grains Quantity in Metric Tons

- Page 91, 1967 Yearbook -

Kind of Grain	1959	1960	1961	1962	1963	1964	1965	1966
Rice	3,759	-	-	-	118,408	-	-	31,500
Barley	31,644	-	189,790	47,119	263,461	225,872	106,257	-
Wheat	133,422	348,730	329,579	377,054	788,757	545,438	440,954	339,666
Maize (corn)	670	9,596	-	1,493	33,789	5,000	-	2,875
Sorghums	26,019	-	-	947	17,802	-	-	-
Soybeans	28,772	35,890	21,616	16,161	10,118	8,934	-	-
Barley (Polished)	-	-	-	-	-	-	-	-
Wheat (Polished)	3,990	-	-	-	-	-	-	-
Wheat flour	38,988	31,867	18,410	20,748	26,562	61,791	54,826	118,697
Corn meal	-	38,520	43,360	34,644	55,670	59,052	61,585	30,019
Others	-	3,085	368	1,031	3,528	9,538	5,257	2,186
Total	266,664	467,688	603,123	499,207	1,318,095	915,625	668,879	524,943

Exports of Grains Quantity in Metric Tons

- Page 90, 1967 Yearbook -

Kind of Grain	1959	1960	1961	1962	1963	1964	1965	1966
Rice	5,000	24,159	5,842	62,002	5,706	14,300	19,208	44,294
Soybean	201	390	1,404	435	-	-	-	-
Blackbeans	-	-	-	240	-	-	1	28
Redbeans	252	60	1,220	1,652	504	190	5,057	4,252
Millet (unhulled)	-	-	-	-	124	-	1,820	1,299
Millet (Polished)	-	-	-	-	-	-	10	2
Buckwheat	-	-	-	-	133	-	-	621
Buckwheat flour	-	-	-	-	-	-	1	1
Total	5,453	24,609	8,466	64,329	6,467	14,490	26,097	50,497

Average Grain Production

Average Production of Principal Grains (Source: Korean Statistics of Food Crops in 1968)

Kind of Grain	Weight in Metric Tons
Rice	3,758,551
Barley	925,821
Naked Barley	820,004
Wheat	306,339
Rye	33,154
Millet	64,312
Corn	36,130
Soybeans	166,205
Total	6,110,516

Rice Year 1967 Planted Area

Kind of Grain	Number of hectares planted	Total production in metric tons
Rice	1,231,328.8	3,919,280.3
Barley (polished)	1,138,790.3	2,374,661.1
Misc. grains	169,953.2	107,107.2
Pulses	341,746.4	195,010.7
Potatoes	208,318.7	971,625.2
Total	3,090,137.4	7,567,684.5

Comparison of Area Increase of Cultivated Land for All Crops - 1960 v.s. 1966

Unit used: Hectare

Year	Total	One crop	Multiple crops	Upland
1960	2,024,804	807,238	399,014	818,553
1966	2,293,088	696,601	590,517	1,005,970
% of increase	+13.25	-1.37	+47.9	+22.7

1968 Area for Various Crops, Including Multiple Use of the Land

Kind	Number of hectares
Rice paddy	1,292,082
Upland rice	51,860
Barley	1,331,869
Cereals (others)	302,922
Floriculture	294
Fruits	61,778
Vegetables	180,466
Special crops	120,874
Potatoes	276,047
Tobacco	37,275
Pulses	11,366
Forage crops	35,445
Mulberry	107,420
Total	3,809,698

Principal Short Grain Rice Varieties Grown in the ROK*

Area	Growing season	Harvest season	Varieties
Northern	140 days	End of September	Fujisuka #5 Shin #2 Suwon #82
North central	150 to 160 days	Middle of Oct.	Shiroyane Paltal Jaekeun Jinheung Pung kwang
South central	170 days	End of Oct.	Palkum
Southern	180 days	First of Nov.	Nori #66 Palkuong Kimmaze

* Information furnished by: Mr. Bae, Sung Ho
Rice Breeding Section Chief
Crop Experiment Station
Office of Rural Development
Ministry of Agriculture and Forestry

Wheat Storage Capacity of Each Flour Mill In Republic of Korea

No.	Name of mills	Milling capacity (Bl.)	Wheat storage capacity in... Warehouse (MT)	Silo (MT)	Open (MT)
1	Daehan	10,005	4,580	14,000	47,200
2	Dong-A (Pusan)	4,926	5,500	10,000	3,000
3	Daesun	2,377	24,285	5,100	16,000
4	Hando	1,138	3,884	-	120
5	Shinhan	2,916	1,200	3,830	8,000
6	Honam	1,503	22,000	400	800
7	Shinheung(Chungju)	2,308	23,000	800	10,000
8	Cheil	5,453	4,000	10,000	10,000
9	Samwha	2,237	6,000	-	14,000
10	Poongkuk	1,013	8,142	-	7,488
11	Daewang	1,205	8,000	-	8,000
12	Hanil (Pusan)	1,579	364	6,000	5,000
13	Hanil (Seoul)	2,568	10,000	-	50,000
14	Shinkeuk-dong	2,282	6,000	6,000	500
15	Dongbang	1,579	8,000	-	5,000
16	Yungnam	1,239	6,000	-	3,000
17	Namkok	1,025	2,500	-	3,000
18	Keumsung	1,207	4,725	600	7,000
19	Daedong	1,185	5,000	-	-
20	Daesung	896	4,670	-	7,405
21	Dong-A (Inchon)	3,338	3,000	8,000	4,000
22	Shinheung (Taejon)	1,132	3,600	-	10,000
	Total	53,111	164,450	64,730	219,513

Present Dock Side Wheat Warehouses for Imported Grain

Unit: MT

Name	City	Silo	Warehouse	Total
Daehan	Inchon	14,000	4,580	18,580
Dong-A	Pusan	10,000	5,500	15,500
Shinkeuk-Dong	Pusan	6,000	6,000	12,000
Hanil	Pusan	6,000	364	6,364
Total		36,000	16,444	52,444

Port Facilities

Relative Importance of Major Ports
(1965 Percent of Total)

Port	Total amount cargo handled	Imports	Exports	Coastal cargo (in and out)
Pusan	41.8%	39.0%	63.4%	38.4%
Inchon	18.0	31.4	12.7	3.9
Mukho	14.0	0.6	16.3	29.1
Ulsan	12.2	16.0	0.0	11.6
Masan	3.6	1.3	3.5	6.3
Gunsan	3.5	6.7	0.0	0.7
Yeosu	2.4	2.0	0.0	3.0
Mokpo	2.3	0.9	3.7	3.5
Cheju	1.3	0.0	0.0	3.2
Pohang	1.3	1.5	0.0	0.8
Total	100.4%	99.4%	99.6%	100.5%

Korea Ports of Discharge

Data furnished by ROKG, Ministry of Transportation
Basis Lower Low Water Datum

	Minimum Docking depth meters	Mean tidal range meters
Pusan	9.0	1.33
Inchon	4.0	9.15
Ulsan	11.0	0.63
Kunsan Changhang	9.0	6.06
Mukho	6.0 (Coal 8.0)	0.46
Pohang	4.0	0.18
Masan	7.5	2.18
Chungmu	3.0	2.60
Yosu	7.0	3.43
Cheju	5.5	2.64
Mokpo	9.5 (as of Dec.1, 1968)	4.18

The important port of Inchon is under development at the present time. At present, grain ships lie offshore at a 12 meter anchorage, some 8 kilometers at sea. Grain is discharged to lighters and pulled by tugs to dockside. There is construction underway to dredge a deep water channel to dockside, build a tidal gate, and maintain 9 meters minimum depth at dock side. Completion is expected in 1970.

Section III

Analysis of the Information

Essentially the problems of the ROK grain food supply can be broken down into three inter-related but differentiated segments. They are:

1. Physical Logistics---The problems of gathering; moving to appropriate processes; location of the appropriate processes, including milling and storage; milling and storage capacity; and the movement of the material from processing thru appropriate channels to consumption.

2. Grain Food Technology---The condition of the grain at each step from the field to consumer, including the farmer; the adequacy and efficiency of the milling resources; the adequacy of the storage space for maintenance of quality and quantity; the kind of rice preferred by the ROK consumer; and the problems of preparation by the consumer.

3. Financial---The problems of logically financing improvements in the physical plant for transporting, processing, and storing grains; the problem of stabilizing the price of grain foods for the consumer; the problem of insurance of an adequate supply of grain foods for the consumer; the importance of the maintenance of an adequate purchase price for grains from the farmer so as to provide an incentive for increased production of grain foods; and the logical place of imported food grains in the economy.

We shall analyze the information gathered in the context of those problem categories. We must again caution that the time alloted did not permit verification of most of the data used, nor did the number of observations made represent a statistically valid sample.

Physical Logistics

The physical problems of moving grain to consumers starts with the large number of farmers centered in the small village having quite small farms. In 1966 there were probably about 2,000,000 rice farmers, tilling about 1,231,000 hectares of rice land, and producing about 3,919,000 metric tons of polished rice. The average rice farmer thus produced about 1.93 metric tons of polished rice on 0.606 hectares of land. They lived in about 56,000 villages near their land.

About 1,783,000 metric tons of polished rice, or 0.878 metric tons per farmer moves to the commercial markets and the balance is utilized by the farmer or sold to area consumers. He retains a portion for seed.

The majority of the farmers appear to thresh their rice shortly after cutting and even those with competing demands for their time complete threshing of the cut grain within about thirty days. There is seasonal dispersion, due to climate and varieties grown.

Movement of rice from the farm to market is spread over the year, with the peak market movement in November-December. In peak month, December, an average, 12.1% of the crop moves to market out of the total of 45.5% moving to market over the year.

The first movement of rice from the farm is typically to the area mill. One study of a small sample showed 100% of the rice being hulled and polished at the village mill although some 84% of the farms still owned mortors that could do the work at home. Movements from the farm by the farmer first to the mill, and also to market are by quite diverse transportation media. They are:

Back packs
On the head
Hand carts
Animal powered vehicles
Bicycles
Bus
Train
Motor truck
Sold on farm - buyer transports

Mechanization and sophistication of the transport method tends to go up as the quantity goes up.

There are 20,557 rice mills in the ROK having a capacity of 25,824 metric tons per ten hour day, more than enough milling capacity to handle the annual crop now and in the foreseeable future. There may be some temporary dislocations at harvest time by demands for prompt milling, since the reported capacity takes 170 ten hour days to mill the present crop.

The initial movement from the farm has quite diverse purposes. Among them are:

1. Toll milling and return to the farm in polished form for storage, consumption, and later disposition.

2. Toll milling and sale to the private sector.

3. Toll milling and payment of debts.

4. Payment of taxes and government loans in paddy rice (unhulled) form.

5. Toll milling and sale to government.

6. Paddy farm sales to the private sector at the farm or mill.

7. Toll milling and direct barter for goods and services.

8. Sale to the government in unhulled form.

All of these reasons, and perhaps others, appear to account for significant movements, that are not amenable to reduction to a standardized form. Any recommendation to standardize the movement from the farm would appear to be doomed to failure within the foreseeable future. That does not necessarily mean that a modest start toward modernization of the farm to market system for demonstration purposes has no place in current planning. Surely at some point in the future the use of human manual labor for making straw bags and back packing grain to market will be too wasteful for this developing society.

Some 54.5% of the rice is utilized by the farmer and his family for food, seed, or feed. Typically, he stores that rice, an average of about one to one and ½ metric tons, in one or more of the rooms of his house. The portions of his crop which are withheld from the market at harvest time for later movement into commercial channels are also stored in the home.

Indications are that in the magnitude of 90% of the home stored grain is in the polished form. Typically it has moved to the mill and back to the farm.

A small sample study indicated that home storage was about 67% in straw bags with the balance in miscellaneous other vessles.

When rice enters commercial channels there are three major avenues accounting for 75% or more of the volume and countless devious routes to market for the balance. The three are:

1. The private sector is by far the more important merchandizer of rice in Korea. Various approaches, and authors, result in estimates varying from about 58% to 75% of the rice entering commerce. We believe that about 72% or 1,086,000 metric tons of polished rice probably moved to market by some route thru the private sector in RY 1966. There is no set pattern of flow but the mode would seem to be: Producer --> Local Assemblers --> Area Assemblers --> Wholesalers --> Retailers. The numbers of entrepreneurs so engaged were not determined.

2. The National Agricultural Cooperative Federation, a quasi-government directed organization, consisted of some 17,970 village co-ops, 139 central area co-ops, and five large city stores in 1965.

The stores sell to wholesalers, retailers, and direct to consummers. The cooperatives appeared to collect and market about 10% of the commercial rice, or about 151,000 metric tons, in RY 1966. The usual flow of the co-op grain is: Producer --> Village co-op --> Area co-op --->
Co-op stores --> Wholesalers --> Retailers --> Consumers

3. The Food Administration Bureau of the Ministry of Agriculture is charged with purchasing and marketing sufficient grain to level out supply-demand fluctuations, stabilize prices, and provide price incentives to the farmer. They acquire rice by:

a. Purchase of both polished and paddy rice primarily from the farmer.

b. Payments in rice for fertilizer supplied by the government.

c. Repayment of government exchange grains in rice by the farmer.

d. Payments of land taxes in rice.

The Government Bureau collected and marketed about 273,000 metric tons of polished rice equivalent in RY 1966 or approximately 18% of the commercial grain.

The government buys and collects rice thru some 3,000 buying and inspection offices well distributed throughout the producing areas.

The Government Bureau utilizes the Cooperative stores and field selling agencies as its selling agency. The grain may physically pass thru the co-op facilities or it may be delivered directly to wholesalers and retailers with the co-op performing a brokerage service only.

The usual flow of government rice is:

Producer --> Government Purchasing Office --> Warehouse / Miller --->
Cooperative Store --> Wholesalers --> Retailers --> Consumers

Most of the government rice is purchased and stored in unhulled form in the producing areas and milled as the movement to the consuming areas starts.

The Korean Ministry of Agriculture expects to increase the supply of home grown rice, and their plan extending to 1971 appears

to have technical support. They project 4,802,000 metric tons of polished rice equivalent in 1971. This amounts to an increase of about 39% over the 1965 base year used in their projections. Logistic planning must take this projected increase into account.

Barley is second to rice as a food grain crop in South Korea. Because it is secondary to rice less data is available concerning it than is available for rice and there are some rather wide differences in the data from the sources available to the team. The current five year development plan uses an estimate based upon field survey data that does not coinside with the official published statistics. The Ministry of Agriculture (MAF) deems the survey based data to be more accurate and useful. We have found it necessary to use both sources for our needs; however, we do not deem the bias so injected to significantly affect the results of our study.

Common barley is grown by about 1,300,000 farmers on 494,000 hectares of land. 1966 production was about 975,000 metric tons. The average farmer produced about 0.739 metric tons on 0.375 hectares of land in 1966.

Naked barley is grown by about 878,000 farmers on 467,000 hectares of land. 1966 production was 1,043,000 metric tons. The average farmer produced 1.188 metric tons on 0.532 hectares of land.

Barley is grown both on paddy fields, in rotation with rice, and it is the predominant crop on unirrigated upland cultivated land. It is predominately fall sown and late spring harvested.

Commercialization of barley is not extensive. It appears from interpolation of the limited data available that only about 34% of the crop or 525,000 to 550,000 metric tons enters commercial channels. The peak month for the barley movement to market is July with perhaps six to seven percent of the crop or 110,000 metric tons moving to market at that time.

We did not find data to indicate how barley moves to market; however, we believe from conversations that it follows essentially the same channels as does rice. Government appears to use barley as a supplement to rice in compensating for shortages of rice. Government uses barley as a diluent for rice. At the present time, restaurants are required to use some 30% pearled barley with rice.

Due to its late spring - early summer harvest time barley does not compete with rice for storage, milling and transport capacity. Barley production is not expected to change significantly to 1971.

Indigenous wheat is grown on about 153,000 hectares by about 1,393,000 farmers. The 1966 production was about 315,000 metric tons. Each wheat farmer produced, on average, about 0.226 metric tons of wheat from about 0.11 hectares of land devoted to wheat.

The present indigenous wheat supply does not move into commercial channels in significant volume. It is largely consumed on the farm. The stated reason for lack of use of this grain in the domestic flour milling industry is lack of suitable quality for the uses to which the commercially milled flours are put -- too soft. That statement is unverified. Collecting the small lots grown by the average producer is also a problem.

The wheat grown is fall planted and late spring - early summer harvested; therefore, it does not compete significantly for warehouse, and transport space with rice. The plan for the future indicates a quite sizable increase in wheat production from 191,000 metric tons of flour equivalent to 536,000 metric tons of flour equivalent in 1971. This is a 356% increase. The stated basis for attaining it is largely dependent on the diversion of barley land to wheat production. This projection appears to rest on a nebulous assumption, as this team views the data. It would certainly be in the interest of the domestic economy if wheat of suitable quality for the uses made of wheat could decrease dependence on imports after PL 480 aid is reduced or eliminated.

The principal wheat of commerce in Korea is imported. At present, the source is the United States. In 1966, 339,666 metric tons of wheat and 118,697 metric tons of wheat flour were imported, equal to a total wheat equivalent of about 500,000 metric tons. Of that total, 89,000 metric tons or about 18% came in through purchases with foreign exchange and the balance were imported under PL 480.

The bulk of the imported wheat and flour enters Korea through the ports of Pusan and Inchon. Pusan is a deep water port. All but the largest cargo vessels can berth at its piers under load. Inchon is presently a shallow water port. Ships must stand off shore. The grain is lightered to the dock side. Plans are developed to improve Inchon harbor to berth large vessels.

At dock side, imported wheat is generally packed into straw bags, weighed and then transported by truck or rail to the twenty two existing commercial flour mills.

Dock side storage facilities for wheat at these two ports is inadequate.

Grain storage at the wheat flour mills is inadequate.

The twenty two wheat flour mills of Korea have a daily wheat flour capacity of about 4,722 metric tons of flour. They will grind about 6,296 metric tons of wheat daily at capacity. Stretched to a 300 day year, about all that a well managed flour mill can expect to do, they could grind about 1,888,800 metric tons of wheat annually, which is well above any current demand projections. They are obviously over-built, or under utilized today. The present imports of wheat and wheat flour equivalents and the 1971 projection of internal wheat production could each be processed in 80 to 90 days operating time per year, or both could be processed in about 165 days per year. A drastic change in eating preferences would seem to be required to tax the wheat flour milling capacity presently available.

Available data on soybeans is not extensive and there appears to be less interest in it than in the major grains discussed heretofore.

We estimate that about 1,676,000 farmers raised about 160,177 metric tons on 279,991 hectares of land in 1966. This equals about 0.096 metric tons from about 0.167 hectares for each farmer growing soybeans.

We have no significant data on the farm to market channels for soybeans or the food uses made of them. We do know that a significant portion of the crop is used for soy sauce and curd production.

We have seen no data to indicate that soybeans have an important place in the long-range food grain plans.

There are several additional food grains and seeds grown and utilized for food purposes including rye, corn, beans, and millet. They do not presently represent a significant factor in the grain problem in Korea and there are no projections of increases in their supply that should cause them to contribute significantly to the problem.

Milling facilities for all grains appear to have adequate capacity to process the grain crops now and into the future at least to the year 1971 for which changes are projected. While observations, literature investigations, and discussions with other people indicate that much of the facilities are obsolete and quite depreciated by western standards, there was nothing in the data uncovered to indicate significant economic justification to modernize the milling segment of the grain industry. We suggest for the purpose of the current study that improvement of the milling facilities may logically be left to the entrepreneurs who operate them.

Transportation is a national problem. There is a rather complete network of both railroads and roads over which grain may move. The railroad needs road bed work and rolling stock to serve the nation adequately. The roads need improvement and more trucks to provide good service. Little use is being made of the potential for coast-wise and river water transport. These problems are not particularly oriented to the grain industries, but, of course, food transport is of paramount importance to the welfare of the country.

A detailed study by competent people has been made of the transportation industries and much work is underway to implement the improvements needed. We suggest that further study of the transport problem, as it relates to the grain movement, can be left to the transportation people in both governments, with one important exception. Specific site selection for any grain facilities to be built must take into account the transportation service availability as it exists then and the specific plans for improvement, if adequate facilities do not exist, at each site selected. Food material would probably always enjoy a high priority for available service.

The study team concludes from the data available that two problems of physical logistics exist that, if solved, will essentially correct all of the significant problems of that category in the grain movement to market. They are:

1. Adequate storage of rice. Because of the seasonal movement of the various grains, provision of adequate, sound storage for rice, the principal grain, will substantially solve the entire domestic grain storage problem.

2. There is inadequate storage and handling facilities for imported grain at the ports of entry and at the commercial wheat flour mills.

Grain Food Technology

The principal storage repository for rice in Korea is the farm home. With about 54.5% utilized by the farmer and the balance tending to move to commercial channels over the crop year, rather than at harvest time, condition of the grain in the retail markets is determined in great measure by how well the farmer handles it in his home. The Korean rice farmer prizes his grain, understands in general, if not technical terms, what is required to keep it well, and consequently, under adverse conditions, he does a remarkably good job in sending well conditioned rice to market.

He appears to harvest his rice, typically, at about 20 to 23% moisture. He typically field drys in the swath, (or may also sun

dry on straw mats after threshing), to about 16 to 17% moisture. He may lose additional moisture in the range of one to two percent in storage in his home.

In a small sample survey of 300 farms the estimated losses in home storage were about 13% of the rice so stored, which is consistent with indicated losses in the government storage program. These farmers estimated that 88.7% of their storage losses were to rodents, 7.5% to insects, and 3.8% to spoilage.

If we assume reasonable accuracy for the data available, the farm sector losses 13% and marketing channels lose 10% of the grain handled, (all interpolated from available data). We have a total annual loss from all causes of approximately 605,000 metric tons, basis the volume grown in 1966. The overall average loss from the crop, so computed, is 17.3%.

This provides the volume base for real savings to the economy of the nation. Such losses cannot be reduced to zero. Parts of the losses represent moisture losses and none of the other factors can be completely eliminated. Certainly this is a high loss ratio, amenable to reduction by improved warehousing, handling, and processing from farm to market.

Most of the farm storage is in straw bags and is subject to pest infestations. There is probably no way that the farmer could increase his income and the nation its food supply more easily and with less expense outlay than could be accomplished by a determined educational effort to improve the storage vessels in the farm home so that they are made pest proof. The common fired clay jars used for perhaps 10% of farm storage, properly covered to exclude pests, would probably be quite adequate. Some sizable portion of about 455,000 metric tons lost could thus be saved.

The Korean rice condition problem originates with the high moisture content at which they attempt to store the grain. The government standards for the three numbered grades simply place a maximum of 16% moisture. All data observed indicates that the bulk of the grain enters commercial channels at between 15 and 16% moisture. Climatic conditions of high temperature and high relative humidity through the late spring and summer compound the problem. Seed respiration, microbial growth, and insect propagation are all promoted under such a combination of conditions and all three of these deleterious biological conditions can and will contribute to quality deterioration.

The Korean people have told us that their people prefer the soft, high moisture rice for the following reasons:

1. The flavor and eating quality of the rice more nearly equals the prime, preferred, newly harvested rice than does lower moisture grain.

2. Lower moisture grain does not cook properly with the low heat output, habachi style stores used. To attain satisfactory cooking results the rice must be pre-soaked. A nutritionist consultant stated that habitually the Korean people will pre-soak such rice with more water than needed and discard the excess before starting to cook. In pre-soaking, valuable vitamins and minerals are leached out of the grain and lost if the soak water is discarded. Such losses can be ill afforded in a diet so dependent on rice.

Nowhere in the literature known to the team, or in the experience of the team, have the above two objections to dried grain been raised, or investigated.

Most of the Western world solves the moisture problem by artificially drying the grain to a safe level between 12 and 13½% moisture. For Korean conditions that level would be more nearly 12-12.5%.

Japanese rice is marketed at moisture levels more nearly like Korean practice; however, at a somewhat lower level. The maximum moisture content for any grade is 15% and the maximum for the 1st grade is 14%. Even at these levels the Japanese experienced difficulty in storage. They store unpolished, hulled, brown rice.

Low temperature warehouse tests were initiated in Japan as early as 1952 and the use of low temperature warehousing has progressed from that point to today. Today there are reported to be 168 low temperature warehouses storing brown rice in Japan with a capacity of 216,500 metric tons.

The reported storage conditions in Japan are 14 to 15% moisture brown rice, 15°C warehouse temperature, and 75% relative humidity. The results reported are excellent, with even retention of full quality in the rice bran oil.

Korea adopted the Japanese idea for long-term storage. It presently has built a 6,000 metric ton low temperature house in Seoul and a 3,000 metric ton house in Pusan. It has plans to construct four additional low temperature houses in distribution centers this year, totalling 40,000 metric tons capacity.

The first year's experience with low temperature storage in Korea has not been good. Rice deteriorated. The responsible people believe that their difficulties resulted from inability to

maintain temperature and humidity control, accentuated by power failures. They believe that personnel training has progressed to the point that their difficulties are corrected for the future.

A decision should be reached as to which process for protecting rice condition offers Korea the better long-term avenue - low temperature storage or drying. If this team was forced to make a judgement on the available evidence we would recommend drying, but we believe that judgement may be biased on insufficient evidence and, therefore, we shall be recommending additional investigation into the subject before a decision is reached.

As this report is being written we are nearing the end of the old crop rice year. Domestic rice supplies are very low. This is the time of year when "out of condition" rice should be most prevalent after the hot, humid storage season. We have seen about 100 rice samples. None of the samples we have seen have shown any significant deterioration of the kind resulting from the moisture content - temperature - humidity complex. We have no real basis to criticize the quality results of storage other than the well known facts of safe storage conditions.

In nine warehouses visited in the Seoul area the team observed:

	#1	#2	#3	#4	#5	#6*	#7	#8	#9
Class	B	B	A	C	B	Low temp.	B	A	C
Live rats	0	0	0	4	1	0	0	0	0
Rodent pellets	0	0	8	Many	4	0	0	5	0
Live birds	0	0	0	Pigeon feathers	0	0	0	Yes	0
Bird excreta	0	0	0	Yes	0	0	0	0	0
Insects	Yes	Yes	Yes	Yes	Yes	0	Yes	Yes	Yes
Foreign odor	None	None	None	Rodent odor	None	Musty odor	None	None	None

* No rice in store in low temperature warehouse.

Relatively too much emphasis has been put upon height of the building in warehouse classification. We do not disagree with the use of height as a classification factor but we cannot agree that a house with obvious rodent entry and one with obvious insect

infestations should be classed in "A" Class and paid accordingly. There is no evidence that routine inspection for classification is made. We believe inspection should probably precede every use of space by the government. The government payment for Class "A" space approximates $7.20 per metric ton or about $0.43 per 60 kg bag per annum. This should be enough to permit adequate maintenance of the properties, if the property is utilized much of the year. The actual rates are on a sliding scale, per day basis.

We deemed the Class "A" and Class "B" space we observed quite amenable to maintenance of satisfactory conditions at quite reasonable maintenance costs. The Class "C" space we observed could hardly be deemed suitable for food storage. One "C" house could not logically be repaired to meet reasonable standards; the other "C" house could only be improved at considerable cost. Class "C" space, as it is now defined, is generally unsuitable for food storage.

Of the storage space available in the nation, government deems the following to be of real use to it:

	Low temp.	"A"	"B"	"C"	Total
No. of houses	2	291	887	1,249	2,431
Metric tons storage	9,360	141,523	275,570	165,925	592,378
Area in sq. meters	3,967	155,336	282,927	227,532	669,762

The total reported potentially usable by government is:

	Low temp.	"A"	"B"	"C"	Total
No. of houses	2	254	1,309	2,876	4,441
Metric tons storage	9,360	134,102	361,347	364,304	869,113
Area in sq. meters	3,967	123,088	368,686	477,903	973,644

Obviously the two sets of data are at variance.

Theoretically, there is quite enough total storage space in the country to house the rice crop at the rate it moves to market. The problem is not area under cover. Instead, it is the quality of

the available space, and in some instances, the location of the available space.

Government's maximum inventory in the year May 1967 to April 1968 was 544,355 metric tons in April 1968. That inventory included 126,225 MT of California rice, about 46,000 MT of barley, and miscellaneous minor items. 235,291 MT or 43% was unhulled paddy rice and 15% or 81,953 MT was Korean polished rice. The government's storage problem is considerably greater, under food grain shortage conditions, than it would be simply as a regulator of the domestic supply.

If one assumes that all Class "C" space is beyond redemption then space available to the government drops to about 505,000 metric tons with no consideration given to the quality of the specific "A" and "B" space or its location.

The increased production projected to 1971 will increase the demand for storage space but not proportionately to the increase in domestic volume. The foreign component of the rice inventory should disappear and the quantities needed to perform the regulatory functions of the government should not increase proportionately. Storage capacity in all channels of the farm to market movement will certainly have to be expanded to accept another 1,357,000 metric tons at harvest time by 1971, if we accept the projections.

We shall recommend a two directional attack on the warehouse space problem;

1. Improvement of the existing repairable space, and

2. Construction of new space to replace the existing unrepairable space, plus enough to house the increased volume expected on a phased basis.

If we project the commercialization rate of the increased production at the present rate we find the rice storage space problem to be about as follows:

Assumptions: Total commercialization rate 45.5%
Then coml. RY 1966 1,510,000 MT
" " RY 1971 2,210,000 MT

With urban consumption level, then monthly disappearance from inventory equals:
1966 - 126,803 MT
1971 - 184,200 MT
Using monthly commercialization rates (P 204 Grain Statistics Yearbook), peak commercial storage requirements are January - 1966 - 490,573 MT
January - 1971 - 652,184 MT

Projected production 1971 4,858,000 MT
RY 1966 recorded production 3,501,000 MT
Existing space is properly located.

Then storage requirements appear to be:

Year	RY 1966 (Present)	1971 (Projected)
Unit	MT Polished	MT Polished
Farm at harvest	3,501,000	4,858,000
Commercial at peak	490,573	652,184
Available total	816,113	-
Available "A" & "B"	505,000	-
Shortage "A" & "B"	-	147,184
ROKG Planned additions 1968-69	46,000	-

This means that at best with all "A" and "B" space repairable and repaired and it was all in the proper locations all existing capacity would be completely full at the present peak inventory period. This, of course, portrays an impossible condition. The 46,000 metric tons of construction planned by the ROKG for 1968-69 construction should help significantly.

With 40,000 tons of that storage to be refrigerated storage, making a total of 49,000 tons of refrigerated storage available for the 1969 crop there will still be a wide gap in protection for the summer needs. If we assume present level commercial demand of 126,803 MT per month for the four months June-September the inventory in all commercial positions would have to be about 507,000 metric tons at the start of the critical season. To the extent that summer grains are substituted and urban rice consumption is lowered during the summer period that demand would be lowered. However, by any measurement a large gap will persist between protected storage available and demand.

That gap can be filled by either refrigerated storage or by storing dried grain in sound, conventional warehouses fully meeting Class "A" or "B" standards. The less costly method will probably prove to be dried grain.

For reasons of economy in site selection, flexibility in outbound movements, and the desirability of helping to minimize the rapid urbanization of the population we will suggest that maximum use be made of production area building sites for any new construction. We suggest that an urban supply of 60 days maximum should permit orderly transport and distribution. That is an arbitrary number selected as a result of U.S. experience and bears further refinement as it relates to Korean conditions. It seems reasonable to us, viewed from what we believe to be the conditions in Korea.

The limited sample of rice mills observed and the reports of other observers is that the rice mills of Korea are generally old and in a poor state of repair. Sanitation conditions and practices within them are intolerable by United States Food and Drug Administration standards; however, this team has been unable to discern serious deleterious results of that indicated condition in the records of performance of the milling sector and the samples of grain collected for examination.

The key milling equipment appears to be a Korean made disc type sheller with counter weighted control of the discharge and thus control of the polishing severity. In the two mills observed one had 18 consecutive passes thru such machines, and the other 16.

Milling results reported are surprisingly good. Rice yields approximate 72% nationally with about 1% separated broken, an additional 1% separated fine broken, 5% bran, and 21% hulls and loss in milling. Examination of samples did not disclose significant under-milling. Relatively high, but not unreasonable, inclusion of broken rice in the finished product would serve to reduce the average grade by U.S. standards. The reported milling yields shown above approximate those attained in California on similar short grain varieties. In California bran extraction would approximate 9%, and hulls plus milling losses 18 to 19%. This simply indicates a probable loss in Korea of bran to hulls, by reason of the milling methods, in the magnitude of 3 to 4% of the total grain. Improved hullers would probably eliminate this loss to Korea's grain economy.

The bulk of the Korean rice crop appears to be toll milled for the farmer at a most reasonable toll of about 3% of the grain. The government official processing payment for milling rice as of January 1, 1967 was 101.2 won ($0.369) per 60 kg straw bag of polished rice. With a rice price of 2,410 won ($8.80) to the farmer for a 60 kg straw bag the toll amounts to about 72 won ($.264). At such recoveries the Korean miller should be able to well afford to modernize his plant with profit to himself, and benefit to the farmer and the nation.

Probably the most helpful modernization step he could take would be general adoption of the Japanese made Satake or Kyowa rubber shellers. The Japanese hullers and whiteners also offer opportunity. We must reiterate, however, the performance recorded by the Korean rice milling sector is quite good. Therefore, the opportunity is one of profitable refinement, rather than a demonstrated need for a radical overhaul.

Of about 100 rice samples the team has been able to observe, the quality has been quite good from a deterioration viewpoint. We have seen none that would be down graded for that reason. Some samples would be down graded by U.S. standards for chalkiness. Some samples would be down graded for higher broken grain content. Red rice and foreign matter are generally no problem. As a whole the rice was well milled. We have seen nothing in the samples to indicate any general condition that would detract from the value of Korean rice as a healthful, acceptable food product.

Improvements in the milling systems and proper drying could reduce the broken grain component to a more attractive level and would help extraction rates.

Reported Prices - Polished Rice
(1967 Grain Statistics Yearbook)

Unit: 100 L.(80kg)bag
U.S. Dollar

	1962	1963	1964	1965	1966
Farm price #1 grade	$6.30	$10.04	$12.49	$11.72	$12.36
Wholesale price #1 grade	6.45	10.22	12.66	12.13	12.48
Gross margin	0.15	0.18	0.17	0.41	0.12
% of wholesale - Value added	2.3	1.76	1.34	3.4	0.96

Value added - 5 year average - gross margin - $0.206 or $2.575 per metric ton

5 year average - value added - 1.96%.

Approximate Value Added and Material Cost to Government - 1966

Rice

#2 grade purchase price 54 kg - ₩1,562

#2 grade wholesale selling price 60 kg - ₩2,550

Yields #2 rice - 72.07%

Broken rice - 0.86%

Finely broken rice - 0.78%

Rice bran - 5.26%

Broken rice selling price - 54 kg ₩580

Finely broken rice selling price - 54 kg ₩550

Rice bran selling price - 36 kg ₩210

Used bag credit - 1 each per 54 kg paddy ₩20.2

Material Cost per Metric Ton Polished Rice

Paddy	1.3875 MT	$105.56	= $146.46
Credits:			
Broken	0.0119325 MT @ $39.20	= $0.47	
Fine broken	0.0108225 MT @ $37.17	= 0.40	
Bran	0.0729825 MT @ $21.29	= 1.55	
Used bags	25.7 @ $0.0737	= 1.89	
			4.31
Bulk material cost 1 MT #2 Grade polished rice			$142.15

Wholesale selling price 1 MT #2 grade - $155.11

Value added by manufacture and distribution - $12.96

% value added by manufacture and distribution - 8.36%

Government Grain Account
Operating Statement Summary

Year	Revenue	Expenditures	Profit or (loss)
1961	$28,792,700	$24,968,800	$3,823,900
1962	32,487,300	40,243,000	(7,755,700)
1963	56,689,000	50,232,000	6,457,000
1964	74,992,000	65,197,000	9,795,000
1965	51,084,000	58,321,000	(7,237,000)
1966	100,151,000	103,120,000	(2,969,000)

Net six years $2,114,200

Average six years $ 352,360

Government rice expense per metric ton

1966 - Interpolated from p, 197, Grain Statistics Yearbook

Commissions	0.68
Handling	16.55
Losses	0.77
Credit sale of deteriorated rice	(-) 0.31
"Special Account" expense	3.74
Total	$21.43

Financial

If we can believe the reported data, the rice industry is being operated almost exlusively for the benefit of the farmers and consumers and a remarkable job it is. For example, in 1966 the reported difference between prices to the farmer for polished rice and the wholesale price was only 0.96% or about $1.50 per metric ton to provide storage and handling, plus administrative and selling expense, and leave some entrepreneurial profit along the way. It can hardly be done for such a cost. The five year average figure was better at $2.775 or 1.96% but is still quite inadequate to provide adequate facilities and services. For that amount, village level gathering and storage; transportation to area level gathering and storage; and transportation to consumption area and storage must be covered. For comparison in U.S. terms, that would be about $0.017 per 100 lbs bag to provide these services. That could hardly be accomplished anywhere and provide incentive to own and operate good facilities. If, in fact, it is done for that margin, it is being accomplished at the expense of the facilities. The total amount available, basis 1966 commercialized volume of 1,510,000 tons would be about $3,888,250 at the indicated average margin and $2,265,000 at the indicated 1966 margin. Fifty year straight line depreciation alone on the government's new class "A" warehouse will cost $1.85 per metric ton of storage space annually, and more for a house that isn't fully utilized twelve months per year.

The government cost and margin data, calculated from the records provided, shows a better margin than does the polished grain sector discussed above but it, too, is not self-sustaining at present. The value added to rice of $12.96 per metric ton or 8.36% of the selling price is equal to $0.59 per 100 lbs to cover <u>all</u> costs. This is more nearly in keeping with reasonable margins; however, the published cost basis for expense items not covered in the material cost calculation above totals $21.43 per metric ton leaving a deficit of $8.47 per metric ton of rice in 1966. The loss reported of $2,969,000 can probably largely be attributed to failure to cover costs on the rice movement. 354,752 metric tons collected at a loss of $8.47 each would equal $3,000,475, an insignificant deviation from the $2,969,000 loss reported.

It seems quite clear that the people of Korea and their government must be prepared to see the margin between farmers and consumers prices widen significantly if they are to enjoy the benefits of more modern facilities. The only other way apparently open to them would be direct subsidy from general funds. The latter approach does not meet the engineering economy tests usually applied to AID loans of this nature.

The responsible people in the MAF state that ROKG cannot internally finance the new construction needed for proper grain management at this time. Study of the state of the economy in the nation causes us to agree with them. It could only be done by additional debt financing which would add to the inflationary trend, or by substitution of this work for projects deemed to warrant a higher priority. Neither of those methods of financing the work that is needed are likely to be acceptable.

The ROK has capabilities to produce excellent warehouse space internally. All of the material elements for masonry construction are available in Korea at reasonable cost. There is a high rate of unemployment and underemployment. Design competence is also available. A new insulated masonry warehouse constructed in Seoul this year is reported to have cost $554,740 for 5,289 sq meters of space that is capable of housing 6,000 metric tons. This is $104.89 per sq meter ($9.74/sq ft) or $92.46 per metric ton ($4.19/100 lbs).

Double wall insulated metal prefab structures from the U.S. will cost as much in place and they will be inferior structures by comparison with indigenous masonry.

Under these conditions, it behooves everyone concerned to try to find a source of capital for construction of warehouses that is not tied to the Foreign Assistance Act of 1961 with its current requirement of 90% U.S. components. The Asian Development Bank, Manila, has been suggested as a likely source of funds, at attractive rates, that would permit the use of indigenous materials and labor.

Preliminary Loan Application Projects

Two specific projects have been handed to the study team for review. They are:

(1) MAF application for a loan of $7,700,000 (total cost $9,367,360) to provide 30 warehouses capable of storing 108,000 metric tons of grains, and

(2) A Cooley Loan application for ₩270,000,000 ($985,400) to partially pay for the facilities needed to establish a bulk silo grain storage business at dock side at the ports of Inchon and Ulsan. 150,000 metric tons of storage would be provided at each port. The applicant is the Yu Poong Grain Silo Co., Ltd.

We shall review each of these applications.

MAF Application

The Ministry of Agriculture and Forestry through its Food Administration Bureau is held responsible for regulating the flow of grain, including imports, to assure an adequate supply for the people; stabilization of grain prices to insure proper pricing for the consumers; incentives to the farmer; and it is responsible for the management of grain inventories used to provide control; among other duties.

The Grain Management Section of the Bureau collects grain in the country, primarily from the farmer, largely, in the case of rice in paddy (unhulled) form. Typically, grain is stored in straw bags, in paddy form in the case of rice, in commercial warehouses until it is needed in the urban consumption centers. Warehouse space considerations will force grain into the consumption centers at harvest time in greater volume than is required to meet current needs.

Analysis of the available data, and observations made of a limited number of warehouses, indicates that there is sufficient total area to house the present crop but the condition of a high percentage of that space makes it presently unsuitable for food storage.

In addition to the actual physical losses suffered by the government amounting to a total of about 10%, the rice in inferior storage deteriorates in quality through the summer months, the months in which the government provides its principal consumer market regulating function.

To provide the supply needed to feed the people, and to stabilize prices throughout the shortage periods, prior to the new rice crop harvest from late September to early November, the government's peak inventory is shown to be in April, just prior to the start of the hot season. This means that much of the grain must be housed in the class "C" space generally believed to be quite unsuitable for food storage.

There is public criticism of the quality of rice resulting from the current storage practices. Although we have been unable to observe rice with the usual characteristics of damage caused by high moisture grain stored under high temperature - high humidity conditions, the descriptions we have received from all sources parallel the results we would expect to see under the conditions existing. These conditions result in off flavor, off odors, and off color resulting from rapid respiration in the grain and proliferation of microflora. The criticism of off quality in rice is probably quite valid since all of the conditions are present to provide such a result.

Prior data shown in this report has demonstrated to the satisfaction of this team that there is a definite need for more than the 108,000 metric tons of space requested in the application. We can conceive of no likely situation under which any part of such space construction would later prove to be wasteful. We deem it to be only phase 1 in a long-term program to upgrade grain food storage space by both new construction and improvements to the better existing structures.

We do not presently have confidence in the site selections shown in the preliminary application. Much more work needs to be done to firmly determine the site selection according to the longer term plans selected for preservation of quality. If drying is to be the preferred method then the construction of warehouses for milled, bagged grain will be lower in total and would best be located in the distribution centers only. Storage in the producing areas would be in the bulk, paddy form and would move to milling and the distribution centers on a demand basis. If refrigerated storage is to be the preferred method, then greater flexibility, lower ownership costs, better balance in distribution of work opportunities, and population dispersion would tend to dictate maximum use of production area sites.

The 30 warehouses covered in the application are estimated to be corrugated steel outer shell, prefabricated buildings with an inner exposed, roll, fibre glass insulating sheet. No refrigeration is planned. This approach does not appear to follow the logic of the direction the ROKG has been following. If protection of the high moisture grain can best be done by refrigeration then the new 108,000 metric tons of space should be refrigerated. That tonnage plus the currently planned total of 49,000 metric tons would still be less than the required inventory for the August-September period. It is reported that refrigeration was not included for reasons of economy. We submit that refrigeration should be included, if the further studies we will recommend result in the selection of refrigeration as the better alternative to drying.

Insulation, without refrigeration, does not prevent heat transmission through a building shell. It simply slows down the rate of transmission so that, in the case of the subject buildings the range of temperatures inside would be less than the 24 hour outside range. It would be warmer in the night hours and cooler in the daylight hours than outside conditions. The mean over a period of time would be approximately the same. To the extent that the maximum temperatures are reduced, insulation without refrigeration would be expected to have limited value.

If further studies determine that drying offers the better alternative for preservation of quality, then we do not deem insulation to be a necessary, or good investment. Grain dried to the recommended levels can be safely stored with just reasonable attention to sound warehousing practice without the cost of insulation in the warehouse.

Storage in bulk silos becomes practical and economical for properly dried grain. Properly constructed and managed silo storage eliminates rodent losses. Silo storage makes storage in the paddy (unhulled) form more practical. Damage to rice stored in the paddy form will be lower, on average, than when stored in the polished form.

Steel bins can be used to store rice successfully but properly constructed concrete silos are better. Korea has some competence in the construction of concrete silos. We do not know how much. It has been reported that Koreans have built three cement silos, two with static forms and one using the preferred slip form method. We have not observed this construction. This potential should be investigated if drying is the successful alternative.

Concrete silo storage for paddy rice could perhaps be built for a magnitude approximately the same as sacked warehouse space, both calculated to a polished rice basis. Further engineering study would be needed to establish such costs. The size of the silos that can be used will have a great bearing on such a comparison. If little, or no, lotting is necessary we would expect bulk storage to be competitive in first cost and more economical in operation.

We do not deem unprotected fibreglass, roll type insulation to be satisfactory for grain warehouses in which there will be considerable movement of the inventory and from which long life is expected. The roll type material is easily damaged, thus losing its effectiveness as an insulator and it also can provide an untenable insect harborage. Under the operating conditions expected in these houses a minimum requirement for the use of fibreglass would seem to be a double wall construction with the inner wall made impervious to insect penetration. There are other materials made in the U.S. that, upon investigation, might provide sufficient strength and tightness to be used without the double wall, "sandwich" method. This is a subject that should be dealt with by a competent refrigeration and insulation engineer.

No detail engineering has been accomplished on the proposed facilities. The estimates appear to be largely rule of thumb estimates from prior work plus some preliminary quotations from a U.S. manufacturer of prefab steel buildings. This estimate needs to be prepared in "project budget" depth, supported by adequate single line, "project budget" drawings with specifications to properly

meet M.O. 1221.2. An adequate appraisal of the feasibility of the subject project cannot be accomplished without such data. We will suggest a scope of work to provide adequate information. Our impression of the estimates, also using rule of thumb projections, is that the sums requested are approximately adequate to complete the construction in the manner intended by the applicant.

The plan of construction contemplated in which the AID loan would essentially provide U.S. prefabricated super structures to be erected out of the Korean portion of the total funds, on foundations laid out of the Korean funds, is quite practical if properly coordinated.

The detail design is to be a ROKG function. If "project depth" engineering is properly accomplished and some supervision and control remains with AID to assure proper utilization of the funds both in the detail design and construction phases, we believe that utilization of Korean talent and funds for the bulk of that work is quite proper. We suggest quite strongly that design and construction supervision with at least a joint responsibility to AID and the ROKG is most desirable to assure attainment of the intended benefits at the estimated costs.

The estimates of operating expense could not be accurately checked in the time available. Certainly, the number of people calculated for the functions they are to perform seems reasonable, and perhaps high in locations such as Seoul where four houses may be grouped at one site. It must be understood that the estimates for operating personnel do not include the actual materials handling people, who are furnished by the transportation companies to load and unload product.

The preliminary application requests only ten bag conveyors and only five lift trucks for the 30 houses. The rationale for limited mechanization is used only in five large urban centers where turn-over is rapid.

The application requests three men for three months to conduct a feasibility study at a cost of $50,000. We will suggest a different schedule in our recommendations that will more nearly fit the requirements as we view them.

Annual depreciation is calculated at 100 years in the application and shown at $80,688 annually. We do not believe that any sheet metal building should carry a depreciation rate below 4%, or 25 years life. At that rate annual depreciation would be $324,000. Good masonry structures, such as Korea builds, may logically carry a 50 year or 2% rate. Modern engineering thought much prefers to see declining balance methods applied, because no one is clairvoyant enough to look even 25 years into the future.

The calculated benefits from the construction need refinement. An annual saving of $687,744 in commercial storage charges is contemplated based upon 80% occupancy, or 86,400 MT, in the 108,000 MT capacity houses, for 365 days per year. The daily rate used was ₩6 for 365 days. We believe that rate and total to be overstated. The published rates for storage of polished rice are:

Won per metric ton per day

Class "A"	Class "B"	Class "C"	Field pile
5.4	4.80	4.50	3.40

To these rates an insurance charge is added of ₩0.56. Insurance, however, should apply to storage in the new houses too, perhaps at a lower rate.

Proper utilization of the new space should result in lowering the utilization of field piles and class "C" space if the end results anticipated are to accrue. If that is so, then the bulk of the savings should be at the lower rates instead of the "A" class rate, plus insurance.

In actual practice the production area stocks are generally held in paddy (unhulled) form for which the published rates are:

Won per metric ton per day

Class "A"	Class "B"	Class "C"	Field pile
4.80	4.30	4.00	3.00

In paddy form the daily insurance charge is ₩0.38.

It is apparent that the savings in fees quoted are overstated if we are to attain the improvements in storage we all seek. Refinement of these statements will be suggested for the feasibility study.

The second item of financial justification quoted is a saving in wastage of $100,538. The governments report shows a total loss of about 10%. The application base is 3%, reduced further by taking only 1/3 for warehousing loss, and 1/2 of that as the amount that would actually be saved, netting 1/2%. The full 108,000 metric tons of capacity was used instead of the 80% utility factor.

We believe that the loss savings shown are reasonable and attainable if the warehouses are used to supplant the most inferior storage, and are managed with loss control as a measured function. The estimate of 1/2% should be too conservative. Refinement of this estimate should become a function of the feasibility study to follow, and we shall so recommend.

Without refinement of the cost and benefit data cost-benefit analysis of the project has little meaning; however we did calculate equivalence for the stream of earnings and expenditures for twenty-five years using the application data. Using 15% interest the benefit-cost ratio is only 0.52. Using 5% the ratio is 1.0467. The internal rate of return would thus be between five and six percent when using data we deem to be inadequate for approval of the project. These calculations using the five percent rate follow:

Preliminary Evaluation of Proposal

Investment cost		
U.S.	$7,650,000	
Korea	$1,578,950	
Total	$9,228,950	p. 12
Annual cost	$83,607	p. 12
Annual benefit:		
Storage fee	$687,744	
Prevent wastage	$100,538	
Total	$788,282	

Benefit-Cost Ratio at 5% (000 omitted)

Year	Cost	Benefit	0.05 Discount Factor	Present Value Costs	Present Value Benefits
1.	9,229	-	1.05	8,789	-
2.	84	788	1.1025	76	715
3.	"	"	1.1576	73	681
4.	"	"	1.2155	69	648
5.	"	"	1.2763	66	617
6.	"	"	1.3401	63	588
7.	"	"	1.4071	60	560
8.	"	"	1.4775	57	533
9.	"	"	1.5513	54	508
10.	"	"	1.6289	52	484
11.	"	"	1.7103	49	461
12.	"	"	1,7959	47	439
13.	"	"	1.8856	45	418
14.	"	"	1.9799	42	398
15.	"	"	2.0789	40	379
16.	"	"	2.1829	38	361
17.	"	"	2.2920	37	344
18.	"	"	2.4066	35	327
19.	"	"	2.5270	33	312
20.	"	"	2,6533	32	297
21.	"	"	2.7860	30	283
22.	"	"	2.9253	29	269
23.	"	"	3.0715	27	257
24.	"	"	3.2251	26	244
25.	"	"	3.3864	25	233
				9,894	10,356

Benefit-Cost Ratio at 5% = $\frac{10,356}{9,894}$ = 1.0467

In summary, using present charges for warehouse space and probable costs derived from a proper feasibility study we would not expect this project to show a positive (above 1.0) benefit-cost ratio at any reasonable interest rate. We do believe that the Korean people need improved space and should have it promptly. We believe that agreement on logical financing should be the first order of business. We believe the most logical way is to increase the margin between purchase prices and selling prices sufficiently to insure the ability to pay for proper facilities and proper management of the facilities. One can hardly expect either the Government or the private sector to own good facilities, and operate them properly, within the margins calculated from the record.

Yu Pung Grain Silo Co., Ltd. - Cooley Loan Application

Applicant:

Yu Poong Grain Silo Co., Ltd.
No. 75 Suhsomoon-Dong, Daihan Bldg., Room 304
Suhdaimoon-Ku, Seoul, Korea

A corporation, Mr. Yong Joon Park, President, incorporated for the purpose of owning and operating the grain warehousing facilities covered in the loan application.

Estimated Capital Required:

Fixed assets	$11,980,000

Sources of Capital Expected:

Paid in by stockholders	$ 1,094,890
Loan - Buhler Bros., Uzwil, Switzerland	4,380,000
Chartered Bank of England - Loan	2,200,000
Additional sale of capital stock	729,927
Cooley Loan	985,401
Total	$ 9,390,218
Unexplained Capital Shortage	$ 2,589,782

There is a balancing statement entitled "own fund $5,400,000" shown but no indication of how the shortage enters the business. The "own fund" entry appears to be made up as follows:

Paid in capital	$ 1,094,890
Additional sale of capital stock	729,927
Cooley loan	985,401
Unexplained capital shortage	2,589,782
Total	$ 5,400,000

Facilities to be Provided:

Concrete Grain Storage Silo Structures at Ulsan and Inchon having a capacity of 150,000 metric tons each, total 300,000 metric tons, with appurtenant equipment; 20-300 metric ton vessels; and 30 delivery trucks.

Applicant's Business Expected Statement:

1,300,000 metric tons of grain are imported into Korea annually. The applicant expects to unload 70% of that volume (910,000 metric tons) and store 50% of the volume (650,000 metric tons).

Applicant's Statement of Expected Annual Income:

Stevedoring - 500,000 metric tons	@ $1.28	$ 640,000
Storage - 700,000 metric tons @ 4 months	@ 0.164	459,000
Loading - 700,000 metric tons stored	@ 0.547	382,900
Transportation - 400,000 metric tons	@ 1.095	438,000
Ship dispatch - 25 ships, 15 days ea	@ $1000.00	375,000
Merchandising profit - 300,000 MT	@ 2.00	600,000
Total income		$2,894,900

Applicant's Statement of Expected Annual Expense:

Employment expense	$ 155,000
Office expense	43,400
Insurance	41,900
Payment bond	83,900
Safety control expense	9,500
"Secondary" expense - Foreign loan	35,800
Electric power	17,500
Miscellaneous operating expense	43,800
Depreciation	344,800
Taxes and duties	144,600
Total expense	$ 920,200

Applicant's Annual Cash Flow Projection:

Annual operating profit	$1,974,700
Depreciation	344,800
Total annual cash flow projection	$2,319,500

Approximate Loan Repayment Schedules Including Interest

Year	Buhler Bros.	Chartered Bank	Cooley Loan	Total	Approximate Cash Flow Balance ($2,319,500 Annually) After Debt Payments
1.	$456,068	$176,000	$118,248	$750,316	$1,569,184
2.	667,813	176,000	118,248	962,061	2,926,623
3.	639,891	176,000	118,248	934,139	4,311,984
4.	611,968	176,000	118,248	906,216	5,725,268
5.	584,045	2,376,000	118,248	3,078,293	4,966,475
6.	556,123		216,788	772,911	6,513,064
7.	528,201		204,964	733,165	8,099,399
8.	500,278		193,139	693,417	9,725,482
9.	239,668		181,314	420,982	11,624,000
10.			169,489	169,489	13,774,011
11.			157,664	157,664	15,935,847
12.			145,839	145,839	18,109,508
13.			134,015	134,015	20,294,993
14.			122,190	122,190	22,492,303
15.			110,365	110,365	24,701,438
Total	$4,784,055	$3,080,000	$2,227,007	$10,091,062	$24,701,438

Using the applicant's projections, the cash flow generated would be adequate to meet the total loan commitments. Some dividends on equity could logically be paid from the first year on. These calculations would be altered materially if the capital shortage indicated of $2,589,782, and an additional sum for working capital are brought into the business on a debt basis instead of on an equity basis.

The project is reported to have been started on May 16, 1968. Full operation is expected by January 5, 1970.

Buhler Bros. of Uzwil, Switzerland, are responsible for the basic design and supervision of the construction of the facilities. They are among the very best engineers and suppliers of grain facilities in the world. One can depend upon the quality of their work and materials. Their contract does not provide for detail building design and that item does not appear in the estimated costs. Buhler's stated contract restricts responsibility to the machinery and its installation.

The drawings furnished with the application are project outline drawings suitable for defining the scope of the total work.

The work consists of two installations of like nature, one each at Inchon and Ulsan harbors. Each unit consists of: 150,000 metric tons of storage space in a house consisting of 72 cylindrical concrete bins and their interstices; a pneumatic unloading system capable of unloading 300 metric tons per hour; adequate conveying systems for internal movement of the grain; adequate scale weighing equipment; aeration and fumigation equipment for nine bins only; grain temperature detection equipment; bagging equipment of adequate capacity; bulk loading equipment of adequate capacity.

The design concept for the houses is excellent.

The application contains no information to indicate who will do the structural, civil and parts of the electrical design. There appears to be no funds allotted for that use. There are estimates of construction cost included but no support for them, to provide a basis for analysis. We believe the estimates for the buildings and equipment erection may be understated but we do not say so with assurance. The estimates are:

Land	$ 1,459,854
Buildings	4,379,562
Machinery	4,380,000
Machinery installation	215,803
Miscellaneous	893,686
Costs for storage	$11,328,905
20 - 300 MT steel barges	211,679
30 - motor trucks	328,467
Total	$11,869,051

The storage cost is $37.763 per metric ton of space ($1.03 per U.S. bushel). This is a low cost for the facilities planned; however, it may be possible at Korean labor and material costs. We would prefer to see bonded bids before accepting the estimates, or at least estimates by known, qualified engineers.

The method to be used for silo construction is not stated. The slip form method, properly used, results in a better structure at lower cost. We have no knowledge, for certain, that such construction skills are available in Korea. We would recommend that the slip form method be used.

If it were highly desirable to do so, some reduction in the equipment cost would be possible. For example, the pneumatic unloading equipment is excellent equipment and the nicest way of doing the work. It is also the most expensive in first cost, and in operating expense. Dock side cranes, equipped with grain buckets, could probably be provided at less than one half the cost to do the same volume of work.

The application shows no commitment of any kind to use the facilities. We raise the following questions:

1. The applicant estimates that they will unload 500,000 metric tons of wheat and store it for the flour millers, primarily. They also anticipate transportation of 400,000 metric tons. KOFMIA (The Korean Flour Millers Industrial Association) are reported to have stated that they are unaware of the project. Without support from their members the estimates of income are probably meaningless.

2. The applicant anticipates the storage of 200,000 metric tons of the Government's stocks of grain. There is no indication that such a commitment has been made by the Government.

3. The applicant anticipates merchandising 300,000 metric tons of grain. We do not question the nominal mark up of $2.00 per ton he anticipates. We simply ask, to whom would he sell the grain as long as PL 480 dominates the grain import picture?

We have to question the selection of Ulsan as one of the two sites. There is no flour milling capacity in Ulsan. Ulsan has a new deep water port and is excellent from that viewpoint. The problem is, the flour mills are located in Pusan, 71 kilometers by rail from Ulsan. Assuming the millers are willing to use the service in the first place, we then must ask are they willing to pay for 71 kilometers of "out of line" haul to avail themselves of the service? Pusan contains about 43% of the commercial flour milling capacity of Korea and it would have to be the principal customer of the Ulsan house. From a "line of flow" viewpoint this team deems the proper location for such a storage house to be Pusan harbor instead of Ulsan. Location in Ulsan would appear to be burdening the economy with a needless transportation cost.

Staffing of the operation at 203 people is quite excessive by U. S. standards; however, rates paid are low. Well managed, and with competent people in the key positions, additional profit could be shown, in the projections, from this source.

This team fully recognizes a need for port dock storage facilities. USAID/K has estimated that at least 1,000,000 metric tons of imported grain will be needed in Korea as far into the future as can be foreseen. Good facilities, approximating those proposed, should serve that need well if properly financed, and those who would be the users of the service agree that the facilities will be utilized.

Section IV

Recommendations

We shall divide our recommendations into two categories:

(1) Those items which the Government of Korea, with perhaps, nominal assistance from USAID/K, should be able to accomplish at little cost to the government and with considerable potential benefit.

(2) Those items which require expert study to refine data, in the form of a feasibility study.

Suggested ROK Government Action

Farm Storage

We believe that in the magnitude of 455,000 metric tons of rice stored on the farm are lost annually, primarily to pests. A campaign to improve farm home storage, if successful, would probably provide more additional profit to the farmers and grain foods to the economy, at less cost, than any other step that might be taken. We suggest that a vigorous campaign, to accomplish such results, might include:

(1) Preparation and wide, free dissemination of a pamplet describing the losses sustained, including the average farmers' financial loss, ways of storing grains on the farm so that it will remain pest free (fired clay jars, simple block structures, etc.); what to do if it becomes insect infested, wet, or starts to heat.

(2) Prepare press and radio releases outlining the benefits to the farmers from better care of grain.

(3) Utilize all of the offices of NAPIO, the cooperatives, and all area agricultural advisors to carry the word.

Warehouse Classifications and Inspection

We suggest that the government needs to re-examine its public warehouse classification, inspection and payment system. We suggest that the following points be considered for inclusion in such a program:

(1) Warehouses classes "A", "B", and "C" shall be as they now are described. In addition, the description may read:

(a) Before food grains may be placed in a public warehouse for the government account, a NAPIO inspector shall inspect said warehouse for freedom from pests. Any pests, rodents, rodent excreta, live birds, bird excreta, or means of access for such pests, when the access doors are closed, shall result in regrading that warehouse to class "C" immediately, and if used for storage it shall be paid according to the class "C" scale.

(b) As long as government owned grain remains in a warehouse it shall be inspected periodically in the same manner as in (a) above, and regraded as of that time, if sub-standard conditions are found.

(c) Storage for grains in class "C" space shall be the last accepted and the first moved out.

(d) Stored grain in class "B" space shall be moved out before that in class "A" houses, during the period May 1 to September 30.

(2) Higher prices should be considered for "A" and "B" storage as redefined above. The new rates should be based on a study to determine how much additional is required to provide both the funds and incentive to maintain conditions as described above. No change should be made in class "C" rates. Using government data, bare costs, without profit, would cost the operator about ₩2 per day, if a good house were full 365 days per year. The published class "A" rate of ₩.4 would cover annual costs at a load factor of 36% (Break even point) or about 133 days.

An increase of ₩1 to 6.4 would decrease the break even point to a load factor of 31% or 113 days, approximately. What ever is determined a reasonable load factor, an incentive fee for management plus [illegible] profit needs to be added. A chart of payments based on length of storage can also be constructed, if wanted, that would reduce governments cost for the longer term storage. Without having done the recommended study it appears to us that an "A" class rate of about ₩6.4 to ₩6.5 and a "B" class rate of about ₩6.0 should make government storage reasonably attractive under the suggested rules.

Sanitation Practices

The Korean people responsible for warehouses, and the government program, appear to be well aware of the basic need to keep grain foods free of pests. It appears to this team that there is just inadequate action. We suggest that action follow all reports of infestations by the NAPIO inspections recommended above, where government stocks are involved.

(1) Where rodents are involved eliminate entry ways, trap, and poison with anti-coagulants such as Warfarin.

(2) Where insects are involved utilize Phostoxin (trade name for aluminum phosphide) as a gaseous fumingout under tarpaulins. Warehouse surface sprays, using piperonyl butoxide - pyrethrin formulations should be used to routinely spray the building surfaces.

(3) Prepare literature necessary to disseminate information on usage of these materials.

(4) It should not be necessary to employ consultants to initiate such a program. The manufacturers of the materials will generally assist quite readily in the development of usage plans. FOLLOW THEIR RECOMMENDATIONS TO THE LETTER.

Consumer Testing

Initiate a series of consumer tests in the home economics department of one of universities, KIST, or other qualified research entity, to determine:

(1) Is there any difference in flavor between rice dryed to 12 to 13% moisture and rice dryed only to 15 to 16% moisture? These tests should be blind tests, using several different lots of rice, with parts of each sample offered at both the high and low level.

(2) Experiments should also be conducted to determine whether there is, or is not, a problem in cooking dryed rice when using the usual 19 hole briquette for fuel, in the typical "Habachi" style stove.

Such tests should of course be conducted on a scientific basis without opinionated bias. We believe the capabilities to do so exist within the Seoul area.

Rice Milling

Government may wish to disseminate information on rice milling, designed to encourage modernization of the rice milling capacity of the country. Nominal, but worthwhile, improvements in extraction results could accrue to the benefit of the farmer, the miller, and the economy by adoption of the Japanese Satake and Kyowa rice milling machines - particularly their shellers and polishers. We suggest that help in evaluation of the potential, and preparation of promotion material may be available from said manufacturers at little or no cost to the government.

Finance

The government has three areas of finance that this team believes it should study immediately. They are:

(1) Warehouses of superior quality can be built of indigenous masonry materials, fabricated by Korean labor with benefit to the country, when compared to metal shell structures imported from the U.S. The ROKG, with USAID/K assistance, should exhaust every source of attractive term, loan money that would permit use of

these domestic materials, before accepting the 90% U.S. component formula of USAID loans. The Asian Development Bank, Manila,, has been suggested as one likely source.

(2) With new investment money for construction in short supply, the government should seriously consider the possibility of entering long team leases for the full use and control of the best of the "A" and "B" space that is properly located. Each potential leasehold should be reviewed in terms of the maintenance money that would be required to put it in condition and keep it in class "A" shape, as hereinbefore defined. An invitation for offers to provide new space to lease could result in offers by private citizens to build new houses. A lease program might solve the government's problem faster at less financial cost than any other approach.

(3) We recommend that the government immediately start a review of its pricing policy. We deem the margin between prices paid the producers and the prices charged the consumer quite in-adequate to support sound practices and sound facilities for the farm to market grain movement. We see no logical way of repayment of any loans made for facilities construction other than to add the proper costs of ownership and efficient management into the price differential. We believe that the government's price regulating function is also serving as a deterrent to proper storage and handling practices in the private sector. We take the view that proper storage and handling of food grains is in the interests of the consumer, and assumption of the costs to do so, should be borne by the consumer. A decision should be reached prior to completion of the feasibility study, next recommended, as to how any loans resulting from it are to be repaid. This team sees no other logical, acceptable way other than to increase the price differential between the producer and the consumer.

FEASIBILITY STUDY

We recommend that a formal feasibility study be made of the grain storage problems of Korea to guide the ROKG and USAID/K in their further actions. We recommend a scope of work substantially as follows:

1. General Conditions

a. The contractor shall prepare a feasibility study under the conditions and in the form prescribed by the USAID Manual Order 1221.2, and any amendments thereto in effect as of the date of the contract. The contractor shall have, and be familiar with that Manual Order. The pertinent instructions from that Manual Order are not necessarily repeated herein, but are herewith made a part of this scope of work by reference.

b. All drawings required to be provided shall be single line, "project budget", type drawings in sufficient detail to provide estimates of cost and to illustrate to professional engineers the construction recommended.

c. All cost estimates shall be prepared in sufficient depth so that professional engineers may evaluate both the units employed and the extensions.

d. Special reference is herewith made to the requirement for inclusion of a required training plan, and its costs, for management and operators of the facilities recommended.

e. All benefits and cost-benefit analysis shall be presented in sufficient detail so that professional economists may properly evaluate the study.

2. The Study

a. It shall first be necessary for the contractor to familiarize himself with the preceding work pertinent to the present problems of grain storage and handling in Korea. The Kansas State University review of 1968 and its bibliography will provide such source material.

b. Before recommendations for construction are undertaken, the contractor shall first determine which of two alternative approaches to rice storage in Korea offer the ROK the better investment opportunity and the more satisfactory solution to prevention of quality deterioration in Korean rice. Those alternatives are:

(i) Construction of refrigerated, insulated warehouses, in which bagged rice will be stored.

(ii) Construction of rice dryers in the producing areas of the nation, coupled with either bulk or bagged conventional storage houses for unhulled paddy rice, and conventional bagged storage warehouses in the consumption centers.

The contractor shall be required to investigate refrigerated rice storage in Japan, as a base on which to formulate his recommendations.

The contractor shall make his alternative recommendations to USAID/K and ROKG, and obtain their approval of the alternative selected, before proceeding to detail that alternative. That recommendation shall be in sufficient detail to permit reasonable comparison of:

(1) Construction costs -- unit and total.
(2) Operating expense.
(3) Engineering considerations applied.
(4) Product quality results.

Upon approval of the alternative selected, the contractor shall proceed to detail that alternative only; however, the study shall contain the data used to support the selection.

c. The contractor shall be required to detail only those facilities that will be required to fulfill the ROKG control functions; however, the work should also serve as an effective guide to the private sector of the grain business.

d. The contractor shall be required to determine the proper location for new facilities, and he shall provide sufficient soil data to support his foundation design for each site.

e. The contractor shall investigate transportation service availability at each site selected to insure against failure of the facility to be properly served.

f. The contractor shall investigate utility services at each site selected to insure against failure of the facility to be adequately served.

g. The contractor shall determine the proper size and capacity of all facilities recommended.

h. The contractor shall recommend the timing for construction for each of the facilities he recommends. In so doing he shall

not only take into account the present volumes of grain to be handled, he shall also take into account the projections of population changes and production increases to the year 1971.

i. If the contractor recommends use of the drying alternative he shall be required to consider the wisdom of starting the construction phase on a carefully supervised, regional demonstration unit basis.

j. The contractor shall consider, and make recommendations with respect to the desirability of starting to prepackage rice in consumer size packages, at carefully selected commercial rice mills where quality may be controlled. (There is much rice sold at retail in liter quantities. The time may be propitious for such marketing advance).

k. The contractor shall be required to investigate the storage of imported grains and make recommendations with respect to port storage of those portions for which the government is responsible at the port. In doing so he shall take into account:

(1) Plans of entrepreneurs to enter this business.

(2) The support to be expected from the private sector, particularly with respect to KOFMIA members.

l. The benefit-cost analysis prepared by the contractor shall be an equivalence study demonstrating the internal rate of return that can be expected from the construction recommended, or such other method as is approved by the ROKG and USAID/K.

m. The plan of storage proposed shall be submitted to the ROK and UN Military Commands for defense approval prior to performance of the detail drafting and economic evaluation. Alternatives suggested by the responsible military commands shall be evaluated.

n. While a specific scope of work is herein required, the ROKG and USAID will welcome, and the contractor is herewith required to present, other alternatives for consideration which he believes will either improve the construction for its intended purpose, enhance the results, or reduce the costs without loss of effectiveness.

Magnitude Estimate of Feasibility Study Manpower Requirements

General Requirements

Project Manager - Project Supervision and Coordination - 20 man weeks

Office Manager - Contract Accounting and Office Services for Professionals - 20 man weeks

Mechanical Engineer - Refrigeration Specialist - 4 weeks solving Alternative Problem

Mechanical Engineer - Drying Specialist - 4 weeks solving Alternative Problem

Structural Engineer - Grain Storage Specialist - 4 weeks solving Alternative Problem

Cereal Chemist - Rice Specialist - 4 weeks solving Alternative Problem

Economist - Section Leader - Coordination and Analysis - 20 man weeks

Economist - Grain Prod. and Distribution data - 12 man weeks

Economist - Accountant - Benefit-Cost data - 12 man weeks

Office Services

Driver - 1 for 12 weeks

Secretaries 1 for 20 weeks - 1 additional for 4 weeks, during report preparation

Interpreter - 1 for 12 weeks

and,

For Dryer Alternative Design

Structural Engineer - Grain Storage Specialist (Section Leader) - 16 man weeks

Mechanical Engineer - Drying Specialist - 4 man weeks

Mechanical Engineer - Grain Machinery Specialist - 12 man weeks

Electrical Engineer - 2 man weeks

Draftsman - 30 man weeks

or,

For Refrigeration Alternative Design

Structural Engineer - (Section Leader) - 14 man weeks

Mechanical Engineer - Refrigeration Specialist - 2 man weeks

Electrical Engineer - 2 man weeks

Draftsmen - 20 man weeks

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