

A FEASIBILITY STUDY OF  
GRAIN STORAGE  
AND MIXED FEED MANUFACTURING  
IN LIBYA

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## SUMMARY AND RECOMMENDATIONS

### Storage

Annual average production of wheat and barley (1954-62) in Libya is approximately 100,000 Metric Tons. Three fourths of the total production is barley and the balance is wheat. Three fourths of the production (75,000 MT) is stored on farms for home consumption. About 15,000 MT is disposed of through the farmers markets located in all cities and villages. Less than ten percent (10,000 MT) is available for sale through the government purchase program.

The Ministry of Agriculture operates storage facilities with a total capacity of 27,300 MT. These facilities are located in all important areas of production. They are suitable and adequate for safe storage of grain. It is not therefore, economically feasible, to expand country elevator or flat storage capacity.

Wheat imports are averaging 22,000 MT annually (1954-62). Imported flour expressed as wheat equivalent, averaged approximately 60,000 MT. Barley imports were negligible.

Construction of a 15,000 MT port facility at Tripoli is feasible if (1) all wheat now imported into Libya (22,000 MT) is handled through the facility and as much as two-thirds (40,000 MT) or more of the 60,000 MT now received as flour is received as wheat or (2) wheat is imported instead of one half (30,000 MT) of the flour now imported, the 22,000 MT of wheat presently imported and 8,000 MT of wheat imported as a reserve are all handled by the facility.

If the Kingdom of Libya desires a reserve of more than a one month supply of grain the grain storage capacity should be increased by 8,000 MT for each additional month of reserve.

After the Tripoli port elevator is in operation it will be possible to more accurately determine the need for expanding storage and handling facilities to inland points and to port facilities in Benghazi. The reserve supply of grain needed for Libya may also be more accurately determined at that time. Trained personnel will also be available to operate any additional storage.

Port facilities at Benghazi, to be feasible, can be calculated on the same basis as the need for facilities at Tripoli, namely (1) use made of flour milling facilities located there, and (2) amount to be carried as a reserve supply as determined by government policy.

Supply reserves of cereals are costly. The need for carrying large reserve supplies is unnecessary since they are readily available in world markets.

A flour enrichment program should be put into effect as soon as possible and efforts should be made to import only enriched flour. A management training program for operators of grain storage facilities should be arranged.

### Mixed Feed Manufacturing

Most livestock produced in Libya are range animals and offer a very limited market for mixed feeds. The most favorable location for mixed feed manufacturing is in the Tripoli area. Maximum mixed feed needs for this area is estimated at 5,000 MT annually. A mixed feed manufacturing operation integrated with a dairy or poultry production operation offers the greatest possibility of success.

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PART I

GRAIN STORAGE

PREPARATION OF THE REPORT

The preparation of this report was undertaken by first contacting USAID and Government of Libya officials and discussing with them the problems and situation of storage and mixed feed manufacturing in the country of Libya.

All important cereal production, storage, and handling areas in the country were visited. Grain elevator and flat storage managers were interviewed. Flour milling problems were discussed with the millers. Meetings were held with farm leaders of the country to obtain their views. Poultry and Dairy farms were visited. U.S. Embassy officials were contacted for statistical and other information as needed.

Most of data used in the report were obtained from the 1960 Census of Agriculture for Libya. Since the 1960 census is for one year only its value in estimating production is limited. However, confidence can be placed in data on areas planted.

Insofar as possible, recommendations were based on an economic analysis of the data shown as it relates to the problem being considered. In some cases recommendations were made on the basis of the writer's judgment value.

No attempt has been made in this report to project storage needs or mixed feed requirements on trends or technological improvements which may occur beyond the next 5 year period. Changes will occur in Libya which could bring about new methods of operation and can alter condition now existing. For example, government policies can greatly alter existing

situations. Improvement in the transportation system can change present storage and handling methods. Education and increased income can alter present food consumption patterns and would affect the production and consumption poultry and dairy products as well as other commodities. Most of these changes, except possibly government policy, are of a long time nature and as these changes occur their impact on the handling and storage of grain and the manufacture of mixed feed in Libya will need to be considered.

#### CEREAL PRODUCTION IN LIBYA

Barley and wheat are the principal cereal crops produced in Libya. The 1960 Census of Agriculture reports barley production to be 116,000 Metric Tons and wheat production 34,000 Metric Tons. The average yearly production of these two crops is less than the 1960 production and amounts to approximately 100,000 metric tons. Three-fourths of the total production is barley. (Table I and II).

Seventy percent of all wheat grown in Libya is produced in the Tripolitania Province. The Fezzan Province produces less than one-half percent of the total.

Table III shows the hectares sown to barley, wheat and other cereals in 1960 by Mutasarifia (Divisions). Also shown on the table is the percent of the total cereal production in each Mutasarifia. It is recognized that the data used is only for one year, 1960. However, these data on area sown are considered a reliable measure of the importance of each Mutasarifia as it relates to cereal production for all of Libya. Hectares sown, rather than

metric tons production, was used as a measure of the relative importance of each area since cereal production in Libya is erratic from year to year.

The exact boundary of the Mutasarifia is not known. However, since the name is derived from a village or town, the boundary may be said to lie approximately one half the distance to the adjoining division or village. By locating the village, a general idea may be obtained of the size and importance of the Mutasarifia production.

For statistical data on wheat production and imports, barley production and imports, and distribution of wheat and barley seeding in 1960 see tables I, II and III, which follow.

TABLE I

WHEAT PRODUCTION, WHEAT AND WHEAT PRODUCTS IMPORTS, LIBYA1954 - 1962 Inclusive - Metric Tons /1

Source: Agricultural Statistics in Libya - Ministry of Agriculture 1963

	<u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>9 Year Total</u>	<u>9 Year Average</u>
Domestic Production	15270	13800	13300	44743	26392	23064	33490	29992	20000 <sup>/3</sup>	220051	24450
Imports:											
Wheat Grain Imports	17685	910	702	3628	4 <sup>/4</sup>	4785	8708	13582	15409	65779	7309
Wheat Grain Imports Title II	12706	34000	26000	15000	1500	22566	20000	3000	-	134772	14975
Commercial Flour Imports	17770	35242	46003	50183	41518	54213	71454	50665	66599	433647	48278
Wheat Equivalent <sup>/2</sup>	20905	41461	54121	59039	48845	63780	84064	59606	78352	510173	56686
Flour Imports Title III	-	-	-	33	718	5627	5019	9283	-	20680	2298
Wheat Equivalent <sup>/2</sup>	-	-	-	39	845	6620	5905	10922	-	24331	2703
Total Imports	51296	76371	80823	77706	51190	97751	118677	87380	93761	735055	81673
Imports	-	-	-	-	3737	-	-	-	-	-	-
Total Available	66566	90171	94123	122449	73845	120815	152172	116555	113761	950547	105606

<sup>/1</sup> Excludes carryover if any<sup>/2</sup> Wheat equivalent at 85% extraction<sup>/3</sup> American Embassy, USAID estimate<sup>/4</sup> No wheat grain imports (probably due to substantial 1957 carryover)

TABLE II

BARLEY PRODUCTION, IMPORTS - LIBYA1954 - 1962 Inclusive - Metric Tons <sup>/1</sup>

Source: Agricultural Statistics in Libya - Ministry of Agriculture 1963

Year	<u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>9 Year Total</u>	<u>9 Year Average</u>
Domestic Production	61210	56100	49300	110013	61217	50343	116790	73206	120000 <sup>/2</sup>	698179	77575
Imports:											
Commercial Imports	3050	3210	3397	-	3400	-	142	3341	-	16540	1838
Barley Imports Title II	-	-	-	-	-	20000	34720	20000	-	74720	8302
Total Imports	3050	3210	3397	-	3400	20000	34862	23341	-	91260	10140
Exports	-	-	-	-	-	-	-	-	501	501	-
Total Available	64260	59310	52697	110013	61617	70343	151652	96547	119499	788938	87659

<sup>/1</sup> Excludes carry-over if any<sup>/2</sup> American Embassy, USAID estimate

TABLE III

AREA OF CEREALS SOWN IN LIBYA 1960<sup>/1</sup>

Country of	<u>Unit: Hectares</u>				<u>Percent Total Area Sown Ha.</u>
	<u>Barley</u>	<u>wheat</u>	<u>Other</u>	<u>Total</u>	
Libya	718790	223176	3017	944983	100
Province of Tripolitania	519627	133215	2115	654957	70
Mutasarifia					
Tripoli	25	13	9	46	0
Suk El Giama	77445	13854	265	91564	10
Garian	64467	25022	9	89524	9
Mizda	22277	6665	-	28943	3
Jefren	74017	23500	-	97517	10
Nalut	30436	16183	-	46619	5
Ghadames	477	235	8	720	0
Zavia	43666	13702	822	58190	6
Zuara	23859	11523	-	35382	4
Homs	36106	1162	354	37622	4
Tarhuna	61200	10740	-	71939	8
Ben Ulid	18818	1018	-	19836	2
Misurata	17686	3605	407	21698	2
Zliten	26673	2675	241	29589	3
Sirte	22447	3320	-	25767	3

<sup>/1</sup> Source: 1960 Census of Agriculture

	<u>Barley</u>	<u>Wheat</u>	<u>Other</u>	<u>Total</u>	<u>Percent Total Area Sown Ha.</u>
Province of Cyrenaica	197496	88948	365	286809	30
Mutasarifia					
Agedabia	30579	11914	27	42521	5
Benghazi	48549	16936	22	65506	7
Barce	44796	34391	1	79188	8
Beida	20176	13415	19	33610	4
Derna	19922	7687	113	27723	3
Tobruk	33076	4209	1	37286	4
Kufra	353	396	182	931	0
Province of Fezzan	1667	1014	536	3217	0
Mutasarifia					
Sebha and Ubari	79	193	135	407	0
El Shati	1252	411	155	1818	0
Murzuk	97	275	129	502	0
El Jufra	53	84	81	218	0
Ghat	187	51	35	273	0

0 = Less than  $\frac{1}{2}$  percent

GRAIN MARKETING IN LIBYA

Cereals are harvested by hand or combined during the months of June and July. Grain harvested by hand is assembled at a central location near the point of production. It is then threshed by machine or tramping of animals. In recent years producers store in their homes approximately a full year supply for their household. The grain is usually placed in durable heavy grain bags (Hamel), made of wool, goat or camel hair and reported to last for as many as ten years. These bags are stored in the home which may be a tent or a house of more permanent construction.

Practically all of the grain stored in or near the producer's home is consumed in the home by the producer and his household or used for seed. Three-fourths (75,000 MT) of all grain produced in Libya is stored and consumed in this manner. Use of grain by the producer's family thus constitutes by far the most important end-use of the Libyan cereal production.

The balance of the production is stored in the open country in partially-underground pits called Mardumas. The pits are prepared by scooping out a saucer-shaped hole in the ground four or five feet across and one or two feet deep at the center of the pit. The pit or Marduma is then lined with straw. Grain is placed in the pit on the straw and piled, cone-shaped above the ground level. The grain pile is covered with straw and the straw is covered with dirt to a depth of four or five inches. In many cases, the name of the owner of the grain is placed in the grain in the pit. The capacity of the Mardumas vary from three to fifteen quintals.

The Mardumas are located at a site called the Olga. The Olga is selected on the basis of its convenience to production or consumption. It is also necessary that the site be in a well-drained location (ElKaf). The number of Mardumas in each Olga vary from five or six to near one hundred. The Olga is supervised and guarded by a storekeeper who lives at or near the site.

Grain is stored in the Marduma type storage for one year or more. Producers report a minimum loss in quality and quantity in this type of storage. Visual examination of grain at these sites, some of which had been in storage two years or longer, showed no evidence of damage or loss. There is no doubt that this method of storing grain is a very practical and economical method for use in Libya. While it is an ancient method for storing grain, it is also a very modern method for storage in regions of limited rainfall. (See discussion on Page 11). This method will continue to be the most important, economical and practical method of storing grain in Libya for many years to come.

Grain is removed from the Marduma as needed. It may be, used for seed, transferred to the home for consumption, or delivered to the "farmers' market", found in each village and city. These markets play an important role in the sale of agricultural products and supplies in Libya. The size of the market varies with the size of the village or city. "Market Days", held once or twice each week, are well attended and trading is vigorous. Grain is sold at these markets by the producer or his representative to a "merchant". In some cases it may be traded or bartered for needed products or supplies.

No records are available on the quantity of grain handled through farmers' markets. The amount is considerable, however, and is second in importance as a market for grain grown in Libya.

Wheat and barley consumed in the home is ground. Small hand grinders are commonly used by people living in rural areas to grind grain as needed for consumption. Village people usually take their grain to small burr or stone mills for grinding. These mills are operated by electric motors or engines and are an important part of the many small industries in Libya. The city of Misurata alone officially reports 61 of these small mills. Each mill employs several people in its operations.

The third most important market for grain produced in Libya is the Government of Libya. In 1962, government purchases were made in only two months of the year, July and August. Prices paid by the government were as follows per quintal: hard wheat (Durum)\*L£.4.4 1/; soft wheat (hard winter)\*L£.3.4; and barley L£.2.5. Sales of grain by the government were limited to seed sales in the month of November and sales at the silos in the month of June 1963. Sales to individuals were limited to three quintals. The price per quintal was fixed at hard wheat (Durum) L£.4.1; soft wheat (hard winter) L£.3.1; and barley L£.2.3. During this same period of time merchants were selling grain at the farmers' market for the following price per quintal: hard wheat (Durum) L£.4.7; soft wheat (hard winter) L£.4.7; and barley L£.2.5. Some wheat was sold by the government to flour mills in Tripoli in 1962. Government purchases in 1962 amounted to 7,298 MT. See Table V.

\* Durum wheat is referred to in Libya as hard wheat. Other wheat in Libya is classified as soft wheat.

1/ A Libyan Pound is approximately \$2.80

Government purchases were started on 30 July, 1963 for wheat and barley produced in 1963. Prices paid to farmers per quintal were as follows: hard wheat (Durum) L£.4.2; soft (hard winter). L£.3.2, and barley L£.2.5.

#### STORAGE METHODS

Since underground or partially-underground storage is so important in handling and storing grain in Libya, and will undoubtedly continue to be the principal method of handling and storing grain produced in Libya for many years, further elaboration on the subject is in order.

This method of storage is practiced extensively in several countries. The principal advantage of this method of storage is 1) economy of facility, 2) location convenience, 3) control of insects by maintaining an oxygen-free atmosphere around the stored grain. The temperature of the grain remains low because of the cool earth.

Protection against ground and surface moisture is essential. Even if the soil seems dry, the floor and walls of underground storage may impart sufficient moisture to the grain to cause deterioration unless they are covered and adequately moisture-proofed.

Storing grain underground is practiced on the island of Malta with apparent success, (1) the bins are about 15 ft. in diameter and 25 ft. deep. As airtight a condition as possible is maintained to inhibit insect development, and before the bins are filled their walls and floors are covered with layers of straw to provide protection from dampness.

In Egypt, a common practice in the arid region is to store grain underground in ditches covered with sand (2). If sufficiently dry, the grain keeps well and remains free from insect infestations. Near the Nile Delta, grain has been stored successfully in pits with dome-shaped roofs, and with floors and sides plastered with mud and lined with straw. The pits are 3 meters deep and 2 meters in diameter. Insects do not multiply in grain stored in these pits. Before removal of the grain, the pit is aerated for the safety of the workers.

#### GRAIN STORAGE FACILITIES IN LIBYA, 1963

There are, excluding farm storage, approximately 52,000 Metric Tons of Grain Storage Facilities in Libya. Location and type of storage is shown on Map Page 15. About two-thirds of this capacity (27,000 MT) is operated by the Ministry of Agriculture (See Table IV). The balance is operated by: Ministry of Interior 15,000 MT, and Libyan Industries INC (Flour Mill) 10,000 MT. The Ministry of Interior facilities are used primarily to store grain purchased from the Ministry of Agriculture which in turn is sold or otherwise distributed for local consumption. The facility operated by the Libyan Industries flour mill is at present used for the storage of grain imported for use in their milling operations.

The capacity reported for the facilities operated by the Ministry of Agriculture is a conservative estimate. Some of these facilities are in the same building as flat storages operated by the Ministry of Interior. No definite measurements of the capacity of the stores are available. Neither is there definite areas assigned to the two government agencies jointly operating a facility.

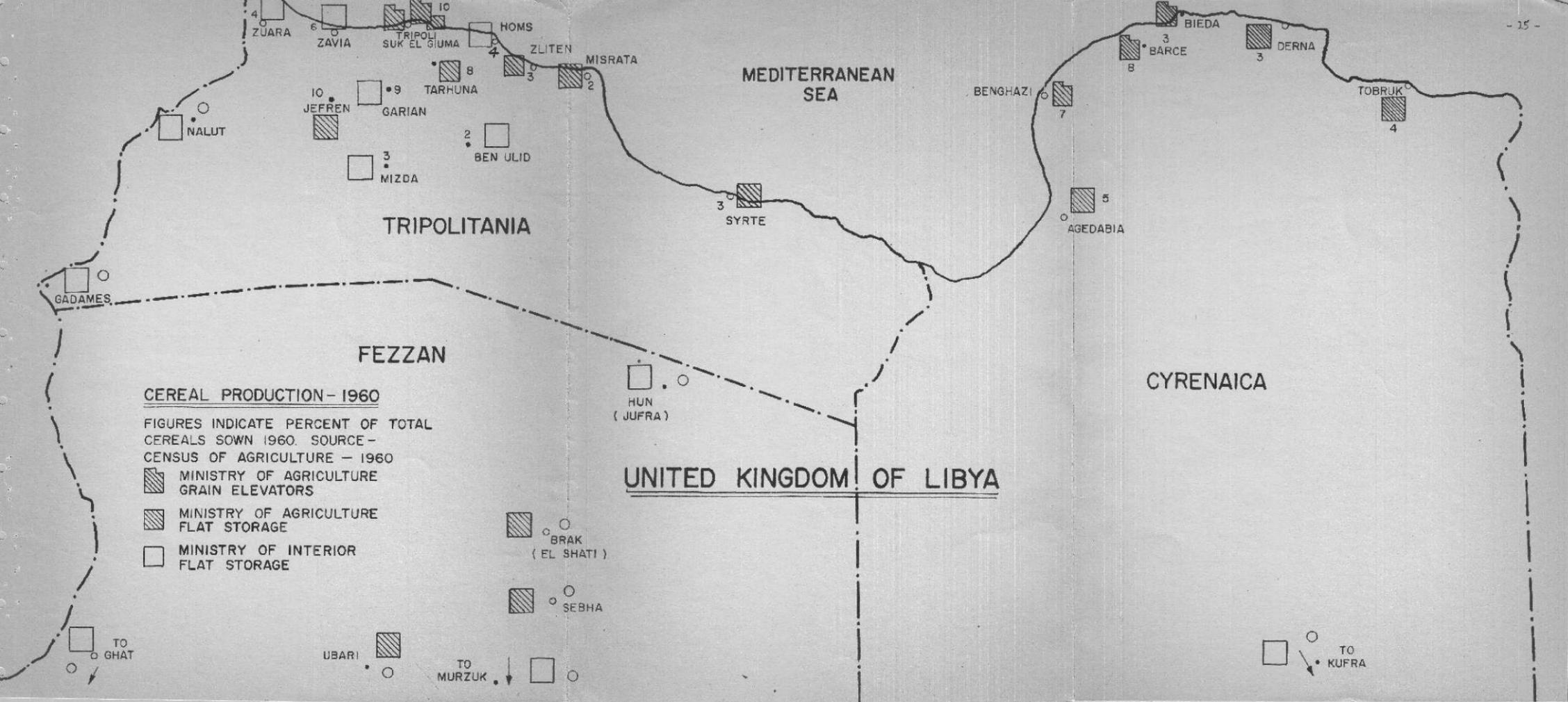
Use of these facilities in 1962 is shown on Table V. These figures show only 15 percent of the capacity of these facilities is used. No use was made of storage facilities at some locations in 1962, and limited use was made at other points. Facilities at several locations handled a large volume of grain.

Generally, it is considered necessary to utilize one-half the storage capacity of a facility to consider it justifiable from an economic standpoint.

Inspection of the grain in storage in Libya discloses it to be in generally good conditions. The facilities are satisfactory to store grain in good condition for one or more years. Some minor repairs of the elevators and flat storage are needed.

Improvement is needed in the handling of sack grain in storage. The following recommendations are made: (1) Sacked grain should not be placed directly on the floor. Poles or wooden racks four inches high should be laid on the floor and the sack grain placed on these poles or racks, thereby providing an air space beneath the grain and thus preventing moisture

Condensation, (2) Sacked grain should not be placed directly against the walls. A space of several inches between the wall and the grain is necessary to prevent moisture condensation. A space which would permit a person to walk between the wall and the grain would be desirable, (3) Sacked grain should be stacked in rows which would permit covering the pile with a tarpaulin for effective fumigation, and (4) One person in Libya should be responsible for examination of grain in storage for stored grain insects and fumigation when needed.



CEREAL PRODUCTION - 1960

FIGURES INDICATE PERCENT OF TOTAL CEREALS SOWN 1960. SOURCE - CENSUS OF AGRICULTURE - 1960

-  MINISTRY OF AGRICULTURE GRAIN ELEVATORS
-  MINISTRY OF AGRICULTURE FLAT STORAGE
-  MINISTRY OF INTERIOR FLAT STORAGE

UNITED KINGDOM OF LIBYA

ZUARA 4  
ZAVIA 6  
TRIPOLI 10  
SUK EL SIUMA 10  
HOMS 4  
ZLITEN 4  
MISRATA 2

JEFREN 10  
GARIAN 9  
TARHUNA 8  
BEN ULID 2  
MIZDA 3

SYRTE 3

BENGHAZI 6  
AGEDABIA 5

BIEDA 3  
BARCE 8  
DERNA 3

TOBRUK 4

FEZZAN

HUN (JUFRA)

CYRENAICA

BRAK (EL SHATI)

SEBHA

UBARI

TO MURZUK

TO KUFRA

TO GHAT

TABLE IV

GRAIN STORAGE FACILITIES OPERATED BY THE MINISTRY OF AGRICULTURE, LIBYA1963Capacity in Metric Tons

<u>Location</u>	<u>Bulk</u>	<u>Sack</u>	<u>Total</u>
Sidi Mesri	3000	700	3700
Suani Ben Adem	3000	700	3700
Benghazi	4800	2000	6800
Barce	2100	3000	5100
Beida	2100	700	2800
Shara Zavia, Tripoli		600	600
Ain Zara *		500	500
Jefren		500	500
Tarhuna		700	700
Agedabia		300	300
Gubba		200	200
Tobruk		500	500
Zliten		400	400
Misurata *		400	400
Sebha		200	200
Brack		200	200
Sirte		300	300
Derna		400	400
	15000	12300	27300

\* Transferred to the Army in 1963

TABLE V

GRAIN PURCHASED BY LIBYAN GOVERNMENT 1962(Metric Tons)

<u>Elevator:</u>	<u>H. Wheat</u>	<u>S. Wheat</u>	<u>Barley</u>	<u>Total</u>
Benghazi	1177	557	888	2622
Barce	1985	-	-	1985
Baida	465	-	804	1269
<u>Store:</u>				
Agedabia	2	52	65	119
Gubba	114	-	54	168
Tobruk	-	-	370	370
Misurata	-	1	-	1
Tarhuna	-	-	388	388
Jefren	-	-	319	319
Sebha	47	-	-	47
Brack	5	-	4	9
Ubari	1	-	-	1
	3796	610	2892	7298

RELATIONSHIP OF STORAGE TO PRODUCTION

The Map on Page 15 shows the location and type of storage facilities operated by the Ministry of Agriculture. Also shown is the percent of cereals (Figures) sown in each Mutasarifia in 1960 as reported in the 1960 Census of Agriculture. A review of this map discloses storage locations operated by the Ministry of Agriculture in most production areas of importance. One exception is the Garian area where considerable production exists and no Ministry of Agriculture facilities are operated. A Ministry of Agriculture operated facility may be needed at this location. All other locations appear to be adequately served by Ministry of Agriculture facilities. At other locations where the Ministry of Agriculture does not operate facilities, arrangements should be made with the Ministry of Interior to use their facilities in the event cereals are purchased from farmers. Cereals purchased at those locations could later be transferred to facilities operated by the Ministry of Agriculture if desired.

IMPORTS OF CEREALS AND CEREAL PRODUCTS

(a) Wheat Imports

Wheat imports have averaged about 22,000 Metric Tons annually for the 9 year period 1954-1962. About two thirds of this amount was received from the United States under the PL 480, Title II program.

The important wheat product imported is flour and amounted to about 60,000 Metric Tons annually for the period 1954-1962. A small portion of this flour (2,300 MT) was from the United States PL 480, Title III program.

Total wheat imports, including wheat flour equivalents 1/, exceed 80,000 Metric Tons - See Table I.

The average annual wheat production in Libya is slightly less than 25,000 MT, or less than one third of the amount imported.

(b) Barley

Barley imports averaged 10,000 tons annually for the period 1954-1962. Most of this amount was PL 480 Title II Barley received from the United States during the drought years 1959-1961 - See Table II.

1/ . 100 MT of wheat yields approximately  
85 MT of flour.

### FLOUR MILLS

Two flour mills are operating in Libya. Both are located at Tripoli. Another flour mill is located at Benghazi.

The two flour mills located at Tripoli have a potential annual output of 50,000 MT of flour each. This output is sufficient to meet all the flour needs of Libya.

Flour mills in Tripoli are, at present, operating at only one-third capacity. The mill at Benghazi is not operating. Flour millers report they are unable to compete with imports since the imported flour delivered price is less than their cost of production. They are able to operate only because they mill a special wheat product (cos-cosi), which is not imported but is used extensively in Libya, and by extending credit to their customers.

Costs of moving wheat from the ship to the mill are high. These costs are reported to be Lf.9 $\frac{1}{2}$  per MT. Lf.6 per MT represents unloading, sacking, and handling costs, and Lf.3 $\frac{1}{2}$  per MT is transportation cost from the ship to the mill.

Port facilities, efficiently operated should reduce the unloading, and handling costs by almost one-half. If this is done; Libyan flour mills, should be able to compete with wheat flour now being imported. The installation of port facilities should lessen congestion compared with the present situation when large shipments of flour arrive, as it would permit removal of the grain over a longer period of time and at times when other port traffic is at a minimum.

There are hundreds of small custom mills in operation in Libya. Farmers and urban consumers bring their grain to these mills in small quantities for grinding on a custom basis.

One or more small stone of burr mills are located in each town or village. It was officially reported that there are 61 of these small grinders operating in the city of Misurata alone.

Wheat by products such as bran is in demand and flour millers report these products usually move into the feed market at fair prices. Large carryover supplies of these products do not present a problem, although one mill reported a two month accumulation of bran which is considered excessive.

### PORT STORAGE FACILITIES

Are port facilities economically feasible in Libya? First it is necessary to analyze the volume of grain being imported or exported that would be handled by the facility.

Since Libya is deficient in cereal production, no cereals are exported from the country. This condition will no doubt continue to exist for many years.

The average imports of cereals for the 9 year period 1954-1962 inclusive was as follows: Wheat 22,284 MT; Wheat flour converted to wheat equivalent 59,389 MT, and Barley 10,140 MT. (Most of the barley was imported during the years 1959, 1960 and 1961). Total average cereal importation (1954-1962) including flour equivalents, amounted to 91,813 Metric Tons (See Tables I and II). This amount is a potential volume for port facilities.

A port facility of 15,000 MT would cost approximately L£ 600,000. In addition, annual operating costs would amount to approximately L£ 60,000 (Depreciation L£ 25,000, Labor L£ 25,000, Power and Repairs L£ 6,000, Shrinkage in quantity and quality of grain and etc. L£ 4,000). The minimum volume for "breakeven" operation is estimated to be eight to ten times the storage capacity. A good volume would be twenty times the storage capacity. Based on above information the minimum volume for a "breakeven" operation for port facilities of 15,000 MT capacity would be 120,000 MT annually. The initial cost of larger facilities would be approximately the same per MT of capacity. Operating costs per MT would decrease slightly.

Only two of the three flour mills in Libya are presently operating, and they operate at about one-third capacity. This is due to their inability to compete with flour imports, partly because of the high handling and unloading costs at the ship, of Lf 6,000 per MT. These costs can be reduced approximately one-half with efficiently operated port facilities. Assuming that reduced costs of handling and unloading wheat through the port permit flour imports to arrive as wheat for milling, port facility operations would be approximately 78,000 MT based on average of 1959-1962 imports. This amount in addition to the 22,000 MT of wheat now imported, would indicate a need for port facilities of 15,000 MT capacity at Tripoli. Although the eight to ten times turn over volume of the capacity of the port facility would indicate a requirement of less than 15,000 MT, the facility is estimated to last twenty years. Therefore, the additional capacity needed by the end of the life of the facility will be approximately 40 percent greater than at present due to population increase and the upward trend in the per capita consumption of wheat. A capacity of 15,000 MT under these conditions would not provide a reserve supply, but would permit unloading large vessels. Also, flour mills at Tripoli would operate at near capacity. Flour could be distributed to other parts of Libya from Tripoli as needed, including the Benghazi area.

If it is assumed that approximately one-half the flour imports continue to be received as flour, and the balance received as wheat, it would then be necessary to carry approximately 8000 MT of wheat as a reserve supply to justify the need for a 15,000 MT capacity port facility. A reserve of this amount would be about one month supply of cereals based on present imports to Libya.

The capacity of port facilities would need to be increased by approximately 8000 MT for each additional month reserve supply determined to be necessary. For example a three month reserve supply of 24,000 MT would require grain storage and handling capacity of approximately 34,000 MT (24,000 MT in reserve storage, 10,000 MT handling capacity for the 22,000 MT now imported as wheat and the 60,000 MT of wheat now received in the form of flour). Costs of such a facility would be approximately L£ 1,350,000. Annual operating costs are estimated at L£ 120,000.

Port facilities appear to be feasible at Tripoli. However before actual construction of a port elevator is started a detailed engineering and economic study is recommended. This study would be designed to determine whether flour mills operated in Libya, with decreased costs in handling wheat from the port to the mill, will be competitive with foreign mills now exporting flour to Libya.

The amount needed as a reserve supply is a government policy decision which needs careful consideration. Reserve supply stocks are costly and large quantities of cereals are available throughout the world and may be obtained within a 30 day period.

The need for port facilities at Benghazi may be considered on the same basis as those outlined above for Tripoli. The deciding factor being (1) the use made of the flour milling facilities there and (2) the government policy with respect to reserve supplies.

RURAL STORAGE NEEDS

Most grain produced in Libya is stored in the farm home or in earthen pits near the point of production. Normally less than 10 percent of the total production (less than 10,000 MT) is available for sale to the Ministry of Agriculture through the government purchase program. The Ministry of Agriculture now operates facilities with a total capacity of 27,300 MT. These facilities are located in all important areas of production. Therefore, it is not feasible to expand the rural grain elevator or flat storage facilities except possibly in one or two locations.

Supply reserves are costly. A 30 day delivery of cereals can be obtained from many parts of the world, thereby reducing the need for carrying large reserve supplies.

It is recommended that any expansion of the storage facilities in Libya start with the construction of a 15,000 MT capacity port elevator at Tripoli. This facility may be increased in size as needed. After experience is gained in the operation of the facility a more accurate determination can be made of the reserve storage needs at Tripoli, and whether a port elevator should be constructed at Benghazi. Personnel from the Tripoli elevator can provide a nucleus of trained management to operate any needed additional storage.

OTHER FACTORS

(a) Enrichment of Flour

The per capita consumption of wheat flour in Libya is large.

Wheat, when milled, consists largely of starch and some protein. In the milling process most of the vitamins and minerals are removed with the bran and germ of the wheat seed.

By enriching the flour, vitamins and minerals are added to replace those removed in the milling process. Enriched flour then contains all the vitamins and minerals found in whole wheat flour.

Health levels of a people consuming large quantities of bread can be substantially raised by enriching wheat flour. Costs for such enrichment amount to approximately one piaster per 40 kilograms (3 cents per 100 pounds) of flour and is not a significant factor in the retail price of bread. The Governments should therefore require all flour sold in Libya to be enriched thereby taking a great stride forward in health improvement of the nation without increased cost to consumers.

(b) Management Training

Grain elevator managers in Libya should be given an opportunity for further management training for professional improvement. Such training could be offered by holding yearly conferences in which two or three day programs would be presented by experts on such subjects as: (1) causes of grain spoilage and how to prevent them (2) insect identification and control through fumigation (3) control of rodents (4) record keeping, (5) grain grading and (6) labor management.

Tours in nearby countries who are successfully handling their grain storage problems would be helpful.

By following such a program with top elevator management, these men can in turn train and assist flat grain storage operators and new employees to reduce storage losses.

PART II

MIXED FEED MANUFACTURING

MIXED FEED MANUFACTURING IN LIBYA

This subject is discussed on the basis of the need for mixed feed, the supply of raw materials with which to make a satisfactory livestock ration and the possible location if a feed mill is to be constructed.

Table VI, based on the 1960 Census of Agriculture by Mutasarifias lists livestock numbers as follows; one and one fourth million sheep, one and one fourth million goats, one fourth million camels, one hundred and sixty five thousand of a combination of donkeys, horses and mules, one hundred eleven thousand cattle, of whom 78,000 are females two years old or older, and three hundred and five thousand poultry.

In Libya sheep, goats, camels, donkeys, horses, mules and a large majority of the cattle are fed little if any mixed feed. Poultry in most cases are small flocks and receive little if any mixed feed.

Based on livestock numbers, types of livestock and method of production as given above it is obvious that the potential consumption of mixed feed is limited.

LIVESTOCK AND POULTRY PRODUCTION IN  
MUTASARAFIA SUK EL GIUMA DIVISION

Economic distribution of a mixed feed, however, is limited to a much smaller area than the all of Libya. A typical market for a small feed mill would be within an area 80 kilometers from the mill. It is necessary to examine a much smaller area to determine the potential market for mixed feed.

Data from the 1960 Census of Agriculture indicates the area having the greatest concentration of livestock and thus offering the greatest potential for a mixed feed mill is the Mutasarafia of Suk El Giuma which includes an area immediately adjoining the city of Tripoli. Livestock and poultry numbers for the Suk El Giuma Mutasarafia are shown on Table VI. Cattle numbers in this area are 35,981 head. Approximately 25 thousand head of this number are females, two years and older, and therefore may be considered potential milk cows. Poultry numbers are 66,568.

Further analysis of the 1960 Agricultural Census shows 32,544 hl of milk production for human consumption during 1959. This amount would represent the production from only twelve hundred to fifteen hundred dairy cows. A survey of the area indicates most of the dairy production is from herds of 1 to 4 cows. However there are a few herds having greater numbers. Most of the cattle produced in the Suk El Giuma Division are native cattle that are produced for meat. Some are milked in season, the milk being used in the home, with some sold to nearby consumers. Poultry, eggs and meat production, comes from flocks of small size.

TABLE VI

NUMBER OF LIVESTOCK FOR COUNTRY OF LIBYA AND  
MUTASARIFIA DIVISIONS 1960 CENSUS OF AGRICULTURE

<u>Country</u> <u>of</u> <u>Libya</u>	<u>Sheep</u>	<u>Goats</u>	<u>Cattle</u>	<u>Camel</u>	<u>Horses</u>	<u>Donkeys</u>	<u>Mule</u>	<u>Poultry</u>
	1,254,661	1,195,636	111,411	255,150	28,968	122,165	3,251	304,602
<u>Mutasarifia</u>								
Tripoli	1006	127	1314	102	145	316	18	836
Suk El Giuna	76325	84967	35981	12662	3424	8885	899	66568
Garian	67338	78960	2378	11177	757	7100	49	18303
Mizda	50585	74953	78	41785	93	1834	1	46
Jefren	59511	55965	1395	12185	306	4248	66	7443
Nalut	53174	66774	629	10465	100	4329	68	10710
Ghadames	1797	4865	9	2412	1	128	1	501
Zavia	70580	44772	15980	13366	1992	10920	454	28418
Zuara	36399	13456	227	10531	278	4205	17	6443
Homs	65354	35126	7690	3740	898	8096	351	16029
Tarhuna	45332	53736	3517	11216	1126	5980	437	17938
Ben Ulid	32641	52443	719	15480	610	3682	15	2578
Misurata	88521	34575	6828	10729	1609	7060	247	31293
Zliten	46395	19016	3021	7821	547	5685	116	11318
Sirte	72346	63579	4128	27408	235	4686	163	6748
Agedabia	51184	24126	50	12486	448	3675	3	5830
Benghazi	108195	58543	5188	9852	3497	6902	53	21456
Barce	110848	165351	13302	4811	7203	8712	18	28837

	<u>Sheep</u>	<u>Goats</u>	<u>Cattle</u>	<u>Camel</u>	<u>Horses</u>	<u>Donkeys</u>	<u>Mule</u>	<u>Poultry</u>
Beida	42514	94720	5550	2575	2972	5118	5	3209
Derna	59382	87727	2590	4315	1818	4429	23	3837
Tobruk	76887	49262	453	11815	828	5489	160	6675
Kufra	4559	3151	4	686	10	1167	-	4531
Sebha and Ubari	6515	6250	67	3543	13	3146	56	1478
El Shati	16923	5928	44	5601	24	2361	2	86
Murzuk	3615	3246	-	1990	14	2488	25	2511
El Jufra	6138	11985	-	5577	6	1040	4	857
Ghat	592	2033	68	820	14	484	-	60

CEREAL PRODUCTION IN MUTASARIFIA

SUK EL GIUMA DIVISION

The Suk El Giuma Mutasarifia is also one of the most important grain production area in Libya. (See Table III). Most of the grain production, however, is used for human food. In addition there are some surplus waste products available in this area. These products include grape, beer and date waste. Waste is also secured from a fish cannery, a slaughterhouse and a tomato paste factory. Barley and wheat bran are produced. Bran production would rise substantially if flour milling is increased under conditions referred to under this report headed "Flour Mills".

Although there are considerable quantities of feed available in the Suk El Giuma Division, prices are high (L£.3 per quintal for barley). Forage prices are also high indicating a good demand, for all forage grown. Forage production is costly due to water expense.

Mixed feed demand in the Suk El Giuma Division for dairy cattle is estimated at 3000 MT annually. Mixed feed demand for poultry in the Suk El Giuma Division is estimated at 300 MT annually. Other feed uses for cattle other than dairy cows, horses, donkeys, camels and drought emergencies are estimated at 1700 MT annually.

### CONCLUSIONS

Total mixed feed consumption in the Suk El Giuma division is estimated not to exceed 5000 MT annually, (3000 MT dairy cows, 300 MT Poultry; and 1700 MT for cattle other than dairy cows, horses, donkeys, camels and drought emergencies).

Such a quantity of feed could be produced in a mixed feed plant with a 20 MT per day capacity.

Much of the feed now being used by dairy and poultry farmers is ground at local or nearby feed mills. Use of locally produced grain and convenience of location will result in continued use of this type service.

Therefore, demand for mixed feed in the Suk El Giuma division, the most favorable location in Libya, is small and could be supplied with mixing facilities of less than 20 MT daily capacity. The mixed feed business in this area to be successful should be integrated with a large poultry or dairy enterprise. Such an arrangement would permit each department of the operation to complement the other and minimize chances of loss, The poultry and dairy business will expand with the rapid population growth of the city of Tripoli.

APPRECIATION

Many people assisted by furnishing information and advising on the assembly of this report. Officials of the Libyan Ministry of Agriculture were most cooperative in furnishing statistical data, information on grain storage facilities and methods of handling stored grain. The Ministry made the services of Mr. Salah Soule, Assistant in the Grain Storage Department available and gave permission to visit all major production and marketing areas of the country.

The U. S. Agency of International Development provided invaluable assistance: Dr. Lindsey Brown gave overall direction to the study, Mr. Clark Milligan assisted in the field investigations and cooperated by furnishing needed economic information.

Last, but not least, was the courteous, helpful cooperation of area supervisors, storekeepers and ordinary employees of the grain industry.

The study of the cereal grain situation in Libya was indeed a delightful and challenging experience. It is hoped that the information and recommendations made in this report will repay the GOL and USAID for inviting me to participate in this study.

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