FLAXSEED STORAGE

at Country Elevators in Minnesota, North Dakota, and South Dakota

MARKETING RESEARCH REPORT NO. 350
AGRICULTURAL MARKETING SERVICE
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PREFACE

This report on marketing practices and costs is part of a broad program of marketing research designed to hold down costs and increase efficiency in the marketing of farm products. The report supplies information on flaxseed storage facilities, operations, and practices at country elevators in Minnesota, North Dakota, and South Dakota. Data on which much of this report is based were obtained from elevator managers, owners, and operators in those 3 States. Though the data were collected in 1956, they are still considered applicable since no substantial changes in the flaxseed storage situation have occurred since that time.

Elevator lists were furnished by the Public Utilities Commission of South Dakota, Public Service Commission of North Dakota, and Railroad and Warehouse Commission of Minnesota. The survey was conducted with the cooperation of the Farmers Elevator Associations of Minnesota, North Dakota, and South Dakota; Northwest Country Elevator Association; Farmers Union Grain Terminal Association; and J. O. Culbertson, president, Flax Institute of the United States. C. Milton Anderson, agricultural economist, Agricultural Marketing Service, assisted in the elevator survey and in preliminary analysis of certain phases of the report.

Valuable suggestions for this study were made by Rex Cox, formerly of the Department of Agricultural Economics, University of Minnesota; Herbert Herbison, Extension Director, North Dakota Agricultural College; and M. J. Johnson of the Minneapolis Grain Division, Agricultural Marketing Service. Manufacturers provided information on prices of grain cleaning equipment.

A companion report relating to practices and costs of handling and marketing flaxseed at country elevators in the above-mentioned States, by William M. Manion and C. Milton Anderson, was published in February 1959. It is Marketing Research Report No. 301, entitled "Flaxseed Marketing Practices and Costs at Country Elevators."

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CONTENTS

CONTENTS--Continued

LIST OF TABLES

Table

LIST OF TABLES--Continued

SUMMARY

This report summarizes information obtained from 265 elevators in Minnesota, North Dakota, and South Dakota concerning flaxseed storage facilities and practices employed in storing and handling flaxseed.

Most of the annual flaxseed crop is delivered to country elevators in farmer-owned vehicles, as only a small portion of the crop is assembled in elevator-owned trucks. Eighty percent of the flaxseed is produced within 10 miles of the elevator where delivered while only 2½ percent is received from distances of 25 miles or more. Large quantities of dockage, which not only increase the difficulty of accurate measurement but also increase transportation costs, are delivered with the flaxseed to the country elevators. Only 1 percent of the flaxseed received at elevators was cleaned for dockage removal by producers prior to delivery. Although improved methods of dockage testing have been introduced, the problem of accurate determination of dockage content still exists at each stage of the marketing channel.

Elevator operators with cleaning equipment usually clean flaxseed upon receipt at the elevator. Sale of the screenings normally covers the cost of the cleaning operation at most elevators, and the cleaning reduces risk of mold growth and heating resulting from high-moisture weed seeds. Flaxseed containing from 10.5 to 11 percent of moisture can become easily subjected to mold growth within a matter of months, depending on the temperature. Flaxseed containing over 11 percent moisture may become invaded by storage molds within weeks. The average length of storage was 5.2 months for flaxseed and 6.6 months for wheat during the 1955-56 marketing year.

It is not uncommon for an elevator to pay a No. 1 price for a lot of flaxseed that actually grades No. 2. Only when the quantity of low test weight flaxseed exceeds the operator's ability to blend it with heavier testing seed is the elevator financially forced to pay the farmer a lower price. The present test weight method of grading flaxseed may, during some years, discriminate against producers delivering high quality seed for which no premiums are allowed, and enables an elevator to pay the No. 1 price for flaxseed testing lower than No. 1. A more equitable method of grading flaxseed would be on the basis of the oil content of the seed.

Flaxseed is more expensive to store than some other grains, such as wheat, because of its slippery nature, its sensitivity to moisture, high dockage content, relatively low test weight, and higher per-unit value affecting shrinkage and insurance costs. For example, the total cost for storing flaxseed 8 months ranged from about 5½ to 8 cents per bushel, depending in part on the dockage content. Elevator storage costs of flaxseed containing 5 percent dockage were found to be 2.6 cents greater per bushel than wheat containing 2 percent dockage, while the returns from the flaxseed were only 1.7 cents more per bushel than that from the wheat. Although cleaning increases flaxseed storage returns, storage rates would be more equitable for flaxseed if they were based on the costs and returns from storing various kinds of grains rather than at the present flat rate for all grains.

One of the significant problems facing the flaxseed grower is that sufficient commercial storage is not always available. One-half of the country elevators surveyed limited the amount of flaxseed received for storage while nearly one-fourth of the elevators limited purchase receipts, because of lack of sufficient space. Storage limitations generally tend to vary directly with (a) the ratio of flaxseed handled to elevator capacity and (b) the extent to which flaxseed harvest follows that for other grains. There is an inverse relationship between the number of elevators limiting flaxseed receipts for storage and the market price of flaxseed.

Elevator managers may relieve their limited storage capacity by (1) cleaning flaxseed, as a bin containing uncleaned flaxseed will normally hold only 75 percent of its rated capacity; and (2) minimizing the capacity utilized by elevator-owned grain by delivering it to terminal markets as soon as possible.

Of the total country elevator capacity surveyed, 83 percent was considered by elevator managers to be suitable for flaxseed storage and 61 percent was so used (elevator units consisting of 61 percent of the total capacity had bins in which flaxseed was stored at one time or another during the marketing year). Wood crib storage structures make up 68 percent of the total elevator capacity and account for 73 percent of the suitable flaxseed capacity. Concrete structures constitute 13 percent of total capacity and 17 percent of suitable capacity. Although the wood crib structure still remains the leading type of storage unit for flaxseed, a relatively greater percentage of the existing concrete silos is considered to be suitable for and is actually used for flaxseed. The other types of elevator structures, although often considered suitable for flaxseed storage, are less commonly used for that purpose.

The total capacity at elevators surveyed nearly doubled between 1945 and 1955. Before 1930, the wood crib structure accounted for more than 90 percent of total elevator capacity. During 1945-55 only 44 percent of the storage capacity constructed was of wood crib; 26 percent was concrete. Recently constructed elevator units are considered to be more suitable for flaxseed storage than older storage units. Still, the wood crib main house continues to be widely used as it usually permits easier cleaning and turning of flaxseed, and better observation of the condition of grain in storage than other types of structures.

Operators of country elevators reported a willingness to set aside 70 percent of their total capacity for commercial grain storage, nearly one-third of which could be used for flaxseed storage during the peak of the harvest season. In practice, however, only 63 percent of the total average capacity was allocated to commercial storage during the 1955-56 marketing year; 37 percent was retained for operating space by the elevator. About 18 percent of the commercial storage space was used for flaxseed. Less than one-half of the total space in elevators having a capacity of 40,000 bushels or less was set aside for storage. In some larger-sized elevators, two-thirds of the capacity was used for commercial storage. In 1955-56, farmers used 35 percent of total grain elevator capacity, the Commodity Credit Corporation used 27 percent, and elevator-owned inventories accounted for 19 percent.

FLAXSEED STORAGE AT COUNTRY ELEVATORS IN MINNESOTA, NORTH DAKOTA, AND SOUTH DAKOTA

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INTRODUCTION

The purpose of this study is to analyze and evaluate flaxseed marketing storage operations at country elevators at various locations with present methods and practices, and to examine changes that would benefit farmers, industry, and consumers by increasing the efficienty of storage.

The 3-State area of Minnesota, North Dakota, and South Dakota produces about 95 percent of the United States flaxseed crop. Here, as in other areas, modern technology and mechanization have greatly speeded up harvesting operations and have affected the marketing and storing of flaxseed. Higher yields per acre, modern self-propelled combine harvesters, and large motor-transport trucks act as a three-pronged force to reduce the peak harvest period to only a few weeks during a period of favorable weather. Consequently, large quantities of flaxseed and other grains are offered to the country elevators over a relatively short period of time, resulting in a quick depletion of available elevator storage space and a shortage of boxcars.

Flaxseed is often considered to be of secondary importance in acreage and production and as a source of income, even in North Dakota, Minnesota, and South Dakota where over nine-tenths of the annual U. S. crop is produced. However, since the value of flaxseed depends upon its oil content, nearly all flaxseed is sold off the farm, whereas varying percentages of other small grains are retained by producers for feed. Because the bulk of the flaxseed enters the marketing system by way of the country elevators, and has a higher per-unit value than any other small grain, its importance to elevator management is greatly increased.

As flaxseed is more risky and inconvenient to store than other small grains, many producers prefer to store it in country elevators. As a result, one-third of the flaxseed received at country elevators during the 1955-56 marketing season was placed in country elevator storage. Storage, as a phase of flaxseed marketing, more than doubled during World War II and, with few exceptions, continues at record levels in these northern plains States. Many elevator managers, however, consider flaxseed less desirable to store than other grains because of its high dockage content, relatively low test weight, sensitivity to moisture, and due to its higher value, more costly insurance charges and shrinkage losses.

METHOD OF STUDY

Data relating to assembly, grading, storage, and suitable flaxseed storage capacity were obtained from 265 elevators in North Dakota, Minnesota, and South Dakota. Of the 265 schedules, 220 were completed through enumerator contacts with the elevator manager and the remaining 45 schedules were returned by co-operating line company elevators with headquarters in Minneapolis. The survey of the 1955 flaxseed crop was conducted during the summer months of 1956, although the study includes supplemental transportation data for 1957. Figures 1 and 2 indicate the area of the 3-State flaxseed production and the corresponding location of the elevators surveyed. Each State has been divided into 3 areas, each of which includes three crop-reporting districts in numerical order from east to west.

In the selection of the sample to be interviewed, every fourth elevator in Minnesota, North Dakota, and South Dakota having outstanding flaxseed storage tickets in October 1955 was included. 1/ The sample did not include terminal elevators or elevators having less than 1,000 bushels of flaxseed in storage at that time. This was done to direct the study toward areas where flaxseed production and elevator storage were significant. In addition to the original sample, all elevators in the 3-State area having 15,000 bushels or more of stored flaxseed outstanding in October were then added. These are referred to in this report as the "15-plus" group elevators.

Elevators were grouped by States, and also by functional classification, which included 154 independent elevators either privately or cooperatively owned, 37 15-plus group elevators, and 74 line company elevators. In instances where the inclusion of 15-plus group elevators would seriously distort the 3-State averages, only data from those elevators selected at random are presented, or each type of elevator is listed separately according to functional classification.

The grain storage capacity of the 265 elevators totaled approximately 31 million bushels. The amount of flaxseed handled by independent and line company elevators averaged 40,000 bushels while the 15-plus group elevators handled an average of 95,000 bushels of flaxseed during the marketing year. The total volume of flaxseed handled by elevators surveyed accounted for one-third of the total 3-State production, or 31 percent of the flaxseed produced in the United States during the 1955-56 marketing year. The marketing year for flaxseed begins July 1 and extends through June 30 of the following year.

Flaxseed, though technically not a grain, is stored and handled in a manner similar to that for the grains; therefore, flaxseed is considered as a grain in this report. Moreover, when the term "all grains" is used, flaxseed is included unless otherwise indicated.

Elevator "units" refer to individual buildings used for storage. An elevator can be comprised of 1 or a number of units.

1/ Storage tickets are warehouse receipts covering flaxseed stored for clients.

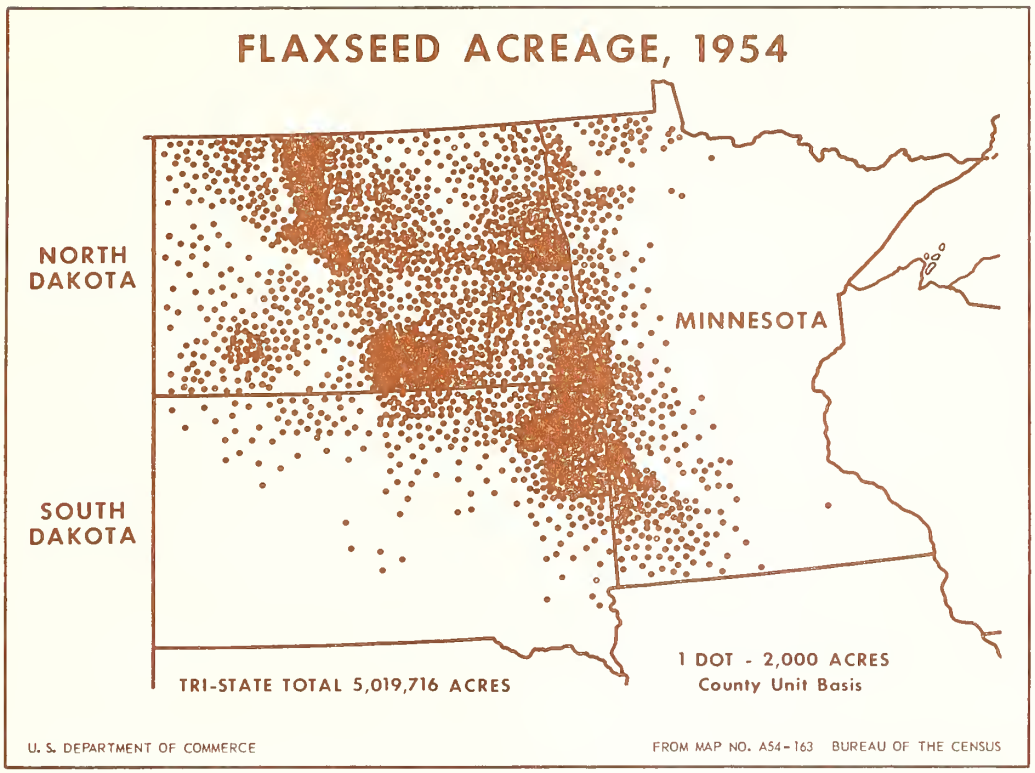

Figure 1

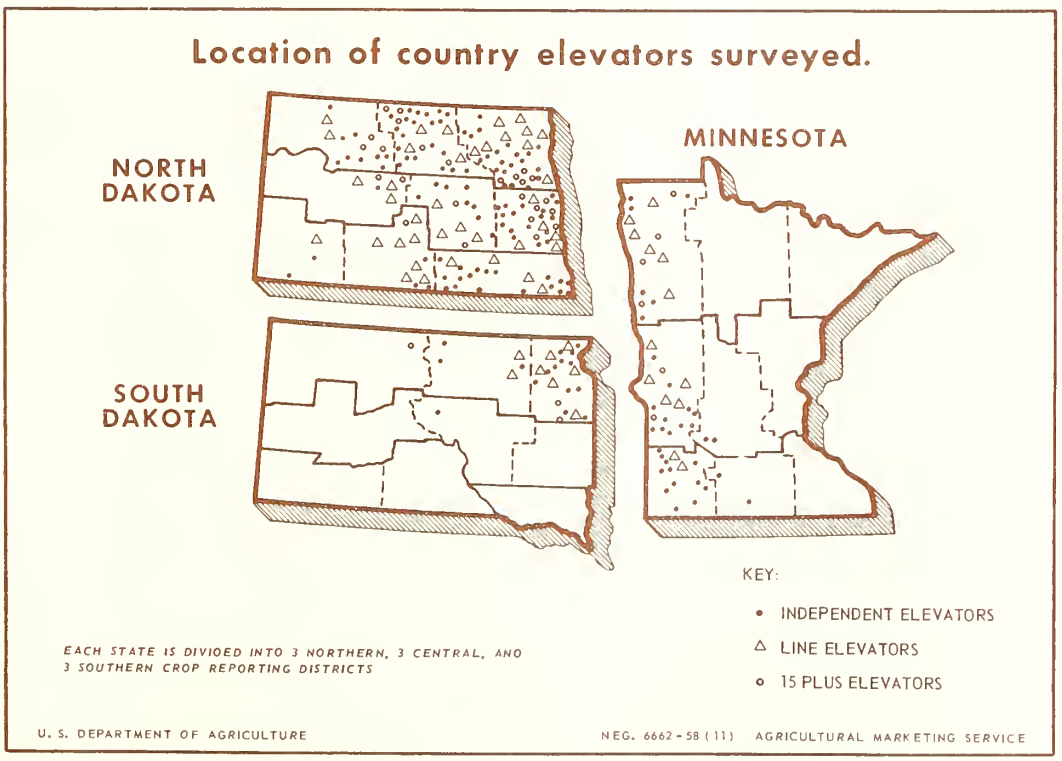

Figure 2

ASSEMBLY OF FLAXSEED AT COUNTRY ELEVATORS

Method of Assembly

Flaxseed is moved to country elevators by farm producers, commercial haulers, or by elevator operators. Most of the flaxseed, however, is delivered in farmer-owned trucks or tractor-drawn wagons. Some flaxseed is transported from the field in trucks provided by custom combine crews who not only supply harvesting equipment but one or more trucks as well. Once loaded into trucks, the flaxseed might either be placed in farm storage bins for later delivery or hauled directly to the elevator for storage or sale.

Country elevator companies owning and maintaining trucks do not make a practice of using them for assembling flaxseed. Some elevator companies haul only a few loads of flaxseed when no other facilities are available to the producer. Most managers, however, did not attach any significance to this sideline operation. Only 23 of the 265 elevators assembled 1955-crop flaxseed in elevator-owned trucks. Generally, the amount of flaxseed hauled by such vehicles to those 23 elevators did not constitute over 10 or 15 percent of their total receipts of flaxseed. A large proportion of grain is marketed at harvest time, and an elevator, to be prepared for this, would need a large fleet of trucks during the harvest season. During the rest of the year, however, these trucks would stand idle. The high fixed cost would have to be paid for during the several harvest months. Elevator management would also need to employ additional labor to drive these vehicles. It is difficult to obtain dependable drivers for only a short period of employment during the harvest season when the demand upon the local labor supply is already at its annual peak. In addition, the many farmers owning a truck would use their own rather than hire transportation except when they needed additional trucks.

The rates charged by those country elevators collecting flaxseed in their own trucks varied from 1 to 5 cents per bushel, with an increase beyond 5 to 10 miles. These rates were similar to those charged by custom haulers in the area and where different, were generally lower.

Some elevators used different methods in establishing truck rates, such as making the charge upon a hundredweight basis or charging a relatively low flat rate per mile regardless of the number of bushels hauled. Another exception occurred when an elevator allowed producers free use of the elevator truck, expecting the returns from increased volume of flaxseed received to compensate for the additional expenses incurred. Some elevators made a practice of using their trucks only for seed delivery and the charge made for use of the vehicle was usually included in the total charge for the seed. Generally, however, transportation rates are proportional to the distance hauled and are sufficient to cover the operating expenses of the vehicle.

Assembly Area of Country Elevators

Although the producer is interested in disposing of his flaxseed where the highest returns can be obtained, he also considers hauling distance. Elevator managers in the survey reported that 80 percent of the flaxseed received at country elevators was produced within 10 miles of the elevator. A total of 97.5 percent of the elevators' flaxseed is received from within 25 miles. All elevator managers in the survey purchased flaxseed from producers within 10 miles of the elevator and nearly three-fourths of them obtained over 70 percent of their total receipts from within this area. Almost 80 percent of the managers received smaller amounts of seed from distances of 10 to 25 miles, while only 16 percent of the elevators received flaxseed from a distance of 25 miles or more and then only in amounts usually constituting less than 10 percent of their total receipts (table 1).

Table 1.--Percentage of country elevators receiving flaxseed from varying distances, 3-State area, 1955-56 survey

Percent of each elevator's flaxseed receipts	Percentage of elevators receiving flaxseed from a distance of--		
	Less than 10 miles	10 to 25 miles	Over 25 miles
	Percent	Percent	Percent
1 - 10	0.4	26.2	11.9
11 - 20	1.6	14.1	1.6
21 - 30	1.2	18.3	2.0
31 - 40	1.6	7.9	0
41 - 50	8.3	7.1	0
51 - 60	6.0	2.0	0
61 - 70	7.1	.8	0
71 - 80	23.8	0	0
81 - 90	21.8	.4	0
91 - 100	28.2	0	0

If prices are higher at one elevator than they are at another, the producer usually sells his flaxseed to the elevator offering a higher price, other factors being equal. It is not uncommon, however, that a producer develops a preference toward a particular elevator manager and bypasses a nearer elevator regardless of possible differences in price. If the producer intends to store rather than sell his flaxseed, the distance hauled may depend on the location of the nearest elevator with space available.

GRADING FACTORS INFLUENCING THE STORAGE AND HANDLING OF FLAXSEED

Flaxseed Dockage

By definition, dockage includes "all matter other than flaxseed which is contained in the lot of grain as a whole; also undeveloped, shriveled, and small pieces of flaxseed removed with the dockage and which cannot be recovered by properly rescreening or recleaning" (1, p. 65). 2/ The word "dockage" is, therefore, associated with poor quality. The dockage content is often looked upon as an indication of the quality of farming practiced; however, higher contents of dockage often occur as the result of unfavorable climatic conditions.

Farmers rarely clean flaxseed on the farm unless they intend to use it for seed. A few have fan mills or combines with cleaning units attached which are designed to remove certain types of dockage. Only 34 of the 265 elevators surveyed received flaxseed that had been cleaned by farmers. An average of 10 percent of the flaxseed received by these 34 elevators had been cleaned before delivery, amounting to about 1 percent of the total flaxseed receipts of all the elevators surveyed. Flaxseed received by country elevators, therefore, contains almost the same percent of dockage as when harvested. The average amount of dockage delivered with flaxseed to elevators surveyed was 16.3 percent, although individual receipts were quite variable, ranging as high as 60 or 70 percent of the gross weight. The number and proportion of farms producing and marketing flaxseed with a high amount of dockage have decreased, but still remain significantly high.

A farmer who raises and markets flaxseed containing a high percentage of weed seeds is not getting the largest return possible per acre. The presence of weeds and weed seeds reduces yields, increases harvesting costs, and lowers the value of the straw in areas where it is marketed.

The handling of excessive dockage is probably the greatest single problem or additional cost factor involved with flaxseed. The additional storage and transportation costs attributable to dockage content are treated in a companion report (4). Costs such as the transportation and storage of dockage are often overlooked by farmers. Not only is the quantity important, but also the fact that the dockage usually contains more moisture than does the flaxseed. Much of the foreign material, such as green weed seeds or even finely broken grains or fine dust, often contributes to heating or mustiness unless the flaxseed is exceptionally dry.

Dockage Determination at the Country Elevator

Almost all flaxseed produced is eventually marketed through country elevators. Upon the delivery of the flaxseed at the elevator, a sample to be graded is commonly drawn by passing a pan one or more times through the stream of

2/ Underscored numbers in parentheses refer to literature cited, p. 55.

flaxseed as it is being unloaded from a truck into the elevator pit. The sample, after being passed through a divider, is usually tested for moisture, test weight, dockage, and sometimes for condition of damaged seed. The percent of dockage is recorded individually for each truck or trailer load. Of the 265 elevator operators surveyed, 34 included dockage as a factor in arriving at the grade for a particular lot of flaxseed. Only 5 of those, however, reported considering the percentage of dockage in deriving the price paid to growers. All elevator operators test for dockage, but generally consider test weight and moisture as the main factors in determining grade and price. Dockage is not technically part of the grade.

Although representativeness of the samples may vary, one major problem in the determination of dockage is in the dockage tester or in the testing itself. There are, of course, various testing methods and types of dockage testers in use throughout the Midwest flaxseed area. At some elevators, the dockage is measured by merely passing the seed through a series of hand sieves. At other elevators, a motor-driven dockage tester is used for all grains and a different sieve is used for each type of grain. A motor-driven dockage tester is also in use for the testing of flaxseed dockage only. In none of these methods is provision made for removing chaff from the sample. Often the one making the test merely blows upon the sample to remove the lightweight chaff material. It is in the removal of the chaff that some operators feel errors are made in testing flaxseed dockage.

During recent years, newer types of dockage testers which feature controlled-air removal of chaff have become available in the market. However, since controlled-air testers are about five times more expensive than conventional types, elevators handling only moderate amounts of flaxseed hesitate to purchase them.

Accurate determination of flaxseed dockage is difficult because of the problems involved in complete separation of the flaxseed from other seeds. Certain seeds are similar in size to flaxseed. Among the most difficult seeds to remove are the water grass and pigeon grass varieties, also certain smart weeds, false flaxseed, and wild buckwheat. Very few elevators attempt to hand-pick weed seeds from a flaxseed sample as they usually lack the time and the personnel to do so, especially during the harvest season. An allowance for such seeds is made by some operators in determining the dockage. Also, if the percentage of such weed seeds is large, the test weight may be affected adversely.

Losses of some broken or shriveled kernels along with smaller seeds often are more difficult to avoid. These small flaxseeds apparently do not vary materially from the larger-size seeds in quality or in oil content per hundredweight. Because of the time and expense required to return to the sample small or broken flaxseed lost through the screens, very little is actually recovered.

Dockage Determination for CCC

Although accurate dockage determination has long been a problem between producer-sellers and elevator buyers, the problem became more acute after World War II when the Commodity Credit Corporation began purchasing surplus flaxseed. In making such purchases, which began in 1946, a belt-run sample was required by the CCC. The official samplers employed by licensed grain inspectors often found substantially more dockage in the flaxseed delivered to CCC than was found at the elevator. Elevator managers indicated that flaxseed delivered to the CCC was found to contain an average of 1.83 percent more dockage than was found at the country elevators. While 72 percent of the operators reported that flaxseed delivered to the CCC was found to contain a greater amount of dockage, 28 percent reported that it was found to have the same percentage. None of the elevators reported having found flaxseed containing a higher percentage of dockage than that found by the official samplers of flaxseed for the CCC. Up until that time, it was generally assumed that dockage content could be estimated accurately at country elevators.

The effect of the percentage difference in the amount of dockage found by the elevators and the official samples of flaxseed delivered to the CCC was indeed important in that the elevators' profit margin was reduced. Some elevator managers found that their flaxseed storage and marketing operations were running at a loss; some did not continue operating on the same margin they had previously established. Elevator managers became aware of the need to obtain a more representative sample including some of the flaxseed on or near the bottom of the trucks where the percentage of dockage usually is the highest. Sometimes the methods used were carried to such an extent that producers were dissatisfied with the amount of dockage the elevator operators found. However, only by accurate determination of dockage content were operators able to reduce the losses that many were sustaining.

Elevator operators near the Canadian border also reported that Canadian elevators were allowed to add 1½ percent of dockage to the actual amount found in the flaxseed received from farmers, to cover shrinkage losses occurring during handling and storage. It is possible that this practice has had some influence on the adoption of similar practices by some domestic elevators.

Representative samples are difficult to obtain in cars containing large amounts of unevenly distributed dockage in the flaxseed. Also, it should be noted that there is a certain amount of shifting, settling, and separation of dockage and flaxseed in most cars during transit. In belt-run sampling, the proportion of dockage to flaxseed is often much higher at the very end than at any other period of the unloading operation. The lightweight foreign material tends to flow out last, on top of the heavier, slippery flaxseed. Often railroad cars are overloaded to the extent that official samplers' probes will not reach the bottom of the car. In such cases the inaccessible lower layer of flaxseed is not represented in the sample taken. There are various explanations as to why dockage runs higher in the belt-run sampling method, but none has yet been substantiated by fact.

Test Weight

Once the percentage of dockage has been established, the next step is to measure a definite quantity of the flaxseed to determine the test weight. Like all other grade-determining factors, an accurate measurement is necessary in order to obtain the basis for correct payment to the flaxseed producer. Normally, about 90 to 95 percent of the annual flaxseed crop meets the weight requirements for grade No. 1 flaxseed.

An established procedure is used for determining the test weight of the flaxseed bought and sold at country elevators and terminal markets. After the dockage has been removed, a representative sample of the bulk of flaxseed is poured into a cup-like container with a total volume equal to 1 1/8 quarts. This quantity is then reduced through the use of a divider and one portion is placed on a scale and its weight calibrated in terms of pounds per bushel.

For flaxseed to grade No. 1, its weight equivalent must represent at least 49 pounds per bushel. Flaxseed with a weight equivalent of less than 49 pounds but more than 47 pounds per bushel is grade No. 2 on the basis of test weight. Below 47 pounds, the flaxseed is classed as "Sample" grade, thus keeping the badly shriveled and immature flaxseed out of the higher grades. The No. 2 and "Sample" grades are considered less valuable to the processor and, therefore, the prices quoted represent the difference in the evaluation.

As the percentage of low-test-weight flaxseed received is normally quite small, many of the elevator operators are able to mix it with flaxseed that has test weight above the No. 1 grade minimum. Nearly all elevators follow this practice as it is often difficult to convince a patron that his flaxseed does not test out to grade No. 1. It is not uncommon, therefore, for an elevator to pay a No. 1 price for a lot of flaxseed that actually grades No. 2. Only when the quantity of the low test weight flaxseed exceeds the operator's ability to blend it does the operator find it necessary to pay the farmer a lower price for the flaxseed.

Moisture in Stored Flaxseed

Excessive moisture is perhaps the most troublesome factor in flaxseed merchandising. The moisture content more than any other factor has an important effect on the quality and keeping ability of the flaxseed. Moisture in flaxseed contributes to mold growth, which causes heating and adhesion of the kernels so that chunks plug up grain conveyors. In extreme cases, these chunks can become so large that they literally have to be chopped up before the bin can be emptied. This condition also causes deterioration of the flaxseed and tends to decrease the drying qualities of the oil. In addition, high-moisture flaxseed is more difficult to process, and less oil and meal are obtained than from an equal amount of dry flaxseed (10).

Moisture problems can arise from excessive moisture within the flaxseed when it is put into storage, from moisture within the accompanying dockage, from faulty storage bins that allow moisture in various forms to enter, and, possibly, from an extended period of humid weather either during the harvesting or storing season. Generally, flaxseed can be stored in the 3-State area with a moisture content about 1 to 1½ percent higher than in flaxseed-producing regions of Texas. Even in cooler climates, however, moisture builds up in the upper layers of relatively dry flaxseed during fall and winter unless adequate forced ventilation is used. Wide differences in temperatures within a bin cause air currents which carry water vapor from a warm center to cooler areas where it condenses and accumulates (11). Generally, the warmer air rises and when it meets the cooler upper layers of grain, moisture is deposited which might cause flaxseed to cake and mold.

Flaxseed tends to pick up moisture in humid weather. Checking moisture content periodically in several places throughout the bin is important, especially when grain is stored warm and during a time of rapidly fluctuating temperature and relative humidity. Even during the cooler months of November to March, the relative humidity averages 80 percent or more in the North Central States (7).

The danger of moisture accumulation in certain parts of the bin can be reduced by using smaller bins.

The size of 304 bins used for flaxseed storage in North Dakota during 1956 ranged from 300 bushels to 16,000 bushels with an average capacity of 3,200 bushels. Flaxseed stored in smaller-size bins of 2,000-bushel capacity or less tends to maintain a more uniform bulk temperature than that stored in larger units, and there is less possibility of moisture deposits in localized areas within a bin. In experiments at Beeville, Texas, temperatures in farm-type bins of small diameter or narrow width were found to respond to changes in atmospheric temperature more readily than larger bins (9).

Tests by the Plant Pathology Department of the University of Minnesota indicate that length of storage is an important consideration in deterioration. Flaxseed stored at 10.5 to 10.7 percent moisture at a temperature of 60° to 70° F. may be safe from serious invasion by storage molds for a period of 6 months, but it is very likely to become heavily invaded by storage molds if stored for 9 months. Temperatures of the stored seed below 60° F. will delay, but not prevent, such mold invasion (2).

Although flaxseed containing up to 11 percent moisture is graded No. 1, many operators prefer flaxseed with 9 percent moisture for storage. Often they may not accept delivery of seed containing greater amounts. High-moisture flaxseed is usually loaded out of an elevator as quickly as possible to avoid heating losses before the seed is processed into linseed oil and meal. Many elevator operators have found it risky to store flaxseed with a moisture content over 10 percent. Flaxseed buyers discount flaxseed with high moisture ½ cent per bushel for each 1/10 of 1 percent moisture between 9 and 9½ percent, then 1 cent for each 1/10 of 1 percent above 9½ percent moisture. This

amounts to a total discount of 17½ cents per bushel for flaxseed containing 11 percent moisture which, according to the U. S. Grain Standards, is still No. 1 flaxseed. With the 1958 crop, CCC began paying premiums of 1 to 4 cents for flaxseed with moisture below 10.6 percent.

The elevators surveyed had very little trouble with high-moisture flaxseed during 1956 because of a very dry 1955 harvest season. Thirteen percent of 251 managers surveyed reported some moisture problems. These were caused mainly by high amounts of dockage, frozen immature flaxseed kernels, and faulty storage structures, but losses were relatively small. The average moisture content of the flaxseed handled in the 3-State area was 8.7 percent, with almost no variation among the States. Most of the managers indicated they had to be cautious, however, as many reported moisture problems in earlier years.

When there is an unusually wet fall, flax producers and elevator operators have considerable trouble in caring for flaxseed. Even so, none of those interviewed who had artificial heat dryers considered them practical for drying flaxseed, as they were too slow and expensive. Some experienced trouble from the wind stream blowing light flaxseed out of the machine and from overheating, which caused some quality deterioration. These conditions might have been due to inexperience in drying flaxseed or to the particular kind of dryer used.

Of 12 million bushels of grain dried artificially from June 1951 to May 1952 by 74 Minnesota elevators, 12,000 bushels were flaxseed. Only 2 elevators reported drying flaxseed, and only 3.35 percent moisture was removed from flaxseed, while 3 percent or less was removed from wheat, oats, barley, soybeans, and rye, and 14.4 percent from corn. Fixed costs of drier installations at 72 elevators averaged 1.30 cents per bushel for all grains (6).

In normal years, proper management practices can overcome moisture difficulties in most elevators. Turning--moving the grain from one bin to another--is one of these practices and over three-fourths of the elevator managers surveyed turned all their flaxseed periodically whether they thought that it required turning or not. Forty-five percent of the managers reported that part or all of the stored flaxseed required turning during the storage period. This is generally done during a cold, dry winter day, to cool off any warm flaxseed and reduce the chance for the seed to absorb moisture from the air. The flaxseed was turned, on an average, every 2 months during the 1956 elevator storage season in the Midwest, although some elevator operators turn flaxseed as often as every week or two, and others as seldom as every 5 or 6 months.

Many country elevator managers storing flaxseed with a critical moisture content make a practice of cleaning and turning flaxseed in one operation. Removing dockage containing green or high-moisture weed seeds is an excellent method of reducing the danger of losses due to heating. High-moisture-bearing weed seeds were reported to be the primary cause for spoilage and resulting losses of elevator-stored flaxseed during 1956 and earlier marketing seasons. Flaxseed samples taken from a combine often contain less moisture than the weed seeds or chaff with which they are combined. During the storage period the moisture transfers from the weed seeds to the flaxseed. This process continues until an equilibrium is reached.

Some elevator managers felt that a part of their moisture problems could be eliminated by the use of more prudent harvest methods. For instance, except with certain varieties which are more brittle and in a wet harvest season when nothing but artificial drying can be done with wet flaxseed, farmers might swath their flaxseed crop and delay threshing the windrows until the flaxseed and any accompanying weed seeds become dry.

Fumigation is another moisture control practice that might be conducted during the turning operation. Insects become more active in warm, moist grains, and they in turn generate additional heat which contributes to mold growth. While insects are not found in flaxseed to the same extent as in other grains, periodic fumigation of empty elevator bins minimizes the danger of heat damage resulting from insect infestation. Although one might normally think of the fumigation of stored grain as primarily a measure to control insects, fumigation of stored flaxseed in the Middle West is used also as a conditioning process. It was noted that whether an elevator manager fumigated flaxseed generally depended upon the condition of the seed. Fumigants are sometimes used to cool flaxseed that is beginning to heat, and also to destroy offensive odors in musty flaxseed.

In summary, the risk of losses in storage due to moisture may be overcome by use of the following practices: (1) Limit storage receipts to flaxseed containing less than 10 percent moisture, (2) turn flaxseed on dry, cool days, (3) remove green weed seeds through cleaning, (4) use smaller size bins of 2,000-bushel capacity or less, (5) maintain weather-tight, moisture resistant bins, (6) fumigate bins to destroy heat-generating insects or fumigate the flaxseed to cool seed beginning to heat, and (7) encourage farmers to swath most flaxseed rather than combine it standing.

Damage

Flaxseed damage according to the U. S. Grain Standards includes "... seeds and pieces of seeds of flaxseed which are heat damaged, sprouted, frosted, badly ground damaged, badly weather damaged, or otherwise materially damaged" (1, p. 66). The extent of the damage is determined on the basis of a representative sample after the dockage has been removed by appropriate sieves and cleaning devices.

The market value of flaxseed is not greatly affected by the presence of a limited amount of damage. Therefore, the grading is liberal in allowing fairly large percentages of damaged kernels. No. 1 flaxseed can contain up to 20 percent and No. 2 up to 30 percent partially or wholly damaged kernels. If the damage exceeds 30 percent or if it contains fire-damaged kernels, the flaxseed is reduced to "Sample" grade.

Damaged seeds are usually characterized by discolorations. Normally, the healthy seeds of the majority of flaxseed varieties are a chocolate brown in appearance. The damaged seeds, however, may vary from the pale color of frozen seed to an almost black shade resulting from heat damage. Often damage is

classified according to its origin, that is, whether it occurred in the field or during the storage period. In normal years, more grain is damaged during storage than in the field (3). The most important causes of storage damages are heat, weevils, and molds. The losses as a result of damage in storage are to a large degree avoidable when flaxseed is properly cared for in the elevator. Adequate and suitable storage facilities play a large part in preventing extensive damage.

The majority of the elevator managers interviewed did not consider damage an important grading factor; only 51 of 265 managers mentioned it when they were asked how grades and prices were established by the elevator at the time of purchase. Some of the managers discounted the importance of damage by indicating that damaged flaxseed could be mixed with flaxseed of higher quality until the entire lot could be sold as grade No. 1. Some managers indicated they would not accept excessively damaged flaxseed. Generally, those who purchased damaged flaxseed resold it as soon as possible in order to lessen the risk of losses.

GRADE DETERMINATION BY OIL CONTENT

The economic importance of flaxseed is due mainly to its high oil content, which is the major factor influencing its price. Flaxseed yielded an average of about 40 percent of its weight in oil during 1955-56 or 22.3 pounds to a 56-pound bushel of seed. Terminal buyers and processors follow the annual flaxseed crop in order to know the areas where seeds of high oil content are being produced and also the areas yielding low quantities of oil. Prices paid to elevators depend, in part, upon whether the elevators happen to be located in an area producing flaxseed having a low average oil content. Extreme heat at various stages of growth, along with other climatic conditions such as rainfall, affects the oil yield of the seed. Some years the percentage of oil per bushel of flaxseed varies markedly among areas within the three leading flaxseed-producing States. It is not uncommon during such years to find producers trucking their flaxseed 50 miles or more outside the area of production when the oil content of their seed is below average and local price differentials are enforced. Thus, the seed may be sold at a better price although it still contains a lower quantity of oil.

Country elevator operators in the 3-State flaxseed belt were asked if they thought a rapid method of testing oil content of flaxseed would be better than the present test-weight grading method. Of a total of 167 operators responding, 50 percent opposed and 27 percent favored such a test, while 23 percent offered no opinion. Many of the elevator managers opposed to testing the oil content of flaxseed thought that the test probably would be more complicated, would require more time, and perhaps would be more troublesome than the present test-weight method. These accounted for about one-half of their objections. Some operators felt that it was not practical for them to make such a test, or that too many bins would be required if flaxseed containing varying amounts of oil were to be kept separate. Two managers believed that the oil test would not be sufficiently accurate and would lead to disagreements between

the buyer and seller, while only one manager objected to the expense of providing the new equipment. Approximately 30 percent of the managers opposing such a test gave no reason for their reply. Here are the number of managers who opposed testing for oil content and the reasons they gave:

Reasons	Number
More complicated than the test-weight method	19
Would require more time and work than the test-weight method	12
Test-weight method is less troublesome	10
Not practical	6
Would require too many bins	5
Difficult for producers to accept	4
Test would be too variable	2
More equipment would be necessary	1
No reason given	24
Total	83

Those elevator managers favoring some rapid method of testing the oil content of flaxseed considered it to be the fairest base for prices. They also felt that such a test would be to the benefit of the flaxseed producer. Since no premiums are offered at the present time, there is no incentive for the individual growers to produce flaxseed yielding a high percentage of oil. Those delivering more valuable seed obtain the same return as growers delivering less valuable seed to the same elevator.

LENGTH OF STORAGE: FLAXSEED AND WHEAT

Many growers sell their flaxseed for cash immediately after harvest. Others store their flaxseed and sell later. The majority of farmers who decide to store flaxseed, whether on the farm or in an elevator, prefer to place it in storage as soon as possible during or after the harvest. If it is once placed in farm storage, the farmer is likely to keep it there unless additional space is required for other grain, especially feed grain.

How long flaxseed is retained in elevator storage depends on a number of factors, each of which is important to the farmer's decision to sell. Probably the most important consideration is given to the market price of flaxseed. During periods of relatively high prices, the crop generally moves through the marketing channels more rapidly than when prices are low. If the market price is 10 to 15 cents or more below the support price, the out-of-storage movement is slow. A large proportion of the crop is held at country elevators by farmers delaying sale until prices advance or waiting for delivery to the Government. However, if prices rise substantially above the established CCC support price, flaxseed storage is of shorter duration. In addition to the market price and anticipated price changes, the length of the storage period also depends on such other factors as the condition of the seed, other storage requirements, road conditions, and transportation facilities.

During the 1955-56 marketing season, flaxseed was stored for a slightly shorter period of time than most other cash grains. 3/ Flaxseed was stored 5 1/5 months while the wheat was retained in elevators 6 3/5 months (table 2).

Table 2.--Average duration of commercial storage for flaxseed and wheat, 3 North Central States, 1955-56

Commodity	States			Functional group			3-State average
	North Dakota	Minnesota	South Dakota	Independent	Line	15+	
	Days	Days	Days	Days	Days	Days	Days
Flaxseed	154	157	185	137	214	164	159
Wheat	202	199	201	191	226	202	201

The shorter storage period of flaxseed during 1955-56 resulted from price changes during the year. The price of flaxseed had dropped to an average of $2.74 per bushel during the harvest of 1955. Thus, the harvest-season price was substantially below the Commodity Credit Corporation farm support price level of $2.91 per bushel, so that well over one-half of the crop went into farm and elevator storage. With an improved demand for oil and more active foreign demand, flaxseed prices advanced steadily to an average of $3.54 per bushel in May 1956. As the market price of flaxseed advanced, storage was terminated and the seed was sold. Practically all of the nearly 9 million bushels under CCC loan was redeemed and none of the flaxseed stored under CCC purchase agreements was delivered. The price of wheat also rose, but only slightly compared to that of flaxseed, so that only a small proportion of the wheat under CCC loan was redeemed and sold from storage.

Flaxseed sales from elevator storage take place gradually throughout the marketing year except for that retained under CCC loan, which is held by the elevator 30 to 60 days after the March 31 termination date unless an agreement for an extension is made. With an average length of storage over 5 months, it is evident that much of the flaxseed is retained in storage over a longer period of time. Those farmers who are pressed for money either sell at harvest or borrow on their warehouse receipts and are thereby able to extend the period of storage.

STORAGE COSTS AND RETURNS

Elevator Costs

As flaxseed competes with other small grain for storage space, the extent to which flaxseed is accepted for storage is influenced by numerous considerations, especially those affecting storage costs and returns. Because of higher

3/ "Cash grain"--any grain entering the marketing system.

handling costs for flaxseed, elevator operators generally obtain a larger gross margin for storing flaxseed than other grains. Returns received per bushel for commercial storage, however, are established at a uniform rate for all grain elevators within each State. Therefore, costs of storage become a prime consideration in determining how much of each kind of grain will be accepted when available storage space at an elevator is limited.

In comparing the costs and returns to elevators storing flaxseed and wheat, it was found that returns above cost were larger for wheat than flaxseed. However, operators can increase storage returns on flaxseed so that they compare favorably with those for wheat. This may be accomplished by cleaning flaxseed immediately upon its receipt at the elevator, selling the screenings, and storing additional flaxseed in the space formerly occupied by flaxseed dockage. This, in turn, would enable elevators to meet more fully farmers' demand for storage services for flaxseed.

Table 3 indicates storage costs and returns for flaxseed and wheat. Some costs are based upon the comparative value of the individual grains, some vary according to the nature of the grain itself, while others are fixed costs applicable to each bushel of grain stored or handled in relation to the total volume of grain handled. Because of the economic importance of the amount of dockage in flaxseed, the table presents data for wheat cleaned to contain 2 percent dockage, flaxseed cleaned to 5 percent dockage and 10 percent dockage, and uncleaned flaxseed containing 15 percent dockage. Elevators storing flaxseed for the Commodity Credit Corporation receive storage returns on a gross bushel basis. Additional bushels of cleaned flaxseed can be stored in place of the dockage removed, thereby increasing the total returns to storage.

Shrinkage

Of extreme importance to elevator management is the problem of shrinkage. When flaxseed is delivered to the elevators any loss in weight or the risk of such loss becomes the responsibility of the elevator. Most of the losses are due to leaky grain conveyors within the elevator legs, poorly adjusted distributor heads, faulty storage bins, spilling over bins, or evaporation of moisture. The small size and slippery nature of flaxseed makes it especially susceptible to the above causes for shrinkage. Sometimes weight is also lost in cleaning if some of the smaller and cracked kernels are not recovered.

At two-thirds of the country elevators surveyed, total handling and storage shrinkage losses were greater in flaxseed than in other grains. The higher shrinkage, however, occurred when the flaxseed was moved, as no appreciable difference was noted during the actual bin storage. Total storage shrinkage amounted to 0.43 percent during an average storage period. Shrinkage of other grains in storage is often as great as in flaxseed, but because of the comparatively higher value of flaxseed, its shrinkage loss is more expensive.

Often the greatest shrinkage losses occur at the time grain is received at the elevator and shortly thereafter. From then on, most of the losses result

Table 3.--Storage costs and returns per net bushel of flaxseed and wheat stored at elevators for 8 months, by dockage content, 3-State area, 1955-56 1/

Item	Stored for farmers				Stored for CCC			
	Wheat, with 2 percent dockage	Flaxseed, with dockage of-- 5 percent	10 percent	15 percent	Wheat, with 2 percent dockage	Flaxseed, with dockage of-- 5 percent	10 percent	15 percent
	Cents	Cents	Cents	Cents	Cents	Cents	Cents	Cents
Costs:								
Shrinkage 2/	0.98	1.29	1.29	1.29	0.98	1.29	1.29	1.29
Insurance 3/	.77	1.12	1.12	1.12	.77	1.12	1.12	1.12
Cleaning 4/	.30	1.81	1.00	--	.30	1.81	1.00	--
Other operating expenses 5/	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49
Certain fixed expenses 6/	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72
Total estimated cost	5.26	7.43	6.62	5.62	5.26	7.43	6.62	5.62
Returns:								
For storage 7/	7.67	7.67	7.67	7.67	11.50	11.50	11.50	11.50
Less: loss due to test weight 8/	--	-.83	-.83	-.83	--	-1.24	-1.24	-1.24
Less: loss due to dockage 9/	-.31	-1.03	-1.03	-1.03	-.45	10/	10/	10/
Estimated net return	7.36	5.81	5.81	5.81	11.05	10.26	10.26	10.26
Sale of screenings 11/	.72	3.36	1.68	--	.72	3.36	1.68	--
Additional storage space after removal of dockage 12/	.16	.68	.34	--	.16	.67	.34	--
Total estimated return	8.24	9.85	7.83	5.81	11.93	14.29	12.28	10.26
Estimated return above cost	2.98	2.42	1.21	.19	6.67	6.86	5.66	4.64

1/ Computed from available data. Costs and returns from grain handling not included. Flaxseed valued at $3 per bushel and wheat at $2 per bushel. These shrinkage costs do not include the 1.01 percent loss on wheat and 1.10 percent loss on flaxseed which occurs during handling.

2/ Shrinkage during storage estimated at 0.49 percent on wheat and 0.43 percent on flaxseed.

3/ Prorated according to the proportion of wood crib, steel, and concrete storage units and according to length of storage period.

4/ Based on $800 annual operating expense including depreciation of cleaning equipment.

5/ Based on 549,000 bushels of merchandised grain and 91,000 bushels of stored grain at an annual operating expense of $18,000. One-fourth of the operating expense is charged to stored grain and three-fourths to merchandised grain (to compensate for rapid turnover of merchandised grain). Sixty percent of the total operating expense is charged to the grain operation and forty percent to sideline enterprises.

6/ Based on $200,000 fixed building cost with a 20-year depreciation period and $40,000 fixed equipment cost with a 10-year depreciation schedule and certain other fixed costs such as interest and taxes. The allocation to the fixed cost is made on the same basis as the operating cost except that 30 percent of the cost instead of 25 percent is charged to stored grain.

7/ Storage revenue from farmers based upon 1 cent per month per net bushel excluding initial free storage period and 1.5 cents per month per CCC storage on gross bushels.

8/ An average bushel by volume of flaxseed weighs 50 pounds instead of 56 pounds and therefore returns only 89.2 percent of a rated bin capacity.

9/ Dockage in stored flaxseed reduces the total revenue-producing capacity.

10/ On CCC stored flaxseed, the revenue is based on gross bushels.

11/ Valued at 0.6 cent per pound.

12/ Storage returns are decreased as the percent of dockage increases.

from the evaporation of moisture which may continue during the entire storage period, but generally at a very slow rate. Shrinkage losses often will be high if flaxseed received contains more than 10 percent moisture. Conversely, if the seed contains less than 7 or 8 percent moisture, the absorption of moisture from humid air may result in an increase in total weight between the time of purchase and sale.

The amount of conditioning required during storage is also an important consideration relating to shrinkage. High-moisture grain requires turning more often than relatively dry grain, so that greater shrinkage losses occur by natural evaporation of moisture and by failure to return all the grain to bins after conditioning. Often flaxseed is run through a cleaner at the time of turning, which increases losses due to shrinkage as many small or broken kernels are often lost along with the screenings. When flaxseed containing high amounts of dockage is not cleaned, it generally must be turned more often because of the moisture in green weed seeds. It is assumed in the illustration (table 3) that the shrinkage from increased conditioning of uncleaned flaxseed will equal the shrinkage occurring during the cleaning operation.

It should be noted that shrinkage losses vary sharply between elevators, but when such losses are high for flaxseed, they are also high for wheat and other small grains. The variations between elevators generally result from the extent to which elevating equipment is maintained. Some shrinkage occurs every time grain is moved from one location to another, and in elevators where equipment is defective or out of adjustment or where bins are in need of repair, shrinkage losses are substantially higher. The operator who maintains proper adjustment of his equipment usually can attain greater efficiency and reduce costs.

Quality losses due to shrinkage in storage are perhaps as important in wheat as in flaxseed. Flaxseed is seldom placed in a storage unit where it cannot be turned to reduce or prevent mold or heat damage resulting from high moisture. In many elevators, nearly all of the flaxseed is stored in the main warehouse where the cleaning and best conditioning facilities are housed and where the seed can be watched more closely. Damage by insects and rodents is less likely to affect the quality and sales value of flaxseed than of other grains such as wheat. Fumigants and insecticides are more often required to maintain the edible quality of wheat than of flaxseed, which is processed into linseed oil and meal.

Although quality losses result from storing high-moisture flaxseed, due to increased fatty acids and decreased iodine number, it has been found that changes in oil are generally insignificant when the flaxseed is dry (5). Flaxseed having iodine numbers ranging from about 169 to 200, lost only 1.3 points, on the average, when stored for 1 to 6 years between 1936 and 1943. In samples where the iodine number decreased the most, the percentage of cracked seeds and injured seed coats was much higher than in those samples which showed no apparent change in iodine number.

Insurance

Many of the risks incurred in storing and marketing flaxseed are covered by insurance of various kinds. Such risks are principally those in which the losses can be predicted with at least a moderate degree of accuracy, so that appropriate premiums can be determined. Protection against losses from fire, internal explosion, and wind storm is available to grain storage elevators. Many of the North Central States have recognized the importance of insurance coverage and require warehouses to carry adequate insurance against these and other risks. Sometimes "adequate" protection may mean only partial coverage, but often it means enough coverage to permit payment in full for the loss, less accrued charges (8). All 3 States require some insurance to protect grain producers against losses from the hazards common to grain elevators and such coverage is usually checked as part of the regular warehouse examination.

Because flaxseed is more valuable than other grains per bushel, the insurance costs on it are proportionally higher. The cost of insurance is 50 percent greater for flaxseed valued at $3 per bushel than for wheat valued at $2 per bushel. As the cost of the insurance on the grain is based on the type of building material used in the elevator's construction as well as the value of the grain, insurance costs vary considerably among elevators. Comparative costs of insurance for flaxseed and wheat stored at elevators according to the type of construction are shown in table 4.

Table 4.--Annual average cost of grain insurance on 1,000 bushels of stored flaxseed and wheat by type of elevator construction and kind of insurance, 3 North Central States

Grain	Price per bushel	Type of elevator construction				
		Wood crib	Concrete silo		Steel silo	
		Flat	Flat	Co-insurance	Flat	Co-insurance
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Flaxseed	3.00	24.00	13.50	3.90	14.40	9.90
Wheat	2.00	16.00	9.00	2.60	9.60	6.60

Rates for co-insurance, whereby both the building and grain are substantially covered, are lowest for concrete structures. Steel units are more costly to insure than concrete, but less than wood structures, which have the highest rate regardless of the kind of grain stored. Although the "flat" (gross) insurance rates for both concrete and steel elevators are lower than the rate for wood, the major advantage is that co-insurance rates are available for the former types of construction but not for the latter. An 80-percent insurance rate requires an elevator operator to carry insurance equal to 80 percent (or more) of the value of both the building and the grain in order to

collect in full on partial losses. Table 5 illustrates approximate insurance rates for the three types of elevator structures.

Table 5.--Average annual insurance rates on Midwest country elevator buildings and stored grain per $100 of insurance, 3 North Central States

Kind of rate	Wood crib		Concrete silo		Steel silo	
	Building	Grain	Building	Grain	Building	Grain
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Flat	0.95	0.80	0.45	0.45	0.50	0.48
80 percent co-insurance	--	--	.15	.13	.35	.33

Insurance rates vary between individual elevators depending upon the presence of cleaning equipment, conveyor legs, adjoining gas or oil storage, and other fire hazards. Rates are substantially lower for units not having elevating equipment and which are used solely for storage. Rates for co-insurance whereby both the building and grain are substantially covered are the lowest on concrete structures.

Insurance rates also vary according to the type of equipment used in the elevator. Installation of cleaning equipment increases the rates on both the building and equipment. If the cleaning machine is of wood construction, the additional rate is 6 cents per $100 on the plant, equipment, and grain inventory, but only 3 cents if the cleaner is constructed of steel. Thus, an elevator with predominantly wooden equipment has higher insurance rates than one with steel equipment, and both have higher rates than a storage unit without any equipment.

Cleaning Costs and Returns

Although cleaning flaxseed is a relatively expensive and time-consuming operation, the returns were found to justify the costs. Revenue derived from the sale of the screening alone will, at most elevators, normally cover the cost of the operation. When older elevators were built, space was seldom set aside for the installation of cleaning equipment, or the space that was provided was often not sufficient. However, any elevator handling 10,000 bushels or more of flaxseed generally could justify reasonable remodeling expenses to provide cleaning machinery that should reduce grain storage and merchandising costs for all grains, particularly flaxseed. The costs per bushel for cleaning and the returns from sale of screenings shown in table 3 are discussed in detail in "Flaxseed Marketing Practices and Costs at Country Elevators" (4).

Other Costs

To permit a correct evaluation of grain storage cost, certain other costs of the elevator should be allocated to stored grain. The proportion of these costs allocated to storage depends upon: (1) The importance of an elevator's sideline activity, (2) the total volume of grain handled in relation to total elevator capacity, and (3) the proportion of the total volume of grain handled that goes into storage. The total fixed costs, including such items as depreciation on plant and equipment, are present whether the elevator is in operation or not. However, as the volume of grain handled increases, the fixed cost per bushel decreases accordingly. Operating costs, on the other hand, generally rise with volume so that increases in volume will not reduce proportionally the cost per bushel, although they will decline somewhat.

The figures in table 3 are based on an annual turnover ratio of about $5\frac{1}{2}$ bushels of grain handled per bushel of elevator capacity. This ratio often varies among elevators from a low of $2\frac{1}{2}$ to 1 to a high of 12 to 1. The cost of storing flaxseed containing 10 percent dockage for a period of 8 months is estimated to be about 6.6 cents per bushel. This cost charged against the storage operation includes "other costs" comprised of about 1.7 cents of the other operating expenses and 1.5 cents of the fixed expenses per bushel of flaxseed stored. The cost of handling and marketing flaxseed containing 10 percent dockage is estimated to be about 10.7 cents per bushel and is treated in the companion report previously mentioned (4).

Test Weight and Dockage

Since flaxseed seldom "weighs out," it takes more than a bushel by volume to make a bushel by weight. For this reason an elevator grain bin will seldom, if ever, hold its rated capacity in bushels of flaxseed. This is an important factor in the utilization of storage space and in the revenue received from storing flaxseed, as the storage rates charged are based upon net bushels by weight rather than volume.

At the average test weight of about 50 pounds per volume bushel, nearly 11 percent of flaxseed storage space is lost because flaxseed fails to weigh the standard 56 pounds per bushel. Table 6 indicates that at an average test weight of 50 pounds per bushel, only 2,232 bushels (by weight) actually would be held in a 2,500-bushel-capacity bin. In such a bin, the difference in storage revenue from flaxseed compared to other grains meeting their standard weight by volume would amount to $2.68 monthly or $32.16 annually at a storage rate of 1 cent per bushel a month.

Moreover, stored flaxseed generally contains varying amounts of dockage. The table also shows that only 2,009 bushels of 10-percent-dockage flaxseed testing 50 pounds per bushel could be stored in the same 2,500-bushel grain bin. Again, the storage revenue lost at a storage rate of 1 cent per month amounts to about $5 monthly or $60 annually for such a bin.

Table 6.--Net bushels of flaxseed of varying test weight and dockage that can be stored in a bin with a capacity of 2,500 bushels

Test weight per bushel	No dockage	5 percent dockage	10 percent dockage	15 percent dockage	20 percent dockage	25 percent dockage
	56-lb. bushels	56-lb. bushels	56-lb. bushels	56-lb. bushels	56-lb. bushels	56-lb. bushels
44 pounds	1,964	1,866	1,768	1,669	1,571	1,473
46 pounds	2,053	1,950	1,848	1,745	1,642	1,540
48 pounds	2,143	2,036	1,929	1,822	1,714	1,607
50 pounds	2,232	2,120	2,009	1,898	1,789	1,674
52 pounds	2,321	2,205	2,089	1,973	1,857	1,741
54 pounds	2,411	2,290	2,170	2,049	1,929	1,808
56 pounds	2,500	2,375	2,250	2,145	2,000	1,875
58 pounds	2,589	2,460	2,331	2,201	2,073	1,942

In this illustration about one-fifth of the average bin storage space and storage revenue is lost in the storing of flaxseed because of high dockage and low test weight. This storage loss is often increased by operators who do not clean flaxseed immediately after receiving it during the busy harvesting season. Therefore, the amount of dockage stored with flaxseed during the critical fall storage months may range close to 16 percent, which was the average amount of dockage in flaxseed as received at elevators from producers during the 1955-56 marketing season. A more precise appraisal of elevators failing to clean stored flaxseed is that only about 75 percent of bin space allocated to flaxseed is utilized by net weight flaxseed itself, while 14 percent of the bin space is lost due to dockage and 11 percent due to low test weight. At a storage rate of 1 cent per month in a 2,500-bushel bin, elevator operators receive only $18.75 rather than $25.00 monthly, or $225 rather than $300 annually in return for the rental of their storage facilities.

An easy guide for determining the actual number of bushels of clean flaxseed that can be stored in a bin of any given size is shown below:

Test weight per bushel	Dockage					
	None	5%	10%	15%	20%	25%
	Percent	Percent	Percent	Percent	Percent	Percent
44 pounds	79	75	71	67	63	59
46 pounds	82	78	74	70	66	62
48 pounds	86	82	77	73	69	64
50 pounds	89	85	80	76	72	67
52 pounds	93	88	84	79	74	70
54 pounds	96	92	87	82	77	72
56 pounds	100	95	90	86	80	75
58 pounds	104	98	93	88	83	78

Multiply the percentage indicated for the test weight and amount of dockage by the gross bushels of flaxseed stored or by the rated capacity of a bin filled with flaxseed.

Table 7 indicates the rental revenue lost by elevators when storing gross flaxseed, or the additional returns that could be obtained through increasing the number of bushels stored after the removal of dockage. For example, during a 5-month period of storage, rental revenues can be increased by one-half cent per bushel by cleaning flaxseed containing 20 percent dockage down to 10 percent. Conversely, storage income that could have been realized by accepting new flaxseed to replace the dockage, is lost at a rate of one-half cent per bushel. By cleaning a 2,500-bushel bin of flaxseed containing 20 percent dockage down to 10 percent, revenue from the additional flaxseed stored would amount to $12.50 for a 5-month storage period or $25 for 10 months. An individual operator may determine the revenue he is losing on dockage by multiplying the additional cost per bushel, as indicated in table 7, according to the percent of dockage and length of storage, by the gross bushels stored or the rated bin capacity.

Table 7.--Additional cost per bushel for storing flaxseed with various percentages of dockage 1/

Length of storage	Dockage in flaxseed stored						
	0	5%	10%	15%	20%	25%	30%
	Cents	Cents	Cents	Cents	Cents	Cents	Cents
1 month	0	0.05	0.10	0.15	0.20	0.25	0.30
2 months	0	.10	.20	.30	.40	.50	.60
3 months	0	.15	.30	.45	.60	.75	.90
4 months	0	.20	.40	.60	.80	1.00	1.20
5 months	0	.25	.50	.75	1.00	1.25	1.50
6 months	0	.30	.60	.90	1.20	1.50	1.80
7 months	0	.35	.70	1.05	1.40	1.75	2.10
8 months	0	.40	.80	1.20	1.60	2.00	2.40
9 months	0	.45	.90	1.35	1.80	2.25	2.70
10 months	0	.50	1.00	1.50	2.00	2.50	3.00
11 months	0	.55	1.10	1.65	2.20	2.75	3.30
12 months	0	.60	1.20	1.80	2.40	3.00	3.60

1/ Based upon 1 cent per bushel per month.

Loss of elevator storage revenue resulting from the storage of dockage would be less important if the elevator: (1) Had sufficient capacity available to accept all grains offered for storage, (2) received such small quantities of flaxseed that a bin allocated to it would never be completely filled, or (3) used other bins for lengthy storage of flaxseed screenings.

Elevators storing flaxseed for the Commodity Credit Corporation receive payment on a gross-bushel basis even though the elevator may clean it and remove part of the dockage. This is not true for other grains such as wheat, for example, where the rental income from CCC storage is received on a net-bushel basis. The charges for gross flaxseed storage will generally more than offset losses resulting from the failure of the seed to weigh up to the standard 56 pounds per bushel. It is, therefore, to the financial advantage of country elevators to clean flaxseed to be stored, including that stored for the Commodity Credit Corporation. Cleaning costs are justified considering anticipated returns from the following: (1) The increase in available flaxseed storage capacity and storage revenue, (2) the sale of flaxseed screenings, (3) CCC storage when the returns are on gross bushels stored although much of the dockage has been removed, (4) reduced risk of heating in storage resulting from green weed seeds, and (5) lower transportation costs to terminal markets.

Grain Storage Rates

State laws in Minnesota, North Dakota, and South Dakota prescribe the maximum storage rates that elevators are permitted to levy; although the elevator need not use this maximum, nearly every elevator manager does. During the study, the rates were 1/25 cent per day per bushel in Minnesota and South Dakota, and 1/30 cent per day per bushel in North Dakota. Under the storage rate structures, charges do not begin immediately as elevators are required to allow free storage for 15 days in North Dakota, 10 days in Minnesota, and 2 days in South Dakota. With the exception of oats, country elevators received 1/20 cent per bushel a day on grains stored for the Commodity Credit Corporation. (In the 1958-59 season, the rate varies for different grains and is 49/1000 of a cent per bushel per day for flaxseed.)

Of the 201 elevator managers responding to a question on flaxseed storage rates, 44 percent were satisfied with the respective storage rates existing during 1956 while 56 percent felt the rates were inadequate. Those managers satisfied with the rates generally felt that they were receiving sufficient returns for the rented space. Some managers indicated that the rates charged farmers were satisfactory, but desired higher rates for grain stored for the CCC. A few were satisfied with the present returns except on flaxseed containing a high moisture or dockage content.

The elevator managers desiring higher storage charges criticized the present rates for not having risen in relation to the rising operating costs. Generally, these rates have remained nearly the same for a number of years. Some managers were of the opinion that since the expense of handling and storing varies for different grains, the storage rates should follow in line with costs for the individual grain. The cost of storing flaxseed is higher than that of other grains because of the greater insurance costs, value of shrinkage losses, use of cleaning facilities, bin requirements, and risk due to moisture accumulation during storage.

Some of the dissatisfied managers felt that the free storage period is an unnecessary service and that charges should begin immediately upon the receipt of the grain at the elevator. Other managers objected to the existing differences in storage rates among the 3 States. Many North Dakota managers favored an increase which would equalize their storage rates with those of South Dakota and Minnesota. It was noted, however, that producers along the western Minnesota border would not seek out storage space at nearby North Dakota elevators in order to obtain the slightly lower storage rate.

Those elevator managers dissatisfied with storage rates indicated that they would favor an increase of 10 to 60 percent above the 1956 level. Thus, in North Dakota, these managers desired annual per bushel charges of 12 to 18 cents rather than the $11\frac{1}{2}$ cents per bushel they received. In Minnesota and South Dakota, managers desired annual rates of 15 to 21 cents per bushel compared to the $13\frac{1}{2}$ cents they received. Sixty operators favoring increased rates desired an increase of 0.4 cent per bushel a month, or about 5 cents per bushel more a year. When the desired higher rate is averaged with the rate actually received by satisfied operators the annual rate would be 2.7 cents per bushel higher.

Storage rates are presently established on a net-bushel basis, although the flaxseed received from farmers is marketed as gross bushels containing varying amounts of dockage. As a result, elevators often store gross bushels of flaxseed for farmers and receive a storage rental on a net-bushel basis. Only for flaxseed stored for the Commodity Credit Corporation does the elevator receive payment on a gross-bushel basis. Additional returns can be made, of course, by cleaning the flaxseed before storing it. Because of the higher cost of storing uncleaned flaxseed, some managers prefer to store grains other than flaxseed.

LIMITATIONS ON FLAXSEED STORAGE AT COUNTRY ELEVATORS

Elevators Limiting Storage and Purchase Receipts

An important outgrowth of increased flaxseed production and modern harvesting techniques is the demand for more storage space in country elevators than is available during the harvesting season. Although a large proportion of the annual flaxseed crop is sold at harvest time, a growing number of producers prefer to hold flaxseed in farm and commercial storage in anticipation of a more favorable market price at a later date. During years of surplus flaxseed production, suitable flaxseed storage space is an absolute necessity if the most favorable market price is to be obtained by delivery under loan or purchase agreement to the Commodity Credit Corporation.

Facilities for temporary farm storage vary from farm to farm. Many farmers do not have adequate bin space suitable for flaxseed storage, and find it more economical to use elevators than to build adequate structures for farm storage. Others find it unprofitable to use a large grain bin for a small amount of flaxseed, especially when the space is needed for competing cash or feed grains.

The flaxseed producer generally does not have cleaning and turning facilities that are normally available at an elevator. Farm-stored flaxseed, therefore, usually contains a high proportion of dockage. Although a large amount of flaxseed is stored on farms, the high dockage content and the tendency of the slippery flaxseed to cake and spoil along the moist walls of farm bins make elevator storage more desirable for flaxseed than for other small grains which can be more easily stored in good condition on the farm.

As a result of the increasing demand for storage capacity at country elevators, half of the 265 operators in the 3-State area who were questioned replied that they lacked sufficient space to accept all of the 1955-crop flaxseed offered during the harvesting season. In North Dakota, where well over half of the nation's flaxseed is now produced annually, three-fifths of the elevators surveyed limited their flaxseed storage receipts. About a third of the elevators in Minnesota and South Dakota limited receipts. 4/

During the same period that half of the elevators were limiting flaxseed storage receipts, less than a quarter found it necessary to limit the amount of flaxseed accepted for purchase from growers (fig. 3). Twenty-six percent of the North Dakota elevators lacked sufficient space to buy all the flaxseed that was offered; in Minnesota and South Dakota 17 percent did not have enough space.

The available storage capacity for flaxseed at country elevators and the demand for that capacity are continually changing and are influenced by many factors. Available flaxseed space varies during the marketing season, and between years, areas, and elevators. At many elevators, flaxseed is a commodity preferred for storage, and all that is offered in good condition is accepted. A large number of elevators receive all flaxseed offered for storage except perhaps for several months during the harvesting season. Some elevators, however, are unable or prefer not to accept any flaxseed for storage during the entire marketing year. Variations in elevator size and in the volume of flaxseed handled affect the manager's allocation of bin space for this commodity. The time and size of the flaxseed harvest and that of grains competing for storage, together with market and price conditions at harvest time, are also important factors affecting available storage space.

Before the end of World War II, most of the annual flaxseed crop was sold at harvest time. However, in recent years, storage as a phase of flaxseed marketing has become increasingly important both at the country elevator and on the farms where produced. Over half of the annual flaxseed production is now being withheld from the market for a time following harvest by growers who store it at elevators or on farms.

4/ Most of the survey sample was randomly selected from elevators having 1,000 bushels or more flaxseed for which warehouse storage receipts had been issued during October 1955. Therefore, the majority of elevators sampled were known to accept flaxseed for storage. Had the sample been taken from all elevators handling flaxseed during the 1955 season, the number limiting flaxseed storage receipts might have been much greater.

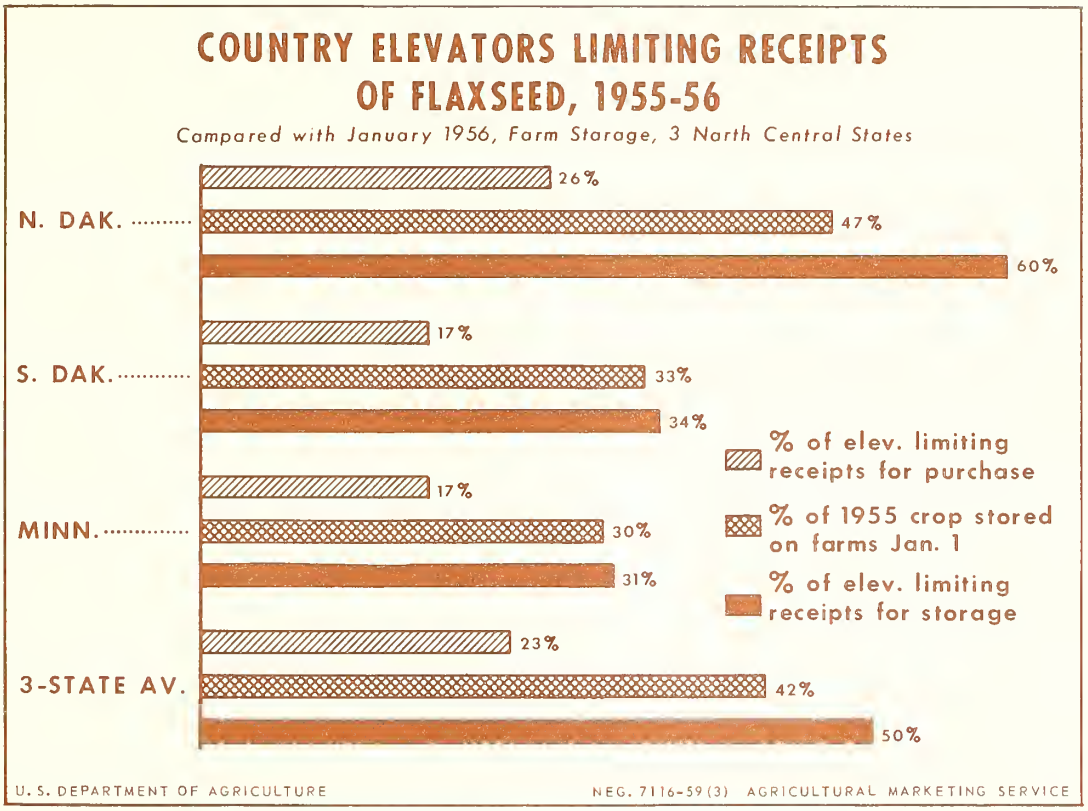

Figure 3

The degree to which farm storage is used by producers depends largely upon whether country elevators can accept flaxseed for storage. Figure 3 shows that the percentage of the 1955 flaxseed crop remaining in farm storage on January 1, 1956, closely corresponds with the percentage of elevators lacking sufficient flaxseed storage space during the harvesting season. All country elevators restricting flaxseed storage receipts during the 1955-56 marketing year also had such restrictions during the harvesting season.

Although an increasing proportion of elevator capacity is being allocated to flaxseed storage in North Dakota, the demand for such space still greatly exceeds the supply. North Dakota farmers converting from surplus wheat acreage have increased their flaxseed production in recent years. This has led to an increased pressure on the available storage since the proportion of producers interested in elevator storage for flaxseed is greater than for wheat. Elevators suitable for storage of other small grains often were not satisfactory for flaxseed, and many of the bins required repairs to accommodate the liquid-like grain.

Extreme climatic changes from north to south in Minnesota have contributed to the corresponding variation in the number of elevators limiting flaxseed receipts for storage. Producers harvesting flaxseed before the all-grain harvest

in the southern portions of the State have very little difficulty in obtaining elevator storage space compared with the northern producers having a later flaxseed harvest. Table 8 shows the percentage of elevators limiting storage and purchase receipts by States, areas, and types of organization.

Length of Storage Limitations

Elevators that limited flaxseed storage receipts found it necessary to turn away storage offerings for an average period of $2\frac{1}{2}$ months in the 3-State area. During that period, many of these elevators were able to accept limited amounts of flaxseed intermittently, as outshipments to terminal markets were made. However, the newly created space was filled quickly and receipts again were limited until additional transportation became available. This often-repeated process continued until the demand for grain storage space diminished after the harvesting season. The period that receipts were limited varied among elevators, ranging from only a few days at some to the entire marketing year at others.

At elevators restricting storage receipts in the 3-State area the average length of storage limitation was $2\frac{1}{2}$ months for North Dakota, 3 months for Minnesota, and 1 month and 20 days for South Dakota. The average limitation at elevators in the northern area of Minnesota was 5 months, while that for elevators in central and southern Minnesota was more comparable to the shorter period of storage limitation for South Dakota. Line elevators tended to restrict flaxseed storage receipts longer than did the independent elevators, and this group, in turn, had longer restrictions than the 15-plus group. This difference, however, may be partly due to variations in average elevator size between these organizational groups.

Both size of the elevator and the volume of flaxseed handled are inversely related to the length of storage limitations. Country elevators handling smaller volumes of flaxseed definitely have a longer period during which they are unable to accept all flaxseed offered for storage than do elevators handling larger amounts. Elevators handling a substantial volume of flaxseed can more readily supply sufficient flaxseed to fill a boxcar for delivery to terminal markets than elevators handling a small amount of flaxseed after the peak harvest has passed. Also, as purchased and commercially stored flaxseed is commonly commingled, larger elevators can more easily keep enough flaxseed on hand to meet outstanding warehouse tickets when outshipments to terminal elevators or processors are made.

As shown in table 9, elevator size is also related to the length of storage limitations. Small country elevators tend to become completely filled during the harvesting season and to remain so until sufficient boxcars are obtained to grant them relief. Large elevators are more versatile, having more adequate loading and unloading facilities besides having more space.

Table 8.--Country elevators accepting limited quantities of flaxseed for storage and for purchase, by type of elevator organization and by areas in Minnesota, North Dakota, and South Dakota, 1955-56

State and area	Independent elevators			Line elevators			"15+" elevators			All elevators		
	Limiting flaxseed	Limiting flaxseed for--		Limiting flaxseed	Limiting flaxseed for--		Limiting flaxseed	Limiting flaxseed for--		Limiting flaxseed	Limiting flaxseed for--	
		Storage	Purchase 1/		Storage	Purchase 1/		Storage	Purchase 1/		Storage	Purchase 1/
	Number	Percent	Percent	Number	Percent	Percent	Number	Percent	Percent	Number	Percent	Percent
North Dakota:												
Area I	45	62	39	21	38	19	14	57	14	80	55	29
Area II	33	55	19	18	72	22	10	40	10	61	57	18
Area III	21	62	35	12	92	25	2	100	50	35	74	32
Total	99	60	31	51	63	22	26	54	15	176	60	26
Minnesota:												
Area I	10	40	10	5	60	0	3	67	67	18	50	17
Area II	16	19	13	5	60	75	4	50	50	25	32	29
Area III	14	7	0	2	0	0	--	--	--	16	6	0
Total	40	20	8	12	50	27	7	57	57	59	31	17
South Dakota:	15	40	20	10	40	20	4	0	0	29	34	17
3-State total	154	47	24	73	58	22	37	49	22	264	50	23

1/ Percentages of elevators having limitations on purchases are based on 260 replies instead of 264. The difference is not significant.

Table 9.--Length of time that elevators limit quantity of flaxseed accepted for storage, by quantity handled and elevator capacity, 3-State area

Item	Period of limited acceptance
	Months
Flaxseed handled:	
1,000 - 9,999 bushels	3.7
10,000 - 24,999 bushels	3.2
25,000 - 49,999 bushels	2.8
50,000 - 74,999 bushels	2.5
75,000 bushels and over	2.0
Elevator capacity:	
0 - 39,999 bushels	4.9
40,000 - 79,999 bushels	4.5
80,000 - 119,999 bushels	3.1
120,000 - 159,999 bushels	2.8
160,000 bushels and over	1.7

Seasonal Harvest Period

The most important cause of the shortage of storage space in country elevators is the flood of all grains moving to market during the harvest season. The turnover of grain is at its highest point at this time, and immediate profits from cash sales often are more desirable than delayed returns from stored grains. Although storage space is available during the harvest season, the demand for that space, plus the supply of cash grains, makes it impossible for many elevators to satisfy all producer requests.

In the 3-State area during the 1955-56 marketing year, the number of elevators limiting receipts of flaxseed for storage reached a peak during September and fell to a low during April, May, and June, at the end of the marketing year (table 10). Figure 4 shows that while the majority of limitations on flaxseed storage occur during the harvesting period, August through November, some elevators remain in this condition throughout the entire marketing season. Of the 132 elevators indicating storage limitations, 86 percent limited in September, 64 in August and October, and 17 percent during the last few months of the marketing season.

Time of Flaxseed Harvest

The time at which flaxseed is harvested in relation to other crops competing for storage space affects the producer's opportunity of obtaining elevator storage. In areas where the flaxseed harvest precedes the average harvest date

Table 10.--Percentage of elevators limiting flaxseed storage, by organization types and areas in 3 States, by months, 1955-56

Type and location of elevators	Elevators in survey	July	August	September	October	November	December	January	February	March	April	May	June
	Number	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Organization type and State													
Independent elevators:													
North Dakota	99	4	31	48	36	17	13	8	7	6	4	4	4
Minnesota	40	3	20	18	15	5	5	5	5	5	5	5	5
South Dakota	15	7	40	27	7	7	7	0	0	0	0	0	0
Total	154	4	29	38	28	14	10	6	6	5	4	4	4
Line elevators:													
North Dakota	51	29	51	63	49	39	33	31	29	27	27	27	27
Minnesota	12	8	25	50	25	25	17	17	17	17	17	17	17
South Dakota	10	0	40	20	10	0	0	0	0	0	0	0	0
Total	73	22	45	55	40	32	26	25	23	22	22	22	22
15+ group:													
North Dakota	26	0	15	46	35	19	15	4	4	0	0	0	0
Minnesota	7	0	29	43	57	14	14	14	14	0	0	0	0
South Dakota	4	0	0	0	0	0	0	0	0	0	0	0	0
Total	37	0	16	41	35	16	14	5	5	0	0	0	0
State and area													
North Dakota:													
Area I	80	7	26	46	33	18	15	11	9	8	7	7	5
Area II	61	11	31	51	39	21	16	13	13	13	11	11	11
Area III	35	20	60	66	57	43	34	23	23	17	17	17	20
Total	176	11	35	52	40	24	19	14	13	11	10	10	10
Minnesota:													
Area I	18	11	22	44	44	28	22	22	22	17	17	17	17
Area II	25	0	32	28	16	0	0	0	0	0	0	0	0
Area III	16	0	6	6	6	6	6	6	6	6	6	6	6
Total	59	3	22	27	22	10	8	8	8	7	7	7	7
South Dakota:													
Area I	29	3	34	21	7	3	3	0	0	0	0	0	0
All elevators	264	8	32	43	32	19	15	11	11	9	8	8	8

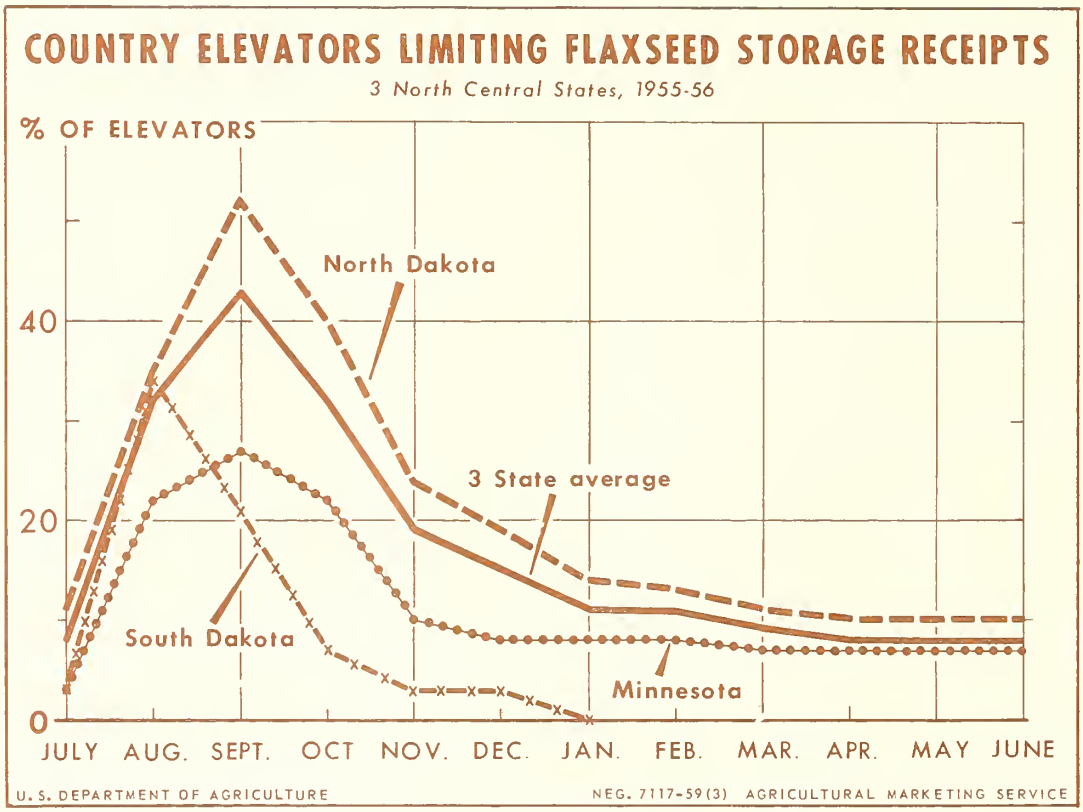

Figure 4

for all grains, fewer elevators limit flaxseed storage receipts than in areas where the peak flaxseed harvest is reached after that of all grains. Although there are extreme variations among States and areas within the Dakotas and Minnesota, the average peak harvest date of flaxseed followed 9 days behind that of all grains during the 1955 harvest.

In most areas of the Dakotas and Minnesota, much flaxseed is harvested late and many elevators are already filled with other small grains before flaxseed is harvested. Many elevator operators plan to market these grains before the flaxseed harvesting peak. Often this practice is successful, and a high turnover ratio of other grains and flaxseed to elevator capacity is achieved. However, the annual boxcar shortage is continually present during this critical period and if the operator is not more fortunate than average in obtaining grain transportation, he is apt to lose his opportunity of satisfying the storage demands of his flaxseed-producing patrons.

It should be noted in table 11 that the percent of elevators limiting flaxseed storage receipts increases as the flaxseed harvest date falls behind the all-grain harvest and the interval between the two middates lengthens. There exists, therefore, an inverse relationship between the proximity of harvest dates when flaxseed follows other grains and the amount of available flaxseed storage space (fig. 5).

Table 11.--Time interval between flaxseed and all-grain harvest related to the percent of elevators limiting flaxseed receipts and to the amount accepted for storage, by areas, 3 North Central States, 1955-56

State and area	Percent of elevators limiting flaxseed storage receipts	Percent of flaxseed accepted	Average peak harvest date		Days that flaxseed harvest peak precedes or follows all-grain harvest peak
			Flaxseed	All grains	
Minnesota II	32	87	Aug. 15	Sept. 2-	-4
Minnesota III	6	91	Aug. 16	Sept. 15	30
South Dakota I	34	79	Aug. 22	Aug. 15	-7
Minnesota I	50	79	Sept. 10	Aug. 31	-10
North Dakota I	55	71	Sept. 15	Aug. 30	-16
North Dakota II	57	67	Sept. 10	Aug. 23	-18
North Dakota III	74	55	Sept. 3	Aug. 15	-19
3-State average	50	73	Sept. 9	Aug. 30	-9

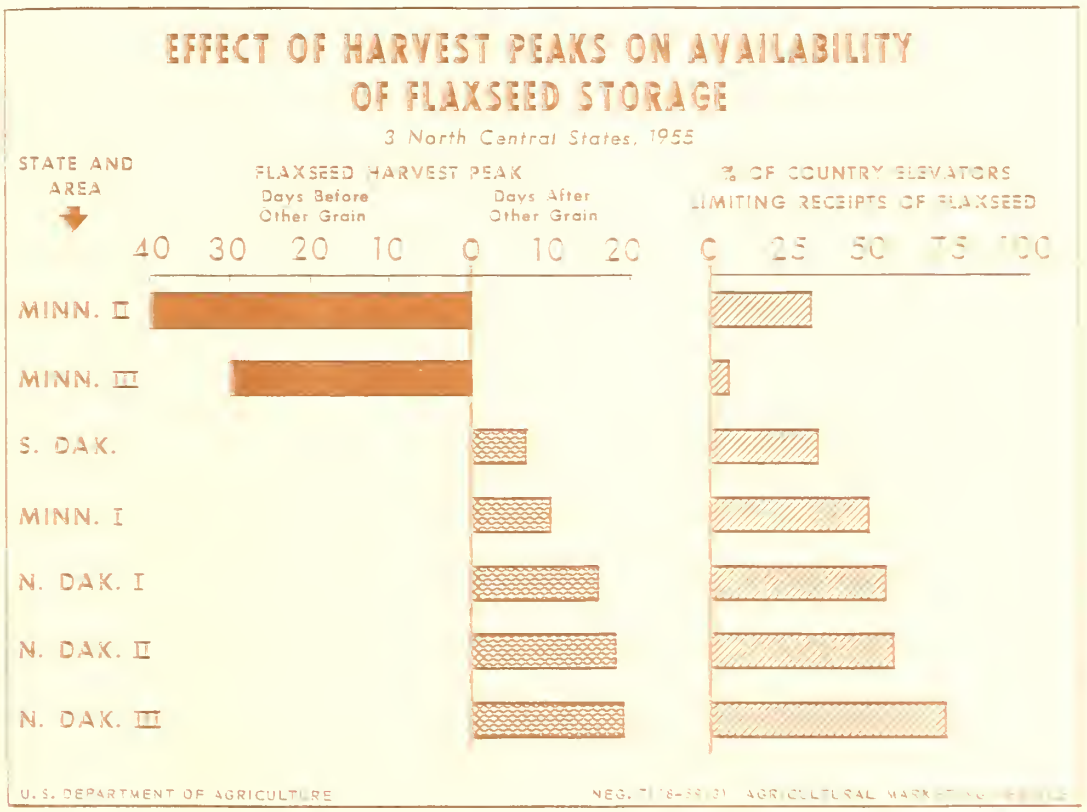

Figure 5

Volume of Flaxseed Handled Related to Total Elevator Capacity

The grain storage capacity of the 265 elevators surveyed totaled approximately 31 million bushels. The amount of flaxseed handled by independent and line company elevators averaged 40,500 bushels while the 15-plus group elevators handled an average of 95,000 bushels of flaxseed during the 1955-56 marketing year. The total volume of flaxseed handled by elevators surveyed accounted for one-third of the total 3-State production or 31 percent of the flaxseed produced in the United States in 1955.

As the volume of flaxseed handled increases in relation to the total elevator capacity, more elevators find it necessary to limit flaxseed receipts for storage during the marketing season. Only about one-third of the elevators having a low ratio of flaxseed handled to elevator capacity limited flaxseed storage receipts, whereas about two-thirds of the elevators having a high ratio limited receipts (table 12).

Size of Elevator

The space required for cash grain in smaller country elevators often encroaches upon the available storage capacity. Such elevators are more apt to accept for storage only the more important grains produced in their local area, and are often either unable to accept any flaxseed or accept only limited amounts of it. Table 13 shows the percent of elevators of various capacities that limited flaxseed receipts for storage and purchase due to lack of space.

Price

Producer demand for flaxseed storage is directly related to the price position of flaxseed at harvest time. If the harvesting season price of flaxseed is above the Commodity Credit Corporation's support price, there is a notable decrease in the demand by producers for flaxseed storage space. Conversely, if the fall flaxseed price drops below established support prices, the storage requirements of flaxseed producers increase. In general, flaxseed producers will be less inclined to risk the shrinkage and quality losses of farm storage or costs of elevator storage when prices are above the support level.

Of importance also to the amount of elevator storage space available for flaxseed is the harvest market price in relation to the support price of grains competing with flaxseed for storage. If the market price of such grains reaching elevators before the flaxseed harvest falls below established support levels, increased amounts of these grains will be stored and the amount of space available for flaxseed storage is reduced.

As shown in figure 6, the average market price of flaxseed generally reaches its lowest point in May or June and then begins to rise slowly reaching

Table 12.--Elevators limiting flaxseed receipts for storage and purchase, by ratio of flaxseed handled to total elevator capacity and by States and type of elevator organization, 1955-56

Range in ratio of bushels of flaxseed handled per 1 bushel of capacity	States			Type of organization			All elevators
	North Dakota	Minnesota	South Dakota	Independent	Line	15+	
	Elevators	Elevators	Elevators	Elevators	Elevators	Elevators	Elevators
Elevators in survey:							
0 - 0.19 bushel	32	19	5	38	17	1	56
0.20 - 0.39 bushel	53	15	3	37	20	14	71
0.40 - 0.59 bushel	39	11	8	34	17	7	58
0.60 - 0.79 bushel	21	5	5	20	6	5	31
0.80 bushel and over	27	9	7	23	11	9	43
Percent of elevators limiting storage receipts:	Percent	Percent	Percent	Percent	Percent	Percent	Percent
0 - 0.19 bushel	41	10	80	29	47	0	34
0.20 - 0.39 bushel	49	33	0	43	45	43	44
0.40 - 0.59 bushel	64	73	0	56	65	43	57
0.60 - 0.79 bushel	81	20	60	70	83	40	68
0.80 bushel and over	85	22	43	56	73	77	65
Percent of elevators limiting purchase receipts:							
0 - 0.19 bushel	16	0	20	11	12	0	11
0.20 - 0.39 bushel	14	28	0	18	15	15	17
0.40 - 0.59 bushel	18	50	0	15	25	38	21
0.60 - 0.79 bushel	60	0	25	58	50	20	50
0.80 bushel and over	46	10	12	39	27	20	32

Table 13.--Elevators limiting flaxseed receipts for storage and purchase, by elevator size and by States and type of elevator organization, 1955-56

Elevator capacity	States			Type of organization			All elevators
	North Dakota	Minnesota	South Dakota	Independent	Line	15+	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Elevators limiting storage receipts:							
Under 40,000 bushels	75	44	33	38	75	--	52
40,000 - 79,999 bushels	68	33	36	68	51	67	60
80,000 - 119,999 bushels	58	39	38	51	61	43	52
120,000 - 159,999 bushels	59	0	33	41	67	60	47
160,000 bushels and over	41	24	25	21	61	45	34
Elevators limiting purchase receipts:							
Under 40,000 bushels	50	33	33	31	57	--	40
40,000 - 79,999 bushels	31	0	18	30	18	67	25
80,000 - 119,999 bushels	30	17	11	27	28	0	25
120,000 - 159,999 bushels	18	0	0	18	0	0	13
160,000 bushels and over	16	24	25	14	0	27	19

a peak in December or January. Both the anticipated supply and the actual arrival of a new crop force flaxseed prices down during this marketing period, and the corresponding demands upon storage space increase. During most of the marketing season, there is an inverse relationship between the market price of flaxseed and the degree of storage limitations at country elevators. If farmers stored a still larger proportion of the flaxseed crop and distributed the sale of their flaxseed throughout the marketing year, there should be less variation in the price, and probably a more stable market would prevail during the entire season.

Generally flaxseed price increases from September to January exceed the cost of flaxseed storage during that period. In 8 of the 10 years from 1947 to 1956, the average price paid to farmers rose an average of 34 cents per bushel from September to January. However, in the remaining 2 years of the 10 years, the price was 7 cents per bushel less in January than in September. Allowing for a 4-cent storage charge, the increased return to farmers would amount to 30 cents per bushel during the 8 years and to an 11-cent loss for the 2 remaining years. During 6 of the 10 years, the price rise would have easily covered the elevator storage costs and returned an additional 41 cents per bushel to growers. In the 4 years when the price declined or the rise was insufficient to cover storage costs, the average loss would have amounted to 7 cents a bushel.

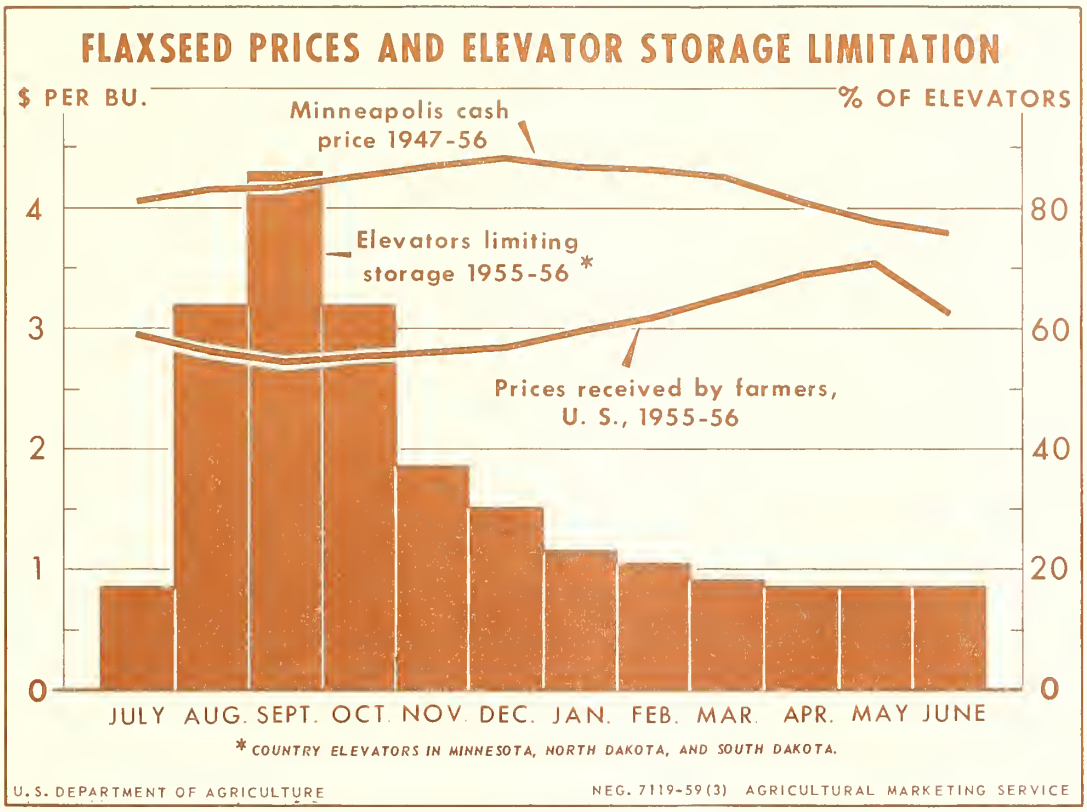

Figure 6

The economic effect of the price change has resulted in an increase in the number of producers desiring storage. An elevator's inability to provide adequate storage results in losses of some storage revenue and perhaps a few of the customers who find available storage accommodations elsewhere. Because prices, more often than not, increase following the receipt of the flaxseed at the elevator during the harvest, the elevator would stand to gain on such price advances in cases in which the risk of price fluctuations had not been covered by deferred delivery sales of the flaxseed. The effect upon the flaxseed producer is, however, more pronounced if he has disposed of his flaxseed due to the lack of available storage space. Analysis of the data for the past decade indicates that it would be to the producer's advantage to obtain storage space as in 6 out of 10 years the probable gain would be great enough to more than compensate for the probable loss during the other 4 years.

TYPES OF ELEVATOR CONSTRUCTION SUITABLE AND USED FOR FLAXSEED STORAGE

Vertical and Horizontal Storage Structures

Commercial grain warehouses are sometimes classified as vertical and horizontal. The most prevalent vertical types found in the Midwest flaxseed belt are the common wood crib elevator, the concrete silo, and the steel silo.

Horizontal structures consist mostly of Quonset-type buildings, steel bins, and wood-frame granaries. There are also some miscellaneous structures such as old railroad boxcars, coal sheds, and a variety of brick and tile buildings that have been repaired and are used for storing flaxseed.

Vertical grain warehouses, designed for efficient grain handling, are the primary buildings of country elevator firms. Their tall, narrow bins with floors slanting towards a grain pit that in turn is connected to a built-in grain conveyor (leg), permit filling and emptying through mechanical means and gravity. These features are essential for efficient and economical operations such as turning, cleaning, and treating flaxseed.

The horizontal types are more often considered to be temporary, emergency warehouses. They are generally economically feasible where the elevator company has access to cheap building sites. They are relatively inexpensive structures and will serve the primary purpose of protecting stored flaxseed from weather, rodents, birds, and insects when properly constructed and maintained. In addition, some of these, such as the Quonset types have such flexibility that they can be used for purposes other than grain storage. The paramount disadvantage of all of the horizontal types is the labor inefficiency and the greater waste associated with them. However, 109 of the 265 elevator companies interviewed used horizontal structures to meet some of their needs for more storage space.

Of the total warehouse capacity surveyed in the Midwest flaxseed belt, 83 percent was considered by the elevator managers to be suitable for flaxseed storage (table 14). The same operators used bins in 61 percent of their warehouses for flaxseed at some time during the 1955-56 marketing year. Eighty-seven percent of the vertical structures and 65 percent of the horizontal structures were considered suitable for storing flaxseed. The vertical units are greatly preferred for actual flaxseed storage, however, as bin space in 68 percent of these units was used for flaxseed while space in only 28 percent of the horizontal units was so used.

Wood Crib Elevators

The most common elevator layout found in the survey was a wood crib elevator serving as the main house with supplemental warehouses of various types. Because of the relatively greater risk involved in storing flaxseed, the wood crib main house was generally preferred over the supplemental warehouses. Here it is easier to "keep an eye" on the condition of the stored seed, and, if necessary, to clean, turn, or fumigate this high-value commodity. Bins are usually smaller in wood crib elevators and are, therefore, more desirable for flaxseed storage than large silos where handling is difficult and moisture is a problem.

Many of the older wood crib warehouses have undergone some interior remodeling to make room for new and more efficient equipment. In addition, over one-fifth of these elevators have been metal clad on the outside to make them more weatherproof. These improvements have enhanced the suitability of these warehouses for flaxseed storage. Elevator operators not restricting the use of

Table 14.--Percentage of total grain elevator capacity, by States and organization types, and percentage suitable and used for flaxseed, 3-State area, 1955-56

Item	States			Type of organization			All elevators
	North Dakota	Minnesota	South Dakota	Independent	Line	15+	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Distribution of elevators' total grain capacity	70	22	8	63	16	21	100
Percent of each State's or type's capacity suitable for flaxseed	83	80	86	82	92	79	83
Percent of each State's or type's capacity used for flaxseed 1/	64	47	74	55	82	62	61

1/ Includes the total capacity of an elevator in which one or more bins were used for flaxseed storage.

small wood crib main houses for flaxseed storage purposes may find that the space needed for receiving, unloading, conditioning, and cleaning is inadequate.

The survey showed that the importance of wood crib elevators in South Dakota was substantially below that for North Dakota and Minnesota, as less than half of the total capacity was in that type of structure (table 15). Most of this difference is largely accounted for by the relatively greater proportion of concrete silo capacity among the single unit elevator companies in that State. The percent of wood crib capacity, including suitable and used, among the line elevator companies was nearly the same in each of the 3 States.

Over 90 percent of line elevators' total grain capacity and capacity suitable for and used for flaxseed was in the form of wood crib elevators (table 16). Among the independent elevators, this type comprised 67 percent of both the total capacity and of that suitable for flaxseed, and 74 percent of the space used for flaxseed. The 15-plus group, having a large proportion of concrete silos and other structural types, had 50 percent of their space in wood cribs, and this type constituted 55 percent of the space suitable for flaxseed and 57 percent of the space used.

Of the total capacity in wood crib elevators (around 16 million bushels), 85 percent of it was considered suitable for flaxseed, and 66 percent of it was used for flaxseed storage (fig. 7). None of the 3 States deviated greatly from these percentages. The independent elevators closely followed this pattern; but line elevator managers, having most of their total capacity in this type of construction, considered 94 percent of their wood crib capacity suitable for flaxseed and they used bins in 84 percent of their wood crib units for flaxseed during 1955-56.

Table 15.--Percentage distribution of total capacity of grain elevators and of capacity suitable for and used for flaxseed, by type of construction, 3 North Central States, 1955-56

Type of construction	3-State totals			North Dakota			Minnesota			South Dakota		
	Total capacity	Suitable for flaxseed	Used for flaxseed	Total capacity	Suitable for flaxseed	Used for flaxseed	Total capacity	Suitable for flaxseed	Used for flaxseed	Total capacity	Suitable for flaxseed	Used for flaxseed
	1,000 bu.	Pct.	Pct.	1,000 bu.	Pct.	Pct.	1,000 bu.	Pct.	Pct.	1,000 bu.	Pct.	Pct.
Wood crib	18,051	68	69	73	13,017	69	71	76	3,993	69	74	86	1,041	49	42	41
Concrete silo	3,464	13	15	17	2,364	13	14	16	373	6	7	4	727	34	40	44
Quonset	1,501	6	5	1/	750	4	3	0	682	12	9	1	70	3	4	0
Steel bins	1,169	4	4	3	831	4	4	3	322	5	4	1/	15	1	1	1
Steel silo	551	2	2	1	395	2	2	1/	141	2	3	4	15	1	1	0
Wood balloon	505	2	1/	1/	302	2	1	1/	169	3	0	0	34	2	0	0
Other	1,459	5	5	5	1,084	6	5	4	150	3	3	5	225	10	12	14
Total percent	---	100	100	100	---	100	100	100	---	100	100	100	---	100	100	100
Total bushels	26,700	1,000 bu. 26,700	1,000 bu. 22,132	1,000 bu. 16,262	18,743	1,000 bu. 18,743	1,000 bu. 15,651	1,000 bu. 11,941	5,830	1,000 bu. 5,830	1,000 bu. 4,662	1,000 bu. 2,738	2,127	1,000 bu. 2,127	1,000 bu. 1,819	1,000 bu. 1,584

1/ Less than one-half of 1 percent.

Table 16.--Percentage distribution of total capacity of grain elevators and of capacity suitable for and used for flaxseed, by type of construction and organization types, 3-State area, 1955-56

Type of construction	All elevators			Independent			Line			15-plus		
	Total capacity	Suitable for flaxseed	Used for flaxseed	Total capacity	Suitable for flaxseed	Used for flaxseed	Total capacity	Suitable for flaxseed	Used for flaxseed	Total capacity	Suitable for flaxseed	Used for flaxseed
	1,000 bu.	Pct.	Pct.	1,000 bu.	Pct.	Pct.	1,000 bu.	Pct.	Pct.	1,000 bu.	Pct.	Pct.
Wood crib	18,051	68	69	73	11,268	67	67	74	3,954	91	92	92	2,829	50	55	57
Concrete silo	3,464	13	15	17	2,345	14	16	18	44	1	1	1	1,075	19	23	29
Quonset	1,501	6	5	1/	1,075	6	6	0	0	0	0	0	427	8	5	1
Steel bins	1,169	4	4	3	638	4	4	3	2,075	5	4	4	323	6	2	1/
Steel silo	551	2	2	1	370	2	2	1	8	1/	1/	0	172	3	4	3
Wood balloon	505	2	1/	1/	437	3	1	1/	44	1	0	0	24	1/	0	0
Other	1,459	5	5	5	606	4	4	4	100	2	2	3	753	13	11	10
Total percent	---	100	100	100	---	100	100	100	---	100	100	100	---	100	100	100
Total bushels	26,700	1,000 bu. 26,700	1,000 bu. 22,132	1,000 bu. 16,262	16,740	1,000 bu. 16,740	1,000 bu. 13,670	1,000 bu. 9,207	4,357	1,000 bu. 4,357	1,000 bu. 4,019	1,000 bu. 3,590	5,603	1,000 bu. 5,603	1,000 bu. 4,443	1,000 bu. 3,466

1/ Less than one-half of 1 percent.

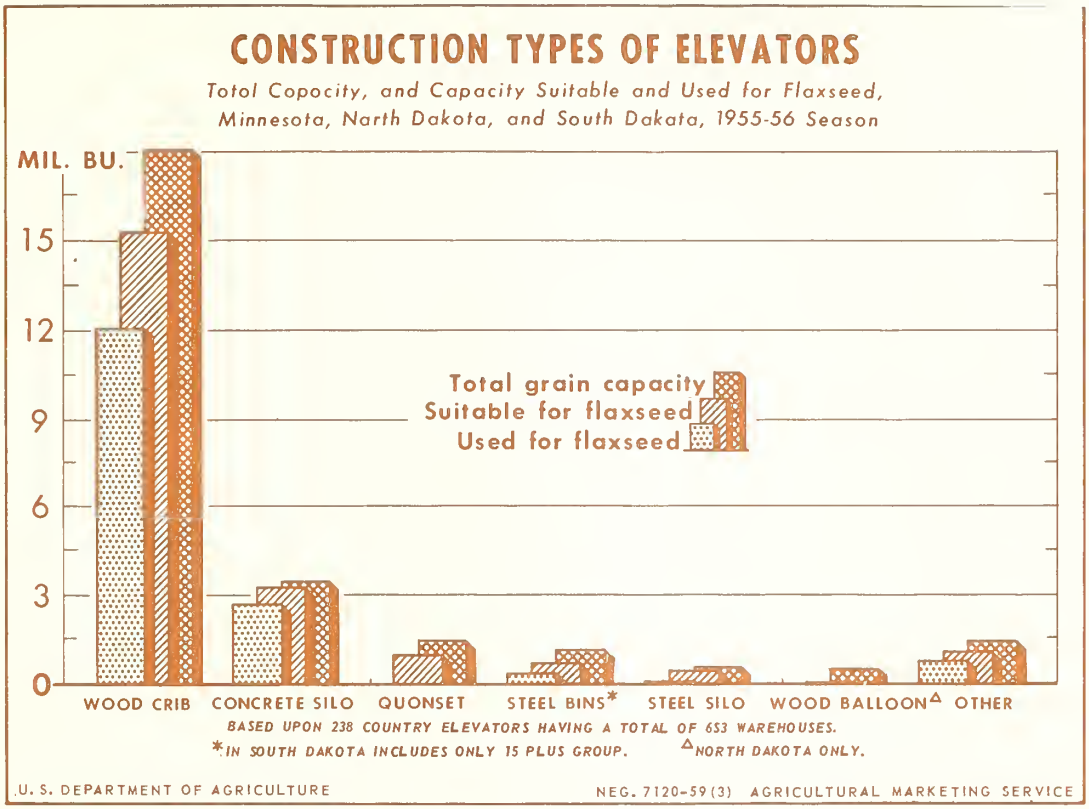

Figure 7

Concrete Silos

Two classifications need to be made with respect to concrete silo warehouses: (1) Those that are merely large cylinders built as additional storage space and connected by grain conveyors to the main house, and (2) those that form an integral part of the main house. The former type of large storage cylinder was usually considered by the elevator managers to be suitable for storing flaxseed, but not all of them were used for this purpose. Some of the reasons given for not using this type of concrete silo for flaxseed were that: (1) They are large and are, therefore, better adapted to the storage of other grain, (2) they were not as handy for turning and cleaning flaxseed as were other structures on the premises, and (3) some managers thought that they might absorb moisture more readily than the wooden warehouses. All of the elevators surveyed that had main houses of concrete used some bins in them for storing flaxseed. Both types of concrete silos have been grouped together in the tables and charts. The concrete silo provided 13 percent of the total capacity, 15 percent of the space suitable for flaxseed, and 17 percent of the capacity used for storing flaxseed. Of the total capacity of concrete silos, 95 percent was considered suitable for flaxseed storage and 79 percent was so used. Thus, the

proportion of total capacity considered suitable and actually used for flaxseed storage was higher for the concrete silo than for any other type of elevator construction.

Very few concrete silos were found among line elevator companies, but this type represented 14 percent of the independent elevator capacity. Concrete silos comprised 19 percent of the total capacities in the 15-plus group, which indicates that this type of structure has accounted for a large part of the country elevator expansion since 1945.

There appears to be a large variation among the 3 States in the use of concrete silos by country elevators for grain storage. While 34 percent of the total capacity and 44 percent of that used for flaxseed in South Dakota was of this type, in Minnesota 6 percent of the total capacity and 4 percent of the flaxseed capacity was in concrete silos. In North Dakota the percentages were almost identical to the figures for the 3-State area. The 3-State figures, however, are greatly influenced by those of North Dakota which had 70 percent of the total capacity, 71 percent of the capacity suitable for flaxseed, and 73 percent of the capacity used for flaxseed.

Steel Silos

The steel silo has not become as popular as the concrete silo for commercial grain storage among the country elevator operators in the Midwest flaxseed belt. This type of warehouse provided only 2 percent of both the total capacity and of the capacity suitable for flaxseed and 1 percent of the capacity used for the storage of flaxseed. Of the total capacity in steel silos, 92 percent was considered suitable for flaxseed, but only 28 percent was used. Less than one-half of 1 percent of line companies' capacity was of this kind, none of which was used for flaxseed during 1955-56.

Further analysis shows that 72 percent of all steel silo capacity was in North Dakota, where only 13 percent of it was used for flaxseed; 3 percent was in South Dakota, none of which was used for flaxseed; but of the remaining 25 percent in Minnesota, 63 percent was used for flaxseed storage. As with the concrete silo, the greatest use of the steel type was in the 15-plus group of elevators.

Eighteen elevators in the survey had steel silo warehouses, but only at 2 were they used for storing flaxseed. A difficulty encountered in storing flaxseed in steel silos is that of bin size. The average steel silo bin capacity of 16,000 bushels is considerably larger than the average 3,200-bushel capacity bin used for flaxseed in the Midwest. Unlike the concrete silo, there are no smaller sized bins constructed between the large steel silos which would provide a greater variety of bin sizes.

Although steel silos are vertical structures, not all of them are equipped with a hopper bottom for mechanical unloading, thereby limiting cleaning and conditioning operations. Often, a less expensive concrete hopper bottom is

constructed, giving extra storage below ground level. This might become a hazard for elevators not properly located for concrete, as a high water table or heavy rains may create a serious moisture problem within the stored flaxseed.

Quonsets

As a commercial grain storage warehouse, the horizontal Quonset is seldom used for storing flaxseed. The efficiency of Quonsets as grain storage structures is impaired since they are often located away from the main house, and flaxseed or other grain has to be trucked to them and unloaded by portable grain conveyors. The reverse procedure is followed when they are emptied. If flaxseed stored in such a structure requires turning, it must be done by hand. These operations are labor-consuming and contribute to greater shrinkage.

The many Quonset types of construction make up 6 percent of the total capacity, which is greater than any of the other horizontal construction types, and 5 percent of the suitable flaxseed storage capacity. However, Quonsets provided less than one-half of 1 percent of the total capacity used for storing flaxseed.

Sixty-seven percent of the capacity in Quonset construction was considered suitable for flaxseed storage by elevator managers, but only 1 percent was used, all of which was in the 15-plus elevators of Minnesota. Quonsets accounted for 12 percent of total construction in Minnesota, 4 percent in North Dakota, and 3 percent in South Dakota.

Steel Bins

When steel bins are properly constructed and maintained in good condition, they provide a tight structure that will protect flaxseed from weather, insects, and rodents. Serious damage to stored grain can be caused by leaks around bolt heads or wall joints, both of which require careful caulking at time of construction. Although moisture is more likely to condense on the underside of a metal roof than on that of a wooden roof, the possibilities of moisture damage are no greater. Damage to dry grain from moisture entering the bin is almost always due to leaks, not condensation (9).

While the steel bin is satisfactory for flaxseed storage, it is subject to the same labor efficiency limitations as other horizontal grain storage structures. This limitation is sometimes increased by poor bin location.

The 4 percent of total warehouse capacity in steel bins indicates the relative importance of this type of construction as commercial storage space among the country elevators surveyed. Four percent of the capacity suitable for flaxseed and 3 percent of the capacity used for flaxseed is also provided by steel bins.

Sixty-eight percent of steel-bin storage capacity was considered suitable for flaxseed storage and 35 percent was used for this purpose. Steel bins in North Dakota provided 4 percent of the total capacity and of the suitable country elevator capacity, and 3 percent of the capacity used for flaxseed storage. They provided 5 percent of the total capacity, 4 percent of the space suitable for flaxseed, but less than one-half of 1 percent of the capacity used for flaxseed in Minnesota. In North Dakota, nearly three-fourths of the steel-bin capacity was considered suitable and almost one-half was used for flaxseed. Minnesota data showed that slightly over one-half of this capacity was considered suitable, but only a very small percent was used for flaxseed storage in that State. Steel bins accounted for slightly more than 1 percent of the total capacity in South Dakota, most of which was used for flaxseed storage.

Wood Balloon or Farm-Type Bins

The wood balloon, most of which was in the form of farm granary types of construction, comprised 2 percent of the total grain storage capacity among the elevators in the sample. Granaries of this type appeared to be relatively unimportant as commercial flaxseed storage structures as they provided less than one-half of 1 percent of the capacity suitable for storing flaxseed and also of that used for flaxseed in 1955-56.

Structures of this type with single walls usually are not tight enough for adequate protection against moisture or loss of fumigants unless they are lined with reinforced paper or roofing felt. Because of this, they are not usually as satisfactory as steel bins for flaxseed storage. Elevators sometimes lease nearby wood balloon and steel bin structures from the CCC. Such an arrangement lends flexibility during the storage season.

Miscellaneous Construction Types

There are several types of relatively unimportant grain storage structures used by country elevators. These include such buildings as coal sheds, oil railroad cars, tile and brick buildings, and other less common types of structures. Most of these structures are used only during emergencies, but according to the information received, they made up 5 percent of the total storage capacity and also 5 percent of the space suitable for and used for flaxseed storage during 1955-56. In the 3-State area, 77 percent of this miscellaneous capacity was reported as suitable for flaxseed storage, and 57 percent was used. The greatest use of this type of warehouse was made by North Dakota and South Dakota elevators. A large variation was found, however, between North Dakota, where 69 percent of total miscellaneous storage was suitable for and 43 percent was used for flaxseed, and the other 2 States, in which most of such space was considered suitable and so used. Very little of this type of grain warehouse storage space was found in line elevators, and that was all in North Dakota.

AGE OF STORAGE STRUCTURES

The survey provides information from operators concerning elevator construction trends since 1900 even though data for the earlier years in this period may not be as representative as those for the more recent years because some of the elevators built in the earlier years no longer exist.

Trends in Types of Elevator Construction

The increased demand by farmers for commercial storage space and the annual shortage of boxcars have stimulated much expansion in grain warehouse capacity of country elevators. This increase in capacity is reflected in a variety of construction types, with trends toward larger units and more steel and concrete structures. These include steel silos, steel bins, and the now prevalent concrete silo and steel Quonset warehouses that were relatively unimportant commercially before 1945.

Two of the most noticeable trends are the decreasing importance of the wood crib construction and the increasing importance of the concrete silo. The survey indicated that around 1900 nearly all of the country grain elevator capacity constructed was in wood crib warehouses while in 1945-55 only about 44 percent was of this type (table 17). This downward trend appears to have continued since 1900, but was quite gradual until after 1940. It should be noted that although wood cribs represent a decreasing proportion of capacity built, total capacity of this type has nearly doubled since 1945. The construction of wood crib elevator units still greatly exceeds those of concrete, but due to their smaller average size, the wood crib units do not contribute proportionally in total capacity being constructed.

Table 17.--Percentage of each type of country elevator capacity constructed during specified periods, 3-State area 1/

Construction period	Wood crib	Wood balloon	Quonset	Concrete silo	Steel silo	Steel bins	Miscellaneous types	All elevator capacity
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Before 1900	97	3	0	0	0	0	0	100
1900-14	96	3	0	1	0	0	2/	100
1915-29	93	1	0	3	0	0	3	100
1930-44	81	7	0	2	2	5	3	100
1945-55	44	3	13	26	3	6	5	100

1/ Data based upon 177 elevators existing in 1956, for which construction data were known.
2/ Less than one-half of one percent.

Before 1945, the concrete silo was of little prominence, but grain storage capacity of this type has been greatly increased since then, and during 1945-55 the concrete silo constituted about 26 percent of the total elevator construction.

The cost of concrete structures generally is substantially more than for wood crib units although it varies with the amount of equipment, the number of bins, and total capacity. The low cost of wood crib construction nearly offsets the high flat (gross) insurance rates, but fails to offset the co-insurance benefits on both the building and the grain. In some areas, however, the increased cost of the large amount of labor required in constructing wood crib units has placed the concrete silo in a very competitive price position when considering the longer life expectancy.

Quonset-type warehouses have become increasingly popular in country elevator grain warehousing since 1945. Indications are that Quonsets made up about 13 percent of the total warehouse construction during 1945-55 while none was built before 1945. The trend is also upward for steel silos, but this type comprised only about 3 percent of the 1945-55 construction represented in the survey.

Construction of grain warehouse space in wood balloon storages remained fairly constant throughout the years except for an increase during 1930-44. While no steel bins existed before 1930, this type comprised about 6 percent of the total capacity constructed since that time. The wide use of steel bins by the Commodity Credit Corporation has contributed to this. Such storage structures are often leased by CCC to nearby country elevator companies which need extra grain storage space.

Elevator Construction by Periods

The amount of country elevator space available in 1956 to flaxseed growers varied substantially as to the period of its construction. Increased grain production, business cycles, wars, and technological developments have affected expansion needs of elevator management and the types of units constructed.

Only about 4 percent of the storage space available in 1956 was built before 1900, as few of those structures still remain (table 18). Total storage capacity increased considerably during the first 15 years after the turn of the century. This was followed by a decrease in the rate of construction during the next 30 years. Volume or aggregate capacity continued to increase during that period, however, since new warehouses were constructed faster than older ones were torn down. Since 1945, total elevator storage capacity has been nearly doubled.

The age of an elevator unit is an important indicator of its suitability or use for flaxseed storage. Elevator managers generally consider newer elevators to be more suitable than older ones for flaxseed. This is illustrated in figure 8, where only 59 percent of the elevator units constructed before 1900

Table 18.--Percentage of total elevator construction according to types of organization, and the percentage suitable and used for flaxseed storage in 1955-56 by periods, 3-State area

Period	Organization type				Flaxseed storage	
	Independent	Line	15+	All elevators	Suitable	Used
	Percent	Percent	Percent	Percent	Percent	Percent
Prior to 1900	3.2	5.0	1.2	3.8	2.8	2.6
1900-14	24.7	21.0	10.8	21.6	18.4	20.1
1915-29	12.6	25.9	10.8	15.6	15.7	17.4
1930-44	10.3	18.9	10.5	11.3	10.5	8.8
1945-55	49.2	29.2	66.7	47.7	52.7	51.1
All periods	100.0	100.0	100.0	100.0	100.0	100.0

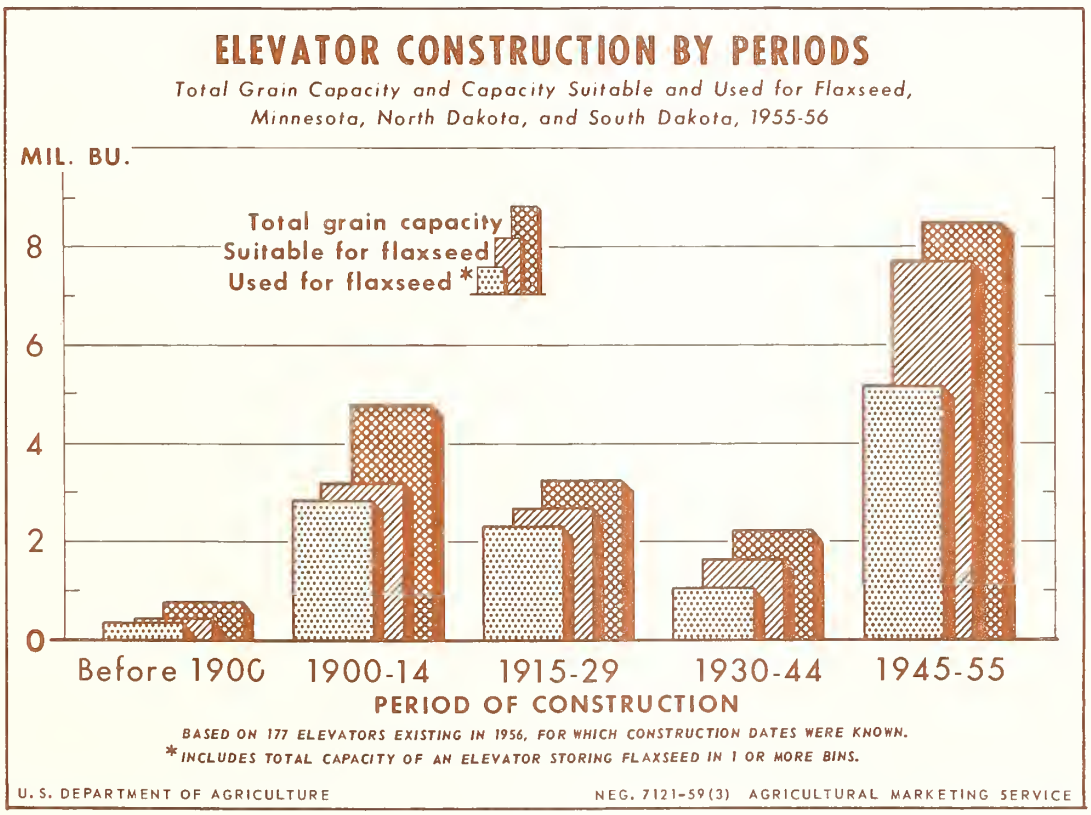

Figure 8

were considered to be suitable, whereas 91 percent of the elevators constructed in 1945-55 were considered suitable for flaxseed by elevator managers during 1955-56.

Curtailed production of flaxseed and small grains during the 1930's resulted in a decline of new elevator construction. More important, however, was the marked change in the style and materials used in building new units. Increased numbers of wood balloon, steel bin, steel silo, and other miscellaneous types of units replaced much of the wood crib capacity. Therefore, slightly less than one-half of the storage construction for the 1930-44 period was used for flaxseed compared with almost three-fourths of the capacity constructed during the preceding period (fig. 8).

Structures other than concrete and wood crib accounted for 30 percent of the capacity constructed during 1945-55 (table 17). These wood balloon and steel structures are commonly preferred for grains other than flaxseed. Thus, although the proportion of total suitable capacity was high, a relatively low proportion of the total capacity was actually used for flaxseed storage during that period (fig. 8).

Only 30 percent of line elevators' 1956 storage space was built after World War II. Half of the independents' space and two-thirds of the 15-plus groups' space was built after 1944 (table 18). Half of the storage space suitable for and used for flaxseed was built in 1945-55.

Whether these trends indicate that line elevators have been declining in importance during recent years or have attained adequate capacity is not definitely known. Proposed construction of large subterminal elevators would tend to relieve storage problems at both terminal and country elevators to some degree in the future. Country elevators in the Midwest flaxseed area already have passed the peak in number and may continue to decline as efficiency, volume, and area of supply of larger elevators increase, displacing the smaller, less efficient elevators.

Size of Elevator Warehouse Units

Through the years, there has been a general trend toward larger elevator units. 5/ Before 1945, however, the increase was very gradual and there was considerable difference in size between elevators according to type of organization. Since 1945, the average size of elevator units has almost doubled. The sharp rise in total elevator capacity during this period resulted, therefore, from an increased unit size as well as an increase in the absolute number of storage units at many elevators. As noted in table 19, average unit size was 27,000 bushels before 1900 and 55,000 bushels during 1945-55. The only exception to the general trend occurred during the 1930-44 period when many smaller and less expensive horizontal structures were built as a result of the economic depression and later the scarcity of building materials during World War II.

5/ No precise information is available on average elevator size by periods. The information pertains to separate storage units of an individual elevator.

Table 19.--Change in average capacity of grain warehouse units by types of elevator organization, 3-State area

Period	Organization type			Average all elevators
	Independent	Line	15+	
	1,000 bushels	1,000 bushels	1,000 bushels	1,000 bushels
Before 1900	25	41	23	27
1900-14	32	28	19	30
1915-29	30	48	33	34
1930-44	29	41	22	30
1945-55	54	46	60	55

Line elevator storage units were generally larger than those for the other two types of organization before 1945, but they are now the smallest. The average unit size was greatly influenced by the expanded construction of concrete silos during recent years. This was particularly noticeable in the 15-plus group elevators, which have an average unit capacity of 60,000 bushels, as concrete structures accounted for 30 percent of their total construction during the 1945-55 period. The average overall unit size in 1956 was 39,000 bushels which is larger than in any of the periods preceding 1945.

USE OF COUNTRY ELEVATOR CAPACITY FOR FLAXSEED AND OTHER GRAINS

Available Storage Capacity

The capacity of country elevators is utilized for operating space and for commercial grain storage. The operating space is used for the temporary storage of grain recently purchased from farmers, for moving and conditioning purchased and stored grain, and for commercial sidelines such as cleaning, drying, feed grinding, and other activities conducted during the everyday operations at the elevator. The amount of space made available for commercial grain storage for others, including farmers, depends upon the individual elevator manager. He must keep sufficient operating space available for receiving and loading out of all cash grain, and also provide a certain amount of storage service for his customers for which a rental is received.

It is almost impossible for any manager to predetermine how much space to allow for commercial grain storage, because of the varying influences of commodity price supports, boxcar shortages, and possible bottlenecks in grain elevator operation. Price fluctuations, and cultural and climatic factors affecting yields of grain, in addition to other economic factors such as relative net returns for storing various grains, also make it necessary for the elevator manager to feel his way along until the demand for storage and his own needs for the facilities can be established.

The amount of storage capacity elevator managers were willing to set aside for commercial flaxseed storage compared with the amount of flaxseed they actually had in commercial storage during the seasonal harvest peak varied, but not substantially considering that: (1) The market price of flaxseed was near the level of the support price during much of the 1955-56 season. (Consequently, less flaxseed was offered for storage than would have been had the market price been appreciably lower.) (2) some areas had been affected by drought; and (3) a greater proportion of the elevator capacity could have been used for flaxseed if it had been requested by flaxseed producers before the elevators accepted other grains for storage.

Elevator operators in the midwestern flaxseed area reported a willingness to make an average of 70 percent of the total capacity available for commercial grain storage during the 3 major harvest months of August, September, and October. The remaining 30 percent of the total capacity is used by the operator for the storage of cash grain owned by the elevator and as working space for sideline activities.

The amount of elevator space allocated to commercial storage was about 70 percent for 3- and 6-month periods, but was about 60 percent for a 12-month period. Some managers prefer to empty their elevator bins about 2 months before the harvesting season begins so as to prepare for the arrival of the new crop, but those interviewed did not, as a rule, set any definite storage termination date. Thus, elevator operators in general were not concerned over the length of time their bins were used for commercial storage during the marketing year.

Data collected at 233 country elevators in the 3-State area indicated that managers were willing to allow up to 21.5 percent of the total elevator capacity for flaxseed storage during the 3 months of the peak harvest season. Nearly all of this capacity could be allocated to flaxseed for a period of 6 months and 1 year (table 20). The fact that elevator operators would allocate nearly one-third of their commercial storage capacity to flaxseed indicates that storage of this seed is not unwanted. This is especially true when flaxseed stored for the Commodity Credit Corporation is cleaned and the screenings sold while storage revenue continues to be received on a gross-bushel basis.

It should be noted, however, that a proportionally smaller amount of elevator capacity will be allocated to flaxseed than to other grains for extended periods of 6 and 12 months' storage. Thus, flaxseed is considered to be somewhat less desirable for longer storage periods than other grains. Storage losses, or the risk of such losses, assumed by the elevator, are generally the greatest in flaxseed (as pointed out earlier). Of the space allocated to commercial storage for 3 months, elevators handling large volumes of flaxseed were willing to retain only 66 percent of the flaxseed for a 12-month period, but would be willing to maintain 83 percent of the all-grain capacity for 12 months.

Table 20.--Percentage of all grains and flaxseed alone that elevator managers were willing to store for 6 and 12 months based upon the amount of capacity available for 3 months' storage, in 3-State area

Commodity	Length of storage		
	3 months	6 months	12 months
	Percent	Percent	Percent
Flaxseed	100.0	97.7	80.8
All grains	100.0	98.6	85.2

Actual Use of Elevator Capacity

Although the managers contacted were willing to set aside up to 70 percent of the total elevator capacity for commercial storage, only about 63 percent was actually so used during 1955-56 (table 21). Only 11 percent of the total capacity was used for the commercial storage of flaxseed although the managers indicated that around 21 percent of their space was available for that purpose.

Table 21.--Percentage of elevator capacity considered available and actually used for the commercial storage of all grains and flaxseed alone, 3 North Central States, 1955-56

Classification	Flaxseed		All grains	
	Available	Used	Available	Used
	Percent	Percent	Percent	Percent
By groups:				
Independent	20.2	8.5	69.0	59.5
Line	21.2	14.0	70.3	61.0
15+	25.6	17.2	74.2	72.0
By States:				
North Dakota	20.8	11.3	72.7	64.0
Minnesota	22.0	9.4	61.6	58.6
South Dakota	25.5	13.6	75.5	64.2
3-State average	21.4	11.0	70.1	62.6

Managers of independent elevators indicated a willingness to set aside for storage of all grains an average of 69 percent of their total capacity, line companies 70 percent, and the 15 plus group 74 percent (table 21).

Total grain held during the seasonal peak of elevator activity occupied, on an average, 82 percent of the total elevator capacity; 63 percent was in commercial storage for others while 19 percent consisted of elevator cash grain inventories (table 22). The remaining 18 percent of the average elevator capacity was used for working space. An average of 14 percent of the total elevator capacity was used for flaxseed during the seasonal peak.

Table 22.--Percentage of total elevator capacity actually used for commercial storage and for operating space during seasonal peak of elevator activity, 1955-56

Classification	Elevators	Commercial storing space			Operating space 1/				Total grain held
		Flaxseed	Other grain	Total	Flaxseed	Other grain	Working space	Total	
	No.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Groups:									
Independent	141	8.5	51.0	59.5	3.5	17.5	19.5	40.5	80.5
Line	21	14.0	47.0	61.0	3.0	12.0	34.0	49.0	76.0
15+	35	17.2	55.0	72.2	2.0	13.0	12.8	27.8	87.2
States:									
North Dakota	124	11.3	52.7	64.0	3.3	19.0	13.7	36.0	86.3
Minnesota	48	9.4	49.2	58.6	2.8	12.0	26.6	41.4	73.4
South Dakota	25	13.6	50.6	64.2	3.4	9.3	23.1	35.8	76.9
3-State average	197	11.0	51.6	62.6	3.2	16.1	18.1	37.4	81.9

1/ Includes storage space occupied by elevator-owned flaxseed and other grains as well as working space.

Although some elevator operators must retain a larger proportion of their bin space for sideline activities, the amount of unused working space may sometimes be a measure of the operator's efficiency. During the seasonal peak of elevator activity, maximum use of the entire elevator facilities is desired, without creating bottlenecks which would slow down the movement of grain through the elevator. Storage bins should be completely filled, as unused capacity above partially filled bins decreases the turnover ratio of grain marketed to elevator capacity. This increases the cost per bushel of grain handled or stored. A few of the elevators in the survey held grain in excess of their total capacity by storing grain in rented Government bins, temporary storage units, or, occasionally, on the ground. Others, however, failed to utilize efficiently the space available, and, therefore, did not obtain the greatest returns possible.

One way to attain a high degree of elevator storage efficiency is to minimize the space used to store grain purchased from farmers. In some elevators surveyed, elevator-owned grain occupied over 30 percent of the total elevator capacity while at others, less than 10 percent of the space was so used. Of course, the size of individual elevators influences the proportion of capacity required for elevator inventories, but a more efficient operation can result from loading out such grain as quickly as possible after receiving it.

Large elevator inventories often accumulate as a result of inadequate transportation facilities. This is more often true in areas where only one mode of transportation is available. It was noted that in areas where both rail and truck transportation are available, a smaller proportion of capacity is used to store elevator-owned grain.

Slightly over 22 percent of North Dakota capacity surveyed held elevator inventories; less than 15 percent of capacity was used in this way in Minnesota and South Dakota. The line and 15-plus group elevators generally made more efficient use of their capacity in this respect than did the independent elevator companies.

Who Uses Storage Facilities

The storage capacity of country elevators is used mainly by farmers, by the elevator company in assembling grain for delivery to terminal markets, and by the Commodity Credit Corporation. Of the total grain storage space, 35 percent was used by farmers, 27 percent by the Commodity Credit Corporation, 19 percent for elevator-owned inventories, and 1 percent for others. As noted already, the remaining capacity was working space for the elevator operator. During the seasonal peak of activity, 61 percent of the flaxseed held at elevators was stored for farmers, but only 39 percent of the other grain held was stored for this group (table 23). Storage for the Commodity Credit Corporation occupied 36 percent of the capacity allocated to other grains, but only 15 percent of the total space allocated to flaxseed.

Space leased under uniform grain storage agreements to the Commodity Credit Corporation amounted to slightly over one-fourth of the total elevator capacity, or 43 percent of the space allocated to commercial grain storage. Thus, a very substantial portion of the average elevator capacity in the Midwest flaxseed belt is utilized by the CCC. This use of storage by the Government has led to increased demands upon the available capacity of country elevators, which in turn limits the storage receipts of flaxseed and other small grains from producers.

Table 23.--Percentage of flaxseed and other grains stored at elevators during the seasonal peak according to ownership, 3 North Central States, 1955-56 1/

State or organization group	Flaxseed				Other grains			
	Elevator inventory	Farmers	CCC	Others	Elevator inventory	Farmers	CCC	Others
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
By States:								
North Dakota	23	60	17	2/	26	39	34	1
Minnesota	23	64	13	0	20	45	35	0
South Dakota	20	67	9	4	16	27	57	0
By groups:								
Independent	29	53	17	1	26	36	37	1
Line	18	74	8	0	21	54	25	0
15+	12	72	15	1	19	43	37	1
3-State average	23	61	15	1	24	39	36	1

1/ Farmer-owned grain in elevator storage under a Commodity Credit loan is classified as farmer-stored grain although it is possible some elevator operators in the survey may have included such grain as storage for the Commodity Credit Corporation.

2/ Less than one-half of one percent.

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