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NEW DEVELOPMENTS IN CATTLE FEEDING: STEAM PROCESSING GRAINS

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During recent years commercial feedlots capable of handling many thousands of cattle per year have come into existence. Marked improvement in performance and feed efficiency paralleled this growth. There are several contributing factors, among which are: additives such as stilbestrol and antibiotics; the use of high concentrate rations fortified with vitamin A, trace minerals, and fat; the use of shade; and, feeding numerous times per day. For improved economics in fattening rations a further improvement in feed efficiency is desirable.

Currently, the method which appears to hold the greatest promise for improved efficiency is a moist heat treatment of the grain of the ration. This can be most easily accomplished by one of two methods. The first is to subject the grain to moist steam in a tempering chamber until the desired temperature and moisture levels in the grain are reached. The second method is to treat the grain in a pressure chamber with steam until the desired conditions are reached. The advantage of a continuous flow type pressure chamber is that the desired specifications of the grain can be obtained in 1 to 5 minutes, whereas the tempering chamber may require from 15 to 30 minutes. Either method can become a continuous operation once started.

Many reports are appearing on the value of steam treated grains in cattle fattening rations; but, unfortunately, the specifications of the grain treatment are not given, so interpretation of the results becomes difficult. The most usual treatment appears to be to subject the grain to steam for about 3 to 5 minutes before rolling. Temperatures of approximately 180^{o} are obtained in such a process. The amount of moisture added to the grain is not known, but is no doubt variable.

The results of three trials at the Arizona station comparing dry-rolled milo with steam rolling are summarized in Table 1. No advantage was noted for steam-rolled over dry-rolled. Reports from the Kansas and Oklahoma stations gave similar results.

Recent trials have been conducted at the Arizona station using a long steaming period on milo and barley. An oversized tempering chamber is filled with grain which is subjected to low pressure-high moisture steam for approximately 20 minutes. The temperature of the grain reaches 205 to 210^{o} F. and is rolled at this temperature. The process becomes continuous when the grain starts to flow by gravity through the roller mill and the dry grain is introduced into the top of the chamber. The moisture content of the milo was approximately 17 percent from the rollers and the corresponding value for barley was 15 percent. A good flake can be obtained from barley at this moisture level, but milo does not make a good flake until the moisture is at least 16 percent. In recent Arizona work, the grain was rolled flat with no tolerance on the rollers. The result was a large flat flake with a lot of the white starch portion showing.

Three feeding trials have been conducted with steam processed milo and two with barley. The rations for the finishing period are shown in Table 2. The milo and barley rations were formulated to contain similar levels of crude fiber. A starting ration containing 40 percent roughage was fed the first 28 days in trials 1 and 2 and the first 56 days in trial 3. The crude fiber level of the starting ration was 16 percent.

A summary of the results of the three growth trials with milo is presented in Table 3. Steam processing and flaking the milo improved gains and feed intake and reduced the feed required per 100 lb. of gain. Gains were increased by approximately 10 percent and feed requirements reduced by 5 percent.

A similar comparison for dry-rolled and steam-processed barley is presented in Table 4. Gains and feed intake were increased by steam processing. The feed requirements were not affected. This suggests that steam processing barley improves the physical characteristics and results in greater feed intake but does not alter its nutritional qualities. This is in contrast to the results of steam processing milo which not only improves its physical properties but apparently affects its nutritional qualities as indicated by the improved feed efficiency.

A digestion trial was conducted to determine what fractions of the milo grain were affected by the steaming process. A ration containing 77 percent dry-rolled or steam-processed milo was used. Table 5 shows the results of this trial.

Steam processing and flaking milo significantly improved the digestibility of the dry matter, nitrogen free extract, and gross energy over dry rolling. The calculated total digestible nutrients of the steam processed grain was 11 percent greater than for the dry-rolled. It is apparent that nitrogen free extract, which represents the starch of the grain, was the fraction most effected. Apparently the steam processing alters the starch to such an extent that it is more available to the rumen microorganisms and/or the animals.

Protein digestibility was not affected by steam processing and flaking. An earlier study with milo cooked with two parts water at high temperature indicated a reduction in milo protein digestibility due to cooking.

In the feedlot studies it appeared that the flatness of the flake influenced the utilization of the steam processed milo. Nylon bag studies were conducted to determine the significance of the flatness of the flake for milo steamed by the Arizona process. The rolled samples included: a poor roll in which all grains were crushed; an extra flat, slightly perforated flake in which the starch portion was ivory -- not white; and, an intermediate roll as to flatness of flake. Table 6 shows the results of this study. Considering all time periods, the dry matter disappearance from the extra flat flake was 22 percent greater than for the regular rolled milo. The poorly rolled, steam-processed milo proved to be no better than the dry-rolled milo. The dry matter disappearance for the regular rolled, steam-processed milo was more than two times greater than for the dry rolled milo.

Steam pressure cookers for treating milo are now being used in certain feedlots. It is probable that the alteration which occurs in steam pressure cooked milo is similar to that described above for steam processing, but because of the greater pressure, the grain can be treated in 1 to 5 minutes. A small sized pressure cooker capable of cooking 125 lb. of milo was made available to the author. Comparisons were made with steam-processed flaked and pressure cooked flaked milo with the nylon bag technique. The pressure cooked material was subjected to 35 lb. pressure for 4 minutes. As it came from the cooker the moisture content was 24 percent and the milo was allowed to dry in the open for about 10 minutes before it was rolled. This lowered the moisture content to approximately 17 percent.

Little difference in the rate of dry matter disappearance can be seen (Table 7) between the two methods of applying moist heat to the grain. Grinding the flakes affected the rate of disappearance very little although there was a slight suggestion that grinding of the pressure cooked flakes increased the rate of disappearance. This suggests that the high rate of dry matter disappearance with the thin flake was not necessarily related to the surface area as the ground flakes presented much more surface area than the flakes which were not ground. It is suggested that the pressure and heat applied during rolling to obtain a thin flake with the hot moist grain further affected the availability of the grain and that this is to some extent independent of the steam processing.

There appears to be no doubt that a well formed flake is necessary to obtain maximum benefit of the steam treated milo. Observations at the Arizona station feedmill indicate that this can be accomplished only if the roller mill is operated at one-third to one-half capacity. This implies that roller mill capacity must be at least doubled if steam-processed or pressure-treated grains are to be employed in the feeding operation. It appears somewhat futile to install good steaming equipment (steam processing or pressure cooker) and have the desirable effects of the treated grain lost by an unsatisfactory rolling process.

Results of an individual feeding trial with pressure cooked grains has been completed by the California station. Milo, barley and corn were each compared with four processing methods as well as with three different grain levels. Comparisons are given in Table 8 for the dry rolled grains and the grain cooked for 1.5 minutes at 20 lb. pressure. Cooking of any of the grains at the above time and pressure improved gain and feed efficiency. The improvement in gain amounted to approximately 11 percent and in this respect is similar to the response noted for milo for steam processing. Cooking the grains at 60 lb. pressure for 1.5 minutes did not improve performance when compared to the dry rolled grain.

Results from the Oklahoma station (Table 9) indicate that complete gelatinization of milo starch is detrimental as it produces lower gains than ground milo. The gelatinized product was dried and ground.

Information is given in Table 10 regarding a trial at the Nebraska station in which a similar type of prepared corn was used. Inclusion of 10 percent gelatinized corn in the fattening ration appeared to improve gains and feed efficiency. The 20 and 50 percent levels were apparently depressing.

Table 11 gives the results from the Colorado station with steamed corn. The corn was steamed at 200^{o} for 12 minutes. If the corn was steamed and cracked, performance was reduced and there was a detrimental effect on feed efficiency. Flaking the steamed corn also reduced gains and feed intake but there was an improvement in feed efficiency. The results obtained with steamed, flaked corn are not in complete agreement with the milo studies. It would appear desirable to increase the feed intake which should result in improved gains. It may well be that the improvement in feed efficiency with steamed flaked corn may offset the depression in daily gain in respect to economies.

A defined moist heat treatment of grains to be used in cattle fattening rations appears to hold much promise for improving performance and feed efficiency for fattening cattle. Additional studies are needed to determine what changes are brought about in the steaming process which are responsible for the improvements noted. An economic evaluation indicates that the feeding value of milo is increased $3.00 to $7.00 per ton by proper steam processing.

TABLE 1. COMPARISON OF DRY-ROLLED AND STEAM-ROLLED MILO

			Dry rolled				Steam rolled			
Trial	Days	Grain in ration	Number steers	Av. daily feed	Av. daily gain	Feed/ 100 lb. gain	Number steers	Av. day feed	Av. daily gain	Feed/ 100 lb. gain
		%		lb.	lb.	lb.		lb.	lb.	lb.
1	126	53	14	25.6	2.82	908	28	25.8	2.86	902
2	97	56	16	22.8	2.49	918	16	23.2	2.32	1002
3	97	49	16	23.2	2.49	934	16	23.2	2.52	928
	Average:			23.9	2.60	920		24.1	2.57	944

TABLE 2. FINISHING RATIONS

Ingredient	Barley DR, SP[a]	Milo DR, SP[a]
Ground alfalfa[b]	5.00	5.00
Cottonseed hulls	10.00	15.00
Barley	74.85	-
Milo	-	68.25
Cottonseed pellets	3.00	4.50
Molasses	5.00	5.00
Dicalcium phosphate	0.50	0.50
Urea	0.50	0.60
Salt	0.50	0.50
Ground limestone	0.60	0.60
Trace minerals	0.05	0.05
Total	100.00	100.00
Vitamin A 10,000 I.U./gm.	10.0	10.0
Protein, percent	11.8	11.5
Crude fiber, percent	10.6	10.1

[a]Dry-rolled and steam processed.
[b]Ground with 1 percent tallow to control dust.

TABLE 3. PERFORMANCE OF FATTENING STEERS FED DRY-ROLLED OR STEAM-PROCESSED MILO

		Dry-rolled milo				Steam-processed milo			
Trial	Days	Number of steers	Av. daily gain	Av. daily feed	Feed/ 100 lb. gain	No. of steers	Av. daily gain	Av. daily feed	Feed/[a] 100 lb. gain
			lb.	lb.	lb.		lb.	lb.	lb.
1	143	16	2.88	21.8	758	15	3.06	21.6	708
2	140	15	2.90	23.4	807	16	3.20	24.7	772
3	134	15	2.71	22.9	845	16	3.07	24.9	811
Average:			2.83	22.7	800		3.10	23.7	764
Percent improvement:							9.5		4.7

[a]Corrected to same moisture content as dry-rolled barley.

TABLE 4. PERFORMANCE OF FATTENING STEERS FED DRY-ROLLED OR STEAM-PROCESSED BARLEY

		Dry-rolled barley				Steam-processed barley			
Trial	Days	Number of steers	Av. daily gain	Av. daily feed	Av. 100 lb. gain	Number of steers	Av. daily gain	Av. daily feed	Feed/[a] 100 lb. gain
			lb.	lb.	lb.		lb.	lb.	lb.
1	140	16	2.90	20.6	710	16	3.11	22.0	707
2	134	16	2.86	21.0	734	16	3.10	23.4	755
	Average:		2.88	20.8	722		3.10	22.7	732
Percent improvement:							7.6		

[a]Corrected to same moisture content as dry-rolled barley.

TABLE 5. DIGESTION OF FLAKED STEAM-PROCESSED AND DRY-ROLLED MILO RATIONS

Item	Flaked steam-processed	Dry-rolled
Number of steers	12	12
Dry matter, percent	69.7*	61.6
Crude protein, percent	51.4	49.6
Ether extract, percent	59.0*	67.3
Crude fiber, percent	13.6	22.5
Nitrogen free extract, percent	78.5*	69.2
Gross energy, percent	69.4*	59.9
TDN of ration, percent	69.8*	63.9
Calculated TDN of grain, percent	79.0*	71.0

* $P < .05$.

TABLE 6. EFFECT OF FLATNESS OF FLAKE OF STEAM-PROCESSED MILO ON DRY MATTER DISAPPEARANCE FROM NYLON BAGS, PERCENT

Hours in rumen	Dry-rolled	Steam processed: Poorly rolled	Regular rolled	Extra flat flake
2	16.7	21.1	43.8	55.4
8	25.1	28.7	51.0	63.1
24	52.4	48.5	73.2	85.2

TABLE 7. DRY MATTER DISAPPEARANCE FROM STEAM-PROCESSED OR PRESSURE COOKED MILO, FLAKED OR GROUND-FLAKED, FROM NYLON BAGS, PERCENT

Hours in rumen	Dry-rolled	Steam processed		Pressure cooked	
		Flaked	Flaked and ground	Flaked	Flaked and ground
2	12.5	44.1	46.0	41.3	42.4
8	21.9	50.7	49.3	44.0	49.1
24	48.9	78.3	77.8	76.6	81.4

TABLE 8. THE EFFECT OF PRESSURE COOKING GRAIN ON UTILIZATION BY CATTLE[a]

	Av. daily gain, lb.		Feed intake, lb.[b]		Feed/lb. gain lb.[b]	
	D.R.[c]	P.C.[c]	D.R.	P.C.	D.R.	P.C.
Corn	3.03	3.35	20.2	21.0	6.70	6.33
Milo	3.10	3.54	20.8	21.3	6.71	6.04
Barley	3.15	3.39	20.5	20.6	6.52	6.11
Average:	3.09	3.42	20.5	21.0	6.64	6.16

[a]California station.
[b]Feed intake and feed requirement on a dry matter basis.
[c]Dry rolled, pressure cooked.

TABLE 9. EFFECT OF STEAM-HEATED (GELATINIZED) MILO FOR FATTENING BEEF CALVES (127 days)

Item	Treatment: Ground	Treatment: Pregelatinized
Number of calves	12	12
Average initial weight, pound	412	418
Average daily gain, pound	2.51	2.27
Average daily feed, pound	16.8	15.3
Feed/100 pound gain, pound	669	674

TABLE 10. EFFECT OF GELATINIZED CORN ON PERFORMANCE OF STEERS[a]

Level of expanded corn	0	10	20	50
Number of steers	12	12	12	12
Average daily gain, pound	2.42	2.70	2.24	2.37
Average daily feed, pound	21.2	21.9	20.2	19.6
Feed/100 pound gain, pound	876	811	902	827

[a]Nebraska station.

TABLE 11. EFFECT OF STEAM-TREATED CORN ON PERFORMANCE OF FATTENING STEERS[a]

Item	Cracked	Steamed and cracked	Steamed and flaked
Number of steers	10	10	10
Average daily gain, pound	2.63	2.49	2.54
Average daily feed, pound	21.2	21.7	19.6
Feed/100 lb. gain, pound	806	871	772

[a] Colorado station.

THE BASIS FOR RECONSTITUTING GRAINS

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Livestock feeders have always shown keen interest in methods of grain processing that would possibly result in one or more of the following advantages:

a. Improved rate of gain.
b. Improved feed efficiency and reduced cost of gain.
c. Preparation with minimum power, machinery, time and storage equipment.
d. Improved carcass desirability.
e. Minimum problems in keeping cattle on feed.
f. Permit the maximum use of "least cost" ingredients.

Much work has been directed toward answering producers' questions concerning the type of mechanical milling equipment used such as roller, hammer and burr mills and degree to which the grain should be ground.

A considerable amount of work has been done in recent years on "conventional" steam rolling of grains. More recently emphasis has centered in the area of treatment with heat and moisture for more extended periods or higher pressures than would be typical of "conventional" steam rolling so that true flaking results after the grain is rolled. Recently, there has been interest in methods of grain processing that involve the addition of moisture as grain is placed in storage and then a period of time, in storage, is allowed to elapse before the grain is processed further for feeding. The product resulting from this latter process has been termed "reconstituted grain."

This discussion will deal primarily with the reasons why the process of reconstitution is attractive in theory and summarize some research data with high moisture grains and limited work with reconstituted grains.

GRAINS HARVESTED AND STORED IN THE HIGH MOISTURE STATE FOR FEEDING

Some work was done with ensiled ear corn in the late twenties and early thirties. Renewed interest in harvesting and storing corn in the high moisture state came in the late fifties with reports from the Indiana, Iowa and Illinois Experiment Stations. Some of that data published in 1956 and 1957 is combined and summarized in Table 1. The grain preparation used in these studies was ground ear corn.

Table 1. Combined Results With High Moisture Ear Corn (Indiana and Iowa)

Level of Moisture	High Moisture Ear Corn 31-32.2%	Dry Ear Corn 14.5-17.7%
Daily Gain of Pounds:		
Indiana 1956	2.56	2.33
Indiana 1957	2.21	2.18
Iowa 1957	2.98	3.05
Average	2.58	2.52
Daily Ground Ear Corn Intake (Dry corn equivalent), pounds: 8		
Indiana 1956	20.6	22.1
Indiana 1957	11.8	13.5
Iowa 1957	20.0	22.9
Average	17.5	19.5
Ground Ear Corn/100 pounds Gain (Dry corn equivalent), pounds:		
Indiana 1956	807	951
Indiana 1957	555	617
Iowa 1957	675	750
	679	772
Percentage Improvement in efficiency		+ 12%

From Iowa (Wise Burroughs) and Indiana (Wm. Beeson) Exp. Sta. Feeders Day Reports for the years indicated.

In this work three points are apparent: (1) average daily gain did not appear to be influenced greatly by the type of corn fed (2) daily feed intake corrected to a moisture equivalent basis was less for the high moisture corn. This pattern of feed intake seems to be characteristic of cattle due to their ability to consume reasonably constant daily levels of useful energy to support the genetic potential for production. That is, if something is accomplished to improve utilization of a feed ingredient by increasing the net energy value, then the animal may consume less since less is required to meet the requirement for his gain potential. If, on the other hand, something could be done to increase the willingness of an animal to consume larger quantities of food, then an increased rate of gain might be expected along with improved efficiency. This assumes that some methods of grain preparation do not entice the animal to eat quantities of energy to reach maximum gain potential. (3) The efficiency of dry matter utilization was improved by 12 percent.

After evaluating the above work with high moisture ear corn, it was concluded by some researchers that the advantage in efficiency was likely due to improved utilization of the cob portion of ground ear corn. This does not appear to be the complete answer, however, since later work with cracked or rolled high moisture shelled corn has also shown dry matter efficiency improvements of approximately 10 percent. Some of the later work at the Iowa Station has demonstrated the danger in assuming that a soft corn of this type can be fed whole since around 20 percent of the unground high moisture corn passed through the animal undigested. The same is true of high moisture whole milo except the depression in efficiency is even more pronounced (Kansas and Texas).

The basic reasons for the improved utilization of high moisture corn are still unexplained. Some researchers have theorized that the level of moisture at the time the grain is stored may be critical in terms of ratios of organic acids and total acid formation in the silo. Work at the Ohio Station has, in fact, established this theory as valid. It is not possible, however, to relate these results in terms of end-point chemical criteria for maximum efficiency of grain utilization. This leads to the importance of "predigestion" that takes place in the storage facility so that some organic acids, which are the end products of carbohydrate digestion in the rumen, are ready for absorption as soon as they are introduced in the rumen or at least require only slight alteration by rumen microorganisms. Other workers have suggested that high moisture grains may promote a more favorable ratio of organic acids and perhaps greater or faster acid formation produced by rumen microorganisms and thus, an improved efficiency. This is an attractive theory since digestibility studies have not consistently shown higher digestion co-efficients for high moisture corn. This suggests that the portion of total dry matter that is actually retained for utilization is utilized more efficiently. Data are limited to permit the conclusion that the high moisture grains do alter the ratios or quantities of organic acids produced in favor of those more efficiently utilized by the ruminant.

The fact, however, remains that high moisture corn, harvested at 25 to 30 percent moisture, is more efficient than dry corn. Since in many cases the corn belt feeder produces his own grain, it is easy for him to enjoy two benefits from using high moisture corn. One, the improved efficiency and secondly, the earlier harvest date which often reduces field wastage greatly and largely eliminates the possibility of frost damage.

In the case of milo, the high moisture grain approach is even more attractive. Research at the Kansas station reported in 1961 and 1962 has shown high moisture milo (when ground before feeding) to be 12-16 percent more efficient than dry milo on a dry matter basis. In this case, the milo was harvested at 36 percent moisture and stored in a concrete bunker silo that was lined and covered with plastic film. Work at the Texas station reported in 1959 and 1960 showed milo harvested at 23 percent moisture to be 18 percent more efficient than dry milo. The basic reasons for such improvement are, again, unknown at the present time. Further, the basic chemical characteristic of high moisture versus dry grain preparations are not established.

The results of the Kansas and Texas work are summarized in Tables 2, 3 and 4.

Table 2. Comparison of High Moisture Milo and Dry Milo in Finishing Rations for Steers. (Kansas)

Level of Moisture (percent)	High Moisture Milo	Dry Milo
	36	12
Average Daily Gain	2.68	2.61
Feed/100 pounds of gain (Air dry basis)		
Milo, pounds	491	586
Hay, pounds	112	115
Silage (1/3 wet weight), pounds	391	430
Total pounds	994	1131
Carcass Data:		
Dressing percent	60.5	61.6
Marbling Score	6.1	5.7
Grade (No.):		
Prime	1	2
Choice	6	5
Good	5	4
Average Grade	5.66	5.81

1 5=Moderate 6=Modest

2 7=Prime 6=Choice 5=Good

From Kansas Ag. Expt. Sta. Bul. 448, Round up Report 49. John Brethour.

Table 3. Comparison of High Moisture and Dry Milo in Growing and Finishing Rations for Steers. (Texas)

	High Moisture Milo	Dry Milo
Level of Moisture (percent)	31	10
Growing Period (112 days):		
Daily Gain, pounds	1.70	1.70
Feed/100 pounds gain: (Dry Matter basis)		
Milo, pounds	163	213
Roughage, pounds	722	738
Supplement, pounds	100	103
Total pounds	985	1054
Finishing Period (140 days);		
Daily gain, pounds	1.96	1.86
Feed/100 pounds gain: (Dry matter basis)		
Milo, pounds	537	757
Roughage, pounds	353	378
Supplement, pounds	89	93
Total pounds	979	1228
Growing and Finishing Periods Combined (252 days):		
Daily Gain	1.84	1.77
Feed/100 pounds Gain: (Dry Matter basis)		
Milo, pounds	387	533
Roughage, pounds	513	536
Supplement, pounds	94	98
Total pounds	994	1167
Shrinkage and Carcass Data:		
Finished Weight	1026	1020
Shrunk Market Weight	967	983
Shrinkage to Market percent	5.75	3.63
Dressing percent (Shrunk Market Weight Basis)	61.94	62.46
Average Carcass grade 1/	13.8	12.4

1/ 8-10-12 = High, Average and Low Choice.
14-16-18 = High, Average and Low Good.

From Texas Ag. Expt. Sta. Progress Report 2160 Cattle Series 162. (J. K. Riggs)

Table 4. Comparison of High Moisture and Dry Milo in Finishing Rations for Steers. (Texas)

Level of Moisture (%)	High Moisture Milo 23%	Dry Milo 13%
Daily Gain (feed lot basis) (154 days)	2.42	2.29
Daily Gain (shrunk market basis)	1.88	1.85
Feed/100 lbs. gain: (Dry Matter Basis)		
Milo, lbs.	539	657
Roughage, lbs.	545	586
Supplement, lbs.	81	87
Total, lbs.	1165	1330
Shrinkage and Carcass Data:		
Shrinkage to Market (%)	6.82	5.54
Shrinkage to Market, lbs.	84	68
Dressing % (Market Wt. basis)	61.15	60.74
Carcass grade (No.)		
Choice	1	2
Good	12	12
Standard	3	1
Average grade1/	4.87	5.07

1/ 6 = choice, 5 = good, 4 = standard.

RECONSTITUTED GRAINS

Since commercial feed lots must depend on grain from trade channels, the possibility of taking advantage of the improvement in efficiency characteristic of milo, harvested in the high moisture state, is remote in many cases. However, the thought of approaching a 12 to 20 percent improvement in efficiency by reconstitution is indeed encouraging. We must not erroneously conclude that we are actually re-creating field-harvested high moisture milo by this process because we do not know the chemical criteria to shoot for. This type of information obviously is not easily obtained since analytical techniques for obtaining such criteria are far more involved than the proximate analysis. Further, we do not know whether the improved efficiency reported for reconstitution or high moisture grains is due to simply the softening of the grain or to differences in the chemistry of the product. This may not seem important at first; but if the influence results from softening of the grain particle, rather than chemical changes that may require specific time and conditions, a totally different solution to the problem could result.

Work at the Arizona station suggests that reconstitution may alter the rate at which the dry matter in grain may be digested. The results are depicted graphically in Figure 1.

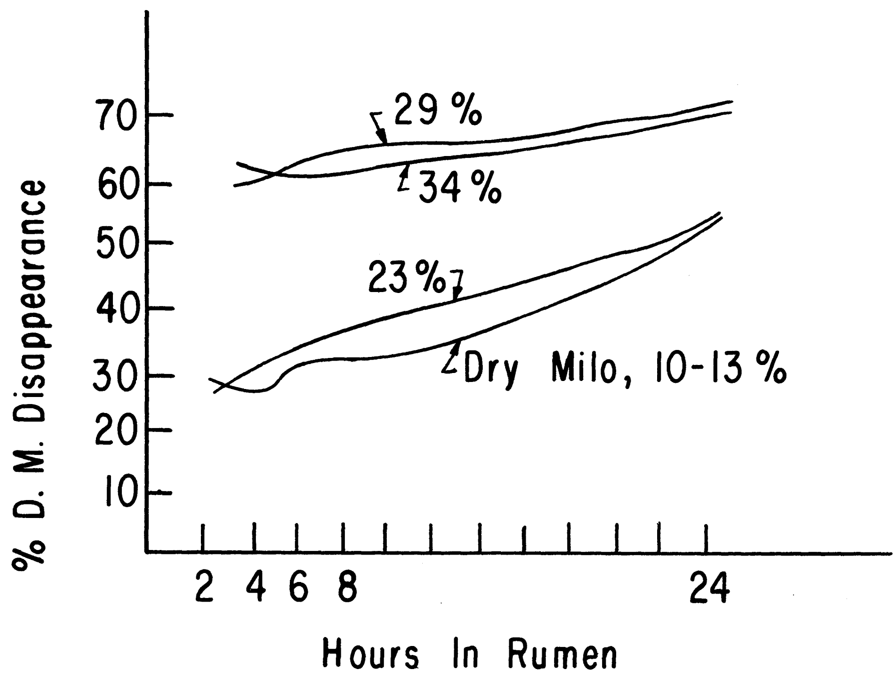

Figure 1. Rate of Disappearance of Dry and Reconstituted Milo From Nylon Bags in Rumen (Arizona)

[1] From Arizona Exp. Sta., Feeders Day Report 1962. W. H. Hale.

Regardless of the specific influence giving rise to increased efficiency, the data on rate of digestion is probably very important. This is likely to be critical in the case of higher concentrate rations which tend to pass through the tract more rapidly. If processing, whether it be steam rolling, fine grinding or reconstituting will improve the speed of digestion then this could explain some of the difference noted in efficiency. The Texas station, however, reports more efficient utilization of high moisture milo in high roughage rations although the magnitude (about 7 percent) of response is much less than for finishing type rations.

Some commercial results have been reported recently from the A. O. Smith Company, in cooperation with the Parker Cattle Company at Happy, Texas, in which air dry ration efficiency was improved by approximately 10 percent when a mixture of 20 percent barley and 80 percent milo was reconstituted to about 25 percent moisture and rolled prior to feeding.

Summary

As a result of this type of review the following factors appear well established:

1. At a given point in the maturity of grains, the dry matter produced is utilized at least 10 percent more efficiently in the case of corn and barley as compared with the same grain harvested below 20 percent moisture. Improved efficiency of high moisture milo utilization has tended to be higher than that for corn with some improvement values above 20 percent compared to dry milo. No work of this nature has been done with wheat or oats.

2. If suitable low cost systems could be developed for reproducing the characteristics of high moisture grain from dry grain and result in the efficiency characteristic of grain harvested in the high moisture state, this would be one of the greatest accomplishments in the history of nutrition research. This is particularly true for the milo feeding area.

3. Limited research data on reconstitution is encouraging; but, as yet, the full potential efficiency of field-harvested high moisture milo has not been attained.

The following questions are unanswered by research data at the present:

1. What are the basic chemical and/or physical characteristics of grains as they mature in the field, or processed by some method, which are correlated with the observed improved efficiency? Without answers in this regard it is difficult, if not impossible to say "these" are the characteristics that must be duplicated by any method of processing.

2. Is the influence physical, by softening, or is it a change in the basic chemistry of the grain, or both?

3. What are the minimum equipment requirements to accomplish the job?

4. What are the comparative losses that occur by processing methods or in other words, what is the actual improvement in efficiency in terms of what was started with on an acreage yield or initial tonnage basis for the nutrient(s) involved?

5. How do such processes influence cattle shrinkage rates, carcass grades and carcass composition?

6. How do such methods alter the management of the grain such as, storage requirements, levels and mixtures of grain that may be used in the ration? Are the results likely to be different when the grain is used in growing, conventional finishing or high concentrate finishing rations?

7. What about cost? The theory on which the process is based is a good one and results to date are encouraging, but it should be recognized that some of the questions we have asked are unanswered at the present time.

BEEF IN THE OKLAHOMA ECONOMY--A CHANGING STRUCTURE

By

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During the past two years, much attention has been focused upon the potential for increased cattle feeding in the Southern Plains Region. In every case, the conclusion has been that the Southern Plains Region--basically Oklahoma and Texas--is among those areas having the greatest competitive advantage (Figure 1)[1/]. The degree of advantage has been estimated to be anywhere from $3.00 to $17.00 per head when compared with the West Coast. My own opinion is that Oklahoma and Texas cattlemen can raise, feed and slaughter cattle in the Southern Plains and ship them into Los Angeles for about $12-$15 per head less than California cattle feeders can perform these functions.

Fortunately, Oklahoma and Texas cattle feeders have markets even more lucrative than California in the Southeast. While they could undersell the West Coast feeder in the big Western market by 1 to 1 1/2 cents per pound, it is unnecessary to do so since they can sell to better advantage in the Arkansas, Louisiana, Mississippi, Alabama, Georgia and Florida areas. Until these markets are saturated, it is unlikely that many feeders will ship West from Oklahoma.

The relevance and accuracy of these recent studies is proved by the fact that both Oklahoma and Texas substantially increased cattle feeding during 1963, 1964 and 1965, while other regions were being forced to cut back because of losses on fed cattle. Some of our feeders lost some money, but they didn't experience enough loss to drive them from the business. In fact, during 1965, the indications are that Oklahoma feeders increased their feeding capacity by more than 20 percent.

All of this is history. Economic analysis has suggested that cattle feeding in the Southern Plains can potentially be lucrative. You as feeders have proved in your individual businesses that the analysis was correct. But the growth in Oklahoma cattle feeding is by no means ended, and the impact of this growth has been and will continue to be felt by many industries in the Oklahoma economy other than those in the livestock feeding sector.

1/ John W. Goodwin, Cattle Feeding..An Analysis of Oklahoma's Opportunity, Okla. Agr. Exp. Sta. Processed Series P-488, January, 1965.

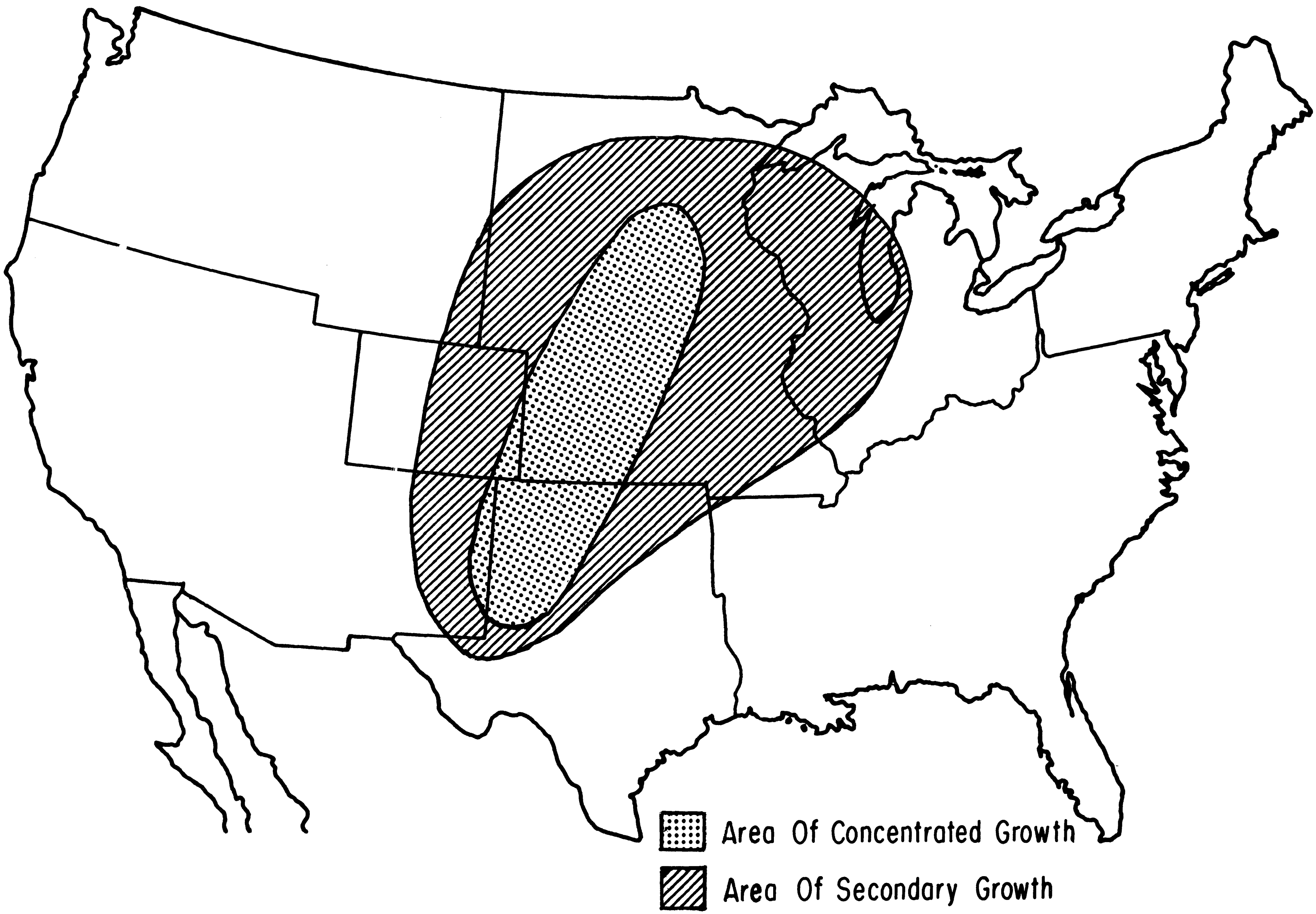


Figure 1. Patterns of Feedlot Growth Expected to Emerge 1965-1975.

What <u>does</u> the growth in cattle feeding mean to the butcher, the baker and the candlestick maker? What changes have we seen in the Oklahoma economy, and how does the beef industry fit into this changing economy? What changes in the beef business have compelled other changes throughout the Oklahoma economy, and what types of change are we likely to see in the future?

The most common means for anticipating the impact of current and future change is to analyze the impact of past change. Let's take a look at the recent economic history of Oklahoma in order to see where we have been and to define where we currently are.

The present state of the Oklahoma economy may be analyzed in terms of three factors--jobs, taxes, and income. These three factors will be used to define where we currently are, and then will be used as measures of what we might expect from changes in the Oklahoma beef industry.

Jobs and Employment

The categories for which we can specify the numbers of people employed in Oklahoma are fairly complete. These categories cover primary, secondary, and tertiary industries. Included in primary industries would be industries such as agriculture and mining which provide basic raw materials. Secondary industries would include those manufacturing industries which utilize the basic raw materials of the primary industries, and those industries which provide the necessary services and equipment for primary industries. The tertiary industries include wholesale and retail trade agencies, personal service industries such as medical, legal and dental services and the like. Some industries such as transportation will be both secondary and tertiary.

There are many ways in which the jobs that exist in the primary and secondary industries may be classified. Some contend that these categories are industries in their own rights and should not be included as a part of any other industry. But it is a fact that these industries exist because of the existence of a primary industry. It is also a fact that economic growth must be based upon a foundation of a stable source of raw materials provided by some primary industry. Thus, it would be sheer nonsense to establish a beef slaughter plant in an area that is incapable of producing beef cattle, or a feed mill in an area that is incapable of producing grains. Therefore, the balance between basic primary industries, which are present in an area and the secondary and tertiary industries are the point with which we must start when planning for economic growth and the resulting job creation.

An examination of the present composition of the labor force in Oklahoma reveals that 14 percent of the jobs in Oklahoma are on farms and ranches (Table 1). An estimated additional 15 percent of the employment exists in industries that are directly dependent upon agriculture. Thus, the ratio of off-farm agricultural jobs to farm jobs in

Oklahoma is about 1:1. In the nation, there are about three off-farm jobs that depend upon agriculture for every job that exists on a farm or ranch. Thus, the ratio in Oklahoma is out of balance when compared with the nation. An additional 130,000 to 175,000 Oklahoma jobs could likely be created through concentration on the development of Oklahoma agriculture and the industries that are dependent on agriculture.

Taxes

When we consider the base for local tax revenues, it becomes readily apparent that the 14 percent of the people working on farms and ranches bear a large share of the local tax burden which supports schools and other local government functions (Table 2). Thirty percent, of the real property assessment in Oklahoma is on farm lands and improvements. Additionally, many farmers today live in town and pay taxes on town lots and improvements. The assessed valuation of the assets belonging to such agriculturally supported industries such as grain elevators, feed mills, meat packing plants and fertilizer mixing installations are not separated. Very likely, 10-15 percent of the valuation on town lots and improvements can be attributed to such businesses. A full 32 percent of the personal property assessed valuation can be attributed to farms and ranches. Twelve percent of this is livestock, most of which is cattle. Thus, more than a third of the tax base for supporting schools and other local services in Oklahoma is agricultural.

The sources of revenue for supporting state governmental functions are dependent upon agriculture in the degree of an estimated minimum of 18-20 percent (Table 3). Thus, if it is considered that about 29 percent of Oklahoma's employment is based upon agriculture, it is apparent that the agricultural sector carries more than its share of the tax burden.

Income

The U.S. Department of Agriculture and the U.S. Department of Commerce provide estimates concerning the gross value of Oklahoma's basic agricultural and mineral production, as well as the value added in the secondary industry of manufacturing. Currently these three sectors account for about $2.2 billion of the value of Oklahoma's gross production. Any attempt to allocate the income derived from the service, trade, and government sectors represents a pure guess since detailed data concerning incomes from those sorts of activities simply are not available.

TABLE 1

NUMBERS OF PEOPLE EMPLOYED AND ESTIMATED NUMBER OF EMPLOYEES ATTRIBUTABLE TO AGRICULTURAL ACTIVITIES OKLAHOMA, 1964

Industry Division	Total Employment	Due to Agricultural Activity Number	Due to Agricultural Activity Percent
	(1,000's)	(1,000's)	
Farming and Ranching	129.4	129.4	100
Mining			
Petroleum and Gas	40.4	0	0
Other	1.9	0	0
Manufacturing	96.6	30.1†	31.†
Transportation	26.3	6.2	23
Public Utilities	19.7	5.8	30
Trade	143.8	57.5	40
Contract Construction, Services, Self Employed, etc.	254.3	28.0	11
Government	143.6	?	?
Total	873.1	257.0†	29†

SOURCE: Oklahoma Labor Market, Oklahoma Employment Security Commission, Oklahoma State Employment Service, February, 1965.

and

Houston E. Ward, "Agribusiness in Oklahoma," OSU Extension Facts, Fact Sheet No. 800, Oklahoma Extension Service, Oklahoma State University, October, 1965.

TABLE 2

GROSS ASSESSMENTS OF REAL AND PERSONAL PROPERTIES, OKLAHOMA, 1963-1964

Property Class	Assessed Value ($1,000)	Attributable to Agriculture Value ($1,000)	Attributable to Agriculture Percent
REAL PROPERTY:			
Farm Lands	445,623	445,623	100
Farm Improvements	159,200	159,200	100
Town Lots	250,590	?	10-15
Improvements on Town Lots	1,176,586	?	10-15
Total Real Property	2,031,999	604,823/	30/
PERSONAL PROPERTY:			
Livestock	76,063	76,063	100
Farm Machinery	58,264	58,264	100
Other	494,982	66,509/	13/
Total Personal Property	629,309	200,836/	32/
PUBLIC SERVICE COMPANIES:			
Railroads & Express	120,480	54,216	45
Elec., Heat, Water Power, and Gas	278,714	46,834	30
Oil Pipeline and Gas Transmission	156,114	--	--
Other	119,037	34,444	29
Total	674,345	135,494	20
GRAND TOTAL	3,335,653	941,153/	28/

SOURCE: Sixteenth Biennial Report of the Oklahoma Tax Commission, July 1, 1962 to June 30, 1964. Oklahoma Tax Commission, January, 1965.

TABLE 3

COLLECTIONS OF STATE REVENUES, AND ESTIMATED SOURCES OF SUCH REVENUES, OKLAHOMA, 1963-64

Type of Revenue	Total Collection	Attributable to Agriculture: Total Collection	Attributable to Agriculture: Percent
	($1, 000)	($1, 000)	
Taxes:			
Gasoline and Motor Fuels	57, 805	8, 093	14
Sales and Use Taxes	56, 859	17, 058	30
License Fees and other Motor Vehicle Taxes	45, 726	13, 718	30
Income Tax	40, 633	5, 689	14
Gross Production Tax	32, 507	0	0
Other	44, 780	6, 269	14
Total Taxes	278, 311	50, 827	18.3
License Fees and Permits	46, 659	6, 532	14
Special Accounts	351	49	14
Miscellaneous	17	2	14
GRAND TOTAL	325, 337	57, 410	18

SOURCE: Sixteenth Biennial Report of the Oklahoma Tax Commission, July 1, 1962 to June 30, 1964, Oklahoma Tax Commission, January, 1965.

We do know that 23 percent of the cargo involved in the Oklahoma transportation industry, for example, originates on farms and ranches. It seems reasonable to assume that a similar proportion of the transportation income is derived from and is hence dependent upon agricultural production. In the case of wholesale and retail trade in communities that are almost totally dependent upon the business from surrounding farm and ranch lands, it seems reasonable to say that these businesses are built upon an agricultural base. But - like any other allocation of the incomes of such businesses - my estimates represent mere guesses. For that reason our discussion: of the source of Oklahoma's income will be restricted to those industries for which sound basic data are available - the value of the production of Oklahoma's primary industries of farming, oil and mining, and to the value added by the secondary industry of manufacturing. While this procedure will omit the income accruing to some satellite and service activities, almost all of the basic foundation for growth will be included.

At the end of World War II, the value of Oklahoma's farm production was more than double the value of production from the oil industry and was more than double the value added by manufacturing (Figure 2). More than a fourth of the value added by manufacturing resulted from the processing of farm products. By 1962 the value of the production from farming, from oil and mining combined and the value added by manufacturing were almost perfectly equal in size. Even though farm production was greatly increased, lower farm prices caused gross farm income to be virtually unchanged -- $735 million in 1947 compared with $748 million in 1962 -- but the value of production income from both the other groups had more than doubled.

If we wish to examine Oklahoma's oil and manufacturing sectors in greater detail, the 1958 Census of Manufacturers provides the most recent information available. Almost a third of the value added by manufacturing came from processing agricultural products. Further, of the gross sales from the oil industry, about one-third went to agricultural customers. Thus, it is apparent that both the oil and manufacturing industries are dependent upon agricultural enterprises for a substantial portion of their business.

Since agriculture is so very important as a basis for the economy of Oklahoma, let's take a close look at the income that is derived from agriculture, the sources of this income, and the changes that have been apparent over the last twenty years.

In 1945, cattle and wheat were our two biggest income-generating farm enterprises, accounting for 49 percent of gross farm receipts (Figure 3). The dairy, poultry and cotton enterprises each accounted for about a tenth. In 1964, cattle and wheat were still the two largest farm enterprises, with cattle alone accounting for 44 percent of farm income. Poultry and eggs -- as products of Oklahoma farms -- had virtually disappeared. Cotton was about half as important and dairy had declined in importance by about 20 percent.

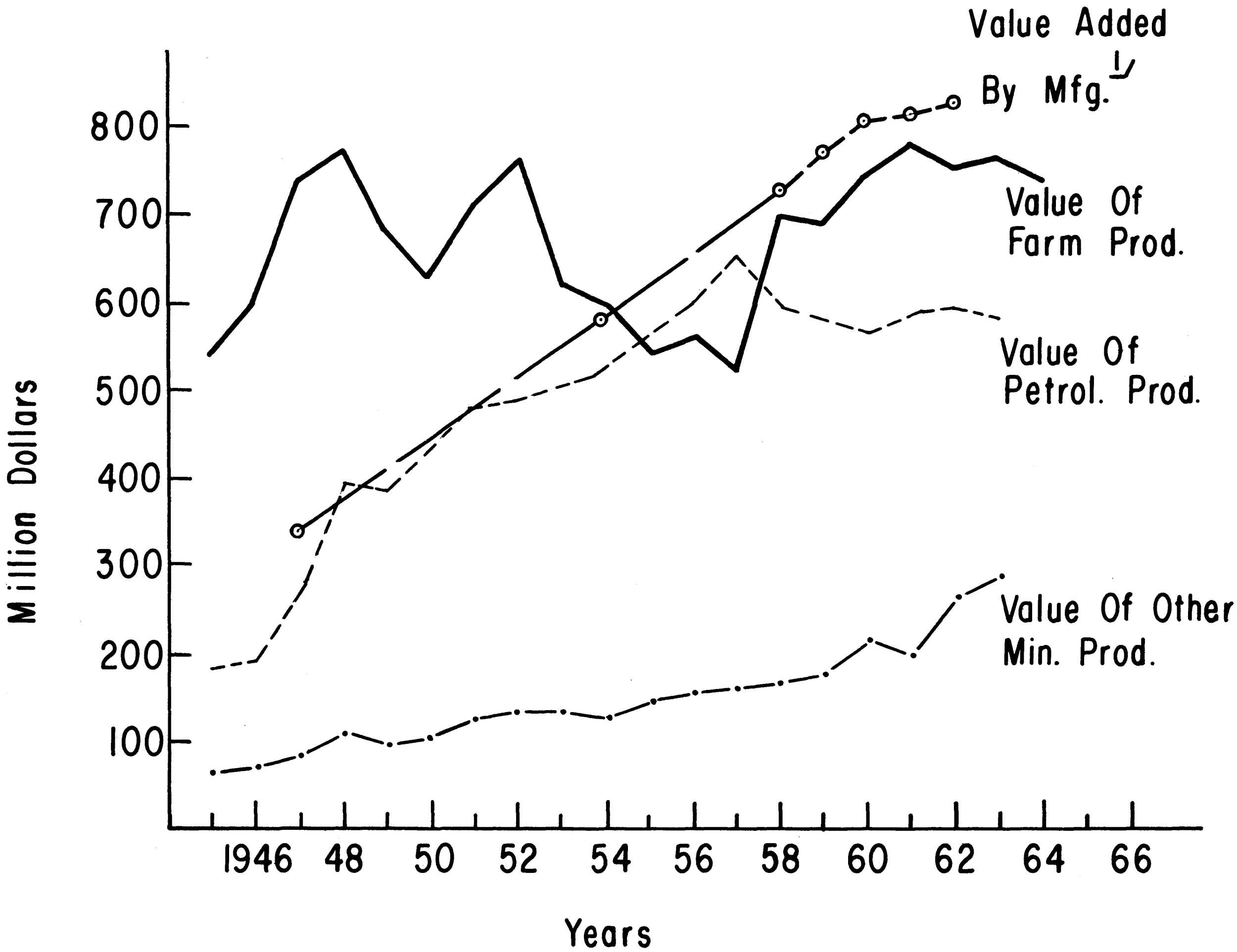


Figure 2. Value of Farm and Mineral Production, and Value Added By Manufacturing, Oklahoma, 1945-1964

1/ Data available only for 1947, 1954, and 1958-62.

We have seen how agriculture is the source of much of the business volume in two other important Oklahoma industries, how agriculture provides the direct source for almost a third of the jobs, and the indirect source for many of the jobs in tertiary industries such as transportation and retail trade, how the agricultural complex provides about 45 percent of local taxes and about 20 percent of state taxes. Thus, in almost every phase of the Oklahoma economy, agriculture accounts for a major portion of the basis for general economic welfare. We have further seen how the beef business provides almost half of the farm income. Therefore, it follows that the fortunes of the entire Oklahoma economy rest heavily upon the beef industry.

The role of agriculture in general and beef in particular in Oklahoma's past development is well defined. The role of these all-important sectors in future development is somewhat less well defined. But the fact remains that economies are developed upon the foundation of resources. When anticipating patterns of economic development and when planning economic growth for any unit -- whether that unit be a farm, a feed mill, a town, county or state -- it is a good idea to take inventory of the resources present and the uses to which those resources have been put. Then, using this information as a foundation for planning, areas in which the injection of new resources may be profitable can be defined.

We've already taken inventory and found agriculture to be Oklahoma's largest single resource. Now let's examine the largest single component of that resource -- that is, the beef industry -- for purposes of estimating the possible impact of potential developments in that industry upon the Oklahoma economy.

Since we know that any increase in Oklahoma beef production is likely to be marketed outside Oklahoma, a quick look at the demand for beef will give us some idea as to whether we really have a market for more beef than we currently produce. There are a number of factors that have tended to increase the demand for beef. Since World War II, U.S. population has increased about 40 percent (Figure 4). Average per capita incomes have increased by about 77 percent. With larger incomes, this larger population has been able to satisfy a preference for beef -- and has actually developed an even greater preference. Per capita beef consumption in 1965 was just about double that of 1945.

The increase in per capita beef consumption was examined in detail the last time this seminar was held. At that time the shifts in demand for beef were related to the cattle cycle (Figure 5). These shifts have seemed to occur historically during periods in which per capita availability of beef is declining. There was a slight decline in per capita beef availability in 1965, and another is likely in 1966. The prices paid for beef in 1965 and the price that is likely this year indicate that we are currently in the transitional phase of another upward shift in the demand for beef. By the 1967-68 period, this shift should be completed. We can expect at that time to be operating along a new and higher level of beef demand that will last for 6-8 years, barring forced liquidation due to drought or some exogenous disturbance such as full-scale war or general economic depression.

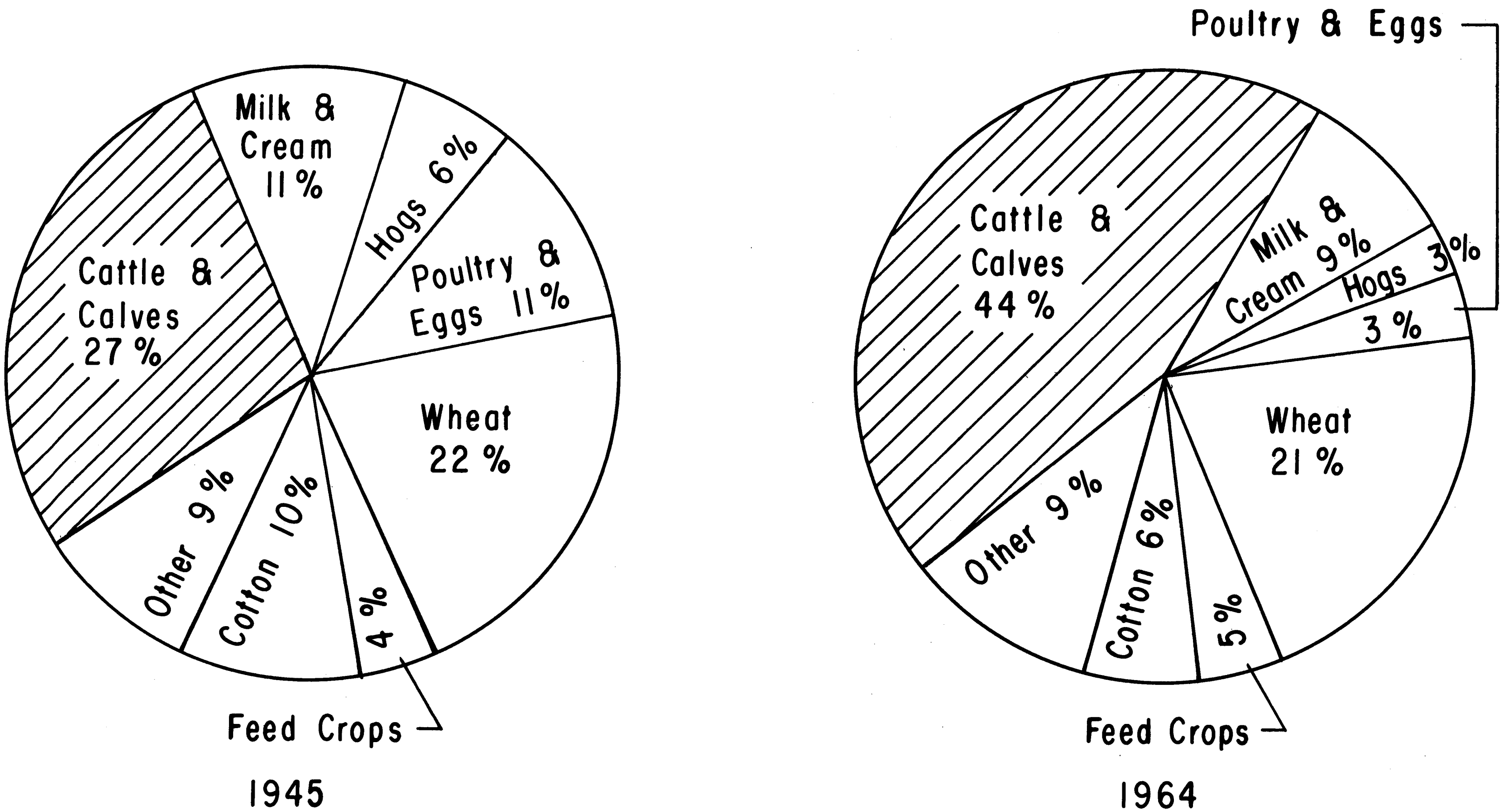


Figure 3. Sources of Cash Receipts from Farming, Oklahoma, 1945 and 1964

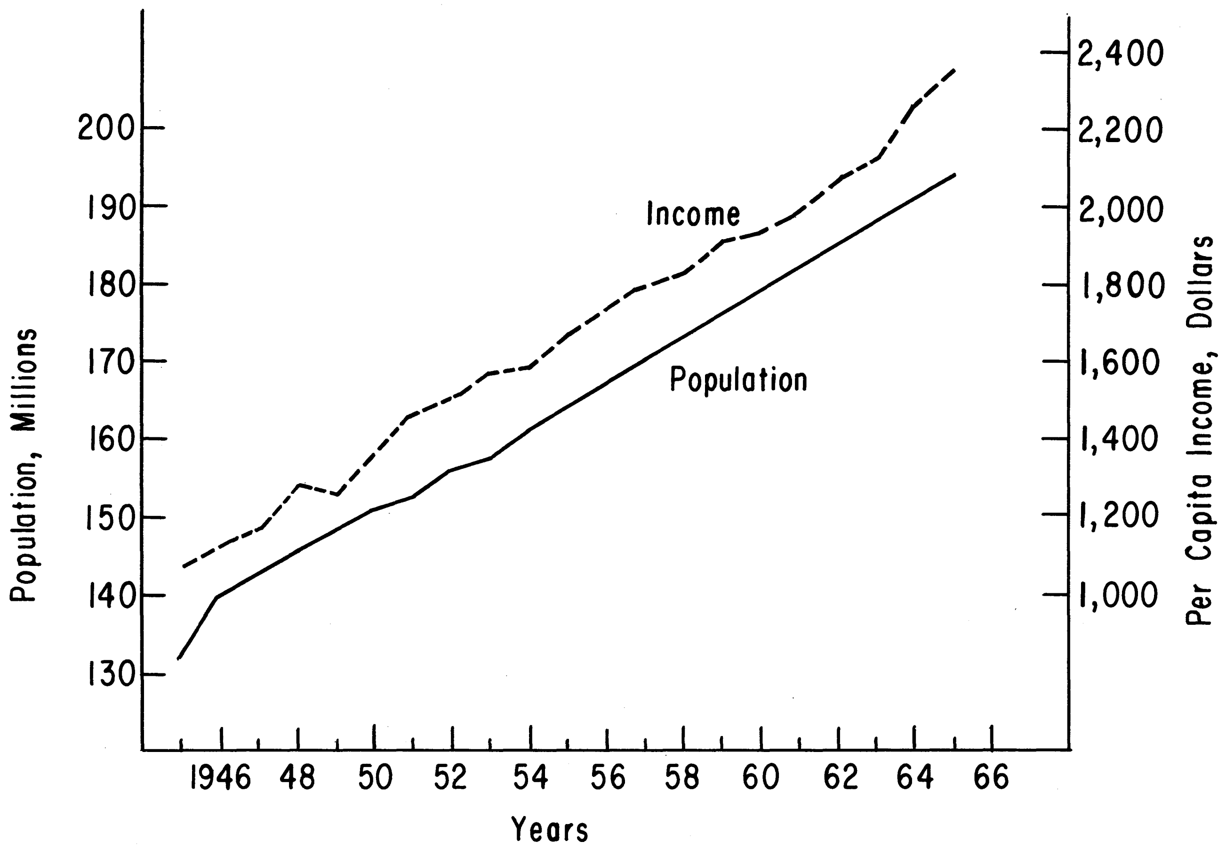
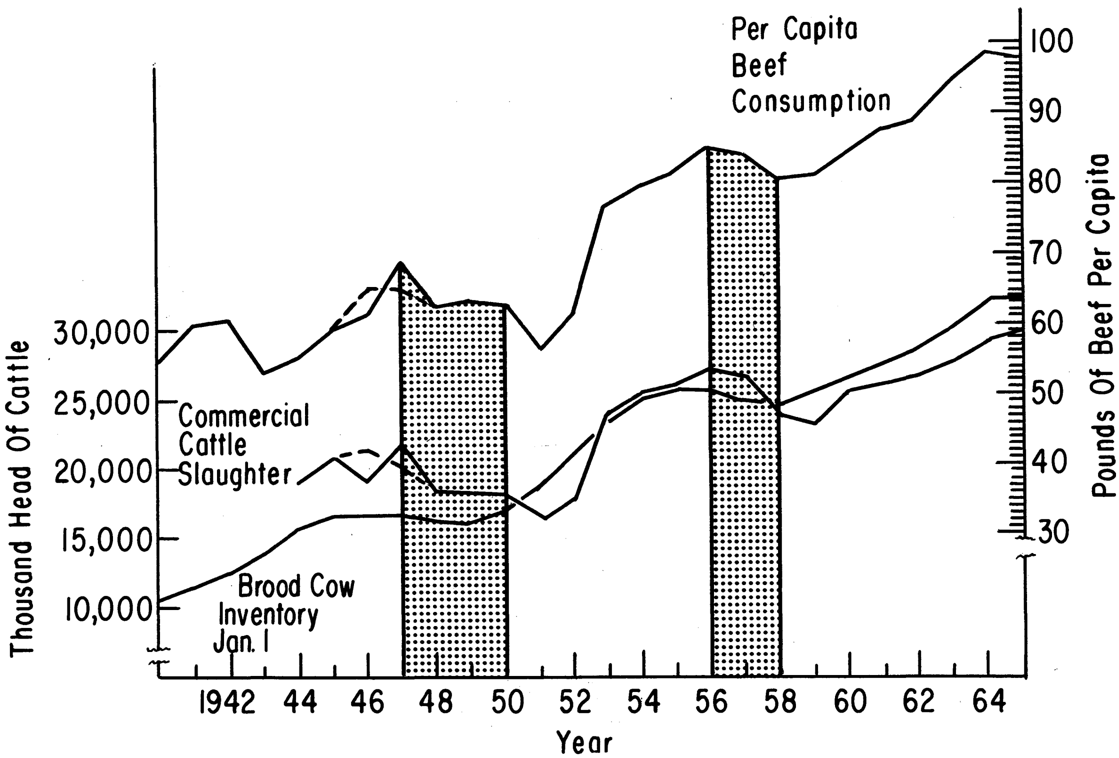


Figure 4. July 1 Population and Per Capita Disposable Personal Income U.S., 1945-1965



Commercial Cattle Slaughter Brood Cow Inventory and Per Capita Beef Consumption, United States, 1940-1964

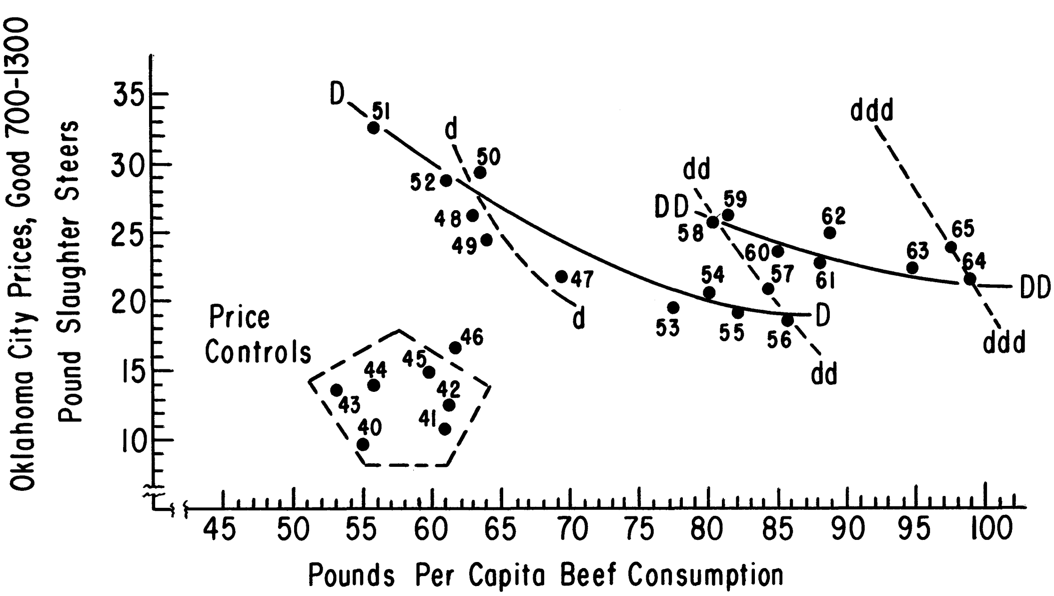


Figure 5. Price-Quantity Estimates of Changes in Per Capita Beef Demand (Oklahoma City Prices and Per Capita Consumption), 1940-1964.

Historically, the magnitude of increases in the per capita demand during "down" phases of the beef cycle have been in the neighborhood of 20-25 percent. This means that the same quantity of beef per person can be sold at a 20-25 percent higher price, or that 20-25 percent more beef per capita can be sold at the same price. Thus, with a 15 percent population increase over the next ten years and a 20-25 percent increase in per capita demand, we can expect an increase in the total U.S. demand for beef in the range of 35-45 percent. Since the Southern Plains region is one of the regions having the greatest potentials for expanding beef production, Oklahoma and Texas may provide a major share of the increased supply which will meet this increasing demand.

There can be little question that the market is present for sharp increases in Oklahoma-Texas beef production. The question now is how much increase can this region generate, and what will be the general economic impact of the increased activity? Let's turn again to history and follow the beef product through all stages of production and marketing in an effort to answer this question, examining the resources available for each stage.

The basic productive unit for beef production is the beef cow herd. While feeder cattle can be transferred from region to region, this process of transfer is an expensive proposition. An abundance of locally produced feeder cattle unquestionably provides some regional leverage when assessing the regional competitive position.

In 1940, there were 432,000 beef cows on Oklahoma farms and ranches. By 1951, the Oklahoma beef cow population had doubled, and by 1964 it had doubled again (Figure 6). The total increase in beef cow numbers from 1940 to 1965 was about 1 1/2 million head -- more than quadruple. The most likely limiting resource for the size of the beef cow herd is forage. From where did the forage come for this 300 percent increase, and how much further increase can be expected?

During the 1940-65 period, dairy cow numbers declined by about 70 percent or a half-million head. Thus, approximately a third of the forage necessary to support the observed increase in beef cows resulted from the decline in dairy cattle. That accounts for about half of Oklahoma's current beef cow herd. The resources for supporting the additional million cows had to come from somewhere else.

The State Office of ASCS reports that about 1 1/2 million acres of Oklahoma pasture have been improved and about 1 1/4 million acres of permanent pasture -- primarily bermuda -- have been established under ASCS programs since 1959. This has provided forage for about 350,000 to 400,000 head of additional beef cows. Considerable acreages have gone into forage crops under private range management practices, and the numbers of horses and mules, sheep, and other forage-using enterprises have almost disappeared. In this manner, the remainder of the forage necessary for supporting record beef cow numbers in Oklahoma has been provided.

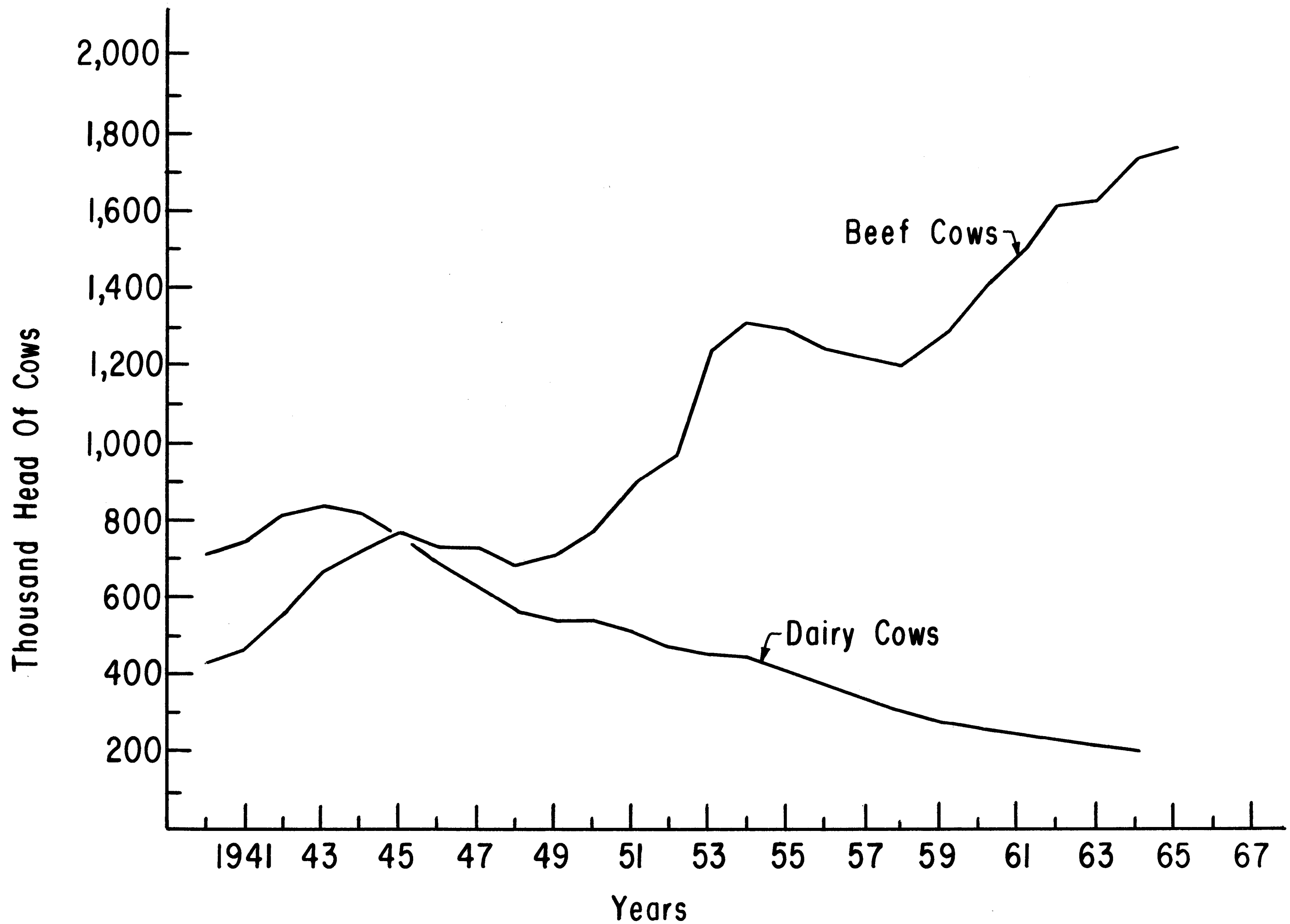


Figure 6. January 1 Inventory of Beef and Dairy Cows, Oklahoma, 1940-1965

The increase in beef cows is by no means restricted to Oklahoma. This has occurred nation-wide to a greater or lesser degree (Figure 7). However, about 20 percent of the national increase has come from Oklahoma and Texas. The per acre increase has been greater in Oklahoma than in any other state. Within Oklahoma, the pattern of increase in beef cow numbers has been well distributed across the state (Figure 8). Between 1950 and 1959, there were only 12 of Oklahoma's 77 counties that showed less than a 4,000 beef cow increase. Fifteen showed increases of more than 10,000 cows. As would be expected, the heavier increases generally occurred in the eastern two thirds of the state where higher rain fall permits pasture fertilization and a broader range of pasture improving grass varieties.

How long can this increase in beef cow numbers continue? It has been estimated that Oklahoma could increase forage production by about 40 percent using only presently known technology and grass varieties.[2] Further, land scheduled for release from the Soil Bank during the next four years will add about five percent to Oklahoma's pasture acreage. Thus, within the next five to ten years, Oklahoma can potentially increase beef cow numbers by about a million head. Obviously, this sort of increase in beef cow numbers is going to cost some money. But the cash costs of producing feeder cattle in Oklahoma are currently among the nation's lowest (Figure 9). Cash costs of production are lower in Western Oklahoma than in Eastern Oklahoma because it is not necessary to feed as much hay, and the advisability of liming and fertilizing pastures in low rain fall areas is questionable. However, forage production in Western Oklahoma becomes limiting much earlier, and the investment cost per cow-unit is much higher for these same reasons. Since Oklahoma's cash costs of production are among the nation's lowest, and since alternative uses for range are quite limited, it is probable that Oklahoma ranchers can afford the additional investment that will be necessary to increase feeder calf production.

The first structural change that is observed in the Oklahoma beef industry, then, is the tremendous growth in the production of feeder calves, and the resulting changes in land use patterns and intensified production techniques. The gross income from the sale of cattle and calves in Oklahoma increased from $125 million in 1945 to about $300 million in 1965. But this gross income figure camouflages another structural change in the industry. Of the $125 million in cattle sales in 1945, virtually all of it was derived from the sale of feeder calves and cull cows. Of the $300 million in 1965, more than $40 million -- or about 13 percent -- was derived from the value added to feeder calves in Oklahoma feed lots. Thus, we have the single-stage industry which produced only grass fat cattle, cull cows, and feeder calves that were shipped to the Corn Belt for fattening twenty years ago becoming a multiple-stage industry that takes feeder calves and transforms them into grain finished beef.

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[2] Oklahoma Beef Institute, Incorporated, Progress Report No. 1, Oklahoma State Dept. of Agriculture, November 17, 1964.

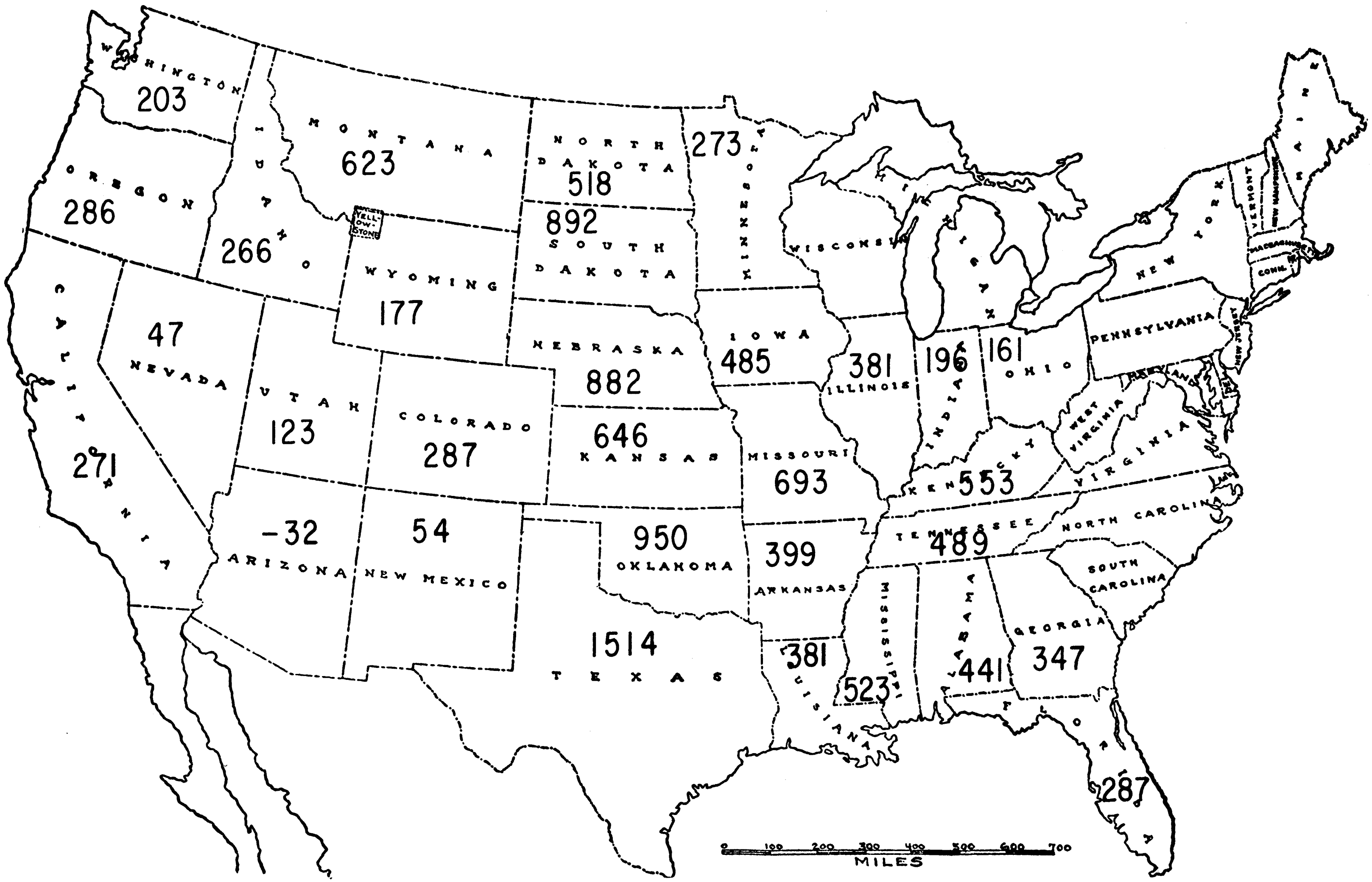

Figure 7. Increase in Beef Calf Crop, 1944-1964 (1000 Head)

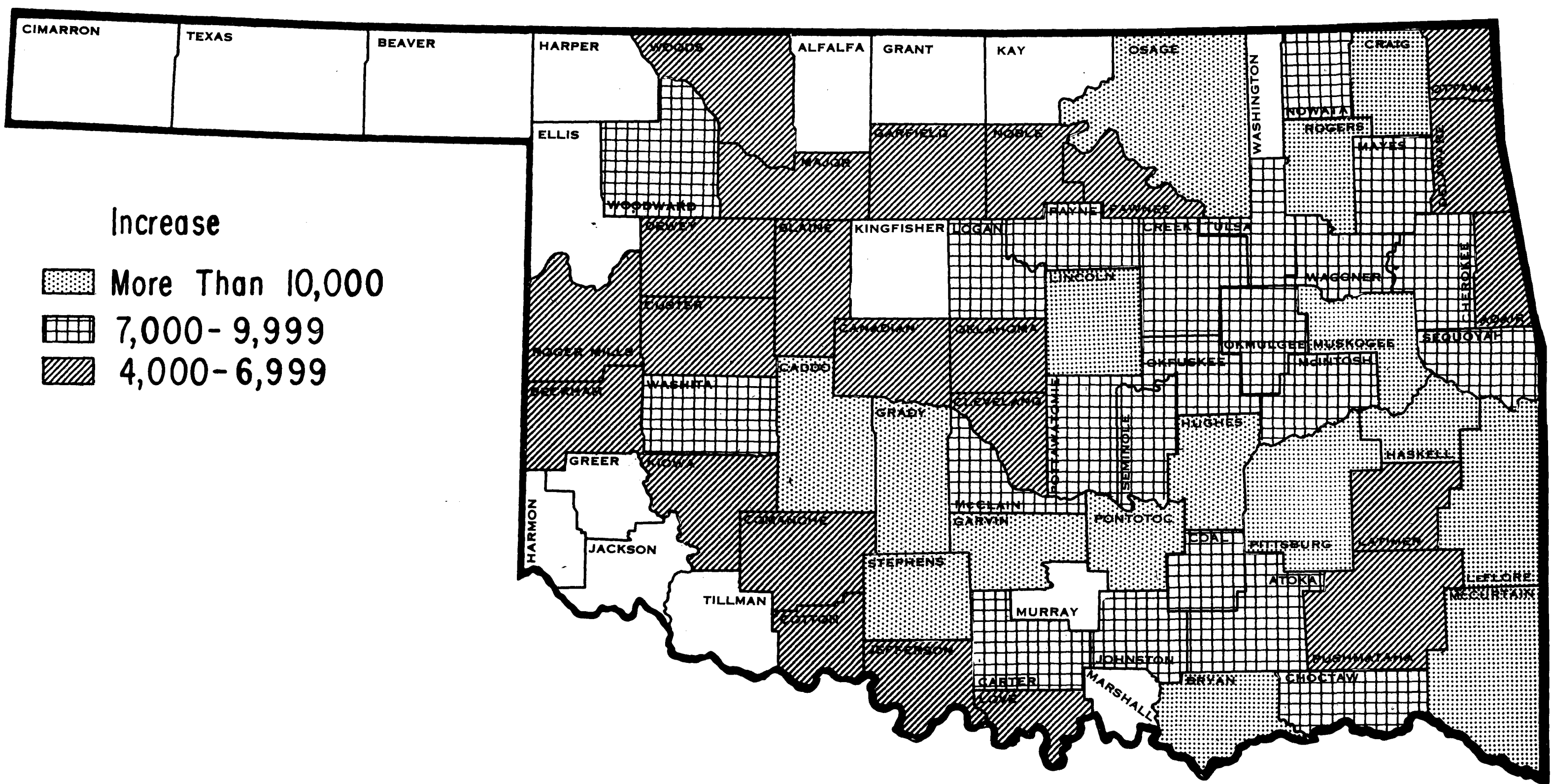

Figure 8. Change in Beef Cow Numbers for Oklahoma Counties, 1950-1959

Oklahoma's cattle feeding got its start in the mid-1950's. Since 1958, the number of cattle fed in Oklahoma has increased by 133 percent. The tonnage of beef produced, however, has increased more rapidly. Early in the development of the feeding industry in Oklahoma, most of the cattle were short-fed to the very light weights that were then preferred in local markets. However, as consumers became more accustomed to grain-finished beef, and as the Oklahoma feeder began to increase the size of his market area, he began to feed to heavier weights. While we still tend to sell cattle at lighter weights than do many Corn Belt feeders, and while we still market some 700-750 pound slaughter cattle, more and more of our cattle are being sold in the 1,000-1,150 pound weight range. In this manner, we have probably increased our tonnage of fed beef by an additional 45-50 percent for a total increase of about 180 percent since 1958. Texas has shown even faster growth.

How much more can the Southern Plains expect to increase their volume of cattle feeding? Do we have the resources to increase cattle feeding indefinitely? While there is a difference between what feeders can and will do, we can get a fair idea of what is possible by taking inventory of the available resources that may be used for cattle feeding, and then translating this information into numbers of cattle that may potentially be fed.

In the general growth of an industry such as cattle feeding, political boundaries have very little meaning. For this reason, rather than making our analysis for Oklahoma as a whole, let's examine the situation for major type-of-farming production areas that include the grain-producing sections of Oklahoma. The three areas selected are the Rolling Plains in Southwest Oklahoma and North Central Texas, the High Plains including the Oklahoma Panhandle, and the Reddish Prairies in North Central Oklahoma and Southern Kansas. While there are other areas in Oklahoma that feed cattle, these three areas have substantial supplies of locally produced grains, as well as major configurations of cattle feeding.

The resources necessary for continued growth in Oklahoma cattle feeding include feeds, feeder cattle, capital, management, and access to live cattle markets. Since each of these areas already has a substantial cattle feeding industry, it is apparent that both management and capital are available in each area. Also, management and capital tend to be more mobile than other resources -- the next speaker is a transplanted cattle feeder from the Corn Belt -- and substantial quantities of these resources can be readily transferred from region to region so long as the other necessary resources are present. Since Oklahoma exports about 1 1/2 million head of feeder cattle annually, and further since feeder calf production is fairly evenly distributed over the state, it is obvious that feeder cattle are not apt to be an effective limitation in any of these three sections. The resource that is most likely to become a limiting factor, then, is feed.

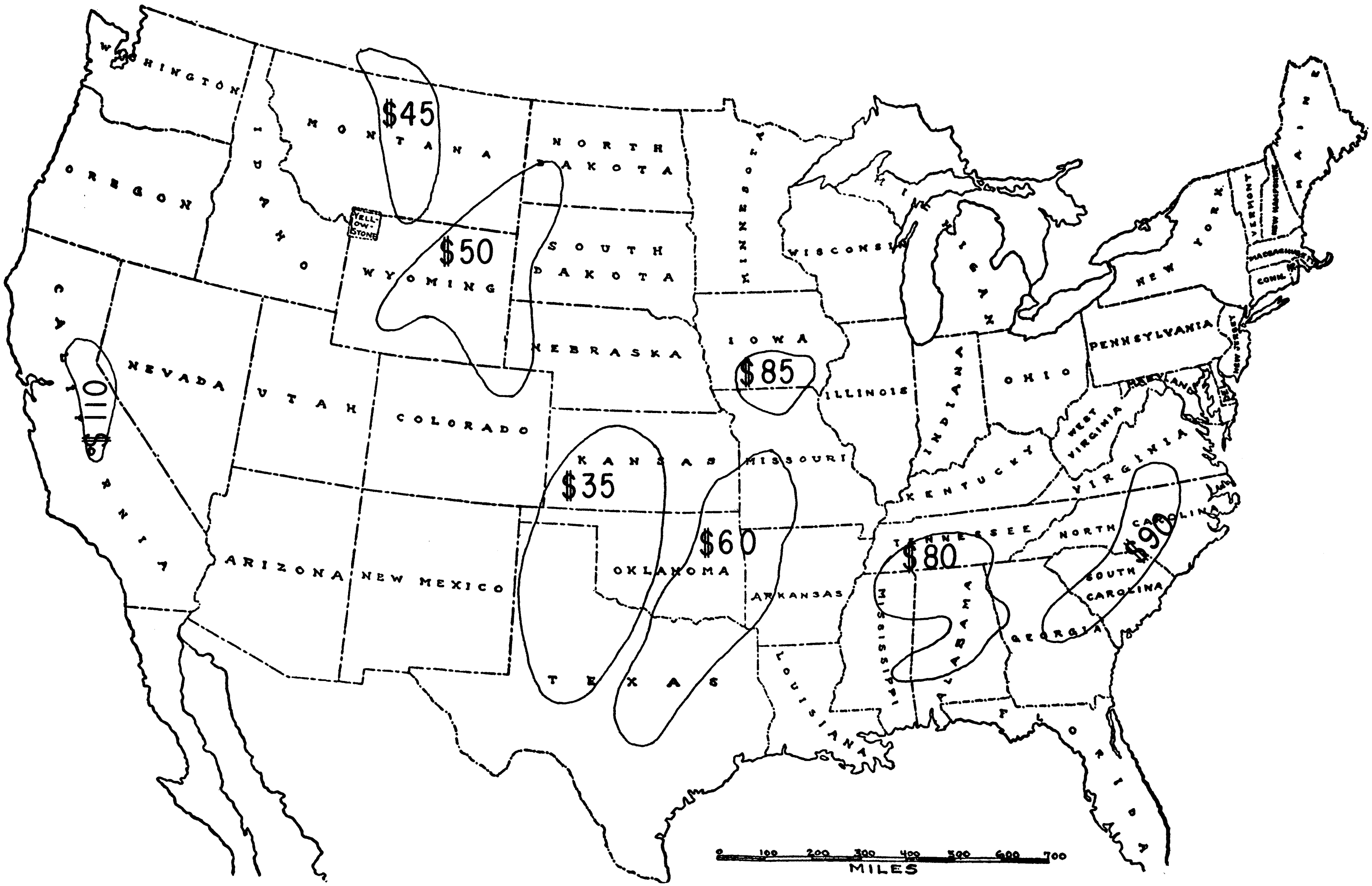

Figure 9. Estimated Cash Costs for Producing 450-500 Pound Feeder Steers, Costs per Head Excluding Land Costs.

Three types of feed are used in substantial quantities in cattle feed lots. These are grains, protein supplements, and roughage. High roughage rations will be used only in areas that can produce roughage at low cost, since the transportation expense prohibits any long-distance transfer of these feeds. Feeders in both the High Plains and the Rolling Red Plains depend heavily upon silage produced under irrigation. While feeders in the Reddish Prairies tend to use less silage than do feeders in the other two areas, forage can be produced inexpensively.

If all the protein supplement needed for animal feeds in Oklahoma came from vegetable sources, we would be importing 6 of every 7 pounds we currently use. However, feedlot cattle can efficiently utilize urea as a protein source. Urea is a product of the petroleum and gas industry, so obviously, almost any section of Oklahoma can easily meet this requirement.

Since 1940, Oklahoma's production of the so-called "feed" grains has declined by about half. Considering only "feed" grains, Oklahoma as a whole uses about the same quantity of grains that she produces. Basically, the three sections that we are considering export grains to the South and West while much of the remainder of the state imports them from the North.

Wheat production, on the other hand, has increased sharply since 1940. Kansas and Oklahoma are first and second in the rank of wheat producing states. For the past two years, wheat has often been priced at levels that made the feeding of wheat advisable. If we consider feed grains alone, and if we reserve grain for the other grain-using enterprises at the 1959 levels of usage, the three production areas considered could feed a total of about 1.9 million head of cattle annually, using only locally produced feed grains (Figure 10). If however, we consider that perhaps a fourth of the wheat could be used for cattle feeding, the cattle feeding potential in the areas increases to a total of about 3.5 million head annually (Figure 11). Obviously, the greatest potentials are in the High Plains and the Reddish Prairies, but the possibilities in the Rolling Red Plains section are quite respectable.

Structural changes in the beef industry haven't been limited to the producing sectors. For several years, we've seen cattle slaughter move away from terminal markets and population centers toward points of cattle supply. This "move to the country" has created an entirely new environment for cattle slaughter. Because of the developments in slaughter technology, the old-time multiple story plant that slaughtered sheep and hogs as well as cattle, and then performed all rendering and processing functions in a plant located at a central marketing point is rapidly disappearing. In its place, we are seeing smaller, specialized, highly efficient plants that slaughter a single species at some rural point of supply.

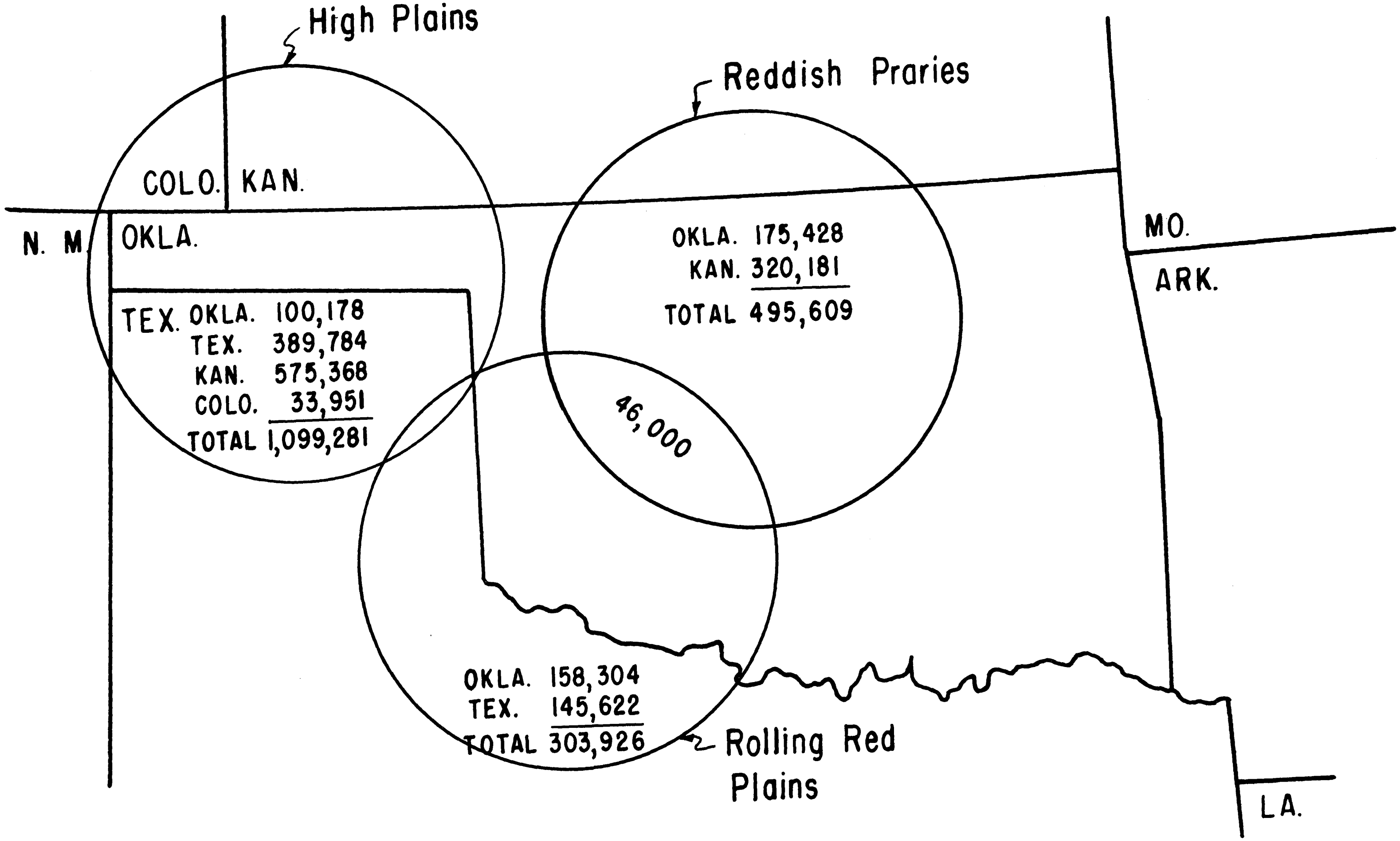

Figure 10. Numbers of Cattle That May Potentially Be Fed With Locally Produced Feed Grains, Type of Farming Areas, Oklahoma.

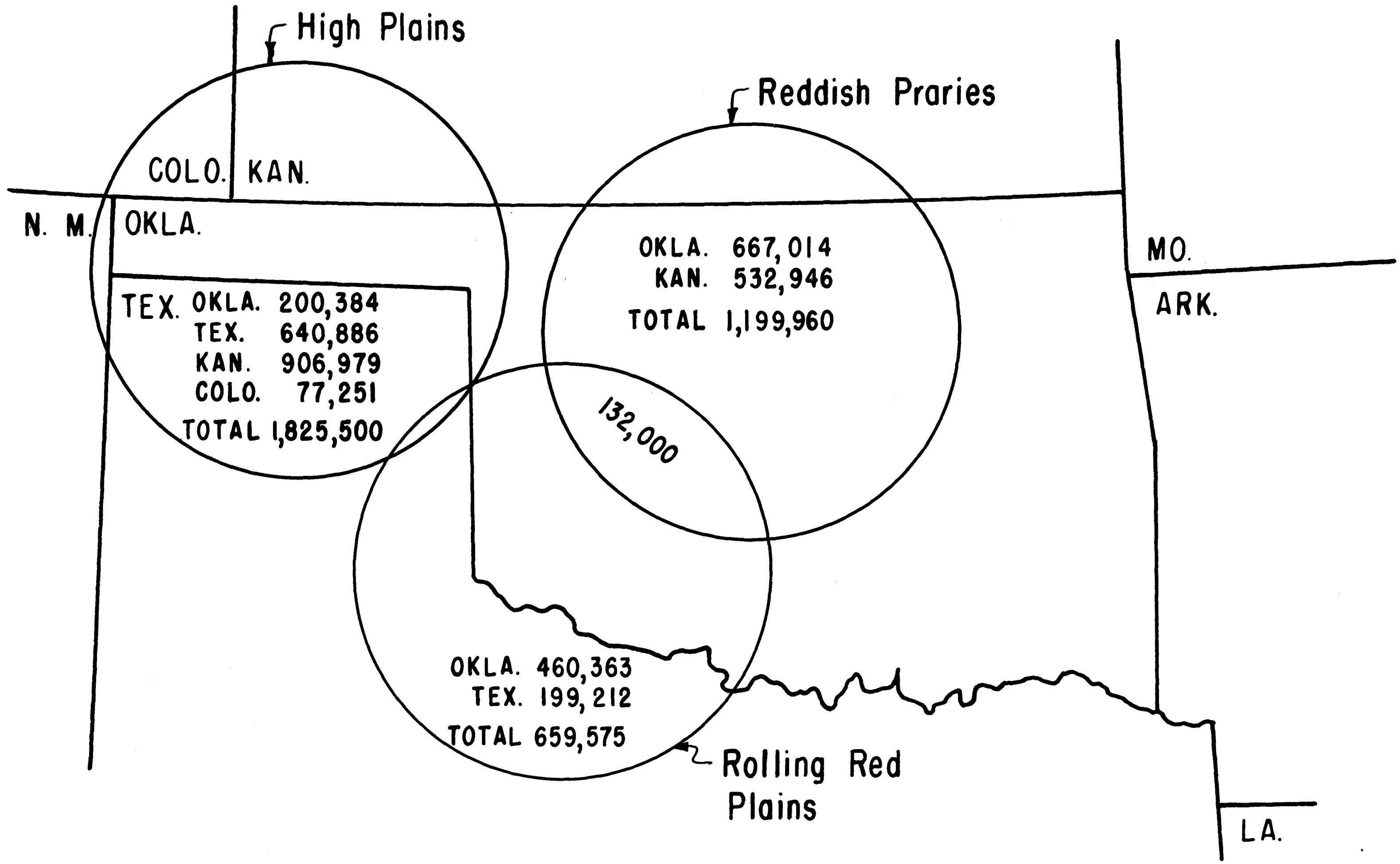

Figure 11. Numbers of Cattle That May Potentially Be Fed With Locally Produced Feed Grains and Wheat*, Type of Farming Areas, Oklahoma

* Assumes that one fourth of the local wheat production is available for feeding.

Since the greatest growth in the production of fed cattle has been in the Southwest and West, there has been a gradual shift of commercial cattle slaughter from the Corn Belt and the Northeast to regions to the South and West (Figure 12). This movement took some of Oklahoma's slaughter capacity prior to the beginning of the growth in Oklahoma cattle feeding. However, in late 1965, Swift and Company announced that a new plant would be built at Guymon. Wilson and Company recently completed a new installation in Oklahoma City. With the increase in feeding in Oklahoma and with two new plants in the state, it is expected that Oklahoma will recover her earlier share of cattle slaughter. Further, Oklahoma may attract still other slaughter facilities into the state.

If further slaughter plants are to be constructed in Oklahoma, there are a number of conditions that must be met. First and foremost, because of the supply orientation of today's slaughter industry, there must be an adequate supply of slaughter cattle available in the area. Labor, utilities, construction costs, taxation, and environmental conditions are other considerations, but the volume of cattle and the way in which a facility will fit into an overall company marketing structure will be the over-riding determinants in locating new slaughter facilities.

A study recently completed at Oklahoma State University suggests that the most efficient size of plant is one which slaughters about 60 cattle per hour -- or about 125,000 per year.[3] This is about the size of the plant that is being established at Guymon. Because of a seasonal tendency in fed cattle slaughter, there may be occasional periods in the fall during which a plant of this size is hard pressed to maintain enough volume for efficient operation. If such a plant is located in an area where cow procurement is feasible, these periods cease to present serious problems. Each of the three production areas defined earlier has a large cow population (Figure 13). Since the pattern of locating new cattle slaughter facilities is oriented toward feeding areas, feeding areas with large potential volumes of cull cows for the purpose of leveling out any seasonal shortages of fat cattle will be particularly desirable. The annual volume of potential cull cows in each of these areas represents a definite asset to potential packing installations. The greatest numbers are in the Reddish Prairies and Rolling Plains region. About an eighth of these cows will be culled each year, so each of these regions should have roughly 100,000 head of slaughter cows in addition to their fat cattle volume. The High Plains area will have about 50,000 head of cull cows annually.

The numbers of cattle locally available for slaughter is only one side of the packing plant feasibility story. Before any firm decides to establish a plant in an area having substantial supplies of slaughter cattle, they must consider the competition they will face for these cattle. Obviously, the cattle are presently being slaughtered by someone

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[3] Franzmann, John R. and B. T. Kuntz, Economies of Size in Southwestern Beef Slaughter Plants, Okla. Agr. Exp. Sta. Bulletin in process.

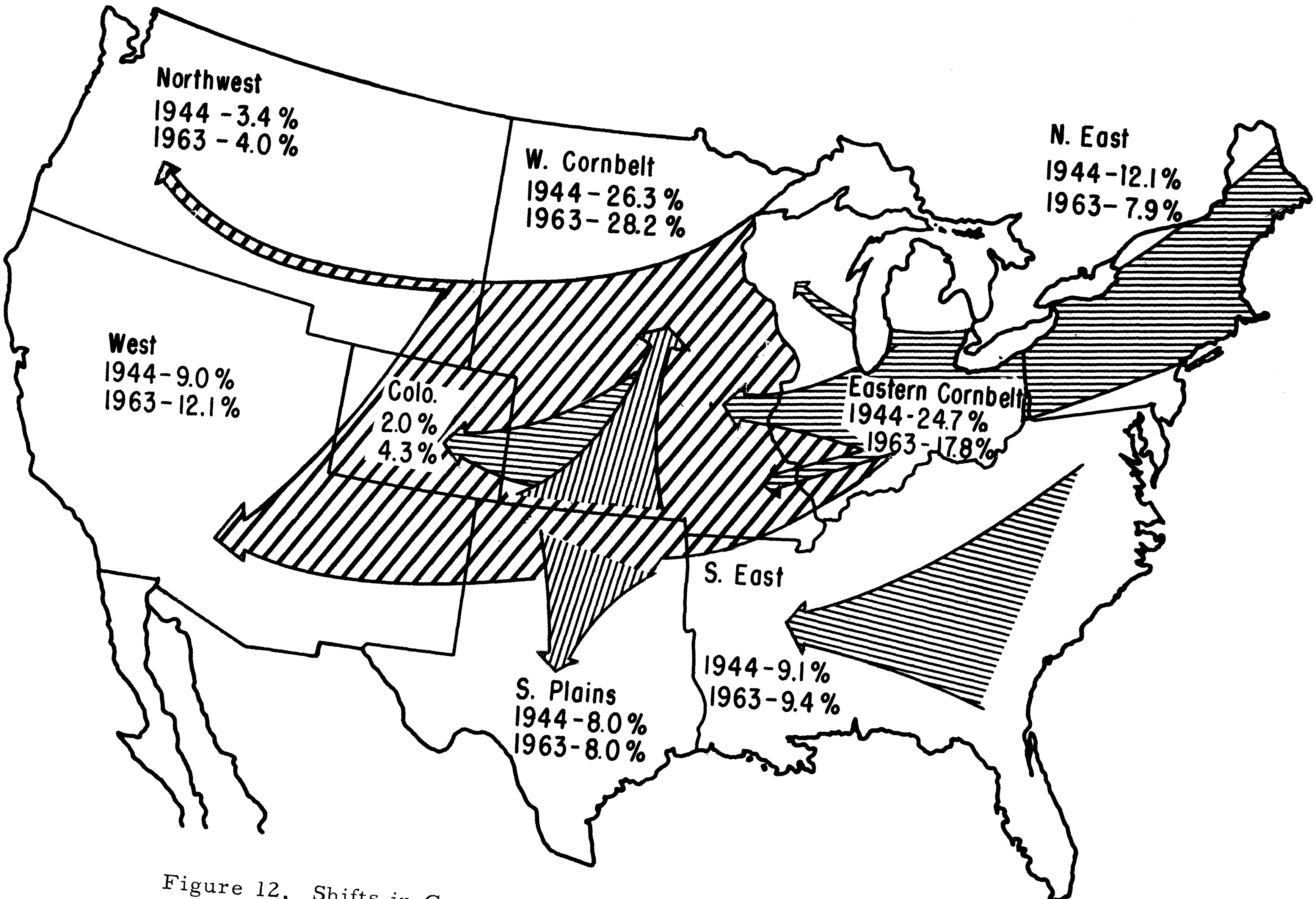

Figure 12. Shifts in Commercial Cattle Slaughter, 1944-1963

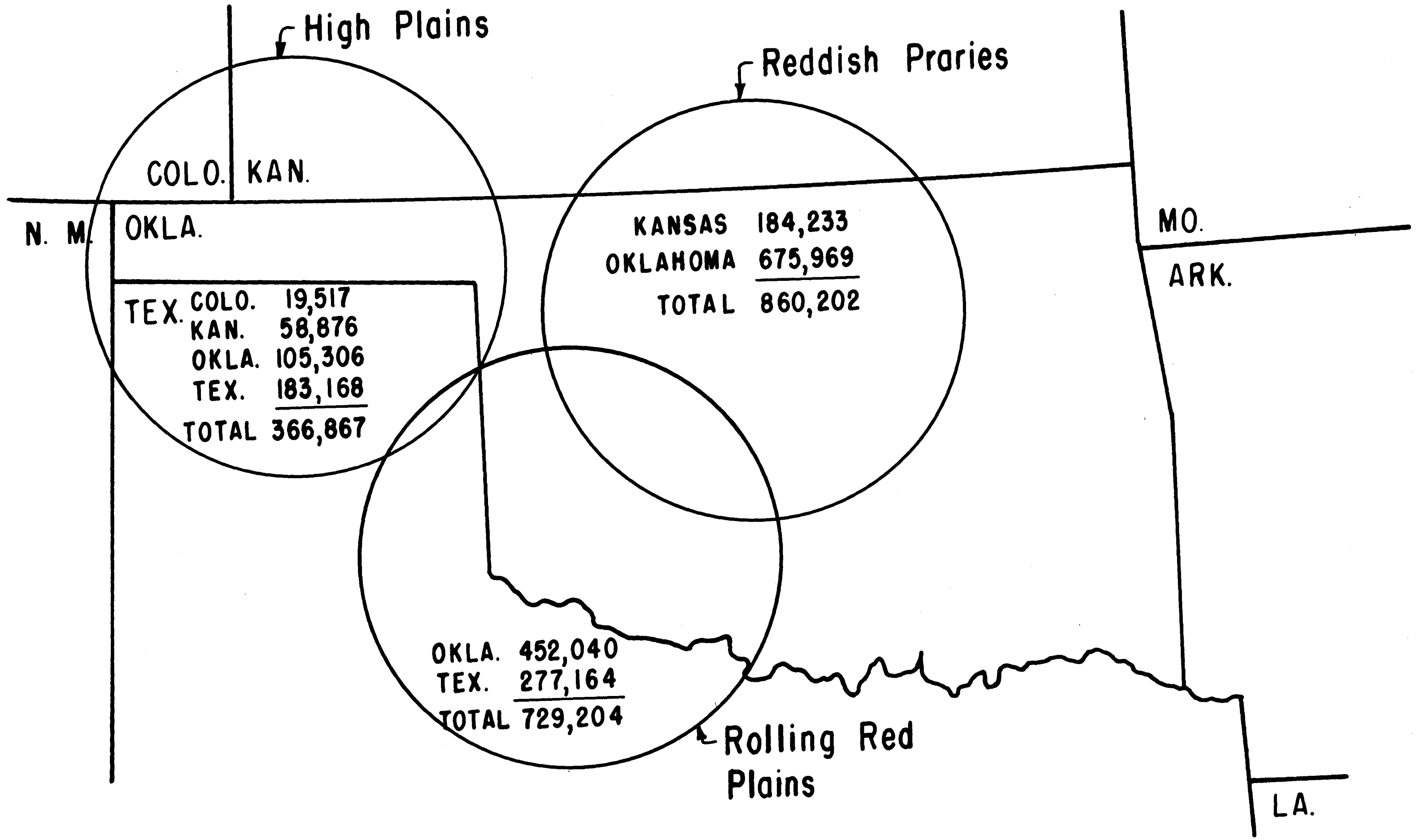

Figure 13. Estimated Numbers of Cows on Farms Located Within 100 Miles of Major Feeding Configurations in Oklahoma, January 1, 1965.

who is not going to give up a source of raw materials without a fight. The question is, how hard is the fight going to be if a new plant is established?

Since a plant of the volume we are considering will undoubtedly be federally inspected, and since most non-federally inspected plants in the Southwest tend to be small-volume operations that will likely continue to operate in about their present manner unless they become federally inspected, we will restrict our discussion to the federally inspected competition.

While it is not uncommon for slaughter cattle to be hauled 200 miles or more to slaughter, the more cattle a plant can procure within a radius of fifty miles, the lower they can keep their procurement costs. Also, the competition for slaughter cattle within 50 miles of a competing plant is likely to be keen, particularly in periods when cattle prices are moving upward. Therefore, an arbitrary figure of a fifty mile radius from the plant has been used to estimate the concentration of competition (Figure 14).

In the High Plains Region, there is a corridor about 50 miles in width from Colorado into the Texas Panhandle in which the new plant at Guymon will be able to buy cattle under the most favorable circumstances. A firm considering a large plant in the Red Prairies would likely meet fierce competition in the Eastern half of the region because of the two plants in Oklahoma City and the one at Arkansas City, Kansas. Thus, expansion of existing facilities or new facilities in this area would likely look West and South for supplies.

The Rolling Red Plains area in Southwestern Oklahoma is likely to have less concentrated competition than any of the regions for the available supplies. There is only one plant within 100 miles of the center of the region, and there are only three within 150 miles. The proliferation of plants to the West of this area are in the heart of the Texas Panhandle feeding area, and very heavy local supplies may reduce the agressiveness of these packers in areas two hundred miles away.

Structural changes in the producing and processing phases of the beef industry have had some strong implications for the Oklahoma segment of the beef industry and for the Oklahoma economy as a whole. But structural changes in the regional composition of beef demand have also occurred. The most remarkable of these changes are the regional shifts of population and purchasing power. The biggest population growth areas are along the Pacific and Gulf Coasts, with the strongest growth occurring in the region from Houston to Pensacola. The most rapid increases in per-capita incomes have also been in this area (Figure 15). Since two of the strongest determinants of demand for beef are population and income, it is apparent that the fastest regional growth in demand has occurred and is occurring in the region South and East of Oklahoma.

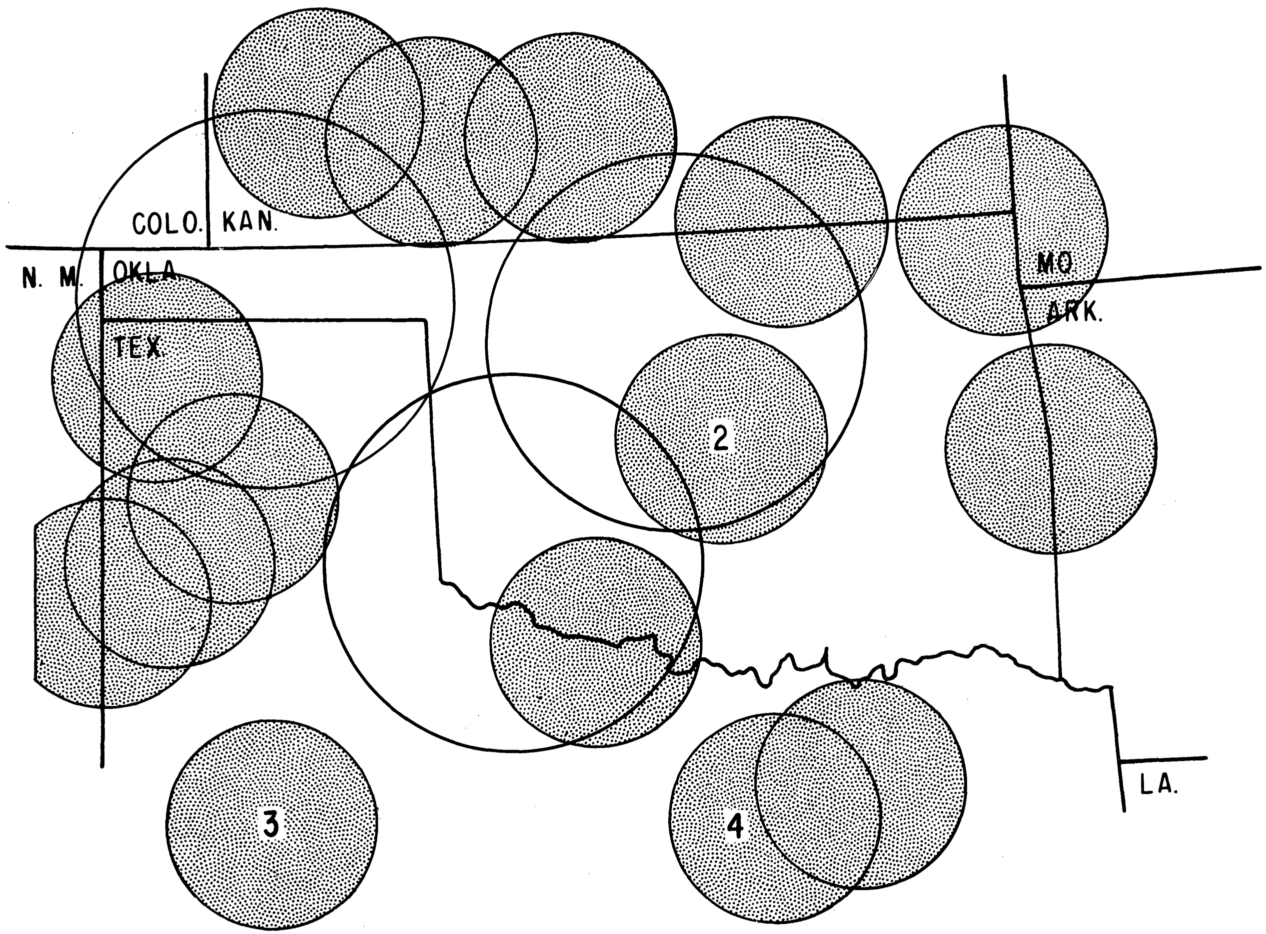

Figure 14. Locations of Federally Inspected Slaughter Installations Available to Oklahoma Cattle Feeders, May 1964.

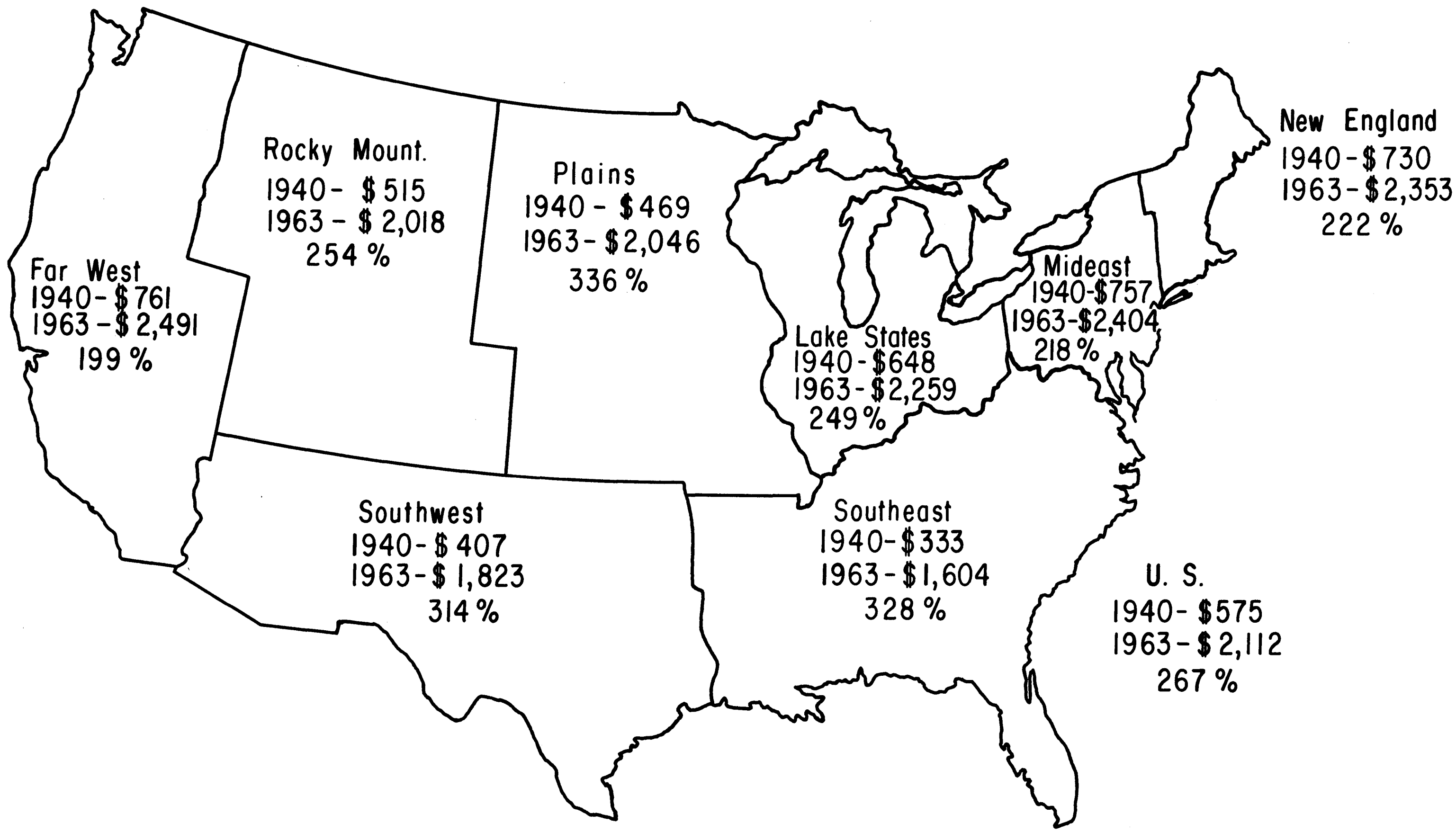

Figure 15. Per Capita Disposable Personal Income With Regional Percentage Increases By Regions, 1940 and 1963.

A study of beef distribution completed at Oklahoma State University in 1963 showed that Oklahoma and Texas had a strong advantage for marketing beef in the states of Arkansas, Louisiana, Mississippi, Alabama, Georgia, South Carolina and Florida.[4/] These states happened to be the area in which the demand for beef is growing the most rapidly. Any surplus beef produced and processed in the Southern Plains should probably be shipped into these areas.

SUMMARY AND CONCLUSIONS

What are the implications of Oklahoma's "New Look" beef industry for the Oklahoma economy? How many jobs, how much tax base, and how much income may potentially be generated as a result of the structural changes in the producing, processing and marketing phases of the industry?

Jobs

If Oklahoma ranchers do in fact increase beef cow numbers by 45 percent or a million head, we can expect about 3,000 jobs to be directly generated in the process. In feedlots, we can expect about one job per 1,000 head of cattle fed, for a total of about 3,000 potential new jobs in the three areas analyzed. In packing plants, we can expect about 120 jobs per plant. In the three areas we have discussed, based upon the feeding potential and the plants already present, there are possibilities for at least five and perhaps ten new plants. Thus, we have about 1,000 potential new jobs in packing plants. In addition are the supply service jobs that this type of growth would generate. The total possible new jobs that may be directly generated by the potential growth in the beef industry exceeds 7,000. A $600,000 annual payroll per new packing plant and the sales of up to 3.5 million fed cattle annually will generate the local business to create many additional new jobs in retail sales, construction, transportation, farm supply, and all the other services necessary for a modern community. Increased cow herd sizes will have similar indirect impacts.

Tax Revenues

The tax base in a community would increase tremendously with the development of a feeding-slaughter complex. Chances are, for every head of feeding capacity, the real property valuation would increase by about $10. Thus, an area with a capacity to feed 100,000 head of cattle at a time would have a million dollar increase in the tax base. A packing plant would likely add about $300,000 to the local tax base, and the additional cows and cattle on feed would add comparably to the personal property tax valuation. Further, the personal incomes generated would be subject to state income tax, and much of the spending of these incomes would be further subject to sales taxes. The Oklahoma Tax Commission

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4/ John W. Malone, A Spatial Equilibrium Analysis of the Fed Beef Economy, Unpublished Ph.D. Dissertation, Oklahoma State University, May, 1963.

estimates that one of every fourteen dollars spent in Oklahoma eventually gets to the State Tax Commission. Thus, the spending generated by the increased business activity resulting from growth in the beef industry would add to state as well as local revenues.

Income

The income directly generated by the expansion potential in the beef industry is tremendous. If we should increase cow numbers to our full potential capacity, this means an annual addition to the value of Oklahoma's basic production of about $100 million. If we should feed cattle to the full capacity of the three type-of-farming areas examined earlier, about $500 million would be added to the value of cattle in such feed lots each year. About $200 million of this could be generated with Oklahoma grains and feeder cattle if these cattle should all be slaughtered in Oklahoma plants, an estimated additional $2.50 per hundredweight of live beef or about $87.5 million annually would be added to the value of Oklahoma's manufacturing production. Thus, the total potential economic growth that can be directly generated by the potential growth in the beef industry amounts to almost $600 million per year. This does not take into account the number of times the money turns over before it leaves a community, nor does it consider the income generated by additional construction, transportation, and auxiliary manufacturing that accompany a growth of this kind.

In a nutshell, the conclusions of our analysis might be stated in this way. Oklahoma is on the threshold of gigantic potential economic growth. Since our largest and most dependable resource is agriculture, the most promising basis upon which to plan growth in Oklahoma is upon a productive agriculture. One of the most promising areas for development is provided by the beef industry, for this industry alone can directly provide at least 7,000 additional jobs, an additional $10 - 15 million in basis for tax revenues, and an increase of $600 million in the value of basic production.

The decisions that will start this growth have been and are being made by men such as yourselves. This growth can occur in Texas or in Kansas just as easily as in Oklahoma. It is up to the citizens and cattlemen of Oklahoma to see to it that the auxiliary business enterprises that can be supported by the further development of Oklahoma beef production are established in Oklahoma.

COMPUTERIZED FARM AND RANCH RECORDS SYSTEMS

By

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Since cattle feeders do business under the same state and federal tax laws as do other farmers and ranchers and under the same contractual law as do all other businessmen, many of your record problems are not unique. But there are some characteristics of the cattle feeding business which set it apart from many others.

1. Most of the inputs are purchased.

2. Nearly every sale must be matched to a purchase to satisfy section II. 1040F tax requirements.

3. Larger portion of the labor is hired.

4. Turnover rate is from 60-120 days contrasted with a year in most crop-farming and ranching.

5. Profits are more rapidly and more seriously affected by short-term variation in feeder and feed prices.

6. Selling decisions are open daily, not only from the standpoint of changing market prices but in condition of stock and cost of gain.

WHAT THE COMPUTER HAS TO OFFER

The rapid adoption of computers by larger businesses in recent years is primarily based on lower cost. This may sound strange in view of the well-known high cost of ownership or rental per computer, but of course we should not measure it that way. The relevant measure is the cost per record. What usually happens when the computer comes on the scene is that records are kept which were prohibitively expensive under former methods.

There is no computation made by a computer which has not been done by hand methods. But the hand-proven procedure is merely done over and over at incredible speed with almost disgusting accuracy, i. e. once "shown" how to handle a problem, it always does it exactly as it was shown, performing arithmetic almost instantaneously, making decisions only when it was instructed to do so and always using the same logic, regardless of the consequences. This leaves the burden of classification on the person who originally records the data since only those errors in recording which were planned for in the computer instructions will be recognized.

One of the most practical characteristics of the use of computers is the ability to process one element of original data into several different records in the same pass. To make these multiple uses of the information punched into a single card possible, codes must be present in each card to permit the machine to make the desired classifications. Since the coding controls the multiple uses of original data written into the record, the feature is the heart of any computerized data processing system. Once it is understood, most of the mystery surrounding machine data processing disappears.

The explanation of a farm record code, a description of what is needed in a farm record system, and an explanation of how such a system works and what may be learned from it is so interrelated that one may arbitrarily choose where to begin. It is much like the chicken and egg situation; which comes first is of little real consequence.

The purpose of any record system is to answer questions for which the manager needs answers or to provide information which he can use to arrive at better decisions. Some of these questions are:

What is the net worth of this business?

How has it changed over the last year?

What is the taxable income for the business for the year?

How much social security tax do I owe on employees?

How much have I paid each employee for the year?

How much depreciation can I claim on buildings and equipment on the tax return?

How much capital replacement must I allow to maintain my facilities?

What is my feed cost per 100 pounds of gain?

How much is it costing to add 100 pounds of gain using a high-grade ration?

Same question on high-forage?

How much have I charged at the feed store; how much have I paid and how much should I still owe at this firm?

How do my earnings compare with those of other similar operations?

How much labor does it require to feed yearlings from 700 to 1100 pounds?

There are innumerable questions which different managers might want to have answered in addition to the several pointed out here. Each of these questions must be approached asking whether the cost of obtaining the data exceeds the value it is expected to have in decision making. All of the data mentioned above could conceivably be maintained by previous methods. The prospect of adding features through Electronic Data Processing is simply through low cost of additional uses. Much of the original data required for enterprise cost records are also necessary for tax records and are now being kept in one form or another. Some of these systems are so weak that totals are not known until after the fiscal year has expired, and they are useful only for tax reporting, not even useful for tax management. Timely classification and interpretation of data is therefore a primary advantage of EDP.

The modern farm requires several kinds of records in order to approach the questions posed earlier. They are:

1. Annual inventories of all assets and liabilities.

2. Depreciation schedules containing all information required for tax purposes.

3. Records of all income and expense transactions.

4. Recording of feed transfers and other inputs between enterprises.

5. Timely summaries of the original data listed above.
    a. Taxable income and expenses.
    b. Capital purchases and sales.
    c. Employee's wages and social security deductions.
    d. Obligations, payments and due balances of accounts payable.
    e. Reclassification of income and expenses for major enterprises.

6. Annual Summary and Analysis specifying such items as:
    a. Taxable farm income and deductable expenses.
    b. A full record of costs, depreciation and book value of Capital Assets.
    c. Overall business analysis including:
        1. Net Cash Income.
        2. Inventory changes for the accounting period.
        3. Rate of earnings on capital investment.
        4. Returns to labor.
        5. Returns to management and risk.
        6. Cash flow credit requirements.
    d. Analyses of major enterprises within the farm.
        1. Cash income and expenses.
        2. Allocation of distributable "overhead" costs.
        3. Charges and credits for farm-produced inputs.
        4. Relevant cost factors such as:

a. Machine cost per hundredweight of beef produced.
b. Feed cost per hundredweight of beef produced.
c. Marketing and transportation costs.
d. Cost per hundredweight of feed fed.

The application of any record system to any particular individual business is not automatic nor effortless. Such a system may appropriately be described as analogous to a kit of tools. The mere rental of such a kit will not guarantee the construction of a useful product. The user must first know what each tool is designed to do, when to take it in hand, and learn to use it with dexterity. Just like every tool is not equally useful in the construction of a given particular item, some phases of a record system will be more important than others in maintaining records for a particular farm.

The classification scheme for landlords and partners is inapplicable to single-proprietorship, owner-operated farm. Sections of the code dealing with livestock are unused on cash-crop operations, etc. The most difficult and expensive part of operating such a system is teaching the cooperator the capabilities of the system and enabling him to use the right tools at the right time so as to generate the kind of records he needs and wants with the level of precision he feels is necessary. Labor records kept daily are obviously more precise than than those recorded weekly or monthly. Yet weekly recording is often quite acceptable to serve the intended purpose. In some cases no labor records at all may be justified.

The benefits of such a system cannot be assessed in a general sense unless we make some sometimes unwarranted assumptions. Like any other tool the amount of benefit received will depend on how effective the tool they replace has been and how much they are used. Some farmers have never had timely and complete net worth statements; they usually find these very useful. Many times new cooperators find that the self-discipline imposed through such records forces them to make more timely entries and thereby gain tax benefits heretofore missed simply because of omission. Some have had no previous notion of what certain phases of their businesses were doing and were able to make real improvements in farm organization. Some find through records that their previous "seat-of-pants" notions were quite good. They may not make changes, but do gain the satisfaction of having verified their intuitive judgement. Comprehensive and well-organized documentation are always appreciated when the tax auditor makes his occasional investigation. Adequate records are becoming more and more important to institutional lenders who are more comfortable with documented loan portfolios. The banker, in fact, may turn out to be one of the most effective forces in stimulating better farm records as he is stimulated, in turn, by the loan auditing system. Credit sources are placing increasing emphasis on projected ability to pay with compensating diminished importance on the capitalization of the lender.

The ability to compare results with similar farms is also important.

AVAILABILITY

The centrally processed record system described herein is not generally available in most areas of the country, and Oklahoma is no exception. There are unmistakable signs, however, they soon will be. Some of those available soon will not be as complete as described here. Regardless of how comprehensive they are to begin with, they will be modified to fit what the farmer or feeder or rancher wants. They will likely begin as a compromise between what the designer thinks the cooperator needs and what is possible with the equipment which happens to be available because of it's use for other businesses.

Several trial projects are underway in Oklahoma this year. They vary in size, form and cost. Our COST-FINDER pilot project at Oklahoma State is working with 20 farms developing forms, cooperator training materials, and computer routines. As an education-research institution our projected total enrollment is less than 300 farms to be used jointly for special research in records and farm cost analysis. Several firms are following our progress closely, to evaluate the possibility of adapting systems to be offered on a commercial basis in the next year or two. We are interested in helping anyone who can offer such a system to Oklahoma farmers do the best possible job of serving their needs. As these systems become available, our Extension Farm Management Staff will conduct training sessions for farmers to teach them the principles of farm records, mechanics and procedures for recording, and interpretation of results.

We also intend to continue research into the improvement of such systems and extensions into other management tools which show promise as aids in making management decisions.

Questions?

ANALYZING INVESTMENT OPPORTUNITIES

By

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One of the most striking disparities between todays farm and ranch management practices and sound management theory lies in the area of capital budgeting and investment decisions. Investment decisions involving the expenditure of millions of dollars on the purchase of farm machinery, land, remodeling and repairing production facilities and equipment and acquiring new production facilities and equipment occur annually in Oklahoma. Yet, little emphasis has been placed either in research or in practical farm and ranch management work on procedures which are useful in evaluating investment alternatives.

Before these remarks are interpreted as a criticism of the farm management work or farm and ranch managers, I will hasten to add that other business managers also experience a serious lack of appropriate procedures for accurately evaluating investment alternatives. There is little doubt but that this situation exists because an economic analysis which considers all aspects of an investment problem is necessarily quite complex. However, the organization and operation of feedlots and other farm enterprises is also becoming more and more complex. At a time when detailed accounting procedures are a necessity, machine record keeping and linear programming analyses are common, and so called "scientific" management and feedlot practices are rapidly expanding, procedures for analyzing investment decisions need to be developed, understood and used by cattlemen. Otherwise, investment decisions based upon hunches can hardly be expected to be consistent with either the short-run or the long-run objectives of the individual cattlemen.

During the next few minutes I shall discuss two procedures which are commonly used by other business managers to evaluate investment alternatives. I will point out some of the advantages and disadvantages of these procedures. Next, I shall present an investment analysis procedure based on a partial budgeting technique with which many of you are already familiar. I will indicate how this budgeting procedure overcomes many of the disadvantages associated with the first two procedures presented.

Two Common Investment Analysis Procedures

The Payback Period or Capital Recovery Procedure

The concept of "payback period" or "capital recovery" is perhaps the most popular method of evaluating capital expenditures in the business field. Briefly, the payback period procedure attempts to measure the length of time it will take expected cash proceeds generated by an investment to equal the initial cash outlay required to make that investment.

For example, if a machine cost $15,000 and is expected to produce operating savings of $3,000 per year for seven years, it has a payback period of five years. If the expected cash flows vary annually, the payback period is determined by adding the expected proceeds for each year until the sum of the proceeds equals the initial cash outlay. In either case, the shorter the payback period the more desirable the investment or asset is assumed to be.

Table I illustrates the use of the payback period procedure for evaluating two investments having, respectively, constant and variable cash flows. If it is assumed that neither Investment A nor Investment B in Table I will produce a cash flow beyond the seventh year, management might erroneously conclude that there is little difference between the two investments. Each investment produces $21,000 over a seven year period for the same $15,000 initial investment. However, when the payback periods associated with the two investments are computed, Investment B would usually be preferred to Investment A. The payback period for Investment B is only four years as compared to five years for Investment A. Thus, the payback period procedure is of definite value in investment decision making.

TABLE I

CALCULATION OF PAYBACK PERIODS

Period (Year)	Investment Outlay	Incremental Cash Flows[a]	
		Investment A	Investment B
1	$15,000	$3,000	$2,000
2		3,000	4,000
3		3,000	5,000
4		3,000	4,000
5		3,000	3,000
6		3,000	2,000
7		3,000	1,000
	Totals	$21,000	$21,000

[a]Underlined incremental cash flow values are those increments for which payback of investment outlay is attained.

There are perhaps many reasons for the popularity of the payback period as a measure of the acceptability of investment expenditures by businessmen. The following reasons, however, appear to be the principal ones:

1. It is easy to calculate. Thus, the cost, effort and time expended in the evaluation of an investment alternative is small.
2. It is relatively easy to understand. However, this advantage will probably decline in importance as managers become familiar with other approaches to investment decision making.
3. Risk-conscious managers probably have rather strong liquidity preferences. Uncertainty influences all managers to sacrifice some profitability in favor of investments that offer prospects of an early return of the investment outlay. The payback period approach does emphasize this liquidity aspect of the investment decision.

There are also several objections to the use of the payback procedure of evaluating investment alternatives. Perhaps the principal objection to this method of investment analysis is that it fails to measure profitability.

Measuring the length of time it takes to recover an initial investment outlay contributes little to gaging the earning power of the asset. Thus, the payback period ignores differences in the timing of cash flows. In other words, it fails to recognize the difference between the present and future value of money. The basic principle ignored is that a one dollar return at some future date is not equal to a one dollar cost today. Thus, using the payback period or capital recovery procedure as the sole criterion for investment decisions may well lead to an undue emphasis on liquidity at the expense of profitability.

The Discounted Payback Period and Profitability Index Procedure

The conventional payback period calculation clearly fails to consider the cost of capital. To use the conventionally measured payback date as the breakeven date for a given investment is tantamount to suggesting that capital can be obtained and/or used without cost. Thus, the discounted payback period computes the length of time it takes an investment's incremental cash flows, discounted at the opportunity cost, to accumulate to the investment outlay. Only at the end of this period is the breakeven claim one with economic substance, for this is the length of time it takes proceeds from the investment to accumulate to a sum equal to the investment outlay compounded at the opportunity cost rate over the same period. Then, and only then, has the investment broken even with respect to alternative investment opportunities of like degree of risk.

Table II illustrates the use of the discounted payback period and profitability index procedure as it would apply to Investment B of Table I. Columns 1, 2, and 3 of Table II are taken directly from Table I. Column 4 is obtained from standard interest tables where it is assumed that the opportunity cost of the investment outlay is eight percent. The opportunity cost is the expected return from the investment outlay if the funds were to be used in the best alternative other than the investment under consideration. Column 5 of Table II is obtained by multiplying the respective values of Column 3 by the values of Column 4. Note that because of this discounting procedure, the present value of the $21,000 cash flow over the seven year life of the asset is equivalent to only $16,076. Also note that the discounted payback period for Investment B is in fact six years when the opportunity cost of capital is 8 percent as compared to four years using the payback period or capital recovery procedure and its implied zero cost of capital.

Column 6 is the cumulative sum of the discounted incremental cash flows. The percent investment recovery, Column 7, is obtained by dividing the respective elements of Column 6 by the investment outlay, $15,000. The last figure in Column 7, 107.2 is the profitability index associated with Investment B.

The profitability index indicates that the return on Investment B is expected to exceed the annual opportunity cost of 8 percent by 7.2 percent of the initial investment outlay. The return on Investment B is therefore approximately 9 percent. The profitability index clearly indicates that the investment under consideration would be more desirable than other six year investment alternatives which yield returns of only 8 percent per year. In other words, investment alternatives yielding only 8 percent per year return are less profitable than Investment B.

The percent investment recovery figures of Table II, Column 7, are also quite useful in evaluating investment alternatives with respect to a managers liquidity preference through the use of what is called the discounted payback profile of the investment.

The discounted payback profile for Investment A and Investment B are shown in Figure 1. From Figure 1 management can determine not only that, as the previous analyses have already shown Investment B is preferable to Investment A because its payback period and discounted payback period are shorter and its profitability index is higher over the seven year life of the two assets, but after the second year Investment B always has a higher investment recovery rate than does Investment A.

To illustrate a further use of the discounted payback Profile, suppose that management pre-specifies that in order to be acceptable, an investment must not only equal or exceed a certain profitability index but that it must also possess a discounted payback profile of a given type. A standard six year discounted payback profile of 20, 50, 75, 90, 95, and 100 percent recovery for six successive periods is also shown in Figure 1. Thus, of all investment alternatives with satisfactory profitability indices, only those would be considered with discounted payback

TABLE II

CALCULATION OF DISCOUNTED PAYBACK PERIOD AND PROFITABILITY INDEX FOR INVESTMENT

Period (year) (1)	Investment Outlay (2)	Incremental Cash Flow[a] (3)	Present Value of $1 discounted at 8% (4)	Present Value of Incremental Cash Flow[b] (5) = (3)x(4)	Cum. P. V. Cash Flow (6)	Percent Investment Recovery (7) = (6) / (2)
1	$15,000	$2,000	$.9259	$1,852	$1,852	12.3
2		4,000	.8573	3,429	5,281	35.2
3		5,000	.7938	3,969	9,250	61.7
4		<u>4,000</u>	.7350	2,940	12,190	81.3
5		3,000	.6806	2,042	14,232	94.9
6		2,000	.6302	<u>1,260</u>	15,492	103.3
7		1,000	.5835	584	16,076	107.2[c]
	Total	$21,000	Total	$16,076		

*Cash flows received at end of period.

[a]Underlined incremental cash flow value is that increment for which payback of investment outlay is attained.

[b]Underlined present value of incremental cash flow value is that increment for which the discounted payback of investment outlay is attained.

[c]Profitability index of investment B.

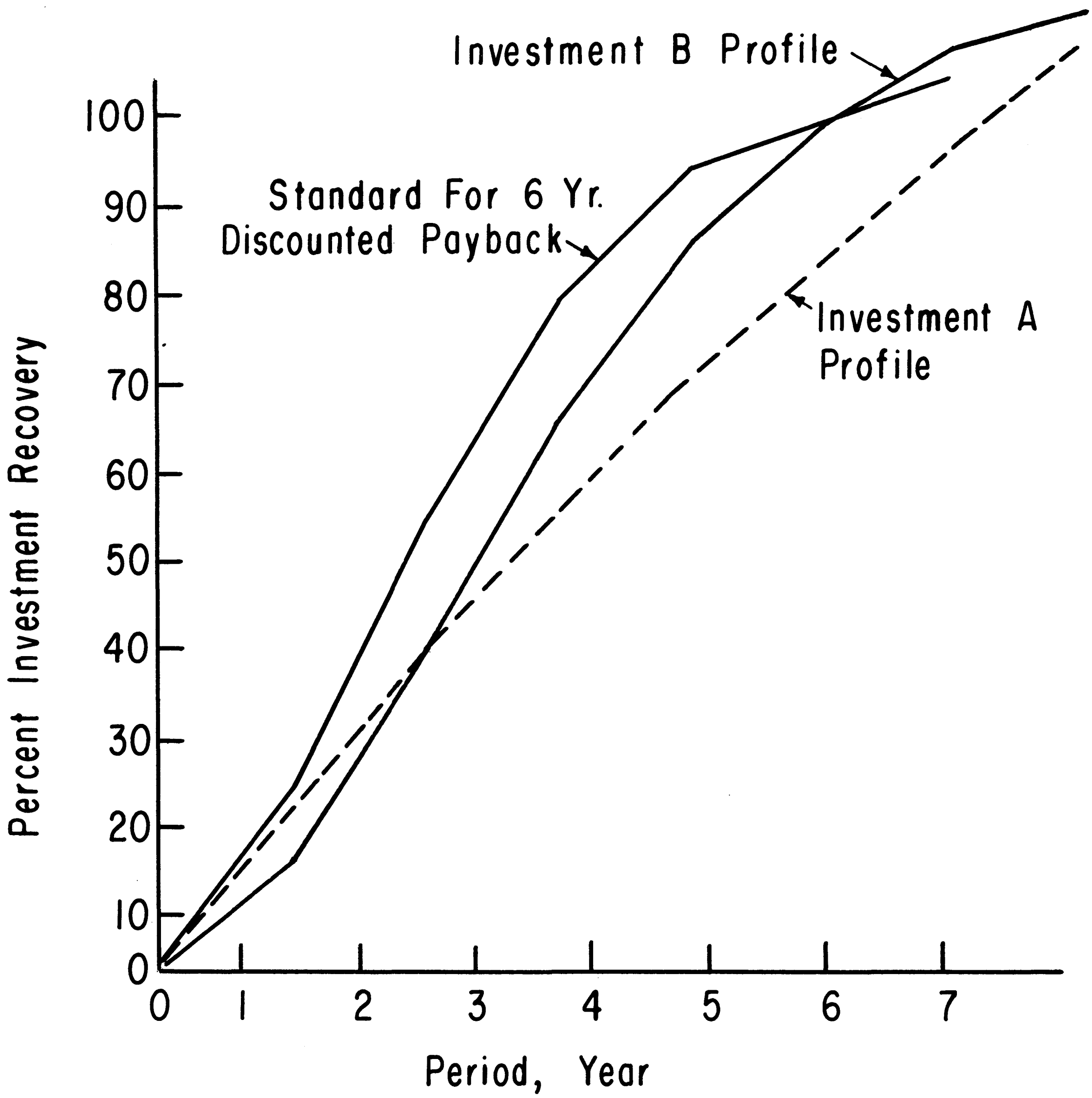

Figure 1. Discounted Payback Profile

profiles which are equal to or exceed the standard profile. Using the standard depicted in Figure 1, management would not invest in Investment B because of an unsatisfactory recover rate of the initial investment.

The advantages of combining the discounted payback period, profitability index, and the discounted payback profile is that profitability, liquidity preferences and the opportunity cost of capital expenditures are considered in the evaluation of alternative investment opportunities. Thus, the discounted payback procedure yields considerably more information for management decisions than does the simple payback or capital recovery procedure.

Several important factors which are usually recognized as having an influence on whether or not an investment should be made are, however, not included in the discounted payback procedure. Some of the principal disadvantages of the procedure are:

1. No distinction is made between owned capital (i.e., internal funds of the firm resulting from retained earnings from past income) and external financing (i.e., mortgages, loans, and other types of commercial credit). The cost of using internal funds is usually quite different from the cost of using funds from external financing even though the returns from the use of the funds are the same. The type of loan and the interest rate should also be considered, in addition to the opportunity cost, at any time that external funds are involved in financing an investment.

2. Tax-offsets on depreciation allowances and on interest payments associated with external financing are ignored. In some cases an investment can only be justified because of the depreciation on allowances or tax advantages associated with the investment. Thus, methods of depreciation and the individuals or firms tax rate should be considered in the investment analysis.

3. The salvage value of the asset at the end of its useful life should also be considered. Salvage value is especially important when the asset is subject to depreciation or when there is a strong possibility that the asset may even appreciate in value during the period being considered.

These shortcomings of the discounted payback procedure can, however, be overcome by a partial budgeting procedure.

The Investment Budgeting Procedure[1]

Table III provides a convenient format for using the partial budgeting procedure in investment analyses. Items A through E represent added

[1] Preliminary work has indicated that it is feasible to program the investment budgeting procedure for investment analyses using the electronic computer. This work also indicates that much useful information concerning investment alternative (i.e. optimum depreciation schedules, break-even interest rates under different types of loans, and the discounted payback profile) can be obtained with such a program in a very short time.

TABLE III

INVESTMENT BUDGETING FORM

Item	Amount	
A. Present value of expected additional income flow[1]	________	
B. Present value of expected cost reductions[1]	________	
C. Present value of tax offsets on depreciation allowances[2]	________	
D. Present value of tax offsets on interest payments[3]	________	
E. Present value of estimated salvage value[1]	________	
F. Total (A+B+C+D+E), present value of expected additional returns		________
G. Reduction in cash balances	________	
H. Present value of expected reductions in future income[4]	________	
I. Present value of expected cost increases[1]	________	
J. Total (G+H+I), present value of expected additional costs		________
K. Difference (F-J), present value of expected change in Net Worth over life of asset		________

[1]Based on opportunity cost.
[2]Based on opportunity cost, method of depreciation and tax rate.
[3]Based on opportunity cost, interest rate, type of loan and tax rate.
[4]Based on opportunity cost, interest rate and type of loan.

returns and/or reduced costs. Items G through I represent reduced returns and/or added costs. All return and cost flows are discounted by the appropriate opportunity cost so that all entries in Table III will represent present values. Given these present values, a valid "returns-costs" comparison can be made of the investment under consideration. If the difference between items F and J, the present values of the expected total additional returns and costs, respectively, is positive, the investment under consideration would increase net worth by an amount in excess of the rate of return which would be generated by the opportunity cost. However, if this difference is negative, investing in the asset under consideration would result in a reduction in net worth relative to other available investment opportunities.

In order to simply illustrate the use of the budgeting procedure for an investment analysis, consider the hypothetical example involving the feedmill which is shown in Figure 2. Assume that the mill is currently used to support an 8,000 head feedlot operation and that an analysis is needed to determine whether or not an investment in steam rolling equipment would be profitable. The steam equipment under consideration is contained within the broken line in Figure 2.

The first step in the analysis involves the estimation of the annual return and cost flows associated with the investment. Table IV provides hypothetical estimates of these flows under selected assumptions.[2] A further assumption is made that if the investment analysis does not show a profit for the first three years, the investment will not be made. As is indicated in the footnotes to Table IV it is assumed that the investment will require $65,580 of which $45,580 can be borrowed at 6 percent on the unpaid balance of the loan. The repayment of the principal plus interest is assumed to be made in six equal semi-annual installments.

After estimates of the annual return and cost schedules, Table IV, have been made, the respective monetary flows are discounted by the opportunity cost (8 percent in this example) to obtain the present value of each item listed. The present values of the respective annual flows in Table IV are shown in Table V. As is indicated by item K in Table V, the steam rolling equipment would be a very profitable investment under the assumptions used in this hypothetical problem. The profitability index would be approximately a 27 percent annual return on the investment over and above the 8 percent opportunity cost. Again, I want to emphasize that this is a hypothetical example and these results apply only for the conditions specified in the example. The example, however, illustrates how not only the opportunity cost but also the depreciation method, interest rate, type of loan and repayment schedule, and income tax rate are included in the partial budgeting procedure for investment analysis.

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[2] Cost estimates for various sizes of feedmills and volumes of feed can be obtained from: "Labor and Capital for Mixing Formula Feed" and "Processing Feed Ingredients-Costs, Labor, and Capital Requirements", by Carl J. Vosloh, Jr., Marketing Research Report Nos. 564 and 731, MED, ERS, USDA, Washington, D.C.

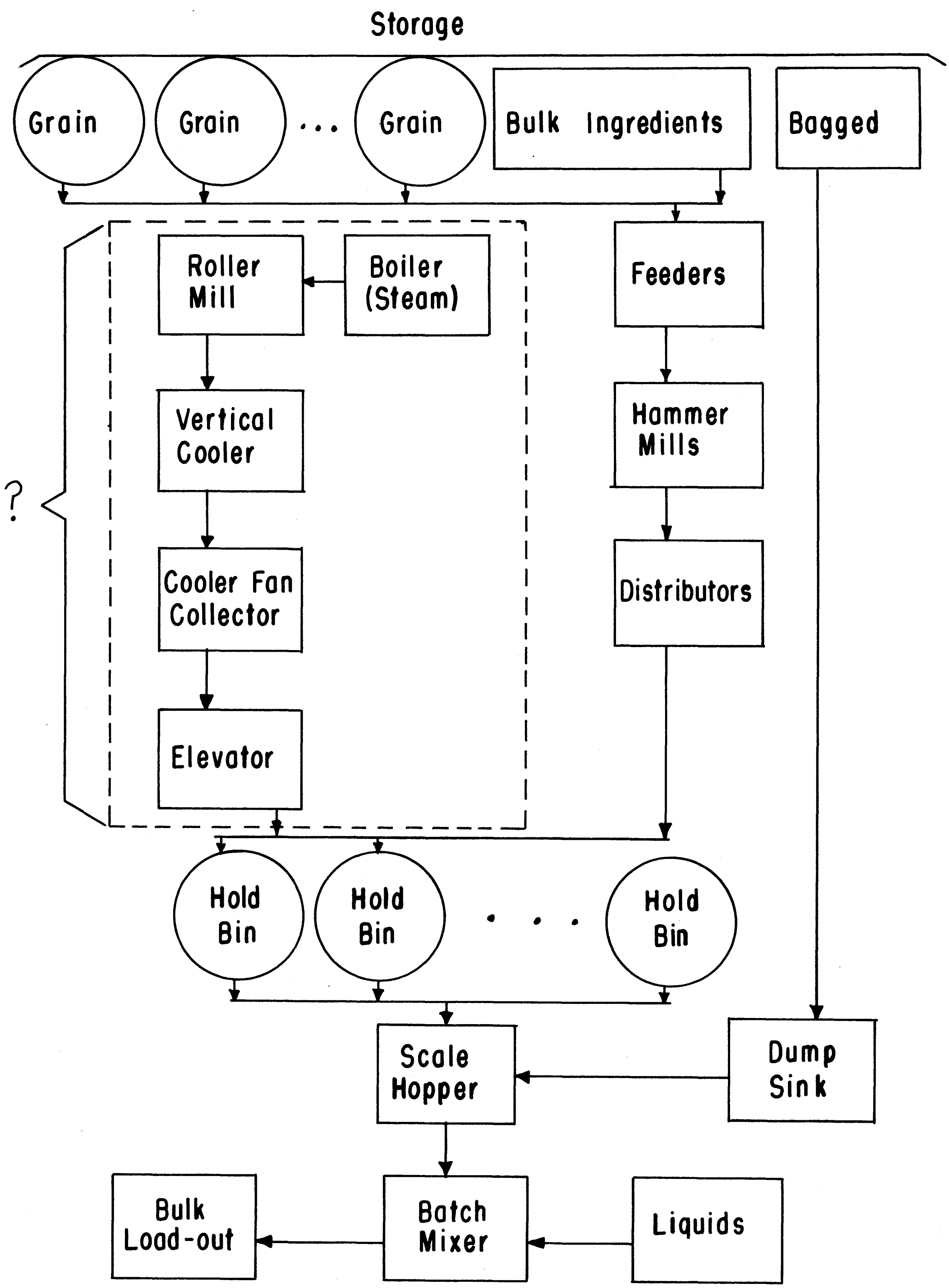

Figure 2. Hypothetical Ten Ton Per Hour Feed Mill

TABLE IV

HYPOTHETICAL RETURNS - COSTS ANALYSIS FOR STEAM EQUIPMENT - 8,000 HEAD FEEDLOT

Item	Year 1	Year 2	Year 3
	(Dollars)		
Estimated Annual Returns			
Added income[1/]	41,600	41,600	41,600
Reduced Costs[2/]	1,560	1,560	1.560
Tax Offset (Dep.)[3/]	786	786	786
Tax Offset (Int.)[4/]	556	364	160
Salvage value (Equip.)	-	-	15,000
Totals	44,442	44,250	59,046
Estimated Annual Costs			
Reduced Cash Balance	20,000	-	-
Reduced Future Inc.[5/]	16,829	16,829	16,829
Added Costs[6/]	4,160	4,160	4,160
Total	40,989	20,989	20,989

1/ 3.5% increased efficiency in present 2.8 pound daily rate of gain, two 130 day feeding periods, 8000 head per period, $20 per cwt slaughter price.

2/ Reduce labor, power, maintenance costs on other hammer mill equipment.

3/ $3576 annual straight line depreciation, 22% tax rate.

4/ 22% tax rate, 6% interest on unpaid balance, 6 equal semiannual installments on loan of $45,580, for $65,580 investment.

5/ Sum of payments on principal plus interest.

6/ Annual labor, power, fuel, maintenance costs on steam equipment, 80 cents per ton, 5,200 tons.

TABLE V

INVESTMENT BUDGET EXAMPLE FOR 8,000 HEAD FEEDLOT

Item		Amount	
A.	Present value of expected additional income flow[1]	$107,207	
B.	Present value of expected cost reductions[1]	4,020	
C.	Present value of tax offsets on depreciation allowances[2]	2,026	
D.	Present value of tax offsets on interest payments[3]	954	
E.	Present value of estimated salvage value[1]	11,908	
F.	Total (A+B+C+D+E), present value of expected additional returns		126,115
G.	Reduction in cash balances	18,519	
H.	Present value of expected reduction in future income[4]	43,370	
I.	Present value of expected cost increases[1]	10,721	
J.	Total (G+H+I), present value of expected additional costs		72,610
K.	Difference (F-J), present value of expected change in Net Worth over life of asset		53,505

[1] Based on opportunity cost

[2] Based on opportunity cost, method of depreciation and tax rate.

[3] Based on opportunity cost, interest rate, type of loan and tax rate.

[4] Based on opportunity cost, interest rate and type of loan.

TABLE VI

HYPOTHTICAL RETURNS - COSTS ANALYSIS FOR STEAM EQUIPMENT - 4, 000 HEAD FEEDLOT

Item	Year 1	Year 2	Year 3
		(dollars)	
Estimated Annual Returns			
Added Income 1/	20, 800	20, 800	20, 800
Reduced Costs 2/	780	780	780
Tax Offset (Dep.) 3/	786	786	786
Tax Offset (Int.) 4/	556	364	160
Salvage Value (Equip.)	-	-	15, 000
Totals	22, 922	22, 730	37, 526
Estimated Annual Costs			
Reduced Cash Balance	20, 000	-	-
Reduced Future Inc. 5/	16, 829	16, 829	16, 829
Added Costs 6/	2, 080	2, 080	2, 080
Total	38, 909	18, 909	18, 909

1/ 3.5% increased efficiency in present 2.8 pound daily rate of gain, two 130 day feedings periods, 4000 head, 20 cents per cwt. slaughter price.

2/ Reduce labor, power, maintenance costs on other hammer mill equipment.

3/ $3576 annual straight line depreciation, 22% tax rate.

4/ 22% tax rate, 6% interest on unpaid balance, 6 equal semiannual installments on loan of $45, 580 for $65, 580 investment.

5/ Sum of payments on principal plus interest.

6/ Annual labor, power, maintenance costs on steam equipment, 80 cents per ton, 2600 tons.

TABLE VII

INVESTMENT BUDGET EXAMPLE FOR 4,000 HEAD FEEDLOT

Item	Amount	
A. Present value of expected additional income flow[1]	53,603	
B. Present value of expected cost reductions[1]	2,010	
C. Present value of tax offsets on depreciation allowances[2]	2,026	
D. Present value of tax offsets on interest payments[3]	954	
E. Present value of estimated salvage value[1]	11,908	
F. Total (A+B+C+D+E), present value of expected additional returns		70,501
G. Reduction in cash balances	20,000	
H. Present value of expected reductions in future income[4]	43,370	
I. Present value of expected cost increases[1]	5,360	
J. Total (G+H+I), present value of expected additional costs		78,730
K. Difference (F-J), present value of expected change in Net Worth over life of asset		-8,229

[1] Based on opportunity cost.

[2] Based on opportunity cost, method of depreciation and tax rate.

[3] Based on opportunity cost, interest rate, type of loan and tax rate.

[4] Based on opportunity cost, interest rate and type of loan.

An important characteristic of this procedure is that it also explicitly separates "overhead costs" from "operating costs". To illustrate this point, the final example involves exactly the same conditions as the previous example except that it is assumed that the feedmill and steam equipment are used to support a 4,000 head feedlot. Table VI provides the hypothetical estimates of annual returns and costs for a three year period. Note that the "overhead" items (the tax offsets for depreciation and interest, the reduction in cash balances, and the reduction in future income required to repay the principal plus interest) are identical to the previous example. The "operating" items (the added income, reduced costs, and added costs) are one half the previous values.

The returns and costs flows of Table VI must now be discounted by the 8 percent opportunity cost to convert them to their present value equivalents. These present value equivalents are presented in Table VII. Because item K in Table VII is negative an investment in the steam rolling equipment under the assumed conditions of this example would not be justified. A better alternative would be to invest the $20,000 at the 8 percent opportunity cost.

These examples illustrate the advantages of the partial budgeting procedure which are not explicitly included in either the payback procedure or the discounted payback procedure. The major disadvantage of the partial budgeting procedure is that it is more complicated and requires more calculations than the first two procedures discussed. However, when decisions involving individual investments of thousands of dollars have to be made, the expenditure of a considerable amount of time and effort in obtaining information upon which to base a decision can be a highly profitable expenditure.

SUMMARY AND CONCLUSIONS

During the past few minutes I have illustrated two conventional investment analysis procedures--the payback period and discounted payback period procedures. In addition, a partial budgeting procedure for investment analysis was also illustrated using hypothetical feedmill examples.

In making management decisions concerning investment opportunities many factors such as methods of depreciation, methods of financing, the tax rate, etc., affect the profitability of each investment alternative. These factors are easily included in the budgeting procedure. After a little practice, the procedure is simple enough so that only a desk calculator and a discount table are needed to perform the analysis.

The major advantage in using the budgeting procedure is that it provides a valid "returns-costs" comparison which includes all of the added returns and costs associated with a given investment decision evaluated at the same point in time. This type of evaluation is a necessary condition if individuals and management are to make optimum investment decisions.

POTENTIAL CHANGES IN MARKETING BEEF

Clifton B. Cox, President
Armour Meat Products Company
Chicago, Illinois

Because we are in an unusual situation in the marketing of all meats, it might be well to take a look at where we are before we look at the potential changes. There is some danger in projecting changes from any current period, particularly if the period is abnormal. The period we are in may seem very normal to most of you, particularly the livestock producers, but some of us in the packing industry hope that it is not normal for us. Below are some comparisons of quantities and prices. In general, I have averaged the quantities for the October-December period of 1965 compared to 1964 and the current prices in January.

	1964	1965	1966	Percent Change
Steers, Chgo(9-1100#) Jan. Price		23.93	26.61	+11%
Carcass Bf, Chgo(6-700#) Jan. Price		37.83	41.42	+ 9
Cattle Slaughter, FIS(000 Hd) Oct-Dec	6,724	7,039		+ 5
Beef Production, FIS Drsd. Wt. (Mil. Lb) Oct-Dec	3,912	4,060		+ 4
Hogs, B & G's, 200-220#, Chgo. Jan. Pr.		17.02	29.15	+71
Hogs, 10-12# Bellies, Jan. Price		28.42	52.66	+85
Hog Slaughter, FIS(000 Hd) Oct-Dec	19,998	15,934		-20
Pork Production, FIS Drsd. Wt. (Mil. Lb) Oct-Dec	3,741	3,049		-19
Broilers, Whsl. Price, Chgo. Jan.		25.30	28.29	+12
Broiler Production, Drsd. Wt. (Mil. Lb) Oct-Dec	1,258	1,409		+12

This is in spite of Government purchases of beef in 1964, but no such program in 1965.

Why has this taken place?

Population and Income Explosion

One theory is that the big increase in demand comes about because we have more people with more money to spend.

	Population		Last Quarter Disposable Personal Income	
Year	Mil. Head	Percent Change	Bil. Dollars	Percent Change
1959	175.8	-	342.1	-
1960	178.7	+ 1.6	351.7	+ 2.8
1961	181.7	+ 1.7	374.7	+ 6.5
1962	184.6	+ 1.6	390.8	+ 4.3
1963	187.4	+ 1.5	414.0	+ 5.9
1964	190.2	+ 1.5	446.4	+ 7.8
1965	192.8	+ 1.4	480.3	+ 7.6
1966	195.0	+ 1.1		

While both are true, you will note that the increase in population is no greater in 1966 compared with the rest of the 1960's. Possibly there is <u>some</u> validity to the "more money to spend" idea.

How much of the "new demand" can be attributed to each of the factors is impossible to determine. One thing might topple the house of cards.....

> ....a little more total meat supply than most people are expecting (which would mean we would move down a very steep demand curve).

Now let us take a look at some of the potentials that I think are in the making. In today's competitive environment, a great marketing man can be denoted by a person who listens to what the consumers have to say. Let me reason with you and see if you agree what the consumers are currently saying to us about beef.

1. We like beef. Beef is a preferred meat. If I were to show you an estimated demand curve for beef, the price-quantity relationship for 1965 is substantially greater than previous years. To me this means that the demand for beef has increased. There has been a definite increase in the demand for beef. As we stated, beef is the preferred meat. There are relatively few vegetarians exclusively, and as far as I know, no medical association has recommended against beef in the diet under any conditions for large numbers of

people. Slaughter of beef has gone up almost 50 percent since 1959. In 1959, commercial cattle slaughter was 22,930,000 head. In 1965, commercial slaughter was 32,404,000 head. All of us are very much aware of the tremendous increase in beef production and the effort being put in the marketing of beef by the chain stores through specials as well as through displays.

2. When I listen again, I believe I find that consumers like fed beef. The number of cattle on feed in the 26 states reported by the U.S. Department of Agriculture has gone from 6,601,000 on January 1, 1959 to 9,500,000 on January 1, 1966. Suffice it to say here, and I think most of you are in agreement without a lot of statistics to support it, that the price of choice steers has not gone down in relation to the increase in volume marketed.

3. I should point out that I do not believe the consumers are saying fat beef, but fed beef. The U.S. Department of Agriculture has been continually changing the grades. As you remember in 1950, grading was amended with the Prime and Choice classified as Prime, with Good moving up to Choice. In 1956, the Standard grade was inaugurated which in substance split the Commercial grade into two categories with Standard denoting the more youthful kinds. Last June another revision was made to lower the grade by modifying the marbling requirements. Therefore, we believe that the consumer is saying I want tender, youthful, fed beef that is not fat.

4. The consumers are saying we like to eat more of our meat in restaurants. Someone has estimated that nearly one-fourth of the meals today are eaten away from home. We see today much more breaking of cattle into wholesale cuts than previously. We estimate that at least 16 percent of the beef today goes through what we term food service, or institutional feeding establishments.

5. Consumers do not trust retailers. There is still so much variation in the cuts displayed by retailers that consumers insist that they be packaged openly where they can be seen almost entirely. Consumers personally inspect each package and dig through the counter to get the best. Much could be saved in shelf life and discoloration as well as repackaging if the package could be closed and sealed with consumers taking the end package. This also would greatly alleviate the problem of turnover in the retail store and encourage central prepackaging of meat.

6. Consumers are still saying that they are price conscious. This means that retailers who offer bargains attract customers. A beef sale by a retailer is one of the most potent food sales possible. The volume moved sometimes is more than five times the normal volume without a beef sale.

Now what do all these things mean to us? We could easily say that food production is a good business to be in. That meat production is the better part of food for us to be in. And then if you are a producer of beef, that this is better than other meats. We know that each of these has to be studied individually rather than a blanket statement. We could also say that many of the trends pointed out here will continue such as more breaking of beef, more eating out. However, I do not believe this is why I was invited to participate in this meeting. Therefore, let's look at this from the producer's standpoint particularly as related to Oklahoma, and being a visitor, I can be an expert.

You here in Oklahoma are large producers of feeder cattle. As far as I know, feeders are still sold on the basis of reputation of the feeder plus an inspection of the animal. In our present scientific management age, I anticipate that in the future many more records will have to be kept by the outstanding feeders. The market for those should not be limited to the personal knowledge of any buyer. The records on weaning weights, rate of gain, and history of herd may become a part of the selling process of feeders. The rate of feed conversion in previous lots may become a part. Feeders without such a record in the future I think will be discriminated against much as eggs in previous times that were just brought to the country store.

Feed lot operators of the future will demand that animals put in which is a very high investment are capable of turning out quality as well as efficient converters of feed. Many of you know of Armour's interest and heavy investment into improved cattle breeding. We have continually searched for bulls that would guarantee progeny, that will be heavy at selling time as feeders, that will convert feed efficiently, and that will have the proper ratio of expensive cuts in the carcass when slaughtered with no excess fat.

Packers in the future, in my opinion, will also demand more than animals just grading a certain Government grade. We have during the past two years invested funds in an electronic instrument that as an animal passes through a space, dials will indicate the approximate weight of the animal, the size of the loin eye, the proportion of the carcass in different cuts so that a much better evaluation can be made of the animal. I am not predicting that this will be used universally in the next few years, but I am saying that buyers will get more conscious as retailers are getting more conscious of cutability.

We still have too much fluctuation in earnings in different segments of the meat industry. Many of the different parts have looked on each other as enemies rather than a part of the total program. The feeders have looked on themselves as sellers of feeder cattle, feed lot operators as converters of feed, and packers as suppliers of retailers. If we were to do the efficient part of a total program, all of us would forget our individual segments and look upon ourselves as assisting in supplying the most desirable part of the human diet. In that framework, each of us would do what is most efficiently to be done and work together as a group. We probably have passed the day when individual initiative can generate a total program. You as a feeder group or as feed lot operators must get together in the working arrangement, but I would suggest to you that an equal partner in that arrangement is a packer and probably a retailer.

We have many requests from towns, from states to come and build a packing plant. Very seldom does this community or state know the needs in number of animals for an efficient operation. Practically none of them are able to assure us of raw material supply or animals. The future program that I am talking about would take group action to say yes, we can furnish the animals and a company such as ours would say yes, we will be the marketing part of that community or group.

This may sound too far away, but I believe that the ones who take the initiative now will be the leaders in the next few years. Armour and Company is one that wants to be a leader and is willing to take one step forward. Are you here in Oklahoma and Texas willing to face this equally optimistically?

COMPETITION FROM MEAT SUBSTITUTES

By

Robert L. Henrickson
Animal Science Department
Oklahoma State University

The topic assigned to me this morning reflects the interest and concern which has been lacking in the industry for many years. Positive action on the part of the Livestock and Meat Industry will prevent meat from becoming only a rich man's food. We of the industry must maintain a strong research program in order to have information with which to attach threatening forces rather than be attached to them.

I have the feeling that you would like to know if meat will go the way of the silk stocking. We sat by and saw the leather market be taken over by synthetics. Some thought nothing could substitute for butter, but oleo does. Animal fat is rapidly giving way to vegatable oils. Similar situations have occurred in commodities other than meat and meat products. Awake is being substituted for oranges and orange juice. Instant coffee for the once famous ground coffee bean. It seems now that nothing can or will replace beef steak or roast, but I doubt that the industry can afford to be complacent. A strong and vigorous research program will provide information necessary to meet the competition.

MEAT SUBSTITUTES

The red meat industry has met competition from meat substitutes for many years. Only recently has chicken, turkey, fish and sea foods been able to replace red meat. Navy beans have always been considered a meat substitute.

Now as the world population continues to increase in magnified proportions, there is already a world wide shortage of food. It is estimated that 1/3 to 1/2 of the world's population suffers from malnutrition and from 300 to 500 million people suffer from actual hunger. With the anticipated population increase, this situation is bound to become more critical.

The greatest shortage in the areas of nutritional deficiency is in protein, fat, and calories. Protein is the most critical. This deficiency in depressed areas can only be met by importation since the current local production is low. As we look at the world food need, it is obvious that large quantities of high value protein will be needed. Since cost is of great importance, it is natural that those who must find low cost proteins look for sources other than meat.

SOURCE OF PROTEIN

Milk casein was the first edible protein commercially available in the U.S. however it has been considered too costly. The use of vegetables as a source of protein is not new. Wheat gluten has been marketed as a protein substitute since 1906. The market price for wheat gluten is about 25 cents per pound (dry basis 78 percent protein). Until 1951, substantially all vegatable protein used was wheat gluten. Since that time, soybean and other oil seeds have been used to make proteins. Even though your main reason for having me on the program was to hear about the oil seed proteins, I want to assure you that the same technology applies to corn, cottonseed, peanut, sunflower, safflower and so forth.

Protein from petroleum is today technically feasible and is based upon the ability of certain yeast or other microorganisms to metabolize straight chain paraffin hydrocarbons. The principal concern studying the process is the British Petroleum Company. They have work under way in Great Britain, France, and Africa. A 50 ton per day pilot plant is in operation at Lavera, France. A large scale plant is under construction at Port Harcourt, Nigeria.

Esso Oil Company in the U.S. is conducting pilot-plant work at Linden, New Jersey. The only published costs indicates a production cost of 6.3 cents per pound for biosynthetic protein (dry cells, 44 percent protein). This provides a protein product of nutritive values at a cost less than can be provided by meat. Protein biosynthesis from petroleum is said to be 2,500 times faster than protein production from livestock.

SOYBEAN

Soybean has been known as a food for 5,000 years. It was originally grown in Manchuria and China as a food crop. Soybeans were first planted in the United States during World War I, but were not planted widely until World War II. Henry Ford saw industrial prospects in the crop for plastics and synthetic wool-like fibers. Prior to the 1930's China produced more soybeans than any other country and most of the crop was consumed domestically. By 1939 the U.S. produced and exported 10.5 million bushels to Europe. People of the U.S. at this period did not accept the use of soybean products since the beans cannot be used as food without processing. They contain antinutritional components that must be removed or inactivated by a heat treatment. The raw bean has a characteristic beany flavor or taste that is objectionable and it, too, must be eliminated. Furthermore, soybeans do not contain large amounts of starch and do not soften on cooking as do other beans.

Soybeans gained popularity in the United States during World War II. They supplied edible oil to replace the oil cut off by the war. Food processors used soy flour in meat loaf, sausage, and bakery products, as extenders and binders.

Soybean production now ranks third in cash crop value in the United States and is excelled only by corn and cotton. The U.S. soybean production in 1965 is estimated to be 866,810,000 bushels. Reliable sources predict that the crop will exceed 1 billion bushels by 1970. This phenomenal growth has been due to the use of soybeans as a source of oil, soybean meal and soy protein as flour, grits, concentrates and isolates. Soybeans in general contain approximately 20 percent oil, 40 percent protein and 40 percent carbohydrate and cellulose.

SOYBEAN OIL

Disposition of the U.S. soybean crop is of interest. The total amount crushed has increased steadily during the past 10 years. The amount used for animal feed and food has not expanded greatly. However, about 30 percent of the recent crop was exported. The important point here is that while the processing capacity has doubled in the past 12 years, nearly 80 percent of the processing capacity is being used. Solvent extraction accounts for over 95 percent of all soybeans processed in this country. Any important expansion in the use of edible fat of oil will likely come from soybeans. The average consumption of food fat is about 46 pounds per capita. This includes butter, lard, shortening, margarine, and cooking and salad oils. Soybean oil account for 40 percent of the total food fats and oils. The trend is for more vegetable oil in the diet. This is mainly due to the publicity about polyunsaturated fat and the bland flavor stable oils now available.

The disposition of soybean oil from crushing is also interesting. Cooking and salad oil accounts for 28 percent of the soybean oil, shortening 24 percent, margarine 21 percent; 20 percent is exported and 7 percent goes for non-food uses. The soybean oil surplus carry over for the past 10 years has decreased. Thus, one might expect higher prices for soybean oil in the future. The U.S. Export of soybean oil during the past 10 years reflects an increase. Thus, it appears that the oil market will remain good in the future.

SOYBEAN MEAL

Soybean meal is the other important component of the soybean crop. The trend is for soybean meal to become increasingly the important component. Indications are that oil has already become a byproduct. This change has been caused by the poultry and livestock industry demand for protein concentrate. Over 57 percent of the U.S. crop is used for animal feed, about 41 percent is exported while less than 0.5 percent goes for nonfeed use. The increased use of high-protein concentrate for livestock feed come from soybean meal.

SOY PROTEIN FOODS

Edible grade soy protein is a more recent manufacturing venture. The process is becoming quite popular and the protein products find their way into many food products. Soy flour and grits are receiving more extensive use as extenders. Two new forms of soy protein are presently available as soy protein concentrate and isolated soy protein. The products are prepared from high quality, sound, clean dehulled soybeans by removing most of the oil and soluble constituents other than protein. The concentrate contains 70 percent protein (dry weight) while the isolated soy protein contains more than 90 percent protein (dry weight). These products may be used in cereal products, bread, meat products, baby food, and candy.

STEPS IN MANUFACTURING VEGETABLE FOODS

1. Use soybean meal or flakes.
2. Extract oil.
3. Dissolve protein and non-protein constituents--mild alkali.
4. Centrifuge to separate dissolved material.
5. Precipitate with an acid.
6. Separate and recover the isolated bland protein. 95-98% purity.
7. Isolated protein is redissolved in alkali and forced through platinum spinnerettes 1/4000 inch diameter into an acid or mineral salt bath.
8. Fibers are washed and oriented by stretching 100-400%.
9. Fibers of 268 mil diameters give approximate meat texture.
10. Fibers are then blended and cooked.
11. Fabricated into food products.

The protein fibers from soybeans are quite versatile. They can be used to make any commodity that has a fiber base, consequently, meat, fruits, vegetables, tackle box, and instrument panels. The protein may be used to enrich other foods such as pancakes, waffles, soup, gravies, and candy. It is an excellent adhesive in boned hams, canned hams, and chicken and turkey rolls.

ECONOMICS

The new created foods, simulated food, processed food, vegetarian food, protein food, soy meat, synthetic meat, meat-like food or meat-less food are meat analogs.

These foods, regardless of their name, are available to the public in three forms---Canned, Frozen, and Dehydrated. A patent use license has been issued to:

Worthington Foods	Worthington, Ohio
Ralston-Purina	St. Louis, Missouri
General Mills	Minneapolis, Minnesota
Swift & Company	Chicago, Illinois
Lever Brothers	Baltimore, Maryland
Lever Brothers	Britton, California

These companies have the production capacity, sales force and distribution system for mass-producing any or all of the products already mentioned.

Presently, Worthington Foods, Inc. is the chief manufacturer of soy meat foods. They employ over 100 people in production and 15 in sales. They have 5 branch houses in addition to selling through regular wholesale houses.

Worthington has been test marketing WHAM and White-Chik through Kroger, A & P, Big Bear, and Albers in Columbus, Ohio. This fall they propose another test in Grand Rapids, Michigan and Ft. Wayne, Indiana. Success in these areas will be followed by expanded distribution in other areas. Production of Worthington Food last year amounted to about $3 million worth of "meat" and soy milk. Brown Packing Company, Philadelphia, Pa. is making a simulated ham loaf and hot dogs.

General Mills has started market testing of "smokey bits" in peanut butter. Smokey bits will soon be market tested in 3.5 ounce packages in selected super markets. They suggest that commercial production of hamburger, chicken, scallops, and steak-like food may be two years away.

The isolated soy protein sells at about 35 cents per pound. The soy protein concentrate sells for about 22 cents per pound. This may seem high, but when compared to protein from animal sources it is cheap.

Dr. Odell of General Mills predicted that the cost per pound of the meat analogs would be about 1/2 of their cooked, natural counterpart. The dried version, when compared to freeze-dried meats should be available for a mere fraction of the other's cost.

ADVANTAGES OF SOY PRODUCTS

1. Control of fat content, protein and other nutrients.
2. Uniform distribution of nutrients.
3. Perfect portion control.
4. No waste or shrink.
5. Greater storage life.
6. Products frozen and thawed will keep 10-14 days under refrigeration.

MARKET

The companies manufacturing "created foods" would like to make the public feel that they are simply trying to appeal to people who normally do not use meat in their diet. The Worthington Food Company started producing these protein foods for the Seventh Day Adventists. This is a market consisting of about 500,000 families in the U.S. Advertising material has now encompassed 2.5 to 3 million vegetarians, 6 million Jews and some 3 million Episcopalians who refrain from eating meat at certain times. The 45 million Catholics observe some meatless days during the year and are potential consumers of these products. The religious market alone would encompass about 60 million people. These figures are probably not too meaningful since 70 million Americans are not listed as church members and because 'fish on Friday' is to some degree a cultural and not a religious practice.

The 'health food' group is also a growing market and one which will become significant. Perhaps one of the larger markets will be those who fit the low income bracket and will purchase products that are a mixture of meat and soy protein. Foods often referred to as 'snacks' will be a large market for this product until it becomes more highly recognized as a good nutritious food. Food similar to dried nuts, potato chips, nut kernels, fruits, and candy are examples.

Charles Pfizer and Company recently gained MID approval on 'imitation meat flavors' such as 'CORRAL'. The product contains monosodium glutamate, sugars, hydrolyzed plant protein, nucleotides, fat, and amino acids. It sells for $4.00 a pound in 5 gallon pails. One pound of the imitation flavor will replace 1.33 pounds of beef extract. It is said to be superior in meaty taste and is 13-15 times more effective than M.S.G. in onion soup, or beef boullion, dry soup and gravy mix.

In order to meet the competition and to hold its rightful position in the vast food industry, it will be necessary for the livestock industry to show more interest in the end product. The day of selling a beef carcass and to some extent the wholesale cuts has passed. People want fabricated convenient nutritious meat items. They no longer want T-bone steaks; they want uniformly tender, juicy, well flavored loin eye or fillet steaks. Each steak must be of the same size and weight. Consequently, portion cutting is gaining popularity. Forty to forty-five percent of the total beef is sold ground. In addition, a large quantity of beef is fabricated into lunch meat like weiners, franks, bologna, and specialty items. Even though figures are not available, it is quite likely that more beef is sold in a comminuted form than is sold as roast or steak.

People of the meat industry need more vision. They will need to be more creative in order to meet competition if meat is to maintain its important position in the diet of the average American.

Meat items are needed for use in a toaster. Meat chips could compete with potato chips. Perhaps we should have beef chips, liver chips, and lamb chips. The vegetable industry has soya milk. I don't know why we don't have steer beer or beef brew on the market. Meat cocktails may go well with bourbon and scotch. Our imagination by now may be running wild, but is there any reason why we should not have meat items for dessert?

A choice animal will dress 60 percent. Thus, a 1000 pound animal will provide a 600 pound carcass. Only about 55 percent of the carcass is lean meat. Consequently, about 670 pounds of the original weight must command a relatively low price. Some of this low cost product through research could well be made into edible animal protein. Such products could be added or mixed with soybean curd or wheat gluten to provide a product with natural meat taste and properties. Since there is little doubt that vegetable proteins will continue to be used, the meat industry should encourage the use of meat to improve the flavor of vegetable protein foods.

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BEEF CONFORMATION AND THE CARCASS

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Many have believed for some time that beef cattle and beef carcass described as more "desirable" in conformation actually yield more lean meat and have a higher ratio of lean to bone than those described as "inferior" in conformation. The "ideal beef carcass" has often been described as blocky, compact, straight-sided, smooth and yielding a high percentage of the higher value wholesale cuts (loin, rib and round).

Beef carcass composition studies have traditionally used such measures as total carcass fat, lean and bone; edible portion and the yield of trimmed, boneless retail cuts from the round, loin, rib and chuck as "end points" for use in characterizing the product. Research to date has failed to demonstrate a significant positive association between desirable conformation, and the yield of separable lean. Moreover, numerous studies have pointed to the rather marked influence of fat in confounding visual appraisals for "desirable" conformation in slaughter cattle as well as in carcass beef. The need to consider more fully a comparison of the yield of thick, high value muscle from carcasses differing in conformation formed the basis for a study I am going to discuss.

Research trials were conducted in an effort to study beef carcass conformation by a new method developed at this station during the past year. The method involves determination of the yield of closely trimmed, boneless "think" and "thin" muscles, expressed as a percent of the streamlined carcass weight, defined later in this report.

In general, "thick" muscles consist of muscles and/or muscle systems from the carcass considered to be suitable for steaks and roasts (high value cuts.). The remaining muscles are classified as "thin" muscles (lower value cuts). The thick muscles of the hindquarter include closely trimmed, boneless muscles and/or muscle systems that were two inches or more in thickness. They are as follows: strip loin, tenderloin, top-butt, knuckle, top round, bottom round and eye of the round. Fore-quarter thick meats include closely trimmed, boneless muscles and/or muscle systems (free of excessive seam fat) that are three inches or more in thickness. These are classified as chuck and rib roasts.

Thin meats include all the lean tissues that do not meet the requirements for thick meats. Muscles and/or muscle systems are trimmed to the specified thickness requirements using a modified swine back-fat probe as a measure of muscle thickness.

Ten pairs of high standard and low choice conformation steer carcasses, carefully paired for similar ribeye area, marbling score, fat thickness at 12th rib, maturity group, carcass weight and estimated percentage kidney, heart and pelvic fat were purchased from a meat packer for use in the study.

The unadjusted mean difference (unadjusted for difference in separable fat between the two conformation groups) of 0.93 percent in yields of thick meat, 31.50 and 30.57 percent for choice and standard conformation groups respectively was statistically significant. Thus there was a small, but an apparent real advantage for choice conformation in terms of the yield of high value steak and roast meat (thick meat). The adjusted mean difference, of 1.52 percent, pointed to a more meaningful advantage for choice in this regard.

Standard conformation carcasses were observed to have a slightly higher percentage of thin meat than choice conformation carcasses. Total lean yields were found to be almost identical between the two groups. Thus, the lean content of these beef carcasses, differing in conformation, but of similar weights, was relative constant and fat and bone were the major variables. The choice conformation carcasses had on the average 2.72 percent less bone than the standard carcasses.

Choice conformation carcasses were found to have higher percentage yields of all muscles studied except two, the tenderloin and knuckle. Choice carcasses had significantly more top-butt and bottom round. This is of special interest since the top-butt (sirloin) and the bottom (outside) round are two muscle systems that are viewed directly when one makes a visual appraisal for conformation in the hind quarter.

Differences in length, width and depth measurements of muscles and muscle systems were quite pronounced. In general, the standard conformation carcasses produced longer, wider, thinner muscles and muscle systems than the choice carcasses. However, most of the standard muscles lost the advantage of greater length and width when these were trimmed to meet the specifications for thick meat (high value cuts). Without exception, muscles of choice carcasses were thicker than those from standard conformation.

The ratio of lean to bone is a commonly used comparison, often employed by those engaged in the evaluation of beef carcasses to indicate carcass desirability with reference to these components. In this study, the choice conformation carcasses had an average ratio (fat adjusted) of thick meat to bone of 2.17:1 as compared to 1.83:1 for the standard carcasses. Similarly, adjusted ratio values of 4.55:1 and 3.90:1 were obtained for total lean to bone in choice and standard carcasses, respectively.

Thus, it appears that differences in total lean in carcasses of similar weight, but of different conformation may, indeed, be very small. Consistent and statistically significant advantages for choice conformation were observed in the yield of thick, high value meat. This advantage for choice, however, is not as great as many have believed. The most striking advantages for choice conformation were found to be in the ratio of total lean to bone and thick high value meat to bone. Standard conformation carcasses, on the other hand, were observed to have appreciably more bone and less fat. Where excellence in conformation is positively associated with high value muscle, conformation is an important consideration. If, on the other hand, conformation excellence, as appraised usually, is confounded by excessive finish, then this appraisal may be of little consequence.

EXPERIMENTAL RESULTS WITH DIFFERENT GRADES OF FEEDER CATTLE

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A cattle feeder is continually faced with the problem of what kind of cattle to feed. He must decide whether to feed steers, heifers or bulls; heavy or light cattle; choice, good, medium or common feeders. This discussion will deal only with the grades of feeder steers and the breed-types associated with these grades.

The feeder wants the kind of cattle that will return the greatest profit at a given time. He wants cattle that will gain rapidly and efficiently and produce a desirable carcass at an early age. Further, he must be able to purchase cattle at a price which will allow for a profit at the end of the feeding period.

The question of whether to feed choice or plain cattle is certainly not a new one but in recent years has been of more importance from an economical standpoint. One reason for a greater interest in feeding plain cattle has been the wide price spread between choice feeders and the plainer grades. Another fact that enters into the picture is that U.S.D.A. carcass grade standards have been lowered so that cattle that once could grade no higher than standard or good may now get into the choice grade.

When we compare different grades of feeder cattle we are for the most part speaking of difference in type or conformation. Whereas, carcass grades give less consideration to conformation and are determined largely by the quality of the meat (primarily marbling). In essence we are using one system of grading at the beginning and another at the end. Ideally, we would like for our feeder grades to accurately represent what the animal will be worth at slaughter, but of course this is as yet not the case.

As the title implies, this report is merely a statement of experimental results observed at various stations and should not be construed to mean that any particular breed or type of cattle is being advocated. Experiments shall be grouped into grade comparisons and breed comparisons. Of course, some studies are a combination of both.

Grade Comparisons:

Iowa State University compared choice, good, medium and common feeder steers in two separate trials. Yearling cattle were full fed a heavy grain ration in both trials and were fed 160 and 198 days in the two trials, respectively. All grades were fed together in Trial 1 so that actual efficiency of feed utilization by grades could not be measured. The grades were fed separately in Trial 11 and feed consumption by grades was measured.

Tables 1 and 2 show the results of Trials 1 and 11, respectively. Rate of gain tended to favor the common grade over the choice grade. This could be expected since Holsteins and Brown Swiss used to represent the common grade have larger mature weights than Herefords and Angus. It is known that rate of gain is highly correlated with mature body weight.

TABLE 1. COMPARISON OF DIFFERENT FEEDER GRADES

(Iowa - Trial 1)

Breeding	Angus - Hereford			Holstein -Br. Swiss	
Grade	Choice	Good	Medium	Common	Common
Days on feed	160	160	160	160	160
Initial wt. (lb)	794	732	743	830	741
Final wt. (lb)	1270	1183	1151	1334	1227
Av. daily gain (lb)	2.98	2.82	2.55	3.16	3.04
Dressing %	60.6	60.2	58.7	57.9	57.8
Carcass grade	L. Ch.	Av. Ch.	Av. Ch.	Hi. Gd.	Hi. Gd.
Fat Cover/cwt. carcass(in)	.06	.06	.05	.03	.03
Purchase price/cwt. (%)	26.60	23.50	22.00	20.90	20.20
Feed cost/cwt. gain ($)	18.80	19.70	21.50	18.00	18.50
Selling price (G&Y) ($)	21.85	22.20	21.51	20.47	20.18
Breakeven selling price ($)	23.70	22.03	21.81	19.81	19.53
Net return/steer ($)	-23.50	+0.23	-3.45	+8.80	+6.18

Iowa Farm Science Vol. 20 No. 2 (FS-1144) Aug. 1965.

TABLE 2. COMPARISON OF DIFFERENT FEEDER GRADES

(Iowa - Trial 11)

Breeding	Hereford		Mixed	Holstein
Grade	Choice	Good	Medium	Common
Days on feed	198	198	198	198
Initial wt. (lb)	762	763	760	824
Final wt. (lb)	1255	1292	1258	1359
Av. daily gain (lb)	2.49	2.67	2.52	2.70
Feed/cwt. gain (lb)	879	861	881	911
Dressing (%)	61.8	61.4	60.2	58.9
Carcass grade	L. Ch.	L. Ch.	L. Ch.	Av. Gd.
Fat cover/cwt. carcass (in)	.09	.09	.06	.02
Retail yield (% carcass)	67.1	66.6	68.7	71.4
Purchase price/cwt. ($)	25.00	23.50	22.50	19.20
Feed cost/cwt. gain ($)	19.80	19.50	19.80	20.50
Breakeven selling price/cwt($)	23.20	22.10	21.40	19.90

Iowa Farm Science Vol. 20 No. 2 (FS-1144) Aug. 1965.

Choice and good cattle tended to gain more rapidly than the medium grade. Efficiency of feed conversion, dressing percent, time required to reach slaughter grade, carcass grade, and selling price favored the higher grades. Similar results were observed in a Michigan study (Table 3.).

TABLE 3. COMPARISON OF DIFFERENT FEEDER GRADES

(Michigan)

	Beef Breeding		Holstein
	Choice	Good	Standard
Initial wt. (lb)	642	618	632
Final wt. (lb)[1]	1042	1021	1062
Av. daily gain (lb)	2.77	2.79	2.98
Dressing %	60.3	58.3	56.3
Carcass grade	Hi. Gd.	Hi. Gd.	L. Gd.

Michigan Beef Cattle Day Report - 1965.

[1] Each lot removed from test when steers averaged 1000 lb.

Plainer cattle cost less as feeders, had less waste fat, higher estimated retail yield, greater improvement in grade from feeder to carcass, and returned more profit. The wide difference between buying and selling price accounted for the greater profit of the plain cattle.

Researchers at Tennessee compared different grades of Hereford and Angus feeder cattle fed a silage and grain ration to a constant grade of high good to low choice. Grades compared were choice, good and medium.

Results (Tables 4 and 5) indicate that the good and medium grades gained faster than choice feeders and tended to have less trimmable fat. The higher grades were more efficient in feed conversion, had higher dressing percentages, and higher carcass value per pound than plainer cattle. Little difference was shown in rib-eye area or final carcass grade when averaged together. Although cost of gain was similar the lower grades were more profitable due to the wide spread in purchase price and the narrow spread between selling prices.

California workers compared Herefords with "Okie" cattle and observed that Herefords gained more rapidly, were more efficient in feed utilization, had higher yields, graded higher and produced higher value carcasses than "Okies" when fed for the same period of time (Table 6). When "Okies" were fed until they reached the same slaughter weight as Herefords they were about equal in grade, dressing percent and carcass value. However they were less efficient in feed conversion.

TABLE 4. COMPARISON OF FEEDER GRADES OF HEREFORD STEERS

(Tennessee)

Feeder Grade	Choice	Good	Medium
Days on feed	196	196	196
Initial wt. (lb)	570	566	600
Final wt. (lb)	1025	1027	1084
Av. daily gain (lb)	2.32	2.35	2.47
Feed/cwt. gain (lb)	740	745	760
Dressing %	62.9	62.5	62.2
Carcass grade	Av.Gd.	Hi.Gd.	Hi.Gd.
Fat cover (in)	.46	.52	.50
Initial cost/cwt. ($)	24.41	23.71	22.52
Feed cost/cwt. gain ($)	14.06	14.17	14.16
Final live value/cwt. ($)	21.20	20.80	20.80
Net return/steer ($)	14.11	14.40	21.86

Livestock Producer Days Bulletin, Tennessee Agri. Exp. Sta. 1964.

TABLE 5. COMPARISON OF FEEDER GRADES OF ANGUS STEERS

(Tennessee)

Feeder Grade	Choice	Good	Medium
Days on feed	203	203	204
Initial wt. (lb)	479	488	492
Final wt. (lb)	893	918	920
Av. daily gain (lb)	2.04	2.12	2.10
Feed/cwt. gain (lb)	875	856	894
Dressing %	60.2	59.5	58.8
Carcass grade	L. Ch.	L. Ch.	Hi. Gd.
Fat cover (in)	.50	.42	.37
Initial cost/cwt. ($)	28.58	27.78	25.18
Feed cost/cwt. gain($)	16.10	15.70	16.37
Final live value/cwt. ($)	23.55	23.38	22.53
Net return/steer ($)	4.65	9.76	11.63

University of Tennessee Agr. Exp. Sta. Bul. 1964

TABLE 6. COMPARISON OF HEREFORDS VS. OKIE FEEDER STEERS

(California)

	High quality Herefords	Average Herefords	Okies	Long fed Okies
Feeder grade	Ch.	Ch.	Gd.	Gd.
Days on feed	191	191	191	243
Initial wt. (lb)	468	479	421	414
Final wt. (lb)	1018	1027	905	1018
Av. daily gain (lb)	2.88	2.87	2.58	2.48
Feed/cwt. gain (lb)	656	678	767	798
Dressing %	62.1	62.2	61.7	62.1
Carcass grade	Av. Ch.	Av. Ch.	L. Ch.	Av. Ch.
Fat cover (in)	.60	.56	.41	.52
Retail cuts (% live wt)	48.3	48.6	50.2	49.5
% fat in carcass	23.6	23.1	21.1	23.1
Carcass value/cwt. ($)	40.16	39.91	39.90	40.48
Purchase price/cwt. ($)	29.25	28.25	22.50	22.50
Feed & overhead cost per head ($)	97.64	100.65	100.46	128.49
Net return/hd. ($)	9.82	9.31	5.90	12.39

California Feeder's Day, University of California. 1964

"Okie" steers had less fat cover and less fat in the carcass when fed for the same length of time resulting in higher estimated retail cut yield than Herefords. Due to higher cost of gain, lower carcass value, and greater death losses "Okie" steers were less profitable than Herefords when both were fed the same length of time. When "Okies" were fed to equal weight with Herefords they were more profitable in spite of higher gain cost. It is interesting to note that there was a spread of $6.75 per hundredweight in feeder price but only a difference of 26 cents per hundredweight of carcass among the cattle fed the same time period.

A comparison of Southern and Colorado Hereford steers of similar grade showed little difference between groups in rate of gain or efficiency of feed conversion (Table 7). Colorado steers dressed higher but produced a lower percent of choice carcasses than Southern steers.

California workers compared choice, "Okie" and Holstein feeder cattle with regard to feedlot performance, carcass merit and profit. All grades were fed together for 132 days.

TABLE 7. COMPARISON OF COLORADO AND SOUTHERN STEERS

(Colorado)

	Colorado Steers	Southern Steers
Initial Grade	Choice	Low Choice
Initial wt. (lb)	456	430
Days on feed	180	180
Daily feed intake (lb)	34.15	33.98
Dressing %	63.8	63.1
% choice carcasses	83.1	86.6

BEEF. October. 1965.

Results (Table 8) show that Holsteins and "Okies" outgained Herefords, with Holsteins making the most rapid gains. Herefords had higher dressing percentages, graded higher and sold for a higher price per pound than the plainer grades. "Okies" and Holsteins were similar in most respects and both had less fat trim, higher percent of trimmed major cuts, increased more in value per pound and returned more profit. Holsteins grossed the most profit because of lower initial cost, more rapid gains and greater improvement in carcass grade and value.

Breed Comparisons:

A number of studies have compared various beef breeds as well as dairy breeds as to feedlot performance and profitability. Although the beef breeds are similar in many respects, they differ considerably in conformation and body size. Thus, we need to consider the differences in performance among the beef types as well as some of the dairy breeds.

A comparison of Holstein steers with steers of Angus and Hereford breeding at Iowa (Table 9) shows that Holsteins outgained beef-bred steers by nearly three-tenths pound per day with equal efficiency of feed conversion and were more profitable for the feeder. However, Holsteins had 3.1 percent lower dressing percentages and graded about one-half grade lower in the carcass. Holstein carcasses were higher in estimated cutability of the primal cuts expressed as a percent of the carcass, due to less fat trim. However, when cutability was expressed as a percent of the live weight the beef-bred cattle had a slight advantage because of the difference in dressing percent. Although cost of gain was about equal for the two breed-types Holsteins returned more profit because of their lower purchase price. It was pointed out that in order to realize greatest profits from Holsteins they should be marketed on a grade and yield basis because of packer buyer descrimination against dairy steers. Other observations were that Holsteins should be fed a high energy ration for a long feeding period (about 200-220 days).

TABLE 8. PERFORMANCE OF VARIOUS KINDS OF FEEDLOT CATTLE

(California)

Kind	Choice	Okies	Holstein
Days on feed	132	132	132
Initial wt. (lb)	723	628	734
Final wt. (lb)	1041	988	1106
Av. daily gain (lb)	2.42	2.73	2.81
Dressing %	57.2	55.7	55.3
Carcass grade	Hi. Gd.	Av. Gd.	Av. Gd.
Fat cover (in)	.37	.23	.16
Yield of major cuts (% live wt)	50.3	51.5	51.3
Carcass price/cwt. ($)	36.50	34.40	34.20
Retail value/lb. (¢)	72.4	67.9	68.2
Feeder value/cts. ($)	19.00	17.00	15.00
Final value/cwt. ($)	20.90	19.20	18.90
Increase in value/cwt. ($)	1.90	2.20	3.90
Return over purchase cost ($)[1]	80.29	83.10	99.23

Proceedings Western Section American Society of Animal Science 16:241. 1965.

[1] All kinds were fed together so feed cost could not be determined by kind.

TABLE 9. COMPARISON OF HOLSTEIN AND BEEF-BRED STEERS
Average of Three Years
(Iowa)

	Holsteins	Beef-Bred
Days on feed	197	197
Initial wt. (lb)	781	674
Final wt. (lb)	1295	1206
Av. daily gain (lb)	2.97	2.70
Feed/cwt. gain (lb)	812	817
Dressing %	58.3	61.4
Est. cutability:		
% of carcass	71.7	68.9
% of live wt.	40.6	40.9
Initial cost/cwt. ($)	19.08	25.55
Feed cost/cwt. gain ($)	15.46	15.79
Selling price/cwt. ($)	20.11	22.08
Net return/steer ($)	+1.51	-22.49

Iowa State Extension Service, A.S. -134. 1965

A Tennessee study (Table 10) comparing British, Zebu (Brahman crosses), Holstein and Jersey breeds showed similar results. British breeds graded higher and were higher in dressing percentage than the other breeds. Holsteins made the most rapid gains, were most efficient in feed conversion but had the lowest carcass grade. Illinois workers found similar results when they compared Holsteins, Angus, Charolais and crosses of these breeds. Jerseys were the slowest gainers, were the least efficient in feed conversion and lowest in dressing percent. Brahmans gained slower and were less efficient in feed conversion than British or Holstein breeds but were similar to British breeds in dressing percent.

A comparison of Charolais with Hereford and Charolais x Hereford Crossbred steers by workers at Ohio indicates that Charolais and Charolais Crossbred steers made more rapid gains, had less fat trim and produced a higher percent of edible carcass than Herefords (Table 11). Crossbred steers were more efficient converters of feed to gain, followed by Herefords. Hereford steers graded higher and had a lower percent bone than Charolais and Crossbred steers.

Contrary to most results, California work comparing Herefords, Brahman and Holstein breeds (Table 12) shows a slight advantage for Herefords over Holsteins in rate of gain. Brahmans gained slower than either of the other breeds. Herefords were the highest and Holsteins lowest in efficiency of conversion of feed to weight gain. Brahmans and Holsteins produced carcasses with a higher percent protein and water than Herefords.

Energy studies showed that all three breeds were similar in efficiency of feed utilization for maintenance but Herefords were more efficient in utilizing feed for gain. Brahmans were 87% and Holsteins were 73% as efficient as Herefords in converting feed to gain.

TABLE 10. COMPARISON OF BREEDS OF FEEDER STEERS

(Tennessee)

	British	Zebu	Holstein	Jersey
Days on feed	312	321	294	378
Initial wt. (lb)	336	338	291	219
Final wt. (lb)	875	880	909	791
Av. daily gain (lb)	1.80	1.77	2.16	1.56
Feed/cwt. gain (lb)	888	906	776	959
Age at slaughter (days)	464	495	444	527
Dressing %	62.8	62.5	59.7	57.5
Carcass grade	L. Ch.	L. Gd.	Hi. Std.	Hi. Std.
Fat cover (mm)	18.9	14.1	9.1	10.8
Rib-eye area (Sq. in)	9.4	9.6	8.8	8.0

Livestock Producer Days, 1964. University of Tennessee Agr. Exp. Sta.

TABLE 11. COMPARISON OF BREEDS OF STEERS IN THE FEEDLOT

(Ohio)

	Hereford	Charolais	Hereford x Charolais
Av. daily gain (lb)	2.07	2.31	2.33
TDN/cwt. gain (lb)	562	581	532
Age at slaughter (days)	538	528	530
Slaughter wt. (lb)	837	1033	972
Carcass wt. (lb)	572	638	597
Dressing %	61.3	61.8	61.5
Carcass grade	L. Ch.	Av. Gd.	Hi. Gd.
Fat cover (in)	.54	.29	.40
% edible portion (carcass)	69.3	72.5	71.2
% bone	14.5	16.1	14.8
% fat trim	16.4	11.3	14.0

Beef Cattle Research Summary No. 7. 1965. Ohio Agr. Res. & Dev. Center.

TABLE 12. COMPARISON OF DIFFERENT BREEDS OF FEEDER STEERS

(California)

	Hereford	Brahman	Holstein
Days on feed	140	140	140
Initial wt. (lb)	586	569	570
Av. daily gain (lb)	3.22	2.57	3.10
Energy gain/day (megcal)	6.64	4.61	5.43
Feed/cwt. gain (lb)	629	641	680
N.E. obtained/cwt. feed (megcal)	57	50	47
Dressing %	59.5	60.5	58.2
Carcass grade	5 Ch. 3 Gd.	1 Ch. 7 Gd.	8 Gd.
Composition of gain			
% fat	38.7	30.9	29.6
% protein	16.2	18.1	18.5
% water	41.3	46.8	47.4

California Feeder's Day. 1964

Conclusions:

1. Lower grades of cattle gain as well and in some cases better than higher grades. Plain cattle often gain faster because they are older, have more frame and carry less condition than choice feeders.

2. Holsteins and the larger beef breeds will often gain faster than British breeds due to their larger mature body size.

3. Higher grades and British breeds are usually more efficient converters of feed than lower feeder grades, dairy breeds and the larger beef breeds.

4. Plainer cattle will increase more than higher grades in grade and value per pound.

5. Higher grade feeder cattle will reach choice slaughter grade in a shorter feeding period than the lower grades.

6. High grade feeder cattle will normally have higher dressing percentages and produce higher grading carcasses than the lower grades.

7. Plainer cattle, Holsteins and the larger beef breeds tend to produce carcasses with less trimmable fat and consequently higher cutability than choice feeders.

8. Plainer cattle are more profitable than higher grading feeders when they can be purchased at a much cheaper price than choice feeders.

9. Although results of these studies indicate some advantages of plainer feeder cattle over choice feeders they should not be construed to mean that we should encourage breeders to produce plain cattle. Rather, the advantages in gainability and cutability that plainer cattle and dairy breeds often have over the beef breeds should serve to stimulate breeders to improve their cattle in these areas and still retain their good features of carcass grade, efficiency of feed conversion and dressing percent.

SEX AND THE CATTLE FEEDER

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Sex is the largest genetic difference among animals of the same species. Since earliest domestication, man has added the castrate making essentially three sexes. Cattle of each sex can be purchased, fed, and sold to the packer. Which sex to feed depends on the purchase cost, the production costs and the sale price obtained. The purpose of this report is to present research results on feed lot and carcass performance of bulls, steers and heifers. Purchase cost and sale price will not be considered.

MATERIAL

The 1964 calf crop from the Angus progeny test herd comprise the data. Of 109 calves there were 35 bulls, 30 steers and 44 heifers. A random half of the male calves from each of eight sires were castrated at four months of age. These data are replicate one of a three year study designed to investigate the sire by sex interaction. If this interaction is small, adequate sex corrections can be developed and make progeny testing for carcass traits more economical by using all offspring in the test rather than just one sex.

These calves were fed at the Fort Reno Livestock Research Station for 168 days on a 60 percent concentrate - 40 percent roughage ration after being weaned at seven months. Cooler carcass data were obtained at the Mauer-Neurer packing plant at Arkansas City, Kansas.

RESULTS

The performance in the feedlot favored the bulls, then steers, and then the heifers. The 154 day average daily gains were 2.85, 2.49, and 1.99 for bulls, steers and heifers, respectively. The feed required per 100 pounds of gain was 757 for bulls, 818 for steers, and 924 for heifers. Costs as of 1964 were 19.0, 20.5 and 23.0 dollars, respectively.

The performance in the cooler favored the bulls for amount of meat over the steers and heifers. This is evidenced by the retail cut percentages of 51.2 for bulls, 48.4 for steers and 48.1 for heifers. The found percentages were 21.2, 20.9 and 20.5 for the bulls, steers and heifers, respectively.

The bulls also had less external and internal fat than the steers and heifers. The fat thickness at the 12th rib was .54, .70 and .64 for the three sexes. Also the retail cut percentage reflects this fat difference since percent kidney fat and fat thickness are used in its computation.

The steers and heifers had a higher marbling score which led to higher carcass grades for them than for bulls. The marbling scores were slight for bulls, small for steers and small minus for heifers. The bulls had a high good carcass grade while the steers had average Choice and the heifers low Choice carcass grade.

DISCUSSION

These results are in full agreement with other workers in this area. A 1962 review in Animal Breeding Abstracts compiled such comparisons from all over the world. The evidence is quite clear that under feed lot situations, bulls gain faster and more efficiently than do steers. Under pasture situations, the evidence is slightly in favor of steers over bulls which probably reflects behavior differences.

Age at castration has an influence although some compensation occurs. Early castration produces a difference due to the lack of the male hormone through the growth period. Late castration also produces a difference due to the setback caused by the act of castration.

Evidence is strong that bulls produce more edible portion of carcass by 3 to 4 percent than steers and heifers. However, some evidence exists that suggests the carcass quality of bulls is less than for the other sexes even when slaughter is from 12 to 15 months of age. The review concludes that probably carcasses of bulls reared in the feed lot and slaughtered between 12-15 months are of comparable quality to steers and can be produced more cheaply. The data from the present study show the bulls to be of lower quality as evidenced by the marbling score and the carcass grade than the other sexes, but the edible portion is greater.

A Wyoming study carried the test to the consumer level. Their results indicated that consumers selected bull chucks over steer chucks by a ratio of 3:2 probably due to less fat in the bull chucks. Differences in selection of other cuts were not as great. Bull steak was rated lower in taste and tenderness than steer steak. They found slightly higher palatability ratings for steer meat indicating that consumers can tell the difference between steer and bull meat even when the bulls were slaughtered at a young age.

There is resistance to bull carcasses on the part of the packer although he has an outlet for some young bull carcasses. This probably results from the fear that beef could lose some of its palatibility and consumer acceptance, which has increased its per capita consumption, by the improper feeding of a large percentage of bulls.

SUMMARY

Bulls under feed lot programs gain faster on less feed than do steers and heifers. Further they produce more edible portion of carcass than steers and heifers but have a lower carcass quality than either the steers and heifers. These are pieces of information that need to be considered in the choice of cattle to feed along with price considerations.