(* - *)

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Farm Economics Research Division

TECHNOLOGICAL CHANGES THAT AFFECT LIVESTOCK AND FEEDS 1/

By

Orlin J. Scoville, Chief
Costs, Income, and Efficiency Research Branch

The persistent and continually growing surplus of feed grains with its potential for livestock surpluses is one of our major farm problems. The Center for Agricultural Adjustment at Ames, Iowa, has called it "... probably the foremost problem facing agriculture over the next few years." Some economists view this problem with special concern because they see no adjustment processes now at work that will curb or reduce the enormous buildup in feed grains.

What are the dimensions of the feed-grain problem? What technological changes are responsible for it, and how will technology influence the solution?

Comprehension of the feed-grain problem requires an understanding of the feed-livestock economy and of other sectors of agriculture. The relationships between feed output and livestock output must be kept in mind. Today's feed surplus is tomorrow's livestock surplus. Feed grains have competitive and complementary relationships with high-protein feeds, with forages, and with pastures. The feed problem is tied closely to the wheat problem. Feed grains and wheat are alternative uses of land, and wheat can be a competitive source of feed. Acreage-allotment programs, particularly those for wheat and cotton, impinge upon the feed-grain problem, because of the possibilities for shifting land into feed crops.

The feed surplus affects a broad sector of American agriculture. Feed crops make up three-fourths of the total acreage of crops harvested. Of the seven crops with the largest acreages, six are used for feed; the other is wheat, a part of which is used for feed. In addition, there are about a billion acres of pasture varying in quality from good rotation pastures to woodland or desert grazing. On a feed-equivalent basis, pastureland is about equal to 183 million acres of average hay land.

Livestock makes up about 55 to 60 percent of the value of farm marketings. Fifty-two percent of all fertilizer used is applied to feed crops and pasture. As of August 31, 1959, feed grains and soybeans were 39 percent of the value of all commodities owned by the Commodity Credit Corporation.

1/ Talk prepared for delivery before the 37th Annual Agricultural Outlook Conference, Washington, D. C., at 9:45 AM, Tuesday, November 17, 1959.

Some idea of the magnitude of the surplus of feed concentrates may be gained by comparing stocks with annual disappearance for uses that include feed, seed, export, and industrial uses. At the beginning of the current feeding year, October 1, 1959, the supply of feed concentrates was 265 million tons. Total disappearance for the year is estimated to be about 185 million tons, and stocks of feed grains at the end of the year will be about 80 million tons. In addition, stocks of wheat on July 1 were equal to 38 million tons, a part of which might be used for feed if made available at a competitive price.

There are various ways of deciding how large stocks of feed grains ought to be in order to stabilize prices and protect against emergencies. Application of the definition of "normal" stocks of corn in the Agricultural Act of 1954 to all feed grains indicates a normal carryover of about 20 million tons. A recent review of several studies indicates that about 35 million tons of all feed grains are about the maximum that would be needed for stabilization purposes. 2/ With respect to wheat, a USDA study indicates that a carryover of about 14 or 15 million tons would provide adequate protection against all except the worst weather hazards, and would meet the initial shock of defense emergencies. 3/ Viewed against these norms, stocks of feed grains are more than twice as large as needed, and stocks of wheat are about 2 1/2 times as large as needed.

The annual rate at which we are adding to feed grain and wheat stocks provides another view of the surplus. Since the fall of 1954, we have accumulated an average of 7.3 million tons of feed grains per year. This is equal to an annual average production from about 7.9 million acres. We have added to stocks 2.1 million tons of wheat a year, or the equivalent of production from 2.6 million acres of wheat. These additions have occurred, even though we have had an expanded conservation-reserve program and a land-adjustment program in the Great Plains. Without these programs, the stocks would be greater. It is estimated that 14.5 million acres in the conservation-reserve program have been diverted from wheat and feed grains.

The pervasive changes in the feed-livestock economy reflect rapid changes in technology. Progress in crop and livestock technology must be kept in mind in order to understand the changes that have occurred in production and utilization of feed grains.

Significant changes have occurred in consumption of feed grains among different kinds of livestock. Hogs are the chief users of feed grains, but consumption of grain by poultry has been increasing rapidly. Poultry now consume half as much feed grain as do hogs. Dairy cattle are the third most important consumers of feed grains. An increasing amount of feed grain is fed per milk cow, but the heavier rates of feeding are partly offset by the declining numbers of milk cows. Beef is fourth in importance, and an increasing proportion of grain is taken by beef cattle. Horses and sheep use very little grain.

2/ Shepherd, Geoffrey. "How Much Too Large Are the Stocks of Feed Grains?" Proceedings, Feed Livestock Workshop. Center for Agricultural Adjustment, Iowa State College, Ames, 1959.

3/ Post, R. E. "Present Size, Composition and Expected Change of U. S. Wheat Surpluses." Paper presented at Intl. Wheat Surplus Utilization

Over the last 50 years, the numbers of grain-consuming livestock have fluctuated sharply from year to year. The number of grain-consuming animal units has increased more rapidly than the number of roughage-consuming animal units. Annual changes in roughage-consuming livestock tend to follow closely the beef cattle cycle.

Changes in numbers of animal units do not indicate trends in livestock production, because production per animal has risen over time. Feed consumption per animal unit also has increased. The calculation of animal units maintains constant unit values from year to year for each kind of livestock. But changes in numbers of grain-consuming and roughage-consuming animal units can be used to compare relative trends between them.

In terms of nutrients, a little less than a third of the total is supplied by grains and an additional 11 percent is supplied by other concentrates that include various grain byproducts. Pasture supplies a little more than a third, and harvested roughages supply about a fifth. Over the years, the largest percentage increase in the total supply of nutrients has come from concentrates, with harvested roughages a fairly close second. The smallest increase has come from pastures.

Seventy-five percent of the production of feed grains comes from the Midwest, with 42 percent from the Corn Belt alone. Since 1952, the largest increases in actual tons have come from the Northern Plains, Southern Plains and Corn Belt, in that order. About two-thirds of the total increase has come from these three regions.

The chief cause of increased production of feed grains has been the higher yields, although changes in acreage have had some effect. Changes in land use resulting from acreage allotments in wheat, cotton, and other crops have contributed to the feed surplus, but they are not its major cause. The harvested acreage of feed grains in 1957-58 was about 5 percent, or 7.1 million acres, higher than in 1952-53--the last years before wheat allotments went into effect. By regions, increases appear only in the West and in the Great Plains; these reflect adjustments to feed grains from wheat and some cotton.

In 1959, 158 million acres were planted to the 4 feed grains plus forage sorghum. This was 8 million acres more than in 1958, reflecting in part the acreage taken out of the Soil Bank. In 1959, there were 71 million acres of hay, 2 million acres less than in 1958, and a decrease of 4 million since 1952-53. The soybean acreage of 23 million was 2 million less than in 1958, but 8 1/2 million acres more than in 1952-53. Sales of cottonseed to oil mills in 1958 were about 20 percent below those of 1952, partly offsetting the increase in soybeans.

Among the feed grains, shifts in land use have resulted in more feed production per acre. The acreage of corn in the Corn Belt has increased, while acreages of oats and barley have declined by about the same amount. In the Great Plains, acreages of corn and oats have declined, while the acreage of grain sorghum has increased.

The progressive and rapid rise in yield per acre is the chief cause of the increased production of feed grains. Recent average yields and a projected yield for 1965 are shown in table 1. In recent years, the outstanding causes of increased yields have been increased fertilization and introduction of hybrid sorghum seed. Land selection and better management are also factors. Increases in yield have been largest for corn and grain sorghum.

Table 1. - Harvested yields per acre, 1947-49, 1954-58, 1958 and 1959, and projections for 1965 1/

Item	All corn	Oats	Barley	Sorghum grains	All hay	Wheat	Soybeans for beans
	Bushels	Bushels	Bushels	Bushels	Tons	Bushels	Bushels
1947-49 average	36.3	33.5	25.5	19.2	1.33	16.8	19.9
1954-58 average	44.5	37.8	29.2	26.2	1.55	21.4	22.0
1958	51.7	44.7	31.6	36.7	1.67	27.3	24.2
1959 preliminary	52.5	37.3	27.1	35.9	1.60	21.0	24.1
Projection 2/ 1965	51.0	39.0	32.0	32.0	1.70	23.0	24.0

1/ Historical data from Crop Production, AMS-USDA, October 9, 1959.
2/ Preliminary projection for 1965 made by a committee of Agricultural Research Service Scientists. They assumed acreages for harvest as in 1959 and continued adoption of known practices. Rapid increases were projected for sorghum grains because of recent development of hybrid seed. The average increase in yield for the four feed grains, however, is projected at a slower rate than recent trends.

Use of fertilizer has increased rapidly for feed crops. From 1947 to 1954, the amount of nitrogen used on corn, oats, and barley increased by 208 percent. The increase for P_2O_5 was 55 percent; for potash, it was 148 percent. In 1954, fertilizers were used on 60 percent of the corn, 31 percent of the oats, 27 percent of the barley and grain sorghums, and only 18 percent of the soybeans. At 1954 fertilizer rates and with the crop yields of that year, it is estimated that use of fertilizer was responsible for increases in yield as follows: 23 bushels per acre of corn fertilized, 19 bushels per acre for oats, 13 bushels per acre for barley, almost 8 bushels per acre for soybeans and grain sorghums, and 16.5 bushels for wheat. These increases in yield reflect improvements in other practices, along with fertilizer use.

Statistics on the amount of fertilizer used for each crop are not available for the later years, but it is known that there have been further increases in rates of application per acre and in the proportion of acreage fertilized.

It is estimated that in 1954, the marginal return for each dollar spent for fertilizer was about $3.00 for corn, $2.27 for soybeans, $1.55 for grain sorghums, $1.62 for barley, $1.44 for oats, and $2.26 for wheat. As calculated, these figures reflect the average of the marginal returns realized by farmers in general including those who applied fertilizer liberally and those who applied very little. With these favorable returns, a substantial increase in fertilizer use and in output per acre can be expected for feed grains, and particularly for corn. Ibach and Lindberg, basing their estimates on crop-response relationships, believe that by 1965, the average yield of corn might be as much as 59 bushels per acre, if 75 percent of the acreage were fertilized at an average rate of 60 pounds of nitrogen per acre. This rate of fertilization would give an estimated marginal return of $2.00 for each $1.00 of fertilizer under the price-cost conditions assumed. 4/

Most of the big increase in corn yields resulting from hybrid seed had been realized by 1945 or 1950, although there has been continual improvement in hybrids since then. Improved varieties of barley and oats have increased yields moderately. We appear to be on the threshold of gains of perhaps 25 to 30 percent in yields of grain sorghum as a result of the development of hybrid varieties. Hybrid sorghum seed was available for only about one-fifth of the big acreage of 1957. In 1959, about half the acreage of grain sorghum was planted to hybrid seed, so further substantial gains in yield are in prospect.

Looking ahead for the next 5 or 6 years, we can expect the supply of feed grains to be affected by further changes in yields and by shifts in acreage.

Changes in acreage could have a tremendous effect on production of feed grains if farm programs were altered or even discontinued. In recent years, changes in acreage have not been the major factor, and probably it is realistic to assume that there will be no large changes in land use in the next few years. The most significant changes in production of feed grains are likely to come from continuing changes in yields. For the 4 major feed grains, combined yields per harvested acre in 1957-58 were 21 percent higher than in 1952-53 and about 40 percent above the 1940-42 level. If the trend of yields from 1940 to date were continued to 1965, yields per acre would increase an additional 15 percent. A preliminary projection of 1965 yields has been made by ARS scientists, as shown in table 1. This estimate assumes average weather and further adoption of known improvements in technology. The estimated rate of increase is about half the historical trend.

4/ Ibach, D. B. and Lindberg, R. C. "The Economic Position of Fertilizer Use in the United States." Agr. Res. Ser., USDA, Agr. Inf. Bul. 202, 1958.

In addition to technological improvements in production of feed grains, changes in the efficiency and productivity of forage production must be considered as forages compete with grains in rotations and in rations. This competition is increased by improved methods of handling, storing, pelleting, and processing forages.

Yields of hay have increased also. These increases have not been as rapid as those for corn or sorghum but they have been at least as good as those for the other feed grains. Also, the quality of hay has been improved as a result of a higher proportion of legumes and better harvesting and storage. For example, in 1959 alfalfa hay is 57 percent of all hay, compared with 40 percent 10 years ago. Limited data indicate that average pasture yields also have increased to some extent in both quantity and quality.

There is a growing body of evidence that it would be economical to substitute forages for a part of the grain now fed to dairy cattle in those regions that can produce high-quality forages at low cost. A few years ago, the Farm Economics Research Division, ARS, and the Michigan Agricultural Experiment Station made a study of the cost of feeding dairy cows on actual farms. 5/ In the study, cows were fed concentrates at three different rates: 1 pound to 2.6 pounds of milk; 1 pound to 3.7 pounds of milk; and 1 pound to 5.7 pounds of milk. Dairymen with good-quality roughage were able to reduce sharply the amount of concentrates fed, with little, if any, reduction in milk production. The study was based on actual experience with cows that produced about 12,000 pounds of milk. The cows fed concentrates at the lowest rate produced milk at the lowest feed cost.

A study of irrigated pastures in northeastern Colorado made by the Farm Economics Research Division, ARS, in cooperation with the Colorado Agricultural Experiment Station indicates that for the farms studied, digestible nutrients could be produced at least cost per TDN from high-quality pastures. Corn silage was second, alfalfa hay third, and corn for grain fourth. 6/

An unpublished Master's thesis written at Pennsylvania State University by Richard Dailey indicates that in west-central Pennsylvania, alfalfa pasture is the cheapest source of nutrients, followed by corn silage, alfalfa silage, corn, and alfalfa hay.

5/ Wilt, H. S. and Hoglund, C. R., Reducing Dairy Feed Costs, Mich. Agr. Expt. Sta. Spec. Bul. 383, 1952.

6/ Sitler, H. A. and Rehnberg, R. D., Northeastern Colorado Irrigated Pastures, Colo. Agr. Expt. Sta. Bul. 437-A, 1954.

We have here something of a paradox. Several research studies indicate cost advantages of forages over grains. Yet historical statistics indicate that grains are an increasing part of our total feed supply. Grains have benefitted more than forages from recent labor-saving innovations, but most of these have been taken into account in the cost comparisons used. The advantages of grains in storability, marketing and transportation are not included and must be important factors. Also, it often is difficult for tenants to include perennial forages in their cropping plans. Very probably there is a greater lag in the adoption of improved management practices for forages than for grains. These factors may offset the advantages of forages, but the competition between high-quality forages and feed grains may be closer than is frequently supposed.

Other technological changes that affect feed-grain requirements include improvement in the efficiency of feed conversion through improved breeding, preparation of rations, and management. Experimental results show considerable increase in feed efficiency for all classes of livestock. In beef-feeding experiments, it has been found possible to produce 1 pound liveweight gain with 5.6 pounds of feed. But at the national average level, about 8 pounds are used. In experiments, using pelleted feeds, stilbestrol, and antibiotics, lambs have been fed to produce 1 pound of gain with 4 pounds of feed. This compares with a national average ratio of 1 pound of gain to 10 of feed. Under experimental conditions, hogs can be fed to produce a pound of gain with less than 3 1/2 pounds of feed including feed consumed by the breeding herd. But under farm conditions, the average is almost 5 1/3 pounds. In experiments with high fat rations for turkeys, feed use has been as low as 2.7 pounds per pound of turkey produced, compared with a national average of 5.7 pounds. For broilers, average feed consumption per pound of gain is about 3 pounds, and best experimental results show about 1 pound of gain to 2 pounds of ration.

Some improvement has been made in average feed-conversion efficiency; but except for broilers and turkeys, it has been modest. Improvements in rations and livestock management have been partly offset by the diminishing returns associated with heavier milk production per cow and heavier market weights for beef cattle.

The spectacular improvement in feed efficiency for broilers, and more recently for turkeys, has resulted from a unique combination of new technologies that has focused the attention of producers on maximum meat production per pound of feed.

Most farmers think of maximum production per acre, because land tends to be their most limiting resource, and they have made noteworthy improvements in yield per acre. But, once having been produced, feed crops are fed in a way that will return the highest profit to the farm as a whole rather than the lowest cost per unit of product. As a result, many farmers tend to be careless in the use of feed in years of good yields, and to plan their rations much more carefully in lean years. This tendency is reflected in the flucuations in the national statistics of feed fed per animal unit.

Maximum production per acre means nothing to the livestock producer who buys his feed. This is the situation of broiler growers. Similarly, integrated hog fatteners and operators of large-scale custom feedlots can be expected to try very hard to improve feed efficiency. The rapid increase in volume of commercial formula feeds indicates that an increasing proportion of livestock production is becoming dependent on purchased feeds. As a result, we may see more rapid gains in feed conversion efficiency.

With respect to possible improvements in feeding efficiency, some preliminary estimates made by the Agricultural Research Service indicate that in the next several years, we might expect beef output per pound of feed to increase by about one-half of 1 percent a year. Milk and pork output per unit of feed probably will increase by about 1 percent a year. For eggs, feed efficiency might increase by about 1 1/2 percent a year. By 1965, improvements in feed efficiency might result in an overall reduction in feed-grain requirements per animal unit of between 3 and 4 percent. This would add about 4 1/2 million tons to feed supplies or reduce acreages of feed grains needed by about 5 million acres.

With 1959 levels of domestic per capita consumption of livestock products, exports of 450 million bushels of wheat and 10 million tons of feed grains, increased yields at the conservative levels of table 1, comparable improvements in pasture production, and with no change in feed efficiency, we could meet wheat and feed-grain requirements in 1965 with 15 to 18 million fewer acres in wheat and feed crops. Alternatively, if acreages of wheat and feed-grain were held at present levels and stocks were not allowed to increase further, enough livestock could be fed so that per capita consumption of red meats would go up from 157.5 pounds in 1959 to about 180 pounds in 1965, and at this level, livestock prices would surely be in trouble. James Cavin of the Agricultural Marketing Service has observed "The price structure of producers is endangered whenever the supply of meat for consumption is much in excess of 160 pounds per capita." 7/

From the review of probable trends in production of feed grains and similar trends in improvement of forage and pasture production, and with the availability of land for feed crops taken into account, it seems probable that for some years to come, unless we have a severe drought, or reduced output for some other reason, we will have a burdensome surplus of feed grains resulting in costly storage problems and a constant threat of surplus livestock production. What adjustment alternatives are there in use of land producing feed crops or in utilization of feed by livestock that might reduce the pressure of feed supplies? Again, we must take account of the effects of technological changes.

7/ Iowa State College Center for Agricultural Adjustment Research, Special Report 24. Proceedings, Feed-Livestock Workshop, February 1959. Ames, Iowa.

Let us first consider the possibility of shifting land fron feed crops to grass. This idea frequently pops up in adjustment proposals. The effect of substitution of forage for feed grains would depend upon the level of management followed on pasture and forage lands. As summarized in table 2, available data indicate that there might be little difference in nutrient production per acre if land were shifted from feed grains to high-quality hay or to grass silage, if these crops were managed and fertilized at levels comparable to those of feed grains and if the entire production were eaten or stored. A shift to permanent or long-term pastures would reduce feed production per acre substantially, perhaps by about 50 percent in the short-run until pasture-management practices were improved, but such an adjustment would reduce farm income greatly.

One of the important effects of a shift to either improved or permanent pasture might be in the incomplete utilization of surplus pasture in favorable years. Farmers tend to utilize pasture only to the extent needed and to stock at conservative rates. A study made at Iowa State College indicates that in southern Iowa, farmers having beef herds do not as a rule make a strenuous effort to utilize all available forage. 8/ With reference to year-to-year changes, 61 percent of the farmers interviewed planned their livestock programs on the expected output of pasture in the poorer years. Considering seasonal variation, 73 percent of these farmers based their livestock programs on pasture supplied in the lowest period of seasonal production. Only 13 percent stored the surplus pasture available in favorable months by making hay or silage. On the farms studied, 28 percent of available pasture forage was not utilized in 1951, the year of the study. More research on pasture-management practices is needed, but results from the study mentioned probably are indicative of management practices elsewhere, and the lack of easy storability of pasture makes the feed supply much more adjustable than is the case with feed-grain production.

A second adjustment possibility would be to shift some of our production effort from raising grain to be fed to hogs to producing grass for cattle and sheep. If we assume equal numbers of feed units per acre from grain and from forage, a considerable reduction in meat output could be realized by shifting from hogs to beef cattle, for example. On the average, hogs use about 514 feed units to produce 100 pounds of live-weight gain. Ninety-five percent of this feed consists of concentrates. Beef cattle use about 893 feed units, of which 16 percent are concentrates, for 100 pounds live-weight gain. When livestock output is adjusted to a dressed weight, it takes about twice the number of feed units to produce 1 pound of beef as are required for 1 pound of pork and lard. So for each pound of beef substituted for a pound of pork, we could add 1 pound to our feed requirements or subtract 1 pound from the feed supply. This kind of adjustment would reduce the feed surplus, but it would not be economical for farmers to make this adjustment with the price relationships that usually prevail. From 1948 to 1957, the average farm price of hogs in the United States was $18.92 compared with an average beef price of $19.95.

8/ Heady, E. O., Olson, R. O., and Scholl, J. M. Economic Efficiency in Pasture Production and Improvement in Southern Iowa. Iowa Agricultural Experiment Sta. Res. Bul. 419. Ames. 1954.

Table 2. - Estimated feed production per acre with improved management from alternative uses of land, as shown by selected farm management studies 1/

Crop or land use	Estimated feed production per acre in total digestible nutrients					
	South Carolina, Piedmont 2/	Oklahoma, Eastern Prairie 3/	Pennsylvania, Central 4/	Colorado, N. E. irrigated 5/	Michigan, moderately productive soils 6/	Minnesota, S. E. 7/
	Number	Number	Number	Number	Number	Number
Grains:						
Corn	1,708	1,708	2,640	3,160	3,192	2,653
Oats	1,030	---	---	---	1,452	956
Barley	---	---	---	2,040	---	1,034
Grain sorghums	---	1,491	---	---	---	---
Silage:						
Corn	---	---	2,800	5,610	4,800	3,287
Oats	---	---	---	---	3,000	---
Alfalfa-brome	---	---	---	---	4,120	---
Sudan grass	---	---	---	---	2,988	---
Hay:						
Alfalfa	---	---	8/ 2,576	4,024	---	2,569
Alfalfa-brome 9/	---	---	---	---	3,320	---
Oats and lespedeza	---	2,000	---	---	---	---
Tame pastures:						
Bermuda grass	2,825	---	---	---	---	---
Bermuda grass top-seeded with crimson clover	3,690	---	---	---	---	---
Tall fescue and ladino	2,500	---	---	---	---	---
Rye grass and crimson clover	2,725	---	---	---	---	---
Orchard grass and ladino (av. mgt.)	---	---	2,352	---	---	---
Orchard grass and ladino (impr. mgt.)	---	---	3,120	---	---	---
Irrigated pasture mixt.	---	---	---	4,050	---	---
Annual pastures:						
Vetch and rye	---	1,350	---	---	---	---
Permanent native pastures:						
With average mgt.	---	1,035	1,200	---	---	---
With improved mgt.	---	---	1,888	---	---	---

1/ These estimates of feed production are based on good management and improved production practices. The estimated nutrient production from pastures involves an assumption that optimum rates of stocking are maintained. Nutrients are expressed as total digestible nutrients (TDN), which may somewhat overstate the feeding value of forages in comparison with grains. 2/ S. C. Agr. Expt. Sta. Bul. 411, 1953. 3/ Okla. Agr. Expt. Sta. Bul. B-430, 1954. 4/ Pa. Agr. Expt. Sta. Bul. 545, 1951. 5/ Colo. Agr. Expt. Sta. Bul. 437-A, 1954. 6/ Research Problems in the Economics of Forage Production and Utilization, Mich. State Col., Mimeo. 1957. 7/ Minn. Farm Business Notes, May 31, 1955. 8/ Includes 576 TDN aftermath grazing. 9/ Field-

An expanded conservation reserve and land retirement are other possible approaches to adjustment. These cannot adequately be discussed within the context of feed-livestock adjustments. 9/

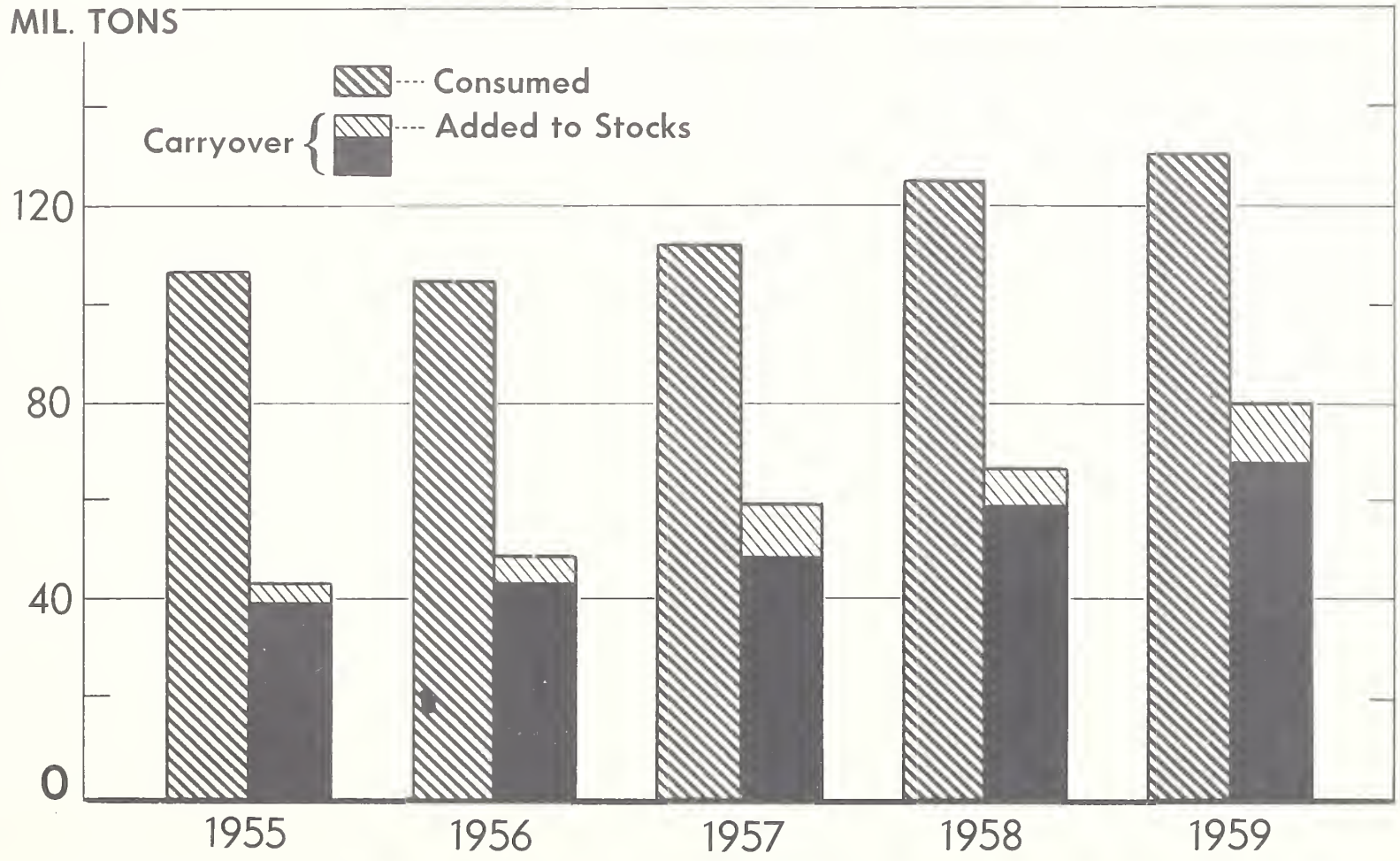
There will be no easy solution to the feed-grain problem. With current projections of population, exports and industrial uses, and with current farm programs, the rate of increase in consumption of livestock products will not catch up with anticipated increases in production of feed and livestock so long as technological progress continues at its present pace, unless we should have a very severe and prolonged drought.

Efforts to cope with the feed-grain problem by diverting lands to more "extensive" uses, such as forages and pasture, may help, but farmers are learning also to increase output of pasture and hay land, and they are finding that improved management and increased fertilization pay for forages as they do for grains.

In any event, the time has arrived when we can no longer assume that surplus acres from any source can be diverted to feed crops without creating new problems equal to or greater than those we are trying to solve.

9/ For a discussion of these, see J. Carroll Bottum, "The Conservation Reserve." Iowa State College Center for Agricultural Adjustment. Special Report 24. Ames, 1959.

FEED-GRAIN FED AND CARRIED OVER



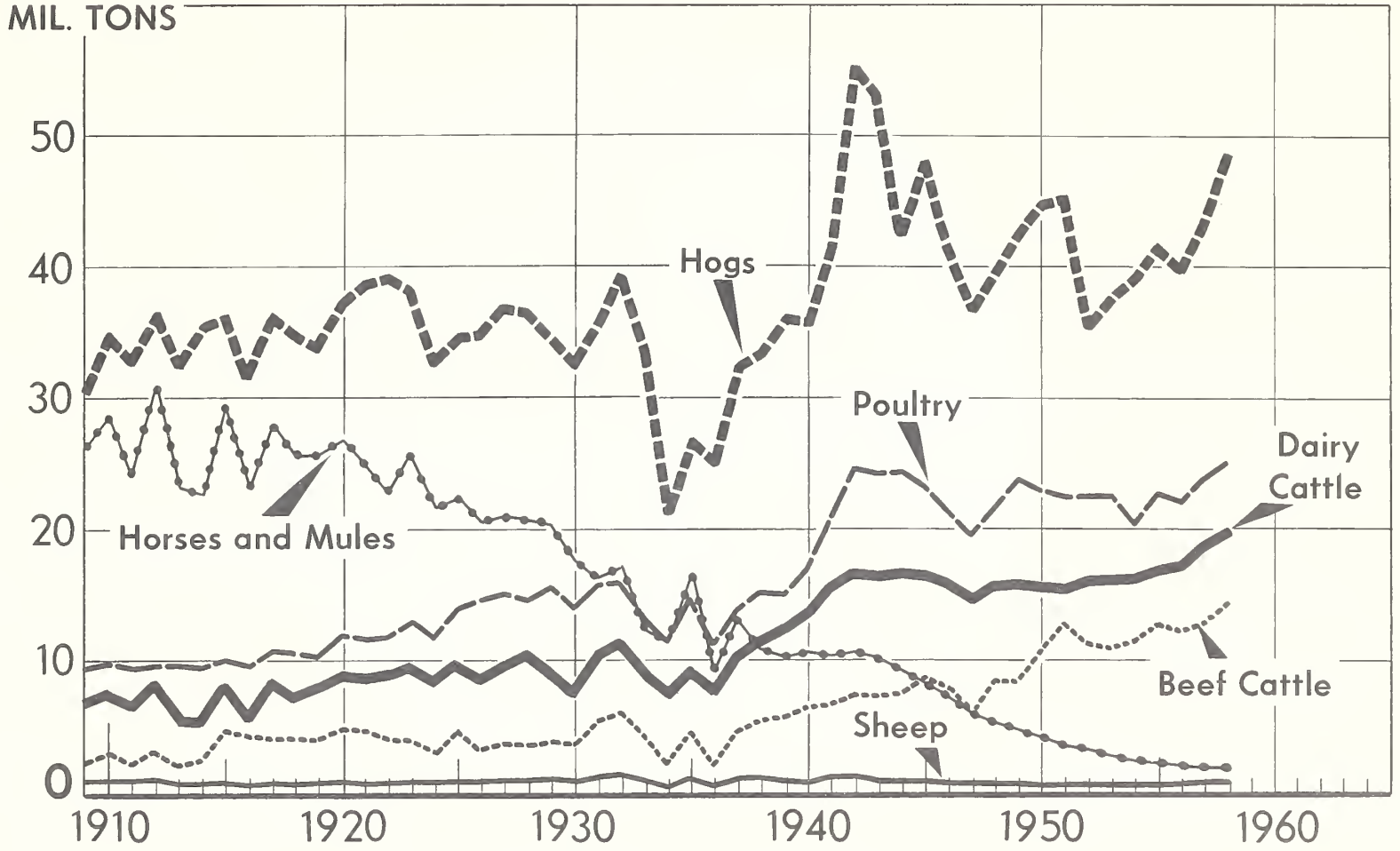
FEEDING YEARS BEGINNING OCT. 1; CARRYOVER AT END OF FEEDING YEAR

1959 PRELIMINARY

U.S DEPARTMENT OF AGRICULTURE

NEG. 59 (10) - 2823 AGRICULTURAL RESEARCH SERVICE

GRAIN CONSUMED BY LIVESTOCK

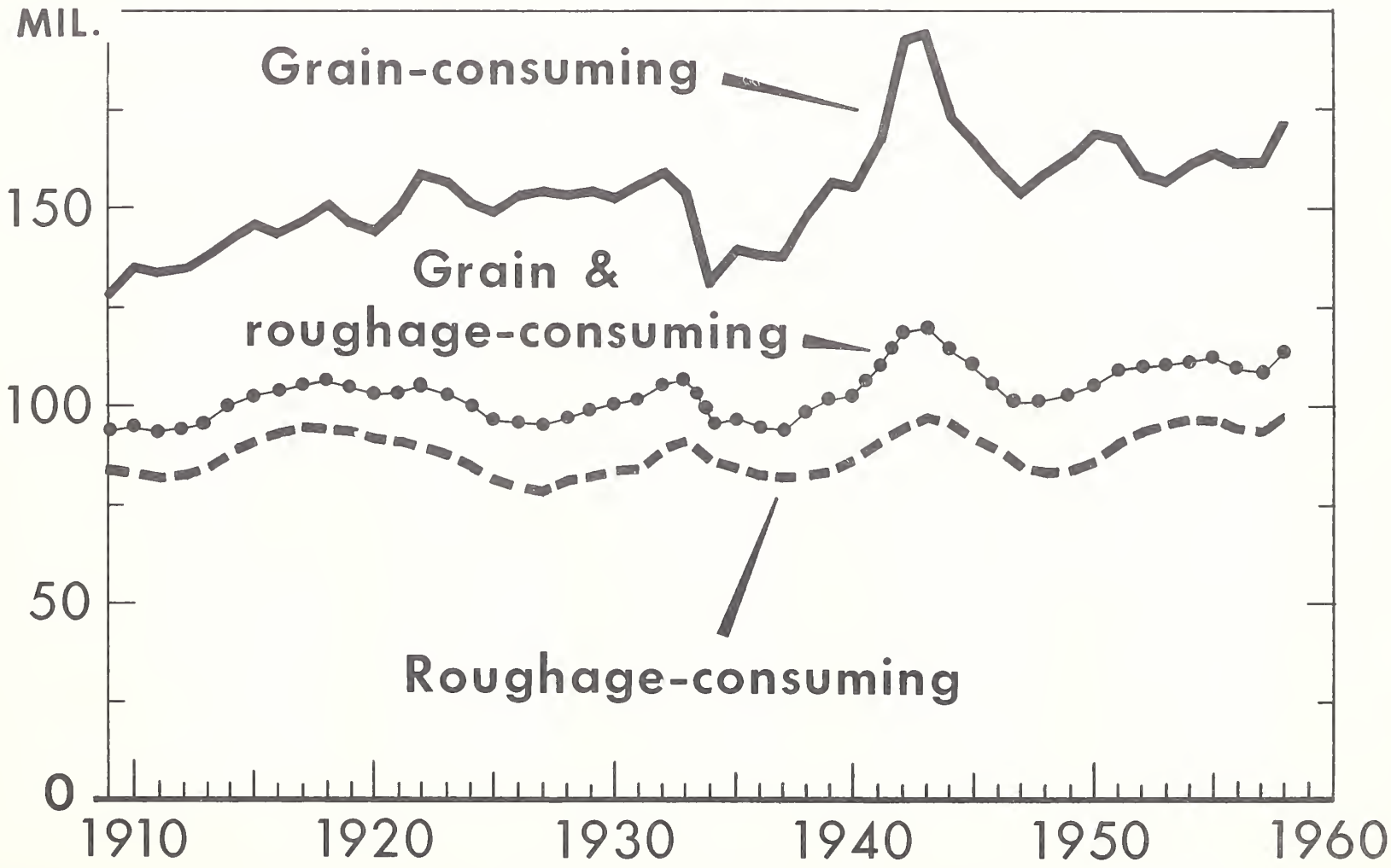


FEEDING YEARS BEGINNING OCT. I

U.S. DEPARTMENT OF AGRICULTURE

NEG. 59(10)-2821 AGRICULTURAL RESEARCH SERVICE

ANIMAL UNITS OF LIVESTOCK, U. S.

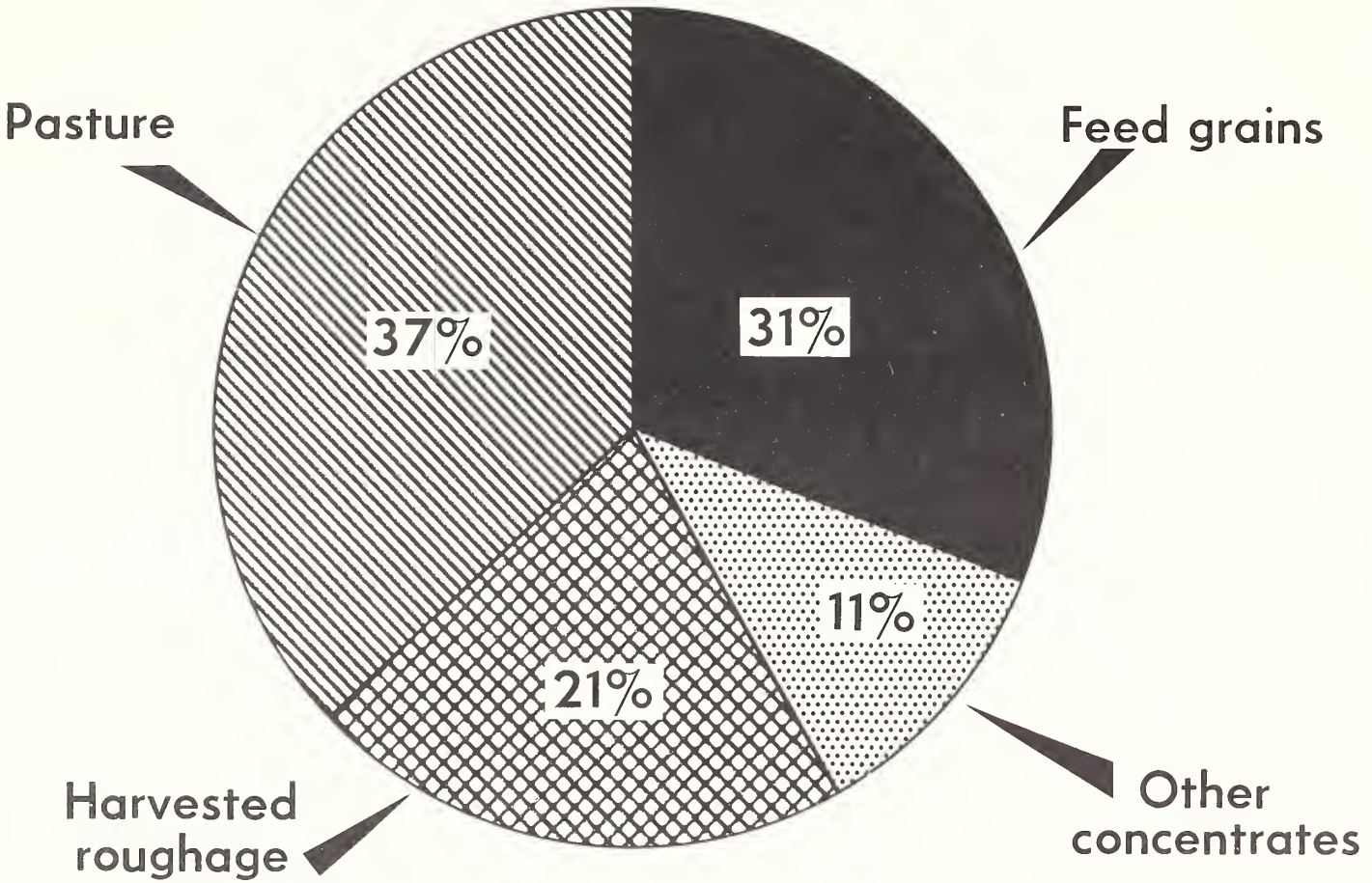


U. S. DEPARTMENT OF AGRICULTURE

NEG. 59 (6)-2183 AGRICULTURAL RESEARCH SERVICE

SOURCES OF LIVESTOCK FEED

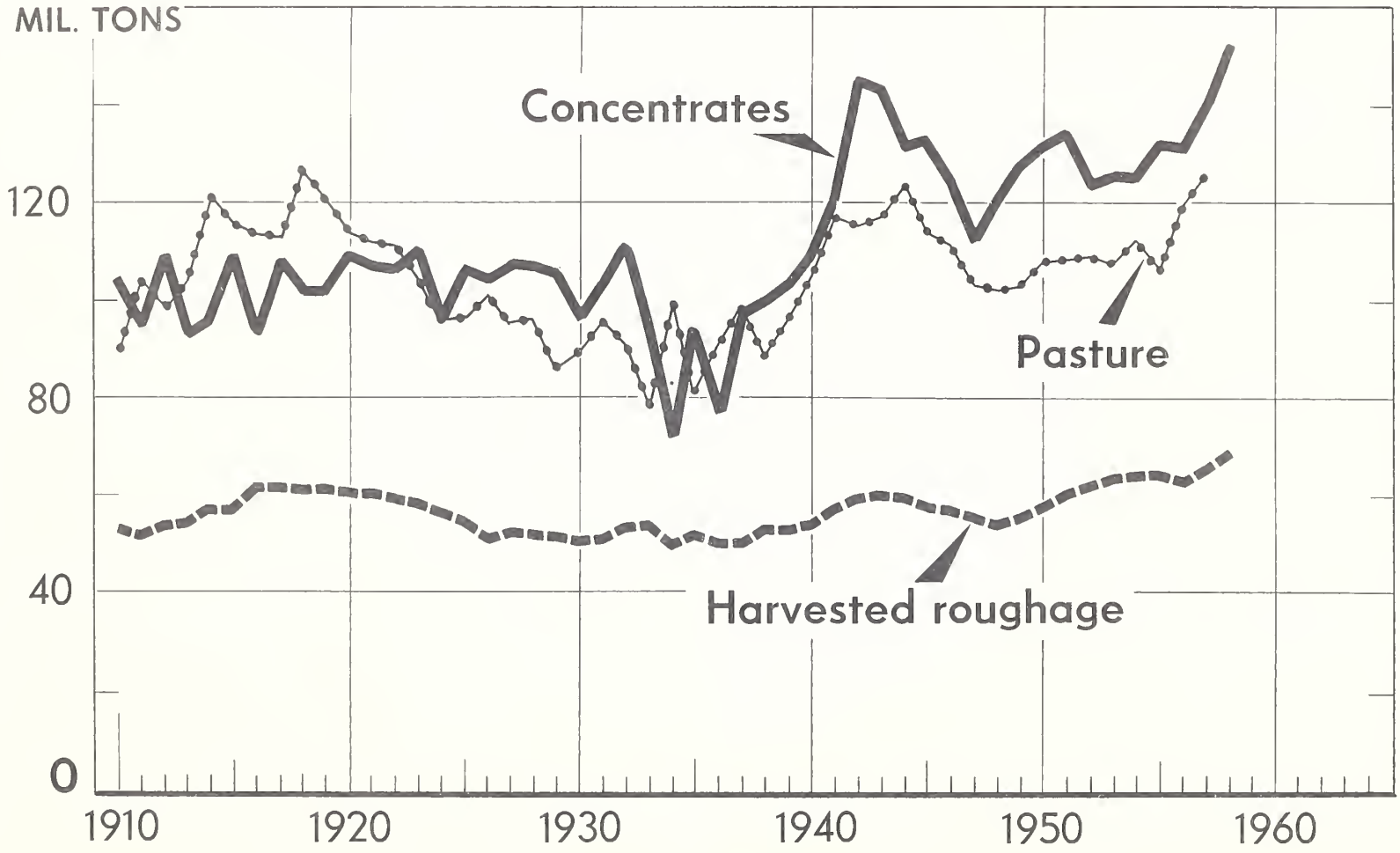
In Feed Units, 1953-57



U.S. DEPARTMENT OF AGRICULTURE

NEG. 59(10)-2819 AGRICULTURAL RESEARCH SERVICE

FEED UNITS BY SOURCE

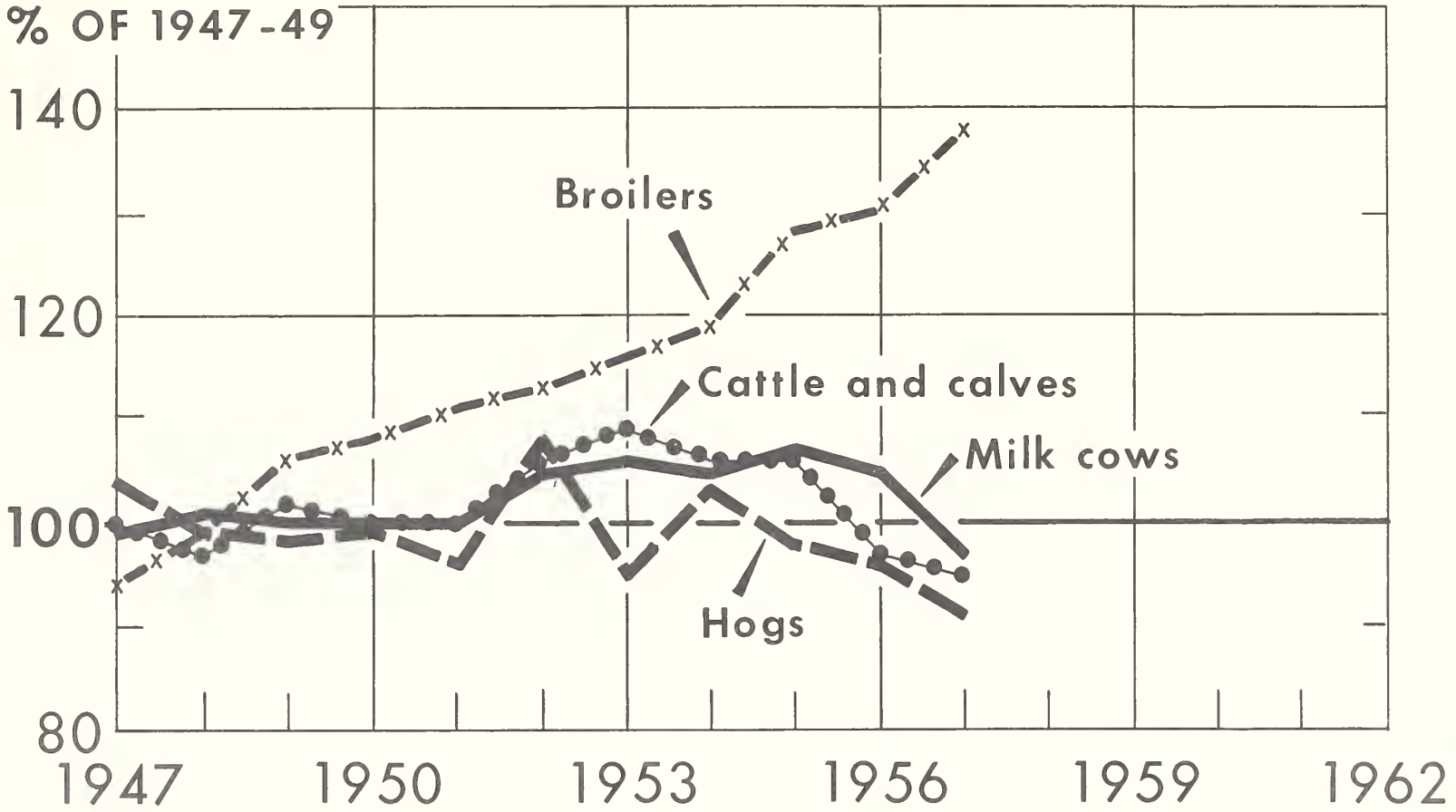


FEEDING YEARS BEGINNING OCT. I

U.S. DEPARTMENT OF AGRICULTURE

NEG. 59(10)-2822 AGRICULTURAL RESEARCH SERVICE

LIVESTOCK PRODUCTION PER UNIT OF FEED CONSUMED



FOR FEEDING YEARS BEGINNING OCTOBER 1

U. S. DEPARTMENT OF AGRICULTURE

NEG. 59 (9)-2785 AGRICULTURAL RESEARCH SERVICE