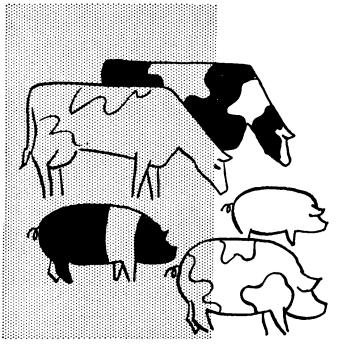

CHAPTER 7

Recent trends; feed efficiency potentials; economies of scale in livestock production; economics of location.

Present and Future Livestock Production

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THE TOTAL SUPPLY AND COMPOSITION of livestock products depend basically on supply of feed and forage available. Changes in technique of feeding, breeding, and management modify the volume of production. In very large measure livestock and livestock products represent the major return from the grass and forage land of this country. Over one billion acres, nearly 60 percent of the total land area of the continental United States, are used for hay or grazing. (See Table 6.1, Chapter 6.) Grass, hay, forage, and forested rangelands provide more than one-half of the feed for all livestock.[1] Livestock makes use of some lands,

[1] H. H. Wooten and C. P. Barnes, "A Billion Acres of Grasslands," in *Grass, Yearbook of Agriculture 1948*, USDA, Washington, D.C., 1948, p. 25.

TABLE 7.1

NUMBER OF LIVESTOCK AND POULTRY ON U. S. FARMS, JANUARY 1, 1949–58 AND 1960

Class of livestock and poultry	Average 1949–58	1960
	1,000 head	*1,000 head*
Cattle	89,612	101,520
Milk cows, 2 yrs.	23,361	21,331
Hogs	54,478	58,464
All sheep	31,167	33,621
Stock sheep	27,100	29,481
Horses and mules	5,482	3,089
Chickens	407,448	366,859
Turkeys	5,173	5,673

Source: *Livestock and Poultry Inventory*, Crop Reporting Board, AMS, USDA Jan. 1, 1960.

particularly in western regions, that has limited alternative uses. While all domestic animals utilize some grass and forage, swine and poultry require considerably more grains and concentrates in the finishing rations than do the ruminants.

The national production of livestock is usually measured in terms of the total number of head of the several species. The inventory of livestock on January 1, 1960 was the second largest on record (Table 7.1).

Significant postwar trends in numbers of livestock in-

TABLE 7.2

AVERAGE NUMBERS OF DIFFERENT CLASSES OF BEEF CATTLE FOR TWO TIME PERIODS AND COMPARATIVE RATIOS FOR THE TWO PERIODS

Item	1935–39	1956–60
Cows—million	10,600	25,467
Bulls—million	1,625	1,712
Steers—million	5,406	9,871
Calves—million	10,515	19,376
Ratio—bulls to cows	.153	.067
Ratio—cows to steers	1.96	2.58
Ratio—cows to calves	1.01	1.31

Source: Computed from *Annual Livestock and Poultry Inventory Series*, Crop Reporting Board, AMS, USDA.

clude a continued decline in cows and heifers kept for milk, in numbers of chickens, and in horses and mules. Hogs have increased only moderately. On the other hand, cattle not kept for milk have increased rather rapidly in the postwar period. The changed composition of the national beef cattle herd is quite significant (Table 7.2).

Since World War II, a larger proportion of the national beef cattle herd has been composed of cows and heifers. The ratio of bulls to cows is half that of prewar while there are more cows to steers. These changes in composition reflect a general tendency toward marketing of cattle at younger ages. In contrast to prewar management, the fifties and early sixties have seen fewer steer cattle marketed at two and three years of age.

MEASURES OF LIVESTOCK PRODUCTION

Inventory numbers of livestock and poultry at a particular point in time, while useful, measure national production only at a particular level of the production process. Livestock output should be considered a flow of products, i.e., live animal, milk, poultry, meat, and eggs from U.S. farms and ranches. Data on total production of meat, poultry, and dairy products give an indication of this magnitude. A measure of products at processing and marketing stages gives an accounting of the production available for consumption (Table 7.3).

Statistics of livestock numbers and of inventory of livestock products are useful for year to year comparisons within the respective classes and species of livestock. However, to relate livestock production to total feed supply the measure of "animal unit" developed by the USDA is probably more useful.

Method of Computing "Animal Units"

Numbers of each class of livestock are converted into the standard "animal unit" by comparing consumption of feed by each species to consumption of feed by one milk cow. Three standardized series have been developed: (1) a

TABLE 7.3

COMPARISON OF U.S. PRODUCTION OF ANIMAL PRODUCTS, 1946–48 AND 1956–58

Product	Average production		Percentage change
	1946–48	1956–58	
	(*Million pounds*)		
Beef	9,626	14,005	+ 45.5
Pork	10,569	10,741	+ 1.6
Veal	1,490	1,450	− 2.7
Lamb and mutton	838	712	− 15.0
Total "red meats"	22,524	26,908	+ 19.5
Chickens*	2,753†	4,879	+ 77.2
Turkeys*	491	1,043	+112.4
Milk	113.7	125.4	+ 10.3
Eggs (dozen)	5,079	5,390	+ 6.1

* Ready-to-cook basis.

† For years 1947–49. Ready-to-cook basis not available prior to 1947.

Source: Agricultural Statistics, USDA, and *Food Situation*, USDA, May 1960.

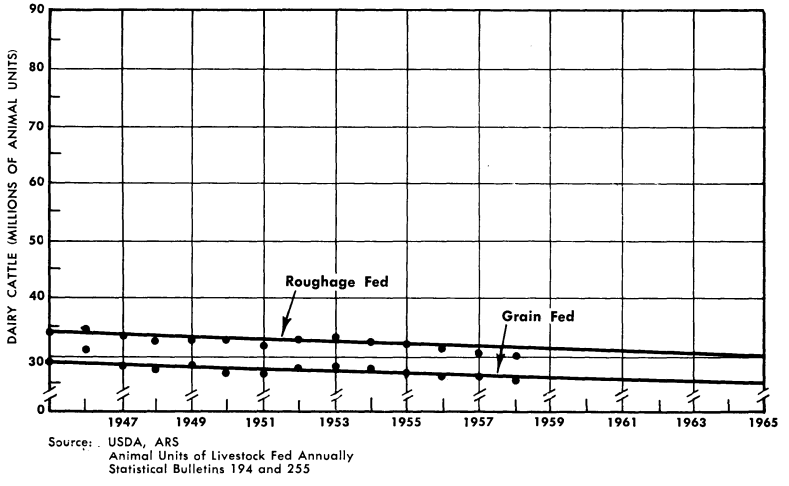


Fig. 7.1 — Animal units of dairy cattle fed annually with trend line (1946–58).

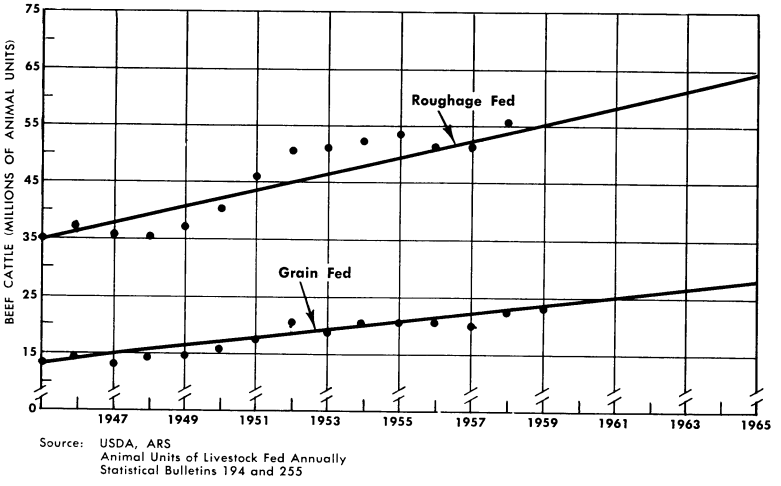


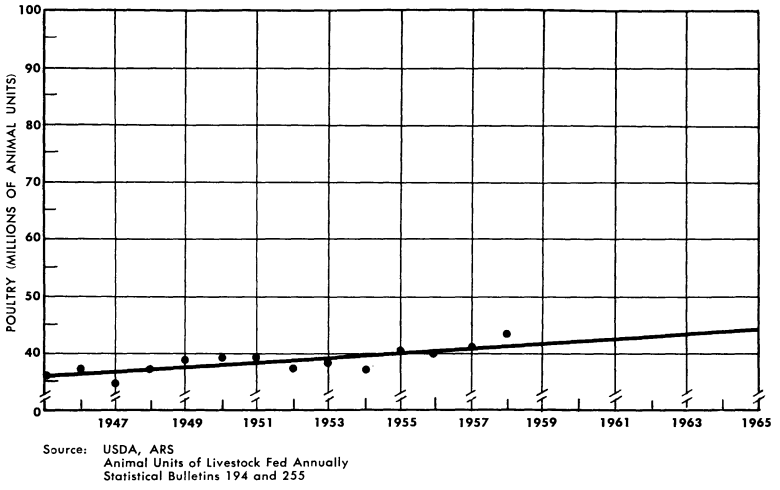
Fig. 7.2 — Animal units of beef cattle fed annually with trend line (1946–58).

grain consuming animal unit, (2) a roughage consuming animal unit, and (3) a combined grain-roughage consuming unit.[2] These series account for and combine inventory numbers of classes of livestock as well as those fed during the year. In essence, these series represent estimated total feed consumption for each species and for all livestock.

Trends in dairy cattle animal units after World War II show about the same decline in both grain consuming and roughage consuming units (Figure 7.1). In contrast to the dairy cattle is the beef cattle trend, where a rather strong upward trend in both grain and roughage consuming units has occurred in the postwar period. The rather strong upward trend in beef cattle is significant when measured in terms of roughage consuming units (Figure 7.2).

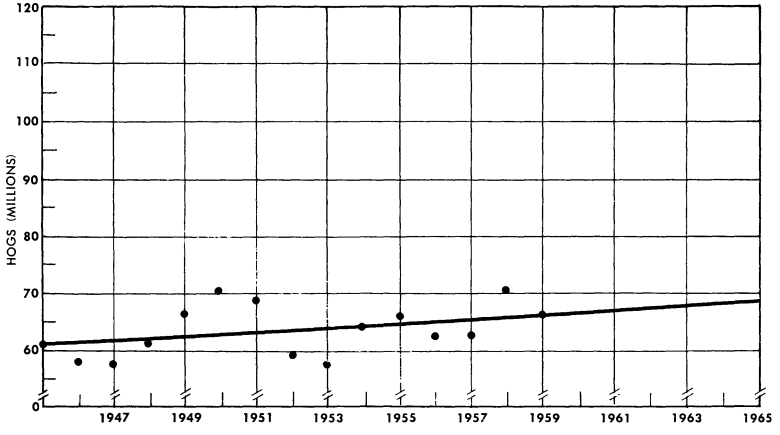
The trend for hogs and poultry is upward in terms of grain consuming units. In case of poultry, this has occurred

[2] Cf. R. D. Jennings, *Animal Units of Livestock Fed Annually*, USDA Stat. Bul. 194, October 1956, and subsequent series. Also *Agricultural Handbook No. 118*, Vol. 2, Chap. 5. USDA, September 1957.



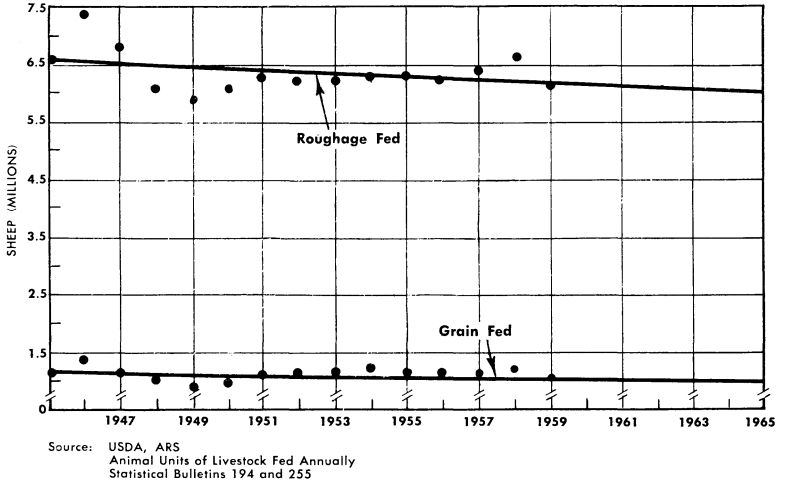
Source: USDA, ARS
Animal Units of Livestock Fed Annually
Statistical Bulletins 194 and 255

Fig. 7.3 — Animal units of poultry fed annually with trend line (1946–58).



Source: USDA, ARS
Animal Units of Livestock Fed Annually
Statistical Bulletins 194 and 255

Fig. 7.4 — Animal units of hogs fed annually with trend line (1946–58).



Source: USDA, ARS
Animal Units of Livestock Fed Annually
Statistical Bulletins 194 and 255

Fig. 7.5 — Animal units of sheep and goats fed annually with trend line (1946–58).

in spite of a sharply declining inventory of chickens kept for egg production and reflects greatly increased feed grain requirements of rapidly expanding numbers of broilers and turkeys kept for meat production (Figures 7.3, 7.4, 7.5).

Sheep classified as grain consuming units declined but increased slightly as roughage consuming animals.

When viewed in the aggregate, including all kinds of livestock, the total grain and roughage consuming animal units remained remarkably stable between 1949 and 1958. Variation has been between 102 to 114 million animal units.[3] The peak of 120 million animal units attained in 1943 with wartime wheat feeding and other incentive programs had not been achieved again as the U.S. farm economy entered the 1960's.

Red meat production increased nearly one-fifth between 1946–48 and 1959, while chickens and turkeys have increased 77 and 112 percent respectively. The 45 percent

[3] USDA, *Stat. Bul. No.* 225, October 1959, Table 1.

increase for beef in contrast to only a 1.6 percent increase in pork is significant (Table 7.3).

Data on meat, milk, and egg production suggest that an increasing proportion of the feed grains produced is utilized by beef cattle, broilers, and turkeys. This diversion of feed grains reflects the relative strength of beef prices to pork prices.

Postwar efficiency in broiler and turkey meat production resulted in lowered costs and in relative prices and thus expanded market opportunity. While dairy cattle show a downward trend as measured in terms of either grain or roughage consuming animal units, total milk production has increased a modest 10 percent in the postwar period. It is worth restating that while the aggregate measure of livestock in this country has remained quite stable between 1949 and 1959, the production of meat and livestock products has increased substantially. Only veal, lamb, and mutton show declines in production. Significant is the increase in beef in total production of red meat. This reflects increased grain feeding. To a lesser degree, improved forages are no doubt responsible for increases in both beef and milk production.

SYSTEMS OF PRODUCTION

Almost from the Colonial times some degree of specialized livestock production took place according to geographical areas. After the Civil War, the tendency for geographical specialization became more evident. For many decades the Mountain and Great Plains regions specialized in the range sheep and cattle business, the Northeast and the Lake States in dairying, the Corn Belt in hog and cattle finishing. While each of these areas followed somewhat uniform methods or systems of production, there was and continues to be considerable variation in livestock production methods.

Beef cattle production has a wide diversity in systems, part of which is associated with alternative opportunities

for use of land. More than half of the beef cattle in this country are produced in the western states. Beef cattle as well as sheep utilizing range and forested pasture provide the major use of the land in this area. This region will likely continue to be a leading producing area for feeder cattle.

The term "baby beef production systems" applies to more intensive grain feeding of beef animals, beginning while they are very young and just able to eat grains. These animals are usually marketed at twelve to eighteen months of age. This system, though not general, is practiced in the Corn Belt and associated areas where cows are kept and where sufficient grain is produced on the same farm to "feed out" calves.

Sheep production systems include the common farm-flock procedure used in the humid farming areas of the eastern half of the United States and the rangeland system used in western ranges. About two-thirds of the sheep in this country are handled by herders on open rangelands.

Swine production is largely centered in the north central states in association with intensive corn production. In contrast to sheep and cattle, swine traditionally have been generally farrowed and fattened on the same farm. Cattle, and to some extent sheep, have a two-stage system of production: a large proportion of the young are produced on western or other range areas and then shipped to grain producing areas for finishing.

Intensive dairying enterprises tend to be located nearer population centers. Dairy enterprises outside fluid milk sheds tend to be smaller and are located in areas where good forage is available and with processed and manufactured dairy product outlets. Dairy cows kept on many midwestern farms produce milk for family consumption and a little butterfat for sale.

Poultry enterprises in the north central region, until recently, were largely farm laying flocks. Production of poultry for meat has become a highly specialized operation

and has in the case of both broilers and turkeys developed in highly localized areas.

Considerable space would be required to detail the shifts in importance among regions of the United States in various livestock enterprises. Enterprise specialization is increasing rapidly. In 1954 there were reported 3.3 million commercial farms. Of these, 16 percent were classified as dairy farms having received more than 50 percent of their farm income from dairying. Similarly, almost 5 percent were classified as poultry farms and 21 percent as livestock farms. However, these measures do not fully indicate the extent of specialization.

In 1935 only 716 farms reported as many as 3,200 chickens four months old and over per farm. In the 1954 census nearly 6,500 farms reported 3,200 or more chickens per farm and these farms marketed 17 per cent of all eggs reported sold. Broilers were first reported separately in the 1954 census. Slightly over 4,000 farms reported having sold 40,000 or more broilers per farm during 1954.

In the thirties turkeys were usually a sideline enterprise on many farms, but by 1960 most turkey production had been concentrated on specialized farms. In 1940 there were 443,000 farms reporting 2.3 million turkeys. In 1954 83,500 farms reported 5.3 million birds.

The poultry industry has undergone further rapid concentration since the 1954 census. Cattle and lamb feeding and hog feeding enterprises of large scale were reported in the late fifties. There appears to be pressure to increase man-hour productivity on livestock and poultry farms through improved feeding, disease control, and enlarging the size of business.

PRODUCTIVITY PER MAN-HOUR

The amazing story of the tremendous increase in productivity per man-hour in farming is familiar. Less well known is the variation in the impact of technology among different enterprises (Table 7.4).

TABLE 7.4

FARM PRODUCTION PER MAN-HOUR

Enterprises	Percent increase during decade	
	1939–48	1949–58
All farm products	62	81
All livestock and livestock products	25	38
Meat animals	6	9
Milk cows	35	35
Poultry	22	92
All crops	65	93
Feed grains	102	132
Hay and forage	67	43
Food grains	93	141
Vegetables	44	58
Fruits and nuts	9	30
Sugar crops	25	118
Cotton	45	79
Tobacco	27	62
Oil crops	100	118

Source: Compiled from Table 17, *Changes in Farm Production and Efficiency*, USDA Stat. Bul. 233, September 1959.

The contrast between livestock and crop enterprise is striking. Particularly noteworthy is the relatively small increase in man-hour productivity in growing meat animals. Only in the poultry enterprises does increase in man-hour productivity in the 1950's approach that of some of the crop enterprises.

Mechanization, power, fertilizer, and improved seeds contributed to increasing production of feed and food grains per worker. Increased man-hour productivity made possible tremendous increase in crop acreages per worker and stimulated the combination of small farms into large units.

Productivity per man-hour achieved in animal enterprises is chiefly associated with the great improvement in knowledge of nutrition which revolutionized poultry feeding and brought substantial improvement in swine, cattle, and sheep feeding. Behind these gains are the basic discoveries indicating the qualitative and quantitative requirements

TABLE 7.5

FEED UNITS CONSUMED PER UNIT OF POULTRY MEAT PRODUCTION, UNITED STATES, 1940–57

Year*	For broilers			For turkeys		
	Feed units†		Pounds liveweight produced by 100 feed units†‡	Feed units†		Pounds liveweight produced by 100 feed units†‡
	Per broiler produced	Per 100 pounds liveweight		Per turkey raised	Per 100 pounds liveweight	
	(*Units*)	(*Units*)	(*Pounds*)	(*Units*)	(*Units*)	(*Pounds*)
1940	14.3	489	20.4	114	723	13.8
1941	13.8	466	21.5	116	723	13.8
1942	14.1	482	20.7	107	666	15.0
1943	13.5	451	22.2	111	668	15.0
1944	13.6	448	22.3	112	650	15.4
1945	13.8	459	21.8	113	634	15.8
1946	13.5	448	22.3	113	630	15.9
1947	13.2	434	23.0	115	630	15.9
1948	12.5	410	24.4	114	610	16.4
1949	11.8	382	26.2	109	592	16.9
1950	11.5	374	26.7	100	561	17.8
1951	11.2	366	27.3	94	556	18.0
1952	11.0	359	27.9	95	561	17.8
1953	10.9	351	28.5	93	545	18.3
1954	10.6	342	29.2	89	537	18.6
1955	10.2	318	31.4	93	560	17.9
1956	10.1	313	31.9	95	569	17.6
1957	9.7	295	33.9	100	585	17.1

* Beginning October.

† A feed unit is the approximate equivalent in value to a pound of corn.

‡ Computed.

Source: Agricultural Outlook Charts, 1960, USDA, November 1959.

for at least a dozen vitamins, mineral requirements for different species of livestock, the role of balance in nutrients, and the efficiency of high energy diets. Research in disease and parasite control has kept pace so that these productivity gains have been maintained.

The productivity gains per man-hour in livestock production so far are largely those in physical efficiency. The possibility of improving productivity per man-hour in livestock husbandry through larger farms and changing systems of production began to unfold in the 1950's through various types of "integration" arrangements. Indeed, the prospect of increasing labor productivity is one of the incentives in so-called integration arrangements.

The rapidly increasing scale of broiler and turkey enterprises was made possible in part by greatly improved feeding efficiency associated with much improved methods of disease control (Table 7.5).

Less dramatic increases have occurred in other species of livestock (Table 7.6). Some of these "gains" in other species probably are because of differences in age when marketed, changes in relative proportion of breeding stock to other animals, etc.

TABLE 7.6

TRENDS IN FEED UNITS OF ALL FEEDS CONSUMED PER UNIT OF PRODUCTION BY DIFFERENT CLASSES OF LIVESTOCK*

Year	Milk cows per 100 pounds of milk	Cattle and calves per 100 pounds produced	Hens and pullets per 100 eggs produced	Hogs per 100 pounds produced
	(*Pounds*)	(*Pounds*)	(*Pounds*)	(*Pounds*)
1940–1944....	114	1,015	63	538
1945–1949....	112	967	62	535
1950–1955....	108	924	58	520
1956.....	104	897	55	519

* A feed unit is the equivalent in feeding value of a pound of corn.

Source: *Food*, The Yearbook of Agriculture 1959, USDA, Washington, D.C., 1959, p. 332.

POTENTIAL IMPROVEMENT IN FEED EFFICIENCY

Outstanding features of the published material on efficiency of feed utilization by livestock are a gradual trend toward greater efficiency and the step by step lowering of feed requirements as research findings are put to use. This can be documented more carefully with swine than with beef cattle and sheep.

Developments In Swine Feeding

The new developments with swine at the present time and estimated possible effects of future innovations are selected from the best experimental lots at the agricultural experiment stations of states where swine represent a major part of farm income.

It appears that research in nutrition is not the limiting factor in swine production. Possible areas for more improvement will be: (1) in the area of amino acid balance — either by breeding corn and soybeans with a superior amino acid composition, by introducing new protein sources, or by supplementation with amino acids made by the chemical industry; (2) through a more intense study of mineral interrelationships; and (3) by improving energy utilization.

Additional improvement in feed efficiency will result from breeding programs. This has already been evidenced by the performance of the superior animals now in the swine testing stations and by the development of more intensive selection and superior gene concentration techniques. It has been shown experimentally that correctly controlled temperature and humidity can decrease the amount of feed per 100 pounds of gain by at least 50 pounds for swine.

Disease is a limiting factor in many areas where farmers are attempting to establish an intense swine operation under confinement. Much additional research on the effect of nutrition on disease resistance is urgently needed.

New management techniques resulting from studies of the hog's response to various stimuli and the use of relaxing drugs may promote additional gains.

Considering the research in progress and estimating that the intensity of effort will increase in the future, at least one major innovation should be available by 1965 and a second one before 1980. Therefore, it would seem feasibly possible to produce 1 pound of pork on less than 2 pounds of feed by 1980.

Applying research findings to general farm conditions will be more difficult than making the findings in the first place. Some good swine producers are now getting feed efficiencies equal or superior to those obtained by the agricultural experiment stations. The people most likely to be in the commercial hog business by 1980 should be producing swine on the same amount of feed as is possible under the experimental conditions today. The best figure that has been reported is 1 pound of gain on slightly over 2 pounds of feed. Admittedly, this is for a few animals fed "impractical rations" under very carefully controlled conditions. But when the diverse factors of breeding, feeding, disease, and environmental control are tempered by the right kind of management, it is believed today's best experimental values can be realized by good producers in 1980.

Developments In Cattle and Sheep Feeding

The efficiency which will be obtained with meat producing ruminants (Table 7.7) will be determined largely by the age and size of the animal produced and the type of feed available. Young animals are more efficient users of feeds. If gains occurring as a result of feeding estrogenic-like materials to beef cattle and sheep can be retained and additional research can develop more specific additives which produce desired growth effects without the threat of secondary effects on reproductive organs and other body tissues, a large increase in feed efficiency can be expected.

TABLE 7.7

ESTIMATED EFFICIENCY INCREMENTS FOR RUMINANTS

Year	Reason for improvement	Best experimental lbs. feed per lbs. gain	Feedlot performance
	Beef cattle		
1960.....	.....	6–6½	7–8
1970.....	Nutritive balance	5–5½	6½
1980.....	Change in production pattern and improved genetic capabilities	4½	5½
	Sheep		
1960.....	.....	5–5½	6–7
1970.....	Change in production	4–4½	5½
1980.....	Nutritive balance, cumulative	3½	4

The conventional fattening ration containing about 15 to 20 percent roughage and fed for 120 days can be expected to produce 1 pound of steer gain for about 6½ pounds of feed. Pelleted lamb rations are more efficient, producing 1 pound of lamb for 5½ pounds of feed.

A beginning has been made on a series of investigations into fundamental factors underlying the utilization of feed by ruminants and the part rumen microorganisms play in breaking down the feed. As this research is intensified and applied, it is possible that additional control over factors affecting feed intake, rate of passage of feed through the gastrointestinal tract, and the activities of rumen bacteria may allow us to gain additional control and permit an additional 10 to 20 percent improvement in the utilization of feed.

Many diseases in ruminants, such as bloating, are associated with improper balance of food or by the animal taking in unusually large amounts of feed in a short period of time. Research on rumen microorganisms should help reduce these conditions and the resulting periods of low gains.

Properly applied research has roughly halved the amount of feed required to produce pork (Table 7.8),

TABLE 7.8

IMPROVEMENTS IN FEED EFFICIENCY IN SWINE

Year	Reasons for improvement	Lbs. of feed per 100 lbs. gain
	Ration (cumulative improvements)	
1910	Corn + minerals	600–1,200
1920	+ low quality protein	540
1930	+ mixed protein	400
1945	+ soybean meal + B vitamins	370
1950	+ antibiotics	340
1954	Mixed proteins (better amino acid balance)	300
1959	Results from selected swine testing stations	
	Best lots	260
	Average lots	295
	Projected improvements	
1965	Temperature control, best conditions	250
1970	Disease control, "germ free"	225
1975	Gains from breeding program (cumulative)	205
1980	Gains from improved nutrition under above conditions (cumulative)	190
	Management gains (cumulative)	175

whereas the only real improvement in feed efficiency in ruminants during the same 50 year period has been the 10 to 15 percent that resulted from the use of estrogenic-like materials in the meat producing animals and some gains resulting from the marketing of younger, lighter weight animals.

There appears little likelihood that control of temperature will be a major factor in beef and sheep production by 1980. Since the time required for reproduction of these animals is long, improvement through breeding will not progress as rapidly as has occurred with poultry or which may occur with swine. A compensating factor is the high degree with which rate of gain is inherited in beef cattle as compared to swine.

Improvement of feed conversion efficiency will likely continue to receive the greatest emphasis among livestock breeders and nutritionists. Performance and progeny tests records will become more important in breeding programs.

Several geneticists have suggested that in the production of swine three or four lines will eventually tend to predominate, just as has happened in broiler production.

Considerable progress in cattle breeding is possible with organized programs of progeny testing being undertaken by land-grant colleges and by private organizations. Results of a 112 day progeny test group of a private research organization suggest a wide variation in performance in weight gains among cattle. Several lots of ten head each gained in excess of 3.8 pounds daily compared with average gains of 3 pounds.[4]

FACTORS AFFECTING LOCATION OF LIVESTOCK PRODUCTION

Improvement in feed-conversion of cattle, swine, and sheep coupled with improved disease control procedures will set loose a new force affecting locations of and systems of livestock feeding.

Other things being equal, whether important shifts in location of feeding can take place is dependent in part on relative transportation costs of feed versus livestock products. Indeed, feeding enterprises in feed-deficit areas will be quite sensitive to freight rates. The present rates on the Mississippi River and the influence of the St. Lawrence Seaway would suggest lower freight rates on grains and feed. It is possible that only finishing operations can take place in areas near population centers.

Relative costs of transporting hogs, for example, live or in carcass is dependent on live and dressed meat rates and the dressing yield of hogs. When the feed conversion ratio falls, eventually a point will be reached at which it would be cheaper to move the grain to feeding establishments nearer population centers. It appears that while we are approaching that point we had not reached it by 1960.

[4] *One Hundred and Twelve Day Report,* Codding-Armour Research, Foraker, Oklahoma, June 1960.

LARGER UNITS SHOW SOME SAVINGS

Economies of large scale operations will also be a factor in future livestock production systems. Cost of production data by states or regions are difficult to obtain but are important in relation to movement of products from some areas to distant markets.

A clue to the effect of size on cost was reported in a study of California feedlot operations. This analysis assumed feed costs for all in the California location to be roughly similar and concentrated on costs other than feed as related to size. (Other costs include labor, depreciation, interest on investment, taxes, death losses, etc.)[5] Daily non-feed costs declined 35 percent as size of operation increased from 480 head to 18,000 head units. While there are problems of comparability, it is suggestive of the impact of size. It might be that these cost reductions are sufficient to overcome transport costs on feed requirements from distant points.

Similar data for swine enterprises from Purdue University indicate that there might be substantial economies of scale. Higher returns per man-hour can be achieved.

Economics of Larger Unit Operations

Achievement of sufficient scale to increase man-hour productivity, through improved facilities arrangements, fuller use of facilities, application of appropriate genetic nutrition technology, and superior management are obviously necessary. The feed-livestock economy cannot long remain out of step in man-hour productivity compared with other farm enterprises. In the livestock enterprises great opportunities exist for improvement of red meat animal production. Certainly we must approach that presently achieved in turkey and broiler meat production.

[5] John A. Hopkin, "Economies of Size in the Cattle-Feeding Industry of California," *J. Farm Econ.*, Vol. 40, No. 2, May 1958. Also Tech. Bul. 138, Agr. Exp. Sta., Univ. of Arizona, December 1959.

The implications of moving to this level of attainment are staggering. Some that might be mentioned are:

1. Larger units obviously mean fewer total number of operations. For example, it has been suggested that 100,000 farmers with 100 sows each could produce all the hogs we are now producing. If real economies of scale exist beyond 100 sows, enterprises say to 200-sow unit or to 600-sow unit, one can readily calculate the possible impact on number of individual farms needed to produce our pork.

2. As another possibility, one could imagine commercial separation of pig raising and brooding from that of finishing operations and even area specialization in each of these activities. Feeder pig operations may become more extensive than we have heretofore considered commercially feasible. This two-stage operation has long been a characteristic in beef cattle, i.e., range production with finishing often carried on at widely separated points.

3. If large unit operations mean substantial reductions in costs through the application of the best in technology and management, it is possible that hog feeding operations, for example, can be separated from feed growing operations. Further reductions in feed required per pound of gain will make increasingly possible further extensive feeding operations nearer population centers.

4. Implications of some changes in livestock feeding would include shifts in the type of associated processing and marketing facilities. It is likely that the type of marketing services required by larger unit operations will be different from those demanded under conditions of small, widely dispersed production units.

Specialized Feeding Operations

Specialized operations can achieve better use of facilities, capital, and management. To what extent these advantages can be incorporated in typical Corn Belt feeding

operations is a question for concentrated study. It might be that advantages of combining the growing of feed and feeding livestock offset the advantages of specialization.

Economics of Location of Production Enterprises

The piling up of population in cities and the continuance of this trend means that a new dimension in the production-market relations must be reckoned with. The eastern Corn Belt conceivably has less problems of adjustment on this score. However, the western Corn Belt may have to face up to the prospect of declining relative importance of livestock feeding to the extent that feed production for nearby livestock feeding cannot overcome economies of specialization and location near large market centers.

Disease and Sanitation Control

This is probably a more important problem with swine, particularly on larger farms. A higher degree of management is required to maintain acceptable levels of sanitation control. Special disease problems, not now apparent, will be uncovered as farms become larger. The skills of the veterinary profession will be required to cope with these new problems.

Uniform Quality and Quantity Control

One of the forces coming from large scale retailing is the pressure and need for more uniformity in flow of animals and animal products through the market system. Seasonal and cyclical variation in supplies has long plagued the industry. Integration may be the answer in some cases. In other situations, larger farm marketing combinations may be effective. Ways of recognizing quality in both beef and pork must be improved to facilitate buying and selling. The longer the distance between producer and consumer, in

the market channel sense, the greater the importance of quality identification. Breeders and geneticists must take increasing heed of the need for improving quality uniformity of animals.

Choice of Business Arrangements

A variety of plans and contracts providing capital, facilities, and management are available to producers and feeders. These contracts require close scrutiny on the part of feeders. Consideration must be given to the matter of risk sharing or risk transfers. Also involved are problems of managerial control. Different producers and feeders no doubt will weigh these factors differently. A considerable "shakedown" period in contractual and other arrangements is likely in the immediate future.

MORE COMPETITION COMING

These are some of the problems posed by forces arising from the present and prospective technology and from increasing population concentration. Traditional livestock feeding areas face competition from new areas. Corn Belt feeding is still big league. It is possible that the new feeding areas can, through the use of the best in technology, management, production, and through newer arrangements in processing and marketing effectively compete with the Corn Belt. These new areas will not be hampered by having to unlearn older methods. However, the economical use of labor on many Corn Belt farms can be achieved through an efficient livestock feeding enterprise. Even though these feeding enterprises will likely not be as large as specialized feeding operations, complementary relationships of feed production and livestock finishing will in many cases offset cost advantages of large scale units. Further, no better alternative than livestock feeding for underemployed labor is available on many farms. A considerable force exists in these relationships to sustain a large share of livestock finishing in the Corn Belt.

MAJOR ADJUSTMENTS ARE AHEAD

The major adjustments in livestock production are ahead of us. Population concentrations and rapidly expanding technology are pressing hard on livestock producers to change their methods and size of business. The pressure to change will encourage new business arrangements in production, relocation of some livestock feeding (not all of it), relocation of plants, and new type of marketing institutions.

It is fortunate for the livestock industry that the prospective adjustments in technique on individual farms, between areas, and among processing and marketing firms can be done in a framework of ever-expanding demand for livestock products within the foreseeable future. These adjustments and impacts on particular farms, areas, processors, and marketing firms would be exceedingly painful in a static general demand situation. On the other hand, these same conditions of expanding demand contribute in part to the need for adjustments in the feed-livestock marketing complex.

"ANIMAL AGRICULTURE" AS A TOOL IN AGRICULTURAL ADJUSTMENT

Preceding chapters emphasized the expanding capacity of the U.S. farm plant. The continued existence of large surplus stocks of feed and food grains testifies to this great capacity.

Large surpluses of feed grains generated the expectation in many quarters of increased animal production as a means to reduce feed grain "surpluses" and to improve human nutrition through greater consumption of milk, meat, eggs, and other animal products.

If feed grain surpluses were used for increased feeding of livestock and poultry, certainly rather large short-run dislocations and derangement of the livestock industry would take place. Furthermore, such a "crash" program

would provide only temporary relief, inasmuch as the present backlog of technology applied to our land resources will produce an excess of feed grain supplies in the future, as Bonnen states in Chapter 5.

In view of the present supply and demand imbalance, expansion of the livestock industry has appeared to be an attractive solution. In recent years this notion gained popularity in the annual forums of the National Institute of Animal Agriculture. The initial program and discussion at the Institute supported three general and related objectives: (1) improved human nutrition, (2) increased production and consumption of poultry and livestock products, and (3) soil building and better land use.[6]

Implied in these efforts was greater consumption of livestock products. The Institute speakers hoped it might promote a voluntary program of "storing more grain on the hoof" and an expanding livestock industry was seen "as the best, if not the only, adequate answer to the devastating cyclic problem of farm surpluses." [7]

It has been calculated that animals and poultry, as converters of hay and grain to meats, eggs, etc., require roughly seven times as many nutrients as would be required to feed our population on a strictly cereal diet. Since 1930 this recurring idea has been expresed in a number of ways. For example, it was said that "one pint more milk per day," or "one additional pat of butter," or "one additional slice of bacon" would cause that particular surplus to evaporate. This notion has considerable appeal to livestock, dairy, and poultry producers during periods of low prices.

This solution to expand livestock numbers presupposes a willingness and ability of consumers to purchase more food. In Chapter 4, Fox points out the limitations to increasing demand for even these additional minute quantities of good foods. It also has appeal from the standpoint of the possibility of increasing the amount of land resources used

[6] Cf. *Proceedings First National Institute of Animal Agriculture,* 1951.
[7] *Ibid.,* p. 20.

in producing the total national food supply. The inverse application of the seven to one ratio for direct versus indirect consumption of farm products seems simple enough. It would increase the need for land resources.

This general idea has merit for the longer run. However, it requires an increase in the demand for animal products arising from increasing per capita income, as well as from a growing population. Likewise, increased consumption of animal products could occur if prices of these products declined relative to other food products. Changes in either demand for meat products or in costs are not likely to be great enough to have a significant impact on increasing the derived demand for land resources.

Acknowledgment: Professor William H. Pfander, Department of Animal Husbandry, University of Missouri, contributed a substantial portion of the material in the sections dealing with the developments in swine, cattle, and sheep feeding.