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A BUDGETARY ANALYSIS FOR LARGE DAIRY OPERATIONS IN WEST VIRGINIA

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SUMMARY

A budgetary analysis was developed based on data from this study and the best information available about large dairy operations in West Virginia. After following basic assumptions developed for the budgetary analysis, a net return per cow and replacement was determined. Adjustments were made for economies and diseconomies of scale using an Arizona study as a guideline.

The resulting adjusted net returns for a 100-cow herd producing 12,000, 15,000, and 18,000 pounds of milk were $64, $141, and $215 per cow and replacement. Adjusted net returns for a 200-cow herd producing at the same levels were $95, $172, and $208 per cow and replacement. The returns per cow and replacement in a 300-cow herd were $79, $135, and $156. These data suggest that diseconomies of scale occur somewhere between a 200- and 300-cow herd.

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In the decade from 1960 to 1970, the total number of farm workers in the United States decreased by 40 per cent (Table 1). During the same period population increased 13.5 per cent. The number of persons dependent upon farm products supplied by one United States farm worker for the corresponding period increased by 82.5 per cent! With an ever increasing population and a continuous decrease in the number of farms and farm workers there doesn't seem to be an end to the ability of this country's farmers to provide the needed agricultural production.

In order to produce and market the needed agricultural products with a declining agricultural labor force, larger and larger quantities of capital are required. During the period from 1960-1970, the value of all agricultural marketings increased by 38 per cent. The farm value as a per cent of the retail

TABLE 1

Selected Measures of Population Change and Farm Production Growth for the United States, 1960 and 1970

Item	1960	1970	Per Cent Change
Total population (million)	179.3	203.7	13.5
Total farm workers (million)	7.1	4.2	-40.0
Persons supplied per worker	25.8	47.1	82.5
Marketing receipts (billion)	$ 34.2	$ 47.2	38.0
Total farm assets (billion)	$ 203.1	$ 311.4	53.3
Total assets per worker (thousand)	$ 28.8	$ 73.8	156.3
Per cent farm share of retail cost	39.0	40.0	2.6

Source: U. S. Department of Agriculture, *1970 Handbook of Agricultural Charts,* Agricultural Handbook No. 397 (Washington: U. S. Government Printing Office, 1970) p. 29, 18, 15, 2, 16, and 22.

cost of the farm-food market basket increased by only 2.6 per cent. The value of total farm assets increased 53.3 per cent. The value of assets per worker increased nearly $45,000. Each one per cent increase in farm products marketed was associated with a one and one-fourth per cent increase in productive farm assets. The demand for such large capital investments has had the effect of eliminating many small producers and shifting productions more and more into large production units.

The increased production by larger production units is vividly shown by the following. From 1960 to 1970 the number of farms with sales of less than $10,000 declined 40 per cent and those with sales $10,000 or greater increased by 33 per cent while overall farm numbers declined by 26 per cent (Table 2). The per cent of the total farms with sales less than $10,000 declined 20 per cent but the per cent of total farms with sales $10,000 or greater increased by 80 per cent. Measured by products sold, the movement is clearly toward additional farms with larger volume and fewer farms with small dollar sales.

Not only is the number of farms selling a larger volume of products increasing, but the per cent of the total volume of products sold by these farms is also increasing. In 1960 farms with sales of $10,000 or more, representing 21 per cent of all farms, sold 73 per cent of the total. In 1970 these farms represented 38 per cent of the total farms, and they sold 90 per cent of the total farm products. During the same period the total cash receipts from farm sales increased by 52 per cent.

The trend indicates that with fewer total farms, farms with large volume sales (over $10,000) will become a larger proportion of all farms and total volume of sales. In order to remain in farming and remain competitive, it appears that individual farmers will have to increase the volume of their products sold. Usually output is increased by an increase of the amount of products per unit of resources (per acre or per animal), an increase of the number of units, or a combination of the per unit and number of units.

Total milk production in the United States is declining at a slow rate. In the not too distant past, milk production was increasing even though cow numbers were decreasing. The number of cows kept for milk has been declining rather consistently since the end of World War II but milk production has not declined in a corresponding manner. In fact, milk production reached a production peak in 1964 with 126,967 million pounds. The 1970 production was only 7.5 per cent less than the peak year. One factor contributing to the relatively stable milk production during a period of prolonged decrease in cow numbers has been the increased production per cow. From 1959 through 1970, the average production per cow in the United States has increased 38 per cent (Table 3). In West Virginia for the corresponding period, production per cow increased 34 per cent. At the same time the number of cows kept for milk declined by 30 per cent and 57 per cent for the United States and West Virginia, respectively.

TABLE 2

Farms by Value of Sales Classes, 1960-1969

Farms	Less than $2,500	$2,500 to $4,999	$5,000 to $9,999	$10,000 to $19,999	$20,000 to $39,999	$40,000 and over	All farms
Number farms (thousands)							
1960	1,848	617	600	497	227	113	3,962
1970	1,184	260	370	513	374	223	2,934
Per cent farms							
1960	46.6	15.6	16.7	12.5	5.7	2.9	100
1970	40.5	8.9	12.7	17.5	12.8	7.6	100
Cash receipts from farming (million dollars)							
1960	1,994	2,443	5,115	7,373	6,481	11,450	34,856
1970	1,344	1,113	3,060	8,259	11,346	27,826	52,948
Per cent receipts from farming							
1960	5.7	7.0	14.7	21.2	18.6	32.8	100
1970	2.5	2.1	5.8	15.6	21.4	52.6	100

Source: U. S. Department of Agriculture, *Farm Income Situation,* FIS-218, Tables 1D and 2D, Economic Research Service (Washington: U. S. Government Printing Office, July, 1971) p. 68 and 69.

The decline of cow numbers has been primarily among the herds of small size—small size in this case being herds of less than 30 cows. Change in dairy cows by herd size groupings for the United States and West Virginia are shown in Table 4. In the United States the herds with less than 30 cows decreased by 53 per cent between 1950 and 1959, and by 42 per cent between 1959 and 1964 or an overall decline of 73 per cent from 1950 to 1964. The corresponding declines for West Virginia were: 51 per cent, 1950-1959; 38 per cent, 1959-1964 or an overall decline of 70 per cent from 1950 to 1964. The greatest decline occurred among herds with less than ten cows, followed by the herds with 10 to 20 cows and the least decline among herd sizes of 20 to 30 cows.

The number of farms with herd sizes of 30 or more cows actually increased during the 1950-1964 period. In the United States from 1950-1959 herds with more than 30 cows increased by 94 per cent and from 1959-1964 by another 19 per cent, or overall between 1950 and 1964 by 131 per cent. In West Virginia, during these same periods and for the same herd sizes, the per cent changes were: 1950-1959, an increase of 80 per cent, 1959-1964 a one per cent decline,

TABLE 3

Milk Production Per Cow and Number of Milk Cows Kept on Farms in the United States and West Virginia 1959, 1964, and 1970

Cow Production and Numbers	1959	1964	1970
Production per cow (lbs.)			
United States	6,815[1]	8,099[2]	9,388[3]
West Virginia	4,980[1]	5,430[2]	6,678[3]
Cows on farms (thousands)			
United States	17,901	15,677	12,509
West Virginia	138	95	59

Source:

[1]U. S. Department of Agriculture, *Dairy Statistics Through 1960,* Stat. Bull. No. 303, Economic Research Service (Washington: U. S. Government Printing Office, 1965) pp. 1 and 26.

[2]U. S. Department of Agriculture, *Dairy Statistics 1960-67,* Stat. Bull. No. 430, Economic Research Service (Washington: U. S. Government Printing Office, 1968) pp. 2, 5, and 47.

[3]U. S. Department of Agriculture, *Milk Production,* January, 1971, Crop Reporting Board, Statistical Reporting Service (Washington: U. S. Government Printing Office, February, 1971) p. 7.

thereby giving an overall increase from 1950-1964 of 79 per cent. Although there was a one per cent decline in the West Virginia herd size with more than 30 cows between 1959 and 1964, herds with more than 50 cows increased from 107 to 195, an 82 per cent increase in the five-year period.

TABLE 4

Farms Reporting Milk Cows and the Number of Cows Reported, by Herd Sizes, United States and West Virignia, 1950, 1959, and 1964

	Cow Herd Sizes				
Number	1-9	10-19	20-29	30-49	50+
Number of Farms:					
U. S. (Thousands)					
1950	3,025	473	119	47	17
1959	1,310	262	141	89	35
1964	712	160	114	101	47
W. Va.					
1950	56,464	2,596	636	228	89
1959	27,496	1,301	673	464	107
1964	17,104	678	424	371	195
Number of Cows:					
U. S. (thousands)					
1950	9,179	6,295	2,758	1,692	1,444
1959	N.A.[1]	N.A.	N.A.	N.A.	N.A.
1964	1,943	2,237	2,717	3,701	4,024
W. Va.					
1950	138,956	34,290	15,234	8,320	6,065
1959	N.A.	N.A.	N.A.	N.A.	N.A.
1964	36,823	9,271	10,160	13,682	13,959

[1]Not Available

Source: U. S. Department of Commerce, *United States Censuses of Agriculture,* Vol. II, Chapter VI, 1950,1959 and 1964, Bureau of Census (Washington: U. S. Government Printing Office) p. 412; p. 528; and pp. 126 and 134, respectively.

Prior to 1959, dairy herds with 100 or more cows were not reported in the censuses. However, in 1959 such herd sizes were reported. In the United States in 1959 there were 6,600 herds with 100 or more cows but only seven in West Virginia. In 1964, there were 8,900 and 25 such herds respectively.[1] In 1969, it was estimated that 13,000 herds existed in the United States.[2] From a survey conducted in West Virginia by the Agricultural Experiment Station, Division of Resource Management, during the summer of 1970, it was found that 40 herds with 100 or more cows existed at that time. The growth of herds in excess of 100 cows for the United States between 1959 and 1969 was 95 per cent; such growth in West Virginia during the same period was 470 per cent.

The large percentage growth for 100-cow dairies in West Virginia may not be typical but the continued growth of large dairies appears to be the future trend. In a recent publication, Alden C. Manchester wrote: "At the production level, dairy farms are expected to grow larger in size and fewer in number. The number may drop from 300,000 to 100,000. Farms of less than 50 cows will virtually disappear; the modal size may well be several hundred cows."[3]

PURPOSE

The 1970 survey of West Virginia's large dairy herds was designed to evaluate the extent of the large-scale development; determine the condition and pertinent facts relative to the farms; and to examine some of the effects of scale as related to costs and returns for such farms. Reported in this bulletin are the results estimated to occur with the costs and returns from three herd sizes, 100-, 200-, 300-cow herds, as well as three production levels—12,000, 15,000, and 18,000 pounds of milk per cow per year for each herd size. The report of large scale dairies that existed in West Virginia during 1970 can be found in an earlier bulletin.[4]

The 1970 West Virginia study was an attempt to survey all dairies with 100 or more dairy cows (Figure 1). While attempting to locate all such herds, it was found that at least 295 diary herds had 50 or more cows. There were

[1]United States Department of Commerce, *Censuses of Agriculture,* Vol. II, Chapter VI, 1959 and 1964, Bureau of the Census (Washington: United States Government Printing Office) p. 528; and pp. 134 and 126, respectively.

[2]A. G. Mathis, "Dairy Outlook Statement," (Washington: National Outlook Conference, 1970) Table 3, p. 7.

[3]Alden C. Manchester, *Pricing Milk and Dairy Products—Principles, Practices, and Problems.* (Washington: United States Department of Agriculture, E.R.S. Agricultural Economics Report No. 207, June, 1971) p. 54.

[4]Don C. Sibold and Paul E. Nesselroad, *Large Scale Dairy Operations in West Virginia, 1970,* West Virginia University Agricultural Experiment Station Bulletin 608, (Morgantown, West Virginia University, June 1972).

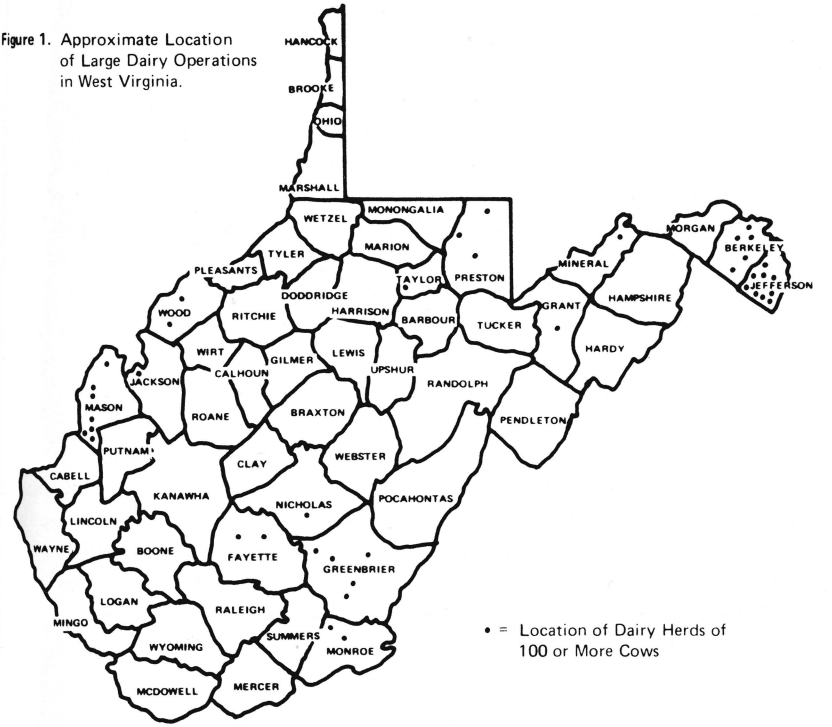

Figure 1. Approximate Location of Large Dairy Operations in West Virginia.

approximately 180 herds with 50 to 75 cows, 75 herds having 76-99 cows, and the 40 with 100 cows or over. Several of the producers with less than 100 cows indicated plans to expand in the near future to 100 or more cows. A few of the 40 100-cow dairies indicated they also plan to expand to 200 to 300 cows, and some of the expansion has already occurred. The data found in this bulletin should prove useful to new producers or those considering expansion of their existing herds.

SOURCE OF INFORMATION

Most of the information pertaining to the physical facilities and equipment was based upon the survey findings in 1970 of all the known dairy farms in West Virginia with 100 or more milk cows. The livestock data and requirements were based upon current research results as published in agricultural bulletins, handbooks, and current periodicals. Soils data were based upon the average percentages of the various Land Use Classes as taken from soils maps. Crop yields and fertilization rates were based upon the upper one-third yields and rates as reported by the 40 farmers included in the study. Other crop data were based upon current recommendations from agronomic research and specialists.

Labor data were based upon current research publications and estimates of various specialists. Capital charges were based upon the 1971 interest rates quoted on the principal for the type and term of the loan stated.

The data presented in this publication are based upon the minimum needs for dairy farms assumed to have herd sizes of 100, 200, and 300 dairy cows. The data do not represent any farm in West Virginia, although every known dairy farm with 100 or more cows in the State during 1970 has contributed to some aspect of the information. Therefore, the data could be a useful and practical measure for those farmers already operating large dairy farms, by farmers considering expanding a dairy herd to 100 or more cows, or for persons considering entry into the dairy business on such a scale.

RESOURCES AND ALTERNATIVES CONSIDERED

Land

A study of soils maps for all land operated provided the basis for computing the percentage of each Land Class found on the 40 dairy operations. Being large operations and having a high dependence upon land for cropland and pastureland the study farms undoubtedly acquired control of larger proportions of the better Land Classes than those available on the average farm in West Virginia (Table 5). The more favorable distribution of Land Classes found on the

TABLE 5

Relative Distribution of Land on Large Dairy Operations and in West Virginia by Land Classes, 1970

Land Class	Large Dairy Farms	West Virginia[1]
	Per Cent	Per Cent
I	6.0	1.0
II	31.0	9.0
III	16.0	9.0
IV	14.0	9.0
VI	20.0	15.0
VII	13.0	57.0
VIII	—	—
Total	100.0	100.0

[1]Based on West Virginia Soil and Water Conservation Needs Inventory, 1970.

dairy farms studied explains the smaller acreages of land resources required. If such operations were conducted on farms having the land class distribution typical of the State much larger acreages would be required.

The amount and utilization of the various Land Classes required by herd sizes of 100, 200, and 300 dairy cows and their replacements for three levels of annual per cow milk production (12,000, 15,000, and 18,000 pounds) are presented in Appendix Table 1. The acreages of required land resources are based upon the average percentages of each individual Land Class found for all the land, owned and rented, operated by the 40 farm operations studied. The reported average amount of all land actually operated was 793 acres. Distribution of land by percentage uses was: cropland 41, cropland pasture 2, permanent pasture 39, brush and timber 14, and all other land 4.

Livestock

Dairy cattle was the only type of livestock considered, as dairy animals were almost the sole type of livestock found on the farms studied (Appendix Tables 2-11). Three levels of milk production were assumed: 12,000, 15,000, and 18,000 pounds of milk per cow per year. Energy expressed as Total Digestible Nutrients (TDN), and Digestible Protein (DP) requirements were computed for each of these production levels.[5] In addition to the TDN and DP requirements, dry matter limits were set for each production level in order to specify the maximum quantities of pasture, hay, and silage that could be fed to keep within the dry matter restriction permitted for each production level. In order to meet the energy and protein minimums and the dry matter maximum, specific rations for each milk production level were formulated.

The majority of dairy herd replacements were raised on the farms. The rations for two age groups of replacement heifers were established—heifers under one year and one- to two-year-old heifers. Heifers were assumed to freshen at 24 months.

Artificial breeding of cows is depended upon for most diary herds of 100 or more cows. But there was at least one mature bull and his replacement reported. Therefore, a suggested ration meeting the necessary energy and protein requirements for a bull less than one year old and for one over two years old was provided.

Crops

Corn for grain and silage, rye and hay (alfalfa) were the only tillable crops considered since these crops were those necessary to meet the ration needs of

[5]Total Digestible Nutrients (TDN) represents the approximate heat or energy value of a feed. Digestible Protein (DP) is an expression of the total protein intake of a feed that can be digested for use by the animal. For a further explanation see: Morrison, F. B. *Feeds and Feeding.* 22nd edition. Ithaca: The Morrison Publishing Company, 1956, p. 40.

the livestock (Appendix Tables 12-14). The needed soybean oil meal, barley, and oats were purchased. Pasture was the only other crop budgeted (Appendix Table 15).

The practices for producing corn grain and corn silage are slightly different. Corn for grain was produced following the usual clean tillage practices. Silage corn was produced following the sod planting procedures using rye as the cover crop. Although not listed as a return the rye may also serve as a fall supplemental pasture for the young stock. Such a practice is commonly followed by dairymen.

Alfalfa was the only hay crop considered since it is an excellent quality hay and yields can be maintained at high levels for several years through proper treatment. The long stand life combines well with corn in a rotation on gentle sloping land. This permits corn production for more than one year on suitable Land Classes.

Sufficient pastureland was available to meet the pasture needs throughout the year by utilization of Land Classes IV and VI as pasture. The Class IV pasture received fertilizer and lime treatment at a heavier rate than the Class VI pasture; also the Class IV pasture was clipped twice annually compared with only one clipping per year for the Class VI pastureland.

Machinery

There are three machinery tables, reflecting the requirements of each of the three dairy herd sizes (Appendix Tables 16-18). The number, size, and kinds of machinery for these herd sizes reflect the change in machinery needs as livestock numbers and crop acreages increase.

Land, Buildings, and Equipment

The land resources and their utilization to produce the crops necessary for grain, silage, hay, and pasture needs of the three herd sizes and at three production levels are presented in Appendix Table 1. The small grains and other ration supplements necessary to meet nutritional requirements for animals are purchased rather than grown (see the crop section). The acreage distribution of land by land classes conforms to the land class percentages found on the 40 large dairy farms (Table 5). Provisions were made for a 180-day pasture season for all replacement stock grown for all three herd sizes. For the 100-, and 200-cow herd sizes pasture was provided for only May and June. The 300-cow dairy was assumed to be a completely dry lot operation.

Values were assigned to cropland and non-cropland in a separate table (Appendix Table 19), thereby providing an estimate of the capital invested in each of these land uses and the total land investment for each herd size and production level. An estimate was made of the annual land tax for farms for

each of the sizes specified based upon the computed land values and the 1970 West Virginia tax rates for owner-occupied farm lands.

There are three buildings and equipment tables for each herd size and the three production levels (Appendix Tables 20-22). Each table presents investment estimates for including the cow, heifer, and calf herds; lot requirements; manure systems; milk room and parlor areas; and feeding systems. The investments change within herd sizes by production levels and among tables due to herd size differences. Investment variations within herd sizes are related to production differences that arise from feeding practices, milk storage needs, and feeding systems. Investment variations between herd sizes are primarily differences that arise from the physical increase in cow numbers. Some difference occurs in the investment for the 300-cow dairy as compared to the two other herd sizes due to the practice of dry lot feeding of production animals in the 300-cow herd.

PROCEDURE

Where possible and applicable, the information gained from the 1970 survey was used in the following budgetary analysis. To provide the basis for the estimated costs and returns presented the survey data were incorporated with the data from dairy, engineering, and economic studies of other sources, and the cultural and agronomic practices recommended for West Virginia conditions.

One aspect of increasing herd size is the economies and diseconomies of size. Increasing the scale of production usually brings about a decrease in the unit cost of production. The economies of scale are usually attributed to the following causes: (1) increased specialization of man labor; (2) better utilization and specialization of the management; (3) more efficient use of productive equipment; (4) economies of buying and selling; and (5) more and better utilization of by-products.

The economies of scale are usually neither constant nor unlimited. Sooner or later diseconomies of scale arise in the productive process. If nothing else contributes to diseconomies, usually the inability of management to coordinate and control all aspects of the expansion process will eventually cause a breakdown or weakness to occur that limits further expansion or makes the expansion process too costly to continue.

Another factor that may contribute to increasing costs in an expansion process is the physical limits of a machine or a production process. When a machine or process is extended to produce at its physical limits, it may do so for a period of time but usually the cost will increase due to increased repairs, maintenance, and time losses. To install a larger machine or process will increase costs unless there is efficiency gained at small levels of output. Cost will also be higher when there is under-utilization of the larger machine. These aspects of increased production cost are caused by the "lumpyness" of components or processes. A four-plow tractor that replaces a two-plow tractor usually can plow

more land faster and cheaper with four plows when used at or near capacity. However, to use a four-plow tractor with only two plows may permit the same amount of land to be plowed faster but probably at a greater cost per acre due to the indivisibility "lumpyness" of the four-plow tractor and its under-utilization.

In the expansion process of the dairy herd, the complement of machinery, buildings, silos, milking parlors, labor and other production components have limits. Herd size can be increased through the addition of components, a second bulk tank, another tractor, only to a certain economic point. At some point adding components is insufficient for expansion to continue. A new production system is necessary such as complete dry lot feeding, an enlarged milking parlor, or an increase in crew size. These are "lumpy" items and are apt to increase costs after their installation unless they are utilized for quantity production beyond that which required their installation. In this bulletin, recognition of such a situation occurs in herd sizes between 200 and 300 cows.

BUDGETARY ASSUMPTIONS

One purpose of the budgetary analysis was to arrive at a range of net income that an operator could expect for his operational and management skills. The herd sizes used for the analysis were: 100, 200, and 300 cows, each with a production level of 12,000 pounds, 15,000 pounds, and 18,000 pounds, respectively. Every 100 cows had a total of 78 replacement head.[6] Forty heifers under one year of age and 35 heifers from one year to two years of age accounted for the bulk of replacements needed. A 90 per cent calf crop was assumed. The remaining three replacements were bulls in the age groups of under one year, over one year, and mature bull. The bulls were assumed to be used to service only those cows which could not be bred artificially.

The budgetary analysis which follows utilizes the resources and alternatives (land, livestock, crops, buildings, and equipment) discussed earlier and found in Appendix Tables 1-22. The first step of the analysis was to balance feed rations for all milk cows and replacements. These rations included the minimum nutrient requirements necessary for heifer growth and cow maintenance, based on a 1,500-pound mature cow. Feed requirements changed as milk production increased from 12,000 pounds to 18,000 pounds. The ratio of grain to milk was 1:7.5 for 12,000 pounds of production and then changed to 1:1.9 for 18,000 pounds of production. Milk production was based on the assumption that 9,400 pounds of milk could be produced using high quality forages and no grain ration. Production greater than 9,400 pounds required a grain ration. Grain rations for

[6]Raymond H. Tremblay and Irving F. Fellows, *1969 ELFAC Dairy Farm Business Analysis,* NEC-66 (Orono, Maine: Northeastern States Cooperative Extension Service, June 1970) pp. 32-33.

the milk cows consisted of 60 parts of corn and cob meal, 30 parts barley, and 10 parts oats. A protein supplement, soybean oil meal, was substituted for corn and cob meal when needed. The heifers' ration was two-thirds shelled corn and one-third barley. All feed mixing and grinding was assumed to be done on the farm.

All crops, except barley and oats, needed to feed the milk herd and its replacements were grown on the farm. Extra acreage of corn grain was assumed to be grown for sale and in turn, the necessary amounts of barley and oats were bought. Crop yields, prices, and minimum ton requirements were used to compute the amount of crop acreage needed. Acreage was adjusted upward to account for harvesting, storage, and feeding loss.[7] The upper one-third of the reported yields on the 40 West Virginia farms were the yields used in this budgetary analysis. These yield levels included five tons of alfalfa hay, 26 tons of corn silage, and 116 bushels of corn grain per acre. Fifty-three to 57 per cent of the total land acreage was cropland.

The total land acreage used in the budgetary analysis varied because of herd size and production levels. The acreage for 100 cows and replacements ranged from 306 acres to 450 acres. Acreage for 200 cows and replacements ranged from 612 to 900 acres. The 300-cow herds required from 805 to 1,185 acres (Appendix Table 1). The 300-cow herds were assumed to be on dry lot; the other two herd sizes were pastured the months of May and June.

INVESTMENT COSTS

Investments included cropland, non-cropland, buildings, equipment, machinery, and cattle. The total land acreage was presented in the same relative land classification distribution as found on the 40 dairy operations in this study. The land class distribution was 37 per cent Class I and II, 16 per cent Class III, 14 per cent Class IV, 20 per cent Class VI, and 13 per cent Class VII (Table 5).

Cropland

The cropland value was assumed to be $225 per acre. The acre value was based on a six per cent capitalization of present renting rates for West Virginia.[8] Total investment of cropland per 100 cows and replacements ranged from $36,500 to $58,300 depending on production levels.

[7] *Agricultural Planning Data for the Northeastern United States,* Department of Agricultural Economics and Rural Sociology, A.E. and R.S. 51 (University Park: The Pennsylvania State University, 1965), Table 29, pp. 45-46.

[8] Robert D. Reinsel and Bruce Johnson, *Farm Tenure and Cash Rents in the United States,* U. S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 190, (Washington: United States Government Printing Office, August, 1970), pp. 25-26.

Non-Cropland

The non-cropland included cropland pasture, permanent pasture, and woodland. The value of non-cropland was determined using the same method as for cropland. Non-cropland had a value of $81 per acre. A smaller range of $11,600 to $15,500 constituted the value of non-cropland per 100 cows and replacements.

Buildings and Equipment

The items included in buildings and equipment were as follows: free stall barn, calf and heifer barns, lot area, liquid manure system, milk room and parlor including milk equipment, silos, feed bins, and feed equipment. Silos were the items that caused the largest variation in total investment between different levels of production. Total investment in buildings and equipment for a 100-cow herd and replacement was $89,500 to $78,200 as the production level increased from 12,000 pounds to 18,000 pounds (Appendix Table 20). Investment decreased as production increased because feed patterns changed toward feeding more concentrates. Therefore, less silo capacity was needed per cow as milk production increased. Total investment increased as the herd increased to 200 and 300 cows. However, this was not a linear increase. The investment levels for these larger herd sizes ranged from $162,000 to $140,800 and from $233,000 to $202,000, respectively.

Cattle

Investment in dairy cattle was assumed to increase with an increase in the production level. A cow producing 12,000 pounds of milk was valued at $363 and for each additional 3,000 pounds of production, $50 was added to the value of the cow. Bred heifers were valued at $225 and yearling heifers were valued at $117.[9] Heifer values did not change to correspond to increased milk cow values.

Machinery

The investment in machinery was based on the list of equipment needs for 100-, 200-, and 300-cow herds and replacements (Appendix Tables 16, 17, and 18). The total investment in machinery ranged from $63,400 to $86,000 for the various herd sizes.

GROSS RETURNS

Gross returns, costs, and net returns for three herd sizes and three levels of production are shown in Tables 6, 7, and 8. The gross returns and costs were

[9]Based upon average value of cows, bred heifers, and yearling heifers obtained from basic ELFAC data provided by Mr. George E. Toben, Professor of Agricultural Economics, Division of Resource Management, West Virginia University.

computed on a per cow and replacement basis. Therefore, all costs and returns for a 100-cow herd are distributed over 178 animals. Gross returns per dairy animal were comprised of income from milk, cull cows, and calves. The milk price used was the average price received by 40 large dairy operators in West Virginia on a milk marketing order basis. The average price was $6.00 per hundredweight, of which $0.45 cwt. was deducted for advertising, membership dues, hauling, and other expenses. Cull cows and calves were assumed to have a fair market value of $270 and $30 per head, respectively. In the course of a year a 100-cow herd was assumed to have received income from the sale of 35 cull cows and 50 calves.

COSTS

All recognizable fixed and variable costs were included in the budgets in order to obtain a net income.

Crops

Individual crop budgets were developed and presented as Appendix Tables 12, 13, and 14. Costs of seed, fertilizer, lime, sprays, twine, manure spreading, implement, power, and labor were included in these budgets. Corn for silage was assumed sod planted in conjunction with an annual rye grain crop planted after corn harvest. The per acre cost of corn silage was figured to be $81.31. The cost of an acre of rye was $11.27. These two costs were combined in reaching a total corn silage cost. An acre of corn grain was calculated to cost $55.75.

An acre of alfalfa hay was assumed to cost $60.80 per year. Based on yield levels and costs, harvested alfalfa cost $12.16 per ton.

Crop costs per animal were constant for all herd sizes. Crop cost differences occurred with the 12,000-pound, 15,000-pound, and 18,000-pound levels. Corn silage costs for these milk production levels were $30.55, $21.29, and $14.82, respectively. The alfalfa hay costs were $22.50, $20.06, and 16.42. The corn grain costs were $11.15, $35.12, and $57.42 for the respective production levels.

Pasture

Similar costs were considered in the cropland and upland pasture budget as in the crop budgets. Cropland pasture was assumed to be clipped biannually and the upland pasture was clipped annually. Cropland pasture was assumed to be primarily Class IV land. In connection with Class IV hayland, a rotation enabled a high TDN yield on Class IV pasture with continuous fertilization of land previously used as hayland. The cost per acre of cropland pasture was computed to be $23.75 and the cost per acre of upland pasture was $12.46 per acre. The per animal cost for cropland pasture was $5.70. Upland pasture costs per animal ranged from $4.24 to $6.23.

Labor

The minimum wage of $1.60 per hour was paid all employees. A full-time employee was assumed to work 2,000 hours per year. The manager or operator was assumed to work 2,600 hours per year which included both physical and managerial work. The total number of hours required to operate a dairy farm included 28 per cent overhead labor. The 100-cow herd required, including the operator, 3.9 employees, the 200-cow herd required 6.7 employees, and the 300-cow herd required 7.9 employees. Total labor costs ranged from $9,856 to $32,528. Perquisites, Social Security, and other benefit payments cost an additional sum amounting to 14 per cent of the total wages paid.[10]

Health, Breeding, and Testing

Veterinarians and medicine costs were assumed to be $12 per cow, $1.40 per heifer, and $4.30 per calf.[11] Breeding fees were assumed to be $7. The average rate charged for milk testing was $6.48 per milk cow.[12]

Supplies and Other Expenses

Dairy supplies amounted to $16 per cow. Protein supplement cost $5.01 per hundredweight and milk replacer cost $15.06 per hundredweight. Death loss was assumed to be two per cent of the fair market value of a cow.[13] A large category of miscellaneous costs was calculated to be $47.19 per animal.[14]

Machinery and Building Depreciation

Depreciation of machinery and buildings was treated as a fixed cost. Therefore, the cost per animal was dependent on the number of animals in the herd. Machinery depreciation was based on the estimated life of each piece of

[10]Based upon ELFAC data provided by Mr. George E. Toben, Professor of Agricultural Economics, Division of Resource Management, West Virginia University.

[11]Cost of veterinarian and medicine for cows based upon Tremblay *op. cit.*, p. 32. Cost for heifers and calves based upon Hollis D. Hall and Ted R. Nelson, *Dairy Costs and Returns,* Cooperative Extension Service, No. 113 (Stillwater: Oklahoma State University, 1968), p. 113. Veterinarian and medicine costs for heifers were assumed to be $1.40 and for calves $4.30.

[12]Based upon State DHIA rates as obtained from Dr. R. O. Kelley, State Extension Specialist—Dairy, Division of Animal and Veterinary Sciences, West Virginia University.

[13]Paul E. Nesselroad, *Optimum Farm Organization for a Portion of the Appalachian Plateau,* West Virginia University Agricultural Experiment Station Bulletin 593T (Morgantown: West Virginia University, 1970) pp. 64-65.

[14]Based upon ELFAC data provided by Mr. George Toben, Professor of Agricultural Economics, Division of Resource Management, West Virginia University.

machinery. The annual depreciation on buildings was based on four per cent of the original cost.[15] Annual depreciation costs for machinery and buildings investment are found in Appendix Tables 16, 17, 18, 20, 21, and 22.

Machinery and Building Maintenance

The cost of machinery maintenance was figured on an individual machine basis which averaged out to be an annual cost of 5.2 per cent of the original cost.[16] Building maintenance was assumed to be 1.5 per cent of the original investment.[17]

Insurance

Insurance costs on machinery and cattle were based on 1970 rates as provided by the West Virginia Insurance Department. Cost of insurance on farm buildings was difficult to obtain and, therefore, was based on rates provided by an insurance agency in Greenbrier County. These annual rates were $0.70 per $100 value of machinery, $0.85 per $100 value of buildings, and $0.80 per $100 value of cattle.

Taxes

Taxes were calculated on 50 per cent of the actual value, which was the assumed assessed value. The tax rate used was for the year 1970. The rate for Class I property (equipment, machinery, livestock, or any other personal property used for agricultural purposes) was $0.75 per $100 of assessed value. For Class II property (land, buildings, and housing used in agricultural pursuits) the rate was $1.41 per $100 of assessed value.[18]

Interest

Interest on investment in cattle, land, machinery, and equipment was included in the budget as a cost of operation. The interest on cattle, machinery,

[15]John W. Wysong, *Economics of Large Size in the Production of Fluid Milk on Specialized Dairy Farms in Maryland,* Department of Agricultural Economics and Agricultural Experiment Station Misc. Publication No. 544 (College Park: University of Maryland, March, 1965) p. 44.

[16]*Agricultural Engineers' Yearbook,* 1962, 1964. "Farm Machinery Costs and Use," (St. Joseph, Michigan: American Society of Agricultural Engineers) pp. 230-235.

[17]Rate based upon recommendation of Mr. George E. Toben, Professor of Agricultural Economics, Division of Resource Management, West Virginia University.

[18]Based upon a listing of tax rates for 1970 obtained from the West Virginia State Tax Commissioner's Office.

(text continued on page 28)

TABLE 6

Estimated Annual Costs and Returns Per Cow and Replacement Producing 12,000, 15,000 and 18,000 Pounds of Milk in a 100-Cow Herd[1]

Item	Unit	Rate or Price	Production Per Cow (Pounds)		
			12,000	15,000	18,000
Receipts					
Milk[2]	cwt.	$ 5.55	$374.18	$467.70	$561.27
Cull cow[3]	head	270.00	53.08	53.08	53.08
Calves[4]	head	30.00	8.43	8.43	8.43
Total			435.69	529.21	622.78
Expenses					
Veterinary and medicine[5]	head	8.05	8.05	8.05	8.05
Electricity[6]	kwh	0.02	2.74	2.74	2.74
Breeding fee[7]	head	3.94	3.94	3.94	3.94
Milk testing[8]	head	3.64	3.64	3.64	3.64
Dairy supplies[6]	head	8.99	8.99	8.99	8.99
Other farm expenses[9]	head	—	47.19	47.19	47.19
Protein supplement[10]	cwt.	5.01	1.51	2.81	7.23
Milk replacer[10]	cwt.	15.06	2.05	2.05	2.05
Death loss[6]	per cent	2.00	5.40	5.40	5.40
Machinery depreciation[11]	head	—	29.26	29.26	29.26
Building depreciation[12]	head	—	20.12	18.69	17.57
Machinery maintenance[13]	head	—	18.74	18.74	18.74
Building maintenance[14]	head	—	7.54	7.81	[illegible]

Insurance on machinery[15]	$100	0.70	3.26	3.28	3.30
Insurance on building[15]	$100	0.85	3.62	3.39	3.13
Insurance on cattle[15]	$100	0.80	2.19	2.45	2.67
Taxes on machinery[16]	$100	.75	1.74	1.76	1.78
Taxes on buildings[16]	$100	1.41	3.00	2.81	2.60
Taxes on cattle[16]	$100	.75	1.04	1.15	1.26
Taxes on land[16]	$100	1.41	1.90	2.43	2.91
Interest on cattle[17]	Per cent	7.87	10.95	12.06	13.16
Interest on land[17]	Per cent	5.00	13.51	17.26	20.71
Interest on machinery and buildings[17]	Per cent	7.87	33.80	32.41	31.30
Corn silage[18]	dollars		30.55	21.29	14.82
Corn grain[18]	dollars		11.15	35.12	57.42
Hay[18]	dollars		22.50	20.06	16.42
Cropland pasture[18]	dollars		5.70	5.70	5.70
Upland pasture[18]	dollars		4.24	5.36	6.23
Labor[19]	dollars		55.37	55.37	55.37
Perquisites, Social Security, and other benefits[20]	dollars		7.84	7.84	7.84
Total	dollars		371.53	388.25	408.01
Net returns			64.16	140.96	214.77

(continued on next page)

Table 6 (continued)

[1]Raymond H. Tremblay and Irving F. Fellows, *1969 ELFAC Dairy Farm Business Analysis,* NEC-66 (Orono, Maine: Northeastern States Cooperative Extension Service, June 1970) pp. 32-33. For every 100 cows, 78 head of replacements are planned. This included 40 heifers under one year, 35 heifers over one year, a bull calf, a young bull, and a mature bull. All costs and returns are on a per animal (cows and replacements) basis.

[2]The milk price used was based upon the average price received by the dairymen from the major markets of Washington, Baltimore, and Charleston, less $0.45 per hundredweight for advertising, hauling, membership dues, and other expenses.

[3]The annual cull rate was assumed to be 35 per cent. The fair market value of cull cows was $270 based on $18 per cwt. and a 1,500-pound cow.

[4]Based upon a 90 per cent calf crop and previous assumptions made on the number of replacements, 50 calves are sold annually for every 100 cows. This includes five heifers not kept for replacement and 45 bull calves.

[5]Cost assumed to be $12 per cow based upon Raymond H. Tremblay and Irving F. Fellows, *1969 ELFAC Dairy Farm Business Analysis,* NEC-66 (Orono, Maine: Northeastern States Cooperative Extension Service, June 1970) pp. 32-33. Costs for heifers were $1.40 and for calves were $4.30 based upon Hollis D. Hall and Ted R. Nelson, *Dairy Cost and Returns,* Cooperative Extension Service No. 113 (Stillwater: Oklahoma State University, 1968), p. 113.

[6]Based upon estimates given by Ronald A. Layton, Alfred L. Barr, and Paul E. Nesselroad, *Estimated Annual Costs, Production and Income for Selected Livestock and Crop Enterprises, Eastern West Virginia,* Agricultural Experiment Station Bull. 594T (Morgantown: West Virginia University, June, 1970) pp. 25 and 39. This was figured on an average of 137 kwh per animal. Total dairy supplies cost $16 per cow. Death losses are expressed as a percentage of fair market value.

[7]Estimated to be $7.00 per cow.

[8]Based upon state DHIA rates as obtained from Dr. R. O. Kelley, State Extension Specialist—Dairy, Division of Animal and Veterinary Sciences, West Virginia University. The rates included $6 for the first 10 cows plus $0.53 for each additional cow tested.

[9]Other farm expenses included: small tools, travel for farm business, legal fees, general supplies, sales tax, excise tax, office expense, farm records, farm magazines and papers, livestock registration and pedigrees, cow rental, storage, commodity sales and service, trucking, hauling and freight, adjustments on sales, bad debt expense, custom and machine hire, land and building rent, charges, and miscellaneous expense based on ELFAC records and codes.

[10]Based on *Agricultural Planning Data for the Northeastern United States,* Department of Agricultural Economics and Rural Sociology, A.E. and R.S. 51 (University Park: The Pennsylvania State University, 1965) Table 30, p. 51.

[11]For cost data used, see Appendix Tables 16, 17, and 18.

[12]Based upon four per cent of the original cost according to John W. Wysong, *Economies of Large Size in the Production of Fluid Milk on Specialized Dairy Farms in Maryland,* Department of Agricultural Economics and Agricultural Experiment Station, Misc. Publication No. 544 (College Park: University of Maryland, March 1965) p. 44.

[13]*Agricultural Engineers' Yearbook,* 1962 and 1964, "Farm Machinery Costs and Use," (St. Joseph, Michigan: American Society of Agricultural Engineers) pp. 230-235.

[14]Rate based upon recommendation of Mr. George E. Toben, Professor of Agricultural Economics, Division of Resource Management, West Virginia University.

[15]Insurance rates on machinery and cattle were based upon 1970 rates as provided by the West Virginia Insurance Department in a letter to Mr. George E. Toben, Professor of Agricultural Economics, dated January 14, 1970. Insurance rates on farm buildings were based on rates given by Farmers Home Fire Insurance Company in Lewisburg, West Virginia.

[16]Based upon a listing of tax rates for 1970 obtained from the West Virginia Tax Commissioner's Office (undated).

[17]Based upon interest rates obtained from Farmers Home Administration, Morgantown, West Virginia.

[18]For cost data used, see Appendix Tables 12, 14, and 15, respectively.

[19]Based on the minimum wage rate of $1.60 per hour and 2.9 paid employees for a 100-cow herd, 5.7 paid employees for a 200-cow herd, and 6.9 paid employees for a 300-cow herd. Number of employees estimated on the basis of time required to perform major cropping jobs plus 28 per cent overhead labor. Based on F. E. Montville, *Forage Harvesting On Dairy Farms,* Agricultural Experiment Station Bulletin 353 (Kingston: University of Rhode Island, April 1960) p. 4; T. S. Thorfinnson and A. W. Epp, *Cost of Operating Tillage and Harvesting Machinery in Nebraska,* U. S. Department of Agriculture, ERS, Farm Production Economics Division, SB 475 (Lincoln, Nebraska: Agricultural Experiment Station, March 1963), pp. 11-13; Earl M. Hughes, Jr. and B. F. Stanton, *Time Spent on Entrepreneurial and Related Activities,* Department of Agricultural Economics, Agricultural Experiment Station, A.E. Res. 187 (Ithaca: Cornell University, December 1965) pp. 9-12.

[20]Based upon ELFAC data provided by Mr. George E. Toben, Professor of Agricultural Economics, Division of Resource Management, West Virginia University.

TABLE 7

Estimated Annual Costs and Returns Per Cow and Replacement Producing 12,000, 15,000 and 18,000 Pounds of Milk in a 200-Cow Herd[1]

Item	Unit	Rate or Price	Production Per Cow (Pounds)		
			12,000	15,000	18,000
Receipts					
Milk[2]	cwt	$ 5.55	$374.18	$467.70	$561.27
Cull cow[3]	head	30.00	53.08	53.08	53.08
Calves[4]	head	270.00	9.82	9.82	9.82
Total			435.69	529.21	622.78
Expenses					
Veterinary and medicine[5]	head	8.05	8.05	8.05	8.05
Electricity[6]	kwh	0.02	2.74	2.74	2.74
Breeding fee[7]	head	3.94	3.94	3.94	3.94
Milk testing[8]	head	3.64	3.64	3.64	3.64
Dairy supplies[6]	head	8.99	8.99	8.99	8.99
Other farm expenses[9]	head	—	47.19	47.19	47.19
Protein supplement[10]	cwt.	5.01	1.51	2.81	7.23
Milk replacer[10]	cwt.	15.06	2.05	2.05	2.05
Death loss[6]	per cent	2.00	5.40	5.40	5.40
Machinery depreciation[11]	head	—	17.12	17.12	17.12
Building depreciation[12]	head	—	17.27	16.58	15.67
Machinery maintenance[13]	head	—	12.31	12.31	12.31
Building maintenance[14]	head	—	6.48	6.23	5.88

Insurance of machinery[15]	$100	0.70	2.07	2.08	2.09
Insurance of buildings[15]	$100	0.85	3.17	2.91	2.67
Insurance of cattle[15]	$100	0.80	2.19	2.45	2.67
Taxes on machinery[16]	$100	0.75	1.10	1.11	1.12
Taxes on buildings[16]	$100	1.41	2.63	2.40	2.12
Taxes on cattle[16]	$100	0.75	1.04	1.15	1.26
Taxes on land[16]	$100	1.41	1.90	2.43	2.91
Interest on cattle[17]	per cent	7.87	10.95	12.06	13.16
Interest on land[17]	per cent	5.00	13.51	17.26	20.71
Interest on machinery and buildings[17]	per cent	7.87	25.47	24.80	23.89
Corn silage[18]	dollars		30.55	22.22	13.88
Corn grain[18]	dollars		11.71	35.12	56.86
Hay[18]	dollars		22.50	20.06	17.02
Cropland pasture[18]	dollars		5.70	5.70	5.70
Upland pasture[18]	dollars		4.24	5.36	6.23
Labor[19]	dollars		52.67	52.67	52.67
Perquisites, Social Security, and other benefits[20]	dollars		7.66	7.66	7.66
Total			335.75	354.48	372.83
Net Returns			99.94	174.73	249.95
Adjusted net returns			94.61	171.75	208.38

[1]See Table 6 for assumptions and documentations.

TABLE 8

Estimated Annual Costs and Returns Per Cow and Replacement Producing 12,000, 15,000, and 18,000 Pounds of Milk in a 300-Cow Herd[1]

Item	Unit	Rate or Price	Production Per Cow (Pounds) 12,000	15,000	18,000
Receipts					
Milk[2]	cwt	$ 5.55	$374.18	$467.70	$561.27
Cull cow[3]	head	30.00	53.08	53.08	53.08
Calves[4]	head	270.00	9.82	9.82	9.82
Total			435.69	529.21	622.78
Expenses					
Veterinary and medicine[5]	head	8.05	8.05	8.05	8.05
Electricity[6]	kwh	0.02	2.74	2.74	2.74
Breeding fee[7]	head	3.94	3.94	3.94	3.94
Milk testing[8]	head	3.64	3.64	3.64	3.64
Dairy supplies[6]	head	8.99	8.99	8.99	8.99
Other farm expenses[9]	head	—	47.19	47.19	47.19
Protein supplement[10]	cwt.	5.01	1.51	2.81	7.23
Milk replacer[10]	cwt.	15.06	2.05	2.05	2.05
Death loss[6]	per cent	2.00	5.40	5.40	5.40
Machinery depreciation[11]	head	—	12.68	12.68	12.68
Building depreciation[12]	head	—	17.45	16.20	15.13
Machinery maintenance[13]	head	—	9.46	9.46	9.46
Building maintenance[14]	head	—	6.55	6.07	5.67

Insurance on machinery[15]	$100	0.70	1.62	1.63	1.64
Insurance on buildings[15]	$100	0.85	2.95	2.84	2.60
Insurance on cattle[15]	$100	0.80	2.19	2.45	2.67
Taxes on machinery[16]	$100	0.75	.86	.87	.88
Taxes on buildings[16]	$100	1.41	2.45	2.35	2.16
Taxes on cattle[16]	$100	0.75	1.04	1.15	1.26
Taxes on land[16]	$100	1.41	1.84	2.36	2.76
Interest on cattle[17]	per cent	7.87	10.95	12.06	13.16
Interest on land[17]	per cent	5.00	13.09	16.55	19.54
Interest on machinery and buildings[17]	per cent	7.87	22.66	22.25	21.22
Corn silage[18]	dollars		30.55	22.22	13.88
Corn grain[18]	dollars		11.71	35.12	56.86
Hay[18]	dollars		25.53	22.50	18.85
Cropland pasture[18]	dollars		1.43	0.72	–
Upland pasture[18]	dollars		3.86	4.73	5.48
Labor[19]	dollars		42.10	42.10	42.10
Perquisites, Social Security, and other benefits[20]			6.17	6.17	6.17
Total			310.65	327.29	343.40
Net returns			125.04	201.92	279.38
Adjusted net returns			79.00	135.00	156.00

[1]See Table 6 for assumptions and documentations.

and equipment was based on 50 per cent of value at a rate of 7.87 per cent. The interest rate on land was assumed to be five per cent.[19]

NET RETURNS

Net returns presented in Tables 6, 7, and 8 were placed on a per cow and replacement basis. The break even point of production was calculated to be 10,000 pounds, based on the assumptions made in the budgetary analysis. Thus, any milk production level less than 10,000 pounds per cow realized a loss. These budgets assumed above average managerial ability, hence, there could be a production level greater than the 10,000 pound level where a loss would occur with below average management.

After fixed costs were invested, production income increased faster than did the variable or production cost. As the herd size increased, the average fixed costs decreased by being distributed over a larger number of cows. However, beyond a certain limit additional fixed investments are needed to handle the increased herd size. Therefore, to realize greater net returns, proper combinations of physical resources and capital investments are needed.

However, economies and diseconomies of scale are a part of the operation. An increase of physical resources and capital investments will not result in continuous increase in net returns. There are technical as well as managerial economies and diseconomies.

The net returns obtained in these budgets were adjusted to help account for these economies and diseconomies. Data published from a study in Arizona was interpolated to account for the herd sizes of 100, 200, and 300 cows.[20] All adjustments were based on the original findings for the 100-cow herd. The per cent increase in net returns for the Arizona study was adapted to the present study for three herd sizes. The Arizona study was based on a 12,000-pound production level. Therefore, the per cent increase in production was applied to account for the increased production levels used in the present study.

The adjusted net returns for the 100-cow herd were $64, $141, and $215 at the 12,000-, 15,000-, and 18,000-pound production levels, respectively. Similarly, the adjusted net returns were $95, $172, and $208 for the 200-cow herd and $79, $135, and $156 for the 300-cow herd. Adjusted net returns for the 300-cow herd decreased because of diseconomies of scale. Based on this study these diseconomies occur somewhere between a 200- and 300-cow herd.

[19]Interest rates obtained from Farmers Home Administration, Morgantown, West Virginia.

[20]William E. Martin and James S. Hill, *Cost-Size Relationships for Central Arizona Dairies,* Arizona Agricultural Experiment Station, Technical Bulletin 149 (Tucson: The University of Arizona, September, 1962) p. 34.

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Appendix

TABLE 1

Acreages of Farms by Herd Size, Production Levels and Land Classification and Use[1]

Land Classification and Use	Annual Milk Production Level Per Cow in Pounds		
	12,000	15,000	18,000
		Acres	
100-cow Herd			
Cropland—I, II, III	162	202	238
Corn grain I, II	36	112	183
Corn silage I, II	59	42	28
Hayland III	67	48	27
Cropland—IV —hayland	—	11	21
Pasture IV	43	42	42
Pasture VI	61	76	90
Woodland VII and other uses	40	49	59
Total	306	380	450
200-cow herd			
Cropland—I, II, III	324	404	476
Corn grain I, II	73	224	364
Corn silage I, II	118	84	54
Hayland III	133	96	58
Cropland—IV—hayland	—	22	42
Pasture IV	86	84	84
Pasture VI	122	152	180
Woodland VII and other uses	80	98	118
Total	612	760	900
300-Cow herd			
Cropland—I, II, III	427	535	628
Corn grain I, II	109	335	546
Corn silage I, II	177	126	82
Hayland III	141	74	—
Cropland—IV—hayland	81	125	163
Pasture IV	32	16	3
Pasture VI	161	202	237
Woodland VII and other uses	104	131	154
Total	805	1,010	1,185

[1]Acreages were based on feed requirements, the upper one-third yields reported in the text and by the proportion of land classified into various Land Classes as compiled from soil maps of the 40 farms included in the study. This included 53 per cent in Classes I, II, and III; 14 per cent in Class IV; 20 per cent in Class VI; and 13 per cent in Class VII and other uses such as roads, streams, waste, and farmstead.

TABLE 2

Annual Energy and Protein Requirements for Maintenance, Reproduction, and Milk Production of a 1,500 Pound Dairy Cow[1]

Item	TDN	DP
	Pounds	
Maintenance		
10.77 lbs./day X 365 days	3,935	
0.91 lb./day X 365 days		329
Reproduction		
8.72 lbs./day X 90 days	785	
0.81 lb./day X 90 days		73
Subtotal	4,716	402
Milk Production		
12,000 lbs.	4,140	587
15,000 lbs.	5,175	734
18,000 lbs.	6,208	1,286

[1]Based upon *Dairy Farm Management Planning Handbook,* Unnumbered Mimeograph Compilation by Hutton and Nesselroad, Department of Agricultural Economics and Rural Sociology, University Park: The Pennsylvania State University, 1961.

TABLE 3

Dry Matter Limits from Roughage for a 1,500 Pound Cow for Three Levels of Production: 12,000, 15,000, 18,000 Pounds[1]

Item	Level of Production		
	12,000	15,000	18,000
		Pounds	
Dry matter permitted	10,950	8,212	5,475
Pasture[2]			
Dry matter supplied	1,520	1,520	1,520
Days	65	65	65
Hay–alfalfa[3]			
Dry matter supplied	2,308	1,629	950
Alfalfa fed per day	8.5	6.0	3.5
Days fed	300	300	300
Corn silage[4]			
Dry matter supplied	7,152	5,037	3,022
Silage fed per day	71	50	30
Days fed	365	365	365
Total dry matter supplied[5]	10,980	8,186	5,492

[1]The general "rule of thumb" for daily intake of dry matter for a 1,500-pound dairy cow with levels of production of 12,000, 15,000, and 18,000 pounds was 2 pounds, 1.5 pounds, and 1 pound of dry matter per 100 pound body weight per day respectively.

[2]Cows were assumed to be pastured during the months of May and June. A herd of 300 cows was considered a completely dry lot operation.

[3]Fed ten months out of the year. Pastured cows were not fed hay. A 300-cow herd was fed hay year around.

[4]Fed 12 months of the year.

[5]Pounds of dry matter required and supplied do not equal due to rounding.

TABLE 4

Ration for a 1,500 Pound Cow Producing 12,000 Pounds of Milk Annually[1]

Item	Feed	TDN[2]	DP[2]
		Pounds	
Total Requirements[3]	—	8,856	989
Requirement sources:			
Pasture	—	1,056	242
Forages			
Alfalfa hay	2,550	1,402	306
Corn silage	25,915	5,209	363
Subtotal	—	7,667	911
Concentrates[4]	1,614	1,189	114
Corn and cob meal	984	713	53
Barley	560	357	46
Oats	170	119	15

[1]The rations in Appendix Tables 4 to 12 have been balanced to provide specified minimum levels Total Digestible Nutrients (TDN) and Digestible Protein (DP) but at the same time not to exceed a specified maximum Dry Matter (DM) limit for the animals for which computed. It is unlikely that both the minima and maxima limits will be satisfied simultaneously, thus there may be excesses of either TDN or DP.

[2]The per cent TDN and DP for roughages was obtained from Morrison's *Feeds and Feeding* (22nd ed.). Adjustments were made for the per cent of TDN and DP in hay and corn silage to account for better crop breeding and crop yields. The per cent TDN and DP from hay was set at 55 per cent and 12 per cent respectively. The TDN and DP from corn silage was set at 20.1 per cent and 1.4 per cent respectively.

[3]See footnote 1, Appendix Table 2.

[4]Rations for cows were assumed to be made up of 60 per cent corn and cob meal, 30 per cent barley, and 10 per cent oats. The protein supplement, soybean oil meal, was substituted for corn and cob meal when needed.

TABLE 5

Ration for a 1,500 Pound Cow Producing 15,000 Pounds of Milk Annually[1]

Item	Feed	TDN[1]	DP[1]
		Pounds	
Total requirements	—	9,891	1,136
Requirements sources:			
Pasture	—	1,056	242
Forages			
Alfalfa hay	1,800	990	216
Corn silage	18,250	3,668	255
Subtotal	—	5,714	713
Concentrates	5,672	4,213	423
Corn and cob meal	3,412	2,506	188
Barley	1,616	1,253	162
Oats	598	418	56
Soybean oil meal	46	36	17

[1]See footnotes 1, 2, 3, and 4, Appendix Table 4.

TABLE 6

Ration for a 1,500 Pound Cow Producing 18,000 Pounds of Milk Annually[1]

Item	Feed	TDN[1]	DP[1]
		Pounds	
Total requirements	—	10,924	1,286
Requirement sources:			
Pasture	—	1,056	242
Forages			
Alfalfa hay	1,050	577	126
Corn silage	10,950	2,201	153
Subtotal	—	3,834	521
Concentrates	9,664	7,274	765
Corn and cob meal	5,690	4,270	320
Barley	2,754	2,135	275
Oats	1,017	711	95
Soybean oil meal	203	158	75

[1]See footnotes 1, 2, 3, and 4, Appendix Table 4.

TABLE 7

Annual Ration for a Dairy Heifer from Birth to One Year of Age[1]

Item	Feed	TDN[2]	DP[2]
		Pounds	
Total Requirements[2]	–	2,068	251
Requirement sources:			
Milk			
Colostrum (3 days)	25	–	–
Milk replacer (2 mos.)	360	–	–
Forages			
Alfalfa hay	2,970	1,633	354
Concentrates[3]	550	436	43
Shelled corn	360	288	24
Barley	190	184	19

[1]Calves received no pasture from birth to one year. The number of replacements was 75 per cent of the herd size. This was based on information from the *1969 ELFAC Dairy Farm Business Analysis*. This 75 per cent was divided into 40 per cent under one year and 35 per cent over one year of age.

[2]See footnotes 1, 2, and 3, Appendix Table 4.

[3]Rations for young stock were assumed to be made up of 67 per cent shelled corn and 33 per cent barley. The protein supplement, soybean oil meal, was substituted for shelled corn when needed.

TABLE 8

Annual Ration for a Dairy Heifer from One to Two Years of Age[1]

Item	Feed	TDN	DP
		Pounds	
Total requirements[2]	–	4,287	396
Requirement sources			
Pasture[3]	–	2,008	223
Forages			
Alfalfa hay[4]	2,700	1,358	275
Corn silage[5]	5,050	924	11

[1]No grain was fed heifers from one year until freshening at 24 months. Information of feeding dairy heifers was based upon J. B. Stone and Randolph Barker, *Dairy Cattle Feeding—Resource Data on Economics and Nutrition,* Departments of Animal Husbandry and Agricultural Economics, A. E. Ext. 383 (Ithaca: Cornell University, June, 1965), pp. 52-54.

[2]Based upon National Research Council Bulletin, *Recommended Nutrient Allowances for Dairy Cattle.*

[3]Heifers were pastured for 180 days.

[4]Heifers were fed hay for 180 days.

[5]Heifers were fed corn silage for 240 days.

TABLE 9

Annual Ration for A Bull Calf from Birth to One Year of Age

Item	Feed	TDN[1]	DP[1]
		Pounds	
Total requirements[2]	–	2,970	312
Requirement sources			
Milk			
Colostrum (3 days)	25	–	–
Milk replacer (2 mos.)	360	–	–
Forages			
Alfalfa hay	1,980	1,089	238
Concentrates[3]	2,286	1,881	181
Shelled Corn	1,485	1,260	104
Barley	801	621	77

[1]See footnotes 1 and 2, Appendix Table 4.

[2]Based upon National Research Council Bulletin, *Recommended Nutrient Allowances for Dairy Cattle.*

[3]See footnote 3, Appendix Table 7.

TABLE 10

Annual Ration for a Bull from One to Two Years of Age

Item	Feed	TDN[1]	DP[1]
		Pounds	
Total requirements[2]	–	5,295	493
Requirement sources			
Pasture	–	2,008	223
Forages			
Alfalfa hay	1,800	990	324
Corn silage	4,800	965	67
Subtotal	–	3,963	614
Concentrates	1,683	1,332	119
Shelled corn	1,115	892	67
Barley	568	440	52

[1]See footnotes 1 and 2, Appendix Table 4.

[2]Based upon National Research Council Bulletin, *Recommended Nutrient Allowances for Dairy Cattle.*

TABLE 11

Annual Ration for a Mature 2,000 Pound Bull[1]

Item	Feed	TDN[2]	DP[2]
		Pounds	
Total requirements[3]	–	6,033	518
Requirement sources			
Forages			
Alfalfa hay	5,040	2,535	514
Corn silage	4,380	801	52
Subtotal	9,420	3,336	566
Concentrates	3,663	2,697	260
Corn and cob meal	2,233	1,618	121
Barley	1,044	809	103
Oats	386	270	36

[1]There was assumed to be one bull calf, one yearling bull, and one mature bull for every 100 cows.

[2]See footnotes 1 and 2, Appendix Table 4.

[3]Based upon National Council Bulletin, *Recommended Nutrient Allowances for Dairy Cattle.*

TABLE 12

Corn Budget for One Acre of Grain and Silage

Item	Quantity	Rate	Grain	Silage
Annual income				
Corn grain	116 bu.[1]	$1.24[2]	$144.00	
Corn silage	26 T.	8.00[3]		$208.00
Annual cost				
Seed: Grain	16 lb.[4]	0.24[5]	3.84	
Silage	20 lb.[4]	0.24		4.80
Fertilizer				
Grain				
N	90 lb.[6]	0.12 lb.[7]	10.80	
P_2O_5	110 lb.	0.08 lb.	8.80	
K_2O	100 lb.	0.06 lb.	6.00	
Silage				
N	145 lb.[6]	0.12 lb.[7]		17.40
P_2O_5	125 lb.	0.08 lb.		10.00
K_2O	145 lb.	0.06 lb.		8.70
Lime	0.5 T	7.60 T.[8]	3.80	3.80
Atrazine	3.5 lb.[9]	2.80 bl.[10]	9.80	9.80
Paraquat	1.0 qt.[9]	28.00 gal.[10]		7.00
Manure spreading[11]			1.25	1.25
Implement, power and labor[11]			11.46	18.56

Total Cost	$55.75	$81.31
Labor[12]		
Spring (Apr.—June)	2.4	2.4
Fall (Sept.—Oct.)	1.9	4.3

[1]Crop yields were based upon the upper one-third of those yields reported by the 40 farms included in this study.

[2]Price rate based upon prices received by farmers. Source: *Agricultural Statistics 1969,* U. S. Department of Agriculture, (Washington: U. S. Government Printing Office, 1969) p. 29.

[3]Price rate based upon Virgil E. Crowley, *Using Linear Programming as a Farm Management Tool in Pennsylvania,* Agricultural Extension Service Special Circular 136 (University Park: The Pennsylvania State University, 1970) p. 16.

[4]Quantity based upon Robert K. Reynolds and Ralph G. Kline, *Reducing Cost on Selected Grade-A Dairy Farms,* Department of Agricultural Economics and Agricultural Experiment Station, Technical Bulletin 163 (Blacksburg: Virginia Polytechnic Institute, June, 1963) pp.44-66.

[5]Seed cost based upon price list from Southern States in Morgantown.

[6]Fertilization rates based upon those rates reported by the upper one-third of the 40 farms as given in footnote 1. In addition to commercial fertilizer, manure was assumed to be applied at the rate of 2.15 tons per acre of cropland. The composition manure yields 11.4 pounds of N, 4.4 pounds of P_2O_5 and 12.5 pounds of K_2O per ton of manure based on Reynolds, *op. cit.,* p. 42.

[7]Based upon Crowley, *loc. cit.*

[8]Based upon Paul E. Nesselroad, *Optimum Farm Organizations for a Portion of the Appalachian Plateau,* West Virginia Agricultural Experiment Station, Bulletin 593T (Morgantown: West Virginia University, June, 1970), p. 56.

[9]Based upon *Suggestions for Successful Corn Production with Sod Seeded and No-Till Practices,* supplied by the Cooperative Extension Service, West Virginia University, 1971.

[10]Based upon price list from Southern States in Morgantown.

[11]Based upon Athanas S. Kauzeni, "Estimated Cost of Owning and Operating Farm Machinery in West Virginia, 1970" (unpublished Problem Report, Department of Agricultural Economics, West Virginia University, 1970) pp.35-57.

[12]Based upon R. T. Dailey, G. E. Frick, R. H. McAlexander, *Agricultural Planning Data for the Northeastern United States,* Department of Agricultural Economics and Rural Sociology, A. E. & R. S. 51 (University Park: The Pennsylvania State University, 1965) pp. 22-27.

TABLE 13

Rye Budget for One Acre

Item	Quantity	Rate	Value
Annual Cost			
Seed[1]	2.5	$2.89 bu.	$7.22
Fertilizer[2]			
N	–	0.12 lb.	–
P_2O_5	–	0.08 lb.	–
K_2O	–	0.06	–
Implement, power and labor			4.05
Total			$11.27
Labor			
Fall (Sept.–Oct.)			.4 hr.

[1]Seeding rate was based upon West Virginia Cooperative Extension Service recommendations for planting rye in connection with sod planting corn and grazing the crop in winter.

[2]Fertilizer residual from adequate fertilization of the corn crop was assumed as adequate fertilization for the rye.

TABLE 14

Alfalfa Budget for One Acre Assuming a Four-Year Stand

Item	Quantity	Rate	Value
Annual income			
Hay	5 T.[1]	$30.00 T.[2]	$150.00
Annual cost			
Seed	5 lb.[3]	0.80 lb.[3]	4.00
Fertilizer			
N	8 lb.[4]	0.12 lb.[5]	0.96
P_2O_5	125 lb.	0.08 lb.	10.00
K_2O	128 lb.	0.06 lb.	7.68
Lime	0.25 T.[6]	7.60 T.	1.90
Twine	5.00 T.[7]	1.00 T.	5.00
Manure spreading			1.25
Spray	3.50 qt.[8]	1.15 qt.	4.00
Implement, power and labor[9]			25.01
Hauling and storing[9]			1.00
Total			$60.80
Labor[10]			
Fall planting			2.6
Spring			5.2
Summer			2.6

[1]Based upon recommendation of Committee of Agronomy, West Virginia University.

[2]Price rate based upon prices received by farmers from U. S. Department of Agriculture, *Agricultural Statistics, 1969,* U. S. Department of Agriculture (Washington: U. S. Government Printing Office, 1969) p. 266.

[3]Based upon Virgil E. Crowley, *Using Linear Programming as a Farm Management Tool in Pennsylvania,* Agricultural Extension Service Special Circular 136 (University Park: The Pennsylvania State University, 1970) p. 17. Total amount of seed used per stand was 20 pounds.

[4]See footnote 6, Appendix Table 12. Nitrogen only was applied first at a rate of 32 pounds.

[5]See footnote 7, Appendix Table 12.

[6]Based upon Crowley, *loc. cit.*

[7]*Ibid.*

[8]Based upon William K. Waters, *Cost and Returns Guide for Feed Crops in Southwestern Pennsylvania,* Pennsylvania State University Agricultural Extension, April 22, 1966, p. 8.

[9]See footnote 12, Appendix Table 12.

[10]Based upon F. E. Montville, *Forage Harvesting on Dairy Farms,* Department of Agricultural Economics and Agricultural Experiment Station, Bulletin 353 (Kingston: University of Rhode Island, April, 1960) pp. 4-5.

TABLE 15

Cropland and Upland Pasture Budget—Kentucky Bluegrass, One Acre[1]

Item	Quantity	Rate	Cropland	Upland
Annual cost				
Fertilizer				
N	30[2]	$0.12 lb.[3]	$3.60	
P_2O_5	100	0.08 lb.	8.00	
K_2O	110	0.06 lb.	6.00	
N	30[4]	0.12 lb.[3]		$3.60
P_2O_5	30	0.08 lb.		2.40
K_2O	30	0.06 lb.		1.80
Manure spreading[5]			0.75	0.60
Lime	1.0 T.	7.60 T.[6]	1.26	1.01
Fence[7]			1.89	1.89
Implement and power[8]			0.65	0.52
Clipping[9]			1.60	0.64
Total			$23.75	$12.46
Labor[10]				
Spring			.4 hr.	.4 hr.
Summer			.8 hr.	.4 hr.

[1]Cropland pasture was assumed to be Class IV Land and in conjunction with Class IV hayland a rotation enabled a high TDN yield on the cropland pasture with continuous fertilization of land previously used as hayland. Upland pasture was assumed to be Class VI land, and only 80 per cent treatable.

[2] Same fertilization rate as used on alfalfa, Table 15.

[3]See footnote 7, Appendix Table 12.

[4]See footnote 6, Appendix Table 12.

[5]Sixty per cent of the amount of manure spread on cropland was spread on the cropland pasture. It was assumed that only 80 per cent of the upland pasture was treatable. See footnote 11, Appendix Table 12.

[6]See footnote 8, Appendix Table 12. Liming rate computed at one-sixth ton per acre per year.

[7]Pasture fencing costs assumed the use of two strands of barbed wire over 35-inch woven wire. Pasture field sizes were assumed an average of 86 acres per field. Cost for one roll of woven wire was assumed to be $32.50 and one roll of barbed wire was $9.00. Price was based on price list from Southern States in Morgantown.

[8]See footnote 11, Appendix Table 12.

[9]Cropland pasture was clipped biannually and upland pasture was clipped annually. See footnote 11, Appendix Table 12.

[10]See footnote 12, Appendix Table 12.

TABLE 16

Machinery Investment, Estimated Life, and Annual Depreciation for a 100-Cow Herd

Machine	Cost[1]	Estimated Life[2]	Annual Depreciation
		Years	
Tractor			
1-55 hp.	$ 5,876	15	$ 392
1-45 hp.	4,895	15	326
2-35 hp.	7,828	15	522
1-25 hp.	3,000	15	200
Tillage			
2 plows (3—14")	1,400	15	93
Disk (10' tandem)	900	15	60
Harrow	188	20	9
Cultipacker	408	20	20
Planting			
Drill	1,040	20	52
Boom sprayer	626	10	63
Sod corn planter	2,000	20	100
Fertilizer spreader	412	15	27
Harvesting			
Mower-conditioner	3,100	10	310
Baler	2,400	10	240
Field chopper	2,850	10	285
Silage blower	1,249	12	104
Corn picker	3,960	10	396
Grain elevator	641	15	43
2 hay elevator	1,366	15	91
Other			
End loader	867	12	72
Manure tank spreader	1,544	15	103
Brush hog	400	10	40
Feed mixer-grinder	2,400	10	240
Trucks			
Pick-up (3/4 ton)	3,300	8	412
Truck (2 ton)	5,000	8	625
Wagons			
3 self unloading silage	5,250	15	350
2 flat bed	510	15	34
Total	$63,410		$5,209

[1] *Agricultural Prices,* U. S. Department of Agriculture, Statistical Reporting Service, (Washington: U. S. Government Printing Office, July, 1970) pp. 29-30.

[2] *Agricultural Engineers' Yearbook,* 1962, 1964. "Farm Machinery Costs and Use" (St. Joseph, Michigan: American Society of Agricultural Engineers) pp. 230-235.

TABLE 17

Machinery Investment, Estimated Life, and Annual Depreciation for a 200-Cow Herd

Machine	Cost[1]	Estimated Life[1]	Annual Depreciation
Tractor			
2-55 hp.	$11,752	15	$ 783
2-45 hp.	9,790	15	653
2-35 hp.	7,828	15	522
1-25 hp.	3,000	15	200
Tillage			
3 plows (3-14", 4-14")	2,600	15	173
2 disk (10' tandem)	1,800	15	120
2 harrow	376	20	19
Cultipacker	408	20	20
Planting			
Drill	1,040	20	52
Boom sprayer	626	10	63
Sod corn planter	2,000	20	100
Fertilizer spreader	412	15	27
Harvesting			
Mower-conditioner	3,100	10	310
Baler	2,400	10	240
Field chopper	2,850	10	285
Silage blower	1,249	12	104
Corn picker	3,960	10	396
Grain elevator	641	15	43
2 hay elevator	1,366	15	91
Other			
End loader	867	12	72
Manure tank spreader	1,544	15	103
Brush hog	400	10	40
Feed mixer-grinder	2,400	10	240
Trucks			
Pick-up (3/4 ton)	3,300	8	412
Truck (2 ton)	5,000	8	625
Wagons			
3 self unloading silage	5,250	15	350
3 flat bed	765	15	51
Total	$76,724		$ 6,094

[1]See footnotes 1 and 2, Appendix Table 16.

TABLE 18

Machinery Investment, Estimated Life, and Annual Depreciation for a 300-Cow Herd

Machine	Cost[1]	Estimated Life[1]	Annual Depreciation
Tractor			
1-65 hp.	$6,759	15	$450
2-55 hp.	11,752	15	784
1-45 hp.	4,895	15	326
3-35 hp.	11,742	15	783
1-25 hp.	3,000	15	300
Tillage			
3 plows (4-14")	2,850	15	187
2 disk (10' tandem)	1,800	15	120
2 harrow	376	20	19
Cultipacker	408	20	20
Planting			
2 drill	2,080	20	104
2 boom sprayer	1,252	10	125
Sod corn planter	2,000	20	100
Fertilizer spreader	412	15	27
Harvesting			
Mower-conditioner	3,100	10	310
Baler	2,400	10	240
Field chopper	2,850	10	285
Silage blower	1,249	12	104
Corn picker	3,960	10	360
Grain elevator	641	15	43
2 hay elevator	1,366	15	91
Other			
End loader	867	12	72
2 manure tank spreader	3,088	15	206
Brush hog	400	10	40
Feed mixer-grinder	2,400	10	240
Trucks			
Pick-up (3/4 ton)	3,300	8	412
Truck (2 ton)	5,000	8	625
Wagons			
3 self unloading silage	5,250	15	350
3 flat bed	765	15	51
Total	$85,962		$6,774

[1]See footnotes 1 and 2, Appendix Table 16.

TABLE 19

Total Land Values and Real Estate Tax Paid on Farms of 100, 200, 300 Dairy Cows by Land Use

Size of Herd	Land	Annual Milk Production Level Per Cow in Pounds		
		12,000	15,000	18,000
		Total Value[1] (Dollars)		
100 cows	Cropland	36,450	47,925	58,275
	Non-cropland	11,664	13,527	15,471
	Total	48,114	61,452	73,746
200 cows	Cropland	72,900	95,850	116,550
	Non-cropland	23,328	27,054	30,942
	Total	96,228	122,904	147,492
300-cows	Cropland	115,824	148,500	177,750
	Non-cropland	24,057	28,269	31,995
	Total	139,881	176,769	208,745
		Taxes Paid[2] (Dollars)		
100 cows	Cropland	256.62	338.40	410.31
	Non-cropland	81.78	94.47	108.57
	Total	338.40	432.87	518.88
200 cows	Cropland	513.24	675.39	822.03
	Non-cropland	164.97	190.35	217.14
	Total	678.21	865.74	1,039.17
300 cows	Cropland	816.39	1,064.22	1,252.08
	Non-cropland	169.20	198.81	219.96
	Total	985.59	1,263.03	1,472.04

[1]Land values were assumed at $225 for cropland and $81 for non-cropland. These rates were obtained by a 6 per cent capitalization of rent values found in *Farm Tenure and Cash Rents in the United States,* U. S. Department of Agriculture, Economic Research Service, Agricultural Economics Report No. 190, (Washington, D.C., August, 1970).

[2]Based upon 1970 Tax Rates for Class II property obtained from the State Tax Commissioner's Office.

TABLE 20

Estimated Building and Equipment Cost Outlay for a 100-Cow Herd With Production Levels of 12,000, 15,000, and 18,000 Pounds of Milk[1]

Item	Annual Milk Production Level Per Cow in Pounds		
	12,000	15,000	18,000
Free-stall housing[1]			
Barn	$ 9,350	$ 9,350	$ 9,350
Alley	1,012	1,012	1,012
Stalls, steel	2,750	2,750	2,750
Hay storage	2,325	1,550	775
Lot Area			
Concrete lot[2]	5,720	5,720	5,720
Feed bunker, covered	1,650	1,650	1,650
Water troughs–2	200	200	200
Manure system[3]			
Liquid manure tanks	4,800	4,800	4,800
Agitating equipment	954	954	954
Milk room and parlor area[4]			
Double–4 herringbone parlor building	4,032	4,032	4,032
Milk room	2,240	2,240	2,240
Office	640	640	640
Stalls and feeders[5]	2,640	2,640	2,640
Double–4 milking system	4,180	4,180	4,180
Other equipment	2,920	2,920	2,920
Bulk tank	2,800	3,300	3,800
Calf housing[6]			
Barn	2,650	2,650	2,650
Hay storage	930	930	930
Heifer housing[7]			
Barn (pole type)	3,294	3,294	3,294
Hay storage	1,356	1,356	1,356
Feeding system			
Silo[8]	24,600	17,970	12,120
Bulk feed bins[9]	400	400	400
Grain bins[10]	1,250	3,750	5,000
Mechanical feeder[11]	1,694	1,694	1,694
Silage unloader[12]	5,127	3,224	3,100
Total	$89,514	$83,206	$78,207

(continued on next page)

Table 20 (continued)

[1]The free-stall barn had 100 free-stalls with 50 square feet per stall at a cost of $1.87 per square foot. The alley required 23 square feet per stall at a cost of $0.44 per stall. The stalls cost $27.50 each. Cost data were based on C. R. Hoglund, "What Will a New Modern Dairy Barn Cost?" *Hoard's Dairyman,* Vol. CXV, No. 9 (May 25, 1970) pp. 531 and 570. Hay storage cost of $12.50 per ton based upon H. Dean Hawkins and Robert C. Suter, *Dairy Cattle Rates of Resource Use for Budgeting Enterprise Costs and Returns,* Department of Agricultural Economics and Agricultural Experiment Station, Research Bulletin 735 (Lafayette: Purdue University, 1962) p. 7.

[2]Concrete lot was assumed to have 100 square feet of space available per stall. The cost of the lot, which included fencing, gravel, reinforcement, etc., was assumed to be $57.20 per stall. Assumed cost of a covered feed bunker was $16.50 per linear foot. Costs were based upon Hoglund, *loc. cit.* and adjusted to 1970 prices. Troughs were assumed to have a capacity of 500 gallons. Estimated cost of a trough was based upon actual cost of building a trough according to Soil Conservation Service specifications.

[3]Liquid Manure System was assumed to have 60-day storage capacity. Estimated costs were based upon R. C. Wells and G. S. Parsons, *Manure Handling Systems for Free Stall Dairy Housing—An Economic Appraisal,* North Carolina Agricultural Extension Service Circular 480 (Raleigh: North Carolina State University, 1967) pp. 10-13.

[4]Size of a Double—4 Herringbone Parlor building was assumed to be 16' X 21', milk house was 14' X 16', and the office was 8' X 14'. Information was based upon Morris M. Lindsey, *Herringbone Milking System—Economic Appraisal, Labor Efficiency Analysis, and Adjustment Possibilities,* U. S. Department of Agriculture, Agricultural Research Service, Production Research Report No. 45 (Washington: U. S. Government Printing Office, September, 1960) p. 6.

[5]Estimated cost of stalls and feeders, Double—4 milking systems and other equipment was based upon C. R. Hoglund, "What is Your Best Buy in a Milking Parlor?" *Hoard's Dairyman,* Vol. CXV, No. 12 (June 25, 1970) pp. 693 and 705. Bulk tank capacity requirements were calculated to be 400, 500, 600 gallons respectively for the three production levels with every day milk pick-up. Estimated costs of bulk tanks were based upon Hawkins, *loc cit.*

[6]Calf barns were assumed to have two maternity pens (15' X 10'), five calf pens (5' X 5'), and space for 30 calves at 35 square feet per calf. Cost of calf barn was estimated to be $2.00 per square foot. Cost of hay storage based upon Hawkins, *loc. cit.*

[7]Cost of heifer barn was assumed to be $1.35 per square foot based upon Hawkins, *loc. cit.*

[8]Two silos, 30' X 60' and 20' X 60' were calculated to be the requirement for a 12,000 pound herd. One 30' X 60' silo was required for a 15,000-pound herd and one 26' X 60' silo was required for an 18,000-pound herd. Costs were adjusted to 1970 prices and based upon R. T. Dailey, G. E. Frick, and R. H. McAlexander, *Agricultural Planning Data for the Northeastern United States,* Department of Agricultural Economics and Rural Sociology, A. E. and R. S. 51 (University Park: The Pennsylvania State University, July, 1965) p. 61.

[9]Estimated cost of a three-ton feed bin based upon prices quoted by Mr. Max Alt, Manager of Southern States in Morgantown.

[10]Estimated cost of grain bins based upon prices quoted by Mr. Max Alt, Manager of Southern States in Morgantown.

[11]Cost of mechanical feeder was assumed to be $15.40 per linear foot. Costs were based upon C. R. Hoglund, "What Will a New Modern Dairy Barn Cost?" *Hoard's Dairyman,* Vol. CXV, No. 9 (May 25, 1970) pp. 531 and 570.

[12]Estimated cost based upon John W. Wysong, *Silage Costs on Northeastern Dairy Farms,* Department of Agricultural Economics, Regional Technical Bulletin A-128 (College Park: University of Maryland, June, 1963) pp. 22-24, and adjusted for 1970 prices.

TABLE 21

Estimated Building and Equipment Cost Outlay for a 200-Cow Herd With Production Levels of 12,000, 15,000, and 18,000 Pounds of Milk[1]

Item	Annual Milk Production Level Per Cow in Pounds		
	12,000	15,000	18,000
Free stall housing[1]			
Barn	$18,700	$18,700	$18,700
Alley	2,024	2,024	2,024
Stalls, steel	5,500	5,500	5,500
Hay storage	3,750	2,500	1,250
Lot area			
Concrete lot[2]	11,440	11,440	11,440
Feed bunker, covered	3,300	3,300	3,300
Water troughs—2	400	400	400
Manure system[3]			
Liquid manure tanks	9,600	9,600	9,600
Agitating equipment	954	954	954
Milk room and parlor area[4]			
Double—6 herringbone parlor building	5,280	5,280	5,280
Milk room	3,200	3,200	3,200
Office	640	640	640
Stalls and feeders[5]	3,960	3,960	3,960
Double—6 milking system	5,610	5,610	5,610
Other equipment	3,630	3,630	3,630
Bulk tank	4,500	5,300	6,000
Calf housing[6]			
Barn	5,300	5,300	5,300
Hay storage	1,860	1,860	1,860
Heifer housing[7]			
Barn (pole type)	6,588	6,588	6,588
Hay storage	2,188	2,188	2,188
Feeding system			
Silo[8]	41,178	32,708	22,858
Bulk feed bins[9]	475	475	950
Grain bins[10]	2,200	5,000	10,000
Mechanical feeder[11]	3,388	3,388	3,388
Silage unloader[12]	8,055	8,055	4,831
Total	$153,720	$147,600	$139,451

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Table 21 (continued)

[1]See footnote 1, Appendix Table 20.

[2]See footnote 2, Appendix Table 20.

[3]See footnote 3, Appendix Table 20.

[4]Size of Double–6 Herringbone Parlor building was assumed to be 16' X 28', the milk house was 16' X 20', and the office was 8' X 14'. See footnote 4, Appendix Table 20.

[5]Estimated costs of stalls and feeders, Double–6 milking system and other equipment was based upon C. R. Hoglund, "What is Your Best Buy in a Milking Parlor?" *Hoard's Dairyman*, Vol. CXV, No. 12 (June 25, 1970) pp. 693 and 705. Bulk tank capacity requirements were calculated to be 800, 1,000, and 1,200 gallons, respectively, for the three production levels with every day milk pick-up. Estimated cost of bulk tanks was based upon information provided by Dr. Roy Thomas, Assistant Professor of Animal Nutrition, Division of Animal and Veterinary Science, West Virginia University.

[6] Calf barn facilities were doubled to care for a 200-cow herd. See footnote 6, Appendix Table 20.

[7]See footnote 7, Appendix Table 20.

[8]One 16' X 50' and two 30' X 80' silos were calculated as the requirement for a 12,000-pound herd of 200 cows. One 16' X 50' and two 30' X 60' silos were required for a 15,000-pound herd. One 30' X 80' silo and one 16' X 50' silo were required for an 18,000-pound herd. See footnote 8, Appendix Table 20.

[9]Estimated cost of a six-ton feed bin was based upon prices quoted by Mr. Max Alt, Manager of Southern States in Morgantown.

[10]See footnote 10, Appendix Table 20.

[11]See footnote 11, Appendix Table 20.

[12]See footnote 12, Appendix Table 20.

TABLE 22

Estimated Building and Equipment Cost Outlay for a 300-Cow Herd With Production Levels of 12,000, 15,000 and 18,000 Pounds of Milk[1]

Item	Annual Milk Production Level Per Cow in Pounds		
	12,000	15,000	18,000
Free-stall housing[1]			
Barn	28,050	28,050	28,050
Alley	3,036	3,036	3,036
Stalls, steel	8,250	8,250	8,250
Hay storage	5,125	3,875	2,625
Lot area			
Concrete lot[2]	17,160	17,160	17,160
Feed bunker, covered	4,950	4,950	4,950
Water troughs–2	600	600	600
Manure System[3]			
Liquid manure tanks	14,400	14,400	14,400
Agitating equipment	954	954	954
Milk room and parlor area[4]			
Double–8 herringbone parlor building	6,528	6,528	6,528
Milk room	3,840	3,840	3,840
Office	640	640	640
Stalls and feeders[5]	4,840	4,840	4,840
Double–8 milking system	6,380	6,380	6,380
Other equipment	3,830	3,830	3,830
Bulk tank	6,000	6,700	7,300
Calf housing[6]			
Barn	7,950	7,950	7,950
Hay storage	2,790	2,790	2,790
Heifer housing[7]			
Barn (pole type)	9,882	9,882	9,882
Hay storage	3,282	3,282	3,282
Feeding system			
Silo[8]	73,800	53,910	36,360
Bulk feed bins[9]	600	600	1,200
Grain bins[10]	3,750	9,000	14,000
Mechanical feeder[11]	5,082	5,082	5,082
Silage unloader[12]	11,298	9,700	8,074
Total	$233,017	$216,229	$202,003

(continued on next page)

Table 22 (continued)

[1]See footnote 1, Appendix Table 20.

[2]See footnote 2, Appendix Table 20.

[3]See footnote 3, Appendix Table 20.

[4]Size of Double–8 Herringbone Parlor building was assumed to be 16' X 34', the milk house was 16' X 24', and the office was 8' X 14'. See footnote 4, Appendix Table 20.

[5]See footnote 5, Appendix Table 20. Bulk tank capacity requirements were calculated to be 1,200, 1,500, and 1,800 gallons, respectively, for the three production levels with every day milk pick-up. Estimated cost of the bulk tanks was based upon information provided by Dr. Roy Thomas, Assistant Professor of Animal Nutrition, Division of Animal and Veterinary Sciences, West Virginia University.

[6]See footnote 6, Appendix Table 20.

[7]See footnote 7, Appendix Table 20.

[8]One 18' X 50' and three 30' X 80' silos were calculated as the requirements for a 12,000-pound herd of 300 cows. Two 30' X 80' and two 18' X 50' silos were required for a 15,000-pound herd. One 30' X 80' silo, one 30' X 60' silo, and one 18' X 50' silo were required for an 18,000-pound herd. See footnote 8, Appendix Table 20.

[9]Estimated cost of an 8-ton feed bin was based upon prices quoted by Mr. Max Alt, Manager of Southern States in Morgantown.

[10]See footnote 10, Appendix Table 20.

[11]See footnote 11, Appendix Table 20.

[12]See footnote 12, Appendix Table 20.

TABLE 23

Man Equivalents for Persons Working on Farms

Item	Age (Years)	Male	Female
Operator	18-60	1.0[1]	0.4
	61-65	0.8	–
	66-70	0.6	–
	71-75	0.3	–
	76 and over	0.1	–
Wife	–	–	–
Children	18 and over	1.0	0.2
	16-17	0.5	0.1
	13-15	0.3	0
	10-12	0.1	0
Hired help (full-time)	–	1.0	–
College students (summer work)	–	0.4	–
Full-time off-farm employment	–	0.3	–
Part-time off-farm employment	–	0.4	–
Off-farm employment (November through March)	–	0.8	–
School bus driver or equivalent	–	0.7	–
Fall off-farm employment (three months)	–	0.7	–

[1]Each 30-day work period spent on or off farm was estimated to be equal to 0.1 of a man equivalent up to 10 such periods in one year.

Source: A. L. Barr, P. E. Nesselroad, and G. E. Toben, "Estimates of Man Equivalents for Farm Labor in Berkeley, Hampshire, Jefferson, Mineral, and Morgan counties of West Virginia" (Unpublished research report, West Virginia University).

TABLE 24

Productive Man Work Units Required for Livestock and Crops

Kind of Livestock and Crops	Unit of Measure	Productive Man Work Units Per Unit
Dairy cows	Average	8.0
Herd bulls	Average	5.0
Heifers, one year or over	Average	1.1
Calves, to one year	Average	1.6
Corn for grain or silage	Acres	2.7
Small grains for grain	Acres	1.4
Small grains for forage	Acres	1.5
Other hay and silage—first cutting	Acres	0.6
Other hay and silage—later cutting	Acres	0.4

Source: G. E. Toben, Farming for Better Living, West Virginia University.

TABLE 25

Animal Units Per Head of Livestock

Kind of Livestock	Animal Units
Dairy cows	1.10
Heifer, one year or over	0.54
Calves, to one year	0.34

Source: Earl F. Hodges, *Livestock—Feed Relationship 1909-1963,* United States Department of Agriculture, Economic Research Service, Statistical Bulletin No. 337, November, 1968, p. 47. West Virginia data adjusted to beef cows two years or over to 1.0 animal units.