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WORK UNIT ESTIMATES FOR MEASURING SIZE OF BUSINESS

C. L. Pherson and T. R. Nodland

DEPARTMENT OF AGRICULTURAL ECONOMICS
INSTITUTE OF AGRICULTURE
UNIVERSITY OF MINNESOTA
ST. PAUL, MINNESOTA 55101

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Introduction

This report presents the basic data and assumptions used in formulating the 1968 revision of work unit constants for calculating size of business as a part of the summarization of farm records. By knowing the basis for arriving at each work unit value, vocational agriculture instructors, extension personnel, and others working with farm records can more easily interpret individual farm business reports with respect to size of business. When enterprise size and technology are specified, data in this report may also be used for estimating labor requirements in partial budgeting of the farm business. However, the reader is referred to the bibliography for more detailed labor requirement data.

Work units are defined as the average accomplishment of a farm worker in a ten hour day, working on crops and productive livestock at average efficiency, or ten hours off-the-farm work for pay. This definition provides

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the basis for three farm management factors used in the analysis of farm business records: size of business, measured in work units; labor efficiency, measured in work units per worker; and cost control, measured in terms of power, equipment, and building expense per work unit. Work units are primarily a measure of size. They are less effective in determining efficiency of labor utilization on individual farms.

In order to simplify interpretation and computation, only one work unit constant is used per enterprise, regardless of enterprise size or technology. The difficulty lies in determining an average where size and technology varies from one farm to another. As an example, dairy cows in conventional stanchions may take 100 hours of labor per cow per year while parlor milking and loose housing can cut labor to only 50 hours per cow. Instead of revising work units each year to reflect technological change or an increased average size of herd or flock, work units should be formulated in light of recent trends.

Overhead labor (planning, maintenance, painting, repairs, etc.) is included as part of the total labor requirement. When the data in this study did not include overhead labor, 10 to 20 percent has been added in calculating the work unit constants.

Dairy Cattle

Trends for dairy herds within the various organized farm business groups in Minnesota indicate an average size herd of nearly 40 cows within the next several years. Parlor milking and loose housing or free stalls are replacing the conventional stanchion barns. The value of 10 work units per dairy cow per year previously assigned does not accurately reflect the trends in mechanization and increased herd size which are taking place.

The most recent Minnesota dairy labor study was done by Fuller and Jensen (3)

in 1962. Table 1 shows yearly labor required per cow for herds of 30 and 40 cows. Note that table 1 includes time for replacements.

Table 1. Yearly hours of labor per dairy cow (including replacements) - Minnesota

Type of facility	Number of cows	
	30 cows	40 cows
	(hours)	
Grade B milk		
Typical stanchion	86	80
Mechanized stanchion	77	72
Switch milking	83	77
Four-stall parlor	75	68
Grade A milk		
Six-stall parlor	67	60
Double-four herringbone	67	58
Improved pasture	67	59
Green chop	68	60
Storage feeding	64	58
Double-five herringbone	66	57

For herds of 50 cows, in a Massachusetts study, Parsons and Fuller (12) reported the data shown in table 2.

Table 2. Yearly hours of labor per dairy cow (including replacement) - Massachusetts

Type of facility	50 cows
	(hours)
Stall barn with dumping station	62
Stall barn with parlor	58
L-type loose housing	49
Free stall with 4-stall herringbone	48

Kearl and Snyder (10), of Cornell University, reported the data in table 3 for large dairy herds in New York.

Table 3. Yearly hours of labor per dairy cow (including replacements) - New York

Year	Average number cows per herd	Hours per cow
1962	63	76
1963	70	70
1964	75	64
1965	84	63
1966	87	60

In table 4, Maryland data by Stevens and Wysong (14) gives a breakdown for loose housing versus stanchion barns.

Table 4. Yearly hours of labor per dairy cow, parlor vs. stanchion (no replacements) - Maryland

Herd size	Loose housing-parlor milking	Stanchion
30	60	83
50	48	73
100	38	65
150	35	62

Upon consideration of the small average herd size in Minnesota, the widespread use of stanchion barns, additional winter chores, and the addition of overhead labor, a value of seven work units per dairy cow was assigned.

Other Dairy Animals

For ease of computation and interpretation, work units are expressed on a per head basis rather than in animal units. Since 1953, work units for other dairy animals have been 3.5 for two animals, or 17.5 hours per head.

The Pennsylvania State University(1) estimate is 1.65 work units per head, while other studies suggest lower values. University of Maryland (14) data report that a calf requires an average of 27 hours of labor during the first 24 months, or 1.35 work units per head per year. Bulls average 1.80 work units.

Similarly, Cornell (10) cost accounts on herds averaging 90 cows report calf labor of 26 hours per head in 27.5 months, or 1.13 work units per head.

From the above data, 1.2 work units per other dairy animal is consistent with the trends in dairy cattle production and increased use of labor saving equipment for dairy chores.

Hogs

Southern Minnesota's pork producers cooperating in the various management services will soon average 75,000 pounds of pork produced per year or, in other terms, an average of 40 litters per year on farrowing-finishing operations. A separate work unit value should be used for feeder pigs, as finishing takes half the labor required for farrowing-finishing operations. The rapid adoption of automated feeding and manure-handling equipment is responsible for the reduction in labor requirements.

Detailed cost accounts in Illinois (7) report total labor required per hundredweight gained as 1.01 hours on 41 farms in 1964 and .99 hours on 32 farms in 1965.

Van Arsdall (17), of the University of Illinois, has published detailed pork production estimates for a variety of situations. Up to 50 litters per year in partial confinement require 16.88 hours per litter (birth to market) for twice yearly farrowing. Single litter systems require just over 17 hours per litter. From 50 to 800 litters in total confinement for 2-, 4-, and 6-litter farrowing systems require 9.06 hours per litter. At 1920 pounds of gain per litter (including cull sows), .09 work unit is required per hundredweight gained for herds of less than 50 litters per year. Herds of over 50 litters require .05 work unit per hundredweight gained.

Minnesota extension personnel (5) estimate the equivalent of .13 work unit per hundred pounds gained for farrowing-finishing and .06 work unit per

hundredweight for finishing feeder pigs to 225 pounds.

University of Maryland (14) data suggest 17 hours per litter for 30-100 litters and 12 hours per litter on farms with over 100 litters per year. The work unit calculation is .10 per hundredweight gained.

Data from Iowa State University (8) indicate 23 hours for 15 to 39 litters and 20 hours per litter for 40 or more litters per year. This would suggest .11 to .13 work unit per hundredweight of gain.

Feeder pig labor estimates from Pennsylvania State University (1) indicate .09 work unit per hundredweight produced.

From the above data, .12 work unit per one hundred pounds of pork produced seems most reasonable for complete hog operations. A value of .06 work unit per hundredweight produced is applied to finishing operations.

Feeder Cattle

Minnesota feeder cattle lot size trends suggest work unit calculations should be made for lots of approximately 100 head. At this size, mechanization becomes important in reducing labor load. Long-term feeding is common for Minnesota beef producers, who usually buy calves and feed them to 1000 pounds. Available data indicate that the type of ration fed does not affect labor requirements significantly.

Minnesota Extension Cattle Feeder's Planning Guide (4) adapted a study by Van Arsdall of Illinois (18) to give the estimates shown in table 5.

Table 5. Typical labor per hundredweight for feeder cattle

Feeding program	Low mechanization (40-80 head)	High mechanization (100-300 head)
	(hours per cwt. gain)	
Steer calves	1.63 - 1.69	0.66 - 1.23
Heifer calves - yearling steers	1.78 - 1.80	0.66 - 1.33
Heavy steers	1.71 - 1.75	0.75 - 1.14
Dairy steers	1.60 - 2.00	0.60 - 1.20

University of Illinois (7) cost accounting data show results similar to the above table. Nine producers in 1964 averaged 1.21 hours of labor per hundredweight gained, while in 1965 seven producers required 1.28 hours per hundredweight of beef produced.

University of Maryland (14) data indicate five to six hours of labor are required per head for cattle on feed for 11 to 12 months. Short-fed cattle require three to four hours. In other words, over .10 work unit is required per hundredweight of beef produced.

Considering overhead labor, average size of operation and the average levels of mechanization in Minnesota, .12 work unit per hundredweight of beef produced most accurately reflects the labor required on Minnesota farm feed lots.

Beef Breeding Herds

Beef herd work units should be determined on a per cow basis for a 40 cow herd, according to the trends indicated in farm business reports. Some Minnesota beef men have been able to reduce their labor load by using confinement feeding methods during the winter months.

Van Arsdall (18) of the University of Illinois (1965) estimates that herds of 40 cows require 20.27 hours of labor per cow and calf per year with low mechanization. High mechanization and confinement cuts this time in half--10.14 hours per cow. The 1960 USDA (6) estimate for Minnesota was 18 hours per cow. The Midwest Farm Planning Manual (8) reports an Illinois study estimating 20 hours of labor per cow and calf for herds of less than 40 cows, while larger herds required only 15 hours of labor per cow per year. Tennessee (13) data for herds of 20 cows estimate required labor of 17 hours per cow and herds of 40 cows require 12 hours of labor per cow per year.

Pennsylvania State University (1) data report 15 hours of labor per cow

and calf. The University of Maryland (14) estimate ranges from 10 to 15 hours per cow and calf. Another direct labor study at Cornell (2) estimates 1.5 work units per cow and calf per year. Cost accounts in Illinois (17) reported 12.6 hours per cow in 1964 and 17.0 hours in 1965.

Only 10.77 hours of labor per cow per year were required in herds of 35 cows in South Central Iowa (8). Larger herds required 9.8 hours per cow and calf. This area of Iowa has fewer wintering problems than those encountered by Minnesota beef breeders.

Considering small sized herds, wintering chores, pasture methods, and the addition of overhead labor, 1.5 work units per cow and calf per year is a reasonable estimate of beef cow labor required on Minnesota farms.

Chickens

Average laying flock sizes in the various farm management groups are moving towards 1000 birds, while high return flocks average nearly 2000 birds. Few large commercial egg producers participate in the organized farm business management groups. Baby chick raising is the common method of obtaining replacements for the average farm flock and must be considered in formulating a work unit estimate.

Iowa State University's Midwest Farm Planning Manual (8) reports the following estimates, which include chick raising:

Table 6. Hours of labor per hen - Iowa

Number of hens	Hours per hen
50	4.0
500	2.0
1000	1.5
2000	1.1
3000	1.0
5000	0.9

The following 1960 estimates by Ranney (13) at the University of Tennessee include chick labor:

1.5 hours per bird per year for 1000 layers
1.1 hours per bird per year for 2000 layers
.85 hours per bird per year for 4000 layers

The 1960 USDA (6) estimate was 117 hours per 100 hens on all flocks, including chick raising. More recent data from the University of Maryland (14) on large flocks (without chick raising) report 735 hours of labor per year per 1000 hens.

Table 7 presents the Cornell (10) cost account data for large laying flocks without chick raising from 1962 to 1966.

Table 7. Hours of labor per bird per year - New York

Year	Average flock size	Hours per bird
1962	11,000	.56
1963	10,600	.48
1964	10,700	.46
1965	15,000	.42
1966	20,000	.43

Cornell's Farm Management Handbook (2) estimates yearly labor requirements at 40-50 hours per 100 layers on a ready-to-lay basis. When chick raising is added, a total of 55 hours of labor per 100 layers is required.

For Minnesota laying flocks, 5.0 work units per year per 100 layers is consistent with the above data. Another 5.0 work units per 100 layers are added when replacements are home grown.

Turkeys

Although Minnesota was the second largest turkey producing state in 1967, turkey growers are not often cooperators in the organized farm business management groups.

The 1960 USDA (6) study reports 28 to 30 hours of labor per 100 pounds produced. In 1963, researchers at Purdue University (9) published ranges of 84

to 204 hours per 1000 poults or, in other terms, less than two hours per hundredweight produced. Iowa's Midwest Farm Planning Manual (8) of 1965 indicates .40 to .70 hours of labor per hundredweight produced in a 10,000 bird flock. Maryland (14) data show 100 hours of labor is required for 1000 birds at 18 pounds each. This amounts to only .06 work units per hundredweight produced.

Adding overhead labor, the estimate for Minnesota producers is .12 work unit per hundredweight of turkeys produced.

Sheep Flock

The 1953 estimate of work units for Minnesota included only 2.15 hours of labor per year for each sheep over six months old. Later data show this to be too low.

USDA (6) estimates for Minnesota 4.1 hours of labor per head per year. A 1964 survey of 60 farms in Maine (15) reports 9.7 hours of labor per ewe, with the 20 most profitable farms reporting only 7.2 hours. Iowa State University (8) data report only 7 hours of labor per ewe per year in flocks of 25 ewes, while flocks of 50 ewes require only 5 hours per ewe.

The most reasonable value appears to be .6 work unit per ewe and replacement.

Feeder Lambs

Very few feeder lamb finishing operations are reported by the farm business groups at the present time.

A 1958 Ohio study, reported in the Midwest Farm Planning Manual (8), found the following: In lots of less than 300 head, 1.15 hours of labor per head was required for 30 pounds of gain, while larger lots reduced the requirement to .93 hours for every 30 pounds of gain. In other words, .38 to .32 work unit is required for every 100 pounds of lamb produced. 1960 estimates for North Dakota (11) are 1.2 hours of labor for 35 pounds of gain or .34 work unit per hundred-

weight of lamb produced.

The present value of .3 work unit per hundredweight of lamb produced seems adequate.

Crops

Several developments have tended to stabilize crop labor requirements in recent years: higher yields, crop drying, and increased fertilization increase handling time, while labor is being reduced through use of minimum tillage, chemicals, and larger equipment. Crop work units include an allowance for all operator and hired labor in tilling, planting, growing, harvesting, and storage. Additional time is allowed for planning the cropping program, testing soil, determining fertilizer use, and other indirect uses of the farm operator's labor.

The 1962 to 1966 Cornell (10) cost accounting crop labor requirements are shown in table 8.

Table 8. Total hours of labor per crop acre - New York

Crop	1962	1963	1964	1965	1966
Corn grain	7	6	5	5	5
Corn silage	10	9	8	7	7
Hay	5	6	5	5	5
Hay silage	-	-	4	5	4
Oats	6	6	5	5	5
Wheat	6	7	6	4	6
Peas, processing	16	13	-	12	-

Table 9 presents labor data from a number of recent studies of crop labor requirements.

Table 9. Comparison of crop labor statistics - hours per acre

	Total labor used, direct and indirect								Direct labor only	
		Cornell								
		(2)	(10)	Illinois (7)						
	Minn	Hand book	Cost acct	cost account		Illinois (16)(1965)			Iowa (8)	
Crop	1953	1966	1966	1964	1965	4-row	6-row	8-row	1965	1966
Corn grain	7	6	5	5.6	5.7	5.8	4.9	4.0	5.0	5.4
Corn silage	10	10	7	11.7	10.0	13.6	11.7	12.8	12.0	-
Soybeans	5	-	-	5.5	5.3	4.7	3.8	2.8	4.5	4.1
Small grain	5	6	5	2.5	2.5	-	2.8	-	2.6	-
Alfalfa hay	6	6	5	-	-	-	5.4	-	-	5.4
Soybean hay	8	-	-	-	-	-	-	-	-	-
Other hay	4	-	5	-	-	-	-	-	-	-
Hay silage	-	-	4	-	-	-	-	-	-	-
Canning peas	5	-	12	-	-	-	-	-	-	-
Sweet corn	7	-	-	-	-	-	-	-	-	-
Sugar beets	15	-	-	-	-	-	-	-	-	-

For some crops, such as corn silage, the work unit value is highly sensitive to yields. In other words, more tons per acre are reflected in a higher labor requirement per acre. Other crops are more sensitive to mechanization. After accounting for the diversity of Minnesota agriculture, the general yield levels, and the average farm size, the work units assigned to the common crops of Minnesota are reported in table 10.

Summary

Table 10 includes all of the 1968 revised work unit constants. Being a representation of average labor requirements, the constants are used to calculate size of business. Specific labor data for different sizes and types of operations may be found in the sources listed in the bibliography.

Table 10. Number of work units for each class of livestock and each acre of crop

Item	Number of work units	Item	Number of work units
Dairy cows	7.0 per cow	Corn grain	0.55 per acre
Other dairy cattle	1.2 per head	Corn silage	0.80 per acre
Hogs	.12 per 100 lbs.	Soybeans	0.45 per acre
Feeder pigs	.06 per 100 lbs.	Small grain	0.30 per acre
Feeder cattle	.12 per 100 lbs.	Alfalfa hay	0.60 per acre
Beef breeding herd	1.5 per cow (incl. replacement)	Soybean hay	0.60 per acre
		Other hay crops	0.40 per acre
Chickens	5.0 per 100 layers	Canning peas	0.30 per acre
	5.0 per 100 replacements raised	Sugar beets	2.00 per acre
		Sweet corn	0.40 per acre
Turkeys	.12 per 100 lbs.		
Sheep, farm flock	.60 per ewe		
Sheep, feeders	.30 per 100 lbs.		

Bibliography

1. Agricultural Planning Data for Northeastern United States. Department of Agricultural Economics and Rural Sociology, Pennsylvania State University, July 1965.

2. Farm Management Handbook. AE Extension 440, Cornell University, Ithaca, New York, October 1966.

3. Fuller, E. I., and Jensen, H. A., Alternative Dairy Chore Systems in Loose Housing. Agr. Exp. Sta. Bul., University of Minnesota, February 1962.

4. Hasbargen, P., Thomas, K., Hawkins, R., and Jacobs, R., Cattle Feeder's Planning Guide, FM-30. Agr. Ext. Serv., University of Minnesota, September 1966.

5. Hasbargen, P., Hawkins, R., Thomas, K., and Arthaud, R. Hog Feeder's Planning Guide, FM-26. Agr. Ext. Serv., University of Minnesota, August 1966.

6. Hecht, R. W., Labor Used to Produce Livestock, 1959. USDA Stat. Bul. 336, Washington, D. C., September 1963.

7. Hinton, R. A., and Kessler, R. P., Detailed Cost Report for Central and Western Illinois, 1964-1965. AERR 85, University of Illinois, June 1967.

8. James, S. C., Midwest Farm Planning Manual. Iowa State University Press, Ames, Iowa, 1965.

9. Jolliff, M. O., and Suter, R. C., What Are My Costs of Raising Turkeys? EC 276, Purdue University, October 1963.

10. Kearl, C. D., and Snyder, D. P., Costs and Returns from Farm Cost Accounts, 1966. AE Res. 235, 236, 237, Department of Agricultural Economics, Cornell University, January 1968.

11. North Dakota Farm Planning Guidebook, 1960. North Dakota Agr. Ext. Serv., Fargo, North Dakota, 1960.

12. Parsons and Fuller, E. I., Labor Requirements and Related Labor Functions. Department of Agricultural Economics, University of Massachusetts, February 1963.

13. Ranney, W. P., Labor Requirements on Tennessee Farms. Agr. Exp. Sta. Bul. 316, University of Tennessee, September 1960.

14. Stevens, G. A., and Wysong, J. W., Maryland Farm Planning Data. Department of Agricultural Economics, University of Maryland, November 1966.

15. Tuthill, D. F., An Economic Study of Sheep Production in Maine. Agr. Exp. Sta. Bul. 619, University of Maine, 1964.

16. Van Arsdall, R. N., Labor Requirements, Machinery Investment, and Annual Costs for the Production of Selected Field Crops in Illinois, 1965. AE 4112, University of Illinois 1965.

17. Van Arsdall, R. N., Resource Requirements, Investment Costs, and Expected Returns from Hog Production Systems in Illinois, 1965. AE 4074, University of Illinois 1965.

18. Van Arsdall, R. N., Resource Requirements, Investment Costs, and Expected Returns from Raising Selected Beef-Feeding and Beef-Raising Enterprises. AE 4075, University of Illinois 1965.