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University of Tennessee Agricultural Experiment Station

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Costs of Hand Versus Machine Harvesting for Snap Beans

by William E. Goble William C. Erwin



University of Tennessee
Agricultural Experiment Station
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SUMMARY

THIS REPORT PRESENTS INFORMATION on 1) the costs of harvesting snap beans by hand and machine for different acreages and yields, 2) the labor productivity for hand and machine harvesting, and 3) the costs of alternative methods of loading on trucks in the field.

Costs for Hand Harvesting. The only fixed cost is for containers in hand harvesting. The variable costs are mostly for labor. For a 2-ton yield, the total costs per acre are as follows: East Tennessee, \$93.10; Cumberland Plateau, \$117.32; and West Tennessee, \$90.44. Costs per acre are directly proportional to changes in yield.

Costs for Machine Harvesting. The annual fixed costs for the mechanical harvester with an estimated life of 5 years for the sacker (operated by 2 men), pallet box, and hydraulic dump bucket-type trailers are \$3,371.94, \$3,391.98 and \$3,675.02, respectively. These annual fixed costs compare with \$2,133.43, \$2,153.47, and \$2,317.56 when the expected life for the harvester with the three types of trailers is 10 years.

Variable costs per hour to operate the mechanical harvesters with the sacker-type trailer with 2 and 3 men in the crew are \$4.55 and \$5.30 per hour, respectively. Variable costs for a harvester operated with pallet box or hydraulic dump bucket-type trailer are \$4.95 and \$4.20 per hour, respectively.

Total costs per acre are—assuming 200 acres harvested, an expected machine life of 5 years and a yield of 2 tons per acre—\$23.91, \$24.63 or \$24.89, respectively, for a harvester with the sacker (operated by 2 men), pallet box, or hydraulic dump bucket-type trailer. Costs of picking snap beans with a mechanical harvester decrease sharply when the acreage harvested is increased. With a hydraulic dump bucket-type trailer, and a 2-ton yield per acre, the total picking and loading costs, for example, are \$153.51 and \$24.89 when 25 and 200 acres, respectively, are harvested.

Costs of Hand and Machine Harvesting. To illustrate, in East Tennessee, when picking and loading costs are \$93.10 per acre, costs are the same for both hand and machine harvesting with a hydraulic dump bucket-type trailer with an expected life of 5

years, and a yield of 2 tons per acre, when 45 acres of snap beans are harvested. Purchase and use of the harvester to pick more than 45 acres would be cheaper than harvesting by hand compared with 35 acres when the harvester life is 10 years.

If the farmer can have his beans custom harvested at \$42.00 per acre (2 tons per acre, and a harvester life of 5 years), or use his own harvester, the cost of harvesting with a hydraulic dump bucket trailer would equal the costs of custom harvesting when 105 acres are harvested vs. 68 acres when the harvester life is 10 years.

Labor Productivity for Hand and Machine Harvesting. The average labor productivity per man-hour was 1.06 bushels for hand-picked beans in Johnson and Carter counties during 1964. For machine-picked beans the average productivity per man-hour was 95.8, 47.9, and 31.9 bushels with crews of 1, 2, and 3 men, respectively, for mechanical harvesters with three types of trailers.

Net Income for Hand and Machine Harvesting. The net returns per acre are based on a yield of 2 tons per acre for hand- and machine-harvested beans, growing costs of \$67.00 each per acre, and the selling price of beans for processing at \$85.00, \$100.00, and \$115.00 per ton, respectively. The net returns per acre to the operator for land, labor, and management for hand-harvested beans would be \$7.80, \$37.80, and \$67.80, respectively, at the specified sale prices compared with net returns per acre of \$61.50, \$91.00, and \$121.00, respectively, when beans are custom-harvested mechanically at \$42.00 per acre.

If the yields of hand- and machine-harvested beans are 3 and 2 tons, respectively, under the assumptions given the net returns per acre for hand-harvested beans would be \$45.20, \$90.20, and \$135.20 vs. \$61.50, \$91.00, and \$121.00 for machine-harvested beans.

Costs of Alternative Methods of Loading on Trucks. The least-cost method of loading in the field is the pallet box-forklift method at a cost of 1 cent per bushel.

Costs of Hand Versus Machine Harvesting For Snap Beans¹

by
William E. Goble and William C. Erwin²

INTRODUCTION

With the development of the mechanical picker, the farmer now has an alternative method of harvesting his snap beans. Only 32 percent, or 4,200 acres of the state's 13,000 acres, were hand harvested during 1964. Mechanical harvesting may offer considerable dollar savings compared with hand picking, but use of mechanical harvesters requires a large capital investment. In deciding to invest in a snap bean harvester, a farmer must consider the acreage harvested, yield per acre, wage rates, years a machine can be used efficiently, type of trailers used, and the comparative cost of hand harvesting.

Objectives

The objectives of this study were:

1. To determine the costs of harvesting snap beans by hand and by machine as related to acreages and yields.
2. To determine the labor productivity for hand and mechanical harvesting.
3. To determine the costs of alternative methods of loading snap beans in the field.

¹A more detailed report was prepared by William Curtis Erwin, *Costs of Hand and Machine Harvesting Snap Beans in Tennessee*, unpublished M.S. Thesis, University of Tennessee, June, 1965.

²Assistant Professor and Graduate Student, respectively, of the Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville, Tennessee.

Procedure

Input-output data were obtained from snap bean producers in each of the major production areas of the state as follows: 1) East Tennessee (Carter, Cocke, Johnson, Rhea, Meigs, and Monroe counties), 2) Cumberland Plateau (Cumberland and Fentress counties), and 3) West Tennessee (Crockett, Gibson, Haywood, Lauderdale, and Madison counties).

The labor inputs for handpicking were obtained from 233 producers in 13 Tennessee counties.

Mechanical harvesting information was obtained by time and production studies while machines were in operation. A study of 17 machines divided among five owners provided basic data on labor and equipment requirements. Additional information was obtained from accounting records and interviews with owners or field foremen concerning labor costs, upkeep, and average daily operating expenses. Where several machines were operating at the same time, the machines were numbered, and a table of random numbers was used to make the selection.

The annual fixed costs of a Hi-Boy mechanical snap bean harvester were based on the costs as follows: purchase of a Hi-Boy mechanical harvester, and dump trailer, \$14,769.50 plus \$415.15 freight charges from Niagara Falls, N.Y., to Knoxville, Tennessee; depreciation was based on purchase price plus freight minus salvage value \div depreciation period; salvage for the harvesters with 5- and 10-year expected lives were \$1,000 and \$700, respectively, and \$50 for a hydraulic dump trailer with an expected life of 5 years; interest, 4 percent of purchase price plus freight minus salvage value; and taxes and insurance, each, 1 percent of purchase price plus freight minus salvage value.

The cost of 20-bushel capacity pallet boxes was \$14 each, including \$1.65 freight charge.

A straight-line depreciation method was used in computing the average annual costs.

The per hour variable costs required to operate a mechanical snap bean harvester were based on the following: wage rate of \$1.00 per hour for the driver, and 75¢ per hour for the other

workers; gasoline, 3.8 gallons per hour, 17.6¢ per gallon; grease, 3 pounds per day, 3¢ per pound; oil, a quart per day, 40¢ per quart. Repair costs were based on accounting records for 13 harvesters that had harvested 2,050 acres with an average yield of 116.7 bushels per acre during the 1964 season. The average repair cost for each machine was \$327.89. The average per hour repair costs were \$2.28 for the harvester with a sacker-type trailer operated by 2 and 3 men, and \$2.48 per hour each for the harvester with the pallet box-type and hydraulic dump bucket-type trailer.

Time and production studies were done on the alternative methods of loading. The costs of harvesting by hand and loading were compiled for each of the major production areas of the state. Machine harvesting costs were compiled for each type of trailer.

Hand, machine, and custom-machine harvesting costs were compared on a per-acre basis varying the acreages, and assuming a yield of 2 tons per acre and 6 acres harvested during 9 hours of work. The break-even point between mechanical harvesting, hand harvesting and custom-machine harvesting was determined for the three types of trailers.

Description of Mechanical Harvester

The only type of mechanical harvester used in Tennessee at the time this study was conducted was that produced by Chisholm-Ryder Company, Niagara Falls, New York. There were two models, the regular and the Hi-Boy, both mounted on 3-plow tractors. There were trailers to handle three types of containers—sacks, pallet boxes, and a hydraulic dump bucket. Figure 1 shows the regular and Hi-Boy harvesters with the sacker, pallet box, and hydraulic dump bucket-type trailer.

The harvester picks 2 rows at a time and has rotating reels that have spring teeth similar to a hay rake. The snap beans are caught on a belt which passes under a blower that removes trash and broken beans; then the beans ride up an elevator and flow into a container.



Sacker



Pallet Box



Hydraulic Dump Bucket

Figure 1. The three types of trailers used with the mechanical harvesters that were included in the study, Tennessee, 1964.

COSTS FOR HAND HARVESTING

Fixed Costs

In a handpicking operation, very few costs are considered fixed. Picking container costs were the major fixed costs. Depreciation, insurance, taxes, and interest on investment are also included in fixed costs.

The type of picking containers used for harvesting snap beans varied considerably by size of operation, by acres, and by type of market outlets in the state.

The average prices paid were 32 cents for new hampers and 20 cents for used hampers. The estimated life for new hampers was 2 years. The average costs of new and used sacks were 25 cents and 15 cents, respectively. The estimated life for new sacks was 2 years. Table 1 gives the 1963 average cost of containers per

Table 1. Snap Bean Container Costs Per Acre, by Areas, and by Acreage Groups, Tennessee, 1963

Area	Size of producer ^a	Container cost per acre
East Tennessee	Small	\$13.72
	Medium	7.31
	Large	3.80
Cumberland Plateau	Medium	6.11
	Large	1.42
West Tennessee	Small	4.73
	Medium	1.88
Weighted average cost of all producers in State		\$ 9.05

a. Small producers based on .5 to 4.99 acres of snap beans; medium producers based on 5.00 to 19.99 acres of snap beans; large producers based on 20.00 and more acres of snap beans. Source: W. E. Goble, *Costs of Producing and Marketing Snap Beans by Areas in Tennessee*, University of Tennessee, unpublished manuscript, 1963.

acre by areas in Tennessee. The container cost per acre is inversely related to the size of the acreage group. For example, the cost of containers per acre was highest—\$13.72—in the small acreage group in East Tennessee where relatively more producers in the small-acreage group sold beans on the fresh market. In this area truck loads of beans sold on the processing market were usually hauled loose in a truck bed. The average container costs per acre in the same area for the medium- and large-acreage groups were \$7.31 and \$3.80, respectively.

Table 2 indicates that the estimated annual fixed cost for containers used in handpicking amounted to \$4.98 per acre.

Table 2. Estimated Annual Fixed Costs for Containers Used in Handpicking and Transporting Snap Beans in Production Areas, Tennessee, 1963^a

Item	Container cost per acre
Depreciation ^b	\$4.53
Interest ^c	.27
Taxes ^d	.09
Insurance ^e	.09
Total	\$4.98

a. Based on average cost of \$9.05 for harvesting containers in the three areas of the state and an expected life of 2 years for the containers. The multiple use of the containers is not considered.

b. Based on 55 percent of average purchase price per acre.

c. Interest 3 percent of average purchase price per acre.

d. Taxes 1 percent of average purchase price per acre.

e. Insurance 1 percent of average purchase price per acre.

Variable Costs

Variable costs vary directly with the volume of snap beans harvested. Labor used in picking snap beans is the largest variable cost per acre in hand harvesting. Additional variable costs include hauling pickers to the fields where the snap beans are harvested, employment of field foremen, luggers, and one or more persons to weigh the beans and maintain records in the field or at the assembly shed near the edge of the field.

The average variable costs by production areas ranged from 63.8 to 84.8 cents per bushel in the state and averaged 71.8 cents for the three production areas (Table 3). The lowest cost was in West Tennessee, and the highest harvesting cost was on the Cumberland Plateau.

Costs for transporting pickers varied from one area to another. For example, East Tennessee producers paid 50 cents for each picker hauled to the field. The Cumberland Plateau area producers paid from 15 to 17 cents for each bushel harvested by pickers who were transported by truck.

Picking costs ranged from 50 to 60 cents per 30-pound bushel in the state. In East Tennessee, pickers were usually paid 50 cents per bushel; in the West Tennessee area, pickers were paid 45 to 75 cents per bushel, the usual rate being 60 cents. In the Cumberland Plateau area, the pickers were paid 60 cents per bushel.

Table 3. Average Variable Costs of Handpicking Snap Beans by Areas in Tennessee, 1963

Areas	Hauling pickers	Field foremen	Cents per bushel		Weigh station	Total
			Picking	Lugging		
East Tennessee	7	1	50	5	3.8	66.8
Cumberland Plateau	15	1	60	5	3.8	84.8
West Tennessee	—	—	60	—	3.8	63.8
Average for areas	11.5	1	56.5	5	3.8	71.8

Source: W. E. Goble, *Costs of Producing and Marketing Snap Beans by Areas in Tennessee*, University of Tennessee, unpublished manuscript, 1963.

Luggers were used for moving the beans after they were harvested so that older men, women, and children, who had some difficulty moving the containers filled with beans, could have more time for harvesting. Some luggers were paid on an hourly basis for carrying beans in the field. The hourly rates for luggers ranged from 50 cents to \$1, while the rate per bushel was 5 cents. For a lugger to earn 50 cents or \$1 an hour on a piece-rate basis, he would be required to move 10 or 20 bushels, respectively, of beans per hour. The number of bushels he carried per hour would depend on the number of pickers in the field, their picking rate, distance to scales, the number of luggers working, and his industry.

In most cases, the owner performed the duties of field manager, assigned picking areas, and moved and set up scales. Snap bean producers who hired a field manager paid him 50 cents per hour.

In addition to pickers, other personnel required to handle the beans in the field—if the acreage justified it—included a cashier and two men to load the beans on the truck and empty the sacks. These persons were paid on an hourly or daily basis comparable to wages for everyday farm jobs in that area. These wage rates ranged from 50 cents to \$1 per hour. In large fields, where the trucks were available, two stations were operated. Weighing stations were unnecessary when beans were picked by family labor or in cases where wages were paid on an hourly or daily basis.

Total Costs

Total costs for handpicking snap beans varied from area to area and between each of the assumed yields (Table 4). The variation in costs from area to area was a result of differences in labor costs and the use of additional labor for jobs other than picking. The number of beans handled was the factor responsible for per-acre cost differential between the assumed yields per acre.

The total costs of harvesting per bushel ranged from 66 cents for a West Tennessee producer with a maximum assumed yield of 200 bushels per acre to 90 cents for a Cumberland Plateau producer with the minimum yield of 100 bushels per acre. In particular cases, some of these costs were eliminated, i.e., weigh station operators were not used where family labor was used exclusively or wages were paid on an hourly basis; picker hauling costs were not incurred when the farmer had pickers living on the farm, and lugger fees were not incurred where pickers carried their beans to the weigh station. There were, in some cases, additional costs, especially with West Tennessee producers where fees for transporting pickers have not been computed in the total costs.

Picking Rates Per Man-Hour

The relation of picking rate for hand harvesting to yield per acre of snap beans was evaluated by regression analysis. According to the results in Table 5 at the 5 percent probability level, a 10 percent increase in X (yield) was associated with an increase of 1.33 percent in Y (amount harvested per man-hour) in the small acreage group. The yield of snap beans was not significantly associated with the amount harvested per man-hour for the medium and large acreage groups. Yields were, however, significantly associated at the 10 percent level with the amount harvested per man-hour for the entire group of small, medium, and large producers. The independent variable (yield per acre) explained only 34 percent of the variation in the dependent variable (amount harvested) for the small acreage group, 30 percent for the large acreage group, and 17.5 percent for the three acreage groups. The average picking rate for the entire study was 1.06 bushels per hour for an average yield of 195 bushels per acre.

Table 4. Total Cost Per Acre for Handpicking Snap Beans, by Yield and by Production Areas, Tennessee, 1963^a

Costs	East Tennessee			Cumberland Plateau			West Tennessee		
	100	150	200	100	150	200	100	150	200
	Bushels per acre								
Dollars per acre									
Fixed picking costs	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98
Variable picking costs									
Field foreman	1.00	1.50	2.00	1.00	1.50	2.00	—	—	—
Pickers	50.00	75.00	100.00	60.00	90.00	120.00	60.00	90.00	120.00
Haulers	6.00	9.00	12.00	15.00	22.50	30.00	—	—	—
Luggers	5.00	7.50	10.00	5.00	7.50	10.00	—	—	—
Weigh station ^b	1.25	1.87	2.50	1.25	1.87	2.50	1.25	1.87	2.50
Total picking costs	68.23	99.85	131.48	87.23	128.35	169.48	66.23	96.85	127.48
Variable loading costs	2.50	3.76	5.00	2.50	3.76	5.00	2.50	3.76	5.00
Total picking and loading costs	70.73	103.61	136.48	89.73	132.11	174.48	68.73	100.61	132.48
Total picking costs per bushel	.68	.67	.66	.87	.86	.85	.66	.65	.64
Total picking and loading costs per bushel	.71	.69	.68	.90	.88	.87	.69	.67	.66

a. Based on Tables 1, 2, and 3.

b. Assumed weigh station with three men working a 10-hour day at a wage of \$.75 per hour, handling 600 bushels per day.

Table 5. Summary of Regression of Bushels of Snap Beans Harvested per Hour on Yield in Bushels per Acre

Acreage group ^a	Coefficient of determination	Constant term	Effect on amount harvested by a 10-percent change in yield per acre ^b	
			Percent	
Small	.342	-.26715		1.3264*
Medium	.005	.02040		.0056
Large	.301	-.29011		1.2628
All producers	.175	-.21093		1.0478**

a. Small acreage group, .5 to 4.99 acres; medium acreage group, 5.00 to 19.99 acres; large acreage group, 20.00 and more acres.

b. The regression lines for the 3 acreage groups and the total of all groups expressed in algebraic form are:

Small acreage group:	Log Y	.26715	+	.13264	log X
Medium acreage group:	Log Y	.02040	+	.00056	log X
Large acreage group:	Log Y	.29011	+	.12628	log X
All 3 groups:	Log Y	.21093	+	.1047	log X

*Significantly different from zero at the 5-percent level.

**Significantly different from zero at the 10-percent level.

COSTS FOR MACHINE HARVESTING

Fixed Costs with Three Types of Trailers

A summary of the various charges, based on an economic life of 5 and 10 years for the mechanical snap bean harvester with sacker and hydraulic dump bucket trailers, is shown in Table 6.

There was some variation in the number of pallet boxes needed for a harvester. If the beans were dumped from the pallet box into a truck located in the field, there was a need for only three boxes. If the beans were hauled from the field to the processing plant, the number of boxes needed would depend on the capacity of the truck that transported them, the time the truck would be away from the field, the number of mechanical harvesters being used, and their picking rates.

Table 7 shows that the annual container costs for 24 pallet boxes amounted to \$20.04 more than for 200 sacks used on a sacker-type trailer.

Table 6. Estimated Fixed Costs for a Mechanical Snap Bean Harvester with Sacker and Hydraulic Dump Bucket-Type Trailers with Expected Economic Lives of 5 and 10 Years, Tennessee, 1965

Item	Type of Trailer			
	Sacker-Type		Hydraulic Dump Bucket-Type	
	Annual costs for life of machine			
	5 years	10 years	5 years	10 years
Depreciation	\$2,573.03	\$1,316.52	\$2,826.93	\$1,448.47
Interest	514.61	525.61	565.39	579.39
Taxes	128.65	131.65	141.35	144.85
Insurance	128.65	131.65	141.35	144.85
Total	\$3,344.94	\$2,106.43	\$3,675.02	\$2,317.56

Table 7. Annual Fixed Costs for Containers Used with Mechanical Snap Bean Harvesters, Tennessee, 1965

Item	Type of machine ^a	
	Sacker	Pallet box
	Annual costs	
Depreciation	\$25.00 ^b	\$33.60 ^c
Interest	2.00	13.44
Total	\$27.00	\$47.04

a. Sacks and pallet boxes were not required for the dump trailer.

b. Based on a 2-year expected life, 200 sacks @ \$.25 each.

c. Based on a 10-year expected life, 24 boxes @ \$14.00 each.

Table 8 indicates the total annual fixed costs—including machine costs and container costs—over a 5- and 10-year depreciation period. Based on a 5-year depreciation period, total fixed costs for a mechanical harvester with a hydraulic dump bucket was \$303.08 higher than for one with a sacker-type trailer and \$283.04 higher than for one with a pallet box-type trailer. With a 10-year depreciation period, the harvester with the hydraulic dump bucket-type trailer had fixed costs only \$184.13 and \$165.09 higher, respectively.

Table 8. Total Annual Fixed Costs for Three Methods of Handling Machine-Picked Beans for 5- and 10-Year Depreciation Periods, Tennessee, 1965

Item	Type of machine					
	Sacker		Pallet box		Hydraulic bucket	
	5 years	10 years	5 years	10 years	5 years	10 years
Machine cost	\$3,344.94	\$2,106.43	\$3,344.94	\$2,106.43	\$3,675.02	\$2,317.56
Container cost	27.00	27.00	47.04	47.04	—	—
Total	\$3,371.94	\$2,133.43	\$3,391.98	\$2,153.47	\$3,675.02	\$2,317.56

Variable Costs with Three Types of Trailers

Variable costs consist of labor, maintenance, fuel, and repair costs. With the exception of labor costs, there was no observed variation in operating costs between the different machines (Table 9).

Harvesters with sacker-type trailers require a driver plus either one or two men, according to the rate the beans are being picked. Harvesters with pallet boxes require a driver and one person to level the beans as they come into the boxes. A harvester with a hydraulic dump trailer requires only a driver who also operates the hydraulic dump. Labor wage rates varied among the different farms.

Table 9. Estimated Variable Costs Per Hour to Operate Mechanical Snap Bean Harvesters with Three Types of Trailers, Tennessee, 1965

Item	Sacker		Pallet box	Hydraulic trailer
	2 men	3 men	2 men	1 man
Labor	\$1.75	\$2.50	\$1.75	\$1.00
Gas	.67	.67	.67	.67
Oil and Grease	.05	.05	.05	.05
Repair	2.08	2.08	2.48	2.48
Total	\$4.55	\$5.30	\$4.95	\$4.20

Fuel consumption was based on the Nebraska Test Report, and the price used does not include taxes.³ The oil and grease consumption rates are average data received from 17 operators.

Total Costs with Three Types of Trailers

An estimate of the total cost of picking snap beans mechanically, using three types of trailers, is obtained by adding variable costs to fixed costs. Table 10 shows, for example, that the total costs per acre, when 50 acres are harvested, ranged from \$74.49 per acre for a 2-man crew on a sacker-type trailer to \$80.01 for a harvester with a hydraulic bucket-type trailer. If 300 acres of snap beans are harvested with the use of a sacker-type trailer,

³Official Tractor and Farm Equipment Guide (St. Louis: NRFEA Publications, 1965), p. 13.

Table 10. Total Costs Per Acre for Picking Snap Beans Mechanically by Specified Type of Trailer and Acres Harvested, and with a 5-Year Harvester Life, Tennessee, 1964

	Annual acreage harvested										
	15	25	50	100	150	200	250	300	350	400	500
	Dollars per acre										
Sacker (2 men)											
Fixed costs	224.80	134.88	67.44	33.72	22.48	16.86	13.49	11.24	9.63	8.43	6.74
Variable costs	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05
Total costs	231.85	141.93	74.49	40.77	29.53	23.91	20.54	18.29	16.68	15.48	13.79
Sacker (3 men)											
Fixed costs	224.80	134.88	67.44	33.72	22.48	16.86	13.49	11.24	9.63	8.43	6.74
Variable costs	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22
Total costs	233.02	143.10	75.66	41.94	30.70	25.08	21.71	19.46	17.85	16.65	14.96
Pallet box											
Fixed costs	226.13	135.68	67.84	33.92	22.61	16.96	13.57	11.31	9.69	8.48	6.78
Variable costs	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67
Total costs	233.80	143.35	75.51	41.59	30.28	24.63	21.24	18.98	17.36	16.15	14.45
Hydraulic bucket											
Fixed costs	245.00	147.00	73.50	36.75	24.50	18.38	14.70	12.25	10.50	9.19	7.35
Variable costs	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Total costs	251.51	153.51	80.01	43.26	31.01	24.89	21.21	18.76	17.01	15.70	13.86

the costs per acre would decline from \$74.49 (for 50 acres) to \$18.29 per acre. When harvesting 50 to 300 acres with a machine using a hydraulic dump bucket trailer, the costs decline from \$80.01 to \$18.76 per acre, respectively. The costs of harvesting 300 acres with a harvester using hydraulic dump-type trailer is 47 cents more per acre than with a harvester using a sacker-type trailer and a crew of 2 men. Table 11 shows similar costs using a 10-year depreciation schedule.

Relationship of Acreage Harvested, Yield and Per Ton Costs

Assuming an expected harvester life of 5 years, Table 12 shows the cost of harvesting per ton, using a hydraulic dump bucket-type trailer when acreage harvested ranges from 50 to 500 and when yields range from 1.5 to 4.0 tons. For example, if the yield is 2 tons per acre, when 50, 100, and 300 acres are harvested, the costs per ton are \$40.01, \$21.64, and \$9.39, respectively. If 100 acres are harvested, the costs per ton are \$21.64, \$14.42, and \$10.82 when the yields are 2, 3, and 4 tons, respectively.

Appendix Tables 2 and 3 show similar costs for harvesters with sacker and pallet-box type trailers with expected machine life of 5 years. Appendix Tables 4, 5, and 6 show similar costs for the sacker, pallet-box, and hydraulic dump bucket-type trailers when the expected machine life is 10 years.

COSTS OF HAND AND MACHINE HARVESTING

Sacker-Type Trailer

Total picking cost per acre is shown for different acreages in Figures 2A and 2B, for hand and machine harvesting with the sacker-type trailer with two men in the crew, based on 5- and 10-year expected life periods for the machine. In Figure 2A, the assumed yield is 2 tons per acre, while in Figure 2B, the assumed yields for machine and hand-picked beans are 2 and 3 tons per acre, respectively. The costs for hand harvesting and loading on the truck were \$93.10 and \$139.65 per acre based on a yield of 2 and 3 tons per acre, respectively, in East Tennessee. If the expected life of the harvester is 5 years and yields of machine and

Table 11. Total Costs Per Acre for Picking Snap Beans Mechanically by Specified Type of Trailer, Acres Harvested, and with a 10-Year Harvester Life, Tennessee, 1964

Method Used	Annual acreage harvested											
	15	25	50	100	150	200	250	300	350	400	500	
	Dollars per acre											
Sacker (2 men)												
Fixed costs	142.23	88.34	42.67	21.33	14.22	10.67	8.53	7.11	6.10	5.33	4.27	
Variable costs	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	
Total costs	149.28	95.39	49.72	28.38	21.27	17.72	15.58	14.16	13.15	12.38	11.32	
Sacker (3 men)												
Fixed costs	142.23	88.34	42.67	21.23	14.22	10.67	8.53	7.11	6.10	5.33	4.27	
Variable costs	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22	8.22	
Total costs	150.45	96.56	50.89	29.55	22.44	18.89	16.75	15.33	14.32	13.55	12.49	
Pallet box												
Fixed costs	143.56	86.14	43.07	21.53	14.36	10.77	8.61	7.18	6.15	5.38	4.31	
Variable costs	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67	7.67	
Total costs	151.23	93.81	50.74	29.20	22.03	18.44	16.28	14.85	13.82	13.05	11.98	
Hydraulic bucket												
Fixed costs	154.50	92.70	46.35	23.18	15.45	11.59	9.27	7.73	6.62	5.79	4.64	
Variable costs	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	
Total costs	161.01	99.21	52.86	29.69	21.96	18.10	15.78	14.24	13.13	12.30	11.15	

Table 12. Costs per Ton of Harvesting Snap Beans Mechanically with Expected Machine Life of 5 Years, on 50 to 500 Acres, with Hydraulic Bucket-Type Trailer, Operated by One Man, Tennessee, 1964

Total yield per acre	50 Acres			100 Acres			150 Acres		
	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs
Tons									
1.5	\$49.00	\$4.34	\$53.34	\$24.50	\$4.34	\$28.84	\$16.33	\$4.34	\$20.67
2.0	36.75	3.26	40.01	18.38	3.26	21.64	12.25	3.26	15.51
2.5	29.40	2.60	32.00	14.70	2.60	17.30	9.80	2.60	12.40
3.0	24.50	2.17	26.67	12.25	2.17	14.42	8.17	2.17	10.34
3.5	21.00	1.86	22.86	10.50	1.86	12.36	7.00	1.86	8.86
4.0	18.38	1.63	20.01	9.19	1.63	10.82	6.13	1.63	7.76
	200 Acres			250 Acres			300 Acres		
1.5	12.25	4.34	16.59	9.80	4.34	14.14	8.17	4.34	12.51
2.0	9.19	3.26	12.45	7.35	3.26	10.61	6.13	3.26	9.39
2.5	7.35	2.60	9.95	5.88	2.60	8.48	4.90	2.60	7.50
3.0	6.13	2.17	8.30	4.90	2.17	7.07	4.08	2.17	6.25
3.5	5.25	1.86	7.11	4.20	1.86	6.06	3.50	1.86	5.36
4.0	4.59	1.63	6.22	3.68	1.63	5.31	3.06	1.63	4.69
	350 Acres			400 Acres			500 Acres		
1.5	7.00	4.34	11.34	6.13	4.34	10.47	4.90	4.34	9.24
2.0	5.25	3.26	8.51	4.59	3.26	7.85	3.68	3.26	6.94
2.5	4.20	2.60	6.80	3.68	2.60	6.28	2.94	2.60	5.54
3.0	3.50	2.17	5.67	3.06	2.17	5.23	2.45	2.17	4.62
3.5	3.00	1.86	4.86	2.63	1.86	4.49	2.10	1.86	3.96
4.0	2.63	1.63	4.26	2.30	1.63	3.93	1.84	1.63	3.47

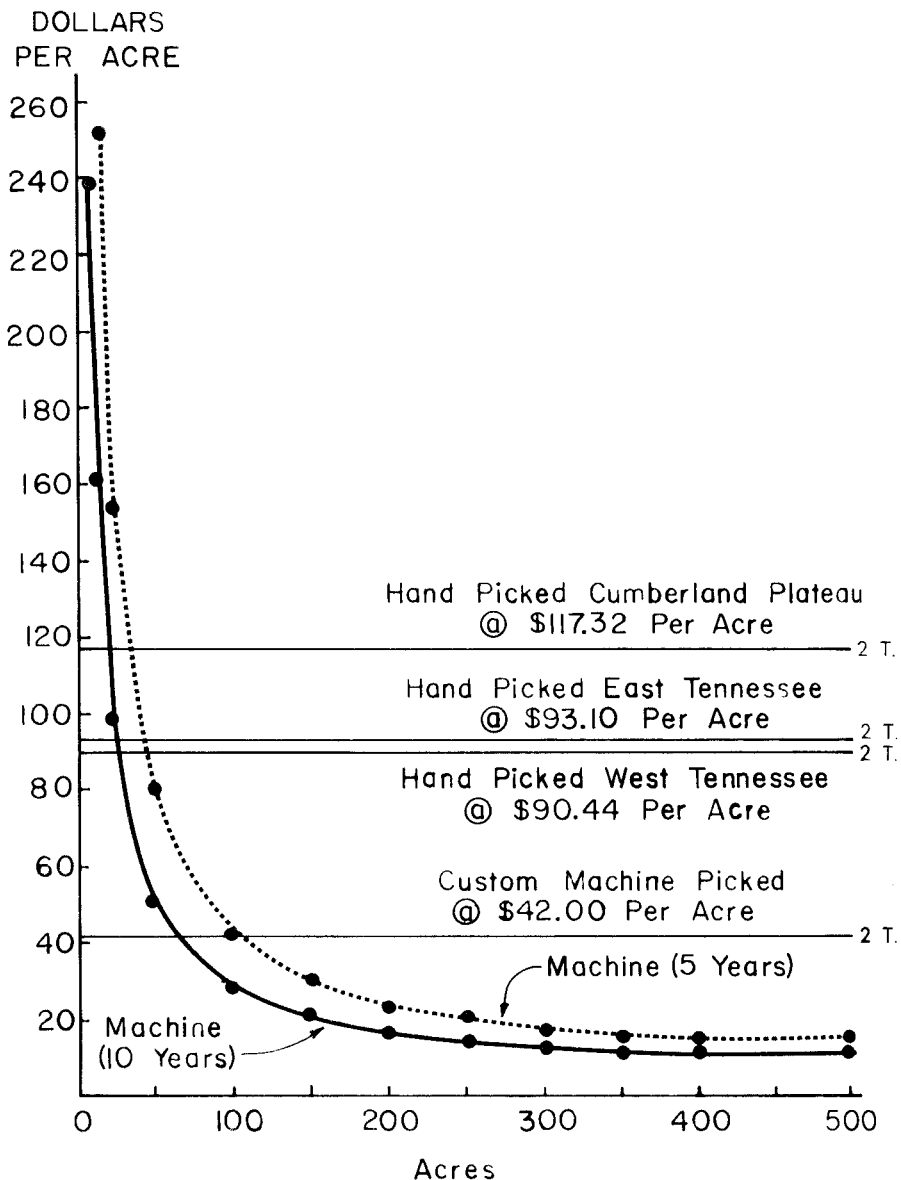


Figure 2A. Per-acre hand and machine harvesting and loading costs for snap beans using a sacker-type trailer operated by two men with expected lives of 5 and 10 years for the harvesters, with a 2 ton yield per acre for each method.

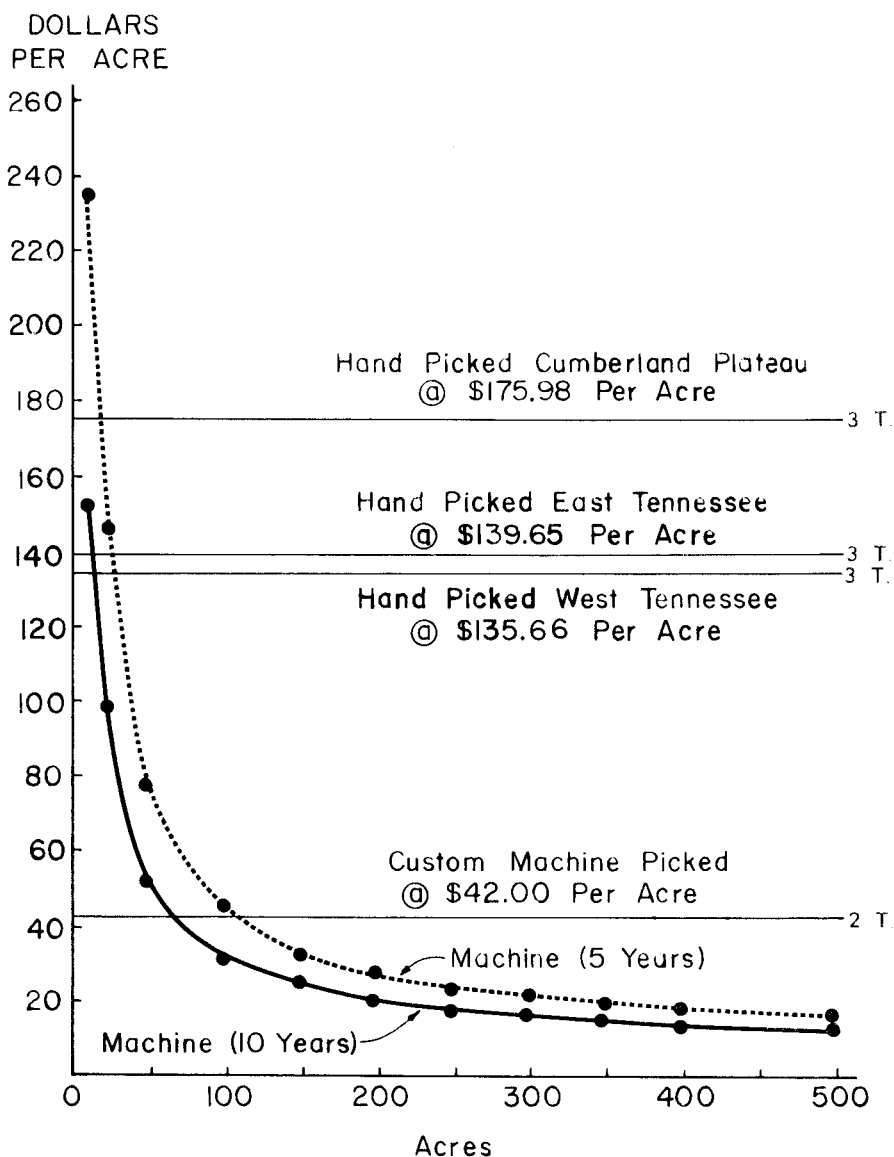


Figure 2B. Per-acre hand and machine harvesting and loading costs for snap beans using a sacker-type trailer operated by two men with expected lives of 5 and 10 years for the harvesters, with a yield of 3 tons per acre for hand and 2 tons per acre for machine harvesting.

hand harvested beans are 2 tons per acre each, picking costs per acre are the same for both the hand and machine methods when 38 acres of snap beans are harvested. If the yields per acre for machine- and hand-picked beans are 2 and 3 tons, respectively, the costs per acre are the same for both the hand and machine methods when 26 acres are harvested.

The acreage required for a savings of machine harvesting over hand harvesting would be relatively close in both East and West Tennessee inasmuch as the costs per acre for hand harvesting and loading on the truck in East and West Tennessee were \$93.10 and \$90.44, respectively.

On the Cumberland Plateau, however, the costs for hand harvesting and loading 2 tons on the truck were \$117.32 per acre. With an expected harvester machine life of 5 years, harvesting costs per acre are the same for hand and machine harvesting when 30 acres are harvested.

When the yields for hand harvested beans are 3 tons, costs are \$175.90 per acre in the same area, and costs per acre are the same for hand and machine harvesting when 23 acres are harvested.

If the life of the harvester is 10 years, and with a yield of 2 tons per acre, the machine and hand harvesting costs are the same when 25 acres are harvested, with hand harvesting and loading costs based on \$93.10 per acre in East Tennessee. If the yield is 3 tons per acre, with a cost of \$139.65 when beans are hand harvested—compared with 2 tons per acre when machine harvested—the machine and hand harvesting costs are the same when 17 acres are harvested.

Hydraulic Dump Bucket-Type Trailer

If the expected life of the hydraulic dump bucket-type trailer is 5 years, and, for example, the picking and loading costs per acre are \$93.10 (costs in East Tennessee), costs per acre are the same for both the hand and machine methods when 45 acres of snap beans are harvested (Figures 3A and 3B). Purchase and use of the harvester for an acreage greater than 45 acres would show a saving over the hand harvesting method, but harvesting less

than 45 acres would be cheaper by the hand method. When yields are assumed to be 2 tons and 3 tons, respectively, per acre for machine harvested and hand harvested beans in East Tennessee with costs for hand harvesting the 3 tons at \$139.65, hand and machine costs per acre are the same when 27 acres are harvested (Figure 3B).

If the hand picking and loading costs are \$117.32 per acre on the Cumberland Plateau, hand and machine harvesting costs per acre are the same when 36 acres are harvested. When the yields for machine and hand harvesting are 2 and 3 tons per acre, respectively, and hand harvesting costs are \$175.98 for the 3 tons, the machine and hand harvesting costs per acre are the same when 23 acres are harvested.

If the expected life of the harvester is 10 years and when hand picking costs are \$93.10 for 2 tons in East Tennessee, the machine and hand harvesting costs per acre are the same when 25 acres are harvested. With a 3-ton yield, when beans are hand harvested at a cost of \$139.65, hand and machine costs per acre are the same when 18 acres are harvested. When hand harvesting and loading costs are \$117.32 per acre on the Cumberland Plateau, costs are the same for hand and machine harvesting when 19 acres are harvested.

The farmer may harvest snap beans with his harvester or hire a custom harvester. If the expected life of the harvester is 5 years, the costs of harvesting with his own machine with a hydraulic dump bucket-type trailer would equal the cost of custom harvesting at \$42.00 per acre with a yield of 2 tons per acre when 105 acres are harvested. If the expected machine life is 10 years, the costs would be the same when 68 acres are harvested.

LABOR PRODUCTIVITY FOR HAND AND MACHINE HARVESTING

As shown in Table 13 and Appendix Table 1, the average labor productivity per man-hour was 1.06 bushels for hand-picked beans in Johnson and Carter counties during 1964. For machine-picked beans, average productivity per man-hour was 95.8, 47.9, and 31.9 bushels with crews of 1, 2, and 3 men for mechanical harvesters with three types of trailers, respectively.

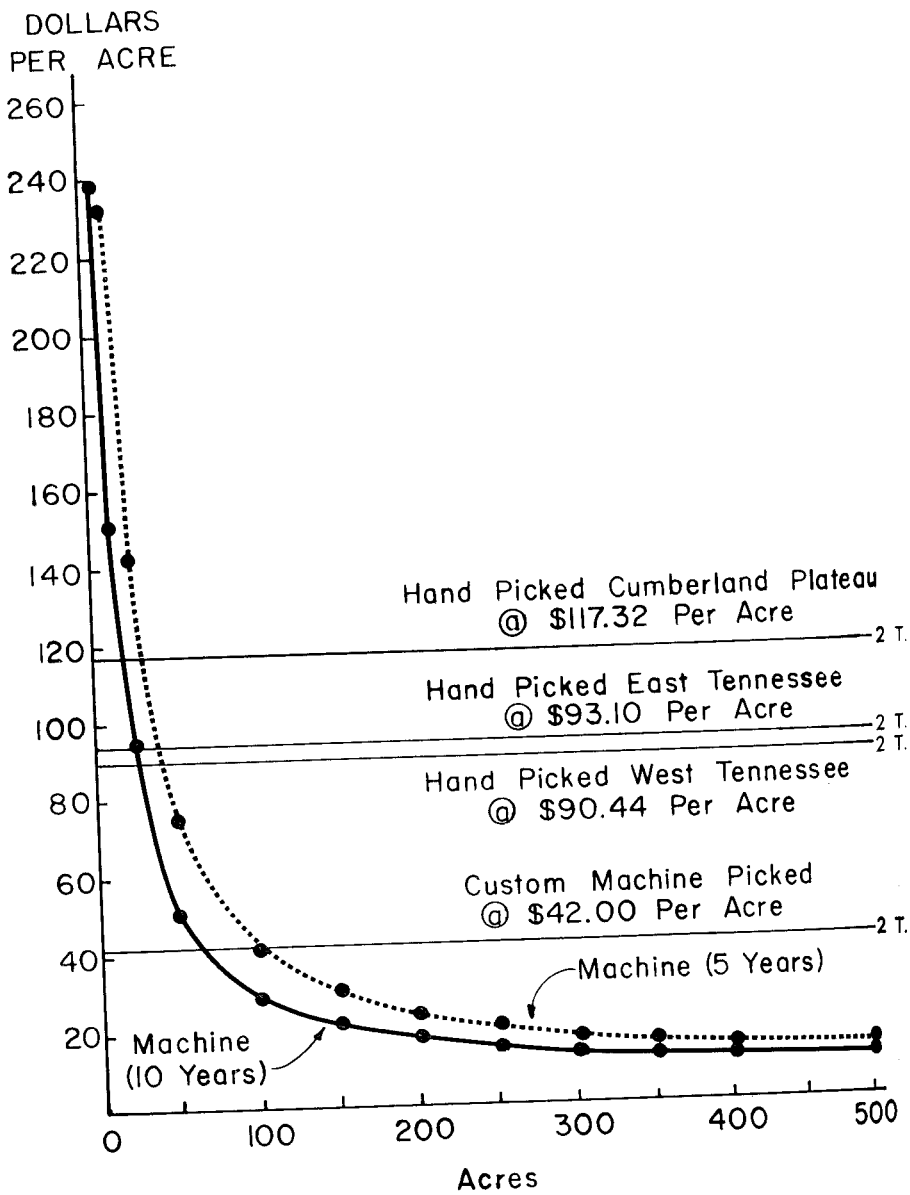


Figure 3A. Per-acre hand and machine harvesting and loading costs for snap beans using a hydraulic dump bucket-type trailer, with expected lives of 5 and 10 years for the harvesters, with a 2-ton yield per acre for each method.

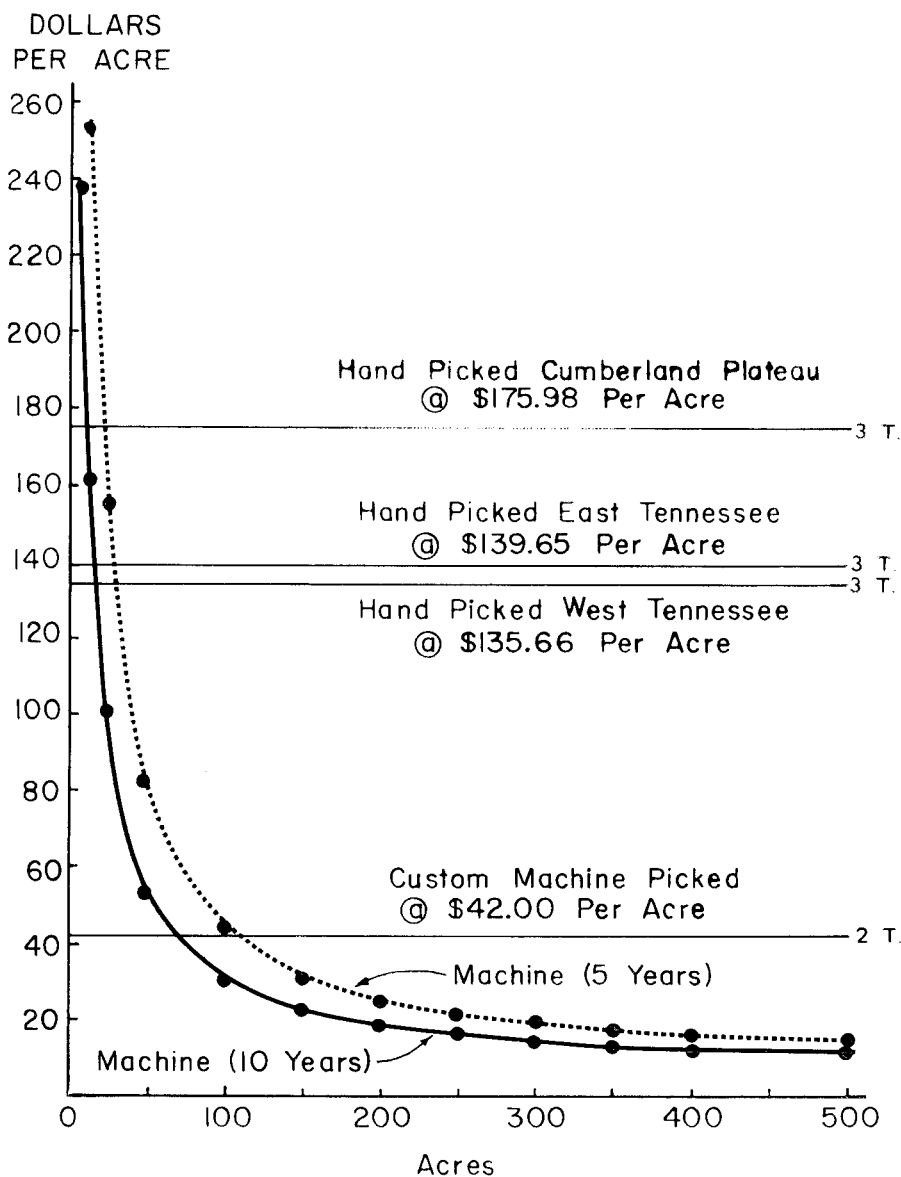


Figure 3B. Per-acre hand and machine harvesting and loading costs for snap beans using a hydraulic dump bucket-type trailer, with expected lives of 5 and 10 years for the harvesters, with a yield of 3 tons for hand and 2 tons for machine harvesting.

Table 13. Labor Productivity in Harvesting Snap Beans by Machine and by Hand, 1963 and 1964

Crew size	Average productivity per man-hour
Number of men	Bushels
Machine picked	95.77
1	47.89
2a	31.92
3	
Hand picked ^b	1.06

- a. This would include both the 2-man sacker operation and the pallet box operation.
 b. An average of data in Appendix Table 1.

NET INCOME FROM HAND AND MACHINE HARVESTING

Table 14 shows an estimate on the costs and returns per acre for snap beans harvested by hand and machine for processing, with yields of 2 and 3 tons each. The net income per acre to the operator for land, labor, and management would vary according to growing costs, harvesting costs, and prices received per ton for the snap beans. For example, assume a yield of 2 tons each per acre for machine- and hand-harvested beans, growing costs of \$67.00 each per acre, and the selling price of beans to the processor at \$85.00, \$100.00, and \$115.00 per ton, respectively. The net returns per acre for hand-harvested beans would be \$7.80, \$37.80, and \$67.80, respectively, at the prices specified above compared with net returns of \$61.00, \$91.00, and \$191.00, respectively, when beans are custom-harvested mechanically.

If the yield per acre is 2 tons, the net returns per acre for contract machine-harvested beans at the three prices outlined above would be \$61.00, \$91.00, and \$191.00, respectively. This compares with net returns of \$45.20, \$90.20, and \$135.20 per acre for hand-harvested beans with a yield of 3 tons per acre.

COSTS OF ALTERNATIVE METHODS OF FIELD LOADING

Snap beans were loaded on trucks by four different methods as shown in Figure 4.

Table 14. Estimate on Costs and Returns Per Acre of Snap Beans, with Yields of 2 or 3 Tons Per Acre, and Harvested by Hand or Machine for Processing

Item	Method of Harvest					
	Hand		Machine (Contract)		Machine (Owned) ^a	
Yield per acre	2 tons	3 tons	2 tons	3 tons	2 tons	3 tons
Variable and fixed growing costs	\$ 67.00	\$ 67.00	\$ 67.00	\$ 67.00	\$ 67.00	\$ 67.00
Variable and fixed harvesting costs	95.20	142.80	42.00	63.00	43.26	64.89
Total costs	\$162.20	\$209.80	\$109.00	\$130.00	\$110.26	\$131.89
Net per acre to operator, labor, land, and management with processed beans at:						
\$85.00 per ton	\$ 7.80	\$ 45.20	\$ 61.00	\$125.00	\$ 59.74	\$123.11
\$100 per ton	37.80	90.20	91.00	170.00	89.74	168.11
\$115.00 per ton	67.80	135.20	121.00	215.00	119.74	213.11

a. Costs are based on harvesting 100 acres.



Manually



With an Elevator



With Forklift



With Hydraulic Dump Bucket

Figure 4. Methods of loading snap beans on trucks in production areas of Tennessee, 1964.

Total Costs

The least-cost method of loading in the field is the pallet box-forklift method (Table 15). It was assumed that the forklift would be operated for a 500-hour season. If the season were shorter than this, the fixed cost would be spread over fewer hours making the per hour fixed cost more than the \$1.00 computed in this study. Likewise, the fixed costs could be reduced with a longer season of operation.

Table 15. Equipment Input-Output Requirements and Costs for Loading Snap Beans, Tennessee, 1964

Method	Crew required	Equip-ment required	Bushels per man hour	Bushels per crew hour	Cost per hour			Cost per bushel
					Fixed costs	Variable costs	Total costs	
By hand								
Dumped	5	—	27.6	138.0	\$ —	\$3.75	\$3.75	\$.027
Sacks	5	—	39.9	199.5	—	3.75	3.75	.019
Elevator								
Dumped	3	Elevator	51.8	155.4	.056	2.34	2.40	.015
Pallet boxes	1	Forklift	290.0	290.0	1.00	1.91	2.91	.010

APPENDIX

Appendix Table 1. Bushels of Snap Beans Harvested Per Man-Hour, by Acreage Groups and by Yield Per Acre, Johnson and Carter Counties, Tennessee, 1963

Acreage groups					
.5 - 4.99		5.00 - 19.99		20.00 and over	
Yield per acre	Bushels per man-hour	Yield per acre	Bushels per man-hour	Yield per acre	Bushels per man-hour
170	.85	240	1.00	225	.77
200	.83	95	.79	150	.90
143	1.04	425	.76	250	.81
217	1.20	265	.83	225	1.30
275	1.43	100	1.25	222	1.25
254	.91	250	.98	169	.92
200	.97	400	1.33	150	1.02
230	1.84	150	.79	250	1.12
180	1.41	164	1.02	45	.90
167	1.39	140	1.17	200	.96
200	1.67	231	1.17	300	1.00
154	1.07	120	1.56	100	.72
90	.94	200	1.25	200	1.50
200	.93	227	.89	255	.94
120	.62	193	1.35		
200	1.00	82	1.12		Average 1.01
160	1.07	200	1.06		
140	1.40	200	1.11		
200	1.25	200	1.11		
200	.69	314	.98		
100	1.04	175	.91		
267	.83	200	1.00		
250	.94	150	1.12		
250	1.25	350	1.22		
138	1.38	200	1.11		
133	.95	100	.73		
200	1.61	200	1.27		
185	.92				
100	.96		Average 1.07		
180	.75				
200	1.25				
200	1.00				
275	1.29				
200	1.04				
200	.62				
150	1.17				
103	.90				

(Continued)

Appendix Table 1 (Continued)

		Acreage group	
		.5 - 4.99	
Yield per acre	Bushels per man-hour	Yield per acre	Bushels per man-hour
333	1.74	50	.83
100	.83	200	1.25
225	1.04	275	1.03
200	1.11	150	.62
200	1.67	325	.99
300	1.00	125	1.98
300	1.17	190	.74
300	1.00	200	.83
175	1.09	200	1.56
444	.93	250	.83
180	1.20		
150	1.08		Average 1.09
142	.89		
180	1.00		
374	1.12		
150	.94		
170	1.25		
200	1.33		
250	.89		
175	1.09		
160	1.22		
150	.94		
160	1.00		
100	.97		
175	1.22		
150	.94		
250	1.04		
300	.83		
58	.60		
100	1.88		
270	.84		
86	1.08		
100	.89		
350	1.10		
100	1.25		
300	1.50		
350	1.09		
280	1.09		
167	1.25		
75	.94		
240	1.25		
200	1.04		
75	.62		

Appendix Table 2. Costs Per Ton of Harvesting Snap Beans Mechanically with Expected Machine Life of 5 Years, on 50 to 500 Acres, with Sacker-Type Trailer, Operated with a Crew of Two Men, Tennessee, 1964

Total yield per acre	50 Acres			100 Acres			150 Acres		
	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs
Tons									
1.5	\$44.96	\$4.70	\$49.66	\$22.48	\$4.70	\$27.18	\$14.98	\$4.70	\$19.68
2.0	33.72	3.53	37.25	16.86	3.53	20.39	11.24	3.53	14.77
2.5	26.98	2.82	29.80	13.49	2.82	16.31	8.99	2.82	11.81
3.0	22.48	2.35	24.83	11.24	2.35	13.59	7.49	2.35	9.84
3.5	19.27	2.02	21.29	9.63	2.02	11.65	6.42	2.02	8.44
4.0	16.86	1.76	18.62	8.43	1.76	10.19	5.62	1.76	7.38
	200 Acres			250 Acres			300 Acres		
1.5	11.24	4.70	15.94	8.99	4.70	13.69	7.49	4.70	12.19
2.0	8.43	3.53	11.96	6.74	3.53	10.27	5.62	3.53	9.15
2.5	6.74	2.82	9.56	5.40	2.82	8.22	4.50	2.82	7.32
3.0	5.62	2.35	7.97	4.50	2.35	6.85	3.75	2.35	6.10
3.5	4.82	2.02	6.84	3.85	2.02	5.87	3.21	2.02	5.23
4.0	4.21	1.76	5.97	3.37	1.76	5.13	2.81	1.76	4.57
	350 Acres			400 Acres			500 Acres		
1.5	6.42	4.70	11.12	5.62	4.70	10.32	4.50	4.70	9.20
2.0	4.82	3.53	8.35	4.21	3.53	7.74	3.37	3.53	6.90
2.5	3.85	2.82	6.67	3.37	2.82	6.19	2.70	2.82	5.52
3.0	3.21	2.35	5.56	2.81	2.35	5.16	2.25	2.35	4.60
3.5	2.75	2.02	4.77	2.41	2.02	4.43	1.93	2.02	3.95
4.0	2.41	1.76	4.17	2.11	1.76	3.87	1.69	1.76	3.45

Appendix Table 4. Costs Per Ton of Harvesting Snap Beans Mechanically with Expected Machine Life of 10 Years, on 50 to 500 Acres, with Sacker-Type Trailer, Operated with a Crew of Two Men, Tennessee, 1964

Total yield per acre	50 Acres			100 Acres			150 Acres			
	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs	
Tons										
1.5	\$28.45	\$4.70	\$33.15	\$14.22	\$4.70	\$18.92	\$9.48	\$4.70	\$14.18	
2.0	21.33	3.53	24.86	10.67	3.53	14.20	7.11	3.53	10.64	
2.5	17.07	2.82	19.89	8.53	2.82	11.35	5.69	2.82	8.51	
3.0	14.22	2.35	16.57	7.11	2.35	9.46	4.74	2.35	7.09	
3.5	12.19	2.02	14.21	6.10	2.02	8.12	4.06	2.02	6.08	
4.0	10.67	1.76	12.43	5.33	1.76	7.09	3.56	1.76	5.32	
		200 Acres			250 Acres			300 Acres		
1.5	7.11	4.70	11.81	5.69	4.70	10.39	4.74	4.70	9.44	
2.0	5.33	3.53	8.86	4.27	3.53	7.80	3.56	3.53	7.09	
2.5	4.27	2.82	7.09	3.41	2.82	6.23	2.84	2.82	5.66	
3.0	3.56	2.35	5.91	2.84	2.35	5.19	2.37	2.35	4.72	
3.5	3.05	2.02	5.07	2.44	2.02	4.46	2.03	2.02	4.05	
4.0	2.67	1.76	4.43	2.13	1.76	3.89	1.78	1.76	3.54	
		350 Acres			400 Acres			500 Acres		
1.5	4.06	4.70	8.76	3.56	4.70	8.26	2.84	4.70	7.54	
2.0	3.05	3.53	6.58	2.67	3.53	6.20	2.13	3.53	5.66	
2.5	2.44	2.82	5.26	2.13	2.82	4.95	1.71	2.82	4.53	
3.0	2.03	2.35	4.38	1.78	2.35	4.13	1.42	2.35	3.77	
3.5	1.74	2.02	3.76	1.52	2.02	3.54	1.22	2.02	3.24	
4.0	1.52	1.76	3.28	1.33	1.76	3.09	1.07	1.76	2.83	

Appendix Table 5. Costs Per Ton of Harvesting Snap Beans Mechanically with Expected Machine Life of 10 Years, on 50 to 500 Acres, with Pallet Box-Type Trailer, Operated with a Crew of Two Men, Tennessee, 1964

Total yield per acre	50 Acres			100 Acres			150 Acres			
	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs	
Tons										
1.5	\$28.71	\$5.11	\$33.82	\$14.36	\$5.11	\$19.47	\$9.57	\$5.11	\$14.68	
2.0	21.53	3.83	25.36	10.77	3.83	14.60	7.18	3.83	11.01	
2.5	17.23	3.06	20.29	8.61	3.06	11.67	5.74	3.06	8.80	
3.0	14.36	2.55	16.91	7.18	2.55	9.73	4.79	2.55	7.34	
3.5	12.31	2.19	14.50	6.15	2.19	8.34	4.10	2.19	6.29	
4.0	10.77	1.91	12.68	5.38	1.91	7.29	3.59	1.91	5.50	
		200 Acres			250 Acres			300 Acres		
1.5	7.18	5.11	12.29	5.74	5.11	10.85	4.79	5.11	9.90	
2.0	5.38	3.83	9.21	4.31	3.83	8.14	3.59	3.83	7.42	
2.5	4.31	3.06	7.37	3.45	3.06	6.51	2.87	3.06	5.93	
3.0	3.59	2.55	6.14	2.87	2.55	5.42	2.39	2.55	4.94	
3.5	3.08	2.19	5.27	2.46	2.19	4.65	2.05	2.19	4.24	
4.0	2.69	1.91	4.60	2.15	1.91	4.06	1.79	1.91	3.70	
		350 Acres			400 Acres			500 Acres		
1.5	4.10	5.11	9.21	3.59	5.11	8.70	2.87	5.11	7.98	
2.0	3.08	3.83	6.91	2.69	3.83	6.52	2.15	3.83	5.98	
2.5	2.46	3.06	5.52	2.15	3.06	5.21	1.72	3.06	4.78	
3.0	2.05	2.55	4.60	1.79	2.55	4.34	1.44	2.55	3.99	
3.5	1.76	2.19	3.95	1.54	2.19	3.73	1.23	2.19	3.42	
4.0	1.54	1.91	3.45	1.35	1.91	3.26	1.08	1.91	2.99	

Appendix Table 6. Costs Per Ton of Harvesting Snap Beans Mechanically with Expected Machine Life of 10 Years, on 50 to 500 Acres, with Hydraulic Bucket-Type Trailer, Operated with a Crew of One Man, Tennessee, 1964

Total yield per acre Tons	50 Acres			100 Acres			150 Acres		
	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs	Fixed costs	Variable costs	Total costs
1.5	\$30.90	\$4.34	\$35.24	\$15.45	\$4.34	\$19.79	\$10.30	\$4.34	\$14.64
2.0	23.18	3.26	26.44	11.59	3.26	14.85	7.73	3.26	10.99
2.5	18.54	2.60	21.14	9.27	2.60	11.87	6.18	2.60	8.78
3.0	15.45	2.17	17.62	7.73	2.17	9.90	5.15	2.17	7.32
3.5	13.24	1.86	15.10	6.62	1.86	8.48	4.41	1.86	6.27
4.0	11.59	1.63	13.22	5.79	1.63	7.42	3.86	1.63	5.49
	200 Acres			250 Acres			300 Acres		
1.5	7.73	4.34	12.07	6.18	4.34	10.52	5.15	4.34	9.49
2.0	5.79	3.26	9.05	4.64	3.26	7.90	3.86	3.26	7.12
2.5	4.64	2.60	7.24	3.71	2.60	6.31	3.09	2.60	5.69
3.0	3.86	2.17	6.03	3.09	2.17	5.26	2.58	2.17	4.75
3.5	3.31	1.86	5.17	2.65	1.86	4.51	2.21	1.86	4.07
4.0	2.90	1.63	4.53	2.32	1.63	3.95	1.93	1.63	3.56
	350 Acres			400 Acres			500 Acres		
1.5	4.41	4.34	8.75	3.86	4.34	8.20	3.09	4.34	7.43
2.0	3.31	3.26	6.57	2.90	3.26	6.16	2.32	3.26	5.58
2.5	2.65	2.60	5.25	2.32	2.60	4.92	1.85	2.60	4.45
3.0	2.21	2.17	4.38	1.93	2.17	4.10	1.55	2.17	3.72
3.5	1.89	1.86	3.75	1.66	1.86	3.52	1.32	1.86	3.18
4.0	1.66	1.63	3.29	1.45	1.63	3.08	1.16	1.63	2.79

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