AN ANALYSIS OF COSTS AND EFFICIENCIES OF CERTAIN METHODS USED IN VINING GREEN PEAS

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CHAPTER I

INTRODUCTION

Green peas grown for canning and freezing are an important crop in the Pacific Northwest. In 1959 this crop returned to the growers of Oregon, Washington, and Idaho a total of $16,100,000 (17, p. 6). This does not include the additional value added to the crop by freezing and canning operations. Production of peas for freezing is especially heavy and accounts for about 70 percent of the United States total (5, p. 1).

Costs of processing green peas have risen sharply in recent years. Many of these costs, such as transportation, machinery, fuel, and labor, are largely beyond the control of the processor. Peas from the Northwest are marketed nationally so must be shipped a greater distance to market than those from some of the competing areas. The industry faces higher transportation costs than other competing areas, and Northwestern wage rates also are higher than its Eastern competitors. As a consequence, the pea industry in the Pacific Northwest faces the problem of keeping its costs in line with Eastern competing areas if it is to maintain its present share of the market.

The Oregon pea processing industry recognizes the nature of this competition and has been alert to making improvements which will improve its efficiency and reduce its costs. Vining, the shelling of the peas, is one important operation that has been receiving particular attention. In past years this operation was performed at the processing plant or at portable stations located in the field. Recently a third method has been introduced. It utilizes a permanent vining station conveniently situated at a point between the plant and the producing area. The permanent nature of this installation and its location permits the adoption of some of the cost reducing characteristics of both plant and portable field vining.

Costs and efficiencies of the two more common methods--plant and portable field vining have already been investigated (5). The present study is intended to expand this earlier work to include a cost analysis of the new permanent field station vining method.

Purposes of the Study

The objectives of this study are:

1. To determine the physical input-output relationships for the permanent field station method of vining green peas.

2. To develop synthesized models of efficient operation for the three methods.

3. To determine the comparative costs of the methods as they are affected by such important variables as distance from processing plant, hourly output rate, length of season and pea-vine ratio.

4. To suggest changes in vining operations based on this analysis that will lead to improved efficiencies and reduced costs in the pea processing industry.

Scope and Limitations of the Study

Vining is the process of separating the peas from the pods and vines, and the first step in preparing them for canning or freezing. A viner operates on the impact and explosion principle. The impact is made by a beater cylinder which reduces the volume of the pod. Pea pods contain some air, and distortion that occurs upon impact compresses this air and this in turn causes the pod to break open. The released peas drop through a perforated reel screen onto an apron and are carried to the side of the viner where they are deposited in either a cannery lug box or an additional conveyor, depending upon the type of vining station and degree of mechanization. The vines and pods are discharged from the viner onto an inclined slat conveyor and are deposited in an ensilage trench.

In portable field vining, the viners are usually set up within two or three miles of the fields being harvested. Vines are hand pitched into the viners.

The shelled peas usually are transported to the processing plant in cannery lug boxes. There they are unloaded, dumped, and the empty lugs are washed and returned to the vining stations (5, p. 1). After harvest the viners are moved by truck to the next temporary location.

Plant vining is performed by a permanent vining station located at the processing plant. The permanent location permits the use of labor-saving equipment and methods not feasible in portable field vining. Vines are trucked from fields located within approximately a twenty-mile radius of the plant. Vines are fed into the viners by means of an electric fork installed on each two viners. The shelled peas are moved directly from the viners to the processing plant by flume, conveyor belt, or pump (5, p. 1).

Permanent field vining has some of the characteristics of both portable field and plant vining. This operation is located at a permanent station near the pea fields and utilizes some of the mechanization common to plant vining. The vines are transported to the viners from the fields usually located within a twenty-mile radius. Viners are fed by electric forks and clean peas are mechanically conveyed to metal tote bins, each holding about 1,200 pounds. The

shelled peas are then transported to the processing plant in these bins.

Two other methods not analyzed in this study, but which have been used experimentally in the Northwest are mobile combines and mechanical pod pickers. Basically, the combine is a stationary viner mounted on wheels with a vine pick-up attachment and a leveling device. One company states in its literature that the leveling device is provided to compensate for slight irregularities in the contour of the field (14, p. 3). A large part of the Oregon pea crop is produced on land with a grade steeper than 5 percent, which would make it difficult, if not impossible, to use this method.

The mechanical pod picker is in the experimental stage. This machine cuts the vines, separates the pods from the vines, and stores them in a hopper until they can be loaded into a truck. Pods are then hauled to the plant where they are run through a conventional viner which has a higher rate of output when only pods are fed into it. It is recognized that many improvements are needed on this machine; one of them being a leveling device that would allow it to operate on hillsides (3, p. 37).

Selection of Factors Affecting Costs

The analysis has been developed around the major

variables that affect costs. These variables are length of operating season, capacity in terms of hourly output of clean peas, ratio of the weight of clean peas to the weight of peas and vines combined, distance from the plant to the vining operation, and from the vining operation to the field.

The length of operating seasons selected were 250, 500, 750, and 1,000 hours. Length of season has its chief effect on fixed costs. The fixed cost per hour or per unit of product will be lower as the length of season increases.

Four different hourly output rates for vining have been used. They are five, ten, twenty, and thirty thousand pounds of clean peas per hour. This range in rates of output is compatible with the processing capacity of most Northwest plants. The problem of indivisibilities of labor and equipment arises with the assumption of a given hourly output and exists regardless of the size of output. Vining operations with larger hourly rates of output are in a better position, however, than smaller operations to obtain optimum use of equipment and labor. Smaller stations have unused capacities of some of the equipment and on some jobs the laborers have excessive wait or idle time.

The number of viners at any one station has been limited to sixteen for permanent field vining stations

and fourteen for the portable field vining stations. These approximate the typical maximum number of viners found at permanent and portable field vining stations in the Pacific Northwest. With such a limitation, more than one station has been used for outputs in excess of ten thousand pounds per hour. When two or more stations are required one station may have less than the maximum assumed number of viners.

The ratio of the weight of clean peas to the combined weight of vines and peas is a factor affecting the costs of vining. As the pea-vine ratio decreases the volume of output of clean peas declines and unit costs increase, assuming no change is made in the amount of labor and equipment. Pea-vine ratios used in this analysis are 10, 15, 20, and 25 percent. The data available indicate that the most common pea-vine ratio encountered was approximately 20 percent, although it varies from nearly 10 percent to slightly more than 25 percent.

The cost of transporting vines and peas and clean peas is closely related to distance and is of major importance. The distance that the vines and peas are transported from the fields to the vining stations has been limited to 20 miles for plant and permanent vining stations and 10 miles for a portable vining

station. The transportation of shelled peas from the permanent and portable vining stations to the processing plant has been limited to 20 miles.

CHAPTER II

METHOD OF DETERMINING COSTS

The synthetic method of determining costs is used in this analysis. This method has been largely developed by industrial engineers, particularly those who combine economics with technology. It sometimes is referred to as the economic-engineering technique or "building block" method. The various operations that are performed in changing the raw product to a finished product are the "building blocks". This method necessitates breaking the process down into the individual operations that are performed. Once a study has been made of several existing plants and physical input-output relationships have been established for the operations, a hypothetical plant can be assembled. Prices can be attached to the physical input requirements of the hypothetical model and total and unit costs then can be calculated.

This method of determining costs was selected over the accounting record approach for two reasons. First, accounting record information between plants is seldom comparable because of the different methods used in allocating fixed and joint costs. Second, considerable differences were found between plants in the prices

they paid for labor, equipment and supplies. This lack of uniformity is the principal reason for using the synthetic rather than the accounting record method (15, p. 2).

The use of a synthetic cost analysis requires that common beginning and ending points be established for the operations being studied. The three methods of vining have a common beginning point in the field where the vine trucks are loaded. Vining as defined here ends when the peas pass over the clipper cleaner at the processing plant. Between these points the methods differ somewhat in the operations performed. It is these differences in operations that form the basis for cost comparisons of the alternative vining methods.

The general procedure for the determination of estimated costs was to first determine the amount of labor, equipment, and facilities required for a given level of hourly output. Current prices for fixed as well as variable compenents were then applied to these inputs to arrive at estimated total costs. The costs do not include joint overhead cost items such as office space, accountants, clerical help, and managerial personnel above the immediate supervisory level. The cost of placing the vines in the ensilage trench is included, but an allowance has not been made for their value.

Labor Costs

The amount of labor necessary to perform the given operations has been determined by work sampling and production studies of individual operations and from interviews with processors. Most operations performed in vining require people to work in groups and this readily lends itself to work sampling. This technique is based on the law of probability. Samples taken at random from a large group tend to have the same pattern of distribution as the universe. If the sample is large enough, its characteristics will differ but little from those of the population (1, p. 498).

Before making a work sampling study it must be made certain that the operation is ready for a work sampling study. Studies taken while an operation is not being conducted in a normal manner produce little useful information. When assurance has been made that the operation is being carried on in a normal manner, it is then necessary to identify all the individual elements of the operation and to determine common beginning and ending points. All the elements must be included. Purposes for which the data are used help to determine the breakdown. The elements "delay", which is referred to as "wait" in this study, must also be included as a measure of the nonproductive time.

When the elements involved have been determined they are identified and described on an observation sheet. The length of the studies to be taken is determined, but a study can be interrupted at any time without affecting the results (1, p. 526). The number of observations that can be made per minute will depend upon the number of elements involved and the number of workers to be observed. It is possible for one person making the time studies to observe four or five workers and record their actions twice during one minute.

An example of handling tote bins at one of the plants studied is used to illustrate the work sampling technique. This operation employs three workers performing the elements of (1) moving the full bin, (2) dumping the bin, (3) moving the empty bin (with the forklift truck), (4) washing the bin, (5) moving the forklift truck without a bin, (6) other work (washing and sweeping the unloading docks) and (7) wait. In this example the observer would momentarily glance at the entire operation at thirty second intervals. On the first glance the observer may notice one man dumping a bin, another washing a bin and the third man waiting. Then he records a mark opposite each of these elements listed on the observation sheet. This

procedure is repeated at the selected interval for the entire length of the study. The studies are repeated at random times for a few days until a sufficient number of observations have been taken. When the studies are completed, the amount of work time and wait time can be determined.

A work standard is developed in terms of output per man or machine hour from the total work observations taken. Before setting the work standard an allowance must be made for rest periods, personal time, short periods of machine down time, and short breaks in the flow of product. This allowance is expressed as a percentage of the time spent working. An allowance of 20 percent has been used for the operations analyzed in this study. This method of compensating for non-productive time has been used in similar studies (5, p. 13) (6, p. 18) (8, p. 266).

The standards in this study were developed by the following formulas:

(1) $$\frac{\text{Total work observations taken}}{\text{Frequency of observations taken per minute}} = \text{Working man minutes.}$$

(2) $$\frac{\text{Working man minutes}}{\text{60 minutes}} = \text{Working man hours.}$$

(3) $\frac{\text{Total pounds of production of clean peas during the study}}{\text{Working man hours}}$ = Pounds of production of clean peas per working man hour.

(4) $\frac{\text{Pounds of production of clean peas per working man hours}}{1 + .25 \text{ (includes 20 percent allowance for delays)}}$ = Work standard in terms of pounds of clean peas per man hour.

The number of workers necessary for a given hourly output can be determined by dividing the hourly output by the work standard. For example, viner clean-up requires one man hour for every 3,200 pounds of clean peas when the pea-vine ratio is 20 percent. A 10,000 pounds per hour output requires 3.12 men which is raised to 4. The number of workers needed is not always a whole number, and all fractions are raised to the next whole number.

Labor standards for jobs that require handling the vines are affected by the pea-vine ratio, but not those involving shelled peas. On all vine handling jobs it has been assumed that the standard varies directly with the pea-vine ratio. As an example the standard for an electric fork operator is 1,600 pounds of clean peas per hour with a 20 percent pea-vine ratio, but this is reduced to 1,200 pounds per hour

when the pea-vine ratio is decreased to 15 percent. Table 1 shows the labor standards developed from the time studies.

The final step in computing the labor cost for an operation is to multiply the number of workers required for a given rate of hourly output by appropriate wage rates. The wage rates used in this study are typical of those existing in the 1959 vining season (Table 2). They were obtained from accounting records and union contracts. A 10 percent allowance for fringe benefits has been added to the wage rate received by the employee. This addition is intended to cover social security and other employer costs.

Equipment and Facility Costs

Equipment and facility costs in this analysis are based upon the installed cost of new equipment and facilities. The prices used for manufactured items were obtained from catalogs, price lists and dealer interviews. Shipping costs were added to list prices where they were applicable. Processor estimates were used for custom built items.

Installation costs were calculated as a percentage of the delivered cost for those items of equipment that needed installing. Vining by portable vining stations does not require an installation cost; however, an

Table 1. Labor Standards for Operations Performed in Vining Peas by the Three Methods of Vining, 1959. 1/

Job Classification 2/	Methods of Vining		
	Plant Station	Permanent Field Station	Portable Field Station
	Pounds of Clean Peas per Man Hour		
Loading in the field*	2,500	2,500	2,500
Loader mechanic*	5,000	5,000	5,000
Field cleanup*	10,900	10,900	10,900
Field foreman*	30,000	30,000	30,000
Electric fork operator*	1,600	1,600	------
Hand pitching (vines)*	------	------	720
Lug box handling (field)	------	------	720
Viner cleanup*	3,200	3,200	------
Viner mechanic*	3,200	3,200	2,900
Viner set foreman*	10,000	10,000	10,000
Tractor operator (crawler type)*	15,000	15,000	10,000
Tractor operator (wheel type)*	15,000	10,000	10,000
Bin filling	------	8,300	------
Weight master	30,000	30,000	30,000
Truck dispatcher*	30,000	------	------
Truck spotter*	30,000	------	------
Tenderometer operator	30,000	30,000	30,000
Clipper clean operator	7,500	7,500	7,500
Bin dumping	------	39,800	------
Bin washing	------	30,700	------
Fork lift operator	------	38,500	------
Hand truck	------	------	11,600
Lug box dumping	------	------	7,900
Lug box washing	------	------	11,600
Receiving dock cleanup	------	------	15,000
Receiving foreman	------	------	30,000

1/ Assumes a 20 percent allowance for delays and a 20 percent pea-vine ratio

2/ Jobs that are affected by the pea-vine ratio are marked with an asterisk. To arrive at the standard for 10 percent pea-vine ratio multiply the standard by 0.5; 15 percent pea-vine ratio multiply by 0.75; for 25 percent pea-vine ratio multiply by 1.25.

Table 2. Labor Cost for the Jobs Performed in Vining, 1959. 1/

Job Classification	Cost per Man Hour
Loading in the field	$ 1.760
Vine loader mechanic	1.925
Field cleanup	1.485
Field foreman	2.200
Electric fork operator	1.485
Viner cleanup	1.485
Tractor operator (track type)	1.925
Tractor operator (wheel type)	1.760
Vine foreman	2.200
Viner mechanic	1.925
Tenderometer operator	1.760
Clipper cleaner operator	1.760
Bin dumper operator	1.760
Bin washer	1.760
Bin filling	1.485
Fork lift operator	1.760
Hand truck lug boxes	1.760
Lug box dumper	1.760
Lug box washer	1.760
Receiving dock cleanup	1.760
Receiving foreman	2.200
Truck spotter	1.485
Truck dispatcher	1.925
Hand pitching	1.485
Weight master	1.925

1/ Labor cost includes 3 percent for Social Security and 7 percent for other employer costs.

allowance has been made for the assembly of new viners.

The standards for equipment used by the various operations were determined by work sampling and production studies, interviews with personnel of processing firms and estimates of equipment manufacturers and dealers. The amount of equipment needed for a given hourly output was determined by the same method used in determining the amount of labor required. Table 3 shows the equipment standards developed from these studies.

Land cost for the permanent and plant vining stations was estimated to be 1,000 dollars for all hourly output rates. Permanent improvements include a cement slab and an ensilage trench plus a building at each permanent station. It has been assumed that the portable vining stations have no slab nor ensilage trench and are located on land previously cropped or land not suitable for cultivation. Consequently, no allowance has been made for a site or improvement cost at the portable vining stations.

The cost of the ensilage trench has been estimated at 25 cents per cubic yard with 100 cubic yards of trench required for every viner. The cost of the concrete slab and buildings was based on Oregon State Tax Commission estimates. The slab cost is equal to 55

Table 3. Equipment Standards for Operations Performed in Vining Peas by the Three Methods of Vining, 1959. 1/

Equipment Item 2/	Methods of Vining		
	Plant Station	Permanent Field Station	Portable Field Station
	Pounds of Clean Peas per Machine Hour		
Viner*	800	800	720
Feed regulator*	800	800	------
Electric fork*	1,600	1,600	------
Oscillating conveyor	7,500	7,500	------
Vine loader*	5,000	5,000	5,000
Tractor (truck type)*	15,000	15,000	10,000
Tractor (wheel type)*	15,000	10,000	10,000
Scales (truck)	30,000	30,000	30,000
Scales (volume)	7,500	------	------
Clipper cleaner	7,500	7,500	7,500
Tenderometer	30,000	30,000	30,000
Scavenger reel	7,500	------	------
Food pump	7,500	------	------
Aluminum tubing	7,500	------	------
Shaker grader	------	7,500	------
Inclined pea conveyor	------	7,500	------
Bucket elevator	------	7,500	------
Bin dumper	------	7,500	------
Bin washer	------	30,700	------
Lug box dumper	------	------	7,500
Lug box washer	------	------	10,000
Lug box conveyor	------	------	10,000
Pickup truck	10,000	10,000	10,000
Fork lift truck	------	38,500	------

1/ Assumes a 20 percent allowance for delays and a 20 percent pea-vine ratio.

2/ Equipment that is affected by the pea-vine ratio is marked with an asterisk. To arrive at the standard for 10 percent pea-vine ratio multiply the standard by 0.5; 15 percent pea-vine ratio multiply by 0.75; 25 percent pea-vine ratio multiply by 1.25.

cents per square foot for a thickness of 6 inches and includes steel reinforcements. A 12-foot by 32-foot slab has been used for each viner. The cost of building facilities at the permanent station is estimated to be $2,925.

The following assumptions have been made in determining fixed costs.

(a) Depreciation is based upon the straight line method without an allowance for salvage value. The estimated years of useful life for each item of equipment are shown in Table 1 of the Appendix.

(b) Interest amounts to 3 percent of the replacement cost. This is equal to approximately 5.5 percent of the undepreciated balance.

(c) Property taxes are based on 1 percent of the replacement cost.

(d) Insurance amounts to 1 percent of the replacement cost.

(e) The cost of maintenance is estimated to be 1.5 percent of the replacement cost for all items except the vine loader and crawler tractor (3 percent) and volume scales (1 percent).

The costs of variable repairs are assumed to be related directly to the number of hours that the equipment is used. They have been estimated as being 0.5 percent of the replacement cost for every 100 hours of operation except for the vine loader, crawler tractor and truck scales. One percent per 100 hours of operation has been used for the vine loader and

crawler tractor, while 0.2 percent has been used for the truck scales.

Allowances for variable repairs include the cost of parts for minor repairs, oil, and grease when they have not been calculated separately. They also include the cost of labor used for repair work.

Prices for diesel fuel and gasoline were obtained from wholesale dealers in eastern Oregon. The price used to compute the cost of diesel fuel was 15.9 cents per gallon. Gasoline was priced at 29.5 cents per gallon. The latter includes six cents per gallon for state taxes and four cents for federal taxes. All of the state taxes would be refundable if the gasoline were not used on a public road. The federal gasoline tax refund amounts to four cents per gallon if the gasoline is used on the farm and two cents per gallon if it is used by industry off the public roads. Table 2 of the Appendix shows the hourly rate of consumption and the net cost of fuel for equipment used in vining.

Electricity consumption was determined by establishing the size of the motors used by the various equipment items and the amount of power drawn by each motor. The theoretical power requirements for a motor has been determined by electrical engineers to be

.746 kilowatts per hour for each rated horsepower. In practice the actual horsepower used is less than the rated horsepower and an adjustment must be made. The average percentage of rated horsepower used has been estimated at 80 percent. When five percent is allowed for line loss and an estimate of 86 percent for motor efficiency, the formula for estimating kilowatt hours required per horsepower is as follows:

$$\frac{1 \text{ hp}}{0.86 \times 0.95} \times .80 \times .746 \text{ kw.} = 0.73 \text{ kw (9, p. 154).}$$

The average cost of electricity has been estimated to be $0.0087 per kilowatt hour. This rate is in line with rate schedules published by the Pacific Power and Light Company and the Milton City Electric Company. Table 3 of the Appendix shows the horsepower, kilowatt hours, and cost of electricity for all electrically equipped machinery used by the three methods of vining.

Transportation Costs

Transportation arrangements vary between different operations or firms with some owning and operating their own trucks while the majority use trucks and drivers furnished by contract haulers. This study uses contract hauling rates published by the Oregon Public Utilities Commission. The 1959 rate for vine transportation from the field to the vining station was $5.08

per hour for truck and driver.

It has been assumed that the average speed for a vine truck hauling to a portable vining station is 15 miles per hour. An average speed of 20 miles per hour has been used for those hauling to permanent field and plant vining stations. Load weights used were based upon a sample of loads weighed and averaged 7000 pounds for vining trucks hauling to plant and permanent stations and 3500 pounds for those hauling to portable stations. The reason for the wide difference in weight is the manner in which the trucks are loaded. Those hauling 7,000 pounds of vines are tramped, while those hauling 3,500 pounds are loaded loosely without tramping.

The contract rate for hauling shelled peas from portable and permanent field stations to the processing plant is on a mileage basis without any minimum or maximum load restrictions and includes the return of the empty containers to the point of origin. Shelled peas contain a percentage of foreign matter when they come from the viners. A five percent allowance has been assumed for foreign matter. As an example, the rate for hauling shelled peas is $2.35 per ton for a distance up to three miles. When a five percent allowance is made for foreign matter, the effective transportation rate for a ton of clean peas is $2.4675 per ton.

Table 4 of the Appendix shows the rates charged for transporting clean peas.

Miscellaneous Costs

Although portable vining does not involve building and land costs, it does incur a cost for transporting the viners to the temporary vining site. This cost has been estimated to be the equivalent of four man hours of labor at the viner mechanic rate and two hours rental on a vine truck, plus an allowance of 20 percent for labor and truck cost for each viner moved. The cost for each move was $21.43 per viner. The number of moves for any given length of season would depend upon the amount of peas grown in one location. This study assumes only one move for every 500 operating hours plus the cost of moving the equipment from storage to the vining site at the beginning of the season and moving it back to storage at the end of the season.

Several small costs involved in vining operations are difficult to estimate. This study makes an allowance of five percent of the total season's machinery cost to cover miscellaneous expenses such as the cost of water, lights, small hand tools, gas and oil drums, and pilferage.

CHAPTER III

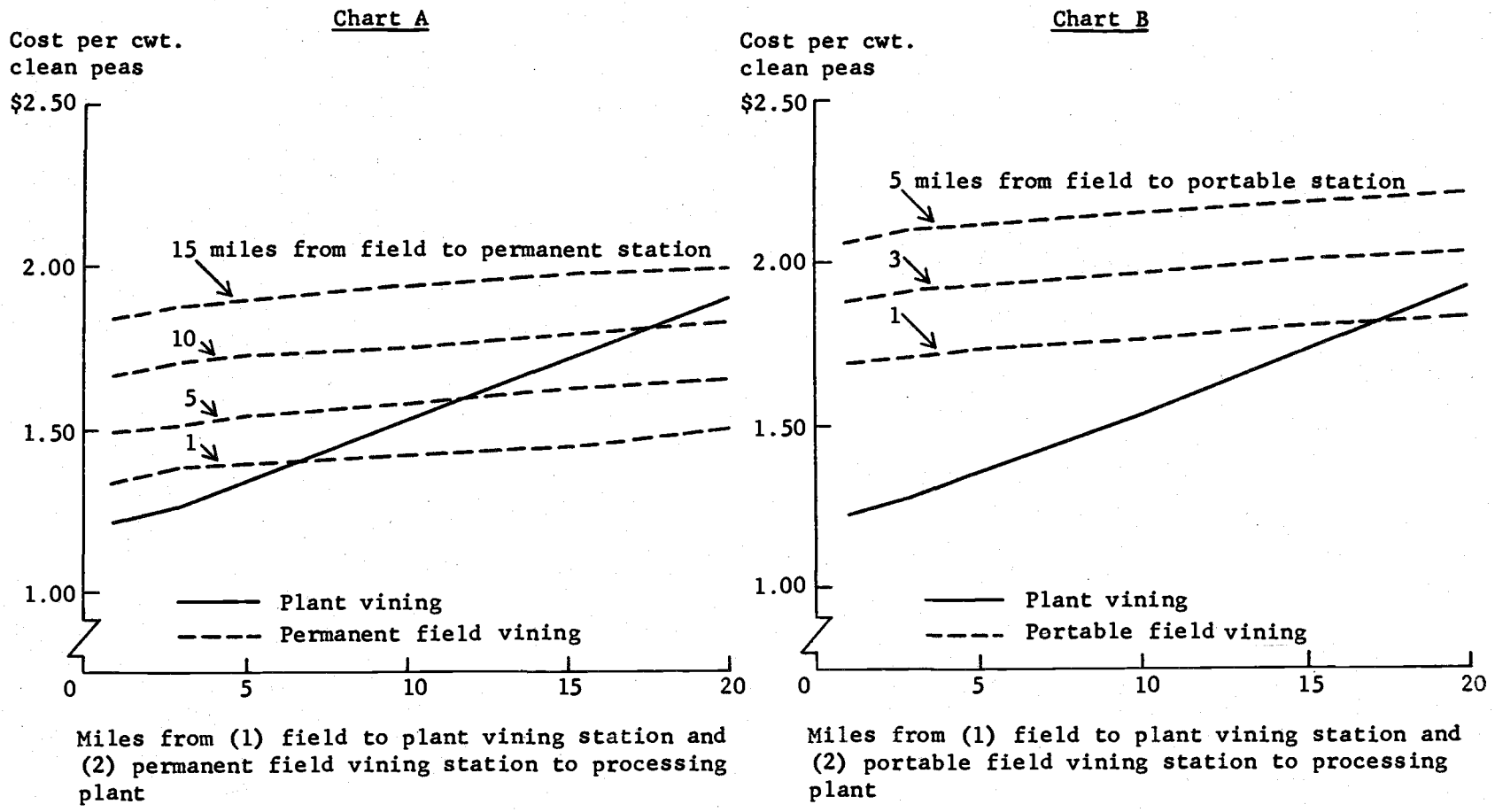
COMPARATIVE COSTS OF THE THREE METHODS OF VINING

Costs for the three methods of vining have been based upon models synthesized for each of the methods. The costs associated with the different methods depend upon the assumptions made with reference to the variables selected as being important. In most cases the variables are subject to some degree of control by plant management. In this study emphasis will be placed on costs of different methods of vining as they are affected by (1) the hauling distance for peas and vines and for shelled peas, (2) volume of hourly output of clean peas, (3) length of the operating season, and (4) ratio of clean peas to vines and peas.

Hauling Distance

The costs for the three methods of vining as they are related to distance are shown in Figure 1. Chart A compares costs for plant vining and permanent field station vining. Chart B shows the costs for plant vining and portable field station vining. The comparative costs for the two field station vining methods can be determined by the vertical level of the appropriate curves in the two charts. In examining this

Figure 1. Estimated Costs for Different Methods of Vining Peas and Different Hauling Distances, 1959/1



/1 Assumes a 20,000 pounds per hour output, a 20% pea-vine ratio and a 1,000 hour operating season.

summary of costs it should be kept in mind that two hauling distances are involved for the field station methods: (1) hauling vines and peas from the field to the station, and (2) hauling the shelled peas from the vining station to the processing plant. Plant vining on the other hand involves only the hauling of peas and vines from the field to the plant located viners.

Figure 1 shows that when the peas and vines and the shelled peas are hauled only short distances that plant vining is a lower cost method than either permanent or portable field vining. The portion of the curves for permanent field station vining and portable field vining that lie below the curve for plant vining represent lower vining cost for those methods than for plant vining. The portion of the curves for the two field station methods that are above the plant vining cost curve represent higher cost operations with the specified conditions. Costs for the permanent station method are lower than for the portable station at all comparable distances.

Equal cost points in Chart A for plant vining and for permanent field station vining are located at approximately 6.5, 12 and 17 miles on the horizontal scale. This assumes hauling vines and peas from the field to the station a distance of 1, 5, and 10 miles,

respectively. In Chart B the only equal cost point between portable field vining and plant vining is at the 17 mile distance with the vines and peas being hauled a distance of 1 mile from the field to the portable vining station.

The slopes of the cost curves for the three methods illustrated in Figure 1 indicate that the costs for plant vining increase faster than for either of the other two vining methods, assuming a constant field to station distance for the latter. The reason for this is apparent when the costs of hauling shelled peas are compared with the costs of hauling peas and vines. Total vining costs increase on the average about 0.6 cents per hundredweight for each additional mile that clean peas are hauled. The average increase amounts to 5.6 cents per hundrerweight per mile for hauling vines and peas to the portable field station and 3.6 cents for permanent field station and plant vining. These wide differences are due primarily to the fact that clean peas make up approximately 20 percent of the field load but about 95 percent of the net load being hauled from the field stations to the plant.

The distance that the peas and vines are hauled to the vining station is a critical point to be considered when selecting the vining method with the

lowest cost. The fact that the increase in the costs of hauling peas and vines is more than five times greater than the cost for transporting shelled peas for the same distance makes the importance of locating vining stations near the pea fields obvious.

Labor requirements necessarily increase as the hauling distance increases. Table 4 shows that in plant vining 27 more persons are required when peas and vines are hauled 20 miles than for a distance of one mile. An increase from an average distance of one mile to an average distance of 20 miles increases labor requirements for permanent field station and portable field station vining by only 2 and 3 people, respectively. This assumes no change in the field to vining station distance.

The three different vining methods discussed have cost differences outside of the hauling operation. When costs for the latter are excluded plant vining has costs for labor and equipment that are slightly lower than for permanent field station vining but substantially lower than for the portable station method. The greatest difference occurs in labor. The portable vining station method requires 44 more workers, excluding hauling, than plant vining and 40 more than the permanent station method. The larger crew requirement is due almost entirely to lack of mechanization.

Table 4. Estimated Costs of Vining Peas by Three Methods of Vining, with Selected Distances, 1959. 1/

Distance (Miles One Way) 2/	Number in crew: Truck Drivers	Number in crew: All Others	Total Season's Costs: Labor (Excludes Hauling Vines and Peas)	Total Season's Costs: Hauling Vines and Shelled Peas	Total Season's Costs: Equipment and Facilities	Total Season's Costs: Total Cost	Average Cost per Hundredweight
Plant Vining							
1	16	55	$ 94,270	$ 81,280	$ 69,113	$244,663	$1.22
5	21	55	94,270	106,680	69,113	270,063	1.35
10	33	55	94,270	142,240	69,113	305,623	1.53
15	35	55	94,270	182,880	69,113	346,263	1.73
20	43	55	94,270	218,440	69,113	381,823	1.91
Permanent Field Vining							
1	22	59	100,595	126,275	73,618	300,774	1.50
5	23	59	100,595	136,670	73,618	311,169	1.56
10	23	59	100,595	143,075	73,904	317,514	1.59
15	24	59	100,595	150,740	73,904	325,239	1.62
20	24	59	100,595	156,410	74,187	331,192	1.66
Portable Field Vining							
1	30	99	162,360	136,435	77,907	376,702	1.88
5	31	99	162,360	146,830	78,032	387,222	1.93
10	31	99	162,360	153,235	78,155	393,750	1.96
15	32	99	162,360	160,900	78,280	401,540	2.01
20	33	99	162,360	166,570	78,404	407,334	2.04

1/ Assumes a 1,000 hour season, a 20 percent pea-vine ratio and an hourly output of 20,000 pounds of clean peas.

2/ Shows distance from field to plant for plant vining and distance from field stations to plant for other vining methods. Field to station distance assumed to be 5 miles for permanent station and 3 miles for portable station.

Each portable field viner has an operating crew of two--one hand pitching and one off-bearing or lug box handling. Their output of peas amounts to 360 pounds per man-hour. The plant and permanent field stations have one man operating two viners with the assistance of an electric fork. His output of clean peas at a 20 percent pea vine ratio is 1,600 pounds per hour.

A larger crew also is required for the portable station method in handling clean peas and pea containers. This operation is much more mechanized at permanent station vining by the use of mechanical conveyors and fork lift handling of pallet boxes. It is completely mechanized in plant vining.

Operating costs of equipment and facilities for any given method are affected only in a minor way by differences in distance. In the two field methods, these increase slightly as distance increases due to the larger number of bins and lug boxes required. This explains the increased costs shown for equipment and facilities in Table 4.

As indicated earlier the costs of operating portable field vining equipment is greater than it is for either of the other two methods. Tables 2 and 3 of the Appendix show that fuel cost for operating viners at portable stations is higher than the electric power cost for operating viners at the plant

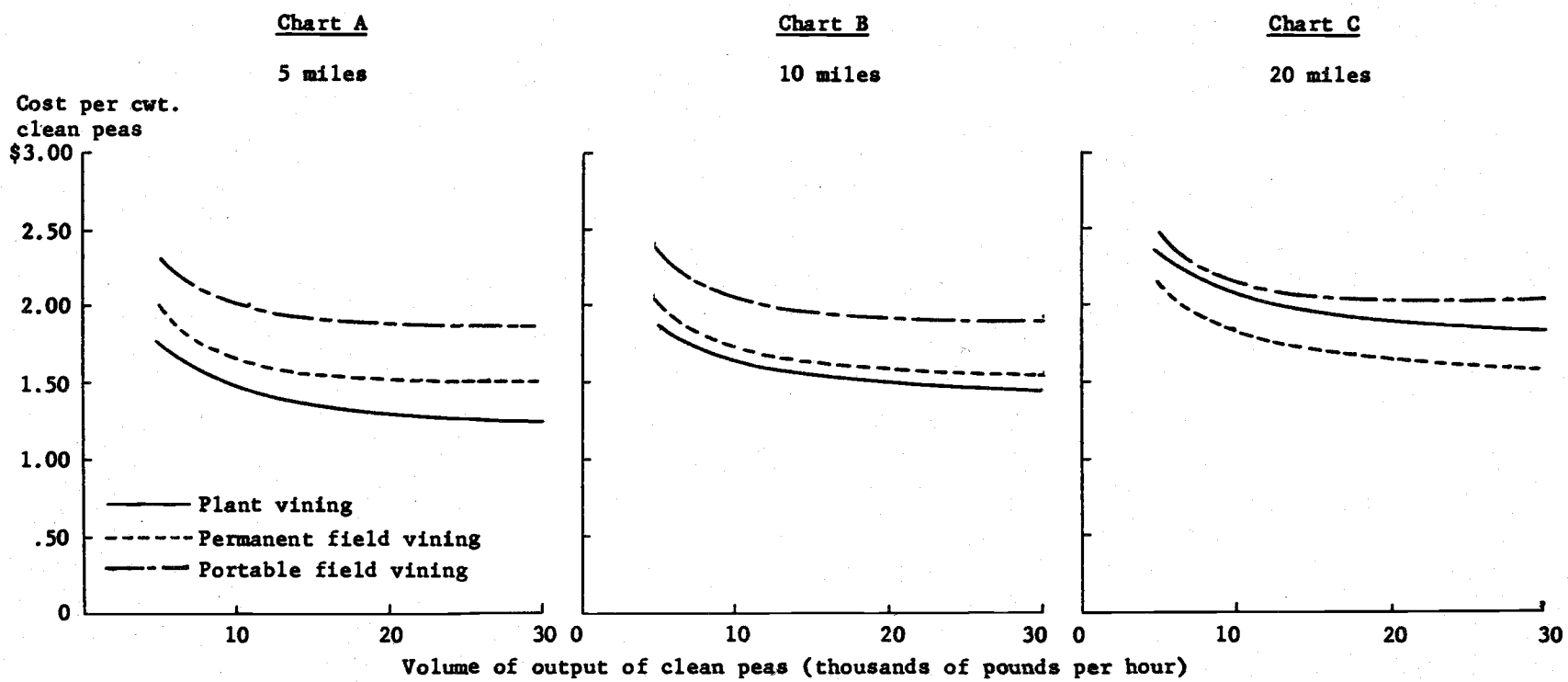
or permanent field vining stations. Viners at the latter two are operated on electricity and will run for nearly 5.4 hours for the same cost required to operate a gasoline-powered viner for one hour at the portable stations.

Rates of Output Per Hour

The volume of hourly output of clean peas is an important variable for two reasons. First, management has as much or more control over it than any of the other variables discussed. Second, the rate of output materially affects costs. Costs per hundredweight decrease with increases in hourly volume over the 5,000 to 30,000 pound range of outputs shown in Figure 2. The largest decrease in costs per hundredweight occurs when hourly output capacity is increased from 5,000 to 10,000 pounds of clean peas per hour. Reductions in costs beyond this point occur at a decreasing rate. Charts A and B show plant vining to be a lower cost vining method than either permanent or portable field station vining for all levels of output. Chart C shows permanent field station vining to be the lowest cost method when distance is increased to 20 miles.

Increases in hourly output are made possible only with substantial investment in equipment and facilities. Replacement cost as of 1959 for the three methods are

Figure 2. Estimated Cost of Vining Peas by the Three Methods of Vining with Selected Hourly Output Capacities and Distances, 1959./1



/1 Assumes the following:
(a) A 1,000 hour operating season and a 20% pea-vine ratio.
(b) Distances shown above the charts indicate distance from field vining stations to plant for the field methods and distance from field to plant for plant vining.
(c) Cost includes hauling vines 5 miles to permanent stations and 3 miles to portable stations.

shown in Table 1 of the Appendix. Permanent field station vining requires a larger amount of investment for a given level of output than either of the other two vining methods; however, plant vining is a more mechanized method. Investment for the permanent field method is higher than plant vining because of the added investment in the bins used for transporting the shelled peas from the vining stations to the processing plant and the bin handling equipment used at the vining stations and processing plant. Portable field vining requires a lower amount of investment than the other two methods because it is less mechanized and substitutes labor for equipment. Table 5 of the Appendix shows that the investment in equipment does not increase in direct proportion to the increase in hourly rates of output. As an example, the output of a plant vining station can be increased from 5,000 to 10,000 pounds of clean peas per hour by increasing the amount of investment from $102,528 to $164,126 or an increase of $61,598.

Indivisibilities of equipment and facilities present a situation of excess capacity for some items of equipment. It is because of these indivisibilities that the amount of investment does not increase in direct proportion to hourly output. The per hour rate

of output can be increased without making additional investment in equipment required to perform some operations. An example of equipment with excess capacity is the truck scales. One truck scale is used for all hourly rates of output analyzed in this study. Vining operations with less than 30,000 pounds per hour output have excess capacity for this item and consequently a higher fixed cost per unit of output for a given length of season.

Indivisibilities of labor present a situation similar to that of equipment requirements (Table 5). Crew size is affected by changes in output but does not necessarily change in direct proportion. Certain operations require a fixed number of workers for all levels of output shown. A low hourly output results in idle time for those workers performing these operations. Examples of some of these operations are field foremen, weighmasters, truck dispatchers and spotters, and tenderometer operators.

Length of Operating Season

Processors in cooperation with growers have considerable control over the length of the harvest and consequently the pea processing season in the Eastern Oregon-Washington pea producing area. This area is unique in that peas are grown at elevations ranging

Table 5. Estimated Costs of Vining Peas by Three Methods of Vining with Selected Rates of Hourly Output, 1959. 1/

Volume Clean Peas Vined Per Hour	Number in Crew: Truck Drivers	Number in Crew: All Others	Season's Costs: Labor (Excludes Hauling Vines and Vines and Peas)	Season's Costs: Hauling Shelled Peas	Season's Costs: Equipment and Facilities	Season's Costs: Total Cost	Average Cost per Hundred-weight
			Plant Vining				
5,000	7	21	$ 36,630	$ 35,560	$ 24,843	$ 97,033	$1.94
10,000	14	32	55,385	71,120	38,201	164,706	1.65
20,000	28	55	94,270	142,240	69,113	305,623	1.53
30,000	42	77	131,305	213,360	94,534	439,199	1.46
			Permanent Field Vining				
5,000	6	24	39,985	35,768	27,808	103,561	2.07
10,000	12	35	59,950	71,537	41,160	172,647	1.73
20,000	23	59	100,595	143,025	73,904	317,574	1.59
30,000	35	83	140,875	214,612	106,229	461,716	1.54
			Portable Field Vining				
5,000	9	32	54,340	40,848	25,128	120,316	2.41
10,000	16	53	87,945	76,618	41,344	205,906	2.06
20,000	31	99	162,360	153,235	78,155	393,750	1.97
30,000	46	145	236,940	224,772	117,346	579,058	1.93

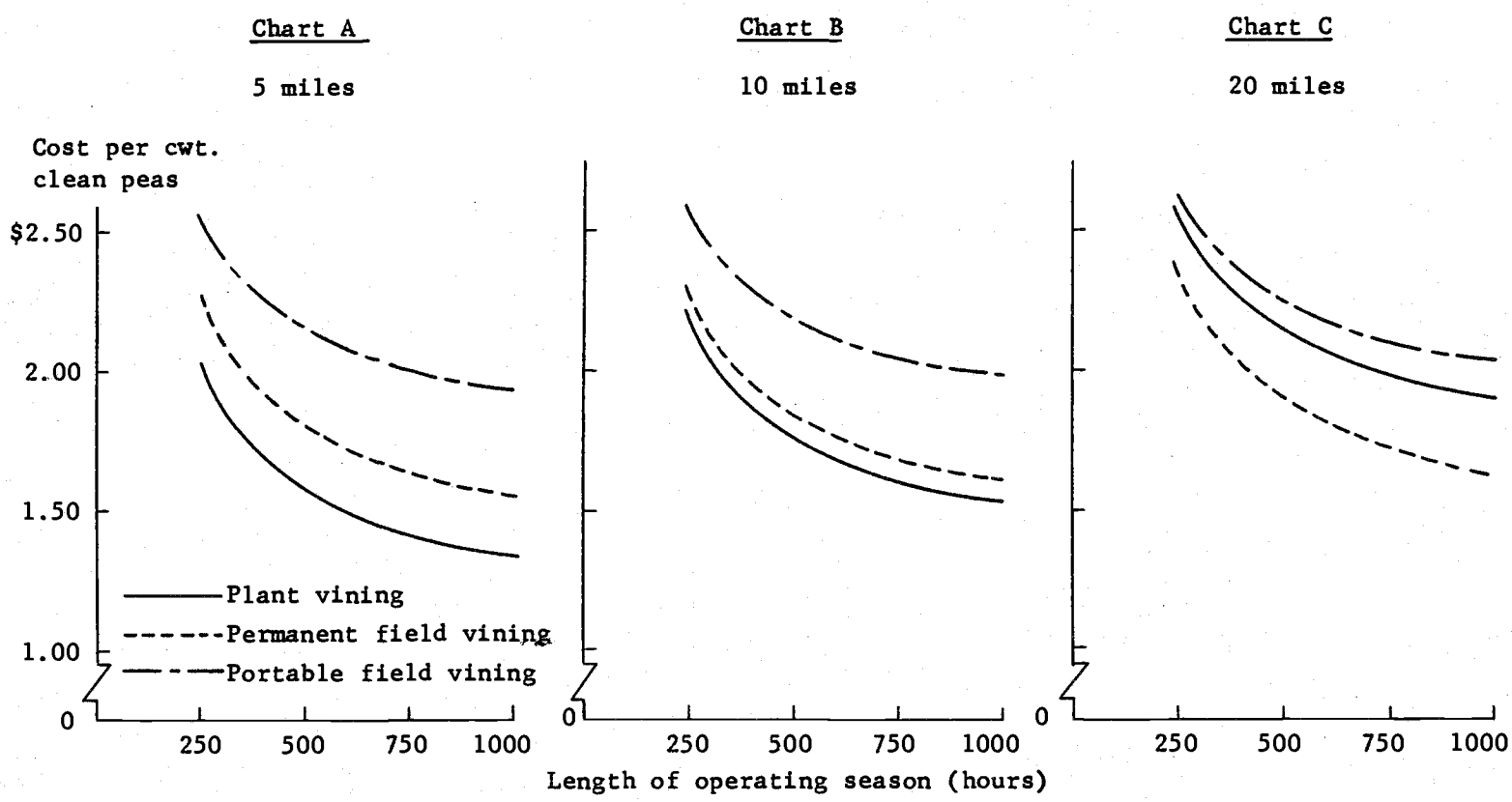
1/ Assumes the following:
(a) A 1,000 hour operating season and a 20 percent pea-vine ratio.
(b) Distance one way:
(1) Plant vining - 10 miles from field to plant.
(2) Permanent field vining - 10 miles to the plant; 5 miles to the field.
(3) Portable field vining - 10 miles to the plant; 3 miles to the field.

from less than 1,000 feet above sea level to more than 3,500 feet (18, p. 4). This permits staggered planting dates and extends the length of the harvesting season. Other pea producing areas such as in New York, Wisconsin and Minnesota do not have this physical characteristic and consequently have much shorter harvest and processing seasons.

Costs per unit of product for all three methods decline as season's length is extended (Figure 3). This relationship results from the spreading of the fixed costs over a greater number of units. Fixed costs compose a larger portion of the total vining costs for short seasons than they do for longer seasons. Depreciation, interest, taxes, and fixed repairs and maintenance for equipment and facilities have been held as constant percentages of the replacement cost regardless of the operating season's length. It has been assumed that if the useful life of equipment and facilities were not terminated by the time used to calculate the depreciation that it would be obsolete and its unused life would have no value.

Results presented in Figure 3 should not be interpreted as meaning that plant vining is a lower cost method than the permanent station method for all situations. As pointed out in the section dealing

Figure 3. Estimated Cost of Vining Peas by the Three Methods of Vining with Selected Lengths of Operating Season and Distances, 1959./1



/1 Assumes the following:
(a) An hourly output of 20,000 pounds of clean peas and a 20% pea-vine ratio.
(b) Distances shown above the charts indicate distance from field vining stations to plant for the field methods and distance from field to plant for plant vining.
(c) Cost includes hauling vines 5 miles to permanent stations and 3 miles to portable stations.

with hauling distance, the permanent station method can have lower costs than plant vining depending upon the distances that vines and peas and clean peas are hauled. This applies also when length of season is considered as the variable to be illustrated. For example, if 20 mile distances for plant vining and for permanent stations to plant had been assumed in Figure 3, the permanent station cost curve would have been at a lower level showing this method to be the lower cost method for that distance. Its curve would have been even lower if the field to vining station distance were decreased from the five miles assumed.

Figure 3 shows that plant vining is the lowest cost method of vining for all lengths of operating season at the 5 and 10 mile distances. The permanent station method has the lowest costs at 20 miles. Vining costs decrease as the length of season is extended with the largest decrease between 250 and 500 hours although additional savings are made beyond this point. Cost reductions for the above interval amount to 44, 47, and 41 cents per hundredweight for plant, permanent field and portable field vining stations, respectively. The cost reduction between 750 and 1,000 hours is 7, 8, and 7 cents per hundredweight for plant, permanent field and portable field vining, respectively (Table 6). As the season's length increases, the costs

Table 6. Estimated Costs of Vining Peas by Three Methods of Vining with Varying Lengths of Operating Seasons, 1959. 1/

Length of Operating Season Hours	Number in Crew: Truck Drivers	Number in Crew: All Others	Season's Costs: Labor (Excluding Hauling Vines and Peas)	Season's Costs: Hauling Vines and Shelled Peas	Season's Costs: Equipment and Facilities	Season's Costs: Total Cost	Average Cost per Hundredweight
Plant Vining							
250	28	55	$ 23,568	$ 35,560	$ 50,480	$109,608	$2.19
500	28	55	47,135	71,120	56,691	174,946	1.75
750	28	55	70,703	106,680	62,902	240,285	1.60
1,000	28	55	94,270	142,240	69,113	305,623	1.53
Permanent Field Vining							
250	23	59	25,149	35,769	54,332	115,250	2.30
500	23	59	50,298	71,538	60,870	122,670	1.83
750	23	59	75,446	107,306	67,408	250,160	1.67
1,000	23	59	100,595	143,075	73,904	317,574	1.59
Portable Field Vining							
250	31	99	40,590	38,309	49,698	128,597	2.57
500	31	99	121,770	114,926	68,869	305,565	2.04
750	31	99	81,180	76,618	58,984	216,782	2.17
1,000	31	99	162,360	153,235	78,155	393,750	1.97

1/ Assumes the following:

(a) A 20,000 pound hourly output capacity and a 20 percent pea-vine ratio.

(b) Distance one way:

(1) Plant vining - 10 miles to the plant.

(2) Permanent Field vining - 10 miles to the plant; 5 miles to the field.

(3) Portable Field vining - 10 miles to the plant; 3 miles to the field.

for the permanent field station method decline more rapidly than the other two methods. Consequently, the vertical distance between the curves for plant vining and permanent field station vining narrows, but expands between the two field methods. The more rapid decrease in costs for the permanent vining station method is attributed to its higher fixed costs. As stated earlier, extending the season tends to spread the fixed costs over a greater volume of output. An indication of the relative importance of fixed costs which for the most part arise from equipment and facilities is illustrated in Table 5 of the Appendix.

Pea-vine Ratio

The pea-vine ratio has an important effect on the unit costs of vining peas. Growers and processors, however, have little control over this variable. Delaying harvest will tend to increase the ratio of the weight of clean peas to the weight of combined peas and vines, but any benefit from this can be more than offset by reductions in quality and in the price received per unit of product (9, p. 11). As the maturity of the peas increases the tenderometer test rises and price per ton of product decreases.

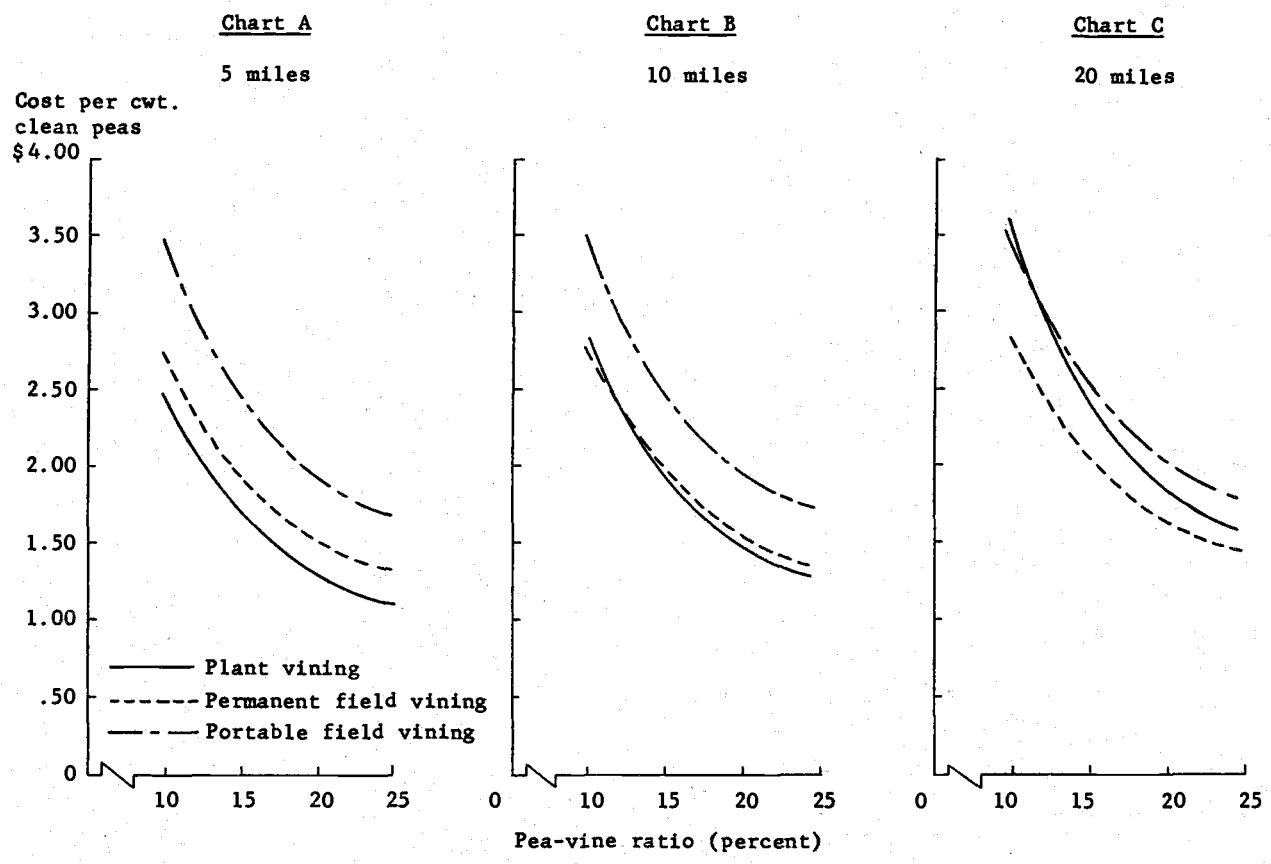
Some research in the area of optimum harvest time

has been made but this could well be supplemented by work of this kind in the Pacific Northwest (13, p. 14). It would be anticipated that this would consist of an analysis indicating maximum grower profit levels for different sets of prices, tenderometer readings, yields, and vining costs.

In the present study an analysis of the effect of the pea-vine ratio on costs is included primarily to show that vining costs are very sensitive to changes in this ratio (Figure 4). With a constant output of clean peas an increase from 10 percent to 20 percent pea-vine ratio almost halves the cost per hundredweight for vining (Table 7). The costs of all phases of vining are affected except those involving the handling of shelled peas.

Growers and processors are well aware of the sensitivity of vining costs to changes in the pea-vine ratio. This is illustrated by their keen interest in new harvesting methods directed toward reducing the weight of the vines to the harvested product. The development work with pea pod pickers and pea combines are examples. Breeding work aimed at producing a strain or variety with better pea-vine ratio characteristics would be in the same direction.

Figure 4. Estimated Cost of Vining Peas by the Three Methods of Vining with Selected Pea-vine Ratios and Distances, 1959./1



/1 Assumes the following:
(a) A 1,000 hour operating season and an hourly output of 20,000 pounds of clean peas.
(b) Distances shown above the charts indicate distance from field vining stations to plant for the field methods and distance from field to plant for plant vining.
(c) Cost includes hauling vines 5 miles to permanent stations and 3 miles to portable stations.

Table 7. Estimated Costs of Vining Peas by Three Methods of Vining with Selected Pea-Vine Ratios, 1959. 1/

Pea-Vine Ratio	Number in crew: Truck Drivers	Number in crew: All Others	Season's Costs: Labor (Excludes Hauling Vines and Vines and Peas)	Season's Costs: Hauling Vines and Shelled Peas	Season's Costs: Equipment and Facilities	Season's Costs: Total Cost	Average Cost per Hundred-weight
Plant Vining							
25	23	48	$ 48,995	$116,840	$ 59,250	$259,085	$1.30
20	28	55	94,270	142,240	69,113	305,623	1.53
15	38	71	121,605	193,040	86,651	401,296	2.01
10	56	100	172,920	284,480	119,158	576,558	2.90
Permanent Field Vining							
25	19	52	89,320	122,755	64,219	276,294	1.38
20	23	59	100,595	143,075	73,904	317,574	1.59
15	29	77	121,615	173,555	98,044	403,214	2.02
10	42	105	179,080	239,595	136,315	554,990	2.77
Portable Field Vining							
25	27	87	144,100	132,915	70,148	347,163	1.74
20	31	99	162,360	153,235	78,155	393,750	1.97
15	38	130	213,125	188,795	105,842	507,762	2.54
10	52	182	295,955	259,915	150,777	706,647	3.53

1/ Assumes the following:
- (a) A 1,000 hour operating season and an hourly output capacity of 20,000 pounds.
- (b) Distance one way:
  - (1) Plant vining - 10 miles to the plant.
  - (2) Permanent field vining - 10 miles to the plant; 5 miles to the field.
  - (3) Portable field vining - 10 miles to the plant; 3 miles to the field.

CHAPTER IV

SUMMARY AND CONCLUSIONS

This study is intended to develop information relating to the comparative costs and efficiencies of three pea vining methods--plant vining, permanent field station, and portable field station vining. The results are intended to be useful as guides toward management decisions that will reduce costs and improve the industry's competitive position in the national market.

In plant vining the peas and vines are hauled directly to a permanent vining station located at the processing plant. In permanent and portable field station methods, peas and vines are hauled from the field to nearby vining stations. The shelled peas are hauled from permanent vining stations in tote bins and from the portable vining stations in lug boxes. As the name of the method implies, the permanent station is permanently located and has some of the advantages of both the portable field and plant vining methods. The portable station is moved from one location to another.

The synthetic method of determining costs is used in this analysis. The use of a synthetic cost analysis

requires that common beginning and ending points be established for the operations being studied. The three methods have a common beginning point in the field where the vine trucks are loaded. Vining as defined in this study ends when the peas pass over the clipper cleaner at the processing plant. Between these points the method differ somewhat in the operations performed. It is the differences in operations that form the basis for cost comparisons of the alternative vining methods.

The synthetic models are based on standards that were determined for labor, equipment and facilities. The standards were determined by work sampling and production studies, interviews with personnel of processing firms, and estimates of equipment manufacturers and dealers. Current prices for fixed and variable inputs are then applied to a multiple of these inputs to arrive at cost figures for a given rate of output.

It was concluded that the distance the peas and vines are hauled from the field to the vining stations is the most important point to be considered when selecting a method of vining. Total vining costs increase on the average of about 0.6 cents per hundredweight of clean peas for each additional mile that

they are hauled. The average increase amounts to 5.6 cents per hundredweight of clean peas per mile for hauling vines and peas from the field to the portable field station and 3.6 cents to the permanent field station and plant. When the peas and vines and the shelled peas are hauled only short distances plant vining is a lower cost method than either permanent or portable field station vining methods. Costs for the permanent station method are lower than for portable station vining at all comparable distances and also lower than plant vining costs at certain distances for hauling shelled peas and peas and vines.

The three different vining methods discussed have significant cost differences outside of the hauling operation. When the latter is excluded plant vining has costs for labor and equipment that are slightly lower per unit of product than for permanent field station vining, but substantially lower than for the portable station method. Labor costs for portable field station vining are higher per hundredweight of clean peas than for either of the other two methods for all levels of output.

The volume of hourly output has an important effect on unit cost with the largest decrease in costs per hundredweight occurring when hourly output capacity is increased from 5,000 to 10,000 pounds of

clean peas per hour. Reductions in cost beyond this point occur at a decreasing rate. These relationships are due primarily to the existence of excess capacity in certain items of equipment and in some labor at the lower levels of output. As output is increased the equipment and labor are used more efficiently.

Increases in hourly output are made possible only by substantial capital investments in equipment and facilities. The investment for the permanent field method is higher than plant vining because of the added investment in the bins used for hauling shelled peas from the vining stations to the processing plant and the bin handling equipment used at both the vining station and processing plant.

Costs per unit of product for all three methods decline as season's length is extended with the largest decrease taking place between 250 and 500 hours, although additional savings are made beyond this point. This results from spreading fixed costs over a larger number of units. As the season's length is increased, costs for the permanent field station method decline more rapidly than for the other methods because its fixed costs constitute a larger proportion of total costs than for the other two methods.

Growers and processors have little control over

the pea-vine ratio. Delaying harvest will tend to increase the ratio of the weight of clean peas to the combined weight of peas and vines, but any benefit from this can be more than offset by reductions in quality and in the price received per unit of product. The analysis of the effect of the pea-vine ratio on costs is included primarily to show that vining costs are very sensitive to changes in this ratio. Because of this sensitivity the industry is extremely alert to changes that would increase the ratio of clean peas to peas and vines in the product being hauled from the field to the vining station or plant. New harvesting equipment designed for this purpose is now being tested.

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APPENDIX TABLES

Table 1. Replacement Cost and Annual Fixed Cost of Equipment Used in the Three Methods of Vining, 1959.

Item	Used in: Plant Vining	Used in: Permanent Field Vining	Used in: Portable Field Vining	Replacement Cost 1/	Years Useful Life	Annual Fixed Cost 2/
Viner (15 hp. electric)	x	x		$6,446	15	$ 848.94
Viner (gas)			x	5,805	15	764.52
Feed regulator	x	x		443	15	58.34
Electric fork assembly	x	x		976	15	128.54
Oscillating conveyor (8)	x	x		3,408	15	448.83
Oscillating conveyor (6)	x	x		2,975	15	391.81
Oscillating conveyor (4)	x	x		1,442	15	189.91
Vine loader	x	x	x	3,000	10	540.00
Wheel tractor (26 hp.)	x	x	x	2,625	10	433.12
Crawler tractor and bulldozer	x	x	x	14,000	10	2,520.00
Scales (truck)	x		x	3,425	15	451.07
Scales (volume)	x			1,500	10	240.00
Clipper cleaner	x	x	x	3,036	15	399.84
Front end tractor loader	x	x	x	750	10	123.75
Tenderometer	x	x	x	1,470	15	193.60
Scavenger reel	x			695	10	114.68
Food pump (4 in.)	x			1,140	10	188.10
Aluminum tubing (200 ft.)	x			499	10	82.23
Shaker grader		x		1,172	15	154.35
Inclined pea conveyor (22 ft.)		x		521	15	68.62
Bucket elevator	x	x	x	1,731	15	227.97
Bin dumper		x		800	15	105.36
Bin washer		x		500	15	65.85
Hand truck			x	50	15	6.58
Lug box dumper			x	500	15	65.85
Lug box washer			x	500	15	65.85
Lug box conveyor			x	2,400	15	316.08

Table 1. (Con't)

Item	Used in			Replacement Cost 1/	Years Useful Life	Annual Fixed Cost 2/
	Plant Vining	Permanent Field Vining	Portable Field Vining			
Pickup truck	x	x	x	1,850	10	305.25
Fork lift (3,000 pounds)		x		5,100	10	940.50
Tote bins (each)		x		113	5	29.94
Lug boxes (100)			x	85	5	23.80

1/ Includes cost f.o.b. site plus installation cost

2/ Calculated as a percent of replacement cost. Depreciation is based on years of life and is calculated by the straight line method. Includes insurance 1 percent, taxes 1 percent, interest 3 percent, which is about 5½ percent of undepreciated balance, fixed repairs 1½ percent except for crawler tractor, lug boxes, and vine loaders 3 percent, and volume scales 1 percent.

Table 2. Consumption and Cost of Fuel for Vining Equipment, 1959.

Vining Equipment	Gallons of Gas Per Hour	Cost (net) per Gallon	Cost per Hour	Cost per 100 hours of use 4/
Viner (gas) 1/	2.5	$0.205	$0.5125	$51.25
Tractor (wheel type)	2.0	0.205	0.41	41.00
Tractor (track type)	3.5 2/	0.159	0.5565	55.65
Pickup truck	.30 3/	0.295	0.885	8.85
Fork lift truck	1.0	0.215	0.215	21.50

1/ Used only for portable field vining.

2/ Refers to diesel fuel.

3/ One gallon for 10 miles, assume pickup runs 3 miles per operating hour.

4/ Round to nearest one cent.

Table 3. Electricity Consumption for Electrically Operated Equipment Used by the Three Methods of Vining, 1959.

	Used in					
	Plant Vining	Permanent Field Vining	Portable Field Vining	Hp. Each	Kw. Hours Required 2/	Cost per 100 Hours 3/
Viner (electric)	x	x		15	10.95	9.53
Electric fork	x	x		.75	0.5475	.48
Oscillating conveyor 1/	x	x		2	1.4600	1.27
Shaker grader		x		1	.7300	.64
Inclined pea conveyor (22 ft.)		x		1.5	1.095	.95
Bucket elevator (20 ft.)		x	x	1	.73	.64
Clipper cleaner	x	x	x	7.5	5.475	.76
Bin dumper		x		7.5	5.475	.76
Tenderometer	x	x	x	.5	.365	.32
Scavenger reel	x			.33	.2409	.21
Food pump	x			3	2.19	1.91
Lug box washer			x	7	.73	.64
Lug box conveyor			x	1.5	1.095	.95
Lug box dumper			x	.5	.365	.32

1/ Oscillating conveyor for 8 viners.

2/ Computed by multiplying hp. x .73 K.W.H.

3/ Computed by multiplying K.W.H. required x $0.0087, rounded to the nearest one cent.

Table 4. Effective Transportation Rates for Clean Shelled Peas, 1959. 1/

Distance in miles	Effective rate per ton 2/
0 to 3	$2.4675
3 to 5	3.1990
5 to 7	3.5070
7 to 9	3.7800
9 to 11	4.1475
11 to 13	4.4310
13 to 15	4.7145
15 to 17	4.9140
17 to 19	5.1870
19 to 21	5.4810
21 to 23	5.7645
23 to 25	6.0375
25 to 27	6.4260
27 to 29	6.6885
29 to 31	7.0770

1/ Based on Oregon Public Utilities Commission rates for transporting shelled peas.

2/ Includes an allowance of 5 percent for foreign matter.

Table 5. Estimated Replacement Cost for Equipment and Facilities for Different Methods of Vining with Different Hourly Rates of Output, 1959. 1/

Hourly output rates	Method of Vining		
	Plant vining	Permanent field vining	Portable field vining
5,000	$102,528	$141,761	$ 80,652
10,000	164,126	176,751	133,857
20,000	298,576	319,836	256,900
30,000	416,176	459,940	379,844

1/ Assumes a 20 percent pea-vine ratio and a 10 mile distance that the shelled peas are transported from the permanent and portable field vining stations to the processing plant and leased trucks.