

# Processing Limas for Freezing

unit costs drop rapidly as percentage of grade-out drops and as total volume and effective utilization of plant increase

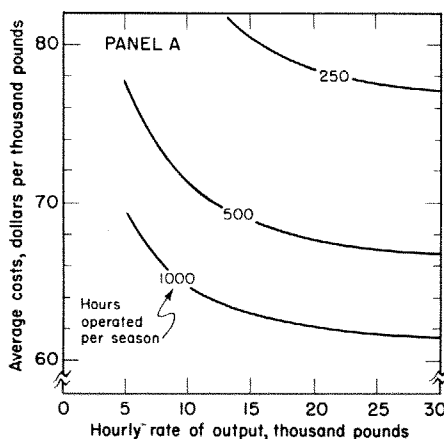
Robert H. Reed

The following article is the sixth in a series of progress reports on efficiency in the processing and marketing of frozen fruits and vegetables. The studies are being conducted cooperatively with the Agricultural Experiment Stations in Washington, Oregon, and Hawaii and the Agricultural Marketing Service, United States Department of Agriculture.

**Costs of processing** frozen lima beans in California freezing plants are primarily related to methods used at particular stages of field and plant operations, the quality of raw product, style of pack, capacity rate of output, and the length of operating season. Capacity output capabilities of the plants included in studies on processing and marketing of frozen fruits and vegetables ranged from around 5,000 to 30,000 pounds per hour of operation. The number of hours operated in these plants varied from about 250 to a maximum of 1,000 hours per season.

Among the principal objectives of the study were the estimation of the relative costs of different methods or techniques used in the various operating stages and the determination of the least-cost combination of techniques for plants of various sizes and lengths of operating season. Field and plant operations were classified into 10 operating stages and four general cost components. The operating stages included vining, viners-to-plant transportation, receiving, initial cleaning and quality grading, blanching and second quality grading, visual inspection and manual quality grading, packaging or filling, variable water costs, casing, freezing and initial storage, and in-plant transportation of cased goods and packaging materials. The general cost components included investment costs of plant buildings, water piping, and electrical wiring; supervision and miscellaneous labor; administrative and office costs; and miscellaneous equipment.

Total annual costs were calculated for each operating stage in relation to methods used, hourly rates of output, and length of operating season. These cost estimates provided the basis for comparing relative costs of different methods of operation and for selection of the most efficient or least-cost organization for each operating stage. Aggregation of costs representing efficient stage organization, along with general cost components not associated with specific



The effect of capacity rate of output—size of plant—and hours of operation per season on average costs per 1,000 pounds of lima beans processed by freezing. Costs based on an average distance of haul—viners to plant—of 10 miles; 70% of the total season volume is packed in retail cartons, 20% in institutional cartons, and 10% in bulk bags or cases; and an average manual grade-out of 5%.

operating stages, gave total annual costs for field and plant processing activities. Estimates of costs developed on this basis are given in the accompanying illustrative panels, which show how average total costs per 1,000 pounds of lima beans vined and packed are affected by such variables as size of plant, hours of operation per season, distance of haul from viners to plant, percentage manual grade-out, and style of container used. The particular values of these variables on which the costs illustrated are based are given in the separate captions identifying each chart. The costs were calculated at the 1958 price level. Prices and wage rates typical for the industry were used in estimating the costs of labor and other variable factors, while annual fixed charges for equipment were computed on the basis of a percentage of the current equipment replacement costs. Selling expenses and raw product costs are not included.

Average total costs per 1,000 pounds of beans decrease with increases in plant capacity and in the number of hours operated per season as well as with reductions in the percentage of manual grade-out—defective and overmature beans—and in the distance of haul from viners to plant. The cost curves in the accompanying charts illustrate this behavior for the operating conditions assumed.

The rate of reduction in total average costs per 1,000 pounds pack-out as the rate of output—size of plant—increases is shown in Panel A. The curves show that average cost drops rapidly—for any given length of season—as size of plant increases. This results from more effective utilization of supervision and other partially fixed labor and equipment costs as plant size increases and the substitution of various cost reducing techniques in the larger plants. Substantially higher costs are indicated in plants of low capacity. Under the operating conditions specified for Panel A, and with an operating season of 500 hours, for example, average total cost for a plant operating at capacity rate of 5,000 pounds per hour is about \$78 per 1,000 pounds, while average cost with a plant operating at 15,000 pounds per hour drops to about \$68 per 1,000 pounds. This effect diminishes quite rapidly, however, and the advantages of increased plant size become relatively small in plants above 20,000-pound-per-hour capacity.

The cost curves in Panel A also demonstrate that average costs decrease as length of season—with a given capacity output rate—is increased and the annual fixed costs of plant and equipment are spread over a larger total volume of output. For example, in a plant of 15,000-pound-per-hour capacity, costs with 250 hours of operation per season average \$80 per 1,000 pounds, but drop to \$69 per 1,000 pounds with 500 hours, and to about \$64 per 1,000 pounds with 1,000 hours of operation per season. Panel A indicates that economies associated with increased hours of operation per season can be relatively large. A substantial portion of such savings can not be realized in some lima bean producing areas because of the short harvest season. Such a situation may be relieved by processing other products maturing in other periods and using the same equipment. Under favorable circumstances with respect to raw product procurement and sales, frozen peas may serve this purpose in many California plants.

Panel B on page 15 shows that viners-to-plant hauling charges have a relatively small effect on average total costs per 1,000 pounds packed for distances up to 100 miles. This is principally because

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ing in the generation and sale of electricity, for example, have averaged only about 10% of their total annual receipts from water sales since 1930. Similarly, large districts—over 75,000 gross acres—also have had a lower than state average percentage of total annual returns from water sales receipts. Small districts, and those providing domestic water service, on the other hand, derived approximately 70% of their total annual income in 1955 from water sales.

The wide ramifications of the payment complex make it reflective of many interests internal to the district. The dis-

trict administration is directly concerned with the pricing impact upon district solvency; the irrigator makes annual water use decisions on the basis of the district toll, a variable cost of water; and the membership at large is concerned with the water management programs of a particular district.

Broad social interests also attach to the pricing practices of districts with respect to the degree they facilitate or obstruct the most productive agricultural practices in California.

Changes in the composition and alignment of internal interests as well as in

the economic context of California agriculture in the past have induced changes in district pricing behavior. Differences in this behavior between large and small districts, between those producing electric power and others, and the secular change in assessed valuation through and subsequent to the depression are examples. The payment complex has been a major instrument for district adaptation to such changes, and hence to their permanence and increasing importance.

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## LIMAS

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cost rates per 1,000 pounds hauled tend to level off as distance from the plant increases. However, some additional costs associated with increases in the length of haul were not specifically evaluated. These include increased costs related to the more elaborate in-field cleaning and icing operations that must be performed as length of haul increases in order to avoid losses in grade yield and recovery.

Panel C shows the effect of the level of manual grade-out percentages on average total costs of processing frozen lima beans. Costs of manual sorting are governed by the quantities of defective and overmature beans that must be manually removed to make a particular grade specification and are largely controlled by the effectiveness of mechanical grading. However, losses in grade yield brought about by improper balancing of mechanical and manual quality grading operations could be substantial.

The proportion of total season volume packed in various size containers has an important effect on average total costs of processing lima beans by freezing.

The average cost curves shown in Panel D illustrate this effect for plants packing various percentages of their total season volume in retail, institutional, and bulk styles. Unit costs per 1,000 pounds packed—for a given capacity rate of output—increase substantially as the proportion of total season volume packed in retail cartons increases, chiefly because of higher costs of retail packaging materials. The heavy lines in Panel D define upper and lower cost ranges as proportions of season volume packed vary from 100% bulk style to 100% retail style.

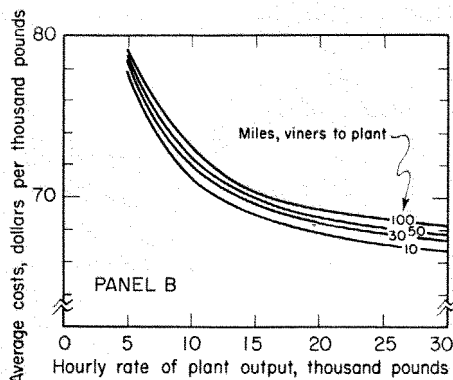
The cost relationships have been based on selected values of the variables affecting costs of frozen lima bean processing. Actual costs in individual plants will be different if other values of the variables are applicable, but the nature of the effects will in general be as represented in the panels.

Although many lima bean freezing plants in California have achieved a relatively high degree of efficiency, the selection of more efficient techniques and movement toward increased hours of operation per season and larger plants could lead to further cost reductions.

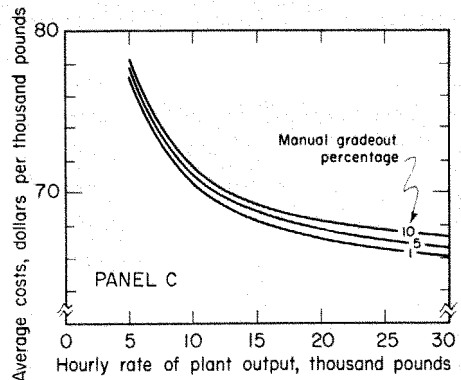
While many of the savings could be achieved in the short run, some of the cost reduction possibilities involve changes in plant and facilities and design which may be economical only as existing facilities are worn out and replaced

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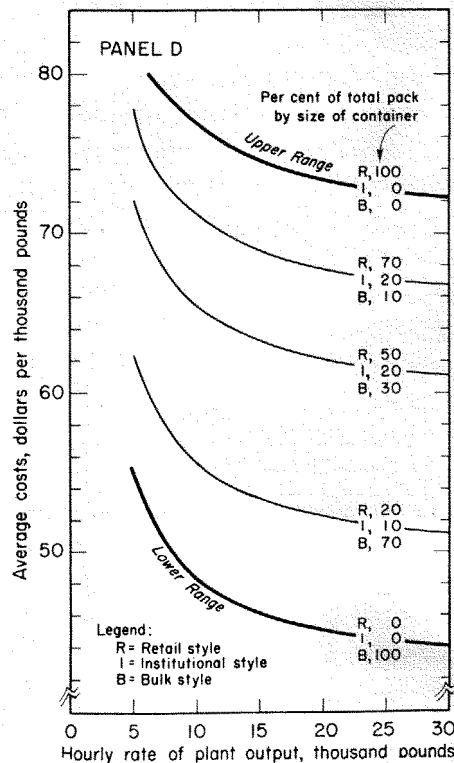
*This brief article is based on a detailed report, "Economic Efficiency in Assembly and Processing Lima Beans for Freezing," which is available without cost from the Giannini Foundation of Agricultural Economics, 207 Giannini Hall, University of California, Berkeley 4.*



The effect of distance of haul—viners to plant—on average total costs in relation to selected lengths of haul and capacity output rates in lima bean freezing plants operating 500 hours per season. Costs based on an average manual grade-out of 5%; 70% of the total season volume is packed in retail cartons, 20% in institutional cartons, and 10% in bulk bags or cases.



The effect on average total costs for 5%, 10%, and 15% levels of manual grade-out in lima bean freezing plants operating 500 hours per season. Costs based on an average distance of haul—viners to plant—of 10 miles; 70% of the total season volume is packed in retail cartons, 20% in institutional cartons, and 10% in bulk bags or cases.



Average total costs of processing lima beans for freezing in plants packing different percentages of their total season volume in retail, institutional and bulk styles for a 500-hour operating season. Costs based on an average distance of haul—viners to plant—of 10 miles; and an average manual grade-out of 5%.