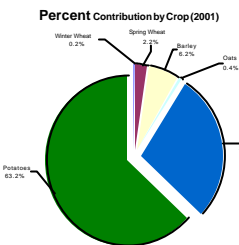


A Warehouse Expansion for Potato Marketing: Real Options Analysis in Colorado's San Luis Valley



Potatoes are a staple vegetable in the American diet accounting for 17% of retail receipts, (ERS, USDA, 1977-2002), with processed potato consumption (66% of total disappearance) increasing at a rate of 5% per annum. Fresh potato consumption remains stagnant at 48 to 50 pounds per capita (Hine, Loureiro, Meyer, 2001). This poor performance is especially problematic for potato cooperatives in Colorado's San Luis Valley. Fresh potatoes significantly contribute to the Valley's gross agricultural receipts generating \$200 million or 63% of total receipts in 2001 (Figure 1).

Figure 1. San Luis Valley Agriculture Receipts



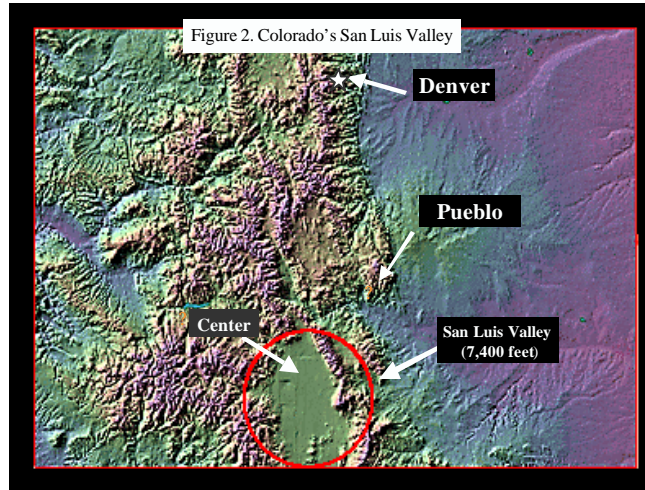
Facing limited demand growth, cooperatives in the Valley seek opportunities to increase net profit margins and members' equity, and one of these opportunities is a warehouse expansion in a Pueblo, CO with concurrent integration into potato trucking. These investments are meant to overcome geographic, transportation and product degradation challenges.

The San Luis Valley (Figure 2) is surrounded by mountain ranges. Rail shipments require six locomotives to negotiate La Veta Pass (9,400 feet) in order to reach the primary railhead in Pueblo, Colorado. Semi-tractor trucks must also negotiate La Veta Pass, and potato cooperatives do not own trucks with which to ship potatoes. Commercial shipments are made on a backhaul basis alone, and few back haul trucking opportunities exist.

Because of these difficulties, San Luis Valley potato cooperatives believe that they miss opportunities to fill buyers' inventory needs during the marketing year, and growers also believe that potato sales to these buyers would increase if the lead-time for orders were reduced. Furthermore, because it is difficult to forecast when potato resellers will ask for shipments, and potatoes must be shipped through difficult conditions, significant degradation of the potato product can occur. An additional warehouse/processing facility, located closer to potato resellers, will allow the cooperative to better meet customer needs, and decrease potato losses due to degradation. The question, then, is how much would sales have to expand or the potato defect rate drop in order to make the investment feasible.

The purpose of this study is to examine the feasibility of locating a 400,000 cwt. warehouse in Pueblo, Colorado for storing and processing potatoes. More specifically, the study seeks to answer the following research questions:

- Should the cooperative immediately invest in the warehouse or is a "wait and see" strategy more appropriate?
- How sensitive is the investment strategy to the new facility cannibalizing sales from the old warehouse facility?



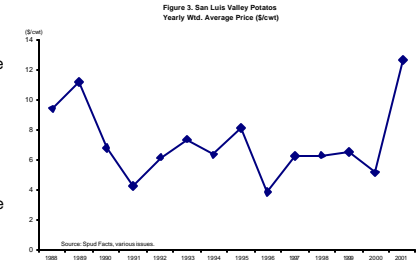
Aerial View of the San Luis Valley
Source: CSU San Luis Valley Research Station



Cities and Roads in the San Luis Valley
Warehouses located in Monte Vista, Hooper, Center, Del Norte, Blanca, and Alamosa.

A warehouse investment is not without risk. Initial capital is nearly \$1 million when packaging machinery is included. In addition, fresh potato prices tend to be volatile with as much as 111% change in the marketing year average price from one year to the next (Figure 3).

Finally, additional sales from new warehouse facilities may actually come at the expense of existing sales, and thus cannibalize the cooperative's market share. Appropriate assessment of the investment opportunity should include a means of characterizing volatility, the size of the investment, the potential for sales cannibalization and the flexibility to abandon the investment if deemed appropriate.



A real options methodology is used to meet these objectives. A contribution of the study is demonstrating how real options may be used to address agribusiness marketing ad investment problems, which has received limited attention in the agribusiness literature.

Why real options? The cooperative is facing a capital budgeting problem implying present value analysis (NPV) or real options analysis (RO). A difference between RO and NPV is how uncertainty is modeled and the degree to which managerial flexibility is considered. RO analysis treats underlying processes (such as the price or revenue generating processes) as stochastic so that revenue volatility may change during the project's duration. RO allows quantitative assessment of flexible expansion investments under conditions of varying risk. Given potato price volatility and managerial flexibility, RO analysis is appropriate for the warehouse investment problem.

When modeling the real option of warehouse expansion, it is assumed that historical price volatility is representative of future price volatility. The warehouse is located in Pueblo, CO and is near a primary railhead and two interstate highways. The warehouse can pack and process 400,000 cwt of potatoes a year, and capital investment costs are \$990,000. Sensitivity analysis will examine how much sales must expand to encourage investment over a wait-and-see strategy. Table 1 presents the results of the sensitivity analysis, while Figure shows the option value of the investment within a binomial lattice.

Given the current assumptions surrounding discount rates, volatility, revenues and operating costs, and implementation costs, it would seem that in order to execute now, the SLV needs to be able to earn \$1,386,000 (Table 1's Trigger Value). Any amount less than that would necessitate a waiting period for which the option would continue to have value.

Risks are associated with any capital expansion, but even taking into account the extreme volatility of the potato market, we would recommend that the SLV producers think hard about expanding their current distribution market by adding another warehouse.

Figure 4 Option Value Binomial Lattice

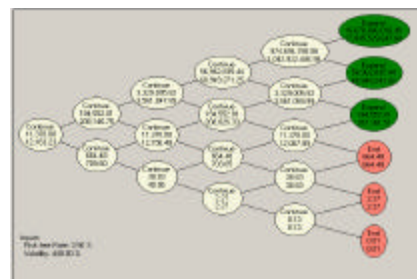


Table 1 Profit, Trigger Investment Level, Net Present Values at Various Sales Increase Levels

Increase In Sales	100%	90%	80%	70%	60%	50%	45%	40%
Profit	\$9,862,000	\$8,421,000	\$6,979,000	\$5,537,000	\$4,095,000	\$2,654,000	\$1,300,000	\$1,212,000
Trigger	\$1,386,000	\$1,386,000	\$1,386,000	\$1,386,000	\$1,386,000	\$1,386,000	\$1,386,000	\$1,386,000
NPV	\$8,272,200	\$6,928,620	\$5,584,110	\$4,239,590	\$2,895,080	\$1,551,500	1,300,000	\$206,990
Strategy	Execute 0 yr	Execute 0 yr	Execute 0 yr	Execute 0 yr	Execute 0 yr	Execute 0 yr	Execute 7 years	Delay > 7 years