ESTIMATING COST OF POTATO PRODUCTION IN IDAHO

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COSTS AND RETURNS ESTIMATES

Many parties, including producers, processors, politicians and consumers have an interest in how much it costs to produce agricultural commodities and whether or not a profitable return is achieved. Commodity costs and returns estimates (CARs) are used to characterize the economic performance of a single commodity for an individual, a region, or even a nation. However, the intended use of a CAR estimate will influence how the costs and revenues are calculated and organized. Availability and accessibility of data can also influence the process. A direct comparison of CAR estimates is appropriate only when they are prepared following similar procedures. To minimize the chance of misinterpretation, the procedures and assumptions used in developing the CAR estimate should be clearly stated, along with the intended use.

CAR estimates can be constructed using either historic or projected cost data. The scope of the CAR estimate can be narrow and represent an individual grower, for example, or it can be a composite that represents the costs for a region, state or nation. The cost data can be from actual farm records, or it can be synthesized or "generated" for a model farm using a standard set of assumptions and procedures. Growers with an interest in calculating cost of production estimates need to develop their record keeping system with this use in mind.

ENTERPRISE BUDGETS

Budgeting is a systematic approach to organizing revenue and cost data used in comparing and analyzing alternatives and in making management decisions. Budgets provide revenue and cost estimates or projections and they should be an integral part of any planning process. An enterprise budget format is generally used for cost of production estimates. An enterprise is any coherent portion of a farm business that can be separated and analyzed as a distinct entity. Traditionally, each crop is treated as a separate enterprise. Different enterprise designations can be made, however. Each field or pivot for example could be treated as a separate enterprise. The record system for the farm would have to be organized with this in mind, however, so that the account structure would support the enterprise structure. The enterprise budget tracks one production cycle – usually a 12-month period – and lists all expected revenue and costs. The enterprise budget can also include the quantity, time of use and cost of each input used, along with the expected yield and price.

IDAHO'S COSTS AND RETURNS ESTIMATES

The University of Idaho's crop CAR estimates are revised and published on a biennial basis in odd-numbered years. We use a computer program, *Budget Planner*, to generate the individual crop CAR estimates. Crop CAR estimates are developed for four distinct geographic regions of the state. Climate and soil conditions not only influence which crops are produced in each region, but also influence the crop specific production practices for the regions. Even within a region

Presented at the University of Idaho Potato Conference on January 23-24, 2002.

where production practices are similar, costs can and do vary from farm to farm. Each farm has a unique set of resources with different levels of productivity, different pest problems and different management skills. While the CAR estimates developed by the University serve as useful benchmarks, they represent only a single point estimate that can't possibly capture the inherent variability that exists in production costs. The University of Idaho potato production cost estimates are representative or typical for a region. They are NOT, however, the average cost of producing potatoes.

The University of Idaho cost of production estimates are affected by the assumptions made in depicting a representative farm for a region. Each region has a model farm (or farms), with assumptions about farm size, crop rotation, typical production practices, equipment used, and irrigation system. *Budget Planner* calculates machinery costs and labor requirements using standard engineering equations developed by the American Society of Agricultural Engineers.

The potato production costs published by the University of Idaho are based on survey data collected from Idaho farmers, farm supply businesses, and Extension faculty, as well as private consultants and industry representatives. Information on tillage, planting, fertilization, pest control, irrigation and harvesting is collected from growers. In addition to the type of machinery and the number of workers used to perform field or custom operations, the type and quantity of inputs used is also collected. Survey information is used to construct a model farm and to develop typical production practices that are replicated by the computer program to generate costs on a per acre basis.

The University of Idaho currently produces eleven potato budgets (Table 1). A sample budget for eastern Idaho is shown in Tables 2 and 3. Some potato budgets include the cost of on-farm storage and/or fumigation, while others do not. Copies of potato and other crop costs and returns estimates are available from local county Extension offices. They are also available on the Internet at the Agricultural Economics and Rural Sociology Department's homepage: http://www.ag.uidaho.edu/aers/ (click on publications).

BUDGET PROCEDURES AND ASSUMPTIONS

Historical input prices are used to generate the University of Idaho's costs and returns estimates. Input prices come from surveys of farm supply businesses collected in the year when the CAR estimates are revised. The Background and Assumptions page describes the model farm's size, irrigation system, water source, crop rotation, and the tillage, fertilization, pest management and irrigation practices. If the CAR estimate includes on-farm storage, the length of storage and the type of storage facility are described. The machinery, labor, land and capital resources used in the production of the crop are also described. This information is critical to understanding how the costs are generated, and the uses and limitations of these cost estimates.

The yield in a CAR estimate is used to calculate gross revenue. It can also be used to calculate breakeven prices needed to cover various costs. Yield is also the basis for some costs, such as promotion and inspection fees paid by growers, as well as storage costs. The yields used in most crop budgets are 5-year rolling averages based on historical Idaho Agricultural Statistics Service (IASS) data. Potato yields are calculated using exponential smoothing applied to county-level or regional potato yield data from IASS. The steep year-to-year increase in potato yields means that a yield based on a 5-year rolling average has a negative bias. Exponential smoothing reduces this bias.

A microcomputer program (Budget Planner from the University of California at Davis) is used to calculate the cost estimates. The computer program replicates each field operation using tractors and equipment typical of that used by producers. The cost to own and operate machinery is computed by the program and summarized for the model farm.

Model Farm

The costs and returns estimate presented in Tables 2 and 3 are typical for growing and storing irrigated Russet Burbank commercial potatoes for a 3-county area of eastern Idaho, including Bannock, Bingham and Power counties. A 1,500-acre model farm grows 500 acres of potatoes, using a typical three-year rotation of potatoes followed by two years of grain. The farm uses a center pivot irrigation system, pumping surface water from a canal so that irrigation power includes only the cost to pressurize the water. The farm is located in an irrigation district where a flat fee per acre is paid for water.

After the stubble from the preceding grain crop is chopped, the potato ground is irrigated, disked twice and ripped in the fall, then chisel-plowed and marked-out in the spring prior to planting. Potatoes are planted in early May using a 6-row planter with a 36-inch row spacing. The seeding rate is 20 hundredweight (cwt) with an additional 5 percent (1 cwt) added to account for waste during cutting and planting. Potatoes are cultivated and hilled in late May and cultivated again in June with a basin tillage tool. In September, vines are rolled and removed mechanically. Potato harvest begins three weeks later using a 2-row harvester, 4-row windrower and five 10-wheeler trucks. Potatoes are hauled directly to on-farm storage. Potatoes are stored for five months in a modern, above ground storage facility with air and humidification. In addition to labor, electricity and sprout inhibitor, the storage operating cost includes a charge for shrink and an interest based on the value of the stored crop.

Most fertilizer is custom applied in a split preplant application, fall and spring. A starter fertilizer is applied at row mark-out and additional nitrogen is applied as needed through the irrigation system. The weed control program uses cultural, mechanical (tillage and cultivation) and herbicidal control methods. For insect control, a systemic insecticide is banded at planting and a contact insecticide is applied by air in July. Three fungicide applications are made for blight control, starting in July. The first application is made by a custom ground applicator. The two remaining fungicides applications are custom applied by air. Potatoes receive 20.5 inches of water during the growing season and 1.0 inch preharvest in September. Water applied to the grain stubble prior to tillage is also credited to potatoes, bringing the total to 23 inches.

ENTERPRSE BUDGET STRUCTURE

The CAR estimates produced by the University of Idaho are based on economic costs, not accounting costs. Accounting costs typically include only out-of-pocket costs and ignore opportunity costs. Economic costs place a market value on all inputs, regardless of whether they are purchased (an out-of-pocket expense) or provided by the producer (a foregone opportunity). For resources supplied by the farmer, such as land or labor, there is foregone income, or an "opportunity cost." For example, owned land could be leased to someone else and the farmer could be working for wages.

Costs in an enterprise budget are classified as either operating (variable) or ownership (fixed). Operating costs are those incurred only when production takes place and they are typically used up or transformed during the production cycle. Seed, fertilizer, fuel, pesticides, hired labor and

water are all operating costs. With the exception of labor and machinery costs, it is relatively easy to assign operating costs to a particular crop enterprise. It is also fairly easy for a grower to modify the operating costs in a published CAR estimate to match those on his/her farm.

In contrast to operating costs, ownership costs are associated with assets used in the production process that last for more than one production cycle. Many of these costs will continue even when production doesn't take place, hence the term "fixed cost". Ownership costs include the DIRTI-five: depreciation, interest, repairs that are a function of time and not of use, taxes and insurance. The assets generating fixed costs include machinery, buildings and land. In addition to lasting more than one production cycle, these assets are typically used on more than one enterprise. There are a number of different procedures that can be used in allocating these costs over time and between different enterprises (crops) on the farm.

Operating Costs

The CAR estimates published by the University of Idaho lists all inputs used in the production process. This makes it easier for users to modify these costs estimates to fit their situation and it also makes it easier to update and revise the cost estimates. The individual inputs are listed along with the quantity applied and the cost per unit of input and per acre.

Similar inputs are grouped together under a common heading. These headings include fertilizers, pesticides, seed, irrigation costs and custom operations. The quantity applied per acre, the unit of measure, and the cost per unit of the input is also listed. Multiplying the quantity applied by the price per unit gives the cost per acre. This is a fairly straightforward process for most operating inputs, especially purchased inputs. The total quantity of product listed may represent one application, as with the 2.0 quarts of Eptam 7E, or multiple applications, as with Dithane where there are two applications of 1.6 quarts each.

Irrigation water for the model farm is delivered through a canal with a fixed water assessment fee charged per acre. Since the model farm uses surface water, the $.99 per acre-inch power charge is only for pressurization and the pivot is a low-pressure system.

Irrigation costs are calculated using information from University of Idaho irrigation cost publications. Irrigation power costs are calculated using Idaho Power rates and the 160-acre center pivot with a corner system described in Bulletin 787. The energy charge used in 2001 was $.041831, the demand charge was $3.58 and the monthly meter charge was $10.07. Season-long irrigation power costs and repairs are calculated for the entire field and then converted to an acre-inch basis. The 23 inches of water is the total application including evapotranspiration. The center pivot irrigation system application efficiency is assumed to be 80 percent. The pumping plant efficiency (electric motor and pump) – used to calculate Kilowatt-hours – is 62 percent.

Some of the abbreviations can be confusing. The 10G designation on the custom aerial application, for example, is for the 10-gallon application rate charged by an aerial applicator. The 10-gallon rate is often used for fungicide applications, while a 3-gallon rate (3G) is charged for applying most insecticides.

The "other" cost category contains three items: crop insurance, promotion fees and dues, and storage operating costs. Crop insurance is self-explanatory. Promotion fees and dues includes the grower's share (60 percent) of the 9 cent per hundredweight advertising tax assessed by the Idaho Potato Commission, the promotion tax paid to the National Potato Promotion Board (1.5 cents per hundredweight), one-half the dockside inspection fee (5.0 cents) and membership dues

in grower organizations. This works out to approximately $.13 per hundredweight. Storage operating costs of $.49 per hundredweight are based on an assumed five-months storage period. Operating costs include shrink, interest, insurance, power, chemicals and labor. Potatoes are assigned a base value of $4 per hundredweight in order to calculate shrink and interest costs. This can be viewed as either the value of inputs in the crop or the value of the crop if sold rather than stored at harvest. Interest is calculated using the rate charged on the operating line of credit. The cumulative shrink for five months is 4.4 percent. Insurance for five months is calculated at an annual rate of 1.5 percent. Power costs are based on calculated kilowatt-hours at a charge of 5.5 cents per kWh. Power for lights and other electric motors used to unload and pile the potatoes is also included. Chemicals include $350 spent to sanitize equipment and the storage facility, as well as a sprout inhibitor valued at 7.5 cents per hundredweight. Labor hours are based on five workers working 10.5 hours per day for 15 days. Four workers' time is valued using the other labor rate, while one worker's time is valued using the machine labor rate.

All the items listed below the "Other" category, except interest, are either for labor or for machinery operating costs. Unlike growers who typically don't track labor to individual crops, the simulation approach used by the computer program calculates and accumulates machinery hours associated with each field operation based on the equipment's width, speed, and field efficiency. Machine labor is calculated for all tractors, trucks and self-propelled equipment. A market value is attached to all labor. No distinction is made between hired labor and unpaid family labor. The non-machine labor is the category name given by the program for the less skilled workers used during planting and harvesting who do not operate machinery. The hourly labor charge includes a base wage plus a percentage for Social Security, Medicare, unemployment insurance, transportation and other expenses. The overhead charge applied to the base wage used by the University of Idaho amounts to 15 percent for non-machine labor, 25 percent for irrigation labor and 30 percent for machine labor.

Machinery operating costs include fuel (gas and diesel), lube and machinery repairs. These values are calculated by the computer program using equations derived by the American Society of Agricultural Engineers. Most producers accumulate fuel and repair costs for the entire farm. The allocation of these whole farm expenses to specific crops can be made using a number of allocation schemes. Growers should use or develop a scheme that is both simple and reasonably accurate.

The last item listed is interest on operating capital. Producers use a combination of their own money and borrowed money and would only pay interest on what they borrow. But since the University of Idaho's cost estimates are based on economic costs, no distinction is made as to the source of the capital. A market rate of interest is charged against all expenditures from the month the input is used until the harvest month. Not all the interest on operating capital is listed in this last category. In the potato budgets with storage costs, an opportunity cost is calculated on the value of the potatoes for the five months of storage as discussed previously.

Ownership Costs

Ownership costs, as stated earlier, are associated with assets that can be used for more than one production cycle. These include machinery, buildings and land. Ownership costs are further divided into cash and non-cash costs. This section will explain how ownership costs are calculated in the University of Idaho CAR estimates.

Ownership costs are based on the assumed values of the machinery and equipment. While not shown in this section, the published CAR estimates contain a table listing all the equipment used

in producing that crop. The current replacement cost (or value) of all equipment is also included. The standard practice in the University of Idaho CAR estimates is to calculate ownership costs based on 75 percent of the replacement cost new.

A distinction should be made between tax depreciation and management depreciation when discussing ownership costs. Depreciation is a measure of the reduction in value of an asset over time. For tax purposes, depreciation is spread over the tax life of an asset as defined by the Internal Revenue Service. Management depreciation, in contrast, spreads depreciation over the expected useful life. The tax life of most farm equipment is currently defined as seven years. The useful life could be 10 to 20 years. Management depreciation should be used in constructing enterprise budgets. For growers, this means keeping two sets of depreciation records.

An interest charge based on the value of the equipment should also be calculated. It makes no difference whether the money is borrowed or supplied by the grower. In the first instance, the interest charge would be an actual cash expense. In the second, the interest calculation is a non-cash opportunity cost. The money could have been invested elsewhere, so the cost to the grower is the foregone income from this alternative investment.

The Budget Planner software used by the University of Idaho uses the capital recovery method to calculate the depreciation and interest on machinery. The total for all equipment used in potato production is listed as Equipment under the Non-Cash Ownership Costs (Depreciation and Interest). Depreciation and interest for the potato storage facility and potato storage equipment are listed separately, but in the same category. Since the Budget Planner software calculates cost on a field operation basis, storage costs are calculated outside the program.

Taxes and insurance are the other two ownership costs. In the University of Idaho costs and returns estimates, these are based on the average level of investment. The average level of investment is calculated by dividing the sum of the purchase price and the salvage value by two. Idaho eliminated property taxes on farm equipment in 2001, so there is no property tax shown in the CAR estimate. The annual insurance cost for each piece of equipment is calculated and then allocated to the appropriate crops based on the percentage of use.

For equipment that is used 100 percent on potatoes, all the ownership costs are assigned to potatoes. But certain equipment, such as tractors and trucks, are used in producing other crops as well. The ownership costs for this equipment needs to be allocated to the different enterprises in proportion to their use. This means that the ownership costs will not be simply divided by the total farm acres. For example, while the farm may have twice as many acres of grain as potatoes, the potato crop may account for half the ownership costs for trucks and tractors based on use.

Unlike other capital assets, land is not a depreciable asset according to the Internal Revenue Service. But the money invested in land, could be invested elsewhere. To avoid the issue of whether land is owned or leased and to be consistent with calculating economic costs, the land cost in University of Idaho crop budgets is a one-year cash rent that includes an irrigation system. Repair costs for the irrigation system are classified as an operating cost under the Irrigation heading.

Two costs not related to land or equipment also show up as ownership costs. The first is general overhead. This is calculated at 2.5 percent of cash expenses and serves as a proxy for general farm expenses that are not typically assigned to a specific enterprise. This includes such things as legal fees, accounting and tax preparation fees, office expenses and general farm utilities. The second non-land and non-equipment expense is the management fee. This is an opportunity cost

and it is a residual in many costs and returns estimates. Because we choose to include a management fee as an economic expense, all costs are accounted for except a return to risk. The management fee is calculated as 5 percent of gross returns.

SUMMARY

Cost of production is influenced by all factors that determine the productivity of land, the type of resources committed to the production process and the alternative uses of these resources. There is no single cost of potato production that fits all Idaho growers or even growers in one region. Table 4 provides a summary of the operating and ownership costs for all the potato costs and returns estimates available from the University of Idaho. The range in per acre values is considerable. This should encourage each grower to calculate his/her production costs so that they know exactly where they stand.

Table 1. 2001 Idaho potato costs and returns estimates by region.

Region	Variety	Farm Size (acres)	Potatoes (acres)	Storage	Fumigation
Commercial					
Southwestern:					
	Russet Burbank	1,000	250	No	Yes
	Shepody	1,000	250	No	Yes
Southcentral:					
	Russet Burbank	1,500	375	No	No
	Russet Burbank	1,500	375	Yes	No
	Russet Burbank	1,500	375	Yes	Yes
Eastern: South Counties					
	Russet Burbank	1,500	500	No	No
	Russet Burbank	1,500	500	Yes	No
	Russet Burbank	1,500	500	Yes	Yes
	Chipping	1,500	500	Yes	No
Eastern: North Counties					
	Russet Burbank	1,500	500	Yes	No
Seed					
Eastern: Seed Counties					
	G3 Russet Burbank	1,350	350	Yes	No

Table 2. Gross revenue and operating costs for 2001 eastern Idaho south district Russet Burbank commercial potatoes costs and returns estimate: On-farm storage

	Quantity per Acre	Unit	Price or Cost per Unit	Value or Cost per Acre
Gross Returns	345	cwt	$4.45	$1,535.25
Operating Costs				
Seed:				
G-3 Potato Seed	21	cwt	$7.25	$152.25
Seed Cut & Treat	21	cwt	$1.50	$ 31.50
Fertilizer:				
Nitrogen – Pre-plant	145	lb	$0.33	$ 47.85
P2O5	215	lb	$0.20	$ 43.00
K2O	175	lb	$0.17	$ 29.75
Sulfur – Pre-plant	85	lb	$0.10	$ 8.50
Nitrogen – Post-plant	120	lb	$0.36	$ 43.20
Liquid Nitrogen	20	lb	$0.36	$ 7.20
Micronutrients	1.0	acre	$16.00	$ 16.00
Pesticides:				
Thimet 20G	15.0	lb	$2.50	$ 37.50
Sencor DF	0.75	lb	$20.90	$ 15.68
Eptam 7E	2.0	lb	$8.85	$ 17.70
Bravo Ultrex	1.25	lb	$ 7.40	$ 9.25
Dithane F45	3.20	qt	$ 3.55	$ 11.36
Monitor 4E	0.75	qt	$23.45	$ 17.59
Irrigation:				
Irrigation Power – CP	23.0	acin	$ 0.99	$ 22.77
Irrigation Labor	2.08	hr	$ 7.80	$ 16.22
Irrigation Repairs – CP	23.0	acin	$ 0.57	$ 13.11
Water Assessment	1.0	ac	$ 9.40	$ 10.30
Custom:				
Custom Fertilize	2.0	ac	$ 4.50	$ 9.00
Consultant	1.0	ac	$14.50	$ 14.50
Custom Ground Spray	1.0	ac	$ 5.50	$ 5.50
Custom Air Spray - 10G	2.0	ac	$ 6.75	$ 13.50
Other:				
Crop Insurance	1.0	ac	$30.00	$ 30.00
Promotion Fees & Dues	345	cwt	$ 0.13	$ 44.85
Storage Operating Costs	345	cwt	$ 0.49	$169.05
Labor (machine)	6.98	hrs	$ 11.70	$ 81.67
Labor (non-machine)	2.34	hrs	$ 6.90	$ 16.15
Fuel – Gas	3.20	gal	$ 1.51	$ 4.83
Fuel – Diesel	31.44	gal	$ 1.07	$ 33.64
Lube				$ 5.77
Machinery Repair				$ 35.71
Interest on Operating Capital				$ 24.85
Total Operating Cost per Acre				$1,039.76
Operating Cost per Cwt	(Based on 345 cwt)			$3.01

Table 3. Ownership costs for 2001 eastern Idaho south district Russet Burbank commercial potatoes costs and returns estimate: On-farm storage

	Value or Cost per Acre
Ownership Costs	
Cash Ownership Costs:	
General Overhead	$ 34.75
Management Fee	$ 76.76
Land Rent	$ 260.00
Property Insurance	$ 6.48
Investment Repairs	$ 10.80
Total Cash Ownership Costs	$ 388.79
Non-Cash Ownership Costs (Depreciation and Interest)	
Commercial Potato Storage Facility	$ 59.82
Commercial Potato Storage Equipment	$ 48.86
Equipment	$ 141.18
Total Non-Cash Ownership Costs	$ 249.85
Total Costs Per Acre	$ 1,678.40
Returns to Risk	- $ 143.15
Total Costs per Hundredweight	$ 4.86
(Based on 345 cwt)	

Table 4. 2001 Idaho potato costs and returns summary by region.

CAR Estimate	Operating Cost		Ownership Costs		Total Cost	
	Acre	Cwt	Acre	Cwt	Acre	Cwt
Southwestern Idaho:						
Russet Burbank: No Storage & Fumigation	$1,318	$2.58	$774	$1.52	$2,092	$4.10
Shepody: No Storage & Fumigation	$1,361	$2.81	$770	$1.59	$2,131	$4.39
Southcentral Idaho:						
Russet Burbank: No Storage	$1,035	$2.65	$563	$1.44	$1,598	$4.10
Russet Burbank: Storage	$1,209	$3.10	$707	$1.81	$1,916	$4.91
Russet Burbank: Storage & Fumigation	$1,430	$3.25	$728	$1.66	$2,159	$4.91
Eastern Idaho: South						
Russet Burbank: No Storage	$ 884	$2.56	$521	$1.51	$1,405	$4.07
Russet Burbank: Storage	$1,040	$3.01	$639	$1.85	$1,678	$4.86
Russet Burbank: Storage & Fumigation	$1,228	$3.19	$652	$1.69	$1,880	$4.88
Chipping: Storage	$1,128	$3.37	$651	$1.94	$1,779	$5.31
Eastern Idaho: North						
Russet Burbank: Storage	$ 951	$3.07	$548	$1.77	$1,499	$4.83
Russet Burbank G3 Seed	$1,018	$4.07	$557	$2.23	$1,575	$6.30