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Introduction to Irrigation Costs and Returns

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Introduction

Variability in crop yield due to weather events can impact profitability. The use of irrigation for agricultural crops has different implications depending on the amount of rainfall needed by the crop and the average annual rainfall of the location. In temperate regions like Maine, where in some years there is enough rainfall to meet crop needs, the analysis of the costs and benefits depends upon usage since it is used to supplement crop needs when rainfall is insufficient. The range of use for supplemental irrigation can be from "not at all" in wet years, to "frequently" in dry years and, as such, the economic costs and returns of an irrigation system are highly variable from year to year.

Annual irrigation costs are uncertain due to the unpredictability of rainfall and the demand for irrigation water. This source of uncertainty largely determines the annual cost of irrigation. During the production season, annual operating costs will accumulate depending upon the labor intensity of the system, the number of irrigation sets per season, fuel and oil requirements, maintenance, as well as financing charges. One of the most important problems facing decision makers is the ordering of alternative investment decisions with different risky outcomes in order to determine which option most reduces operator exposure to production risk.

This section describes costs and returns to irrigation systems, summarizing the findings in two studies on irrigation in Maine. One was conducted for wild blueberries and a second for potatoes grown in Aroostook county.

To derive estimates of cost and returns to irrigation systems, a three-step procedure should be used. First, a prototypical enterprise budget needs to be developed to capture the economic costs associated with irrigation. Second, variable weather and economic factors associated with irrigation investment and annual usage need to be identified. Third, after identifying the elements affecting revenues and costs, the budgets must be repeated with varying the rainfall amounts and subsequent number of irrigations necessary per season.

To quantify the tradeoffs between initial investment and annual operating expense, different irrigation systems must be evaluated. For potatoes, moveable large gun systems, hose reel traveler systems, and center pivot systems are practical systems to evaluate, while a handline moveable large gun system, a large gun attached to a hose reel system, a handline moveable small sprinkler system, and a permanent set small sprinkler system are the most feasible alternatives for wild blueberries. Costs for each system are demonstrated in this chapter for three field sizes. The investment costs of each system are first calculated. These costs are then depreciated over the life of the system. Second, the annual operating costs are calculated at different levels of usage. The approach used to calculate the costs was the same for both crops. The findings for the two crops are presented in separate sections.

Wild Blueberry Irrigation

In this analysis, each field is assumed to be equally divided between fruit-bearing and non-bearing plants. All systems were designed to minimize rainfall risk on both the fruiting and non-fruiting sides of the field. Due to limited water-holding capacity of many soils in the blueberry-growing region, systems were designed to apply 2/3" of water, twice a week to ensure that the field would receive 1" of water per week net of application losses. In a worst case scenario, this is equivalent to having the capacity to water the entire field to ensure bud formation on the vegetative half and berry filling on the fruiting half during one week. The base models assume that 12 of these applications will occur on fruit-bearing land (effectively 6" of water per season) and four on non-bearing land (2" of water per season).

Table 1. Irrigation system characteristics

Irrigation System	Investment Capital Requirement	Frost Protection	Management Input	Labor Requirements	Expandable
Handline Moveable Large Gun	Low	No	Moderate to High	High	Yes [1]
Hose Reel Large Gun	Low	No	Low	Low	Yes [1]
Handline Small Sprinkler	Medium	Limited	Moderate to High	High	Yes [1]
Permanent Set Small Sprinkler	High	Yes	Low	Low	N/A[2]

NOTES:
[1]Limited by pump capacity.
[2]The systems are designed to cover the entire field so expansion is not considered.

Only the permanent set, small sprinkler system can provide complete field protection against frost. The handline small sprinkler system can provide limited protection depending upon how much area can be covered by the equipment. If frost damage is the primary concern of the operator, then only these systems can effectively reduce yield loss due to frost damage.

Cost Analysis Assumptions

All irrigation systems were assumed to be located on level, rectangular fields. The 25-acre field measures approximately 1200’ (length) by 900’ (width), the 50-acre, 2400' by 900,' and the 100-acre, 2400' by 1800.' Water is pumped from a farm pond located 100’ from the irrigated field and all systems are assumed to have the same cost to develop the water source: $15,000. The power unit, sized to meet system peak capacity, and pump are located at the site of the pond. Water is pumped by a diesel power unit from the pond through the main line to the lateral delivery lines and subsequently to the delivery systems.

Ownership Expenses

Total investment costs represent the approximate cost to establish the four different systems described earlier, including water source development, diesel engine, pump, mainline and lateral delivery lines, sprinkler system, and installation labor. These costs were derived from interviews with irrigation equipment dealers conducted during 2001. Sales tax is not added to the total cost under the assumption that the grower holds a commercial agricultural production sales tax exemption certificate.

Total investment costs for irrigation system establishment ($/field)

Irrigation Systems	25 Acres	50 Acres	100 Acres
Handline Moveable Large Gun	$41,000	$ 56,780	$ 80,760
Hose Reel Large Gun	$39,900	$ 53,759	$ 54,630
Handline Small Sprinkler	$45,038	$ 61,615	$ 93,315
Permanent Set Small Sprinkler	$63,564	$103,329	$185,750

Source: Authors’ calculation from model results

Operating Expenses

Operating costs to run and maintain the irrigation systems are calculated in a partial budget format; that is, only costs associated with the operation of the irrigation system are captured. Each of these models assumes that there will be 12 irrigations per season on the land producing fruit and four upon non-bearing acreage. There are four primary components of the operating cost budgets: labor, power, maintenance, and interest charges.

Labor costs accumulate from two different sources: initial set up and end-of-season take-down of the system and variable labor usage per irrigation, excluding managerial time. These per acre coefficients are applied uniformly across the three different acreage examples. A $9.40 hourly wage rate is applied in the calculations. This wage rate is based upon the 2001 Adverse Effect Wage Rate of $8.17 and inflated by 15% to account for meals and other benefits entitled to immigrant workers. Since managerial labor is not included in the calculation, a constant cost-per-acre labor charge is calculated for the four different systems.

Power costs are calculated by determining the number of hours that the pumping unit will operate in order to apply 8" of water on bearing land and 2-2/3" on non-bearing growth. Total pumping time is inflated by 10% to account for flushing, system testing, and mistakes. Total pumping time is then multiplied by hourly fuel-consumption rates of the different diesel motors and then by the per gallon price of diesel fuel ($1.25). This diesel price is based upon sales-tax-free prices from summer 2001. Average fuel costs decline as acreage increases, reflecting economies of size in motor pumping.

Maintenance and upkeep charges are calculated for these systems as a fixed coefficient of initial purchase price. These coefficients represent an average charge that should be incurred over the life of the irrigation component, not one representing a new piece of equipment with little or no maintenance nor an old one with high upkeep costs. Pieces of equipment with moving parts require higher maintenance costs than fittings. Maintenance and upkeep on tubing represents limited unforeseen breakage.

The final component of the operating budget is an **interest charge** on working capital used during the production season. The interest charge represents the financial cost of a short-term operating loan or the opportunity cost of producer capital used to pay for these expenses before blueberry receipts are received. A short-run nominal interest rate of 8%, inflation adjusted to 4.7%, is applied over a seven-month period of time, (e.g., April through October) on the balance of labor, fuel, and maintenance charges. This rate is a representative rate provided to producers by the Farm Credit Service for short-term operating loans.

Partial Cost Budgets for Wild Blueberries

Incremental cost budgets are calculated on a per acre basis. The cost budget of the irrigation system is composed of two elements: ownership costs tied to depreciation, interest, tax, and insurance costs, and operating charges distinctly attributable to the irrigation process. These budgets are presented in the following tables for the large gun, hose-reel traveler, handline small sprinkler, and permanent set small sprinkler systems, respectively.

Overall, the hose-reel systems are the least expensive to own and operate, followed by the handline big gun system, and the handline sprinkler system. The permanent set system is the most costly. These illustrative budgets can be used to examine the tradeoffs between capital investment and annual operating charges, in particular, tradeoffs between equipment and labor. The largest cost component lies with depreciation and interest on the irrigation equipment. Depreciation and interest accounts for 50% to 63% of total cost in the handline systems, 40% to 62% in the traveler systems, and 75% for the permanent set sprinkler arrangement. The importance of this cost category decreases as field size increases, illustrating economies of field size.

Labor is the second most important cost component. Both handline systems require considerable seasonal labor to move and operate the irrigation systems. Total labor cost is the highest on the handline sprinkler system, followed by the handline big gun system. Permanent set systems have the third highest labor cost due to initial set-up and take-down requirements.

The third most important cost category is linked to fuel costs. Although the permanent set systems require the largest diesel engines for pumping, they run the fewest hours to deliver the required water. As a result, fuel costs are only 2% of the budget. Combined, fuel, labor, and depreciation and interest costs account for about 90% of total irrigation costs.

	Irrigation Systems		
Cost Components	**Handline**	**Traveler**	**Permanent**
Depreciation and Interest	50 – 63%	40 – 62%	75%
Labor	16 – 33%	5 – 12%	5 – 12%
Fuel Costs	6 – 10%	16 – 38%	2%

Cost estimates for moveable big gun sprinkler systems ($/acre)

	25 Acre	**50 Acre**	**100 Acre**
Annual Operating Costs			
Labor	$ 56.40	$ 56.40	$ 56.40
Fuel	33.19	21.20	20.40
Maintenance and Upkeep	36.82	23.59	15.69
Interest	3.44	2.75	2.52
Total Operating Costs	**$129.85**	**$103.94**	**$ 95.01**
Annual Ownership Costs			
Depreciation and Interest	$171.16	$115.76	$ 80.88
Tax and Insurance	11.15	7.72	5.49
Total Ownership Costs	**$182.31**	**$123.48**	**$ 86.37**
Total Annual Cost Per Acre	**$312.16**	**$227.42**	**$181.37**

Source: Authors' calculation.

Cost estimates for hose-reel systems ($/acre)

	25 Acre	**50 Acre**	**100 Acre**
Annual Operating Costs			
Labor	$ 16.73	$ 16.73	$ 16.73
Fuel	55.76	70.36	70.36
Maintenance and Upkeep	45.77	30.76	15.46
Interest	3.22	3.20	2.79
Total Operating Costs	**$121.47**	**$121.05**	**$105.34**
Annual Ownership Costs			
Depreciation and Interest	$175.43	$115.09	$ 58.22
Tax and Insurance	10.85	7.31	3.71
Total Ownership Costs	**$186.28**	**$122.40**	**$ 61.93**
Total Annual Cost Per Acre	**$307.75**	**$243.45**	**$167.27**

Source: Authors' calculation.

Cost estimates for handline small sprinkler systems (($/acre)

	25 Acre	50 Acre	100 Acre
Annual Operating Costs			
Labor	$ 97.76	$ 97.76	$ 97.76
Fuel	33.19	20.94	20.64
Maintenance and Upkeep	34.04	20.72	13.64
Interest	4.49	3.79	3.59
Total Operating Costs	**$169.48**	**$143.21**	**$135.63**
Annual Ownership Costs			
Depreciation and Interest	$270.06	$182.66	$126.61
Tax and Insurance	12.25	8.38	6.35
Total Ownership Costs	**$282.31**	**$191.04**	**$132.96**
Total Annual Cost Per Acre	**$451.78**	**$334.25**	**$268.59**

Source: Authors' calculation.

Cost estimates for permanent set small sprinkler systems ($/acre)

	25 Acre	50 Acre	100 Acre
Annual Operating Costs			
Labor	$ 51.36	$ 51.36	$ 51.36
Fuel	10.82	8.78	8.78
Maintenance and Upkeep	40.36	25.84	23.07
Interest	2.79	2.34	2.26
Total Operating Costs	**$105.33**	**$ 88.32**	**$ 85.48**
Annual Ownership Costs			
Depreciation and Interest	$319.84	$292.02	$271.56
Tax and Insurance	17.29	14.05	12.63
Total Ownership Costs	$337.13	$306.08	$284.19
Total Annual Cost Per Acre	**$442.46**	**$394.39**	**$369.67**

Source: Authors' calculation.

Potato Irrigation

The three technology-alternative irrigation systems used to irrigate potatoes are distinctly different. In general, systems that have a high initial investment cost require less annual labor to operate than low investment cost systems. In addition, the technical operating characteristics of the three systems are different and affect fuel and maintenance requirements. Given the highly variable requirement of irrigation water from year to year, the tradeoff between investment (and hence annual ownership cost) and variable operating costs is important. In years where irrigation is not required, systems with low fixed costs will be preferred to systems with high fixed costs. On the other hand, during years when demand for irrigation water is high, systems with low operating costs per acre-inch of water will be preferred to high operating cost systems.

Ownership Costs

Capital investment costs were determined through interviews with irrigation engineers and equipment dealers familiar with the production conditions of northern Maine. For each system and field size, investment costs were calculated over five cost centers: 1) permitting and water source development; 2) the pumping system; 3) the main line and lateral delivery system; 4) the water application system; and 5) miscellaneous and system-specific costs. Total investment costs were calculated based upon prevailing market conditions in the fall of 2001 and winter of 2002. The total investment cost for each system is calculated based upon representative conditions facing growers in this region, including a water source that is approximately one-half mile from the fields, an elevation change of 125 feet, and a flat fee of $15,000 for permitting and engineering studies on water withdrawal. All remaining components are sized to insure that one inch of water per week may be applied to the fields.

Overall, this table illustrates the dichotomy between lower cost “flexible” systems and more capital intensive systems. By comparison, the center pivot irrigation systems are between 46% to 68% more expensive than the lowest cost moveable large gun systems.

Total investment costs for irrigation system establishment of potatoes ($/field)

Irrigation Systems	50 Acres	100 Acres	200 Acres
Handline Large Gun	$ 56,568	$ 72,772	$ 95,409
Hose Reel Traveler	$ 59,077	$ 75,828	$117,677
Center Pivot	$ 94,933	$106,229	$151,186

Total investment costs are converted to annual ownership costs using annual equivalent worth analysis. This approach converts total investment cost to an annual basis using amortization and other time-value-of-money techniques in order to derive an economic value for fixed equipment with a lifespan of more than one year. In comparison with the fixed annual cost of supplemental irrigation, annual operating cost is contingent upon the demand for irrigation water.

Operating Expenses

Annual variable costs associated with irrigation include labor to prepare the system for its first usage, the labor required per irrigation set, fuel to operate the pumping system, maintenance and upkeep charges, and financing charges linked to operating expenses accrued during the season.

Labor costs accumulate from two different sources: initial setup and end-of-season take-down of the system, and variable labor usage per irrigation. These per acre coefficients are applied uniformly across the three different acreage examples. A $9.40 hourly wage rate is applied in the calculations. This wage rate is based upon the Maine Adverse Effect Wage Rate of $8.17 and inflated by 15% to account for meals and other benefits entitled to immigrant workers. Alternatively, it can be seen as the benefits premium (Social Security, Unemployment Compensation, Workers Compensation Insurance) attached to attract local workers from non-agricultural employment alternatives. Since managerial labor is not included in the calculation, a constant cost-per-acre labor charge is calculated for the four different systems.

Power costs are calculated by determining the number of hours that the pumping unit operates in order to apply the required amount of irrigation water. Total pumping time is inflated by 10% to account for flushing, system testing, and mistakes. Total pumping time is then multiplied by hourly fuel-consumption rates of the different diesel motors and then by a representative per-gallon price of diesel fuel ($1.25). Average fuel costs decline as acreage increases, reflecting economies of size in motor pumping.

Maintenance and upkeep charges are calculated for these systems as a fixed coefficient of initial purchase price. Maintenance and upkeep coefficients are derived from interviews with equipment dealers and referenced against Paterson et al. (1996a; 1996b). These coefficients represent an average charge incurred over the life of the irrigation component, not one representing a new piece of equipment with little or no maintenance nor an old one with high upkeep costs. Pieces of equipment with moving parts require higher maintenance costs than fittings. Maintenance and upkeep on tubing represents limited unforeseen breakage.

The final component of the operating budget is an **interest charge** on working capital used during the production season. The interest charge represents the financial cost of a short-term operating loan or the opportunity cost of producer capital used to pay for these expenses before potato receipts are received. A short-run nominal interest rate of 8%, inflation adjusted to 4.7%, is applied over a seven-month period of time (e.g., April through October) on the balance of labor, fuel, and maintenance charges.

Nearly 90% of potato production in Maine occurs in the northernmost county of the state. As such, this study evaluates the cost of irrigation systems located within this geographical area and in the context of the historical weather patterns in the heart of the growing region. Over the 40-year period from 1959 to 1998, total rainfall during June through August was normally distributed with a mean of 11.8 inches and a variance of 5.8 inches. Nonetheless, the probability of receiving one inch of rainfall per week, to insure proper crop development, is highly variable. During the early part of the season, this probability drops to less than 20%, and during the critical stages of tuber bulking in August and early September, it is less than 35% (NCDC).

Operating Costs and Benefits Estimation

Uncertainty in cost estimation arises from not knowing with precision how much irrigation water will be required during the season. Since usage is not known with certainty, the underlying cost functions also are not known with certainty. As the annual ownership costs are fixed without respect to usage, this component of total annual cost favors systems with lower investment costs. On the other hand, these lower cost systems have higher variable operating costs per application. The large gun systems require significantly more labor than the hose reel travelers or the center pivot systems. Fuel costs are dependent upon the size of the pumping unit and the number of hours that the system is operated. Maintenance and upkeep charges are related to usage and the investment cost of the systems.

Annual ownership costs are netted from gross expected revenue and total variable costs of production. The problem is subject to the producer constraint that 14 inches of water is needed on the crop over the months of June, July and August. This amount of crop water can be applied in the form of irrigation water or through rainfall. Water applied through irrigation is a function of the inputs used in irrigation process given the stock of capital and the technical requirements of irrigation technology alternative.

The decision to irrigate is determined by summing the difference between the desired one inch per week and observed rainfall amounts until a cumulative one inch deficit is achieved. Once the deficit occurs, the field is irrigated to insure that one inch reaches the crop.

Based upon weather data between 1959 to 1998, total seasonal rainfall is normally distributed with a mean of 11.8 inches, a standard deviation of 2.4 inches, an observed minimum of 7.2 inches and maximum in excess of 14 inches. Therefore, irrigation requirements range from zero inches to 6.8 inches per season, but average 2.2 inches per year. The decision to irrigate, however, is contingent upon a one-inch deficit to prevent infrequent and costly short irrigations. Based upon these characteristics, net returns to irrigated and non-irrigated production are calculated. These results are compared to determine the mean benefit and the risk reduction effects.

Partial Budget Results

Based upon the expected demand for irrigation water, cost budgets for the three systems over three acreages are presented in the following tables. These cost budgets are calculated based upon the expected value of the number of irrigations. Several trends merit discussion. In the annual operating cost category, per-acre power costs decline as acreage increases due to non-linear fuel consumption of larger diesel engines. Maintenance and upkeep charges also decline, reflecting the impact of distributing these costs over a larger acreage.

Ownership costs also decline as acreage increases. Despite higher investment costs as acreage increases, these costs are distributed over a wider irrigated area, thereby decreasing average cost per acre. As tax and insurance charges are based upon the replacement cost of the system, they decrease on a per acre basis when diffused over larger fields.

According to the budget results in the table, the handline large guns are the lowest cost irrigation technology based upon expected irrigation usage. Comparison between the acreage sizes indicates decreasing average cost per acre, or economies of size in irrigation. Doubling acreage from 50 to 100 acres decreases the average total annual cost of irrigation by 27% and 29% for the handline and traveling gun systems but by 43% for the center pivot system. Doubling field size again, from 100 to 200 acres, decreases average total annual cost by 22%, 12% and 28% for the handline large gun, hose reel traveler and center pivot systems, respectively. Overall, this implies that the average annual total cost is nearing its size efficient minimum for the hose reel traveler system, but size economies still exist for the two other systems.

Hand line-Big Gun System: Expected annual irrigation cost budgets for three technologies over three acreages ($/acre)

	50 Acres	100 Acres	200 Acres
Annual Operating Costs			
Labor	$ 27.26	$ 27.26	$ 27.26
Power	23.23	14.66	14.10
Maintenance and Upkeep	14.43	9.92	6.99
Interest	1.79	1.43	1.34
Total Operating Costs	**$ 66.71**	**$ 53.27**	**$ 49.69**
Annual Ownership Costs			
Depreciation and Interest	$ 83.65	56.34	36.46
Tax and Insurance	4.94	3.57	2.55
Total Ownership Costs	**$ 88.58**	**59.91**	**39.02**
Total Annual Cost	**$155.29**	**$113.18**	**$ 88.71**

Hose Reel Traveler System: expected annual irrigation cost budgets

	50 Acres	100 Acres	200 Acres
Annual Operating Costs			
Labor	$ 9.21	$ 9.21	$ 27.26
Power	41.82	29.32	14.10
Maintenance and Upkeep	24.96	19.08	17.10
Interest	2.10	1.59	1.51
Total Operating Costs	**$ 78.09**	**$ 59.20**	**$ 56.03**
Annual Ownership Costs			
Depreciation and Interest	$ 93.88	62.70	50.99
Tax and Insurance	5.31	3.85	3.46
Total Ownership Costs	**$ 99.19**	**66.55**	**54.45**
Total Annual Cost	**$177.28**	**$125.74**	**$110.48**

Center Pivot System: expected annual irrigation cost budgets

	50 Acres	100 Acres	200 Acres
Annual Operating Costs			
Labor	$ 4.77	$ 3.99	$ 5.05
Power	25.21	15.83	11.01
Maintenance and Upkeep	45.74	23.83	16.29
Interest	2.09	1.21	0.89
Total Operating Costs	**$ 77.81**	**$ 44.86**	**$ 33.25**
Annual Ownership Costs			
Depreciation and Interest	$135.85	$ 76.21	$ 54.10
Tax and Insurance	9.66	5.44	4.04
Total Ownership Costs	**$145.51**	**$ 81.64**	**$ 58.14**
Total Annual Cost	**$223.32**	**$126.51**	**$ 91.39**

Risk Management Attributes of Irrigation Systems

Given that demand for irrigation water is dependent upon rainfall, the resulting cost estimates will have a variable component mirroring the derived demand for irrigation water. While total cost increases with the amount of irrigation water applied, average cost per acre-inch of water declines. Nonetheless, when this budget is added into the non-irrigated crop production budget, total annual cost of production will be greater under irrigation in all states of nature. Revenue will vary according to total annual rainfall. Revenue variability is decreased under irrigated production but the expected impact will not always be greater than non-irrigated production, i.e. in years when supplemental irrigation is not required. As a result, the net return to irrigation may not always be positive, especially in years when limited water is applied to the crop.

The median net return per acre to irrigated production is uniformly higher for all irrigation systems applied on 100 or 200 acres, but lower for the center pivot on 50 acres. As a result, two distinct cases occur. In the 100 and 200 acre scenarios, irrigation is an important tool to increase profitability and decrease exposure to weather related production risk. In the 50 acre cases, median income does not always increase.

Water Development Costs

One of the greatest sources of uncertainty facing potato producers is the cost of developing a water source to meet irrigation demands. The presented scenario is representative of historical water source development costs but largely underestimates current and future costs. Most growers who currently irrigate are located in areas where direct water withdrawal from rivers and streams is possible. This technique is currently in disfavor by state and federal authorities with jurisdiction over permitting and will be highly regulated in the near future.

In the future, in some locations of Maine, irrigators will be required to withdraw water from impoundments or ponds, rather than directly from streams or rivers, thereby increasing the engineering and construction cost. In addition, these ponds may require state permitting and environmental impact assessment. Currently, environmental best practices call for the development of upland ponds rather than impacting wetlands in lowland areas. Both alternatives forbear significantly higher development costs. Upland ponds are extremely expensive because conditions are conducive to infiltration. As such, for these ponds to retain water, an artificial impermeable layer may need to be constructed. On the other hand, if a pond is created in a lowland area, the producer may be required to mitigate any damage to the surrounding lowland or wetland ecology. As such, most experts believe that the $15,000 previously spent to develop a water source will only cover basic environmental engineering and permitting application costs. Construction, non-trivial engineering and environmental impact assessment, plus wetland mitigation, will increase initial investment and annual ownership expense substantially.

As such, the cost of water source development is a key factor in the decision to invest in irrigation or not. The profitability and risk analysis must be reevaluated when increasing the cost of water development from the base level of $15,000 by $50,000 and $100,000. This cost of water source development can cause a substantial increase in the cost of irrigation but is realistic of recent grower experience. Increasing water development costs do not affect the risks of any of the irrigation options at the 200 acre scale. While the profitability differences decline, irrigation still increases net returns per acre.

On the other hand, the decision to adopt limited irrigation at 50 acres is sensitive to initial water development cost. When costs increase to $65,000, only the handline gun system is risk efficient for a slightly risk averse producer at the 50 acre scale and the medium investment system for someone who can be characterized as a “highly” risk averse producer. At $115,000 of start-up cost, non-irrigated production dominates all irrigation technologies at 50 acres of coverage. Increasing water development costs has an important impact on the scale level of a producer's decision to adopt irrigation technology.

As such, and holding all other constraints constant, current environmental policy to regulate water development will increase the breakeven scale at which irrigation becomes risk efficient. The current state Department of Agriculture's Water Source Development Cost Share program may be used to achieve welfare improving solutions through cost-sharing water development investment. Under the second scenario, where resource development costs are estimated at $65,000, a 75% cost share would reduce the impact at the 50 acre scale.

Conclusions

Supplemental irrigation has often been described as an "insurance policy." Due to the high investment costs associated with irrigation, size economies are an important component of feasibility. Current state and federal farm policy is promoting water development cost sharing. This policy will have an important role in inducing the adoption of systems for farmers who are seeking to adopt smaller scale systems. On the other hand, farmers who do not qualify for cost shares will be required to adopt irrigation on a larger scale in order to receive the risk management benefits.

For more information please see the following publications available from the Maine Agricultural and Forest Experiment Station at the University of Maine:

Dalton, Timothy J., Andrew Files, David Yarborough. 2002, "Investment, Ownership and Operating Costs of Supplemental Irrigation Systems for Maine Wild Blueberries." Maine Agricultural and Forestry Experiment Station Technical Bulletin 183.

Dalton, Timothy J. and David Yarborough. 2004, "The Economics of Supplemental Irrigation on Wild Blueberries: A Stochastic Cost Assessment." Small Fruits Review. 3(1/2): 73-86.

Dalton, Timothy J., Gregory A. Porter and Noah Winslow. 2003, "Profitability and Risk Management Benefits of Supplemental Irrigation on Northern Potatoes." Resource Economics and Policy Staff Paper 515.

Dalton, Timothy J. , G. A. Porter and N. Winslow. 2004, "Risk Management Strategies in Humid Production Regions: A Comparison of Supplemental Irrigation and Crop Insurance." Agricultural and Resource Economics Review. 32(3): 220-232.