

**ANNUALIZED COST OF AN IRRIGATION SYSTEM**  
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**WHY COMPUTE THE ANNUALIZED COSTS?**

A number of management decisions are based on the annualized costs of owning and operating an irrigation system. Before developing land for irrigation, the first decision should be whether the irrigation system will be economically feasible, (will the returns more than offset the costs?). After deciding to proceed with irrigation development, one is faced with many alternative design choices. Sometimes there are offsetting costs and benefits associated with choices; e.g. lower initial cost for one distribution system vs. another may result in higher labor costs and/or lower irrigation efficiency which may increase operating cost and partially or completely offset the initial savings. Aside from development and design considerations, on rented land, an estimate of ownership and operating costs is necessary when negotiating a fair rental arrangement between the landowner and tenant.

Economic Feasibility Studies

Following a dry year like 2000, there is increased interest in developing irrigation. The question is: Will the return in higher yields over the life of the system more than off-set the cost of ownership and operation plus the additional crop input expenses for irrigated vs. dryland production? The only way to truly answer this question is to do a thorough economic feasibility analysis.

Irrigation systems have many components, each of which has a different expected useful life, anticipated repair costs, and different estimates for labor for normal operation and maintenance. Component costs, service life, maintenance repair, and energy costs all can differ under the same operating conditions depending on the design choices made.

If one has a set of financial records and has been irrigating in the past, they may have a pretty fair estimate of the expected out-of-pocket costs for operation and maintenance for an irrigation system. Out-of-pocket expenses only account for a portion of the total costs, however. When conducting an economic feasibility study, one must consider both the costs associated with ownership and the cost of operation.

### Comparing Choices

The annualized cost of an irrigation system is dependent on the design choices made. Different systems have different costs. For example: A center pivot sprinkler system will likely have a higher initial cost and a higher cost per inch of water delivered than a gated pipe system (because of higher system pressure) but probably will require less gross water applied to meet crop needs and fewer hours of labor for operation. The question is, will the savings offset the higher costs over the life of the system?

The annual energy required for irrigation pumping is dependent on both the quantity pumped (acre-inches) and the total head (lift plus pressure) the pump is working against. In a given situation, the lift component of the head cannot be changed but the system pressure required does change from one type of system to another, resulting in different energy costs per acre-inch delivered and therefore total annual energy costs.

There are four energy sources typically used for pumping irrigation water in Nebraska. They are: Diesel, Electricity, Natural Gas, and Liquid Propane (LP). The University of Nebraska developed the Nebraska deep-well pumping plant Performance Criteria (NPC) based on hundreds of field tests of irrigation pumping plants. Each fuel type was assigned an expected performance, expressed in terms of water horsepower hours per standard unit of energy. Using the NPC, one could compare each energy source relative to the others and find the least expensive energy source provided only the cost of energy is considered.

To truly compare one energy source to another, one must consider more than the cost of the energy used per hour or per season. The energy source selected dictates the type of power unit that must be purchased. Different types of power units have greatly different purchase prices and estimated useful service lives. Some require significantly more labor for maintenance and repairs as well. These differences must be factored into the overall cost before a true cost comparison can be conducted.

### Crop Share Rental Arrangements

Occasionally, extension staff are asked to help landowners and tenants work out fair crop share rental arrangements. One method used in extension is to sit down with both parties and develop a listing of the monetary value of the contributions each party is making. The landowner needs to receive a fair return on the value of his land and other assets as well as cover his costs for taxes, upkeep and insurance. The tenant needs to receive a fair return on his labor and machinery and cover his variable expenses such as fuel and repairs. Some or all, crop input expenses may be shared in most crop-share arrangements, but how they are shared varies case by case.

When computing a fair crop-share rental arrangement, the procedure is to list all

the contributions that are required for crop production in a table (land, irrigation system, machinery, labor, crop inputs, etc.). After each input listed, the contribution each party is making is shown in parallel columns; one for the landowner and one for the tenant. The columns are tallied and the percentage of the total cost that each party is making is calculated. The "fair" rental arrangement would be to divide the crop on the same percentage as the contributions that each party has made. Alternately, after the initial listing is done, changes are sometimes made in the percentage the two parties contribute to certain inputs until contributions match a pre-determined crop share arrangement (e.g. 60/40 or 50/50).

The costs of owning and operating the irrigation system are some of the most difficult to identify when analyzing irrigated crop share arrangements. Much of the total cost of irrigation results from ownership costs and a large percentage of ownership costs are not annual out-of-pocket costs but rather are sunk costs, such as return on capital investment, depreciation, and taxes and insurance.

A complicating factor in some rental agreements results from who owns the various components. In some cases, the landowner may furnish the entire irrigation system; in other cases the landowner may furnish the well, pump and gear head; while the tenant may furnish the power unit and/or the distribution system. A need therefore exists for the analyst to easily estimate the ownership and operating costs for each major component in various irrigation systems so each party is credited with a fair estimate of the contribution he/she is making.

### Examples

The author has developed a computerized spreadsheet that can assist the analyst with estimating the costs of owning and operating an irrigation system. Since a picture is worth a thousand words, some sample runs were selected to illustrate the capabilities of the worksheet, (these are accessible on the web at: <http://www.ianr.unl.edu/ianr/lanco/ag/crops/irrigate.htm> under the heading "ANNUALIZED COST OF AN IRRIGATION SYSTEM".

The worksheet is presented in Microsoft Excel™ (.xls) format. To prevent corruption of the programming code, the spreadsheet has been protected except for the cells requiring user input (blue). The user will find a single worksheet version and a notebook version presenting the four scenarios mentioned below with figures 1-4 each presented as separate tabs. Either worksheet can be used as an interactive web page or can be downloaded at no cost from the website by right clicking on the link. Use the "save link as" feature (Netscape) or "save target as" (Internet Explorer) to save the file to a folder (directory) on your computer. You should then be able to open your spreadsheet program, browse to the file, and open it.

The link titled "Figures 1-4" contains a notebook of four different design choices. Figures 1 and 2 represent a typical center pivot system in central Nebraska. The difference between these are the energy sources used (diesel vs. natural gas).

Figures 3 and 4 both use an electric motor to pump the water, the difference is the distribution system used (center pivot vs. gate pipe with a surge valve). These examples are in a multi-tab notebook for ease of comparison.

### Summary

As can be seen, this approach can be used to determine the annualized costs when conducting an irrigation economic feasibility study. One can compare the ownership and operating costs for an array of possible irrigation design choices, the goal being identification of the most economically feasible choice for a given situation. Finally, it also can be used to help put a value on the capital investment, depreciation, labor, expected fuel costs, etc. when analyzing rental arrangements.