CHAPTER III
AN ECONOMIC ANALYSIS OF THE EFFECTS OF A DECLINING GROUNDWATER LEVEL IN THE RAFT RIVER BASIN

The economic portion of the study provides an interpretation of the economic effects of various rates of groundwater level decline in the Raft River Basin in southern Idaho. Crop farms in the study area were examined to determine how the returns to operator labor and management would be affected by a declining water level. The MPS-360 Linear Programming technique was used for the examination of farm plans.

Farm Analysis

Dissimilar crop possibilities within the study area necessitated the division of the basin into northern and southern portions for the purposes of the study. Early fall frosts and a shorter growing season limit field crops in the southern part of the Raft River Basin to alfalfa hay, pasture, silage corn, and various grain crops. The northern portion has these possibilities plus the additional high value cash crops of potatoes and sugar beets. Two farm sizes were selected for study in each portion of the basin: 640 and 960 acre field crop farms in the northern section of the basin and 320 and 640 acre field crop farms in the southern portion of the study area.

The crop constraints (bounds) of the linear programming model involved in the programming of each farm plan were set at three different levels to give three possible crop combinations for each farm plan. The choice of the crop mix had an important impact on farm income. Annual returns to operator labor and

management were estimated for a 20 year period to determine the present value of the stream of returns from a farm operation.

Costs of Water Level Decline

Groundwater decline is a serious problem in the study area. Water level declines of 100 feet have been noted in portions of the basin since 1952. The rates of decline examined in this study were 1, 2, 3, 4, 5, and 10 feet of water level decline per year.

The power cost for pumping an acre foot of water from a well increases with increased depth to water. The increased power cost is, however, only a portion of the overall cost of the water level decline. Without proper planning, the pumping equipment and wells become obsolete in a shorter than normal period of time. This obsolescence increases the depreciation and replacement costs for wells and pumping equipment. Representative wells for the basin were evaluated and costs were calculated for the improvements and changes necessary to maintain well yields at the current levels for 20 years. The 20 year accumulated present value net return to the 640 acre farm plan in the southern portion of the study area decreased from $182,420 when no decline occurred to $153,248 when 5 feet of yearly decline occurred. Ten feet of yearly decline decreased the return to $121,076. However, this return level for the most profitable crop mix was still greater than the return from the production of the next most profitable crop mix with no decline, $91,111.

Results of the economic analysis indicated that farms in the northern section of the study area should be able to make the necessary well and pumping equipment changes with only slight reductions in their returns. When the acreage of land on a farm is restricted, i.e., adequate irrigation water is not available to irrigate all the crop land on a farm, the ability of a farm operator to make the necessary changes is reduced. This is also the case when low value cash crops are grown on a farm.

Returns to operator labor and management for farms in the southern portion of the study area limit the ability to make improvements and changes in wells and pumping equipment as water level decline occurs. Examination of the 20 year effects of 10 feet of decline per year resulted in a net loss for a 640 acre farm plan producing feed barley and alfalfa hay.

Opportunity Cost of Not Pumping the Groundwater

The opportunity cost or value foregone by not pumping the groundwater in the Raft River Basin is best expressed by the accumulated present value net returns of the farm plans. Without the irrigation water pumped from the aquifer, agricultural use for land in the basin would be limited to desert grazing range. A limited amount of land in the study area is wholly irrigated with surface water from the Raft River and Cassia Creek. An improved Bureau of Land Management grazing area in the eastern portion of the valley containing approximately 5,000 acres produced only 5,404 A.U.M.'s (animal unit months) of grazing in 1971 (interview with a representative of the Burley BLM

office). The value of one A.U.M. of grazing per acre ($.80 for federal lands for 1972) is minimal when compared to the potential returns from irrigation of the land. The opportunity cost of not irrigating would be nearly identical to the present value net return to a farm plan.

Relative Importance of Groundwater Decline

The location and size of the farm, the management capabilities of the operator, crops produced and characteristics of wells affect returns from the farm operation in addition to the water costs. It is desirable to discuss the importance of water level decline and depth to groundwater in relation to other variables affecting farm plan returns.

The location of the farm, in either the northern or southern portion of the study area, has an important impact on farm income. The dissimilar crop possibilities for the two areas is of major importance to farm income. The size of the farm and the management capabilities of the farm operator also affect farm income. As farm size increases, efficiencies of equipment and labor usage tend to increase. These increased efficiencies when accompanied by a high level of management capability can affect returns significantly. The crop mix also has a major impact on return levels for the farm plans. The three crop combinations examined for each farm plan in the southern portion of the Raft River Basin can be produced with the same equipment inventory and amount of irrigation water. The 640 acre field crop plan has 20 year accumulated present value net return

possibilities of $182,420 (390 ac. Malting Barley, 250 ac. Alfalfa Hay), $91,111 (100 ac. Malting Barley, 290 ac. Feed Barley, 250 ac. Alfalfa Hay), and $59,625 (390 ac. Feed Barley, 250 ac. Alfalfa Hay). This range of return possibilities, which is typical for all farm plans in the study area, shows the importance of the crop mix selected for a farm plan.

The characteristics of wells on a farm and depth to water, although important factors influencing farm returns, are not as important as crops produced, farm size, management capabilities, and farm location. Farms located some distance from the river typically have deeper wells and greater depths to water. Power costs per unit of water pumped increase as the depth to water increases. Investment costs and depreciation expenses also increase for deep wells and associated pumping equipment. These changes in costs are relatively minor. For example, the 20 year accumulated present value net returns for the 320 acre farm plan in the southern portion of the study area is decreased by only $21,000, $134,495 to $113,432 when deep wells provide irrigation water rather than shallow wells. Similar relationships exist for other farm plans examined in this study.

Groundwater decline and depth to groundwater do affect farm returns, but in relatively minor amounts when compared to the importance of farm location, farm size, management capability, and crop mix produced. Administration of the groundwater resource based on depth to water or rate of groundwater decline alone ignores several more important factors affecting a farm's return.

Summary

An economic analysis of farm plans in the Raft River Basin was performed to 1) estimate the value of water pumped from the aquifer system, 2) examine the effects of a declining groundwater level on returns to farms, and 3) estimate the opportunity cost of not pumping the groundwater. An examination of agricultural activities in the basin showed dissimilar crop opportunities in the northern and southern portions of the area. Therefore, the basin was divided into two areas for consideration in this analysis.

Data pertaining to costs of production, returns for crops, agricultural practices and cropping patterns in the study area were gathered in 1972 to provide the information base for this study. Activity budgets for producing crops were formulated from this data. A linear programming analysis using the information from the budgets was then applied to estimate the returns to operator labor and management from representative farm plans examined in the two divisions of the study area. This analysis was then extended to examine the effects of 6 rates of decline on the returns to operator labor and management. The added costs which a farm would experience in changing its irrigation wells and pumping equipment to maintain its irrigation water supply were estimated to determine the impact from various rates of water level decline on the 20 year accumulated present value of net returns for each farm plan.

As the rate of groundwater decline increased, the returns and annuity values decreased as expected, but not by the amounts that had been anticipated. The rate of water level decline on

a farm had less impact on the returns than did the alternative crop mixes for the farm plans. Farms in the northern portion of the Raft River Basin should be able to operate with up to five feet of yearly decline and experience only slightly lower returns. Farms in the southern portion of the study area which produce the lower value crop mix of feed barley and alfalfa hay have low returns even without decline. Groundwater decline in the southern portion of the Raft River Basin is far more serious a problem than decline in the northern portion. Income levels for farms in the southern portion are at or below subsistence levels without a decline in the groundwater level. Returns in the northern portion of the study area are at a considerably higher level.

The value of irrigation water is the value of the return to operator labor and management for the crops produced in a farm plan. If the water was not pumped for use at this time, the loss would be nearly equal to this value. The alternative to irrigated agriculture for the lands currently irrigated with groundwater is desert grazing.

Groundwater decline affects farm returns, but by relatively minor amounts when compared to other factors. In the Raft River Basin the major factors affecting the returns to farms are the location of the farm (northern or southern portion of the basin) and crop mix produced. Characteristics of the wells on a farm, depth to water, and farm size and management capabilities also affect returns, but to a lesser degree.

Administration of the groundwater resource should consider all factors affecting farm returns. The effect of groundwater decline is only one measure of the economic position of a farm enterprise.

Conclusions

This analysis has shown the effects of a declining groundwater level on the returns to various farm plans. The rate of decline that can be tolerated on a farm varies for different farms and different cropping patterns. The returns to farm operations in the Raft River Basin are influenced more by farm location and crop mix produced than groundwater decline and depth to water.

The value of a water right is the certainty it provides the holder. When applied to groundwater, the certainty concerns the level of the water and the rate of decline, if any, which can be expected. If the rate of yearly decline can be anticipated, wells and pumping equipment can be designed to minimize costs as decline occurs. The added costs incurred from groundwater decline are influenced more by the time period over which the decline occurs than the depth to water.