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NEBRASKA IRRIGATION DEVELOPMENT & ITS EFFECT ON THE FRENCHMAN VALLEY AND H & RW IRRIGATION DISTRICTS

by

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Introduction

Irrigation is becoming more and more important to the economy of the state of Nebraska. As we irrigate more acres of land, we frequently turn to groundwater for new sources of water.

Groundwater like any natural resource needs proper management to produce the maximum benefits over a long period of time. However it also has its own characteristics as a natural resource which make for its own unique management problems.

The intent of this paper is to look at some of the problems caused by the groundwater development in Chase County, Nebraska. Although it deals specifically with a local situation, the concepts and ideas in this paper can be applied to all groundwater management problems and in some instances, to other natural resource problems.

The Problem

The Bureau of Reclamation captures and stores irrigation water behind the Enders Dam on the Frenchman Creek near Enders, Nebraska. In the summer, this water is released down the Creek and diverted at Palisade into the main supply canal of the Frenchman Valley and H & RW Irrigation Districts. In the last few years the lake behind the dam has not been completely filling up during the off season. On March 22, 1974, at the time of the Frenchman Valley and H & RW irrigation waters users meeting, the lake was 750 acre-feet lower than it was a year ago. The last year that the reservoir was at its conservation level was during 1969 (1). The amount of water in storage before each irrigation season has declined steadily since then. This has caused considerable concern for the farmers who irrigate with water supplied by the Districts. During the last few years, only sufficient rains in August have saved the crops from drying up.

What has caused the decrease in the amount of water stored in Enders Dam each year? The streamflow of the Frenchman Creek is derived from both precipitation runoff and groundwater seepage since the Creek is an effluent stream (i.g., groundwater moves into the surface stream whereas in an influent stream surface water moves in to the groundwater.) Reduction of the streamflow is due either to the reduction of the runoff, the seepage or both.

According to Daryl Watts, extension irrigation specialist at the North Platte Experiment Station, the 1920 to 1955 average rainfall was greater than normal. This long-term "wet Period" could have had the effect of accumulating water in the aquifer above a long-term normal level. During the 1969-70 years, the amount of rainfall received equalled the

average. Since then the amount of annual precipitation has fallen below the long-term average (12). Therefore both the runoff and natural discharge has been less. There have also been an increasing number of water and soil concervation structures such as terraces and water reuse pits to reduce runoff (9:15).

The effect of groundwater pumping is the lowering of the water table in the aquifer. In Chase County, there is one area which has experienced a 19 foot drop of the level of water in the aquifer. The average annual drop in Chase County in recent years has been .92 foot per year (8). "This record of lowering water levels plus records of net declines in observation wells shows the current rate of discharge from the aquifer exceeds recharge and, therefore, groundwater mining is in progress" (9:14).

The base flow of the Frenchman, since it is an effluent stream, is dependent upon the slope of the water table toward the stream. This is the gradient which moves water to the stream. Wells, by lowering the water table, tend to flatten the gradient. As the gradient is reduced, less groundwater flows to the stream. When the gradient is lowered to such an extent that it is lower than the stream level, water will flow out of the stream into the groundwater reservoir. The stream has then changed from an effluent to an influent stream.

Cardwell and Jenkins predicted in 1963, the irrigation wells in Chase County would reduce the base flow of the Frenchman by 13.3 cubic feet per second (cfs) by 1978. The base flow from 1940 to 1960 was 74.3 cfs. The average in 1961 to 1972 was 65.9 cfs. During the last five years, the base flow has fallen to 58.9 cfs. This is a drop of 21 percent less than the 1940 to 1960 average, and even greater than that predicted by Cardwell

and Jenkins for 1978 (9:16).

> The relative effects of (1) less than average rainfall (2) decreased effective drainage areas, and (3) declining water levels on the flow of the Frenchman Creek cannot be determined without further quantitative evaluation. However, the recent sharp decrease in the flow of Frenchman Creek corresponds closely with trends in groundwater pumpage in the water shed. Consequently, it is the writers' opinion that the effects of pumpage on the reduced flow of Frenchman Creek probably outweighs the other considerations. Additional quantative work is required to test this hypothesis (9:17).

Why The Problem Exists

Reasons why this situation is occurring in Chase County as well as other areas of the state, can be grouped into three main divisions: physical, legal and economic.

The physical reason deals directly with groundwater hydrology. Statements about Nebraska's vast groundwater reserves are very misleading. Groundwater is a local phenomenon. Reserves in one area do not help shortages in another area. Furthermore groundwater moves very slowly within an aquifer. In the Chase County area, the average velocity of the groundwater is 900 feet per year (9:6). Another reason for the decline of the water table in the Chase area is the extremely slow recharge rate; in parts of the Frenchman Creek Basin the recharge rate is one inch per year (3:96). The greatest effect on the flow of the Frenchman is the wells that have been placed relatively near the stream. Wells that are within a

three to five mile distance from the stream are having the strongest effect on the stream (12).

The legal reason for the depletion of the groundwater and subsequent lowering of the base flow of the Frenchman Creek, is there are practically no laws regulating the use of groundwater. The rule that applies in Nebraska is the English rule of capture. "In actuality, the English doctrine represents anarchy because allocation of water is determined by location and the pumping capacity of wells. Law has no role in the system" (6:194).

The economic reason for exploiting the groundwater reserves can be compared to the classic example of the tragedy of the commons. If there is no regulation over the use of a resource and one or two individuals use the resource, others feel compelled (because of the economic disadvantage of not utilizing the resource) to use it for their own economic benefit even though the resource may be destroyed from unwise exploitation. In "Management of Ground Water," Fischer presents four reasons why groundwater is exploited. In this situation two reasons apply more readily than the others. "First the supply of water, which can be exploited economically, tends to be overestimated by the individual and the community. Second, the individual water user is normally drawing water from a common pool. Changes in his rate of use will not appreciably affect the total quality of water used, the rate of decline of the water table, or the point in time at which the stock of water will be exhausted" (4:4). This last idea restates the concept of the tragedy of the commons, but as more and more people utilize the resource, the time at which it will be economically exhausted will come sooner.

The Need for a Change

At the present time, Imperial, the county seat, and the Chase area affected by the irrigation development is experiencing great prosperity because of this development. During the period from 1964 to 1972, three of the banks in Chase County that are in the area affected by the irrigation development have experienced an accumulative increase in deposits from $4,632,929 to $12,676,887 or an increase of 2.73 percent. A major distributor of power units has moved to Imperial from Ulysses, Kansas, and industrial development bonds are being issued for sale to help the construction of facilities for a bean processing plant. The growth is such that Imperial has a housing and labor shortage problem (13:1-3). While this economic growth is probably needed since the general trend of western Nebraska communities has been one of decline, it should not be thought as the ultimate solution for the future of areas such as these.

Welfare economics determines how available resources may best be used to promote human welfare. Abundancy economics deals with the question, "What should man want?" The answer to this question is imposed upon society instead of permitting the present community values to prevail. It scorns the idea that the free market which is dependent upon consumer sovereignity can maximize human welfare. The millions spent on advertising for razor blades versus the need for funding of cancer research underscores this idea. Therefore the free market system has serious deficiencies in determining proper resource allocation. "The ideal resource allocation would be achieved by the public policy maximizing a unanimously accepted index of total human welfare" (7:96). "As long as adequate safeguards are available to make sure that the activities of no man do not infringe on the

rights of others, social welfare is maximized by maximizing the sum of the satisfaction brought to each individual" (7:99). This is the key to the present situation in Chase County, as it is the key to all resource management, the extablishment of adequate safeguards.

It is established that the irrigation development is lowering the groundwater table and is effectively taking away water from the Frenchman Creek. The irrigators of the Frenchman Valley and the H & RW Irrigation Districts are relying on the flow of the Frenchman Creek to irrigate their crops. What will be the result when the Districts run out of water in the month of August and the crops dry up? If the farmers cannot rely on the amount of water they are presently receiving, they will have to cut back on their irrigated acreage. There will merely be a shift of irrigated acres from Hitchcock and Red Willow Counties to Chase County. Society will be spending more money to irrigate the same amount of acreage. Also what of the expenditure involved in the construction of the Enders Dam and irrigation canal? Without the revenue to repay the government, the Federal monies will have been wasted on only an unplanned short-term project.

Another issue that should be raised, is what happens when the water table in the aquifer in Chase County has been lowered drastically so that there is no longer an economic reserve? For their own well-being the irrigators cannot afford to let this happen. Retaining sufficient stocks in an aquifer is important in three main aspects. A reserve in the aquifer provides a safety cushion to draw upon in those years when the recharge is less than withdrawl. Furthermore the stocks in the aquifer would reflect "lower pumping costs reflecting reduced lifts and higher

well capacities; and higher yielding wells to provide sufficient water during critical periods within the pumping season" (4:5).

There is also the problem of disinvestment of capital that would occur if the installation of irrigation equipment capacity is more than the long-term capacity or sustained yield of the aquifer. This disinvestment is the major reason that groundwater whould be managed. The problem would be one of idle irrigation equipment since the present long-term withdrawl is greater than the long-term recharge.

Not only would there be a loss on investment in equipment, but there is also a multiplier effect upon the community as well. According to a University of Nebraska study released in 1968, for every dollar output from irrigation, there is an additional $6.68 created in economic activity (10). This is the reason that Imperial is experiencing such a prosperous period. However when the irrigators in Hitchcock and Red Willow Counties cannot irrigate or the economic reserves of groundwater in Chase County are exhausted, what about the negative multiplier effect? If one dollar can create $6.68 in additional economic activity does one dollar less in irrigation output create a deficit of $6.68 in economic activity? If the irrigation development in Chase County can produce such a prosperity, can the subsequent decline in irrigation in Hitchcock and Red Willow Counties (and ultimately the decline in Chase County) produce a recession in these areas? Institutional stability is an important social goal because a continually rapid change promotes uncertainty and insecurity.

What Can Be Done From a Physical Standpoint

One benefit of a shortage of a resource is that the resource is used more efficiently, or units of output become greater per given unit of input

of the resource. Physical solutions are those solutions which will provide more water or will give a greater efficiency in resource use.

Surface distribution of irrigation waters is very inefficient in total water distribution. From the dam to the farmers, seepage losses can be as high as 50 percent. Water losses from the release of water from the Enders Dam down the Frenchman Creek to the diversion dam at Palisade can be very high if too much water is released at one time. This happens because the water level in the Creek has been raised so high that the Creek becomes an influent stream (1). The logical way to curb these losses is to manage the release of water during the peak demand periods so that too much will not be released at one time. This would involve a better planning and use management by the Districts in close cooperation with the irrigators.

At the water users meeting on March 22, 1974, the superintendent stated that when the water was released into the canal last year for spring or early summer users (before the regular irrigation season started), only two or three individuals made use of the available water. More than likely the water lost through seepage was greater than the amount applied by the few users. In the future the Districts should eliminate filling the canal in the spring unless a number of users stated that they want water, and the amount to be applied would justify the seepage losses.

Another solution to the seepage losses would be the lining of the main distribution canal with an earthen material which is relatively impervious to water. However the cost of this project would be $3 million. The Districts would not be able to get a Federal loan on a nonreimbursable basis, so the Districts themselves would have to pay for this lining (8).

The Frenchman Valley Irrigation District could be more efficient in allocating water to the users. Unlike the H & RW District which allocates water on a type of supply and demand basis, the Frenchman Valley simply assigns days of water allocation for each month. If the farmer does not utilize the assigned water, he has lost it for the season. Because of this, water can often be wasted. By allowing farmers the option of denying a water schedule without forfeiting the water for the season, the District could make better use of the water by allowing the farmers to make better management decisions as to the application of the irrigation water.

Keeping the flow of the Frenchman between the Enders Dam and the diversion dam at Palisade low enough to prevent losses while at the same time allowing more flexibility to the individual users may seem to be contradictory policies nearly impossible to accomplish. However with the versitility of computers and the accessibility of remote telephone terminals, it may be worthwhile for the Districts to invest in the facilities and a program to help manage the release and allocation of water on a day to day basis.

Farmers could also be more efficient with the water allocated to them. With gravity flow irrigation systems, the majority of the type of system found in the Districts, the efficiency of the water received to that actually applied to the soil can be as low as 40 to 45 percent. With a reuse or tail-water system, gravity flow irrigation can be as high as 90 percent efficient (8).

Another alternative to finding more water is to build a dam on the Stinking Water Creek north of Palisade. While many people in the Districts feel that this may prove to be the ultimate solution, there are some serious

drawbacks to this plan. There is a question of Federal funding of the project. The most serious problem is the nature of the project and the general hydroligic relationship of the area. The Stinking Water Creek is much like the Frenchman Creek in that it gets much of its base flow from groundwater seepage. Its headwaters are in the central part of Perkins County and it flows through the northeast corner of Chase County. The Stinking Water Dam could be only a stop gap solution with the legal system at the present situation. There is nothing to prevent the irrigation development from expanding into the central part of Perkins County and the northeast part of Chase County. The wells pumping from the aquifer there could reduce the base flow of the Stinking Water Creek. The proposed dam would provide an additional source of water for a number of years but it could ultimately be involved in a situation like the present problem with Enders Dam. Until the legal system is changed, this solution might not be a logical alternative.

The last alternative would be trans-basin diversion. The plan for this area would be to construct a canal from the South Platte Valley and divert water from that valley to the Chase area. This plan has two major drawbacks; at the present time trans-basin deversion of water is illegal in Nebraska, and the cost of just constructing such a canal would be about $30 million (8).

What Can Be Done From an Economic Standpoint

It is logical that none of the above physical solutions will be utilized if the cost of installation will be more than the benefit derived from such action. This is why shortages encourage more efficient uses of resources. As the water becomes more valuable, it becomes more profitable

to make expenditures to utilize the existing water supply more effectively.

The first thing that should be done is to control the water releases to minimize the losses in the Frenchman Creek between Enders Dam and Palisade. It may be a long time before canal lining is economically feasible. The water that is available should be coordinated more effectively. Tailwater or reuse systems can then be implemented to improve on-farm efficiency of water use.

However, better management, reuse systems and canal lining may only be short-term solutions. If the Enders Dam is "dried up," there will be no water to use in the system. The dam on the Stinking Water Creek and trans-basin diversion, while providing more water, may never become economically feasible. The ultimate solution then is groundwater regulation.

What Can Be Done From a Legal Standpoint

Clearly there needs to be considerable legislation to control the use of the resource. Nebraska's courts have proven very ineffective in the allocation of groundwater. In Olsen v. City of Wahoo the Nebraska Supreme Court ruled that " . . . if the mutual underground supply is insufficient for all owners, each is entitled to a reasonable proportion to the whole . . ." (6:204-5). This decision supplements the English doctrine of law of capture with the American rule of reasonable use and the California doctrine of correlative rights(e.g. sharing in time of shortage). However in Metropolitian Utilities District v. Merritt Beach Company, the court stated that the American rule is the law of the land, and made no mention of sharing in a time of shortage (6:205).

It is evident that court-made laws can never be sufficient for the regulation of groundwater. The outcome of cases is uncertain, proceedings are burdensome, and the expense of hydrological evidence is high. Neither the reasonable use rule nor the correlative rights doctrine has proven effective in times of shortage. Litigation does not begin until users actually begin to compete with each other for the water. Courts are unaware of the scope or nature of the problem, merely basing their decisions on an isolated situation which may not fairly reflect complex interdependancies.

Furthermore there is no definite method for the settling of disputes between appropriators of streams and well users. "In the long-run, any legal distinction between surface- and groundwater rights makes little hydrologic or economic sense. Legal procedures for dynamic adjustment of combined surface- and groundwater rights will eventually be required" (7:152).

The administrative bodies for the regulation of groundwater already exists in the Natural Resource Districts. All that remains is to pass the enabling legislation to give them the necessary powers. "NRDs should have power to excise the power of eminent domain, including the power to condemn water rights whenever necessary for development, conservation or allocation of water, or for the effective operation and management of the district" (6:274). "To prepare a plan for groundwater management, the legislature with help from administrative agencies is better equipped than the courts to evaluate empirical data and make necessary value judgements. We believe not only that the burden is legislative, not judicial, but also that a greater sense of urgency is essential" (6:184).

For the meantime, the Frenchman Valley and H & RW Irrigation Districts are losing water, and the aquifer in Chase County is dropping. I recommend that the Districts bring suit against the irrigators in the Frenchman Creek Basin Area. The suit could be based on the reasoning that well irrigators are taking water away from the stream and subsequently harming the stream irrigators. The courts have already recognized that pumping can have an adverse effect upon the flow of a stream. In 1940, the Nebraska Supreme Court observed that the water table necessary for the continuous flow of the Platte River " . . . has been affected materially by pump irrigation" (6:246). If the flow is depressed too much, it is impossible to fulfill the legal obligations downstream. In the situation at hand, the irrigators in the Frenchman Valley and H & RW Districts have a prior appropriation right to the use of the water.

The greatest influence on the Frenchman Creek comes from those wells that are within a 3 to 5 mile distance from the streambed. In 1963, the legislature prohibited pumping for irrigation purposes from pits located within fifty feet of a stream bank without a permit. The theory behind the law was that such a location would be actually pulling water out of the stream. It has now been determined that water can be pulled from a stream at a distance greater than fifty feet.

A court case has occurred in Colorado that is very similar to this proposed one. As a result of the case, several irrigators were phased out along the South Platte River near Brush, Colorado. The Irrigation Districts should not expect results such as these for the water laws in Colorado are very comprehensive. The effect of such a suit would be: (1) to slow down (if not stop) the development of irrigation wells in

the Chase area by making the future uncertain or at least questionable, (2) to bring to the attention to the legislature the urgency of the need for surface and groundwater management and (3) to make sure that any groundwater management plan includes a relationship of groundwater to surface flows.

Summary

The groundwater irrigators of Chase County are effectively taking water away from the Frenchman Valley and H & RW Irrigation Districts. While this is putting a strain on the management abilities of the Districts, there is no serious shortage. However at the present growth rate, there could be serious problems in the future. The strain on the Districts could be alleviated by increasing the efficiency of water use. At the present time the prosperity of the Chase area would probably more than pay for some of the changes that are needed by the Districts.

The first to be affected by the uncontrolled development of groundwater would be the surface water irrigators. The Frenchman Creek would not have a large enough base flow to provide the necessary water.

The second group of people affected would be the groundwater irrigators themselves. Given the slow recharge rate and the relatively fast withdrawl rate, the landowners are mining the aquifer. When the economic reserves of the aquifer are exhausted, the area will have to go through a negative multiplier effect, similar to the one the areas of surface water irrigation will have proviously had to go through.

What is needed is groundwater and surface water conjunctive regulation. This regulation should be from legislative action based only on good scientific data. With sufficient planning and projections, further development of water resources can continue without the fear of shortages or overdevelopment.

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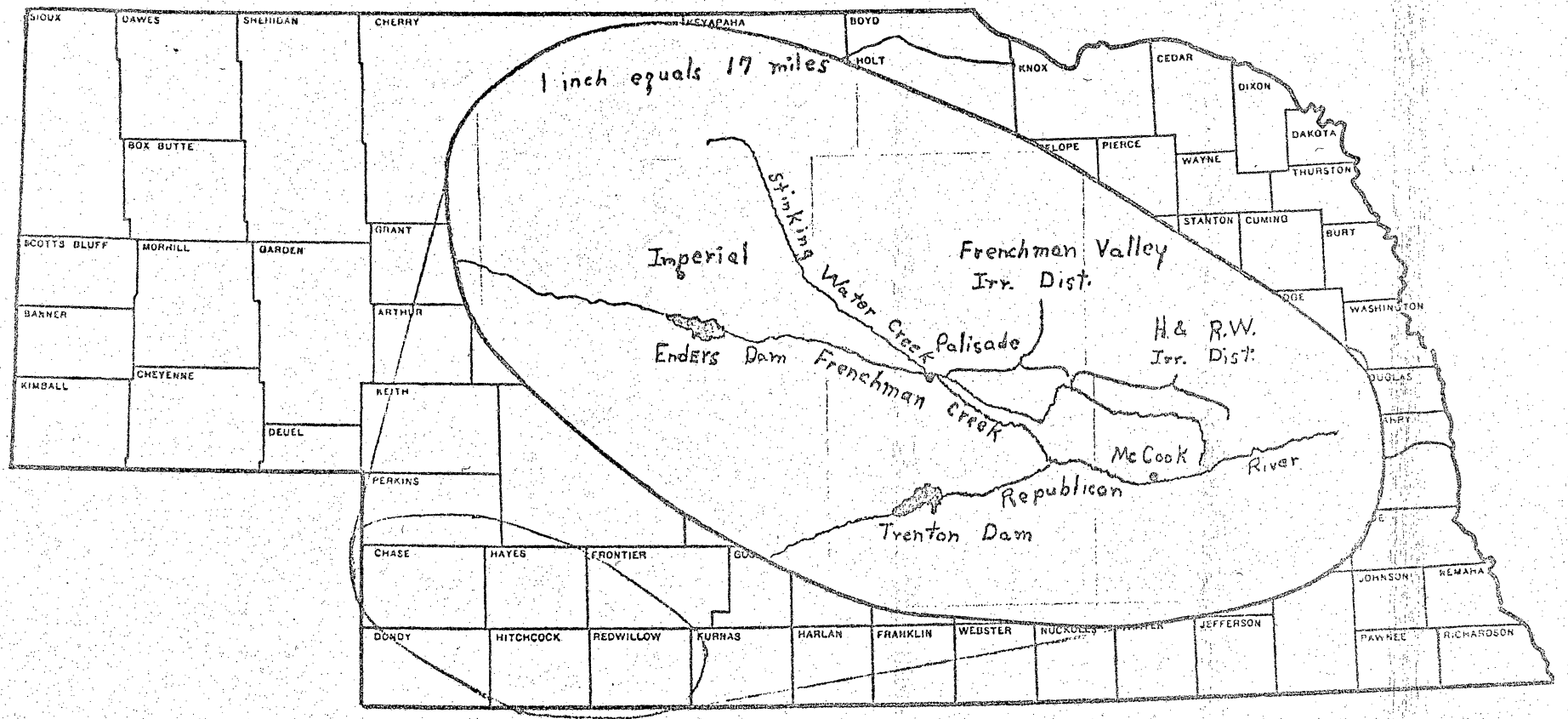

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