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Opportunities for Artificial Recharge

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Put "dirty" water back underground--I'd rather run out of water. This is the attitude many people have had toward artificial recharge in the past, and--sure enough--they are running out of water.

Water used for 75 percent of irrigated farming in Texas comes from underground formations called aquifers. Over-pumping has seriously depleted the supply of underground water in the aquifers, some of which are not capable of natural replenishment. Artificial recharge is a method whereby surface water--rainfall and irrigation run-off--is put back in to the underground aquifer.

Many agricultural areas through out Texas are supplied with water from a ground water source and are facing significant lowering of water levels and reduction in pumping capacities.

Last summer's drought emphasized the unreliability of surface water to maintain the high productive level of our agriculture, and because of this, our shallow ground water reserves are our only reliable source of water for crop production. This means we must protect our shallow ground water reserves from depletion.

Ground water is especially important to Texas where 70 to 75 percent of all water used is ground water, and essentially all of this is pumped from less than 500 feet below the land surface. Because distribution of ground water is statewide--in contrast to surface reservoirs which are located only in central, south and east Texas--the need to protect the ground water reserves from depletion is vital. This pressing need to protect our shallow groundwater reserves in the irrigated regions where rainfall is limited and natural recharge replaces only a fraction of water being pumped presents tremendous opportunities for artificial recharge.

Not Dirty

First of all the "dirty" stigma is unwarranted. Most of the "dirty" water that would be used for artificial recharge comes from high intensity storms and is usually top quality water because of the dilution of dissolved inorganic materials. A study by Texas Tech University indicated that detailed analyses of approximately 220 samples of water collected in the lakes and an equal number of sediment samples collected from lakes revealed that the quality of water collected in High Plains playa lakes is generally superior to the quality of the water contained in the underlying aquifer in terms of the amount of dissolved materials.

Playa lakes are natural ground depressions in a relatively flat plain which collect water. Vast amounts of water accumulate in these surface reservoirs. Leon Hill formerly with the Bureau of Reclamation has stated, "The high quality water presently being lost to evaporation from the playa lakes over the area is the only significant source of undeveloped water left on the High Plains."

Pollution Not Serious

Potential pollution of the aquifer from recharge water, which is runoff from agricultural lands, does not appear to be a serious problem. These runoff waters are usually very low in chemicals normally applied to agricultural lands. While the pollution question must be answered about specific sites, it does not appear to be a serious limitation to the recharge of playa lake water.

The Ogallala formation in the High Plains of Texas is an example of a ground water aquifer in a semi-arid region where the reserves are being depleted. Artificial recharge offers the opportunity to help reduce the rate of depletion, and with an outside additional source of water, to replenish the aquifer as well as reduce evaporation losses and reclaim land subject to flooding.

Underlying one of the most important agricultural regions in the United States, the Ogallala contains 45 percent of all the ground water in Texas. It is estimated to have 280 million acre-feet of recoverable water. (An acre-foot of water is the amount of water required to cover one acre of land one foot in depth.) Like other aquifers in the state, the Ogallala is experiencing a declining ground water level. For example, the water level near Plainview in Hale County has dropped from 70 to 110 feet below the surface since 1956--amounting to 2.2 feet per year. This dewatering of the aquifer has created opportunities for artificial recharge.

The reason for declining ground water level and depletion of the ground water source in the High Plains is that the Ogallala formation is hydrologically isolated. The Pecos River to the west and the Canadian River in the north are 300 to 400 feet below the base of the aquifer. Therefore, the only source of water available to replenish the Ogallala formation is the water pumped on the land which percolates back to the ground water aquifer, plus the water that collects as rainfall in approximately 20,000 playa lakes that dot the High Plains.

Playa Lakes

These lakes vary in size from less than an acre to more than 250 acres in size. They annually collect between two and three million acre-feet of water. Studies show that 15 to 57 percent of this water percolates back underground. Unfortunately, the 57 percent is in the southern sandy areas where there are small lakes; whereas the 15 percent is in the northern two-thirds of the High Plains area.

If water is allowed to remain in these lakes, evaporation accounts for great losses. During the summer when 75 percent of the rain falls, 85 percent of the total evaporation occurs. A 100-acre playa lake can lose an average of 600 gallons every minute during July.

Not only are vast amounts of water lost; some 400,000 to 500,000 acres of land are lost from production annually because of flooding during periods of intense rainfall. Artificial recharge could help by saving vast amounts of water and by reclaiming land. If only $100 per acre were grossed from the 400,000 acres now being lost, it would improve the economy of the area some $40 million.

Recharge Methods

Several methods of artificial recharge have been studied in the Texas High Plains. Studies dealing with both basin recharge and well recharge methods are being conducted at the Southwestern Great Plains Center at Bushland. They have demonstrated that with simple water clarification systems, playa lake water can be recharged successfully by either method. Artificial recharge by pressure injection was investigated by Texas Tech University. Researchers using this pressure method were able to inject water into the Ogallala at rates of 2800 gallons per minute. Such a method may be of value in areas of land subsidence.

At the Halfway Station of Texas Agricultural Experiment Station at Lubbock, formerly High Plains Research Foundation, recharge through multiple-purpose wells and lake pump-recharge systems are being studied. A multiple purpose well is basically an irrigation well that has been modified so that it can be used as a recharge well, a lake pump, and an irrigation water return system. The multiple purpose well is located next to the lake so that recharge is by gravity. Artificial recharge of surplus runoff water replaced 60 percent of the total amount of water pumped for crop production from two multiple-purpose wells being studied in Hale County. For the period from January 1969 through 1974, a total of 1660 acre-feet was pumped while 997 acre-feet were recharged through the same two wells.

In a new project started in 1974, lake pump-recharge systems are now being studied. Water is pumped from the lake and back into an existing irrigation well that has been modified for recharge. This method offers tremendous potential. If the 67,000 wells in the High Plains could be recharged with only 300 gallons per minute for just four months, approximately 10 million acre-feet could be placed underground.

By using a lake pump-recharge system in 1974, a well was recharged with runoff water equal to the amount that was pumped from that well for crop production. Similar recharge systems have been successfully used in the Edwards-Trinity (Plateau) near Kerrville, in the Alluvium near El Paso and Midland, and in the Carrizo-Wilcox in Dimmit County.

Artificial recharge has potential

- as a means of partially "curing" depletion,
- as a method of reducing or; eliminating land subsidence, and
- as a way to fight salt-water imbalances or intrusion.

Hence, it is being recognized for its benefits rather than its drawbacks. Frank Rayner, manager of the High Plains Underground Water Conservation District No. 1 in Lubbock says, "Artificial recharging of aquifers is indeed, from the standpoint of an engineer, a beneficial use. The subsurface reservoirs are natural storage areas for excess surface water supplies. I believe it can be safely predicted that subsurface storage and retrieval of surface water will eventually become a primary facet of most water supply systems.

"Ground water has been pumped from distant locations and recharged near cities for peak summer needs. This beneficial use (subsurface storage) of ground water has been well established, and there is no reason that such practices should not be included as a beneficial use of surface water," he added.

Agricultural Engineer Arland Schneider and Soil Scientist O. R. Jones at the Southwestern Great Plains Research Center, Bushland, claim, "The decline of the Ogallala water table can be arrested only by drastically decreasing pumping and/or increasing recharge of the aquifer. Improved water management and technological advances would reduce the amount of water pumped while artificial recharge of storm runoff or imported water would increase recharge to the aquifer."

It was once stated that "Pandora's box" was opened when artificial recharge research was started in 1954 on the High Plains. Yet today, some areas in the High Plains are completely out of irrigation water, and many other areas are faced with reduced pumping rates. Had artificial recharge been utilized for these 20 years, many of these areas might still have water.

As most ground water aquifers in Texas don't have another 20 years to "waste," now is the time to look into--OPPORTUNITIES FOR ARTIFICIAL RECHARGE--a way to protect our shallow ground water reserves.
Technical research on artificial recharge has outdistanced research in both the economic and implementation aspects of this approach to water conservation.

Pertinent questions remain unanswered in these areas:

- What will be the cost of equipment, installation, and operation?

- Is it an expenditure the individual farmer can undertake?
- If not, who pays?
- Is a local recharge agency needed?
- Once deemed necessary, how long would it take for artificial recharge to become a widespread means of water conservation?

"Opportunities for natural recharge," in the light of realities--rapid depletion of ground water and enormous loss of surface water through evaporation--seems to be a euphemistic label. Since substantial quantities of water which could be stored every year are wasted, it would be prudent to move ahead quickly in the research of economics and implementation of artificial recharge.
--*J.R. Runkles*

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Advantages

- While most water conservation practices are designed to reduce the amount of water used, artificial recharge can be used to stabilize declining water levels and, with an adequate supply of water, replenish dewatered areas.
- Losses due to evaporation and transpiration which can be high in surface storage will be largely eliminated by underground storage.
- Underground reservoirs have a built-in distribution system, although it is limited in some cases by the transmissibility of the aquifer.
- Wells already drilled in ground water aquifers can serve as surface distribution systems.
- Land subsidence can be reduced or eliminated by pressure injection.
- Salt-water intrusion can be controlled.
- Adverse salt-water balances can be prevented by the addition of fresh or less saline waters.
- Land subject to flooding during periods of high rainfall can be drained and put into production.
- Pumping and well construction cost increases can be prevented by maintaining or raising water levels.

Disadvantages

- Recreational facilities that would be available with surface storage are precluded.
- Water must be pumped from the underground reservoirs for surface distribution.
- Possible chemical change in ground water quality may occur due to dissolving of soluble materials in underground formations.
- Possible contamination of ground water could result in cases of excessive surface spills of persistent materials.

Ask the Man Who Owns One

"Every playa lake located over a suitable aquifer formation should have a recharge well," contends Plainview Farmer Paul Stukey, whose first recharge well has been in continual use since 1960.

"Thousands of acre-feet of water could be stored for future use instead of being lost to seepage and evaporation. Land in the drained area could be reclaimed for pasture and crop production," he added.

Stukey maintains his positive view of artificial recharge even though he has experienced some of the problems associated with the system. One well he drilled in 1966 has lost part of its yield because it recharged "too long and too fast," but he is confident he can restore the yield.

Across the lake from Stukey's first recharge well is a second well drilled in 1965. Both multi-purpose wells continue to yield a good supply of water without evidence of clogging. Discussing his own wells and two drilled on another farmer's lakes, he reported satisfaction because "we followed the prescribed plan closely and provided a large deep pit for the solids to settle in." Stukey favors a long narrow pit because it is easy to clean out.

Probably the greatest problem he finds in recharge wells is that most of them pump some sand, causing the pump to wear more rapidly than the pump in a non-recharging well. He explained that a sand pit can be used on the top side of the field and the water distributed from an open ditch.

Actual cost of a recharge well, he claims, is not much greater than a regular irrigation well. Expenses include a waterline to the top end of the field, gas or electric line, gate valve, intake pipe, cement, a screen and settling pit.

Items mentioned above would cost about $1300 at today's prices. According to Stukey, there has been some discussion about Agricultural Conservation Program help for farmers wishing to recharge their lakes. At present, the only assistance has been a 30 percent cost-share program for laying irrigation waterlines.

Yet it is the extra cost that discourages some High Plains farmers from recharging, he says. To those reluctant irrigators, Stukey declares that water saved and land reclaimed will more than offset the extra expense of the recharge well.

"Many times conservation receives a low priority or is simply postponed," he feels.