Economic feasibility of on-farm reservoirs for irrigation water

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DECLINING groundwater levels and institutional and economic barriers to the use of surface water supplies threaten the continuation of irrigated crop production in many parts of the Grand Prairie region of Arkansas. A study was conducted to evaluate the economic feasibility of constructing more on-farm reservoirs for irrigation use rather than drilling new irrigation wells.

Reservoir costs include construction, embankment stabilization and treatment, pumping plant costs, seasonal operating costs and the value of foregone production. The cost savings derived from constructing and operating a reservoir compared to a well system must exceed the net value of the crop production foregone at the reservoir site in order for construction to be economically desirable.

Present value of foregone production was estimated on the basis of economic returns as reported in the 1983 Arkansas Rice and Soybean budgets and assuming prices of $4.90/bushel for rice and $6.00/bushel for soybeans, with a rotation of two years in soybeans and one year in rice (S-S-R) over 50 years discounted at 7⅝%. The results show values ranging from $298 per acre for soils yielding 20 bu/A of soybeans and 100 bu/A of rice to $1,207 per acre for soils yielding 30 bu/A beans and 120 bu/A rice.

Table 1 shows the amount of seepage in acre feet per year, the acres of watershed required to fill the reservoir assuming a 50% delivery ratio, the present value of costs of a well system equivalent to the reservoir, the present value of the costs of the reservoir system, and the difference between the present value of the costs of the well and reservoir systems for selected hydrologic soil groups of Arkansas County. The difference reported in the far right column is considered the maximum value of foregone production allowable to make the reservoir alternative more attractive than the groundwater alternative.

Table 2 shows the value of foregone production from 30 acres of land in a S-S-R rotation discounted at 7⅝% under a range of rice and soybean prices and a yield of 25 bu/A soybeans and 110 bu/A rice. The solid line marks the economic feasibility boundary for reservoir construction for a reservoir four feet deep. Reservoir construction is economically feasible at any combination of prices to the left of the feasibility boundary. At these prices the savings from reservoir use are more than the value of foregone production. Thus, as long as soybean prices are $7.25/bu or less, rice prices can be as high as $4.90/bu and maintain a profitable situation for the use of land to construct a reservoir instead of investing in a new well.

The starred line in Table 2 represents the feasibility boundary for reservoirs five feet deep and the dotted line is for a depth of six feet. Given the S-S-R rotation, the economic feasibility of reservoir construction is much more sensitive to changes in soybean prices than it is to changes in rice prices. At prices of $4.90/bu of rice and $6.00/bu for soybeans, the value of foregone production is less than the difference between the present values of well and reservoir costs. Thus, at current commodity prices, a new reservoir is a cheaper source of water than a new irrigation well. Since investment costs per acre foot of storage decline with increasing reservoir capacity, the larger reservoirs would be economical over a larger range of prices and yields than the smaller reservoirs. In all likelihood, the real cost of energy for irrigation pumping will rise faster than real commodity prices. This assumption and the decreasing water table would cause the present cost of the well alternative to rise more than the reservoir alternative and make the construction of reservoirs more desirable.

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Table 1. Characteristics and economic considerations for constructing a 30-acre reservoir, 5 feet deep with 123 acre feet capacity in Arkansas County in 1983.

Soil	Hydrologic Soil Group	Seepage ac ft/yr	Acres of Watershed	Present Value of Costs: Well	Reservoir	Diff.
				---------- $ ----------		
Acadia	D	24.5	154.9	86,079	53,664	32,415
Amagon H-S	D	8.0	135.4	86,079	53,151	32,938
Calhoun	D	15.2	143.9	86,079	53,375	32,704
Crowley	D	16.0	144.8	86,079	53,400	32,679
Falaya	C	73.7	299.0	86,079	55,196	30,883
Grenada	C	12.3	197.1	86,079	53,285	32,794
Herbert	C	167.6	454.9	86,079	58,118	27,961
Loring	C	46.0	253.1	86,079	54,334	31,745
Sharkey	D	1.6	127.8	86,079	52,952	33,127
Norwood SL	B	73.7	446.3	86,079	55,196	30,883

Table 2. Net present value of foregone production[1] for a two-year soybean, one-year rice rotation: 30-acre reservoir, moderate productivity soil (Yield Per Acre: Soybeans-25 bu., Rice-110 bu.)

Soybean Price	Rice Price (dollars per bushel) 4.60	4.90	5.20	5.50	5.80
$/bu.	----------	----------	$	----------	----------
5.50	15,227	19,622	24,016	28,411	32,805
5.75	16,709	21,104	25,498	29,893	34,287
6.00	18,191	22,586	26,980	31,374	35,769
6.25	19,673	24,068	28,462	32,856	37,251
6.50	21,155	25,549	29,944	34,338	38,733
6.75	22,637	27,031	31,426	35,820	40,215
7.00	24,119	28,513	32,908	37,302	41,696
7.25	25,601	29,995	34,390	38,784	43,178
7.50	27,083	31,477	35,871	40,266	44,660
7.75	28,564	32,959	37,353	41,748	46,142
8.00	30,046	34,441	38,835	43,230	47,624

[a]Discounted at 7 ⅝% for fifty years.
Values left of lines represent prices at which a reservoir is more economical than a well at reservoir depths of 4 feet ________, 5 feet * * * * * and 6 feet ....

Hydrolysis of phytate phosphorus by young rabbits

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APPROXIMATELY two-thirds of the phosphorus in feed ingredients derived from seeds and grains are present as phytate, the salts of **myo**-inositol hexaphosphate. Phytate complexes with cations, primarily calcium, in the digestive tract of animals. Calcium phytate is one of the most insoluble salts of phytate. Once this complex has been formed, the phosphorus cannot be utilized by animals unless the phosphoric ester is hydrolyzed, a process which requires phytase. The phosphorus in phytate is unavailable to monogastric animals, but phytate can be hydrolyzed by ruminants because of microbial phytase in the rumen. An experiment was conducted to determine if phytate is hydrolyzed in the digestive tract of rabbits, which are pseudoruminants.

New Zealand White-Californian crossed rabbits were raised at the University of Arkansas Experiment Station until they were weaned at five weeks of age. At weaning, the rabbits were housed in galvanized metal metabolism cages measuring 45 × 42.5 × 32.5 cm. The cages had wire mesh floors to allow free passage of urine and feces into collection pans. Two rabbits of the same sex and similar size were placed in each cage. One cage constituted a replicate, and there were eight replicates per diet. There were equal numbers of male and female rabbits on each diet. The experiment was conducted in a temperature-controlled room with a range of 20 to 22.2 C, and the room was illuminated 24 hours per day.

The compositon of the basal diet is shown in the table. The dietary treatments were the basal diet or blends comprised of 60% basal diet plus 40% of corn or wheat shorts or 75% of the basal diet plus 25% of soybean meal or wheat bran. The feed was pelleted in a small laboratory pellet machine (California Pellet Mill Co.). The pellets were 4 mm in diameter and about 5 to 8 mm long. Approximately 10% water was used as a pellet binder.

The rabbit pairs were randomly assigned to an experimental diet. They were fed the experimental diets free choice for a one-week adaptation period followed by a five-day collection period. Fresh water was provided at all times in individual stainless steel watering cans attached to each cage. During the collection period, fresh feed was weighed daily and uneaten feed was reweighed and discarded. Feed intake was recorded daily for each pen of rabbits during the collection period.

The cages were equipped with stainless steel pans for collection of feces and urine. Feces were collected from each cage at the same time daily and dried overnight in tared aluminum pans at 55 C in a forced draft oven. After drying, the fecal samples were allowed to attain equilibrium with the air moisture for approximately one hour. They were then weighed and frozen in air-tight plastic bags.

At the end of the collection period, the daily fecal samples were thawed and pooled by replicate. Each pooled replicate of feces was cleaned to remove hair and ground through a 1 mm screen in an intermediate model Wiley Mill. A subsample was taken from each ground composite and stored in air-tight containers until analyzed. Each diet was sampled at the beginning and again at the end of the collection period. The two samples from each diet were composited, ground, and stored similar to the fecal samples. Triplicate samples of feed and feces were used for analyses of phytate phosphorus.

Corn, SBM, wheat shorts and wheat bran all contain phytate and are ingredients commonly used in animal feeds. Phytate phosphorus in the diets (mg/g of diet) were: basal, 2.11; basal + soybean meal, 2.51; basal + wheat bran, 4.19; basal + wheat shorts, 3.85; and basal + corn, 1.77. No phytate was found in the feces of rabbits fed any of the diets, which indicates that all of the phytate phosphorus was hydrolyzed from the diets. Neither the source of the ingredients fed, nor their phytate content, influenced the amount of phytate hydrolyzed.

The ability of rabbits to hydrolyze the phytate phosphorus in diets adequate in calcium suggests enzymatic hydrolysis, possibly by bacterial phytase in the cecum. Most rations formulated for monogastric animals are based on "available" rather than total phosphorus. These data suggest that rabbit rations can be based on total phosphorus.

Composition of basal diet

Ingredients	IFN[1]	%
Yellow corn	4-02-935	46.60
Soybean meal	5-04-604	9.50
Dehydrated alfalfa meal	1-00-023	30.00
Wheat shorts	4-05-201	11.80
Dicalcium phosphate	6-01-080	.75
Ground limestone	6-02-632	.25
Salt		.50
Vitamin premix[2]		.50
Trace mineral premix[3]		.10

[1]International Feed Number.

[2]Furnished the following per pound of diet: vitamin A, 3,000IU; vitamin D_3, 1000ICU; vitamin E, 3IU; menadione sodium bisulfite complex, 2mg; riboflavin, 3mg; niacin, 30 mg; d-calcium pantothenate, 5mg; choline chloride, 225mg; thiamin, .5mg; pyridoxine, 5mg; vitamin B_12, 5ug; d-biotin, 24ug, folacin, .3mg; ethoxyquin, 57mg; and selenium, 45ug.

[3]Furnished the following per pound of diet (mg/lb): Mn, 45; Fe, 45: Zn, 45; Cu, 5; I, .45; Co, .5.

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