corn plant or the ear are transitory and the tillage systems studied did not differ significantly in yield, producers considering a change to a minimum tillage production system should be able to do so with a minimal concern for increased severity of this particular pest problem. This is not to say however that further studies on other pests and their relation to minimum tillage are not required before a general recommendation for change to that method of production can be made.

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EVALUATION OF A WATER CONVEYANCE AND RECOVERY SYSTEM FOR SEEP IRRIGATION[1]

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Additional index words. economic operating costs, ownership costs, investment cost.

Abstract. **Insight is provided regarding water use and investment cost in the evaluation of a water conveyance and recovery system for seep irrigation of vegetable crops. The analysis evaluates a 200 acre farm with a water management system which conveys irrigation water through PVC pipe from a holding pond to the areas irrigated. The system also has the capability to recover runoff water and pump it back to the holding pond. The quantity of water required to be pumped from the deep well was 38% of the total use, while the remainder of the water came from recovery water pumped from the catch basins, rainfall and natural ground water seepage. However, the total cost of the water conveyance and recovery system adds 72% to the costs of the water conveyance system.**

The value of Florida's vegetable production was estimated at over $758 million in 1978-79, which amounts to more than one-fifth of the total cash receipts received for all agricultural commodities (1, 3). Currently, more than 90% of Florida's vegetables are grown with the assistance of irrigation. Because of the importance and contribution of irrigation to vegetable production, any major adjustment in irrigation practices could have a large impact on Florida's agricultural sector and entire economy.

The Florida vegetable industry has expanded significantly over time primarily due to the warm climate (permitting fall, winter and spring production in most areas), and an apparently inexhaustible supply of fresh water. However, the demand for water has rapidly increased due to the growth and expansion of Florida's population, industry and agriculture. As a result of the increased demand for water over the past 30 years, water withdrawal rates often exceed the natural recharge of water supplying aquifers and a possible water deficit situation could easily develop in the future.

Therefore, the economic benefits accruing from irrigated crop production to the economy of Florida may be extended into the future by a more efficient water distribution system. In an effort to reduce water loss and to provide a demonstration of water management, the Bradenton Agricultural Research and Education Center (AREC) has constructed the facilities to convey and recover water from its 200 acre farm by utilizing PVC pipes and pumps and a reservoir for storage.

The use of the PVC pipe conveyance and recovery system has several advantages:

1. Reduces total water pumped from deep wells.
2. Reduces energy requirements and pumping costs.
3. Contributes flexibility to the irrigation system for transporting water.
4. Enables more acres to be irrigated with a given quantity of water. Of course, the PVC pipe conveyance and recovery systems have some disadvantages:
    1. PVC pipe irrigation systems require larger capital investments.
    2. Producers must learn how to manage the system.
    3. The PVC pipe irrigation system may require increased pumping pressure beyond the capacity of the existing pump for open ditch irrigation.

Analysis

This study evaluates the initial investment for installing the PVC pipe water conveyance and recovery system (2). The investment components of a PVC pipe irrigation system

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are composed of essentially pipe materials and labor costs. The size of pipe, quantity and pressure ratings of pipe all influence the systems' investment. Producers can use PVC pipe ranging in size from 4-12 inches with a choice of pressure ratings for pipe larger than six inches of 80 psi, 100 psi, 125 psi and 160 psi. The selection of the size of pipe, quantity and pressure rating of pipe necessary depends on: distance to the field, number of acres to be irrigated, soil type, slope of the field, water requirements of the crop, and potential pump pressure.

Numerous individuals, such as producers, pipe and pump suppliers, USDA Soil Conservation Service personnel, well drillers and other individuals who specialize in designing and installing irrigation systems provided information to design the system. In addition, several industry representatives, area pipe distributors and installers contributed cost data.

Figure 1 illustrates the PVC pipe water conveyance and recovery system developed on the AREC farm. The diagram illustrates the flow of water through the water supply system (PVC pipe) beginning with the main well and pumped into the lake (5 acres). Upon demand, water is pumped through another water supply line from the lake to the area desired for irrigation. At this point, water is released into open lateral furrows for irrigation purposes. The water drains through the open furrows to the end of the field where it empties into drainage ditches that convey the unused water (surface runoff) to the catch basins. The water is then pumped from the catch basin back to the lake for recirculation.

Using the above described system, irrigation water is conveyed to the field through underground PVC pipe (water supply system) of varying size depending on the need dictated by the area to be serviced. In addition, water control valves were installed for each lateral furrow so that water flow in individual furrows could be regulated or cut off when not in use.

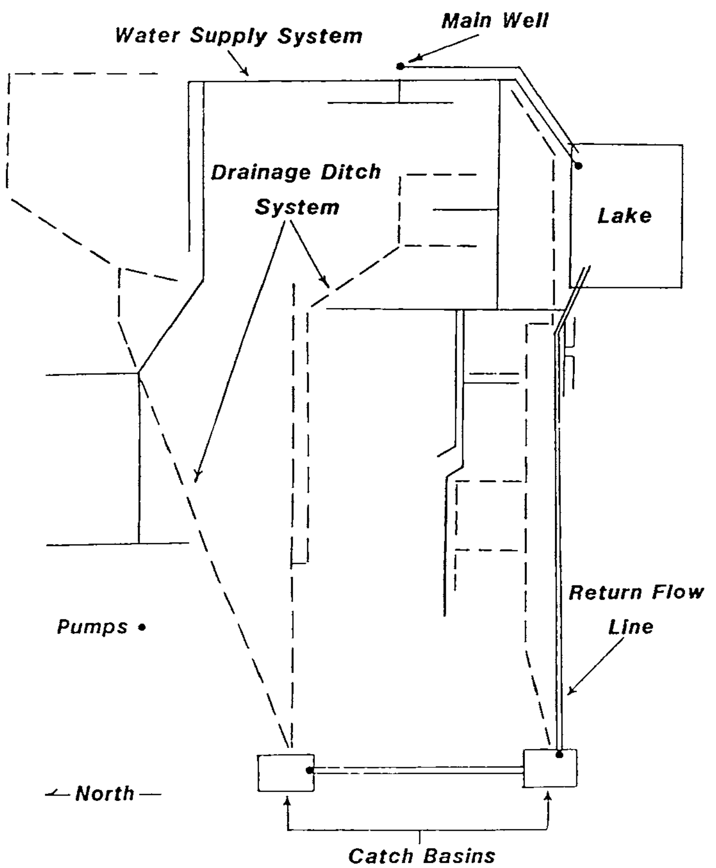

Fig. 1. Outline of water conveyance and recovery system.

After compiling the various cost data on PVC pipe materials and installation labor requirements, a total investment cost was calculated. In addition, costs were calculated for obtaining pumps and PVC pipe and constructing a lake, and catch basins to recycle tail water runoff.

Further evaluation of investment cost is necessary because of the various federal programs to assist agricultural producers as well as tax reducing incentives. Producers should consider incentive programs such as the USDA Agricultural Stabilization and Conservation Service (ASCS) cost sharing benefits, income tax implications and the impact of this investment on the agricultural business.

ASCS Cost Sharing Program

Producers installing PVC pipe irrigation systems may qualify for ASCS program cost sharing benefits. In order to obtain funds, the system must be designed and installed to meet certain ASCS standards and specifications.

The cost-share rate is currently 50% of the investment cost not to exceed $3,500. In order to receive maximum benefits, producers should consult the ASCS office before designing and installing a system.

Income Tax Implications

In most cases, the investment costs of the PVC pipe irrigation systems will be depreciated and will qualify for investment tax credit. The investment cost is the amount of capital necessary to purchase the irrigation system (includes pumps, pipe materials, installation labor, and construction of lake and catch basins).

Investment tax credit is determined by multiplying the allowed level of investment tax credit times 10% of the investment cost (level of investment tax credit (%) x 10% x investment cost). The amount of investment tax credit allowed depends on the useful life of the irrigation system. If the system has a useful life of:

3 or more but less than 5 years, 33 1/3% of the 10% credit may be taken.
5 or more but less than 7 years, 66 2/3% of the 10% credit may be taken, and
7 or more years, 100% of the 10% investment credit may be taken.

The PVC pipe irrigation system in this study has an estimated 10 years useful life. Therefore, a producer would be allowed to take 100% of the 10% investment tax credit.

Another income tax implication is income tax liability which depends on taxable income. Taxable income is determined by reducing income by the amount of operating expenses and ownership expenses. Both operating and ownership expenses reduce income, but of major importance in this evaluation is depreciation cost which is a large ownership expense. The investment cost of the PVC pipe irrigation system is a capital expenditure and must be depreciated over its useful life. Therefore, depreciation is a yearly ownership expense which reduces taxable income and is used to recover the decline in value of the irrigation system over its useful life.

The factors necessary to calculate depreciation are investment cost, salvage value, useful life and a depreciation method. In this analysis the straight line depreciation method was used to calculate the annual depreciation as follows:

$$\frac{\text{investment cost} - \text{salvage value}}{\text{useful life}} = \text{annual depreciation}$$

Other depreciation methods, such as declining balance and sum of the year's digits, may be used to more accurately account for the decline in value of the irrigation system when appropriate and to reduce taxable income.

Results and Discussion

The water budget as shown in Table 1 revealed that during the spring season of 1980 only 38% of the water used for irrigation purposes was initially pumped from the main deep well. Approximately 30% of the water pumped from the lake was recovered and pumped back into the lake. The remaining 32% was assumed to have been due to net ground water seepage back into the lake.

Table 1. Estimated water budget during the spring production season, 1980.[z]

Item	Gallons/acre
Pumped water into lake from well	486,037
Pumped water from lake to field	1,263,400
Pumped water from catch basin to lake	384,509
Estimated amount of rainfall added to lake	46,946
Estimated evaporation from lake	74,621
Ground water seeped into lake	420,528

[z]Based on 47 acre inches per season.

The investment cost for the water conveyance system and water recovery system was estimated separately, since each system is different and distinct. The investment costs for the water recovery system was approximately $7,000 greater or 24% larger than the water conveyance system, as shown in Table 2.

Table 2. Estimated investment cost for a water conveyance and water recovery system, 1980.

Item	Dollars
Water conveyance system	
PVC pipe conveyance system	29,987
Investment cost	29,987
Water recovery system	
PVC pipe recovery system	5,873
Catch basin construction	2,160
Lake construction	29,040
Investment cost	37,073

Operating costs in this analysis included labor and electricity costs. The operating costs for the water conveyance system versus the water conveyance and recovery system were comparable, as shown in Table 3. It is important to note that associated with the water conveyance system the electricity costs are attributed to one pump which pumps water from the well, while the electricity costs for the water conveyance and recovery system are due to four pumps used to pump water from the well and transport water to and from the lake. However, the total difference in operating costs between the two systems is only approximately $42 or $ .21 per acre.

The annual ownership costs of each system were largely composed of depreciation and interest costs as shown in Table 4. Total ownership costs for the water conveyance and recovery system was approximately 124% greater than those of the water conveyance system. The per acre ownership costs of the water conveyance and recovery system was $40 an acre greater than the ownership costs of the water conveyance system.

Table 3. Estimated operating costs for a water conveyance system and water conveyance and recovery system, 1980.

Items	Dollars	*Dollars/acre*
Water conveyance system		
Labor	200	1.00
Electricity	4,124	20.62
Total operating costs	4,324	21.62
Water conveyance and recovery system		
Labor	350	1.75
Electricity	3,932	19.66
Total operating costs	4,282	21.41

Table 4. Estimated annual ownership costs for a water conveyance system and water conveyance and recovery system, 1980.

Item	Dollar	Dollars/acre
Water conveyance system		
Depreciation	2,999	15.00
Interest	2,309	11.55
Other ownership costs[z]	1,199	5.99
Total ownership costs	6,507	32.54
Water conveyance and recovery system		
Depreciation	6,706	33.53
Interest	5,163	25.82
Other ownership costs[z]	2,682	13.41
Total ownership costs	14,551	72.76

[z]Repairs, taxes, insurance (4% of investment cost).

The summation of the operating and ownership costs per acre represents the total annual cost of each system, as presented in Table 5. The operating costs of both systems are very similar, while the ownership costs are substantially different. The ownership costs for the water conveyance and recovery system indicates that it requires a much higher capital investment. The total costs of the water conveyance and recovery system is 74% (40.01/acre) larger than the total costs of the water conveyance system.

Table 5. Estimated annual operating and ownership costs per acre of a water conveyance system and water conveyance and recovery system, 1980.

System	Operating costs	Ownership costs	Total costs
Water conveyance system			
Investment		32.54	32.54
Pumping water	21.62		21.62
Total costs/acre			54.16
Water conveyance and recovery system			
Investment		72.76	72.76
Pumping water	21.41		21.41
Total costs/acre			94.17

As can be interpreted from this analysis, producers contemplating investment in a water conveyance and recovery system should compare the operating and ownership costs of the system versus the costs of their existing water conveyance system.

The results of this study under current conditions indicates that an investment in a water recovery system is very costly and unprofitable. However, in the event that a producer was permitted to use only 18 acre *inches* of water (38% of 47 acre inches is the quantity of water pumped from the main well) per season, the production of most vegetable crops would become unprofitable. In this situation, though, the use of the water conveyance and recovery system provides a viable irrigation alternative for vegetable crop production. Therefore, producers should thoroughly evaluate their individual situation and circumstances before committing themselves to a high capital requirement water recovery system.

Producers that have existing water holding facilities available or have an opportunity to significantly reduce the excavation costs of constructing a lake will be among the first to profitably utilize a water recovery system when conditions permit. For most, the profitable investment in a water recovery system will likely only occur in the event that water becomes a limited resource and the total water recovered approaches the total water conveyed.

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AN INTERMITTENT PERISTALTIC FLUID DRILL FOR VEGETABLES[1]

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Abstract. **An intermittent peristaltic fluid pump has been developed to meter gel with suspended seeds for fluid planting. This apparatus is an improvement over previously developed equipment because the gel and seeds are not recirculated thus reducing seed damage. Since the intermittent pump has a simple mechanical drive it can be powered from a ground wheel and no adjustments are necessary for variations in speed.**

The concept of planting seeds suspended in a fluid gel medium was originated by J. G. Elliott, of the Weed Research Organization, Begbroke, Oxfordshire, England nearly 20 years ago for the replanting of pasture and rangeland with grass seeds in established sod (3). This plant establishment technique has been further developed by the National Vegetable Research Station in Wellesbourne, Warwickshire, England for vegetable and flower crops and is gaining in use and popularity throughout the world (2). This planting technique makes possible first of all the germination of seeds in an ideal environment of temperature and moisture conditions before the seeds are placed in the soil. Sprouted seeds can be planted with minimum damage because the gel medium protects and lubricates them as they are metered through the planting machine and conveyed to the seed bed. In the soil the gel keeps the seed moist and can reduce irrigation requirements. When sprouted seeds are planted more uniform seedling emergence results which in turn leads to more uniform maturity of the crop. Additives such as pesticides, fungicides, growth regulators and small amounts of fertilizers can be included in the gel for improved plant emergence and growth.


Fig. 1. Fluid planter unit.

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