JUSTIFICATION FOR WATER TABLE MANAGEMENT IN GEORGIA

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INTRODUCTION

Water table management (WTM) is the process of controlling the shallow ground water table to enhance crop growth conditions. WTM usually is construed to include three basic practices: drainage (removal of excess water by subsurface or surface systems), controlled-drainage (maintaining a controlled outlet for the drainage system to limit outflow and provide an additional source of water for plants), and controlled-drainage/subirrigation (maintaining control on the outlet, but also having the capability to add water back through the drainage system and artificially raise the water table). Drainage systems are the most elementary of the three and can be installed on a wide array of topographic, soil and land use conditions. Controlled-drainage (CD) and controlled-drainage/subirrigation (CD-SI) systems are limited to areas which have minimal slopes (usually less than 1 percent) and where seasonally high water tables occur. These high water table conditions are an indication of an impeding or restricting layer in the soil which reduces or prevents the percolation/downward movement of water. This paper is primarily concerned with the development of CD and CD-SI systems in Georgia.

The purpose of this paper is to evaluate the application area, federal and state restrictions, environmental and economic constraints, benefits and limitations for the development/expansion of water table management systems in Georgia.

DISCUSSION

Application Area

An area known as the Atlantic coast flatwoods, in the south Georgia Coastal Plain, is conducive to this type technology (Fig. 1). Most of the flatwood soils have a sandy surface layer which allows water to move quickly into the soil. This high infiltration rate combined with a low surface slope reduces the potential for surface runoff, and therefore, erosion is usually negligible. These sandy surface soils do, however, have little capacity to hold water and require irrigation for crop growth in dry years.

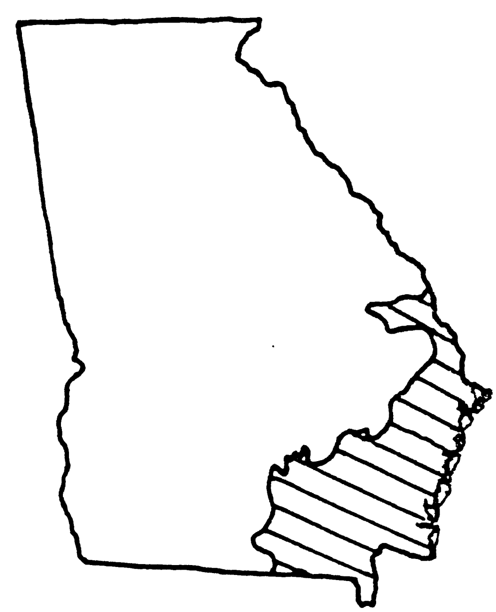

Figure 1. Atlantic coast flatwoods region of the Georgia Coastal Plain.

The sandy surface layer is underlain by a restricting clay layer which prevents deep percolation and causes high water tables during the rainy season. Thus, CD-SI systems are ideal for the area and have been shown to be an effective water management system for growth of blueberries, corn, soybeans and other crops (Shirmohammadi et al., 1990; Carter et al., 1988; Doty and Parsons, 1979).

The land area available for WTM in Georgia is dependent on the type of cropping system proposed. The vast majority of the 2 million ha of flatwood soils in Georgia are currently under forest management. About 160,000 ha of the 20 counties (where the majority of the es (such as pitcher plants) are present only in areas remain wet. As plants become less tolerant to wet itions, the classification grades from facultative wet to tative, facultative upland, and upland plants. The ılence of hydrophytic vegetation is determined by visual ction on a grading system to determine if the area is land. If the area has been altered by man, an adjacent with the natural plant community on the same hydric can be inspected to determine if that area should be ified as a wetland.

veral soil types in Georgia have been proposed for val from the hydric soils list due to the lack of phytic vegetation. The Olustee, Leon, Mascotte, urg and Sapello soil series are the proposed series h have been accepted for removal in Florida. About 00 ha (20% of the hydric soils) in Georgia are ded in these soil series. The soils in Georgia may have difficulty in removal from the list due to the presence spodic layer which is not present on these same soils orida (personal communication, 1990, T. Jarrell, State Scientist, Athens, GA).

he above criteria are directed toward "agricultural nodity crops", i.e., those crops which are considered as nodities. Specialty crops, such as blueberries, and r orchard related crops, are not subject to the above traints for the removal of wetland.

he hydric soils, for the most part, have not been used agricultural production. In Pierce Co., for instance, of the 21 soil series are classified as hydric which esents 34.5% of the county land area. Commodity crop uction figures for soils in the county were estimated in ate 1960's. None of the hydric soils showed potential crop production (USDA, 1968). In the mid 1980's, 00 ha were in crop production in Pierce Co. with the rity of the production estimated on the more ageable upland soils. The best soils for the lopment of WTM systems may not be the hydric soils. increased management required to maintain crop uction on the hydric soils as compared to upland soils preclude the use of these soils. The ability to design tem which can utilize the better agricultural soils, and tain adjacent hydric soil/wetland areas, is a benefit of M systems (Fig. 2).

urrently, no state restrictions exist (that we are aware or the development of WTM system for agricultural However, potential state level restrictions may be coming in the near future related to water quality ressing both ground and surface water).

er quality issues

ainage systems have been shown to provide increased ement of agricultural chemicals (Evans et al., 1989). ever, CD and CD-SI systems have been shown to ce potential chemical losses to surface and deep ground

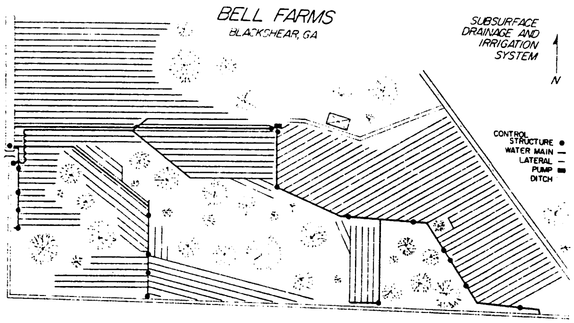

Figure 2. Bell farms controlled-drainage/subirrigation system near Blackshear, GA.

water resources (Evans et al., 1989). The nature of WTM systems reduces the potential movement of chemicals to deep ground water. The restricting clay layer (impeding layer) in the soil is the confining zone for prevention of water movement into one of the primary ground water resources in south Georgia, north Florida and South Carolina known as the Floridan aquifer. Thus, WTM and agricultural practices are effectively shielded from this ground water resource.

A large percentage of rural domestic wells in the flatwoods of south Georgia use ground water which is from 9 and 15 m from the surface. This shallow ground water can be directly impacted by the above ground agricultural activities (whether WTM is present or not). Thomas et al. (1990) found nitrate-nitrogen concentrations in excess of 10 mg/L in the shallow ground water under a CD-SI system in south Georgia (six percent of the samples collected), but no outflow samples exceeded 10 mg/L. Limited studies have been instituted to investigate the current status of water quality in rural wells, but more comprehensive research programs designed to analyze the cause and effect relationship of particular water quality situations are required.

The need for effective and efficient agricultural chemical application is very critical. To reduce the potential for excessive nutrient leaching, nutrient applications (especially nitrogen) should be sufficient for acceptable and economically sustainable crop growth. But, how much nutrients do we need? When is the best time to apply nutrients and chemicals? Are alternatives to pesticides available and are they being applied? These are all questions which must be answered by good quality research programs.

Concerns have been expressed about agricultural water being "short circuited" with a drainage system, i.e., the natural degradation processes which occur on nutrients (such as denitrification) and pesticides will be by-passed and allow these chemicals to be introduced into surface waters before they have been degraded. In CD and CD-SI systems, water is held in the soil during the time of chemical application. Only under excess water conditions (high rainfall events) do these systems respond in a drainage mode to remove the excess water. At this time, rainfall provides an additional source of water for dilution of chemical concentrations. Obviously, proper management, timing and minimization of chemical applications are keys to reducing potential problems.

North Carolina experienced strong opposition to any form of "drainage" system from personnel associated with coastal and marshland fisheries. Their concern was the potential for quick influx of fresh water during critical spawning stages for some types of fish from the drainage water. Research and education in North Carolina has shown that this is not a problem with CD and CD-SI systems.

One other concern is the effect of agricultural development on wildlife habitat. As agriculture removes the cover afforded by forests, the ecological balance of the wildlife will change. Obviously, a strong environmental plan for development of flatwood soils is needed. However, all the areas would not require development. WTM systems can be designed to conform to the land and the better soils, rather than modifying the land to conform to the system.

Economic constraints

WTM systems are not cheap. Estimates for the cost of installation are between $1,300 and $2,600 per ha. How could a farmer hope to pay for this type of system considering the current agricultural glut, farmers going bankrupt and prices for farm commodities? Granted, WTM will most likely not be an acceptable alternative for row crop production for many of the crops grown in Georgia. However, high value crops such as peanut, tobacco, vegetables, fruits, and some nuts have a strong potential under WTM. Unfortunately, little is known about the response of these crops under high water table conditions.

If agricultural development occurs on these flatwood soils, irrigation is required to remove the potential risks due to climatic variability. Several investigations have shown an economic benefit for installing CD-SI as compared to center pivot systems on soils with high water tables (those that require improved subsurface drainage). The low pressure and utilization of gravity flow when subirrigating decreases the energy needs as compared to sprinkler systems, which is a major component in irrigation costs (Worm et al., 1982; Massey et al., 1983).

What about the future?

As we look to the future of agricultural production, current trends in global climate have shown an increase in drought periods in many of the major food producing areas of the United States and other countries. Water supply and salinity problems are increasing in the mid-west and California in particular. If current trends continue, dryland crop production, irrigation with saline water and agricultural commodity gluts may be a thing of the past.

Erosion is still a major problem in many crop production areas. The Sodbuster component of the 1985 Farm bill is designed to reduce erosion problems, but more restrictive legislation may be on the horizon. The most logical and historical alternative to crop production on these erodible soils is forest management. As highly erodible land is removed from crop production, the need for additional cropland is projected to grow.

Population trends show a continued influx of people into the warmer climate of the southern United States. Projections have placed one-half to two-thirds of the population below the Mason-Dixon line by the year 2000. As the local population increases, the need for more readily accessible agricultural commodities will increase.

Georgia resides in a position with immense opportunities on the horizon. Atlanta is one of the prime development and business locations in the southeastern U.S. and is projected to have increased growth. As in the past, legislative measures have followed a need. As the availability of agricultural commodities decrease and prices increase, changes will occur. The two alternatives are to grow our own or import from other countries.

Georgia has the people, climate, soils, land area, and water resources to allow expansion of agricultural production in the future. WTM, especially CD and CD-SI, has enormous potential in south Georgia. The technology has been shown to be effective, but many questions remain unanswered.

CONCLUSIONS

Water table management is a feasible alternative for irrigated agriculture in the flatwoods region of the south Georgia Coastal Plain. Current Federal and State regulations do not preclude the use of these systems on land that is the most viable for WTM technology.

Economics will be the major driving force for the expansion of WTM in the future. Agricultural expansion in Georgia has potential due to current trends toward a dryer climate, salinity problems in other agricultural areas, projected population increases in the southeastern U.S. and the water resources available in south Georgia. However, alternative agricultural management systems, which are less energy intensive, are needed.

WTM potential can not be realized without research programs which have a holistic approach to agricultural production with environmental and economic concerns being addressed to anticipate, rather than create, problems.

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