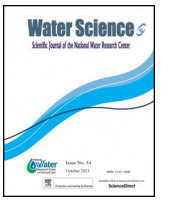
Water Science

ScienceDirect

Water Science 32 (2018) 138–150

journal homepage: www.elsevier.com/locate/wsj



Research Article

The concept of water storage on agriculture lands: Exploring the notion in South Florida

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Received 19 December 2016; accepted 22 February 2018
Available online 18 May 2018

Abstract

Lands in the Everglades Agricultural Area (EAA) can be used for increased water storage in order to relieve coastal estuaries of excess runoff in the rainy season. The goals of this study were: (1) to quantify the environmental and economic tradeoffs of different water storage scenarios using water tolerant sugarcane cultivars; and (2) to quantify the amount of water storage possible in the EAA under different water storage scenarios. A mathematical model was developed to calculate soil depth, soil subsidence, depth to the water table, and water storage for three different sugarcane cultivars with different water tolerances. The results showed raising water tables on farmlands did have the environmental benefits of reduced soil subsidence, extended farm life and increased years of water storage. In addition, raising water tables in the EAA to increase water storage is overall more costly, but yearly costs are very low. Therefore, water storage on farmlands is an affordable interim method of water storage.

Keywords: Water management; Sugarcane; Ecosystem services; Everglades

1. Introduction

The South Florida landscape has changed dramatically over the past century. The development of cities, agricultural areas, canals, dikes, levees, roads and other infrastructure has changed historic Everglades hydrology (NRC-CERGEE, 2005). Hydrological modifications for flood prevention in urban and agricultural areas have critically degraded the Everglades ecosystem, which is a unique environment of global importance (Harwell, 1998; Milon et al., 1999). Now,

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Peer review under responsibility of National Water Research Center.

Production and hosting by Elsevier

https://doi.org/10.1016/j.wsj.2018.02.004

state and federal actions are being undertaken in one of the largest environmental restoration efforts in the world, the "Comprehensive Everglades Restoration Plan (CERP)," to restore the Everglades and surrounding ecosystems of South Florida (Comprehensive Everglades Restoration Plan, 2012; Milon et al., 1999). Doing nothing to restore historic hydrologic flows would have far reaching costs that outweigh any perceived savings (Clark and Dalrymple, 2003; Haman and Svendson, 2006; NRC-CERGEE, 2005).

Moreover, water storage goals can be achieved more cost-effectively by rethinking how our farming systems operate. For instance, by incorporating the ideas of ecosystem services and multifunctional agriculture – where utilitarian and non-utilitarian values are measured to incentivize environmental conservation in public policy – a production-centered system can transform into a system that serves other functions and needs, enhancing both sustainability and profitability (de Fraiture et al., 2010). Croplands in the Everglades Agricultural Area (EAA) could raise water tables during the growing season to provide the ecosystem service of increasing water storage to help meet CERP restoration goals. EEA lands are prime candidates for increased water storage due to (1) their location south of Lake Okeechobee and north of the Everglades; (2) pre-existing hydrological structures (Aillery et al., 2001); and (3) the fact that sugarcane, the primary crop of the EAA, requires large amounts of water (Glaz et al., 2004). Raised water tables on active farmlands would also lead to a better management strategy that would reduce soil oxidation rates, thereby prolonging the economic life of soils and agriculture in the EAA (Aillery et al., 2001; Haman and Svendson, 2006; Morris et al., 2004; Snyder, 2004; Wright and Snyder, 2009).

This research expands on previous research by Aillery et al. (2001) by using newly developed water tolerant sugarcane cultivars to evaluate the costs of increased water storage in the EAA by raising water tables on farmlands. The goals of this study are to quantify the economic and environmental tradeoffs of different water storage scenarios on farmlands using water tolerant sugarcane cultivars, and to quantify the amount of possible water storage in the EAA with these different water table depths. This will allow us to answer the following research questions: (1) What are the measurable environmental benefits, or ecosystem services, of raising water tables on farmlands in the EAA? (2) What are the economic values of the ecosystem services provided by raising the water tables on the farmlands in the EAA?, and (3) Is raising water tables on agricultural lands a more cost effective option than building storage reservoirs on farm lands? Importantly, this study develops an analytical framework for use in future analyses of water storage costs in the EAA.

2. Ecosystem service approaches

The ecosystem service approach aims to measure utilitarian and non-utilitarian values through economic means and thus, provide further incentive for the consideration of environmental issues in public policy (Millennium Ecosystem Assessment, 2005). The underlying idea is that ecosystems function to provide services that are necessary for the well-being and survival of humans. Even though people have become increasingly separated from our natural environments with technology and culture, we are still components of our ecosystems and, consequently, we are dependent upon our environments for the provisioning of ecosystem services. Water management in agriculture provides many opportunities on this front since it is intimately integrated with multiple ecosystems and their various services. A lack of knowledge still exists concerning consequences of past efforts for agricultural water management as well as public perspectives toward water and its allocation, which can differ according to incomes, geography, and availability of water (de Fraiture et al., 2010).

Ecosystem services approaches have previously been used in the Everglades. For example, the Florida Ranchlands for Environmental Services Project (FRESP), funded by the South Florida Water Management District (SFWMD), was the first major project in the region to establish a Payment for Ecosystem Services (PES) program, serving as a model for establishing future programs for crops in the region. All participating ranchers in the program have expressed strong interests in continuing with the scaled-up PES program at the end of the pilot program, which will offer ten-year contracts totaling roughly $43 million with capitol and annual payments (Horne, 2011). The FRESP has shown that farming and Everglades restoration can be mutually compatible. In addition, SFWMD carried on a water storage project in 2013 to benefit the St. Lucie Estuary. This will be a three-year pilot project with Caulkins Citrus Company, who has agreed to capture an estimated 6,780 ac-ft of water annually on 450 acres of fallow citrus land. The SFWMD has agreed to invest $1.2 million for the project, amounting to $76 per ac-ft of water storage each year (SFWMD, 2013). Another storage reservoir, C-43 to be located in Hendry County off of the Caloosahatchee River, will help to meet regional water storage goals in a different way. This reservoir will serve to hold excess overflows from Lake