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Adapting Middle Rio Grande Irrigated Agriculture to a Warm Dry Future

Pierfranco Costabile *

Department of Environmental Engineering, University of Calabria, Rende, Italy

Introduction

In order to adapt irrigated agriculture to the growing water scarcity in a desert environment under a predicted warm-dry future, long-term tradeoffs of technologically possible land and water management interventions were examined. The MRG's water budget and potential watershed-scale agricultural water savings were evaluated across 19 different intervention scenarios. The management innovations of growers in implementing deficit irrigation and altering cropping patterns with existing crops, altering cropping patterns with the introduction of new drought- and salt-tolerant alternatives, and the SWAT model's inability to perform scenario simulations are the foundations of the interventions. mIn the face of diminishing river water and likely fresh groundwater depletion in the 21st century, the current crop mix cannot be sustained by the status quo in irrigation management; (2) Current irrigation and cropping practices result in limited water savings; (3) Deficient irrigation of alfalfa or its removal from the crop mix allows for moderate water savings in order to maintain high-value perennial pecan crops, but the region will continue to be susceptible to severe and prolonged droughts [1].

Description

Desalinating brackish groundwater for irrigation, developing water markets to increase flexibility in water use, and switching to relatively drought- and salt-tolerant crops are all potential future agricultural water sustainability strategies in the study area. The significance of adaptive management strategies for maintaining agricultural production in arid and semi-arid regions of the world is emphasized by the increasing susceptibility of these regions to water shortages. Food security and the economy benefit from water conservation and agricultural sector resilience, especially in the face of water scarcity uncertainties. Adaptive irrigation methods like deficit irrigation, partial root zone drying, mulching, and altering crop patterns make it easier to deal with an increasing lack of water. Using remote sensing data and on-farm monitoring, such as soil moisture and evapotranspiration (ET), as well as technological advancements like surface and subsurface drip irrigation, precise scheduling and application are now possible to reduce the need for irrigation. Additionally, practices like partial root-zone drying and deficit irrigation can be implemented without significantly affecting yields during crop growth, when the plant is less susceptible to water stress.

The impact of various cropping and water management strategies on irrigated agriculture's resilience to diminished and less reliable water availability in arid regions like the Middle Rio Grande (MRG) basin, where a significant portion of the U.S. irrigated lands are located, is expected to negatively impact the quantity and quality of water available for agricultural production. Other options include breeding new crops that are tolerant of droughts, growing known crops that are adaptable to droughts, and land leveling to improve water distribution. MRG is an example of a desert environment with water-scarce agricultural watersheds in which heavily irrigated croplands run the risk of becoming more salinized and running out of water as a result of the increasing demand and extreme variability of renewable water [2-5].

Conclusion

Pecan orchards, the highest-value crop that is also the most susceptible to water scarcity and quality decline, saw a 25% increase in area in the region between 1994 and 2013. Adaptive approaches to agricultural water management, such as irrigation scheduling, deficit irrigation, and land use management, do not necessitate significant adjustments to existing infrastructure and are already in use by farmers in the region to some extent. In recent severe droughts, farmers have typically reduced or stopped growing other crops, particularly alfalfa and cotton, to conserve water for pecan orchards. Due to fundamental changes in irrigation infrastructure and a variety of challenges facing irrigation districts, other methods like drip irrigation would put a greater financial burden on farmers. In a similar vein, drought-tolerant crops compatible with climates have been used as an adaptation strategy in arid regions to replace vulnerable high-value commodity crops.

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***Address for Correspondence:** Pierfranco Costabile, Department of Environmental Engineering, University of Calabria, Rende, Italy, E-mail: pierfranco.costabile11@unical.it*

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