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A web application for cotton irrigation management on the U.S. Southern High Plains. Part II: Application design

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ABSTRACT

A web-based application to help Southern High Plains cotton producers estimate profitability under center pivot irrigated production is described. The application's crop modeling and general profit calculation approach are outlined in a preceding companion paper, while additional details of the profit model and the application's operational features and GUI design are presented here. In addition, the assumptions and approximations made in the application's crop modeling and profit calculation are summarized, and directions are provided for accessing the application on the Ogallala Aquifer Project web page.

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1. Introduction

Dropping Ogallala Aquifer levels and volatile commodity prices and energy costs make irrigation management an important but uncertain issue to cotton producers on the U.S. Southern High Plains (SHP). For example, is deficit or full irrigation more profitable under the current pumping cost and lint price conditions? Also, what is the most profitable way to divide production into dryland and irrigated acreage with limited well capacity? To help SHP cotton producers answer these questions the web application described here estimates the effects of irrigation on the profitability of center pivot cotton production. This application's main purpose is to estimate the irrigation effect on yield and the related effects on both profits per acre and profits over a center pivot area with combined dryland and irrigated production. A preceding companion paper (Mauget et al., 2013a, hereafter, Part I) describes the application's foundations, i.e., the weather data used, the crop modeling procedures, yield calibration, and profit calculation at both the acre and center pivot area spatial scale. The current paper describes the application's operational features and external design. Section 2 provides a brief overview of the application's main functional flow, while Section 3 provides a description of the application's working details, JavaScript software components, and external graphical user interface (GUI) features. Section 4 provides summary, caveats for the application's use, and directions for accessing the application on the Ogallala Aquifer Project's (OAP) web page.

2. Functional overview

Fig. 1 is a functional flow chart of the application, which consists of three main parts. The first component consists of JavaScript arrays that hold the simulated dryland and irrigated lint yields generated by the CSM-CROPGRO-Cotton (hereafter, CROPGRO-Cotton) model of the DSSAT crop modeling suite (Hoogenboom et al., 2010; Jones et al., 2003). The second component consists of JavaScript and PHP code that calculates seed yields from the database's lint yield per acre values, and the corresponding profit per acre from both lint and seed yields. Those profit values per acre (π) are calculated for both dryland production and irrigated production at 12 total irrigation levels. The dryland and irrigated π distributions displayed by the application reflect the commodity price, production cost, and pumping cost conditions defined by the user using the application's slider controls. The JavaScript code of the final component estimates values of profit over a center pivot area (Π) under mixed dryland and irrigated production, based on calculated dryland and irrigated π values and a user-defined center pivot area (A_{cpv}) and central well capacity (F).

3. Application features

3.1. "Read This First!" tab

The application's graphical user interface (GUI), pictured in Figs. 2–5, consists of three main tabs. The "Read This First!" tab (Fig. 2) is a scrolling informational HTML page that provides an introduction and covers the key points of Part I. This includes descriptions of the weather and crop evapotranspiration (ET_c) data used, the CROPGRO-Cotton modeling and yield adjustment process, and how the application calculates profit over a unit area and over

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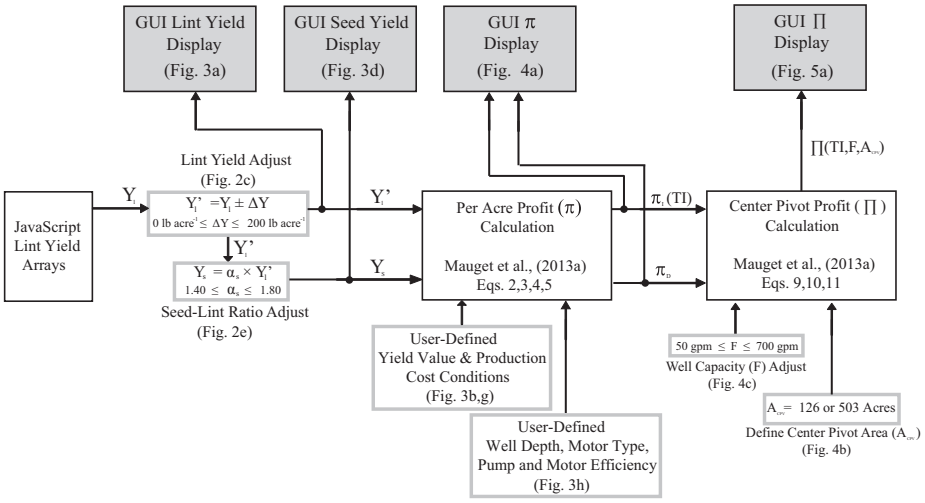

Fig. 1. Flow chart of web application's main components. Gray outlined elements indicate user controls marked in Figs. 3–5. Gray shaded elements indicate Figs. 3–5's yield, profit per acre (π) and center pivot profit (Π) display features..

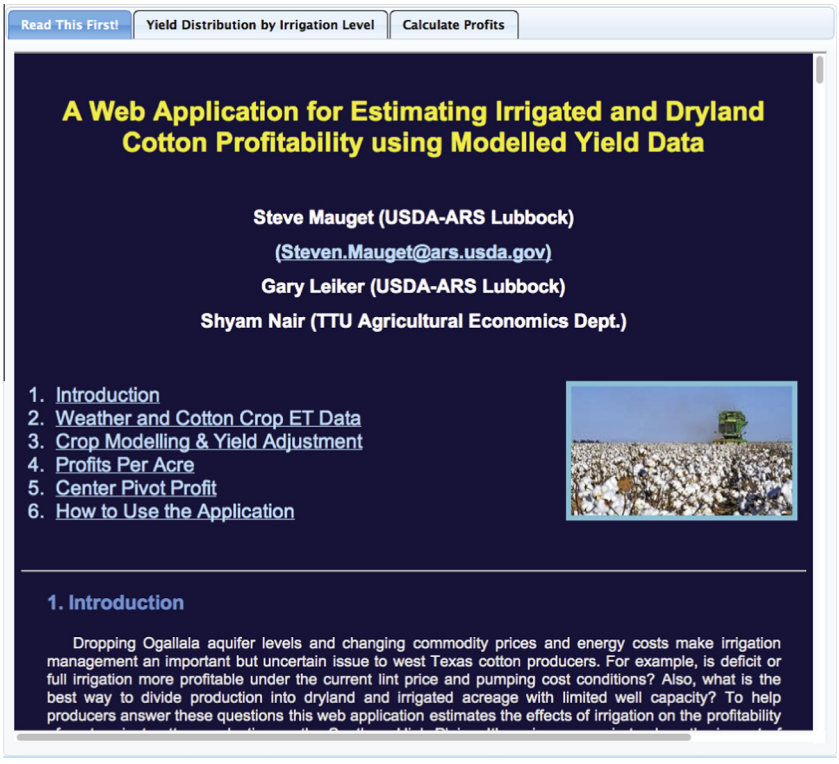

Fig. 2. Screen shot of the application's "Read This First!" scrolling informational tab.

the area of a center pivot. The descriptions of weather and crop ET data and crop modeling are more qualitative than that found in Part I, while the description of profit calculation – reproduced here in Section 3.3 – provides more detail. The "Read This First!" tab also includes a basic "road-map" for the application and instructions for use, e.g., the various ways the application's slider controls can be operated.

3.2. "Yield Distribution by Irrigation Level" tab

Fig. 3 is a screenshot of the "Yield Distribution by Irrigation Level" tab. The jqPlot[1] graphics display on the tab's upper graph (Fig. 3a) contains thirteen "Bar and Whisker" (B&W) diagrams for the distributions of modeled CROPGRO-Cotton lint yields. These diagrams mark the minimum, maximum, 25th, 50th, and 75th percentiles of yield for dryland production and 12 irrigation levels. In the irrigated simulations 11.0–22.0 in. of total irrigation was applied in increments of 1.0 in. As described in Section 2 of Part I, each distribution was formed from the results of simulations conducted with weather data from four SHP sites during 1975–2004. The dryland and irrigated simulated yields for each irrigation level were aggregated across the four sites, resulting in 120 yields per distribution. As a result, the lower and upper whiskers mark the range of the lowest and highest 25% of yield values, i.e., the lowest and highest 30

[1] http://www.jqplot.com.