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Shiny Apps: The Evolution of Extension Tools from Spreadsheets to New Interactive Dashboards

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Cover Page Footnote

USDA-NASS for data and API. Agmanager.info for hosting the interactive tools. Emrah ER for development of Farmland App. R and RStudio acknowledgment and own source community.

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Shiny Apps: The Evolution of Extension Tools from Spreadsheets to New Interactive Dashboards

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Abstract. The Interactive web dashboard is the newness with characteristics and features that are replacing the status quo downloading spreadsheets. RStudio is the program used to create Shiny Apps dashboards with R. We explain some of those features so that Extension specialists can adopt the methodology, engage stakeholders, and help them understand and apply results to their production systems, although we do not explain the creation process step by step. Our approach offers not only a useful and modern way to disseminate information to empower decision-making, but also a safe environment in which data can be automatically updated and users cannot inadvertently corrupt the tool.

INTRODUCTION

In the modern era, farm managers are more likely than ever to have at least some higher education and formal coursework introducing current trends, new technologies, and best agricultural practices (Huffman & Mercier, 1991; Putler & Zilberman, 1988; Mishra & Park, 2005; Mishra et al., 2009). These days, consumers are looking for products that are ready to eat and ready to use. In other words, farmers need information that can be easily understood and is applicable to their production system. Spreadsheets have been a useful and common practice for several years; however, migrating to interactive e-learning tools presents new concerns about farm managers' ability to make the most of the technology (Williamson & Smoak, 2005).

Interactive Shiny Apps dashboards allow for other Extension professionals to use existing tools—by retrieving the source code that is publicly available on GitHub — to customize the app using their own parameters, such as their regional level of inputs or the product specifications for their clients' operations. Users need an internet-connected device such as a laptop, iPad, tablet, or smartphone. Once the app is loaded, users can run as many hypothetical analyses as needed and print the results without downloading files or worrying about file corruption. All calculations occur on the server, so the user's device requires minimal computational power and connectivity to be operational. Less reliance on wireless capacity is an important feature for rural areas with weak connectivity (Whitacre et al., 2014). Given the nature of agricultural work, many farms have become dependent on mobile electronic devices (Griffin, 2020).

RStudio is a tool used to develop Interactive web dashboards (RStudio Team, 2022). R is a freely available language and environment for statistical computing and graphics (R Core Team, 2022). RStudio is an integrated development environment (IDE) for R. Rather than describe or explain step by step how to create an interactive tool using RStudio, our objective was to provide a series of examples—developed by the Department of Agricultural Economics at Kansas State University—to give insights and details such that other Extension specialists can adapt these tools for use in their respective regions and areas of expertise.

BACKGROUND

This project builds upon Caris and Griffin's (2016) article of a similar nature by introducing some new interactive web dashboards to the Extension world. They described the process of creating interactive graphs using Google Docs and embedding them into existing websites, hoping that others could use this method within their own areas of expertise. Morgan and Wang (2019) developed a computational template to schedule irrigation for efficient water use. Their goal was to apply the dual crop coefficient method to calculate evaporation and transpiration rates to improve soil-water tracking.

The main goal of Extension is to disseminate applied research by making it accessible to all field practitioners regardless of their formal educational background. An Extension specialist is successful if a crop producer understands what the specialist means when they say that, "days suitable for fieldwork will be during the last week of April and the first week of May." All the tools presented in this article access data directly from the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) Quickstats (USDA NASS, 2017) via an application programming interface (API) (Saia et al., 2021). Unlike spreadsheets, the web dashboards were developed to retrieve the most current data set each time the tool is used. On occasion, the USDA corrects or amends data sets; these changes are also reflected on the dashboards.

APPROACH

The two components of the app are powered by two separate sets of code: the back end, or the server side, and the front end, or user interface (UI). Reactive expressions are created on the server to generate outputs on the UI. In other words, all the calculations and analytics occur on the server side, while the output is presented for the user experience on the UI side. Although we do not delve deeper into how the app is created in this article, we provide examples and explanations below of how interactive web dashboards are useful for Extension programming.

AMERICAN FARMLAND: 421 PAGE VIEWS FOR THE PERIOD 1 JANUARY–9 NOVEMBER, 2021

Figure 1 shows a screen capture of the Farmland Values app's comparison of state versus US farmland values. Farmland values are of interest to farmers, landowners, lenders, and policymakers. This dashboard view allows users to compare their state land values against the current US average and historic land values, giving them the opportunity to estimate value for any given year using a known value from another year.

Figure 2 shows a screen capture of the calculator for an estimated stepped-up basis. Every year, often during income tax preparation season, Extension specialists at Kansas State University receive 20-30 calls from landowners, accountants, and others asking how they can estimate the value of inherited land for some year in the past. The guide for estimating stepped-up basis describes how landowners and their advisors can use the farmland value index to estimate potential tax liability in their respective locations. Users can select the base year, state, inheritance year, current year, and the current value of the land. Estimated farmland values from the app are not a substitute for land appraisals; users need to be aware that land improvements, buildings and facilities, pressure from development and urban sprawl, or previous farm production management practices may cause estimated values to deviate from the true market value (Griffin & Lashmet, 2017).

DAYS SUITABLE FOR FIELDWORK – ALL STATES: 1103 PAGE VIEWS FOR THE PERIOD 1 JANUARY–9 NOVEMBER 2021

Figure 3 shows a screen capture of the Days Suitable for Fieldwork app. Farmers use information on fieldwork probabilities to estimate the number of workdays that are available during key planting and harvesting periods in their area. This allows them to make farm management decisions regarding sizing machinery to given acreage and vice versa (Griffin & Barnes, 2017).

CONCLUSION

An efficient approach to engage Extension clients is through interactive web dashboards. Modern collaboration applications, including Shiny Apps, enable hosting data online, ensuring real-time delivery. By creating and sharing interactive tools through RStudio, data can be kept up-to-date with the latest available information, reflecting coordinated updates by organizations like the USDA.

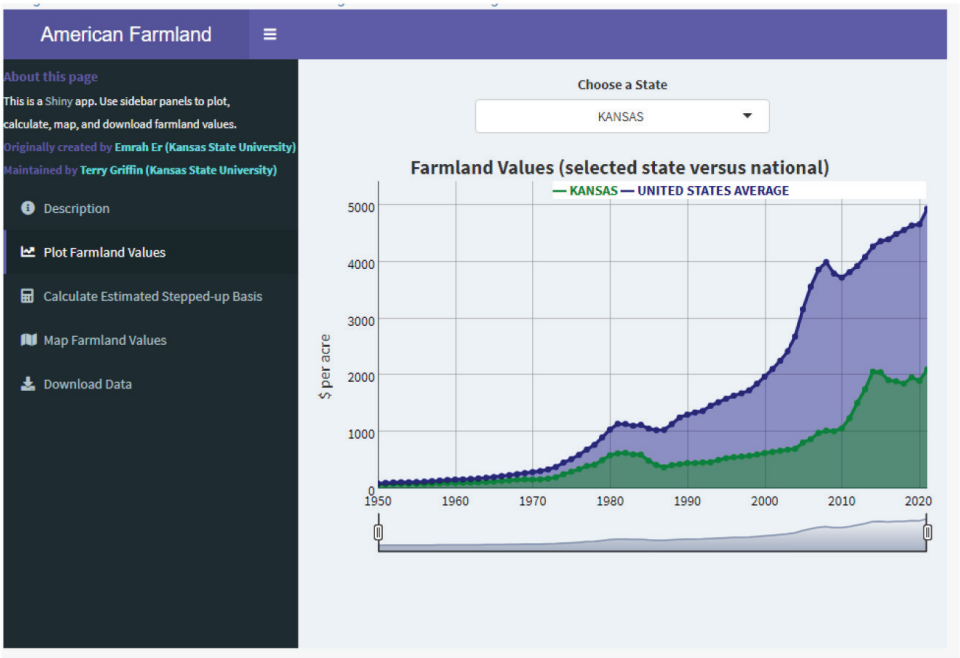

Figure 1. Screen capture of American Farmland app with "plot farmland values" selected.

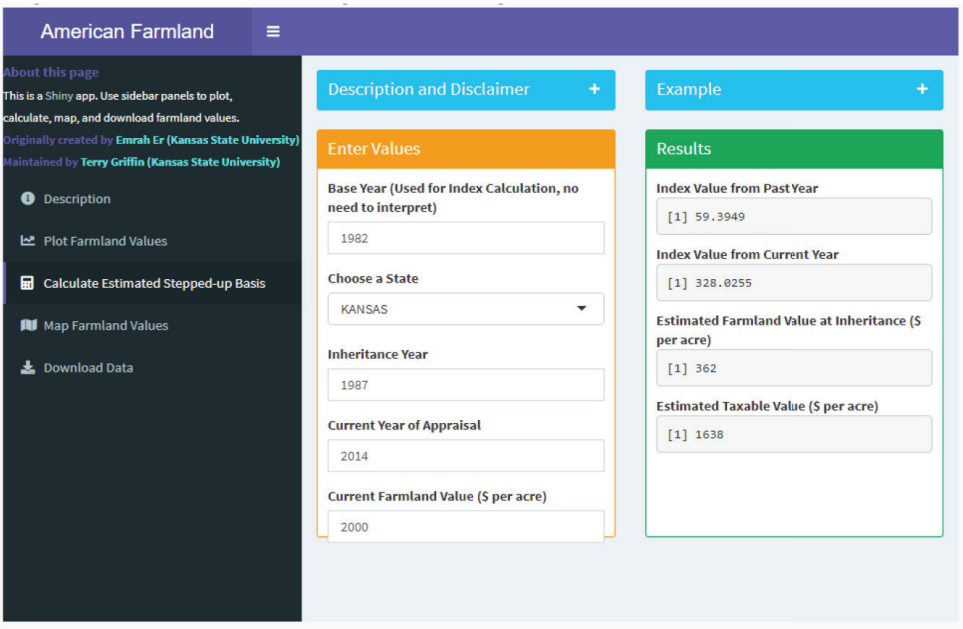

Figure 2. Screen capture of American Farmland App with "calculate estimated stepped-up basis" selected.

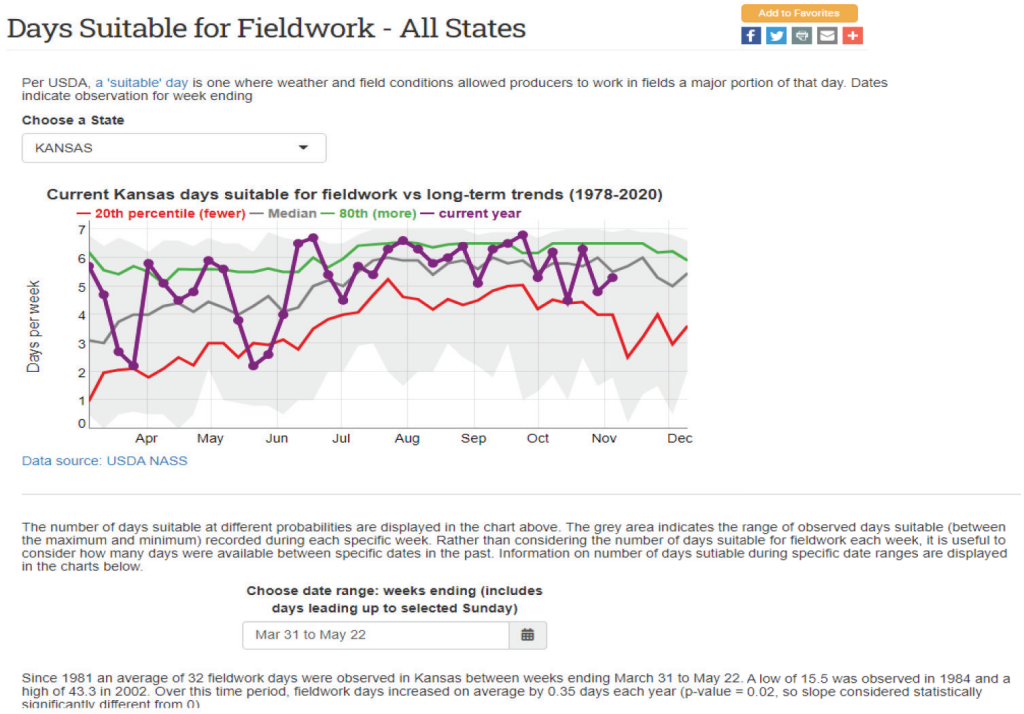

Figure 3. Screen capture of days suitable for fieldwork—all states.

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APPENDIX

GITHUB LINKS

- spaceplowboy/autonomousCottonHarvest: R Shiny script for cotton harvest machinery decisions; aka autonomous vs status quo (github.com)
- spaceplowboy/shinyDaysSuitable: Shiny app to collect USDA NASS data each week and update dygraph graph (github.com)
- emraher/Farmland_Values: Shiny App for Farmland Values (github.com)