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Estimating Agricultural Flood Loss

TEXAS WATER DEVELOPMENT BOARD

AGFL Tool User Guide V 1.0

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Dr. Ronnie Schnell, Professor and Cropping Systems Specialist, Soil and Crop Science Dept., Texas A&M AgriLife Extension

Dr. David Anderson, Professor and Extension Economist - Livestock Marketing, Agricultural Economics (AGEC), Texas A&M AgriLife Extension

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Executive Summary

The Agricultural Flood Loss (AGFL) Tool User Guide provides detailed instructions and background information for estimating crop damage and associated economic losses due to flooding events in Texas. The Excel-based AGFL Tool is designed to support benefit-cost analyses (BCA) of flood mitigation projects and to assist agricultural planners, researchers, and producers in assessing flood-related crop losses.

The tool calculates crop-specific damage estimates based on user-defined inputs such as county, flood depth, duration, and affected acreage. It integrates 2008–2022 United States Department of Agriculture National Agricultural Statistics Service (USDA NASS) county-level data on crop yields and acreage, using literature-derived damage functions that relate flood timing and duration to yield reductions for major Texas crops including corn, cotton, sorghum, wheat, soybeans, and others. For high-value crops such as fruits, nuts, and vegetables, total yield loss is assumed following flood events.

The AGFL Tool enables users to estimate monthly or annualized damages by crop and region, aligning outputs with the TWDB's Benefit-Cost Analysis Toolkit. Built-in safeguards and lookup tables protect the integrity of embedded calculations while providing a straightforward user interface for data input and result interpretation.

Validation against USDA Risk Management Agency (RMA) indemnity data from 2008–2022 demonstrates strong correlation (R^2 = 0.66–0.91) between AGFL estimates and reported losses, supporting its reliability as a flood impact assessment tool.

Overall, the AGFL Tool enhances the accuracy and consistency of agricultural flood loss estimation, improving the integration of agricultural damages into statewide flood planning and mitigation efforts.

1 Introduction

Flooding of soil can cause a variety of problems and lead to economic losses for agricultural producers. Logistical problems include delayed planting and disruption of field activities, like the application of fertilizer and pesticides. Disruption of crop management will have agronomic consequences such as poor weed control and inadequate fertility resulting in reduced crop yield. Flooding can also have direct impacts on crop performance. The slow diffusion of oxygen through water when soil is saturated or flooded creates an oxygen limited environment (hypoxia) that transitions to anoxia (oxygen is completely depleted). Hypoxic and anoxic conditions limit plant respiration, growth, and development, and can lead to death of root tissue and the loss of entire plants (Morard and Silvestre, 1996). Crop damage varies depending on species, timing, duration, and depth of flooding.

The Agricultural Flood Loss tool is an Excel-based tool designed to help estimate the economic damage associated with crop injury due to flooding. Users select which crops and how many acres of each crop will be affected by flooding in a county. The average planted acres and yield for crops grown within each county are provided for reference within the tool. All damage estimates consider timing in relation to expected planting dates, duration, and depth. Damage is calculated by estimating economic loss using reference crop prices and estimates of yield loss. County yield estimates by crop and expected precent yield loss due to flood scenario are calculated and summarized by the tool.

This AGFL Tool User Guide provides details on crop loss functions derived from available literature and explains how damage estimates are calculated based on user inputs. Data supporting calculations are provided in the appendix.

2 Background

2.1 Common Uses

The AGFL tool was developed for use in conjunction with the Texas Water Development Board (TWDB) - Benefit Cost Analysis (BCA) tool. The BCA tool has inputs for agricultural damage for three broad crop categories. BCA crop categories include high value (vegetable, fruit, nut, etc.), low value (grain and fiber crops), and range/pasture. The AGFL tool provides options for selecting specific crops and acreage that may be affected by flooding and estimating economic damage. The BCA tool requests crop inputs before and after implementing a project. The AGFL tool can be used to provide better estimates of expected crop damage for a given project by adjusting acreage, timing, or crops affected before and after implementing a project.

In addition to planners, the AGFL tool may be useful to the agricultural sector for estimating economic damage following severe weather events. If the user has estimates of flood acreage and crop types, the duration of flooding, and approximate depth, the damages for the month when the event occurs can be estimated. Additionally, annualized damages can be used to evaluate seasonal sensitivity of various crops to flooding.

2.2 Developing Damage Functions

Crops are particularly vulnerable to flooding from planting through emergence, as their growing points (meristem tissue) are located below the soil surface. Any level of flooding or even saturated soil conditions during this period can hinder emergence and decrease crop stands. For corn and grain sorghum, the growing point remains below the soil for 4-6 weeks post-planting, making them sensitive to flooding for an extended period. In contrast, crops like cotton and soybeans elevate their growing points above the soil after emergence and continue to do so as they develop. After establishment, the resilience of different species to flooding varies significantly, so understanding crop development patterns is essential when assessing potential yield losses from flood events.

For major crops in Texas, a literature review was conducted to compare damage levels reported for various flood scenarios and crops. Timing and duration of flood conditions were common factors in most publications. Flood depth varied but typically was less than one foot for most studies. Deeper flood depths that completely submerge plants would likely result in complete death and total loss of yield. For crops with adequate data, regression analysis was performed with timing as “days after planting” and “duration in days” as independent variables and “percent yield reduction” as the dependent variable to develop damage functions. Some crops did not have adequate duration data. For these species, timing of flooding was the only factor used to estimate yield reduction. For high value crops that include vegetables, fruit, and nut crops, any flooding was assumed to result in complete yield loss.

2.2.1 Corn

Corn (Zea mays L.) is a warm-season annual cereal grown extensively across Texas, with about 2-2.5 million acres cultivated each year, 60 percent of which is irrigated. Planting typically occurs near the last frost date for each region, ranging from January in the Rio Grande Valley to May in the Texas Panhandle. Many corn-growing areas, particularly in the eastern half of Texas, are susceptible to occasional flooding. Corn undergoes distinct vegetative (Vn) and reproductive (Rn) growth phases, and it is particularly sensitive to stress during critical growth stages. The timing of flood events can have varying impacts on corn's survival and yield potential.

Research from Ohio (Fausey et al., 1985) evaluated corn hybrid responses to flooding during germination. Seeds subjected to 48-144 hours of flooding showed a decline in emergence, dropping from 83 percent to 47 percent at 10 °C and from 85 percent to 3 percent at 25 °C with 96 hours of flooding. This highlights how temperature affects plant responses to anoxic conditions: warmer temperatures lead to quicker oxygen depletion in soil and severely impact plant stands. Corn's response to flooding later in the growth cycle relies on its ability to maintain metabolism under anoxic conditions. A study in Iowa(Mukhtar et al., 1990a; Mukhtar et al., 1990b) demonstrated that flooding for 10 days at 36 days after planting led to a 64 percent reduction in grain yield, while flooding at later stages caused less damage. A Missouri study found an average yield decline of 0.57 Mg ha-1 (9 bu acre-1) for each day of flooding.

Six reports describing corn response to flooding were reviewed for developing a damage function (Fausey et al., 1985; Kaur et al., 2017; Liu ZuGui et al., 2013; Mangani et al., 2018; Mukhtar et al., 1990a; Zaidi et al., 2004). Duration of flooding ranged from 1 to 20 days across the 6 studies. The timing of flooding ranged from 1 day to 100 days after planting. A mixed model analysis of covariance was fit using SAS 9.4 data summarized from literature. The timing of flooding was the main factor and duration of flooding was used as a covariate. Model parameters were applied to the monthly time steps of 0, 30, 60, and 90 days to generate damage estimates for the AGFL tool. Duration of flooding (in days) modifies the estimate of damage using the covariance parameter estimate.

2.2.2 Cotton

Cotton (Gossypium hirsutum L.), a significant fiber crop, covers over 6 million acres in Texas annually, with a cash value of approximately $3 billion. Cotton planted well after the frost risk exhibits indeterminate growth, with vegetative and reproductive phases occurring simultaneously. While it is adapted to heat and drought, cotton is sensitive to flooding depending upon its timing and severity.

Seedlings and early vegetative cotton plants are especially vulnerable to waterlogging, particularly at higher temperatures (Bowen et al., 1971). Though intermittent flooding may not cause lasting damage, prolonged inundation can lead to substantial mortality. Two weeks of flooding can increase mortality rates to 60 percent during early stages, while flowering and boll formation are less affected. Short-term waterlogging generally does not impact lint yield, but multiple longer inundation events can lead to significant yield reductions, particularly during critical periods like squaring.

Five reports describing cotton response to flooding were reviewed for developing a damage function (Bange et al., 2004; Kuai et al., 2015; Qian et al., 2020; Wang et al., 2017; Zhang et al., 2016). The duration of flooding varied between 2 and 20 days across the 5 studies, while the timing of flooding occurred anywhere from 1 to 120 days post-planting. A mixed model analysis of covariance was conducted using SAS 9.4, based on summarized literature data. In this model, timing of flooding was the primary factor, with duration of flooding treated as a covariate. Model parameters were applied to monthly intervals such as 0, 30, 60, 90, 120, and 150 days after planting to produce damage estimates for the AGFL tool. The duration of flooding (in days) influences the damage estimate through the covariance parameter estimate.

2.2.3 Grain Sorghum

Grain Sorghum (Sorghum bicolor (L.) Moench) is another important warm season crop in Texas, cultivated on 1.5-2.0 million acres annually out of 22 million acres of Texas cropland. Sorghum experiences distinct growth phases, with sensitivity to stress particularly during critical stages such as flowering. Research has shown that flooding during early vegetative stages can significantly impact yield.

Flood studies indicate that early flooding can lead to about 34 percent yield loss, generally diminishing during late vegetative stages (Howell et al., 1976; Orchard and Jessop, 1984; Zolezzi et al., 1978). Analysis of available data failed to produce a significant model due to variation among limited datasets. Expected yield loss due to flooding was generalized for monthly timesteps with adjustment for duration to reasonably align with available data. The sorghum damage function follows a similar pattern to corn with less influence from duration.

2.2.4 Peanut

After an extensive literature search, only a single report describing peanut response to flooding was found and reviewed for developing a damage function (Orchard and Jessop, 1984). The duration of flooding varied between 0 and 15 days, while the timing of flooding occurred 3 growth stages that were approximately 7, 50, and 80 days after planting. A linear model was fitted with available data using SAS 9.4. In this model, timing and duration of flooding are included as variables. Model parameters were applied to monthly intervals such as 0, 30, 60, 90, 120, and 150 days after planting to produce damage estimates for the AGFL tool.

2.2.5 Rice

Flooding rice is a normal part of managing this crop. Therefore, a flood damage function was not developed. The only factor for damage to rice would be complete inundation. If flood depth exceeds the expected crop height in-season, complete yield loss is assumed.

2.2.6 Soybean

Soybeans (Glycine max [L.] Merr.), planted in various Texas regions, have an annual acreage of 100,000-200,000. This indeterminate legume can suffer severe losses if flooded during germination but shows better tolerance at later stages. Studies indicate that flooding for more than 10 days can lead to significant yield losses, especially during early reproductive stages (Scott et al., 1989; Wu et al., 2017).

2.2.7 Sunflower

Literature review revealed a single report describing sunflower response to flooding (Orchard and Jessop, 1984). The duration of flooding in this report varied between 0 and 9 days, while the timing of flooding occurred at 3 growth stages that were 30-50 days after planting. An additional treatment evaluated flooding at all three growth stages. A linear model was fitted with available data using SAS 9.4. In this model, the timing of flooding was the primary factor. Duration of flooding provided a very weak response and was therefore not included in the damage function. Model parameters were applied to monthly intervals such as 0, 30, 60, 90, 120, and 150 days after planting to produce damage estimates for the AGFL tool.

2.2.8 Wheat

Wheat (Triticum aestivum) is a cool-season crop planted in the fall, with over 5 million acres cultivated in Texas annually. It shows sensitivity to flooding during early growth phases, with yield reductions noted after prolonged inundation. Later flooding has a less pronounced effect on wheat yield.

Five studies were evaluated to develop flood damage functions for wheat (Asgari et al., 2012; Collaku and Harrison, 2002; Ghobadi et al., 2011; Marti et al., 2015; Sharma and Swarup, 1988). The timing of flooding ranged from 25 to 150 days after planting. Duration of flooding ranged from 2 to 30 days across all studies. Significant model parameters include timing, timing squared and duration. Model parameters were applied to monthly intervals such as 0, 30, 60, 90, 120, and 150 days after planting to produce damage estimates for the AGFL tool.

2.2.9 Hay/Forage/Range/Pasture

Forages in Texas consist of various warm and cool-season species. Perennial grasses like bermudagrass (Cynodon dactylon) and bahiagrass (Paspalum notatum) exhibit high tolerance to flooding, recovering well from extended submersion. Recovery is typically expected unless severe conditions lead to stand loss. Disruption of forage production is the main factor used in damage estimates.

A warm season perennial grass species growth curve was estimated over a 6-month period. Early season losses are estimated to be 10 percent while peak forage loss is estimated at 70 percent during mid-season. The growth curve peaks in month three of production and then declines back to early season levels. The production period begins the month after the final frost month.

2.2.10 High Value Crops

High value crops include all tree, fruit, nut, and vegetable crops. While acreage and crop mixes vary by county, acreage is generally small compared to other row crops in Texas. However, potential value is high. Any flooding to high value crops will be assumed to cause complete loss of value. Many high value food crops may not be marketable following a flood event, even if plants survive with limited yield loss. The NASS data was explored to extract the mean value per acre of all high value crops by county. This value will be multiplied by the damaged acres selected by the user for this category.

2.2.11 Validation of Damage Functions

Model outputs were evaluated for accuracy in two ways. First, subject matter experts at Texas A&M AgriLife Extension reviewed the tool to ensure damage estimates were reasonably accurate for various crops and regions. Secondly, 2008-2022 USDA Risk Management Agency (RMA) data for flood related crop indemnity payments were used for validation. The RMA dataset included county of loss, commodity name, year of loss, month of loss, stage code (h- harvested, UH unharvested), net determined quantity (acres), and indemnity amount ($). Corn (n=77), cotton (n=132), grain sorghum (n=60), and wheat (n=96) provided 365 data points for evaluation. For each RMA flood loss record, county, month of loss, acres, and commodity type were used to calculate damage using AGFL damage functions. Regression analysis was performed with AGFL estimates of damage ($) and RMA indemnity ($). Corn, grain sorghum, and wheat tend to overestimate levels of damage with slopes less than 1.0. Overall correlation (r^2) ranged between 0.61 and 0.91.

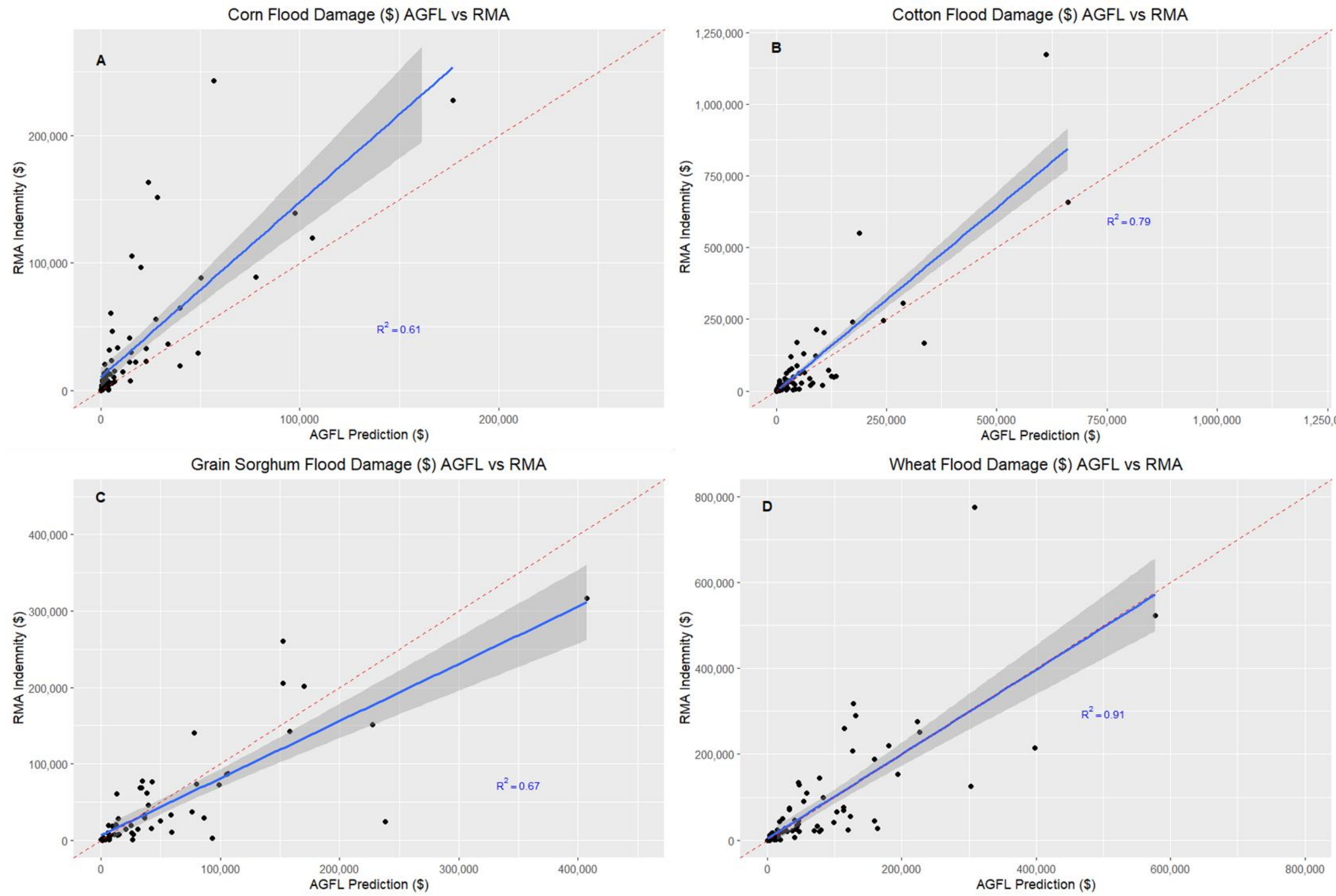

***Figure 1**. The AGFL tool was used to provide estimates of county level crop flood damage given crop type, month of loss, and acres affected. Estimates of damage ($) for corn (A), cotton, (B), grain sorghum (C), and wheat (D) are provided and compared to reported RMA indemnity for these crops between 2008-2022. Red dashed line indicates 1:1 and regression model R^2 is also provided.*

While validation against RMA data provides added confidence in predictions, there are some variables that cannot be accounted for. Flood depth and duration are not included in the RMA dataset. For AGFL estimates, a 21-day flood duration and mean flood depth of 1 foot was assumed. Flood duration is likely to vary across events reported through RMA and lead to variation in estimates. Flood depth will have less influence unless the RMA event resulted in complete crop submersion. Additionally, crop prices vary over time with relatively lower prices used in the AGFL tool. The final factor is that RMA indemnity payments are not 100 percent of crop loss and are based on producer yield and coverage levels, rather than NASS county level yield data.

3 Getting Started

The AGFL tool was developed using Excel in Microsoft 365. The tool has not been tested on other versions of Excel. The AGFL tool can be downloaded at https://www.twdb.texas.gov/flood/research/Agricultural-Flood-Loss-2022/index.asp. The tool has two visible tabs, User Guide and AGFLT. All cells other than user inputs are locked to protect formulas and lookup tables.

4 Features Overview

4.1 User Guide

The user guide tab provides a brief overview of the tool and an example of user inputs and outputs.

4.2 Main Tool

Users will select a Texas county for estimation of economic crop damage. Only one county can be selected at any time. The county information for mean annual type of crops grown, yield, and production season will be displayed. In addition, sum of all row crops, high value, range, forage and hay acres will be displayed. All values are the mean for the selected county for the period of 2008–2022.

Users select annualized or monthly damages. Annualized damages estimate the expected loss per year if the flood event has equal chance of occurring in any month. Damages for all selected crops and associated acreage are provided for the given flood condition. The other option is monthly damage. Users select a month of interest for various crops and expected acreage damaged. The sum of damages for all selected crops is provided.

4.2.1 Definitions

Mean Flood Depth – the estimated mean depth, in feet, of flood water across the damaged area. Value must be between 0.1 and 50 ft of flood depth.

Flood Duration – estimated duration of flooding in days. Value must be between 1 and 30 days.

Damages (Monthly) – calculates crop damage and associated value per acre for selected month.

Damages (Annualized) – calculates crop damage and associated economic value and divides by 12 for each month.

NASS County Mean Acres – mean acres of each crop grown in the selected county using NASS estimates from 2008 through 2022. Only crops with greater than 1,000 acres grown within the county are reported through NASS. Range/Forage acres were extracted from the 2021 CropScape Cropland data layer.

NASS County Yield – yield potential by crop for each county using NASS estimates from 2008 through 2022. Annual yield reported for each county is the county mean. The maximum county mean over the 15-year period is used to estimate yield potential under good conditions. Some counties report irrigated and non-irrigated acres separately. If irrigated acres are split, yield estimates will reflect the difference in yield potential. If irrigated acres are not split, county mean yield is reported under irrigated and non-irrigated. If yield estimates are not available, statewide averages are used. Measuring units vary by crop types- for example bushels, tons, pounds, etc. (Table 1). High Value crops include all tree nut, fruit, and vegetable crops, and provide value per acre rather than yield. Hay yields are reported for each county through NASS. Forage/Rangeland yields for each county were estimated as 50 percent of reported hay yields.

Damaged Area Acres – a user input of damaged area, in acres, for each crop. Set area values to 0 for crops not expected to be affected by flooding.

BCA-tool Damage $ – sum of damages ($) for three categories used within the TWDB BCA toolkit. Grain and fiber crops are summed as Low Value crops. Pasture is the sum of Hay, Forage/Range production damages. High Value uses sum of the high value output, which includes tree, fruit, nut, and vegetable crops.

BCA-tool Acreage – sum of acres for three categories used within the BCA tool. Grain and fiber crops are summed as Low Value crops. Pasture is the sum of Hay, Forage/Range production acreage. High Value uses sum of the high value input acreage, which includes tree, fruit, nut, and vegetable crops.

4.3 Calculations

Calculations are based on user selection of county, flood depth, flood duration, and acreage of various crops. Economic loss associated with various crops and acreage is calculated on a monthly or annualized level. Crops included in these calculations are corn, cotton, oats, peanuts, rice, sorghum, soybeans, sunflower, wheat, and hay/forage/range production. County level yields and commodity prices are provided in lookup tables for use in calculations (Table 1). NASS county level mean acres are provided for reference from a lookup table. However, only user input acre value for each crop is used in damage calculations.

Table 1. *Reference crop prices used in the AGFL tool.*

CORN, IRRIGATED	bushel	$	4.50
CORN, NON-IRRIGATED	bushel	$	4.50
COTTON, UPLAND, IRRIGATED	pound (lint)	$	0.75
COTTON, UPLAND, NON-IRRIGATED	pound (lint)	$	0.75
OATS	bushel	$	4.00
PEANUTS	pound	$	0.27

RICE	pound	$ 0.18
SORGHUM, IRRIGATEDD	bushel	$ 4.00
SORGHUM, NON-IRRIGATED	bushel	$ 4.00
SOYBEANS	bushel	$ 10.00
SUNFLOWER	pound	$ 0.35
WHEAT, WINTER, IRRIGATED	bushel	$ 6.00
WHEAT, WINTER, NON-IRRIGATED	bushel	$ 6.00
HIGH VALUE ($/A)	sales/A	$ NA
Hay Production	ton	$ 300.00
Forage/Range Production	ton	$ 300.00

4.3.1 Percent Yield Reduction Calculation

As user inputs of flood parameters are completed, calculations will be updated based on selections. Hidden tables perform many background calculations. Damage functions- as percent yield reduction by crop- are assigned to corresponding months for each crop based on the county that is selected. The percent yield reduction is pulled from the crop growth stage damage function table. This table provides estimates of percent yield loss for each crop starting in month one of growth and continuing monthly until maturity. The assignment of yield reduction to each month of the year by crop is adjusted based on the county plant month table.

4.3.2 County by Crop Plant Month

A table with plant month for every crop by county is used when a county is selected. Plant months for crops are assigned for each county with some examples provided in appendix 1. Plant month calculation approximates planting time relative to the mean final freeze date for each crop and county. For example, corn is normally planted near the final freeze date, while grain sorghum is planted about 14 days after the final freeze date. The exception is for winter annuals (wheat, oats), which use November as the normal plant month, and high value crops which do not use planting months in calculations. The optimum plant date is rounded to the nearest month for all other crops. A limitation is the monthly timesteps for calculations. For example, some crops may be planted during the end of February and will use March as the plant month. Despite the variation in exact planting time, this method will provide closer estimations of growth phase for monthly damage calculations.

4.3.3 Flood Duration Modifier

The percent yield reduction is modified according to the duration selected for the flood scenario. Flood duration of up to 30 days is selected by the user. Literature reviewed for developing flood damage functions rarely exceeded 30 days, which limits the ability to estimate longer term flood impacts. Flood duration modifier values are calculated by multiplying the days of flood duration by the factor in the duration damage function table. Flood duration equations were developed for crops with adequate data. The duration modifier value is added to the baseline estimate of yield reduction to generate a total yield reduction (percent) value.

4.3.4 Actual Yield Reduction

Actual yield reduction combines percent yield reduction estimate and county yield estimates to calculate yield units per acre of loss. Measuring units vary by crop type (for example bushels, pounds, etc.). The exception is high value crops. The units used for high value crop calculations are $ per acre. Mean county value of high value crops was extracted for 2008-2022 from NASS datasets. As previously described, this value includes all fruit, tree, nut, and vegetable crops as $ per acre. Any flood damage to high value crops will assume 100 percent damage and complete loss of the crop. This does not include future production losses or replanting of perennial crops.

4.3.5 Crop Damages

Damages as $ per acre are calculated by multiplying reference crop prices times the unit of yield loss per acre. Damages are calculated for every crop based on acre value in column D for the given flood scenarios. Damages are totaled by month and by crop. A grand total is provided as well.

4.3.6 BCA Tool Damages and Acres

Two boxes are found in the upper right-hand corner that summarize damages and acres to align with BCA tool inputs. Low value acres and damages include all grain and fiber crops. High value use the High Value line only. Pasture sums hay, forage, and range production.

5 Assumptions

It is assumed the user will know what crops will be flooded in addition to approximate acres. If there is uncertainty about which crops might be damaged, county estimates of acres planted and yield by crops are provided for reference. When no acres or yield is reported through NASS, it does not mean that various crops are not grown in the county. NASS does not report for counties with less than 1,000 acres for a given crop. For counties without NASS reported acres or yield, columns will show zero acres and zero mean yield. However, statewide average yield will be used in calculations of damage if acres are included by the user for that crop.

Flood depth is provided by the user. While flood depth may vary within a flood zone, a mean flood depth must be provided. Damage for a given flood depth varies by crop type and timing. Some crops elevate sensitive tissue as the crop grows and develops greater plant height. Other crops may be sensitive to very shallow depths. Minor variation in flood depth is of no consequence. If flood depth exceeds critical crop heights, affecting sensitive plant tissue, complete crop depth is assumed.

6 How to Use

All beige colored cells have user inputs.

1. Select county of interest from drop down menu by clicking on down arrow on right hand side of cell.
2. Enter mean flood depth for affected area.
3. Enter days of flooding expected.
4. Select monthly or annualized calculation of damages.
    a. If annualized damages are selected, move to next step.
    b. If monthly damages are selected, choose month from the dropdown menu.
5. Enter damaged area in acres for each crop of interest in column D.
6. Damage estimates ($) are provided for each selected crop in column Q.
7. Total of damaged acres by BCA commodity type are provided in the upper right-hand corner of column Q.
8. Total $ of damage by BCA commodity type is provided in the upper right-hand corner of column O.
9. Flood variables (depth, duration, acreage) are adjusted and results recorded for baseline (before project/mitigation) and project (after project/mitigation) to provide damage estimates used in the BCA tool.

7 Example

7.1 Annualized Damages

For this example, Colorado County was selected using the drop-down list, a mean flood depth of 1 foot is used, and flood duration of 7 days is selected. To provide damage estimates as annualized, "Annualized" was selected from the drop-down menu.

County	COLORADO	select county from drop down menu
Mean Flood Depth (ft)	1	values limited to 0.1 to 50 ft
Flood Duration (days)	7	values limited to 1 to 30 days
Damages	Annualized	lect damage calculation method

Estimates for damaged areas were entered for five crops: irrigated corn, dryland corn, dryland cotton, hay, and forage range production. The total acres entered totaled 1,345.

	NASS County Mean Acres	NASS County Yield	Damaged Area Acres
CORN, IRRIGATED (bushel)	1,000	148.0	20
CORN, NON-IRRIGATED (bushel)	10,800	143.1	750
COTTON, UPLAND, IRRIGATED (pound (lint))	0	1362.0	0
COTTON, UPLAND, NON-IRRIGATED (pound (lint))	2,650	1362.0	200
OATS (pound)	0	0.0	0
PEANUTS (pound)	0	0.0	0
RICE (pound)	30,990	9710.0	0
SORGHUM, IRRIGATED (bushel)	0	63.9	0
SORGHUM, NON-IRRIGATED (bushel)	1,600	63.9	0
SOYBEANS (bushel)	1,900	33.2	0
SUNFLOWER (pound)	0	0.0	0
WHEAT, WINTER, IRRIGATED (bushel)	0	0.0	0
WHEAT, WINTER, NON-IRRIGATED (bushel)	4,250	38.2	0
HIGH VALUE (sales $/A)	181	4834.3	0
Hay Production (ton)	24,192	2.4	300
Forage/Range Production (ton)	177,015	1.2	75
		Total	1,345

As acres are entered, annualized damages by month will populate as well as totals by month for all crops and totals by crop across all months. The grand total is provided in the lower right-hand corner.

County	COLORADO	select county from drop down menu
Mean Flood Depth (ft)	1	values limited to 0.1 to 50 ft
Flood Duration (days)	7	values limited to 1 to 30 days
Damages	Annualized	select damage calculation method

	BCA-tool Damage $		BCA-tool Acreage
Low Value	$ 116,137	Low Value	970
High Value	$ -	High Value	0
Pasture	$ 31,019	Pasture	375

Annualized Damages

	NASS County Mean Acres	NASS County Yield	Damaged Area Acres	January	February	March	April	May	June	July	August	September	October	November	December	Total
CORN, IRRIGATED (bushel)	1,000	148.0	20	$ -	$ -	$ 1,110	$ 449	$ 270	$ 91	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,920
CORN, NON-IRRIGATED (bushel)	10,800	143.1	750	$ -	$ -	$ 40,247	$ 16,272	$ 9,790	$ 3,309	$ -	$ -	$ -	$ -	$ -	$ -	$ 69,618
COTTON, UPLAND, IRRIGATED (pound (lint))	0	1362.0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
COTTON, UPLAND, NON-IRRIGATED (pound (lint))	2,650	1362.0	200	$ -	$ -	$ -	$ 17,025	$ 17,025	$ 3,632	$ 2,969	$ 2,306	$ 1,643	$ -	$ -	$ -	$ 44,599
OATS (bushel)	0	0.0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PEANUTS (pound)	0	0.0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RICE (pound)	30,990	9710.0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SORGHUM, IRRIGATED (bushel)	0	63.9	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SORGHUM, NON-IRRIGATED (bushel)	1,600	63.9	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SOYBEANS (bushel)	1,900	33.2	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SUNFLOWER (pound)	0	0.0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
WHEAT, WINTER, IRRIGATED (bushel)	0	0.0	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
WHEAT, WINTER, NON-IRRIGATED (bushel)	4,250	38.2	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
HIGH VALUE (sales $/A)	181	4834.3	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Hay Production (ton)	24,192	2.4	300	$ -	$ -	$ 1,253	$ 6,624	$ 11,996	$ 4,834	$ 1,253	$ 1,253	$ -	$ -	$ -	$ -	$ 27,214
Forage/Range Production (ton)	177,015	1.2	75	$ -	$ -	$ 224	$ 895	$ 1,567	$ 671	$ 224	$ 224	$ -	$ -	$ -	$ -	$ 3,805
		Total	1,345	$ -	$ -	$ 42,834	$ 41,265	$ 40,647	$ 12,537	$ 4,446	$ 3,783	$ 1,643	$ -	$ -	$ -	
															Grand Total	$ 147,155

*High value crops includes all tree fruit/nut and vegetable crops as $per acre in value.

** State average yields are used to estimate damage when no acres or yield is reported for a county.

Values used by the BCA tool are calculated in the upper right-hand corner. Crops are summarized by low value, high value, and pasture. Damages and acres for category are provided.

	BCA-tool Damage $		BCA-tool Acreage
Low Value	$ 116,137	Low Value	970
High Value	$ -	High Value	0
Pasture	$ 31,019	Pasture	375

7.2 Monthly Damages

For this example, Colorado County was selected using the drop-down list, a mean flood depth of 1 foot is used, and flood duration of 7 days is selected. To provide damage estimates as monthly calculation, “Monthly” was selected from the drop-down menu. The month of May was selected as the month when flooding occurs.

County	COLORADO	select county from drop down menu
Mean Flood Depth (ft)	1	values limited to 0.1 to 50 ft
Flood Duration (days)	7	values limited to 1 to 30 days
Damages	Monthly	lect damage calculation method
	May	select month damage occurs

Estimates for damaged areas were entered for five crops: irrigated corn, dryland corn, dryland cotton, hay, and forage range production. The total acres entered totaled 1,345.

	NASS County Mean Acres	NASS County Yield	Damaged Area Acres
CORN, IRRIGATED (bushel)	1,000	148.0	20
CORN, NON-IRRIGATED (bushel)	10,800	143.1	750
COTTON, UPLAND, IRRIGATED (pound (lint))	0	1362.0	0
COTTON, UPLAND, NON-IRRIGATED (pound (lint))	2,650	1362.0	200
OATS (pound)	0	0.0	0
PEANUTS (pound)	0	0.0	0
RICE (pound)	30,990	9710.0	0
SORGHUM, IRRIGATED (bushel)	0	63.9	0
SORGHUM, NON-IRRIGATED (bushel)	1,600	63.9	0
SOYBEANS (bushel)	1,900	33.2	0
SUNFLOWER (pound)	0	0.0	0
WHEAT, WINTER, IRRIGATED (bushel)	0	0.0	0
WHEAT, WINTER, NON-IRRIGATED (bushel)	4,250	38.2	0
HIGH VALUE (sales $/A)	181	4834.3	0
Hay Production (ton)	24,192	2.4	300
Forage/Range Production (ton)	177,015	1.2	75
		Total	1,345

As acres are entered, damages for the selected month will be calculated. The grand total is provided in the lower right-hand corner.

Agriculture Flood Loss Tool

County	COLORADO	select county from drop down menu
Mean Flood Depth (ft)	1	values limited to 0.1 to 50 ft
Flood Duration (days)	7	values limited to 1 to 30 days
Damages	Monthly	select damage calculation method
	May	lect month damage occurs

	BCA-tool Damage $		BCA-tool Acreage
Low Value	$ 325,023	Low Value	970
High Value	$ -	High Value	0
Pasture	$ 162,747	Pasture	375

Monthly Damages

	NASS County Mean Acres	NASS County Yield	Damaged Area Acres	January	February	March	April	May	June	July	August	September	October	November	December	Total
CORN, IRRIGATED (bushel)	1,000	148.0	20					$ 3,240								$ 3,240
CORN, NON-IRRIGATED (bushel)	10,800	143.1	750					$ 117,483								$ 117,483
COTTON, UPLAND, IRRIGATED (pound (lint))	0	1362.0	0					$ -								$ -
COTTON, UPLAND, NON-IRRIGATED (pound (lint))	2,650	1362.0	200					$ 204,300								$ 204,300
OATS (bushel)	0	0.0	0					$ -								$ -
PEANUTS (pound)	0	0.0	0					$ -								$ -
RICE (pound)	30,990	9710.0	0					$ -								$ -
SORGHUM, IRRIGATED (bushel)	0	63.9	0					$ -								$ -
SORGHUM, NON-IRRIGATED (bushel)	1,600	63.9	0					$ -								$ -
SOYBEANS (bushel)	1,900	33.2	0					$ -								$ -
SUNFLOWER (pound)	0	0.0	0					$ -								$ -
WHEAT, WINTER, IRRIGATED (bushel)	0	0.0	0					$ -								$ -
WHEAT, WINTER, NON-IRRIGATED (bushel)	4,250	38.2	0					$ -								$ -
HIGH VALUE (sales $/A)	181	4834.3	0					$ -								$ -
Hay Production (ton)	24,192	2.4	300					$ 143,948								$ 143,948
Forage/Range Production (ton)	177,015	1.2	75					$ 18,799								$ 18,799
		Total	1,345					$ 487,770								
																$ 487,770
																Grand Total

*High value crops includes all tree fruit/nut and vegetable crops as $per acre in value.
** State average yields are used to estimate damage when no acres or yield is reported for a county.

Values used by the BCA tool are calculated in the upper right-hand corner. Crops are summarized by low value, high value, and pasture. Damages and acres for each category are provided.

	BCA-tool Damage $		BCA-tool Acreage
Low Value	$ 325,023	Low Value	970
High Value	$ -	High Value	0
Pasture	$ 162,747	Pasture	375

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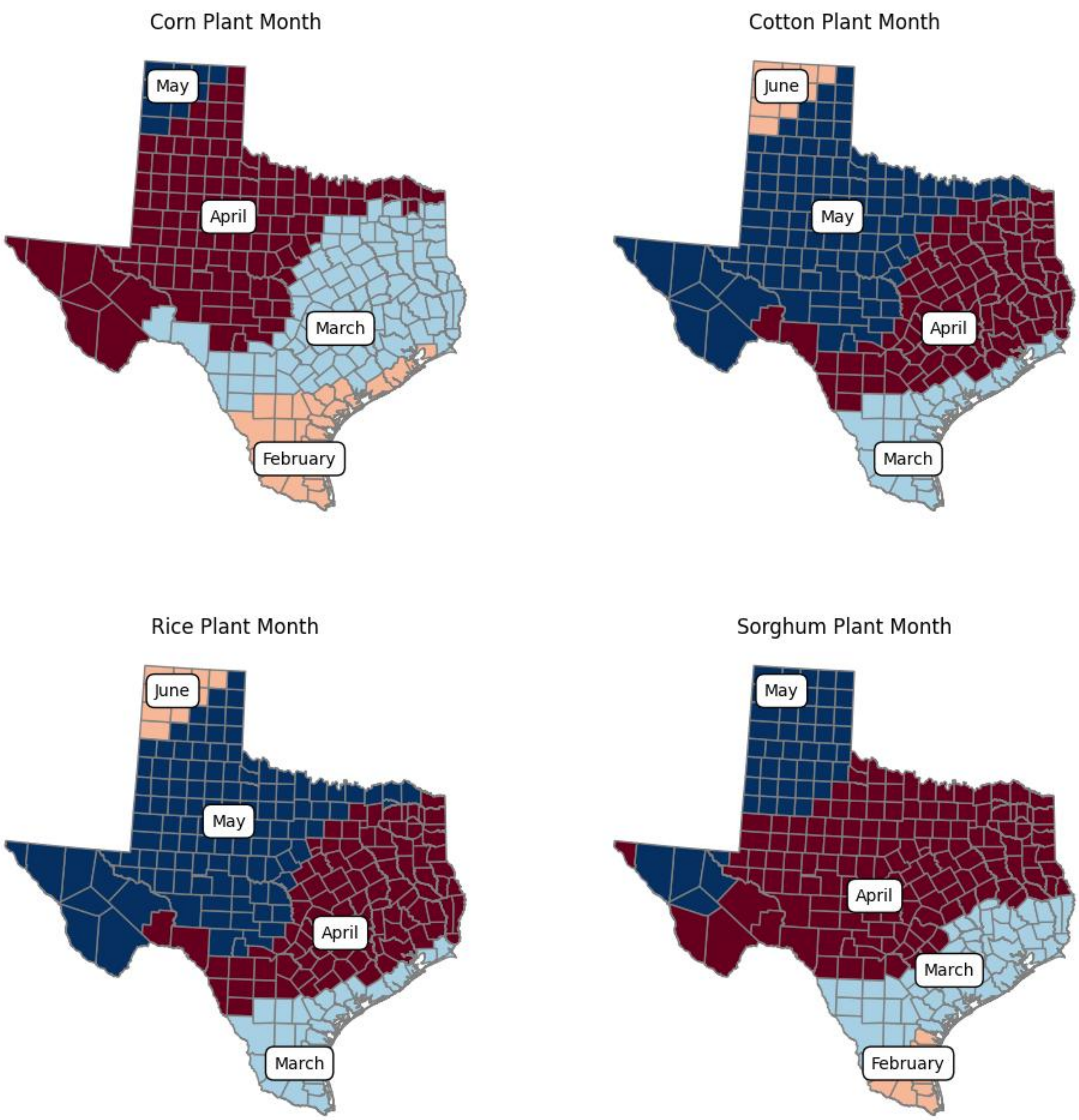
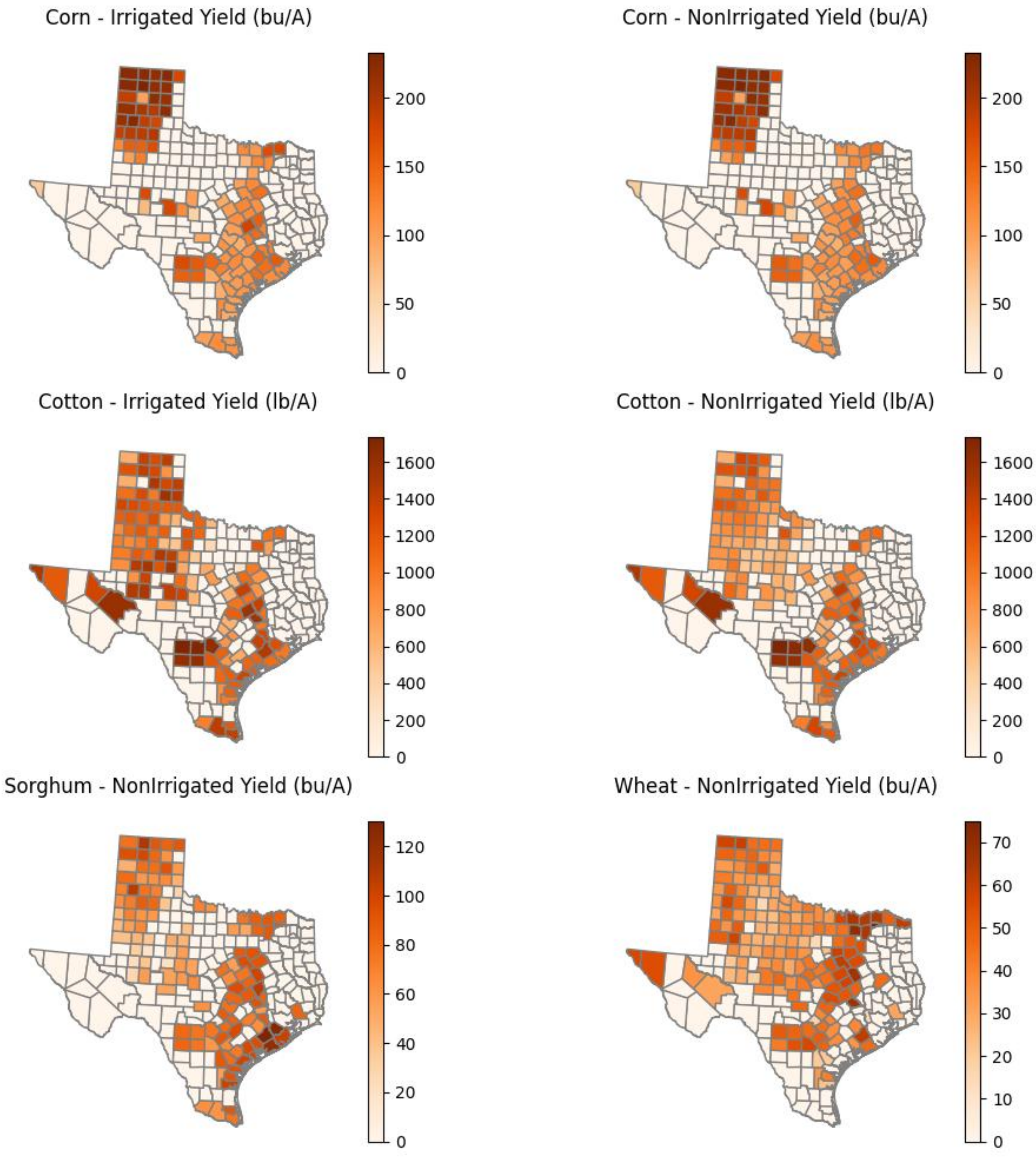
9 Appendices

1. Crop Plant Month Examples



2. Examples of County Level Crop Yields



3. Examples of County Level Crop Acreage