**Supporting Information for**

# Regional Water Stress Forecasting: Effects of Climate Change, Socioeconomic Development, and Irrigated Agriculture—A Texas Case Study

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**Table S1**. Crop types and their planting areas in Texas

| Crop types | Area ($km^2$) | Area Percentage |
|---|---|---|
| Cotton | 25518.87 | 31.07 |
| Winter Wheat | 22949.91 | 27.94 |
| Corn | 11183.45 | 13.61 |
| Sorghum | 9660.77 | 11.76 |
| Other Hay/Non Alfalfa | 6670.63 | 8.12 |
| Oats | 1778.37 | 2.17 |
| Rice | 943.43 | 1.15 |
| Peanuts | 520.99 | 0.63 |
| Soybeans | 517.83 | 0.63 |
| Alfalfa | 402.50 | 0.49 |
| Triticale | 290.44 | 0.35 |
| Rye | 202.99 | 0.25 |
| Pecans | 192.43 | 0.23 |
| Spring Wheat | 188.73 | 0.23 |
| Winter Wheat/Corn | 181.46 | 0.22 |
| Sugarcane | 174.68 | 0.21 |
| Winter Wheat/Cotton | 121.28 | 0.15 |
| Winter Wheat/Sorghum | 120.89 | 0.15 |
| Sunflower | 82.67 | 0.10 |
| Canola | 72.81 | 0.09 |
| Millet | 68.42 | 0.08 |
| Barley | 44.64 | 0.05 |
| Citrus | 40.47 | 0.05 |
| Herbs | 32.29 | 0.04 |
| Potatoes | 27.51 | 0.03 |
| Winter Wheat/Soybeans | 19.23 | 0.02 |
| Peas | 17.59 | 0.02 |
| Other Crops | 13.60 | 0.02 |
| Peppers | 12.52 | 0.02 |
| Watermelons | 12.29 | 0.01 |
| Oranges | 11.95 | 0.01 |
| Onions | 11.36 | 0.01 |
| Sweet Corn | 10.28 | 0.01 |
| Dry Beans | 9.13 | 0.01 |
| Pumpkins | 8.77 | 0.01 |
| Greens | 5.42 | 0.01 |
| Carrots | 4.16 | 0.01 |
| Oats/Corn | 2.59 | 0.00 |
| Cabbage | 2.49 | 0.00 |
| Squash | 1.89 | 0.00 |
| Cantaloupes | 1.67 | 0.00 |
| Barley/Corn | 1.62 | 0.00 |
| Olives | 1.61 | 0.00 |
| Grapes | 0.89 | 0.00 |

| | | |
|---|---|---|
| Other Tree Crops | 0.71 | 0.00 |
| Honeydew Melons | 0.48 | 0.00 |
| Barley/Soybeans | 0.43 | 0.00 |
| Tomatoes | 0.40 | 0.00 |
| Peaches | 0.38 | 0.00 |
| Corn/Soybeans | 0.32 | 0.00 |
| Blueberries | 0.23 | 0.00 |
| Cucumbers | 0.19 | 0.00 |
| Vegetable&Fruits | 0.11 | 0.00 |
| Soybeans/Oats | 0.07 | 0.00 |
| Pistachios | 0.05 | 0.00 |
| Sugarbeets | 0.03 | 0.00 |
| Christmas Trees | 0.03 | 0.00 |
| Pears | 0.02 | 0.00 |

Note: Fallow/Idle croplands are not included. Data are based on the 2016 Cropland Data Layer from National Agriculture Statistics Service, United State Department of Agriculture. https://nassgeodata.gmu.edu/CropScape/

**Table S2.** Summary of the efficiencies (fraction) of MESA/LESA/LEPA irrigation systems in Texas

| **Study area** | **MESA** | **LESA** | **LEPA** | **References** |
|---|---|---|---|---|
| Bushland, Texas | | | 0.96 | Lyle et al., 1983 |
| Texas | 0.78 | 0.88 | 0.95 | Steve, et al., 2011 |
| Texas High Plains | 0.6-0.70 | 0.70-0.80 | >0.90 | Rajan et al., 2015 |

Note: low energy precision application (LEPA), low elevation spray application (LESA), and mid-elevation spray application (MESA).

**Table S3.** Crop coefficients used for different crops

| **Crop** | **$K_{C1}$** | **$K_{C2}$** | **$K_{C3}$** |
|---|---|---|---|
| Winter Wheat/ Barley/Wheat/ Spring Wheat /Triticale | 0.30 | 1.15 | 0.20 |
| Alfalfa /Sorghum | 0.30 | 1.25 | 1.10 |
| Oats | 0.30 | 1.15 | 0.20 |
| Rice | 1.10 | 1.25 | 1.00 |
| Peanut | 0.40 | 1.05 | 0.60 |
| Soybeans | 0.35 | 1.10 | 0.45 |
| Rye | 0.95 | 1.05 | 1.00 |
| Pistachios/Pecans | 0.20 | 1.10 | 0.40 |
| Sugarcane | 0.40 | 1.25 | 0.70 |
| Sunflower | 0.30 | 1.15 | 0.35 |
| Canola | - | 1.10 | 0.35 |
| Millet | 0.30 | 1.10 | 0.25 |

| | | | |
|---|---|---|---|
| Citrus | 0.65 | 0.80 | 0.65 |
| Herbs | - | 1.00 | 0.95 |
| Potato | 0.40 | 1.10 | 0.75 |
| Soybeans | 0.35 | 1.10 | 0.45 |
| Peas | 0.40 | 1.10 | 1.05 |
| Peppers | 0.35 | 1.05 | 0.85 |
| Watermelons | 0.40 | 1.00 | 0.75 |
| Orange | 0.80 | 1.25 | 0.85 |
| Onion | 0.50 | 1.00 | 1.00 |
| Sweet Corn | 0.40 | 1.15 | 1.05 |
| Dry Bean | 0.40 | 1.15 | 0.35 |
| Pumpkin | 0.40 | 1.00 | 0.75 |
| Cabbage/Greens | 0.40 | 1.05 | 0.90 |
| Carrots | 0.50 | 1.10 | 0.80 |
| Oats | 0.30 | 1.15 | 0.20 |
| Squash | 0.30 | 0.95 | 0.75 |
| Cantaloupe | 0.50 | 1.00 | 0.80 |
| Olives | 0.40 | 0.70 | 0.70 |
| Grapes | 0.30 | 0.80 | 0.40 |
| Other Tree Crops | 0.80 | 0.80 | 0.80 |
| Blueberries | 0.30 | 1.05 | 0.40 |
| Honeydew Melons | - | 1.00 | 0.75 |
| Tomato | 0.40 | 1.20 | 0.65 |
| Peach | 0.80 | 1.15 | 0.85 |
| Soybeans | - | 1.15 | 0.50 |
| Cucumber | 0.35 | 0.95 | 0.75 |
| Fruits | 0.80 | 1.25 | 0.85 |
| Sugarbeets | 0.30 | 1.15 | 1.00 |
| Christmas Trees | 1.20 | 1.20 | 1.20 |
| Hay/Non Alfalfa | 0.60 | 1.20 | 1.05 |
| Pears | 0.80 | 1.20 | 0.85 |

Note: "-" denotes no value. Data are from TexasET Network, Texas A&M AgriLife Extension. https://texaset.tamu.edu/ and Allen, et al. (1998).

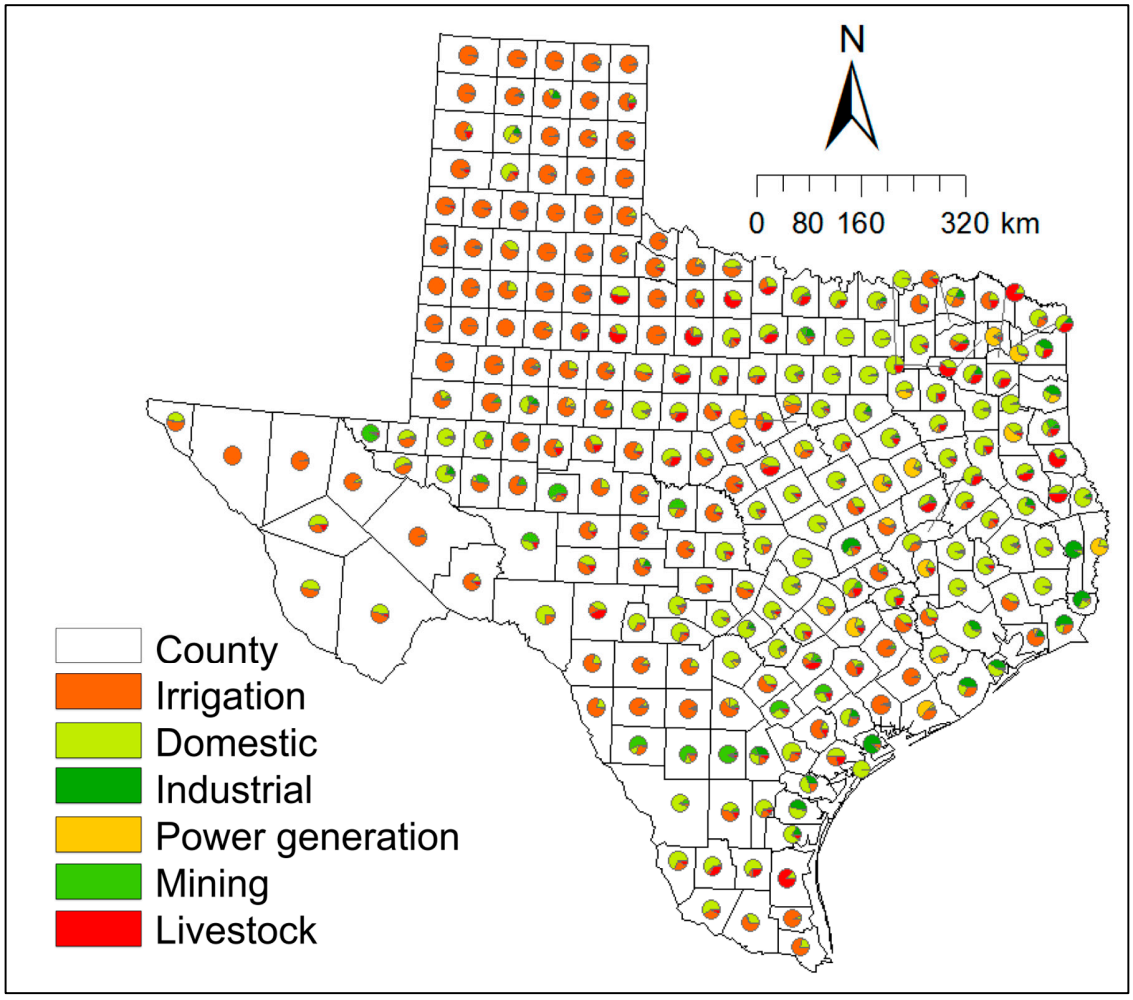


**Figure S1.** The proportion of sectoral water use in different counties in Texas in 2015. Data are from Texas Water Development Board, https://www.twdb.texas.gov/waterplanning/waterusesurvey/index.asp

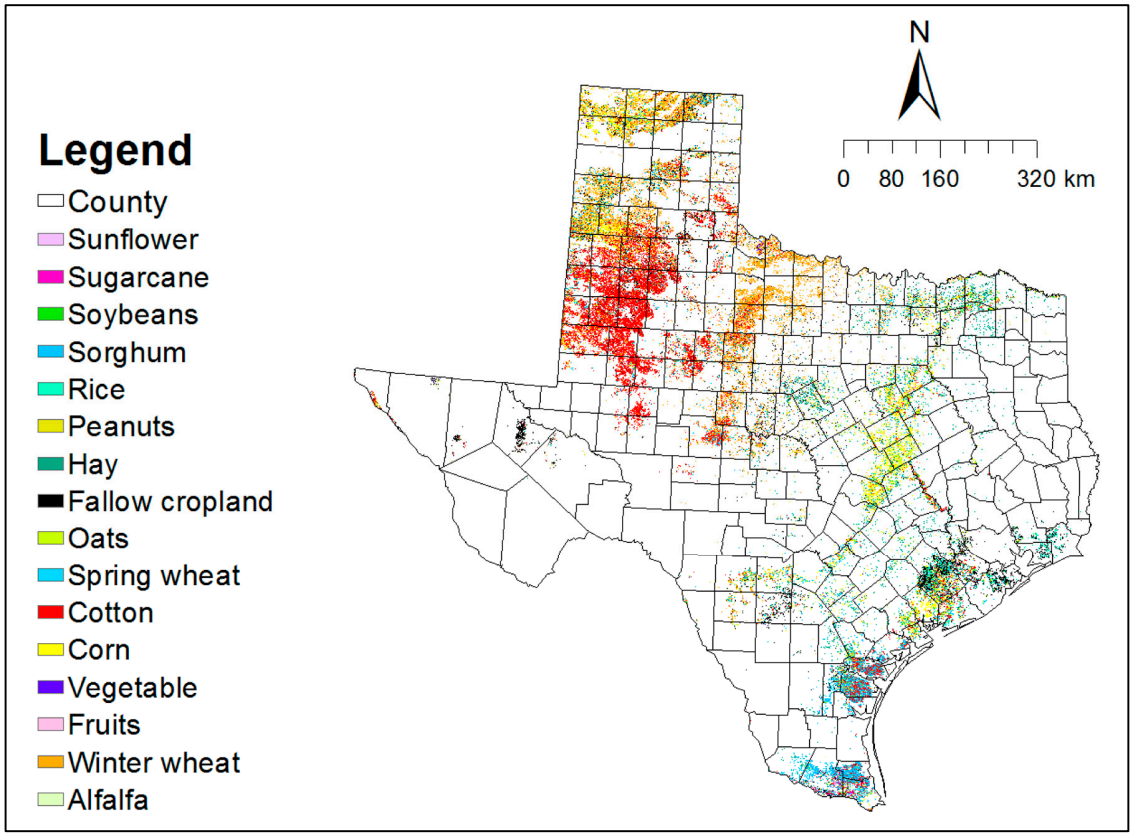


**Figure S2.** Spatial distribution of major crop types in Texas. Data are based on the 2016 Cropland Data Layer (CDL) from National Agriculture Statistics Service (NASS), United State Department of Agriculture. https://nassgeodata.gmu.edu/CropScape/

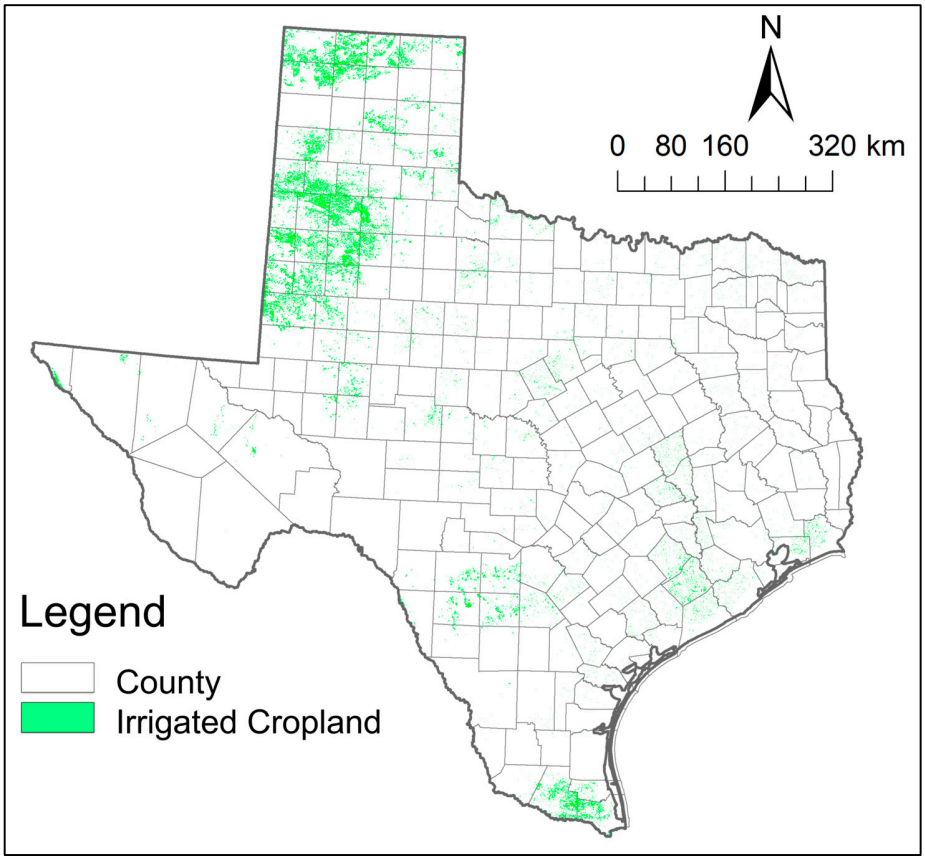


**Figure S3.** Spatial distribution of irrigated croplands in Texas. Data are based on the 2017 Moderate Resolution Imaging Spectroradiometer (MODIS) Irrigated Agriculture Dataset for the United States (MIrAD-US). https://www.usgs.gov/special-topics/monitoring-vegetation-drought-stress/science/modis-irrigated-agriculture

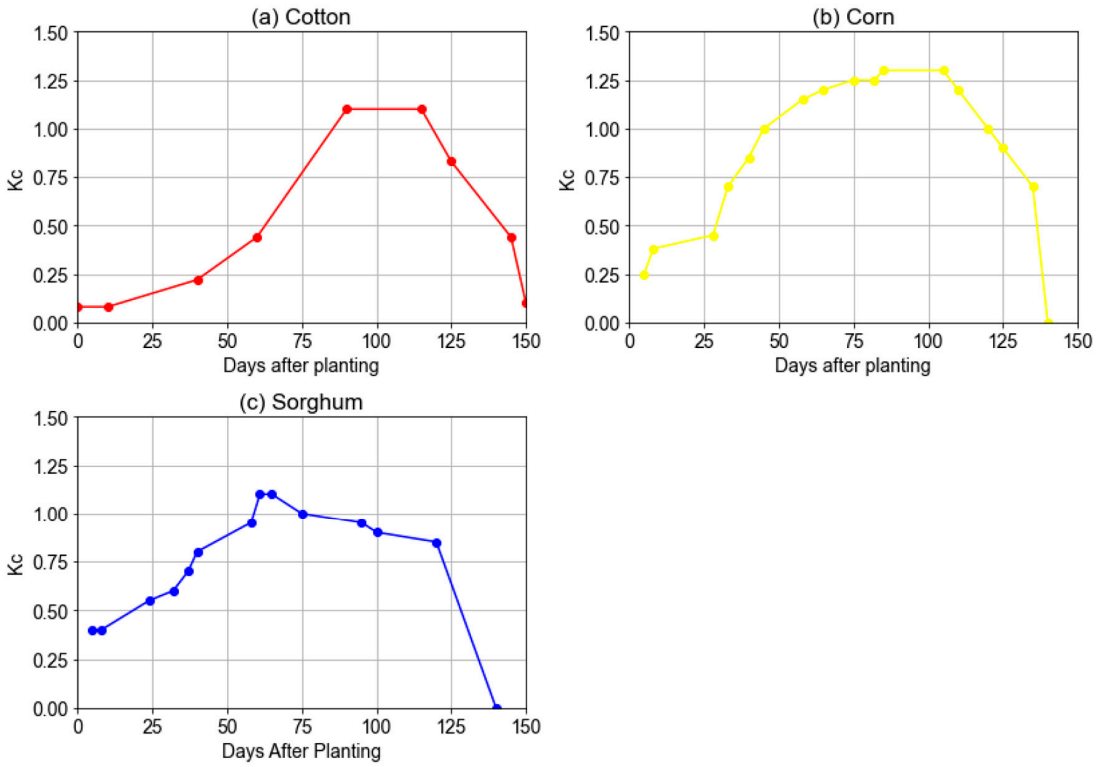


**Figure S4.** Crop coefficients used for (a) Cotton, (b) Corn, and (c) Sorghum. Data are from TexasET Network, Texas A&M AgriLife Extension. https://texaset.tamu.edu/

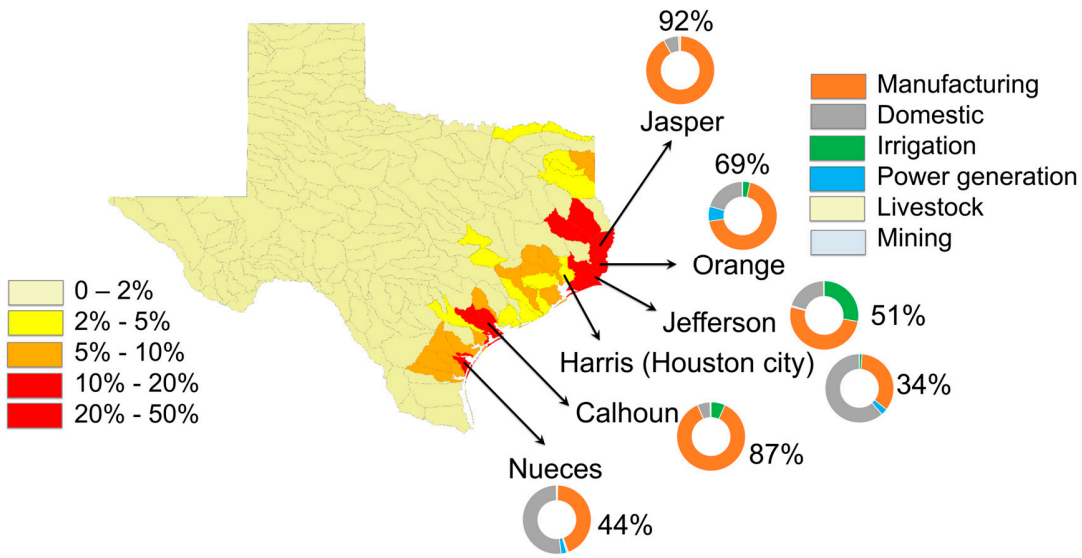


**Figure S5.** Water stress index (WSI) change under GDP-high scenario and sectoral water use in major counties.

**References:**


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Steve, A., Almas, L., Girase, J.R., Kenny, N., Guerrero, B., Vimlesh, K., Marek, T., 2011. *Economic of irrigation systems. Texas A&M AgriLife Research. Irrigation-bulletin-Final-B6113.* http://amarillo.tamu.edu/files/2011/10/Irrigation-Bulletin-FINAL-B6113.pdf

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