Valuation of Agricultural Weather Information Networks

Mohammed Al Hassan

Jeffrey D. Mullen

Gerrit Hoogenboom

University of Georgia

Contact Information: Jeffrey D. Mullen, jmullen@uga.edu, Phone: (706) 542-0767

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1.3 Objectives of the Study

The overall objective of this research is to develop a methodology that is able to estimate the value of site-specific weather information for irrigated agricultural management. This methodology is then applied to irrigation management in Southwest Georgia, although the methodology is applicable wherever the relevant data are available. The application of the methodology in Camilla entails the following specific objectives.

1. To determine, in an expected utility framework, the optimal planting date and irrigation strategy for irrigated corn, cotton, peanut and soybean production in Camilla.
2. To simulate average crop yield and estimate expected revenues for the four crops under consideration based on the optimal planting date and irrigation strategy.
3. To estimate the cost of losing the Camilla Georgia AEMN weather station, forcing growers in the study area to use weather data from other neighboring Georgia AEMN weather stations to make optimal irrigation decisions.

Figure 2.1. Thiessen Polygons With all Weather Stations

Figure 2.2. Thiessen Polygons without the Camilla Station

Figure 2.3. Thiessen Polygons Showing an overlay of the with and without Camilla

Figure 3.4 Diagrammatic Presentation of the Decision Process

Step 1

Use DSSAT crop models to simulate crop yield for selected planting dates and irrigation thresholds over a number of years for selected crops on selected soils at the location where weather data were collected (reference weather station). This is the first simulation.

Step 2

Use an economic optimization model (The Constant Relative Risk Aversion (CRRA) utility function) to identify the combination of planting date and irrigation threshold that maximizes expected utility over the years simulated at the reference weather station. This is referred to as the optimal strategy for the reference weather station.

Step 3

For each of the other selected neighboring weather stations to the reference station, simulate crop production to identify discrete irrigation events (amount of water applied and date of application), using the optimal strategy for the reference weather station from step 2 and the historic weather data from the neighboring weather stations.

Step 4

Simulate yields for each year using the discrete irrigation events from step 3 and weather data from the reference weather station.

Step 5

Estimate expected net revenues based on the predicted crop yield in step 1 and step 4 and calculate the difference between those two net revenues (the difference is the lost in revenue from losing the reference weather station, and forcing farmers to use weather data from neighboring weather stations to make optimal irrigation decisions).

Step 6

Use the Thiessen polygon technique to create Thiessen polygons for all selected weather stations and another one without the reference weather station. Overlay the two Thiessen polygons to show which weather stations constitute the nearest neighbor of the reference station (this is called the union polygon).

Step 7

Use Kriging to create an interpolated surface for the union polygon created in step 6 with the expected net revenue lost estimated in step 5 as the input data.

Step 8

Use Zonal Statistics to calculate the average value of the interpolated surface created in step 7 for each polygon in the Union polygon.

Figure: Kriging Results for Corn TLS

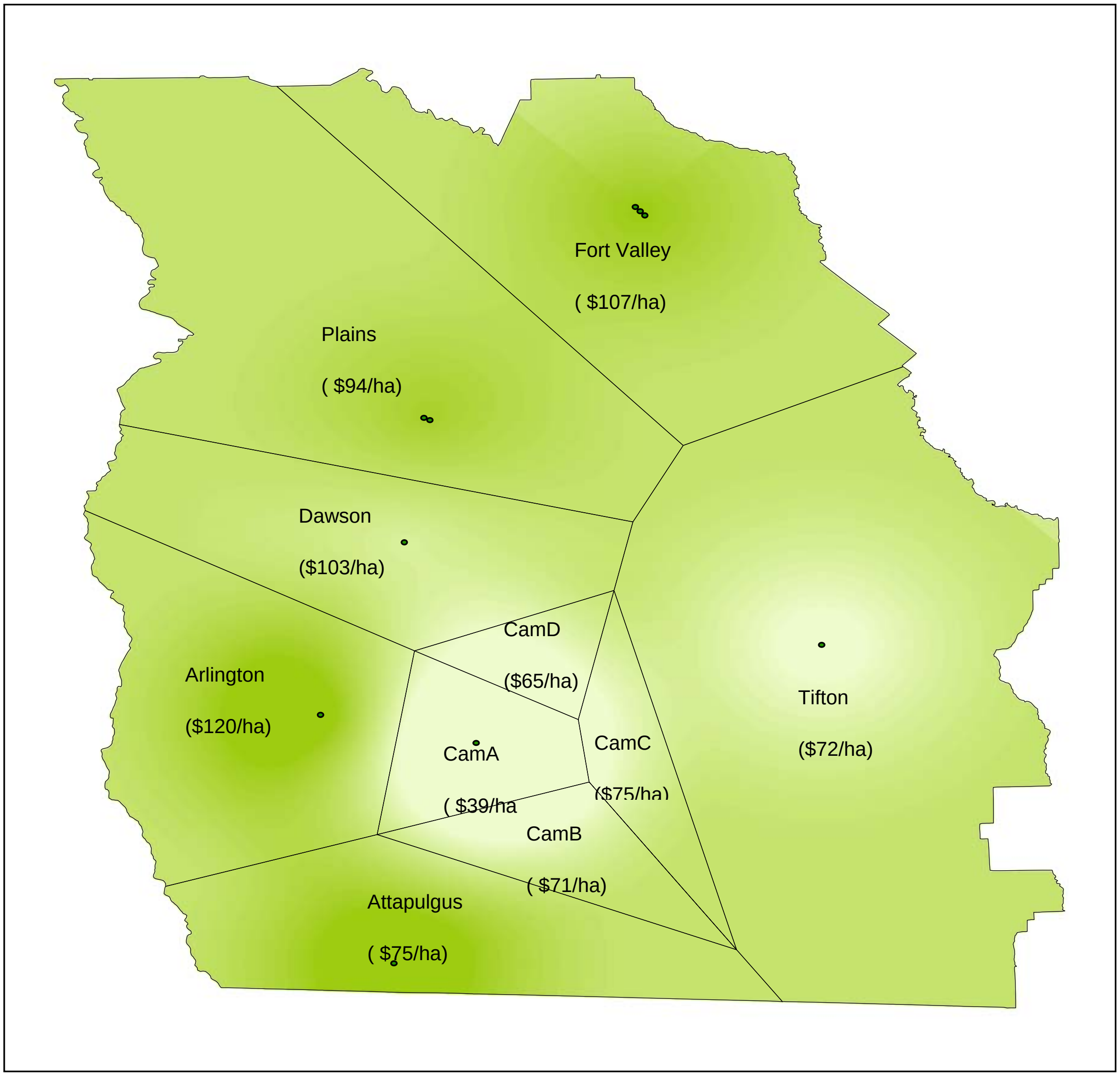

Table: Total Cost of Losing Camilla (Corn NLS and TLS)

County	Proportion of county in Camilla polygon	Total irrigated corn hectares on NLS in the Camilla Polygon	Total irrigated corn hectares on TLS in the Camilla Polygon	Total cost of irrigated cotton on NLS	Total cost of irrigated cotton on TLS
Baker	0.55	159.41	126.98	4623	3936
Calhoun	0.01	9.39	8.39	272	260
Colquitt	0.32	316.39	38.61	9175	1197
Decatur	0.04	6.12	15.92	177	494
Dougherty	0.67	80.78	373.69	2343	11584
Grady	0.27	43.55	339.68	1263	10530
Mitchell	1.00	1911.47	2511.94	55433	77870
Thomas	0.46	38.21	940.32	1108	29150
Worth	0.12	3.03	187.84	88	5823
Total				**$74,482**	**$140,844**

Table Total Cost of Losing Camilla (Cotton NLS and TLS)

County	Proportion of county in Camilla polygon	Total irrigated cotton hectares on NLS in the Camilla Polygon	Total irrigated cotton hectares on TLS in the Camilla Polygon	Total cost of irrigated cotton on NLS	Total cost of irrigated cotton on TLS
Baker	0.55	174.18	138.74	4180	5133
Calhoun	0.01	10.99	9.83	264	364
Colquitt	0.32	1772.37	216.31	42537	8003
Decatur	0.04	23.24	60.39	558	2234
Dougherty	0.67	56.15	259.79	1348	9612
Grady	0.27	19.25	150.13	462	5555
Mitchell	1.00	2371.84	3116.93	56924	115326
Thomas	0.46	16.08	395.66	386	14639
Worth	0.12	10.36	640.65	249	23704
Total				**$106,908**	**$184,570**

Table Total Cost of Losing Camilla (Peanut NLS and TLS)

County	Proportion of county in Camilla polygon	Total irrigated peanut hectares on NLS in the Camilla Polygon	Total irrigated peanut hectares on TLS in the Camilla Polygon	Total cost of irrigated peanut on NLS	Total cost of irrigated peanut on TLS
Baker	0.55	165.47	131.81	8108	5667
Calhoun	0.01	5.23	4.68	256	201
Colquitt	0.32	698.23	85.22	34213	3664
Decatur	0.04	15.71	40.83	770	1756
Dougherty	0.67	42.84	198.20	2099	8523
Grady	0.27	7.39	57.64	362	2479
Mitchell	1.00	1716.98	2256.35	84132	97023
Thomas	0.46	7.64	188.10	374	8088
Worth	0.12	7.22	446.63	354	19205
Total				**$130,668**	**$146,606**

Table Total Cost of losing Camilla (Soybean NLS and TLS)

County	Proportion of county in Camilla polygon	Total irrigated soybean hectares on NLS in the Camilla Polygon	Total irrigated soybean hectares on TLS in the Camilla Polygon	Total cost of irrigated peanut on NLS	Total cost of irrigated peanut on TLS
Baker	0.55	24.66	19.64	1776	1237
Calhoun	0.01	0.57	0.51	41	32
Colquitt	0.32	86.89	10.61	6256	668
Decatur	0.04	5.93	15.39	427	970
Dougherty	0.67	5.06	23.41	364	1475
Grady	0.27	1.49	11.69	107	736
Mitchell	1.00	51.12	67.18	3681	4232
Thomas	0.46	20.64	508.03	1486	32006
Worth	0.12	1.99	123.61	143	7787
Total				**$14,281**	**$49,143**