Economic Impacts of Natural Disasters on Agriculture

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Since 1980, the State of Florida has experienced 48 “billion dollar” natural disasters.

- $5 - $10 billion in economic losses for the State of Florida each year.

1980-2017 Billion-Dollar Weather and Climate Disasters by State

Average Frequency per Year of Billion Dollar Disasters

Please note that the map reflects a summation of billion-dollar events for each state affected (i.e., it does not mean that each state shown suffered at least $1 billion in losses for each event).
1980-2017 Billion-Dollar Weather and Climate Disasters by State

Average Cost per Year of Billion Dollar Disasters

Please note that the map reflects a summation of billion-dollar events for each state affected (i.e., it does not mean that each state shown suffered at least $1 billion in losses for each event).
Agricultural Assets at Risk

- Standing annual and perennial crops
- Live animals
- Forest inventory
- Nursery/greenhouse structures
- Irrigation systems
- Roads, ditches, stormwater impoundments
- Livestock and aquaculture facilities
- Farm machinery
- Farm office buildings
- Packinghouses and processing facilities
- Research, extension, and teaching facilities
Impacts of Natural Disasters on Agriculture

“Losses” vs. “Damages”
Types of Agricultural Losses from Natural Disasters

- Direct crop and animal losses
- Decreased output and revenues
- Increased input costs (e.g. fertilizer, chemicals, feed, vet services)
- Cleanup, repair and other recovery costs
- Reduced employee earnings and business owner profits
- Long term loss of market share
Types of Agricultural Damages from Natural Disasters

• **Crop and animal damage**
  – Destroyed trees
  – Deceased animals

• **Infrastructure damage**
  – Irrigation systems
  – Livestock shelters
  – Veterinary services
  – Aquaculture equipment and hatcheries
  – Farm equipment and machinery
  – Post-production facilities
Additional Considerations

- Agricultural impacts of natural disasters can potentially cause
  - Unemployment and/or a decline in wages among farmers and farm workers
  - Rises in food imports and drops in food exports
  - An increase in the level of food insecurity

- Damages and losses to the agriculture sector accumulate over time as a result of recurring natural disasters
  - Constrains economic growth in the agricultural sector

- Some disasters cause more agricultural losses than others

- Losses vary by agricultural subsector and geography
Policy Implications

• National strategies for disaster risk reduction that support resilience and sustainable agricultural development must
  – Address disasters that cause the greatest losses
  – Design measures specific to the crop, livestock, fisheries and aquaculture, and forestry subsectors
  – Adopt strategies that counteract the impact of disasters on sector growth and development and on national food security

• Effective policy requires crop-specific damage and loss data for the agriculture sector.
Case Study: Hurricane Irma
Hurricane Irma Wind Speeds and Rainfall

Total Precipitation, September 9 – 12 (observed inches)
- 0.0 – 3.0
- 3.1 – 6.0
- 6.1 – 9.0
- 9.1 – 12.0
- 12.1 – 17.0

Legend
AL112017_windswath
Irma48hprecip
<VALUE>

Hurricane force wind speeds
Cat. 1: 74 – 95 mph
Cat. 2: 96 – 110 mph
Cat. 3: 111 – 129 mph
Cat. 4: 130 – 156 mph

Tropical storm force winds (39 – 57 mph)
Tropical storm force winds (58 – 73 mph)

Data Sources: National Hurricane Center, National Weather Service
Approach to Economic Impact Assessment

- Field damage surveys by UF-IFAS, FDACS, FSA, FDOC
- Windspeed zones mapped on cropland area and counties (NHC, NWS)
- Loss functions and seasonal factors
- Average yields and prices, 2016 (USDA-NASS)
- Regional economic modeling (Implan)

Source: https://nassgeodata.gmu.edu/CropScape
Florida Agricultural Production Losses to Hurricane Irma

- Citrus
- Forestry
- Other field crops
- Vegetables
- Greenhouse & Nursery
- Livestock/Animal Products
Citrus

- Citrus hit just before harvest season
- Early oranges and grapefruit worst affected
- 412,000 acres
- Average value/acre: $2500-$3900
- Loss: $553 million
- Flooding damages to trees not considered yet
Field Crops

- Sugarcane, cotton, grains, oilseeds, sod, forages
- Most crops near harvest
- 534,000 acres sugarcane
- 800,000+ acres other crops
- Average value/acre: $100-$1200
- Sugarcane loss: $383 million
- Loss all crops: $506 million
Nursery and Greenhouse

- Floriculture (flowers, foliage) and woody ornamentals (tree farms)
- 46,000 acres
- Average value/acre: $11,000-$49,000
- Assumed loss levels half for crops under greenhouse-shadehouse
- Loss: $436 million
Forestry

- FDACS estimated losses using Forest Service timberland inventory and prices for sawtimber, chip-n-saw, pulpwood
- 36 million trees, 17.2 million acres
- Total damage: $1.633 billion
- Assumed annualized harvest loss level 20%
- 20% salvage value
- Net annualized loss: $261 million
Vegetables and Strawberries

- Strawberries, tomatoes, peppers, beans, sweet corn, cucumbers, squash, potatoes
- 164,000 acres
- Average value/acre: $3,000-$34,000
- Assumed 10% of fall/winter season lost
- Loss: $72 million
- Damages to mulched growing beds and irrigation
- Melons and blueberries not in season
Livestock-Animal Products

- FDACS estimated losses to beef cattle ranches, dairy farms, aquaculture
- Dead animals, lost weight, dumped milk
- Loss: $39 million
- Pasture loss minimal
- Infrastructure damages not considered
## Summary of Florida Agricultural Production Losses to Hurricane Irma

<table>
<thead>
<tr>
<th>Commodity Group</th>
<th>Loss (M$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citrus</td>
<td>553</td>
</tr>
<tr>
<td>Vegetables</td>
<td>72</td>
</tr>
<tr>
<td>Field crops</td>
<td>506</td>
</tr>
<tr>
<td>Nursery-Greenhouse</td>
<td>436</td>
</tr>
<tr>
<td>Livestock-Animal products</td>
<td>39</td>
</tr>
<tr>
<td>Forestry (timber)</td>
<td>261</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,861</strong></td>
</tr>
</tbody>
</table>
## Economic Impacts of Florida Agricultural Production Losses to Hurricane Irma

<table>
<thead>
<tr>
<th>Impact Type (Regional Multiplier Effect)</th>
<th>Employment (Fulltime, Part-time Jobs)</th>
<th>Labor Income (Wages, Benefits)</th>
<th>Value Added (GDP)</th>
<th>Industry Output (Revenue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct (Ag Revenue Losses)</td>
<td>-20,845</td>
<td>-$785</td>
<td>-$1,010</td>
<td>-$1,861</td>
</tr>
<tr>
<td>Indirect (Supply Chain Purchases)</td>
<td>-7,094</td>
<td>-$273</td>
<td>-$499</td>
<td>-$847</td>
</tr>
<tr>
<td>Induced (Household, Gov. Responding)</td>
<td>-27,914</td>
<td>-$1,331</td>
<td>-$2,235</td>
<td>-$3,817</td>
</tr>
<tr>
<td>Total</td>
<td><strong>-55,854</strong></td>
<td><strong>-$2,389</strong></td>
<td><strong>-$3,743</strong></td>
<td><strong>-$6,525</strong></td>
</tr>
</tbody>
</table>

Note: Values in 2017 dollars

Data Source: IMPLAN model and 2015 State of Florida model data (Implan Group, LLC).
Source: UF-IFAS report, Hurricane Irma Update #4, Oct. 2, 2017
## Florida Citrus Historic Production and Forecast

<table>
<thead>
<tr>
<th>Variety</th>
<th>2015-16</th>
<th>2016-17</th>
<th>2017-18 Forecast</th>
<th>Forecast Change from Previous Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oranges</td>
<td>81.7</td>
<td>68.8</td>
<td>45.0</td>
<td>-35%</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>10.8</td>
<td>7.8</td>
<td>4.7</td>
<td>-40%</td>
</tr>
<tr>
<td>Tangerines and Tangelos</td>
<td>1.42</td>
<td>1.62</td>
<td>0.86</td>
<td>-47%</td>
</tr>
<tr>
<td>Total</td>
<td>93.9</td>
<td>78.1</td>
<td>50.5</td>
<td>-35%</td>
</tr>
</tbody>
</table>

Source: USDA-NASS, Citrus Forecast, Feb. 8, 2018
Citrus Fruit Deliveries to Florida Processing Plants: 2016-17 and 2017-18 Seasons

Source: Florida Department of Citrus, Processor Statistics
Florida Fresh Citrus Fruit Shipments

Source: Florida Department of Citrus, Fresh fruit statistics
## Florida Citrus Crop and Tree Losses to Hurricane Irma Reported in Survey of Growers

<table>
<thead>
<tr>
<th>Hurricane Windspeed Zone</th>
<th>Oranges</th>
<th>Grapefruit</th>
<th>Specialty Citrus</th>
<th>Percent Trees Destroyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 3</td>
<td>75.0</td>
<td></td>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td>Category 2</td>
<td>40.5</td>
<td>79.5</td>
<td>38.4</td>
<td>8.0</td>
</tr>
<tr>
<td>Category 1</td>
<td>5.0</td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Tropical Storm</td>
<td>19.6</td>
<td>47.5</td>
<td>23.3</td>
<td>4.2</td>
</tr>
<tr>
<td>Total</td>
<td>48.8</td>
<td>61.3</td>
<td>38.9</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Source: Florida Department of Citrus, grower survey, 31 respondents
Bulk Movement of Florida Fresh Fruits and Vegetables, 2017-18 vs. 2016-17 Seasons

Source: USDA-AMS, Market News Service, data for 10,000 lb. units
<table>
<thead>
<tr>
<th>Commodity</th>
<th>Volume Change</th>
<th>Price Change</th>
<th>Value 2016-17 (M$)</th>
<th>Value 2017-18 (M$)</th>
<th>Value Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabbage</td>
<td>-39.4%</td>
<td>67.3%</td>
<td>$8.9</td>
<td>$9.0</td>
<td>1%</td>
</tr>
<tr>
<td>Corn-sweet</td>
<td>-21.3%</td>
<td>1.5%</td>
<td>$32.5</td>
<td>$26.0</td>
<td>-20%</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>-48.1%</td>
<td>25.1%</td>
<td>$17.3</td>
<td>$11.2</td>
<td>-35%</td>
</tr>
<tr>
<td>Eggplant</td>
<td>-53.0%</td>
<td>69.7%</td>
<td>$4.6</td>
<td>$3.7</td>
<td>-20%</td>
</tr>
<tr>
<td>Escarole</td>
<td>-57.3%</td>
<td>65.7%</td>
<td>$0.9</td>
<td>$0.6</td>
<td>-29%</td>
</tr>
<tr>
<td>Okra</td>
<td>-38.5%</td>
<td>19.5%</td>
<td>$2.9</td>
<td>$2.1</td>
<td>-26%</td>
</tr>
<tr>
<td>Peppers, Bell Type</td>
<td>-46.1%</td>
<td>123.1%</td>
<td>$31.2</td>
<td>$37.5</td>
<td>20%</td>
</tr>
<tr>
<td>Peppers, Other</td>
<td>-42.3%</td>
<td>99.1%</td>
<td>$2.5</td>
<td>$2.8</td>
<td>15%</td>
</tr>
<tr>
<td>Radishes</td>
<td>-18.9%</td>
<td>8.5%</td>
<td>$1.4</td>
<td>$1.2</td>
<td>-12%</td>
</tr>
<tr>
<td>Squash</td>
<td>-0.9%</td>
<td>6.1%</td>
<td>$16.5</td>
<td>$17.3</td>
<td>5%</td>
</tr>
<tr>
<td>Strawberries</td>
<td>-18.8%</td>
<td>4.9%</td>
<td>$302.0</td>
<td>$257.2</td>
<td>-15%</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>-41.0%</td>
<td>123.5%</td>
<td>$164.2</td>
<td>$216.5</td>
<td>32%</td>
</tr>
<tr>
<td>Tomatoes, Cherry</td>
<td>-59.6%</td>
<td>80.4%</td>
<td>$13.3</td>
<td>$9.7</td>
<td>-27%</td>
</tr>
<tr>
<td>Tomatoes, Grape Type</td>
<td>-52.5%</td>
<td>70.6%</td>
<td>$62.6</td>
<td>$50.7</td>
<td>-19%</td>
</tr>
<tr>
<td>Tomatoes, Plum Type</td>
<td>-30.0%</td>
<td>68.8%</td>
<td>$31.9</td>
<td>$37.8</td>
<td>18%</td>
</tr>
<tr>
<td>Total all commodities with comparable information</td>
<td></td>
<td></td>
<td>$712.1</td>
<td>$714.1</td>
<td></td>
</tr>
</tbody>
</table>

Note: Some minor commodities not shown
Source: USDA-Agricultural Marketing Service, Market News
# Federal Crop Insurance Claims in Florida, 2017

## All Crops, By Cause, 2017

<table>
<thead>
<tr>
<th>Cause of Loss</th>
<th>Policies</th>
<th>Acres</th>
<th>Indemnity ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARPI-SCO-STAX-MP Crops</td>
<td>2,105</td>
<td>0</td>
<td>39,891,541</td>
</tr>
<tr>
<td>Cold Wet Weather</td>
<td>3</td>
<td>83</td>
<td>24,048</td>
</tr>
<tr>
<td>Decline in Price</td>
<td>4</td>
<td>6</td>
<td>534</td>
</tr>
<tr>
<td>Drought</td>
<td>90</td>
<td>9,320</td>
<td>2,067,480</td>
</tr>
<tr>
<td>Excess Moisture-Precipitation</td>
<td>305</td>
<td>24,372</td>
<td>16,181,351</td>
</tr>
<tr>
<td>Failure of Irrigation Equipment</td>
<td>1</td>
<td>63</td>
<td>5,985</td>
</tr>
<tr>
<td>Freeze</td>
<td>32</td>
<td>1,108</td>
<td>1,491,342</td>
</tr>
<tr>
<td>Hail</td>
<td>16</td>
<td>386</td>
<td>173,038</td>
</tr>
<tr>
<td>Heat</td>
<td>5</td>
<td>262</td>
<td>85,931</td>
</tr>
<tr>
<td>Hot Wind</td>
<td>2</td>
<td>65</td>
<td>22,051</td>
</tr>
<tr>
<td>Hurricane-Tropical Depression</td>
<td>187</td>
<td>21,994</td>
<td>8,959,635</td>
</tr>
<tr>
<td>Insects</td>
<td>5</td>
<td>122</td>
<td>482,696</td>
</tr>
<tr>
<td>Insufficient Chilling Hours</td>
<td>7</td>
<td>105</td>
<td>437,731</td>
</tr>
<tr>
<td>Plant Disease</td>
<td>13</td>
<td>711</td>
<td>1,695,121</td>
</tr>
<tr>
<td>Wildlife</td>
<td>26</td>
<td>1,067</td>
<td>203,767</td>
</tr>
<tr>
<td>Wind/Excess Wind</td>
<td>27</td>
<td>3,104</td>
<td>1,864,583</td>
</tr>
<tr>
<td>Grand Total</td>
<td>2,828</td>
<td>62,768</td>
<td>73,586,833</td>
</tr>
</tbody>
</table>

## By Crop for Hurricane, Excess Rain, and Wind Causes, Sep-Dec, 2017

<table>
<thead>
<tr>
<th>Crop</th>
<th>Policies</th>
<th>Acres</th>
<th>Indemnity ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grapefruit</td>
<td>58</td>
<td>13,606</td>
<td>4,359,419</td>
</tr>
<tr>
<td>Peppers</td>
<td>21</td>
<td>1,069</td>
<td>4,121,642</td>
</tr>
<tr>
<td>Peanuts</td>
<td>98</td>
<td>8,177</td>
<td>2,075,799</td>
</tr>
<tr>
<td>Fresh Tomatoes</td>
<td>17</td>
<td>851</td>
<td>2,063,114</td>
</tr>
<tr>
<td>Cotton</td>
<td>22</td>
<td>2,856</td>
<td>932,563</td>
</tr>
<tr>
<td>Avocados</td>
<td>3</td>
<td>301</td>
<td>825,403</td>
</tr>
<tr>
<td>Oranges</td>
<td>35</td>
<td>1,507</td>
<td>761,033</td>
</tr>
<tr>
<td>All Other Crops</td>
<td>19</td>
<td>2,057</td>
<td>701,065</td>
</tr>
<tr>
<td>Fresh Sweet Corn</td>
<td>3</td>
<td>473</td>
<td>377,571</td>
</tr>
<tr>
<td>Tangelos</td>
<td>14</td>
<td>497</td>
<td>248,674</td>
</tr>
<tr>
<td>Mandarins/Tangerines</td>
<td>6</td>
<td>427</td>
<td>151,397</td>
</tr>
<tr>
<td>Corn</td>
<td>11</td>
<td>659</td>
<td>136,527</td>
</tr>
<tr>
<td>Tangors</td>
<td>4</td>
<td>82</td>
<td>79,268</td>
</tr>
<tr>
<td>Soybeans</td>
<td>11</td>
<td>550</td>
<td>48,542</td>
</tr>
<tr>
<td>Nursery</td>
<td>1</td>
<td>0</td>
<td>6,440</td>
</tr>
<tr>
<td>All Other Citrus Trees</td>
<td>2</td>
<td>0</td>
<td>2,280</td>
</tr>
<tr>
<td>Grand Total</td>
<td>325</td>
<td>33,112</td>
<td>16,890,738</td>
</tr>
</tbody>
</table>
Legislative Process for Agriculture Disaster Assistance

U.S. Senate Committee on Appropriations, Feb. 2018

Agriculture, Food and Drug Administration and Related Agencies

- The supplemental provides $3.597 billion in disaster funding for programs under the jurisdiction of the agriculture subcommittee. This funding will provide relief for producers, families, and communities in states affected by Hurricanes Harvey, Irma, and Maria and recent wildfires. The bill also makes changes to existing mandatory disaster programs to accommodate losses resulting from the 2017 drought.

**Ad Hoc Agriculture Disaster – $2.36 billion**

- $2.36 billion for crop disasters as a result of hurricanes and wildfires. Producers who purchased crop insurance or Noninsured Crop Disaster Assistance Program (NAP) on eligible crops will be allowed to recoup up to 85 percent of their losses. Producers who did not have crop insurance or NAP on eligible crops will be allowed to recoup up to 65 percent of their losses. Producers receiving payments will be required to purchase crop insurance or NAP policies on eligible commodities for each of the next two years.

**Disaster Program Changes – $42 million**

- Removes the annual statutory cap on the Emergency Assistance for Livestock, Honey Bees and Farm-Raised Fish Program, currently set at $20 million per year.
- Amends the Livestock Indemnity Program to cover “sold livestock for a reduced sale price” as cause for an indemnity payment due to natural disaster or drought (only mortality is currently covered), and removes payment limitations currently capped at $125,000.
- Increases payment acreage for the Tree Assistance Program from 500 acres to 1,000 acres.
- All changes would be applied to losses incurred on January 1, 2017 or later.

**Office of the Inspector General – $2.5 million**

- $2.5 million for Office of Inspector General (OIG) audit and investigative oversight activities related to Hurricanes Harvey, Irma, and Maria.

**Research Programs – $21 million**

- $22 million for the Agricultural Research Service (ARS) to repair damages to 14 ARS-owned facilities and equipment resulting from Hurricanes Harvey, Irma, and Maria.

**Conservation Programs – $841 million**

- $400 million for the Emergency Conservation Program to address anticipated project demand due to the hurricanes and wildfires, as well as current backlogs for Stafford and non-Stafford projects.
- $541 million for the Emergency Watershed Program to address anticipated project demand due to the hurricanes, as well as current backlogs for Stafford and non-Stafford projects.
Conclusions

- Natural disasters are the “new normal”
- Distinguish between damages and losses
- Crop map data are poor for winter specialty crops
- Damages may appear worse than actual
- Losses can occur over extended period
- Market price increases can offset volume losses
- Difficult to assess losses in rapidly changing industries (e.g. citrus greening)
- Federal crop insurance provides minimal protection in Florida
- Need tools for rapid assessment to be policy-relevant
Future Developments

GIS Application for Rapid Assessment

- Interactive scalable maps
  - Desktop or mobile apps for user input
- Define area of interest
- Report assets at risk or impacted
  - Population
  - Number of businesses and employees
  - Crop/livestock inventory and value
  - Regional economic impact (sales, jobs, GDP, taxes)
- Simulation module to support training for defined disaster scenarios

Integration efforts

- UF One Health Center of Excellence
  - Crowd-source pre- and post-disaster aerial drone footage to improve crop map data and infrastructure damage estimates
  - Incorporate impacts related to the spread of animal and plant pathogens
  - Human health impacts of natural disasters
- Sandia National Laboratory
  - Impacts associated with loss of power
- UF/IFAS Extension
  - Harmonize damage and loss reporting

Mobile Collector Application