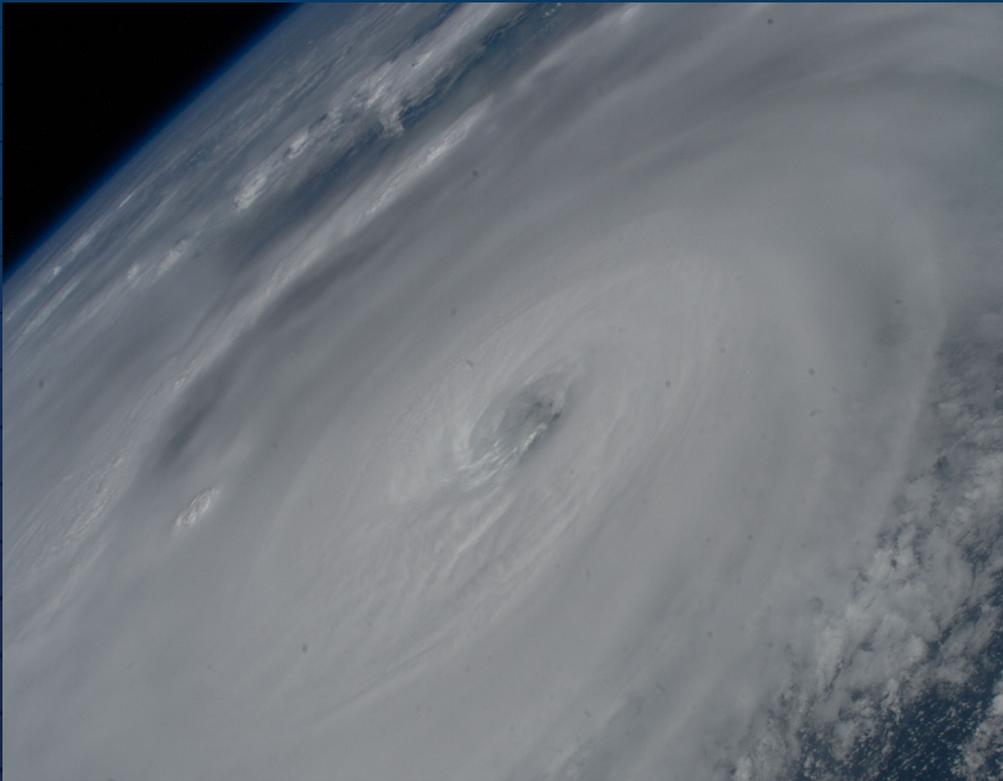


Preliminary Assessment of
AGRICULTURAL LOSSES
resulting from
HURRICANE IAN



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October 17, 2022

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**ECONOMIC IMPACT
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INTRODUCTION

The system that would eventually become Hurricane Ian first became a tropical storm in the central Caribbean on September 23, 2022 and rapidly intensified, strengthening into a hurricane on September 26. It attained Category 4 strength prior to its first landfall on September 28 on Cayo Costa Island, followed by a second landfall on the southwestern peninsula of Florida near Punta Gorda. Afterwards, Ian crossed the peninsula, downgrading to a tropical storm once the center of the system was well inland. Eventually, Ian entered the Atlantic Ocean as a tropical storm, regaining Category 1 hurricane status just before making a third landfall in South Carolina.

The production agricultural sector frequently experiences substantial adverse impacts following tropical cyclone

events. Producers might experience losses (changes in economic flows) resulting from a change in the level or value of sales or a change in input costs and they might also experience damages (changes in economic stocks) that require repair or replacement. Agricultural losses might result from situations such as fruit drop in a citrus grove, a flooded field of vegetables, dumped milk at a dairy farm due to cold storage not being available during a power outage, or even a lower sales price for a rancher that had cattle that were not able to get the appropriate nutrition due to stress or flooded grazing lands. Agricultural assets at risk for damages include farm homes, farm buildings, greenhouse and nursery structures, machinery/equipment, fencing, irrigation systems, other infrastructure, livestock animals, and perennial plantings such as citrus trees and vineyards.

EVENT DATA AND IMPACTED AGRICULTURAL LANDS

The wind swath of Hurricane Ian, as published by the National Oceanic and Atmospheric Administration's National Hurricane Center is shown in Figure 1, with affected agricultural lands identified in bright green. A large swath of southwest Florida experienced hurricane force winds and the two tropical storm force wind categories extended across the entire peninsula, as far north and west as Taylor and Madison Counties. A summary of the commodity groups that were affected by the different wind speed zones is provided in Table 1.

Nearly five million acres of agricultural land were affected by Hurricane Ian, of which almost 60% was grazing land. Over 700,000 acres of agricultural lands (~60% grazing land) were affected by Category 4 hurricane conditions with nearly an additional 500,000 acres affected by less intense hurricane (Category 1 - 3) conditions. The commodity groups that were most affected (in terms of acreage) by hurricane conditions (not including grazing land) were citrus and vegetables and melons.

The data on the estimated value of the production on affected acreage by commodity group and wind speed zone are displayed in Table 2. Data published by the United States Department of Agriculture's National Agricultural Statistics Service (USDA-NASS) on price and yield were used to estimate value per acre in Florida for individual crops within commodity groups for the years 2017 - 2021, where

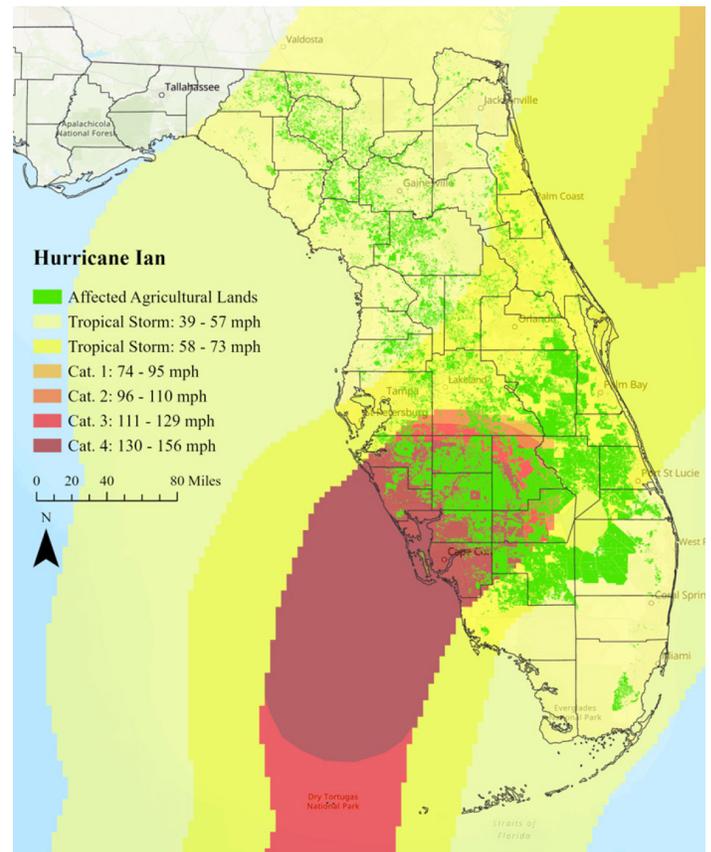


Figure 1: Wind swath pattern of Hurricane Ian with agricultural lands identified

Note: The wind swath geospatial data are from the National Hurricane Center (<https://www.nhc.noaa.gov/gis/>). The agricultural lands geospatial data are from the Florida Statewide Agricultural Irrigation Demand (FSAID) Agricultural Lands Geodatabase (ALG) developed by the Florida Department of Agriculture and Consumer Services (FDACS) (<https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Water-Supply-Planning>)

Table 1: Estimated affected acreage by commodity group and wind speed zone

Commodity Group	Acres						
	TS1	TS2	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Total
Citrus	10,091	131,997	3,998	24,922	49,449	154,846	375,302
Fruit (Non-citrus) and Tree Nuts	14,942	10,690	20	1,088	1,567	3,450	31,757
Vegetables and Melons	41,252	60,766	524	1,505	3,891	45,701	153,638
Field and Row Crops	728,120	276,440	70	21,240	49,446	19,832	1,095,149
Horticultural Crops	33,960	26,940	326	409	3,596	6,617	71,847
Animals and Animal Products	717,766	1,522,090	50,617	98,947	167,944	488,787	3,046,151
Total	1,546,129	2,028,904	55,555	148,107	275,886	719,211	4,773,792

*Note: Citrus acreage includes non-bearing acreage.

Data source: Author's calculations based on preliminary analysis of survey data along with observations from previously analyzed tropical cyclone events (Irma [2017] and Michael [2018]).

Table 2: Estimated value of production on affected acreage by commodity group and wind speed zone (2022\$)

Commodity Group	2022\$						
	TS1	TS2	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Total
Citrus	14,644,000	191,847,000	5,802,000	36,164,000	71,757,000	224,700,000	544,914,000
Fruit (Non-citrus) and Tree Nuts	91,708,000	319,491,000	265,000	23,375,000	48,902,000	99,111,000	582,852,000
Vegetables and Melons	275,910,000	712,402,000	2,970,000	9,601,000	44,148,000	585,285,000	1,630,316,000
Field and Row Crops	878,536,000	315,217,000	8,000	17,248,000	49,803,000	12,750,000	1,273,562,000
Horticultural Crops	1,024,668,000	1,307,376,000	26,411,000	42,450,000	56,470,000	143,814,000	2,601,189,000
Animals and Animal Products	821,960,000	267,443,000	3,088,000	21,204,000	73,090,000	305,089,000	1,491,874,000
Total	3,107,426,000	3,113,776,000	38,544,000	150,042,000	344,170,000	1,370,749,000	8,124,707,000

available. When not available, value per acre was estimated using commodity-level price and yield at the national level or using sales revenue data for the aggregated commodity group in Florida from IMPLAN®. The resulting five-year averages (2017-2021, converted to 2022\$) were used to estimate the value of production on affected acreage by commodity group and wind speed zone.

Hurricane Ian impacted agricultural lands that produce over \$8.12 billion dollars of agricultural products (crops, livestock, aquaculture, etc.) throughout a calendar or marketing year, some with multiple growing seasons within a one-year period. Lands experiencing hurricane conditions (Category 1 - 4 wind speeds) produce nearly \$2.0 billion

dollars of agricultural products across the same time periods. The commodity groups that were most affected in terms of value by hurricane conditions include vegetables and melons, citrus, and animals and animal products, which includes aquaculture and apiculture.

In addition to destructive winds, the storm characteristics, path, and speed of Hurricane Ian made it a particularly “wet” storm, with catastrophic storm surge, heavy precipitation, and significant inland flooding. The 7-day accumulated precipitation (09/24 - 09/30, 2022) are shown in Figure 2 and indicate that over 20 inches of rain fell in the areas near the center of the storm with rain amounts above 12 inches extending all the way to the Atlantic Coast.

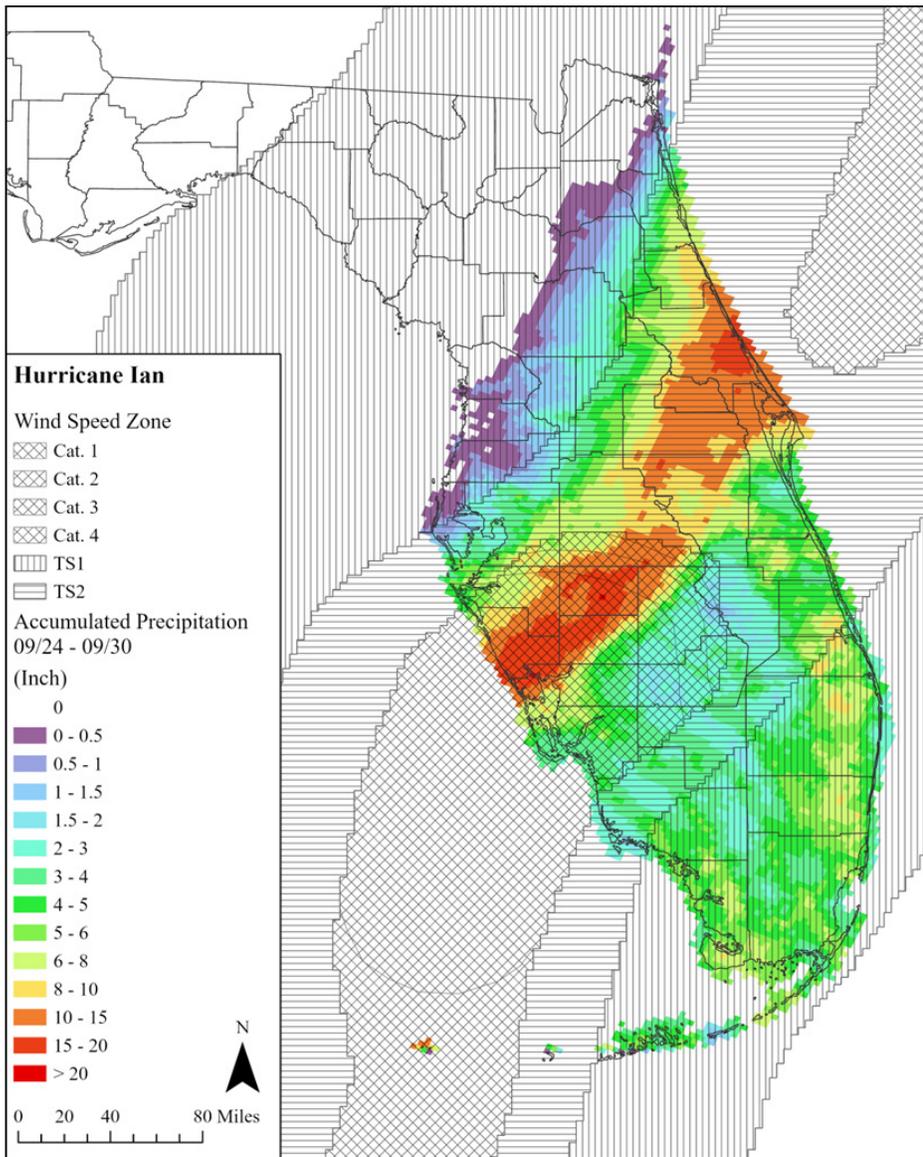


Figure 2: 7-day cumulative precipitation rates (09/24 - 09/30, 2022)

Note: Precipitation data are derived from the Advanced Hydrologic Prediction Service (AHPS) from NOAA National Weather Service (<https://water.weather.gov/precip/download.php>).

PRELIMINARY ASSESSMENT OF PRODUCTION LOSSES

UF/IFAS began collecting information on agricultural losses and damages resulting from tropical cyclone events in 2016 in the wake of Hurricane Irma and has been improving baseline and impact databases for these types of analyses since. On September 29, 2022, The UF/IFAS Economic Impact Analysis Program distributed the *Assessment of Losses and Damages to Florida Agriculture from Hazard/Disaster Events* to begin assessing losses and damages associated with Hurricane Ian. This survey instrument (IRB202201431) was developed to assist Florida's Cooperative Extension system in collecting information on the impacts of natural disasters using the Qualtrics® survey system, which is a licensed survey platform recognized for its robust data security, analytics, and logical control programming features. The online survey instrument

collects information directly from the owners/operators of farms, ranches, and other production agriculture operations, or via representatives of Florida Cooperative Extension and/or local, state, or federal government agencies, allowing for more timely and accurate reports on observed damages. In the days since, these individuals and organizations began visually surveying their territories, communicating with producers, and sharing the invitation to participate in the assessment to encourage participation.

On October 14, 2022, completed survey responses were downloaded and prepped for analysis by investigators from the UF/IFAS Economic Impact Analysis Program. The investigators compiled the survey information for all commodities in each county affected by the disaster. This preliminary analysis of survey data along with observations

from previously analyzed tropical cyclone events (Irma [2017] and Michael [2018]) were used to calculate “low” and “high” estimates of average production losses (%) by commodity group for each wind speed zone. These ranges should be interpreted as estimated ranges around the average production loss for a commodity group within the calendar or marketing year and do not represent minimum or maximum values. Certainly, these values will vary by commodity within commodity groups and also by county and smaller local area within the wind speed zone categories identified. Estimates of percentage losses within the low and high scenarios were then combined with available baseline information from the most recent year available (in most cases, 2019 - 2022). Baseline data include information on geospatial crop acreage, value per acre, and season or growth stage for specific commodities as well as total number and select types of farm infrastructure in each county. The baseline data are compiled from sources such as the USDA’s United States Census of Agriculture, annual surveys by the USDA-NASS, IMPLAN®, Ask IFAS, as well as data compiled by the Florida Department of Agriculture and Consumer Services (FDACS-FSAID ALG geospatial data layer) and the Federal Emergency Management Agency (USA Structures geospatial data layer).

Estimated annual production losses (%) by commodity group are displayed in Table 3. Note that these estimated production loss percentages are preliminary and might change as additional information specific to Hurricane Ian is collected. Production loss estimates convey the percentage of annual production that has been lost due

to Hurricane Ian. Note that some crops (e.g. fresh market vegetables) have two growing seasons in Florida, with fall planting already underway at the time of Ian's landfall. Other commodity groups have production and sales that occur many times throughout the year or even year-round. These multiple and ongoing seasons are reflected in these annual production loss estimates and further adjustments might be made as information on delayed planting in the face of Hurricane Ian or the potential for growers to replant damaged acreage becomes available.

Considering all of this information, we believe that the production losses for agricultural producers (crops, livestock/aquaculture, and animal products) resulting from Hurricane Ian will likely be between \$787 million and \$1.56 billion. The estimated agricultural losses by commodity group are displayed in Table 4. At this point in time, we are providing ranges as opposed to point values to reflect the uncertainty surrounding percentage production losses in the hardest hit areas of the storm to which power and internet access have yet to be restored and, in some cases, are still focused on disaster response as opposed to assessment and recovery. There is also still significant uncertainty surrounding the impact of flooding on different types of agricultural land, which cannot be determined until fields have dried out and can be assessed, and which, in some cases, occurred in areas that were outside of the strongest wind speed zones. Depending on how long this process of drying out takes, there could be moderate to significant impacts to yield, grade, or quality of the crop that are not apparent at this point in time.

Table 3: Estimated annual production loss by commodity group for low and high scenarios based on preliminary analysis of survey data for Hurricane Ian along with observations from previously analyzed tropical cyclone events (Irma [2017] and Michael [2018])

Commodity Group	Estimated Potential Production Loss (Annual)											
	TS1		TS2		Cat. 1		Cat. 2		Cat. 3		Cat. 4	
	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario
Citrus	5%	20%	10%	25%	20%	30%	20%	40%	40%	80%	40%	80%
Fruit (Non-citrus) and Tree Nuts	5%	15%	10%	25%	15%	30%	20%	40%	25%	55%	25%	55%
Vegetables and Melons	5%	10%	5%	20%	10%	25%	10%	25%	25%	35%	25%	35%
Field and Row Crops	5%	10%	5%	10%	10%	20%	10%	20%	40%	60%	40%	60%
Horticultural Crops	5%	10%	5%	10%	10%	20%	10%	20%	15%	25%	15%	25%
Animals and Animal Products	5%	10%	5%	15%	5%	15%	10%	20%	15%	25%	15%	25%

Table 4: Estimated potential range of agricultural losses due to Hurricane Ian by commodity group

Commodity Group	Estimated Losses (2022\$)	
	Low Scenario	High Scenario
Citrus	146,893,127	304,262,703
Fruit (Non-citrus) and Tree Nuts	78,252,802	184,465,330
Vegetables and Melons	208,031,264	393,515,827
Field and Row Crops	86,434,127	160,358,621
Horticultural Crops	153,531,344	297,047,800
Animals and Animal Products	113,471,791	221,561,186
TOTAL	786,614,456	1,561,211,468

Data source: Author's calculations based on preliminary analysis of survey data along with observations from previously analyzed tropical cyclone events (Irma [2017] and Michael [2018]).

Significant production losses are expected for citrus crops in the areas impacted (\$147 million - \$304 million), the local severity of which will depend on the level of fruit drop, damage to branches, and impacts due to heavy precipitation and flooding. Note that major river flooding events occurred in groves that were outside of the more intense wind speed zones, which could have effects on production that are not yet known. Also note that the United States Department of Agriculture's October 2022 citrus forecast released on October 12 suggested a significant reduction in production for the 2022-2023 season, largely influenced by the freeze event that occurred in January 2022. This production decrease was accounted for in the estimates of production losses associated with Hurricane Ian presented within this report. Without this reduction, the overall estimated value of citrus production on all affected acreage, based on a five-year average value per acre, would have been \$757 million and losses would have been higher. Production loss values do not include repair or replacement values associated with down trees (which were significant in the aftermath of Hurricane Irma and are expected to be so in the aftermath of Hurricane Ian) or damages to infrastructure such as irrigation equipment and buildings.

Significant losses are also expected for vegetable and melon crops in the affected area (\$208 million - \$393 million). The impacts on these crops are heavily dependent on the ability (or inability) to replant damaged or destroyed crops since many vegetable crops are close to or still in planting season in this region. Some growers delayed planting but those that had not are reporting wind damage as well as flooding, the severity of which depends on time since planting, sturdiness or hardiness of the plant, and the depth and duration of flooding.

Losses associated with animal operations (beef and dairy cattle, horses, apiculture, aquaculture, etc.) and producers of animal products (milk, eggs, honey) are expected in the affected area (\$113 million - \$222 million) due to damaged fencing, power outages, and flooding. Animals can be killed or severely injured by flooding, flying and falling debris, destruction of shelters, or loss of feed. Losses estimated for this commodity group reflect revenue losses for the current calendar year that are expected to result from these types of damages, but they do not incorporate the repair or replacement value of infrastructure damages. These repair and replacement values for damaged infrastructure such as fences, buildings, machinery, and lost or deceased animals can also be significant and would be in addition to the estimated production losses.

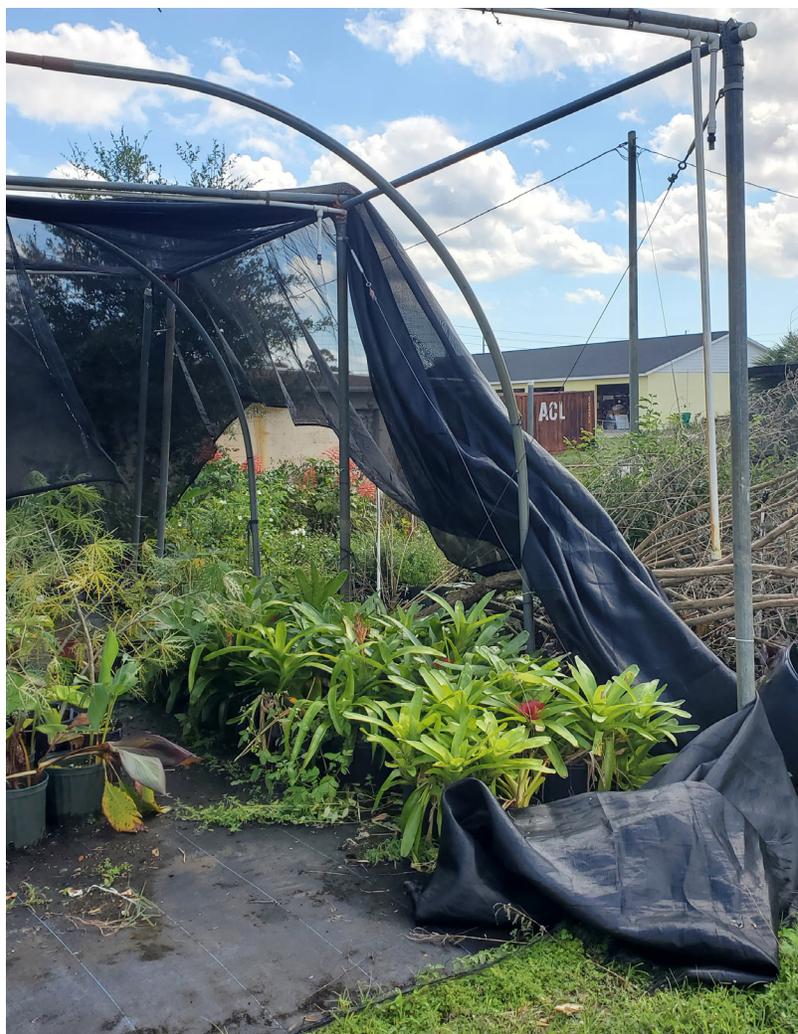
ADDITIONAL CONSIDERATIONS

Reported production loss estimates in this report do not include the value of stored inputs or stored harvested products that were damaged or destroyed nor do they include the value of damages to infrastructure (including perennial plantings and lost/deceased animals) that will require repair or replacement. The estimates in these two scenarios (low and high) represent the estimated total value of production loss due to Hurricane Ian and do not account

for the fact that some crop losses might be eligible for or covered by crop insurance or other risk management tools available to producers.

Survey responses and conversations with Florida Cooperative Extension representatives and industry representatives in the affected areas indicate the following:

- Additional impacts beyond the acute, visible, and measurable impacts of the event include delayed planting, reduced nutritional value of flooded grazing lands, etc.
- Stored inputs such as fuel for farm equipment, fertilizer, and other agricultural chemicals might have been damaged or destroyed due to damage to the buildings, garages, or sheds in which they were stored.
- Previously harvested crops that were stored on-farm and not yet sold might now be less valuable due to damage incurred during or after the hurricane event or destroyed.
- Several reports on infrastructure damages including damage to homes, barns, sheds, and fences due to falling trees or tree limbs (ranging from minimal to significant), irrigation equipment, bee boxes, perennial plantings (reports of defoliation, limb damage, and fallen trees and vines), and damages to or loss of plastic mulch that had been laid prior to the storm and will need to be replaced.





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