

Estimated
AGRICULTURAL LOSSES
Resulting from
HURRICANE IAN



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UF|IFAS
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**ECONOMIC IMPACT
ANALYSIS PROGRAM**

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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.

The UF/IFAS Economic Impact Analysis Program (EIAP) began collecting information on agricultural losses and damages resulting from tropical cyclone events in 2017 in the wake of Hurricane Irma and has been improving

the baseline databases, methodologies for collecting and using event-specific data, and the processes and tools for collecting information on the agricultural impacts of specific events ever since. On September 29, 2022, the UF/IFAS EIAP 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 and weeks since, Florida Cooperative Extension representatives began visually surveying their territories, communicating with producers, and sharing the invitation for this survey tool to encourage participation.

This report summarizes the findings of the UF/IFAS EIAP's efforts to rapidly assess state-level and county-level losses for specific commodity groups due to Hurricane Ian. While this will be the final report associated with rapid assessment for this event, data will continue to be collected via the *Assessment of Losses and Damages to Florida Agriculture from Hazard/Disaster Events* tool through marketing season 2022-2023 to be used in broader studies of the agricultural impacts of these types of events as well as to inform assessments of future events.

EVENT DATA

The wind swath of Hurricane Ian, as published by the National Oceanic and Atmospheric Administration's National Hurricane Center (NOAA NHC), is shown in Figure 1. 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. 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. Data representing the 7-day cumulative precipitation amounts (09/24 - 09/30, 2022) are

shown in Figure 2, indicating that over 15 inches of rain fell during this period in the areas near the center of the storm with rain amounts above 12 inches extending all the way to the Atlantic Coast. Figure 3 shows the simulated flood inundation depths in Florida on Sep 30th, published by the Pacific Northwest National Laboratory. The simulated results suggest that storm surge associated with Hurricane Ian reached over 8 feet on the barrier islands and coastline of Southwest Florida. Many areas also experienced inland flooding in or downstream of areas with heavy precipitation.

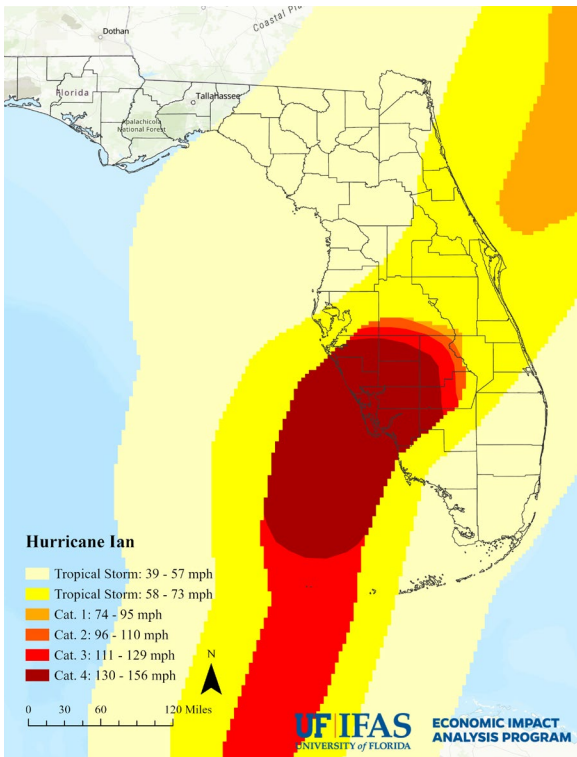


Figure 1: Wind swath pattern of Hurricane Ian as it impacted Florida

Note: Geospatial data of wind swath for Hurricane Ian are derived from NOAA NHC (<https://www.nhc.noaa.gov/gis/>).

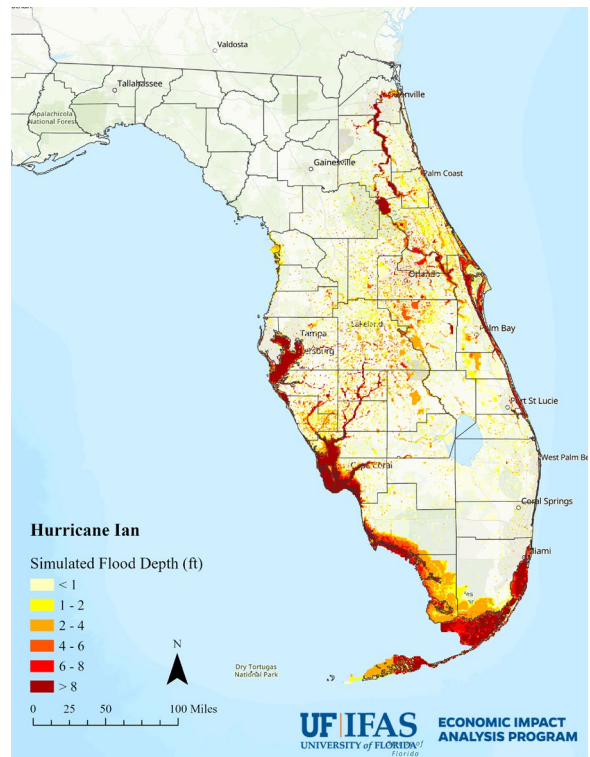


Figure 3: Simulated flood inundation depth caused by Hurricane Ian in Florida

Note: Flood inundation data are retrieved from Pacific Northwest National Laboratory (<https://esri-disasterresponse.hub.arcgis.com/maps/790341f1db624c9caef6ccbda0dfe481/about>).

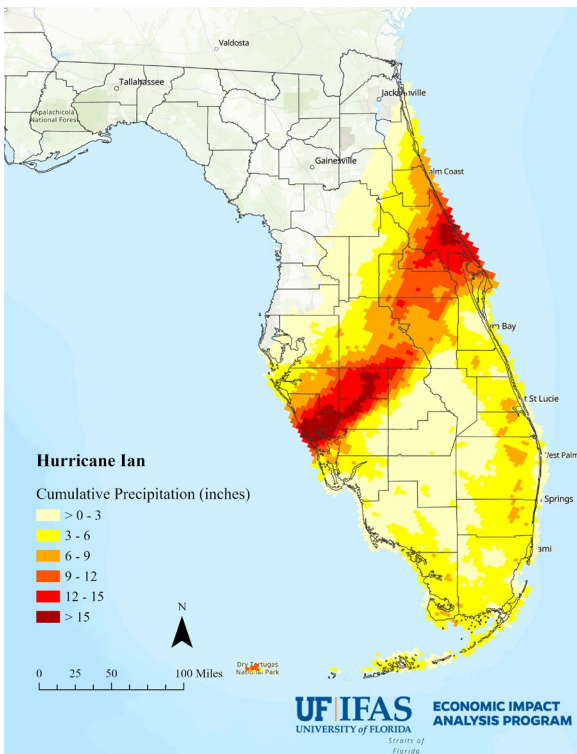
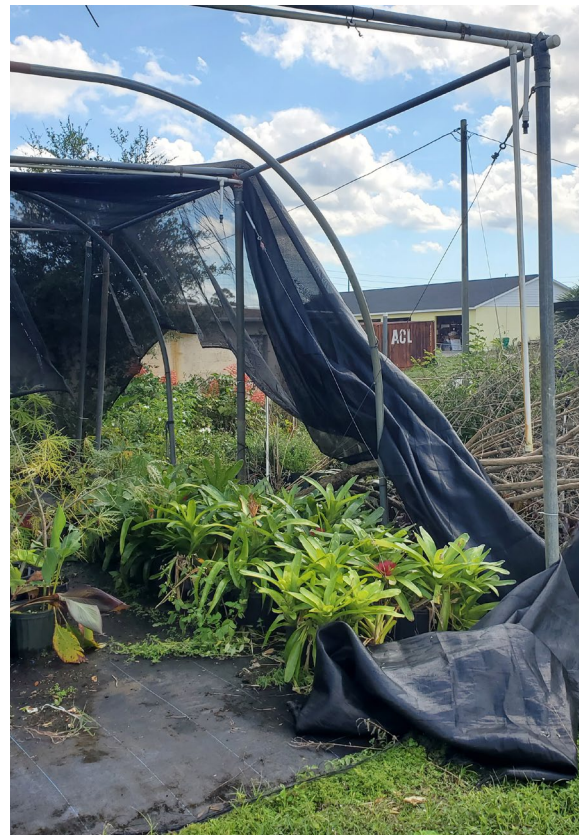


Figure 2: Cumulative precipitation in Florida (09/24 - 09/30, 2022)

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



IMPACTED AGRICULTURAL LANDS

A Hurricane Composite Intensity Index (HCII) is used to quantify the comprehensive impacts of Hurricane Ian that the agricultural lands experienced in terms of wind, rainfall, and flooding. The HCII level is calculated as the sum of the intensity index of wind, rainfall, and flooding, which are all classified into 6 levels based on wind speed (mph), cumulative precipitation (inches), and flood depth (ft), as shown in Table 1.

Table 1. Intensity index of wind, rainfall, and flooding

Intensity Index	Wind Speed (mph)	Precipitation (inches)	Flood Depth (ft)
1	TS1: 39 - 57	> 0 - 3	> 0 - 1
2	TS2: 58 - 73	3 - 6	1 - 2
3	Cat. 1: 74 - 95	6 - 9	2 - 4
4	Cat. 2: 96 - 110	9 - 12	4 - 6
5	Cat. 3: 111 - 129	12 - 15	6 - 8
6	Cat. 4: 130 - 156	> 15	> 8

Using geographic information systems (GIS) software (ArcGIS Pro), the hurricane wind swath, cumulative precipitation, and flood depth map shapefiles were overlaid on the agricultural land geospatial data to determine the wind, rainfall, and flooding intensity that each parcel of affected agricultural land experienced. The agricultural land 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). Then the HCII level was calculated for each parcel of affected agricultural land, shown as Figure 4. Table 2 summarizes the impacted acreage of agricultural lands by commodity group and HCII level in Florida.

County-level impacted acreage of agricultural lands by commodity group are shown in Table A-1 in the appendix. Information on the percentage of agricultural lands affected in each county of Florida are shown in Table A-3. 50 of the 53 affected countries had 100% of their agricultural lands affected.

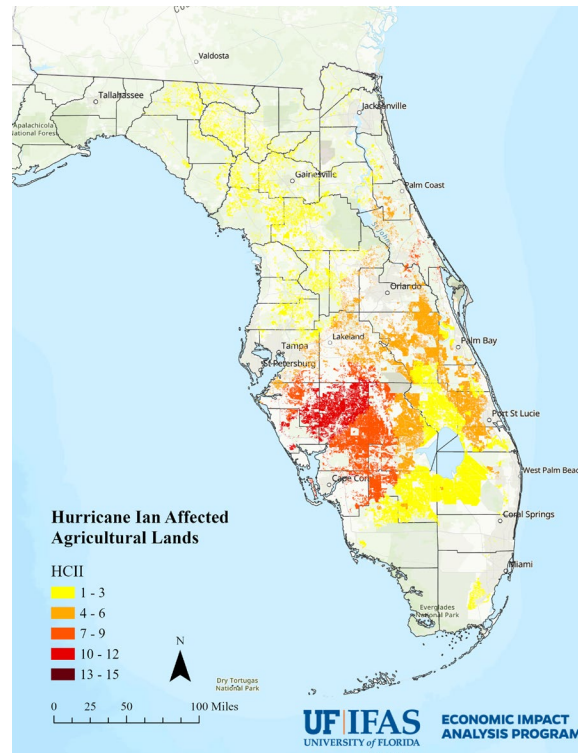


Figure 4: The HCII level of impacted agricultural lands in Florida

Note: 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 2. Estimated impacted acreage by commodity group and HCII level

Commodity Group	Hurricane Composite Intensity Index (HCII)					Grand Total
	1-3	3-6	6-9	9-12	12-15	
Citrus ¹	53,133	107,004	143,928	71,236	0	375,302
Field and Row Crops ²	916,633	130,909	24,058	5,828	0	1,077,427
Fruit (Non-citrus)	17,178	10,477	3,654	2,076	0	33,385
Greenhouse/Nursery	40,170	22,840	5,064	4,335	17	72,426
Animals and Animal Products ³	1,321,480	1,151,468	466,573	122,954	239	3,062,715
Vegetables and Melons	76,215	32,709	32,968	17,380	0.06	159,272
Total	2,425,096	1,455,360	676,085	223,730	256	4,780,527

Note: Citrus acreage includes non-bearing acreage and was adjusted to reflect the 2022 Commercial Citrus Inventory Preliminary Report from USDA NASS.² Field and Row Crops acreage includes field crops, hay, and sugarcane.³ Animals and Animal Products acreage includes grazing land.

Nearly five million acres of agricultural land were affected by Hurricane Ian, of which almost 62% was land of grazing land. The commodity groups that were most affected (in terms of overall acreage impacted) by Hurricane Ian (not including grazing land) were Field and Row Crops (including hay and sugarcane, 1,077,427 acres), Citrus (375,302 acres), and Vegetables and Melons (159,272 acres). However, not all acreages were affected equally. For most commodity groups, over 40% of the impacted acreage experienced HCII conditions of just 1 - 3; 85% of Field and Row Crop acreage experienced these lower HCII conditions. On the other hand, a majority of Citrus acreage (215,165 acres or 57%) experienced HCII conditions of 6 - 12.

Table 3 shows the estimated annual value of production on affected acreage by commodity group and HCII level. Data published by the United States Department of Agriculture 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 available. When not available, value per acre was estimated using commodity-level price and yield at the national level or using the average value per acre of the relevant commodity group. The resulting five-year average of value per acre is used to estimate the value of production on affected acreage by commodity group and

HCII level. For Greenhouse/nursery and Animals and Animal Products, the shares of the agricultural area in each county affected by different HCII levels were used to allocate the sales revenues (five-year averages of 2017-2021 from IMPLAN®, converted to 2022 dollars) to estimate the value of impacted acreage. Information on county-level estimated annual value of production by commodity group are shown in Table A-2.

Hurricane Ian impacted agricultural lands that produce over \$7.96 billion dollars of agricultural products (crops, livestock, aquaculture, etc.) throughout a calendar or marketing year, some across multiple growing seasons (e.g., Vegetables and Melons) and others that might produce year-round (e.g., Greenhouse/Nursery and Animals and Animal Products). Considering impacts of all intensities, the commodity groups that were most affected in terms of “annual value at risk” by Hurricane Ian include Greenhouse/Nursery, Vegetables and Melons, and Animals and Animal Products. A majority, 56%, of the estimated value of annual production across all commodities, was impacted by less intense conditions (HCII levels 1 - 3). The annual value of agricultural products grown or raised in areas experiencing HCII levels 6 - 15 is estimated to be \$1.67 billion, including Vegetables and Melons (\$655 million), Citrus (\$316 million), and Animals and Animal Products (\$273 million).

Table 3. Estimated value of annual production (2022\$) on impacted acreage by commodity group and HCII level

Commodity Group	Hurricane Composite Intensity Index (HCII)					Grand Total
	1-3	3-6	6-9	9-12	12-15	
Citrus	\$78,039,702	\$157,490,220	\$211,395,206	\$104,628,722	\$0	\$551,553,849
Field and Row Crops	\$1,161,889,744	\$106,664,978	\$14,334,751	\$1,625,743	\$0	\$1,284,515,216
Fruit (Non-citrus)	\$157,433,228	\$289,110,839	\$109,884,823	\$58,319,820	\$0	\$614,748,710
Greenhouse /Nursery	\$1,243,057,285	\$794,546,090	\$128,683,137	\$111,740,871	\$317,683	\$2,278,345,066
Animals and Animal Products	\$1,044,960,915	\$266,289,141	\$136,392,009	\$136,102,914	\$56,111	\$1,583,801,090
Vegetables and Melons	\$754,086,295	\$239,405,498	\$413,393,106	\$241,619,003	\$321	\$1,648,504,223
Grand Total	\$4,439,467,169	\$1,853,506,766	\$1,014,083,033	\$654,037,073	\$374,114	\$7,961,468,155

AGRICULTURAL LOSSES IN FLORIDA

On November 8, 2022, completed survey responses were downloaded and prepped for analysis by investigators from the UF/IFAS EIAP. The investigators compiled the survey information for all commodities in each county affected by the disaster. The survey tool does not ask for an address or exact location of the responding agricultural operation. Also, many agricultural operations in Florida operate on multiple parcels, some with operations in multiple counties. Due to the difficulty in knowing the exact location of survey respondents' farms, and in turn the exact hurricane characteristics that they experienced on their farm, we calculated the HCII level of each impacted county to correlate respondents' reported losses to average hurricane conditions at the county level. The event data shapefiles (e.g. wind, precipitation, and flooding) were overlaid on county boundary shapefiles available from the U.S. Census Bureau to determine each county's wind, rainfall, and flooding index respectively, as well as the percentage of the

agricultural lands in each county affected by the different wind, precipitation, and flood categories. Then an area-weighted method was used to respectively calculate the composite index of wind, precipitation, and flooding of each county. In the end, the HCII was calculated for each affected county as the sum of area-weighted wind index, area-weighted precipitation index, and area-weighted flood index of the county, as shown in Figure 5 and listed in Table A-3. The area-weighted HCII level of each affected county was used to connect with the analysis results of survey data along with observations from previously analyzed tropical cyclone events (Irma [2017] and Michael [2018]) to estimate the production loss percentage (%) of different commodity groups at different HCII levels. These estimates of percentage production loss by commodity group and HCII were then combined with the estimated value of annual production on impacted agricultural lands to determine estimated losses.

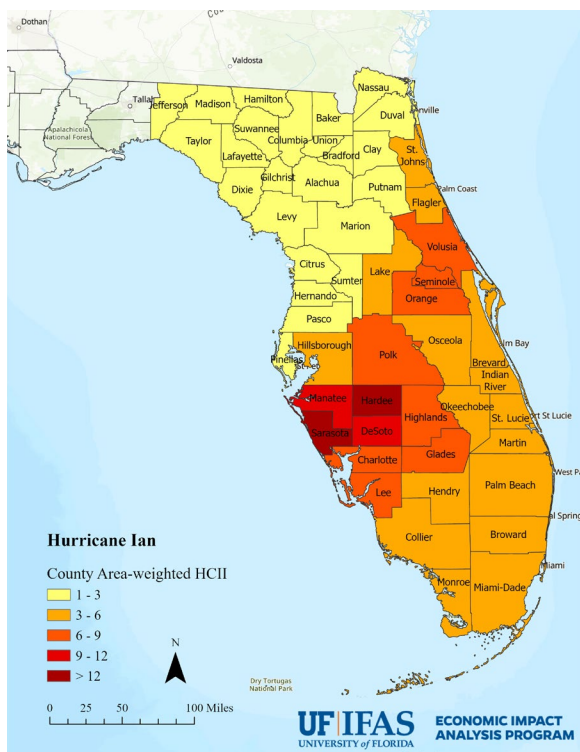


Figure 5: Area-weighted HCII levels of affected counties in Florida

Table A-4 displays the estimated annual production loss (%) information by commodity group. 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 multiple growing seasons in Florida, one of which was just getting underway with fall plantings. The multiple seasons as well as considerations regarding delayed planting or replanting and the compounding impacts of the January 2022 freeze event are reflected in these annual production loss estimates.

Considering all of this information, estimated production losses for agricultural producers in Florida resulting from Hurricane Ian are \$1.03 billion. The estimated agricultural losses by commodity group and HCII level are displayed in Table 4. The commodity groups that were most affected in terms of production losses are Citrus (\$247 million), Vegetables and Melons (\$205 million), and Greenhouse/Nursery (\$195 million). The top five counties in terms of agricultural losses were Manatee (\$126 million), Hillsborough (\$104 million), Palm Beach (\$89 million), Hardee (\$73 million), and Hendry (\$72 million). Losses were generally higher in counties experiencing more intense hurricane conditions (higher values of HCII) and where the value of agricultural production in the path of the storm was high.

Table 4. Estimated agricultural losses due to Hurricane Ian by commodity group and HCII level

Commodity Group	Hurricane Composite Intensity Index (HCII)					Grand Total (\$2022)
	1-3	3-6	6-9	9-12	12-15	
Citrus	\$15,607,940	\$62,996,088	\$105,697,603	\$62,777,233	0	\$247,078,864
Field and Row Crops	\$116,188,974	\$10,666,498	\$2,866,950	\$487,723	0	\$130,210,145
Fruit (Non-citrus)	\$23,614,984	\$57,822,168	\$32,965,447	\$23,327,928	0	\$137,730,527
Greenhouse/Nursery	\$62,152,864	\$79,454,609	\$25,736,627	\$27,935,218	\$95,305	\$195,374,623
Livestock and Animal Products	\$52,248,046	\$26,628,914	\$20,458,801	\$20,415,437	\$14,028	\$119,765,226
Vegetables and Melons	\$37,704,315	\$35,910,825	\$82,678,621	\$48,323,801	\$80	\$204,617,641
Grand Total	\$307,517,124	\$273,479,101	\$270,404,050	\$183,267,339	\$109,413	\$1,034,777,027

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

Table A-5 shows county-level loss estimates by commodity group. The counties with the largest Citrus losses were DeSoto (\$43 million), Polk (\$37 million), Highlands (\$34 million), Hardee (\$31 million), and Hendry (\$31 million). The top five counties with the largest Vegetables and Melons losses were Manatee (\$89 million), Collier (\$22 million), Hendry (\$18 million), Hillsborough (\$11 million),

and Charlotte (\$10 million). The losses associated with Greenhouse/Nursery are highest in Miami-Dade (\$34 million), Orange (\$24 million), Volusia (\$18 million), Hillsborough (\$13 million), and Lake (\$13 million) counties. County-level losses for additional commodity groups are shown in Table A-5.



AGRICULTURAL DAMAGES IN FLORIDA

The estimated loss values presented in this report focus solely on near-term production losses that are expected to result from Hurricane Ian within calendar year 2022 or marketing year 2022-2023. These estimates 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. The values also do not account for the costs or value of agricultural damages. Agricultural damages can include asset damages, which include damages to agricultural structures, lost perennial plantings, lost/deceased animals, and damages to other infrastructure assets and equipment that will require repair or replacement. Agricultural damages can also include production damages, which include damages to stored inputs such as fuel for farm equipment, fertilizer, and other agricultural chemicals or damages to previously harvested crops that were stored on-farm and not yet sold.

Near-term production losses that might occur as a result of agricultural damages are accounted for in the estimated loss values reported to the extent that they were considered by producers or industry/agency representatives as they estimate and report losses through the UF/IFAS EIAP survey tool. However, statewide, commodity (or commodity group) specific baseline data are very limited with respect to agricultural infrastructure, stored inputs, and stored harvested products and their values, making it difficult, if not impossible, to estimate state- or county-wide values associated with agricultural damages. As a result, the costs or value of reported agricultural damages are not included in these estimates.

While the costs or value of agricultural damage is not estimated, survey responses and ongoing conversations with Florida Cooperative Extension representatives,

representatives of industry associations, and state and federal government agencies in the affected areas do still indicate that agricultural operations in the areas impacted by Hurricane Ian did experience significant damages to structures, perennial plantings, live animal stocks, equipment, and other infrastructure, including but not limited to:

- Structural damages, ranging from minimal to extensive, including farm homes, farmworker housing, barns, shade and greenhouse structures, storage sheds and buildings [including refrigerated storage], post-harvest structures such as packinghouses, and livestock pens and structures.
- Reported damages specific to perennial plantings and live animal stocks include:
 - » Defoliation, branch and limb damage, and down trees in citrus groves as well as defoliation and fallen vines in vineyards.
 - » Lost, injured, shocked, or deceased animals (e.g., beef and dairy cattle, chickens, honey bee colonies) due to damaged or destroyed fences, structures, and flooding.
 - » Deceased fish, shellfish, and other aquaculture products due to power outages that impacted the proper functioning of growing systems or increased freshwater inflows to coastal operations.
- Damages to equipment and infrastructure including irrigation structures and equipment, erosion control structures, plastic mulching, protective structures (including tree defenders and Citrus Under Protective Screen [CUPS]), honey bee boxes, exterior and interior fencing, farm equipment and tools stored in damaged sheds or storage facilities, power generators, etc.



Photo courtesy of Ray Hodge

APPENDIX A

Table A-1. Estimated county-level affected acreage by commodity group

County	Citrus	Field and Row Crops	Fruit (Non-citrus)	Greenhouse/ Nursery	Livestock and Animal Products	Vegetables and Melons	Grand Total
Alachua		32,592	1,726	1,029	78,909	644	114,901
Baker		1,179	5	149	10,390	28	11,750
Bradford		5,776	25	65	17,405	232	23,503
Brevard	687	13,792	13	480	81,512		96,484
Broward		3	15	510	3,981	534	5,044
Charlotte	13,069	2,227		37	74,789	7,618	97,740
Citrus	38	816	268	153	2,844	391	4,509
Clay		619		427	15,098		16,143
Collier	26,277	1,299	80	605	55,232	24,592	108,085
Columbia		20,953	15	268	36,300	66	57,602
DeSoto	54,626	1,134	548	445	66,387	4,087	127,227
Dixie		8,245		9	18,786	134	27,174
Duval		912	1	309	12,367		13,588
Flagler		1,909	15	518	23,484	1,256	27,181
Gilchrist		35,615	37	234	29,425	813	66,124
Glades	5,634	66,444	170	699	181,981	709	255,636
Hamilton		18,611	28	252	19,408	2,834	41,133
Hardee	35,597	4,016	1,443	1,192	62,410	1,710	106,368
Hendry	56,968	140,621	26	5,406	219,325	20,854	443,199
Hernando	151	981	186	663	5,209		7,190
Highlands	48,988	20,301	375	3,285	248,470	2,382	323,801
Hillsborough	1,906	565	9,513	1,581	25,463	6,129	45,158
Indian River	17,765	7,756		1,092	51,639	1,394	79,646
Jefferson		5			203		208
Lafayette		17,320	48	327	17,988	224	35,907
Lake	5,766	4,486	582	3,674	83,136	280	97,924
Lee	7,206	119	134	2,384	32,699	2,556	45,098
Levy		43,109	158	1,557	64,336	2,636	111,797
Madison		39,373	36	341	40,833	1,756	82,340
Manatee	10,565	1,017	983	1,728	21,165	27,201	62,659
Marion	931	16,304	440	1,515	107,420	547	127,157
Martin	1,828	33,261	10	3,654	95,470	7,855	142,079
Miami-Dade	2,350	10,562	10,991	2,177	8,224	34,304	
Monroe				5	5		10
Nassau		2,659	33	105	14,092	13	16,902
Okeechobee	3,622	13,141	15	896	284,795	2,655	305,124
Orange	876	550	357	1,360	72,640	124	75,906
Osceola	6,725	11,247	173	1,631	437,658	2,491	459,924
Palm Beach	407,319	24	5,552	12,946	8,319	434,161	
Pasco	710	2,082	378	547	15,579	10	19,306
Pinellas					124		124
Polk	54,877	2,032	2,472	1,061	121,488	746	182,676
Putnam	105	7,364	558	2,460	37,974	876	49,337
Sarasota	1,004	382		349	20,057	1,080	22,872
Seminole	323	302	11	784	18,429	19	19,868
St. Johns		3,463		223	7,965	2,970	14,621
St. Lucie	18,721	10,277	1,240	2,395	73,360	8,790	114,783
Sumter		4,413	289	764	9,376	640	15,482
Suwannee	58,236	174	1,572	54,121	2,548	116,651	
Taylor		1,386		215	16,136		17,737
Union		5,505	157	28	15,673	290	21,652
Volusia	336	3,361	61	6,903	44,058	13	54,731
Grand Total	375,302	1,077,427	33,385	72,426	3,062,715	159,272	4,780,527

Table A-2. Estimated county-level affected value of annual production (2022\$) by commodity group

County	Citrus	Field and Row Crops	Fruit (Non-citrus)	Greenhouse/ Nursery	Livestock and Animal Products	Vegetables (Fresh Market)	Grand Total
Alachua		\$18,955,669	\$19,992,548	\$31,089,180	\$24,711,649	\$3,977,210	\$98,726,256
Baker	\$0	\$197,244	\$35,828	\$1,641,494	\$14,153,910	\$184,734	\$16,213,211
Bradford	\$0	\$2,639,887	\$305,417	\$546,340	\$18,398,984	\$1,335,863	\$23,226,491
Brevard	\$1,009,302	\$5,474,259	\$195,345	\$35,378,677	\$11,912,505	\$0	\$53,970,088
Broward	\$0	\$2,835	\$39,614	\$33,943,446	\$2,375,872	\$3,073,894	\$39,435,662
Charlotte	\$19,194,394	\$1,507,842	\$0	\$6,156,130	\$7,331,147	\$49,890,693	\$84,080,207
Citrus	\$55,950	\$451,174	\$6,151,735	\$3,367,821	\$5,902,616	\$2,780,009	\$18,709,304
Clay	\$0	\$98,421	\$0	\$3,047,587	\$4,580,473	\$0	\$7,726,481
Collier	\$38,594,646	\$141,123	\$1,179,125	\$46,717,080	\$8,726,842	\$416,128,000	\$511,486,816
Columbia	\$0	\$13,062,944	\$19,032	\$7,335,971	\$31,110,543	\$402,434	\$51,930,924
DeSoto	\$80,232,638	\$278,404	\$14,163,142	\$17,583,928	\$46,530,722	\$38,579,444	\$197,368,278
Dixie	\$0	\$6,433,708	\$0	\$33,859	\$6,706,770	\$235,718	\$13,410,054
Duval	\$0	\$118,333	\$3,565	\$6,653,396	\$5,897,960	\$0	\$12,673,254
Flagler	\$0	\$603,819	\$307,412	\$2,898,797	\$2,391,493	\$7,098,542	\$13,300,062
Gilchrist	\$0	\$25,124,361	\$313,801	\$3,571,502	\$65,555,972	\$4,406,045	\$98,971,680
Glades	\$8,274,576	\$77,811,323	\$2,492,067	\$3,447,034	\$24,990,941	\$4,075,984	\$121,091,925
Hamilton	\$0	\$13,400,055	\$412,114	\$1,685,498	\$12,820,071	\$17,009,063	\$45,326,800
Hardee	\$52,283,158	\$837,226	\$40,732,853	\$34,683,925	\$86,591,344	\$15,132,799	\$230,261,305
Hendry	\$83,671,827	\$200,000,111	\$69,081	\$8,073,642	\$23,558,386	\$167,604,946	\$482,977,994
Hernando	\$221,379	\$486,185	\$2,709,155	\$11,479,440	\$13,584,337	\$0	\$28,480,497
Highlands	\$71,950,487	\$10,476,014	\$5,280,856	\$46,104,912	\$62,917,570	\$14,028,967	\$210,758,806
Hillsborough	\$2,800,161	\$248,476	\$352,478,984	\$120,540,260	\$54,964,889	\$69,794,542	\$600,827,313
Indian River	\$26,092,534	\$857,208	\$0	\$8,675,861	\$10,832,008	\$8,019,884	\$54,477,495
Jefferson	\$0	\$2,445	\$0	\$0	\$0	\$0	\$2,445
Lafayette	\$0	\$11,944,030	\$280,575	\$2,250,869	\$68,081,267	\$1,343,203	\$83,899,944
Lake	\$8,468,597	\$1,455,976	\$7,581,693	\$156,139,530	\$33,282,472	\$1,725,430	\$208,653,698
Lee	\$10,584,423	\$12,902	\$438,293	\$45,708,317	\$6,841,951	\$37,446,329	\$101,032,214
Levy	\$0	\$31,802,935	\$2,320,029	\$19,275,005	\$52,683,411	\$15,892,209	\$121,973,589
Madison	\$0	\$27,848,750	\$534,898	\$9,312,998	\$49,603,882	\$17,237,704	\$104,538,232
Manatee	\$15,518,095	\$753,945	\$37,067,750	\$43,482,020	\$43,700,397	\$454,703,659	\$595,225,867
Marion	\$1,367,875	\$8,504,835	\$6,119,855	\$21,658,605	\$104,630,837	\$3,589,885	\$145,871,892
Martin	\$2,684,723	\$42,921,210	\$27,269	\$48,671,765	\$16,171,120	\$59,614,468	\$170,090,556
Miami-Dade	\$0	\$598,979	\$33,510,564	\$687,689,806	\$11,146,119	\$48,352,710	\$781,298,178
Monroe	\$0	\$0	\$0	\$914,405	\$3,315,710	\$0	\$4,230,115
Nassau	\$0	\$541,644	\$42,850	\$116,758	\$11,930,226	\$77,390	\$12,708,869
Okeechobee	\$5,320,129	\$3,027,131	\$40,148	\$17,196,861	\$200,400,074	\$16,693,975	\$242,678,318
Orange	\$1,286,315	\$89,870	\$10,469,170	\$243,908,523	\$7,104,499	\$681,967	\$263,540,343
Osceola	\$9,876,716	\$3,806,092	\$2,016,641	\$24,212,732	\$37,388,047	\$412,630	\$77,712,858
Palm Beach	\$0	\$716,446,203	\$64,778	\$184,632,320	\$17,674,270	\$52,717,588	\$971,535,159
Pasco	\$1,042,707	\$1,051,883	\$5,391,238	\$6,071,284	\$40,421,496	\$128,452	\$54,107,060
Pinellas	\$0	\$0	\$0	\$0	\$895,162	\$0	\$895,162
Polk	\$80,600,631	\$759,163	\$38,954,465	\$52,259,920	\$54,073,237	\$2,194,500	\$228,841,916
Putnam	\$154,094	\$5,009,501	\$5,822,372	\$16,222,470	\$19,358,054	\$4,035,432	\$50,601,923
Sarasota	\$1,474,977	\$147,889	\$0	\$15,000,972	\$7,355,418	\$13,355,417	\$37,334,673
Seminole	\$474,981	\$43,948	\$444,374	\$19,894,560	\$1,972,085	\$108,325	\$22,938,273
St. Johns	\$0	\$1,921,486	\$0	\$14,393,926	\$2,571,733	\$16,698,871	\$35,586,015
St. Lucie	\$27,825,009	\$1,174,024	\$5,062,636	\$14,054,524	\$14,426,694	\$53,724,125	\$116,267,012
Sumter	\$0	\$2,359,849	\$7,350,859	\$18,483,543	\$29,704,862	\$5,688,895	\$63,588,007
Suwannee	\$0	\$38,996,501	\$2,341,710	\$7,547,992	\$179,070,174	\$16,568,877	\$244,525,253
Taylor	\$0	\$517,523	\$0	\$1,288,907	\$2,722,554	\$0	\$4,528,983
Union	\$0	\$2,974,386	\$1,303,302	\$2,010,025	\$5,981,629	\$1,745,511	\$14,014,853
Volusia	\$493,528	\$595,495	\$681,568	\$171,290,651	\$14,746,704	\$7,901	\$187,815,847
Grand Total	\$551,553,849	\$1,284,515,216	\$614,748,710	\$2,278,345,066	\$1,583,801,090	\$1,648,504,223	\$7,961,468,155

Table A-3. The area-weighted intensity of wind, precipitation, and flood, HCII, and percentage of affected agricultural land in each county

County	Area-weighted wind speed index	Area-weighted precipitation index	Area-weighted flood index	Area-weighted HCII	% Affected agricultural land
Alachua	1	0	0.01	1.02	100%
Baker	1	0	0	1	100%
Bradford	1	0	0	1	100%
Brevard	2	1.5	0.33	4.75	100%
Broward	1	1.43	0.12	3.33	100%
Charlotte	6	1.09	0.26	8.02	100%
Citrus	1	0.11	0.11	1.33	100%
Clay	1	0.03	0.04	1.12	100%
Collier	2.28	1	0.2	4.08	100%
Columbia	1	0	0	1	100%
DeSoto	6	2.41	0.55	10.43	100%
Dixie	1	0	0	1	100%
Duval	1	0.06	0.01	1.12	100%
Flagler	2	1.97	0.53	5.75	100%
Gilchrist	1	0	0	1	100%
Glades	4.59	1	0.21	6.4	100%
Hamilton	1	0	0	1	100%
Hardee	5.78	3.9	1.03	13.16	100%
Hendry	2.66	1	0.1	4.31	100%
Hernando	1	0.19	0.11	1.45	100%
Highlands	5.22	1.29	0.24	7.52	100%
Hillsborough	2.57	1.49	0.32	5.29	100%
Indian River	2	1.51	0.48	4.98	100%
Jefferson	1	0	0	1	0.5%
Lafayette	1	0	0	1	100%
Lake	1.76	1.22	0.19	3.88	100%
Lee	6	1.08	0.5	8.37	100%
Levy	1	0	0.01	1.01	100%
Madison	1	0	0	1	94%
Manatee	5.59	2.84	0.33	10.34	100%
Marion	1	0.28	0.1	1.56	100%
Martin	1.61	1.74	0.32	4.7	100%
Miami-Dade	1	1.63	0.03	3.49	100%
Monroe	1	1	1.45	4.68	100%
Nassau	1	0	0	1	100%
Okeechobee	2.23	1.03	0.17	4.04	100%
Orange	2	2.87	0.35	6.83	100%
Osceola	2.03	2	0.35	5.55	100%
Palm Beach	1.1	1.14	0.25	3.18	100%
Pasco	1.22	0.26	0.16	1.84	100%
Pinellas	1.74	0	0.02	1.77	100%
Polk	2.61	2.5	0.48	7.07	100%
Putnam	1.2	0.6	0.15	2.33	100%
Sarasota	6	3.48	0.95	12.65	100%
Seminole	2	3.37	0.81	8.27	100%
St. Johns	1.66	1.03	0.13	3.4	100%
St. Lucie	2	1.15	0.34	4.24	100%
Sumter	1.01	0.83	0.22	2.59	100%
Suwannee	1	0	0	1	100%
Taylor	1	0	0	1	100%
Union	1	0	0	1	100%
Volusia	2	3.02	0.53	7.31	100%

Table A-4. Estimated annual production loss by commodity group for different HCII levels based on analysis of survey data for Hurricane Ian along with observations from previously analyzed tropical cyclone events (Irma [2017] and Michael [2018])

Commodity Group	Hurricane Composite Intensity Index (HCII)				
	1-3	3-6	6-9	9-12	12-15
Citrus	20%	40%	50%	60%	60%
Fruit or Nut Crops	15%	20%	30%	40%	50%
Field and Row Crops	10%	10%	20%	30%	40%
Livestock and Animal Products	5%	10%	15%	15%	25%
Greenhouse and Nursery	5%	10%	20%	25%	30%
Vegetables and Melons	5%	15%	20%	20%	25%

Table A-5. Estimated county-level agricultural losses (\$2022) due to Hurricane Ian by commodity group

County	Citrus	Field and Row Crops	Fruit (Non-citrus)	Greenhouse / Nursery	Livestock and Animal Products	Vegetables (Fresh Market)	Grand Total
Alachua	\$0	\$1,895,567	\$2,998,882	\$1,554,459	\$1,235,582	\$198,860	\$7,883,351
Baker	\$0	\$19,724	\$5,374	\$82,075	\$707,696	\$9,237	\$824,106
Bradford	\$0	\$263,989	\$45,813	\$27,317	\$919,949	\$66,793	\$1,323,861
Brevard	\$450,628	\$547,815	\$58,604	\$3,321,136	\$1,073,886	\$0	\$5,452,068
Broward	\$0	\$284	\$5,942	\$1,792,238	\$119,716	\$153,695	\$2,071,874
Charlotte	\$9,597,197	\$301,568	\$0	\$1,231,226	\$1,099,672	\$9,978,139	\$22,207,802
Citrus	\$11,190	\$45,117	\$922,760	\$168,391	\$295,131	\$139,000	\$1,581,590
Clay	\$0	\$9,842	\$0	\$152,379	\$229,065	\$0	\$391,287
Collier	\$10,385,867	\$14,112	\$176,869	\$2,444,704	\$490,570	\$22,050,379	\$35,562,500
Columbia		\$1,306,294	\$2,855	\$366,799	\$1,555,527	\$20,122	\$3,251,597
DeSoto	\$43,288,047	\$79,683	\$4,516,977	\$3,705,239	\$6,979,608	\$7,715,889	\$66,285,443
Dixie	\$0	\$643,371	\$0	\$1,693	\$335,338	\$11,786	\$992,188
Duval	\$0	\$11,833	\$535	\$332,670	\$294,898	\$0	\$639,936
Flagler	\$0	\$60,734	\$61,482	\$289,880	\$239,066	\$1,059,903	\$1,711,064
Gilchrist	\$0	\$2,512,436	\$47,070	\$178,575	\$3,277,799	\$220,302	\$6,236,182
Glades	\$3,685,307	\$7,844,869	\$747,620	\$483,871	\$2,806,313	\$792,047	\$16,360,027
Hamilton		\$1,340,006	\$61,817	\$84,275	\$641,004	\$850,453	\$2,977,554
Hardee	\$31,313,995	\$251,168	\$16,293,141	\$8,670,981	\$12,988,702	\$3,026,560	\$72,544,546
Hendry	\$31,296,186	\$20,957,307	\$20,724	\$444,423	\$1,592,776	\$17,698,267	\$72,009,683
Hernando	\$44,276	\$48,619	\$406,373	\$573,972	\$679,217	\$0	\$1,752,456
Highlands	\$33,533,099	\$1,250,822	\$1,577,900	\$6,408,060	\$8,129,235	\$2,217,527	\$53,116,643
Hillsborough	\$1,132,664	\$24,848	\$74,274,270	\$13,466,115	\$4,408,432	\$11,079,154	\$104,385,483
Indian River	\$9,955,751	\$85,721	\$0	\$716,576	\$1,022,702	\$1,202,983	\$12,983,733
Jefferson	\$0	\$245	\$0	\$0	\$0	\$0	\$245
Lafayette	\$0	\$1,194,403	\$42,086	\$112,543	\$3,404,063	\$67,160	\$4,820,256
Lake	\$2,624,682	\$145,598	\$1,344,861	\$13,073,541	\$2,522,358	\$250,018	\$19,961,058
Lee	\$5,302,868	\$2,580	\$167,885	\$10,607,951	\$1,030,486	\$7,489,282	\$24,601,051
Levy	\$0	\$3,180,293	\$348,004	\$963,750	\$2,634,171	\$794,610	\$7,920,829
Madison	\$0	\$2,784,875	\$80,235	\$465,650	\$2,480,194	\$861,885	\$6,672,839
Manatee	\$8,535,560	\$190,237	\$12,549,082	\$9,808,332	\$6,309,229	\$89,076,056	\$126,468,496
Marion	\$273,575	\$850,484	\$917,978	\$1,082,930	\$5,231,542	\$179,494	\$8,536,003
Martin	\$807,673	\$4,292,121	\$5,454	\$3,062,232	\$1,304,519	\$5,101,567	\$14,573,566
Miami-Dade	\$0	\$59,898	\$5,026,585	\$34,384,490	\$557,306	\$2,417,636	\$42,445,914
Monroe	\$0	\$0	\$0	\$45,720	\$165,785	\$0	\$211,506
Nassau	\$0	\$54,164	\$6,428	\$5,838	\$596,511	\$3,870	\$666,811
Okeechobee	\$1,597,296	\$302,713	\$6,022	\$859,843	\$12,812,335	\$1,150,966	\$16,729,175
Orange	\$514,526	\$9,379	\$2,093,834	\$24,390,852	\$711,503	\$102,295	\$27,822,389
Osceola	\$3,562,556	\$380,609	\$403,328	\$1,523,994	\$3,472,737	\$61,894	\$9,405,119
Palm Beach	\$0	\$71,644,620	\$10,828	\$11,114,355	\$947,418	\$5,127,811	\$88,845,032

County	Citrus	Field and Row Crops	Fruit (Non-citrus)	Greenhouse / Nursery	Livestock and Animal Products	Vegetables (Fresh Market)	Grand Total
Pasco	\$208,541	\$105,188	\$808,686	\$303,564	\$2,021,075	\$6,423	\$3,453,477
Pinellas	\$0	\$0	\$0	\$0	\$44,758	\$0	\$44,758
Polk	\$36,509,662	\$87,207	\$7,966,023	\$6,098,295	\$5,825,213	\$365,033	\$56,851,432
Putnam	\$43,138	\$500,950	\$875,599	\$1,266,778	\$1,088,589	\$211,360	\$3,986,414
Sarasota	\$881,977	\$44,367	\$0	\$3,710,110	\$1,104,730	\$2,671,083	\$8,412,268
Seminole	\$224,441	\$5,528	\$133,312	\$3,793,482	\$232,019	\$21,665	\$4,410,446
St. Johns	\$0	\$192,149	\$0	\$907,918	\$146,708	\$1,430,074	\$2,676,849
St. Lucie	\$11,100,105	\$117,402	\$933,596	\$1,393,511	\$1,271,614	\$7,534,684	\$22,350,913
Sumter	\$0	\$235,985	\$1,102,629	\$924,177	\$1,485,243	\$284,445	\$4,032,479
Suwannee	\$0	\$3,899,650	\$351,256	\$377,400	\$8,953,509	\$828,444	\$14,410,259
Taylor	\$0	\$51,752	\$0	\$64,445	\$136,128	\$0	\$252,325
Union	\$0	\$297,439	\$195,495	\$100,501	\$299,081	\$87,276	\$979,792
Volusia	\$198,056	\$64,580	\$136,314	\$18,435,368	\$1,854,518	\$1,518	\$20,690,353
Grand Total	\$247,078,864	\$130,210,145	\$137,730,527	\$195,374,623	\$119,765,226	\$204,617,641	\$1,034,777,027







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