Preliminary Assessment of

AGRICULTURAL LOSSES AND DAMAGES

Resulting from

HURRICANE MILTON

Image courtesy of NASA Earth Observatory

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INTRODUCTION

The tropical system that would eventually become Hurricane Milton originated in the western Caribbean Sea and consolidated in the Bay of Campeche on October 5, 2024. Gradual intensification occurred as it slowly moved eastward, becoming a hurricane early on October 7 and undergoing explosive intensification to become a Category 5 hurricane with winds of 180 mph (285 km/h). Increasing wind shear caused the hurricane to weaken as it turned northeast towards Florida, falling to Category 3 status before making landfall near Siesta Key late on October 9. Afterwards, Milton rapidly weakened as it moved across the state into the Atlantic Ocean.

Tropical cyclones, such as Hurricane Milton, can significantly impact production agriculture. Producers can experience both losses (changes in economic flows) resulting from a change in the level or value of sales or a change in input costs and they can also experience damages (changes in economic stocks) that require repair or replacement. Agricultural losses might result from situations such as crop losses due to high winds in a citrus grove, flooded field and row crops, loss of electricity for a greenhouse operation, or even a lower sales price for a beef cattle rancher that had cattle that were not able to get the appropriate nutrition due to stress or damaged grazing lands. Agricultural assets at risk for damages include fencing, irrigation systems, farm homes, farm buildings, greenhouse and nursery structures, machinery/equipment, other infrastructure, and perennial plantings such as citrus trees or grape vines.

The University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Economic Impact Analysis Program (EIAP) 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 databases and methods for these types of analyses ever since. On October 10, 2024, the UF/IFAS EIAP distributed a survey titled "Assessment of Losses and Damages to Florida Agriculture from Hurricane Milton" to begin assessing losses and damages associated with Hurricane Milton. This survey instrument (ET00041674) 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 losses and damages.

This report summarizes the preliminary findings of the UF/IFAS EIAP's efforts to assess state-level losses for specific commodity groups due to Hurricane Milton. Data will continue to be collected via the Assessment of Losses and Damages to Florida Agriculture from Hazard/Disaster Events tool through marketing season 2024-2025 to be used in the final report for this event and for 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 Milton, as published by the National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center (NHC), is shown in Figure 1. Hurricane Milton was also associated with a significant tornado outbreak so data on the wind swaths of tornadoes recorded between October 6 and October 12, 2024, obtained from the NOAA National Weather Service (NWS) Damage Assessment Toolkit, have also been included in Figure 1. Hurricane-force winds impacted 14 counties in Florida: Brevard, Charlotte, DeSoto, Hardee, Highlands, Hillsborough, Manatee, Orange, Osceola, Pinellas, Polk, Sarasota, Seminole, and Volusia, whereas 43 additional counties in Florida experienced tropical storm-force winds.

Data representing the 7-day cumulative precipitation amounts (October 6-12, 2024) are shown in Figure 2. Rainfall was concentrated in the western and central regions of Florida, with certain southwestern areas experiencing cumulative rainfall during this period exceeding 18 inches, in particular Pinellas and Hillsborough counties. Areas experiencing the most intense sustained wind speeds tended to align with areas experiencing the heaviest precipitation for this event.

Estimated flood inundation depths in Florida caused by Hurricane Milton are displayed in Figure 3. These data were retrieved from the Pacific Northwest National Laboratory's Rapid Infrastructure Flooding Tool, which simulated flood depth based on precipitation and storm surge estimates from October 9 to October 14. The results suggest that storm surge and flood inundation depths associated with Hurricane Milton reached up to 15 feet along coastlines and in low-lying inland areas, especially in southwestern Florida. Inland regions also experienced flooding conditions up to 4 ft, mostly localized near rivers, estuaries, and natural lowlands.

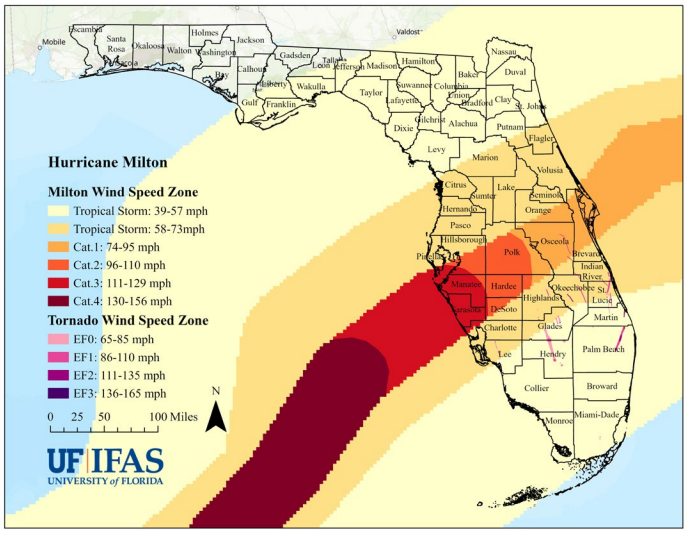

Figure 1. *Wind swath pattern of Hurricane Milton as it impacted Florida.*
Source: Geospatial data on the wind swath of Hurricane Milton are derived from NOAA National Hurricane Center (https://www.nhc.noaa.gov/gis/). Geospatial data on the wind swaths of tornadoes are derived from NOAA National Weather Service Damage Assessment Toolkit (https://apps.dat.noaa.gov/StormDamage/DamageViewer/).

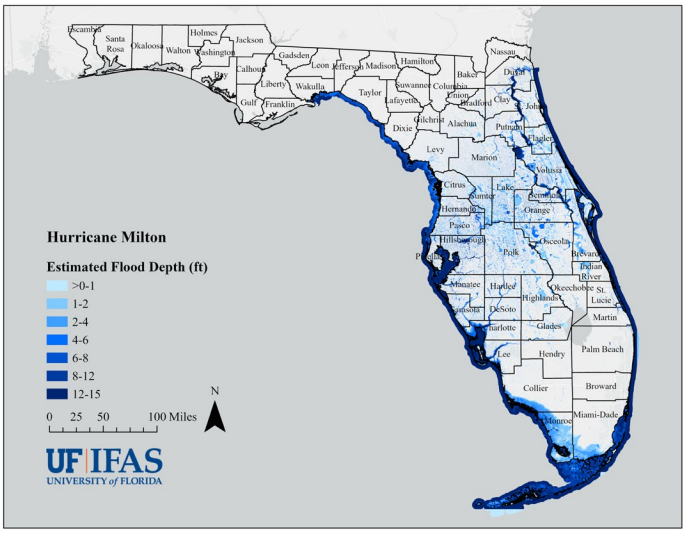

Figure 3. *Estimated flood inundation depth caused by Hurricane Milton in Florida.*
Source: Estimated flood inundation data are retrieved from Pacific Northwest National Laboratory's Rapid Infrastructure Flooding Tool (https://open-rift-pnnl.hub.arcgis.com/datasets/6ad56f6b56014fbfb0c492379bd78eeb/about).

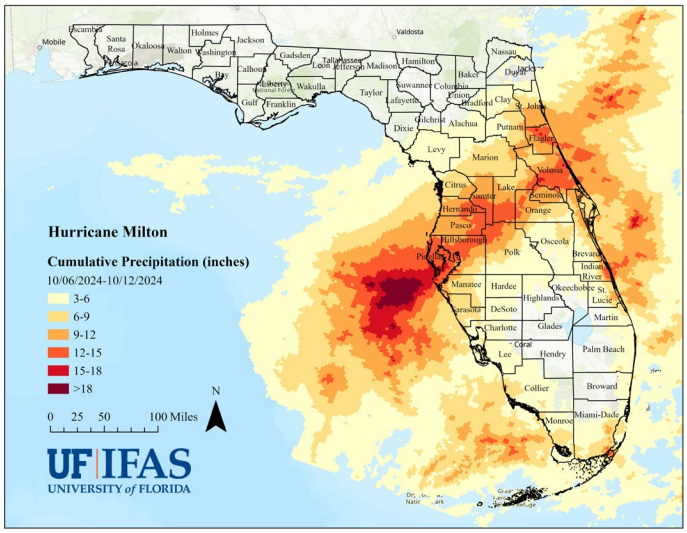

Figure 2. *Cumulative precipitation totals in Florida (October 6-12, 2024).*
Source: Precipitation data are derived from NOAA National Weather Service Quantitative Precipitation Estimate (QPE) Data (https://water.weather.gov/precip/download.php).

Table 1. *Definition of intensity indices for wind, rainfall, and flooding associated with tropical cyclone events, which are components of the UF/IFAS EIAP's Hurricane Composite Intensity Index.*

Intensity Index	Wind Speed (mph)	Precipitation (inches)	Flood Depth (ft)
1	TS1: 39-57	3-6	› 0-1
2	TS2: 58-73	6-9	1-2
3	Cat. 1: 74-95	9-12	2-4
4	Cat. 2: 96-110	12-15	4-6
5	Cat. 3: 111-129	15-18	6-8
6	Cat. 4 & up: › 130	› 18	› 8

IMPACTED AGRICULTURAL LANDS

Using geographic information systems (GIS) software (ArcGIS Pro), the hurricane wind swath, cumulative precipitation, and flood depth geospatial data were overlaid on a geospatial database of agricultural lands in Florida to determine the wind, rainfall, and flooding intensity that each parcel of affected agricultural land experienced. The geospatial database of agricultural lands in Florida is the Florida Statewide Agricultural Irrigation Demand (FSAID) Agricultural Lands Geodatabase (ALG) developed by the Florida Department of Agriculture and Consumer Services (FDACS). The HCII level was calculated for each parcel of affected agricultural land, as shown in Figure 4. Table 2 summarizes the impacted acreage of agricultural lands by commodity group and HCII level in Florida.

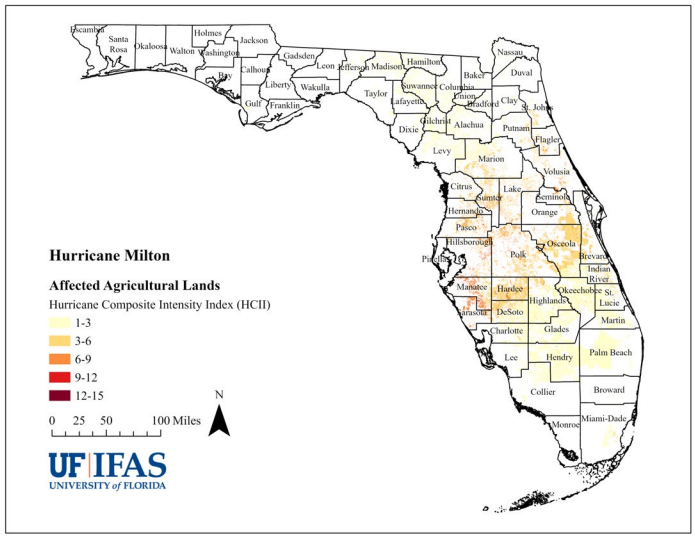

Figure 4. *Hurricane Composite Intensity Index (HCII) level of affected agricultural lands in Florida for Hurricane Milton.*
Source: The agricultural lands geospatial data are from the Florida Statewide Agricultural Irrigation Demand (FSAID) Agricultural Lands Geodatabase (ALG) developed by the Florida Department of Agriculture and Consumer Services (FDACS) (https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Water-Supply-Planning).

Table 2. *Estimated acreage of impacted agricultural lands by commodity group and HCII level for Hurricane Milton.*

Commodity Group	Hurricane Composite Intensity Index (HCII)					Total
	1-3	4-6	7-9	10-12	13-15	
Animals and Animal Products[1]	2,314,918	1,488,241	336,889	29,788	459	**4,170,295**
Field and Row Crops[2]	896,204	58,852	12,031	1,264	10	**968,362**
Citrus[3]	105,821	118,717	43,854	5,924	388	**274,705**
Vegetables, Melons, and Potatoes	143,143	32,546	25,568	185	2	**201,444**
Greenhouse/Nursery	48,183	27,383	4,336	237	-	**80,139**
Fruit and Tree Nuts[4]	16,975	5,051	2,365	47	-	**24,439**
Total	**3,525,245**	**1,730,790**	**425,042**	**37,447**	**859**	**5,719,383**

Notes: [1] Animals and Animal Products acreage includes grazing land. [2] Field and Row Crops acreage includes field crops, hay, and sugarcane. The acreage of cotton is adjusted with the county level harvested acres of cotton from USDA 2022 Census of Agriculture data. [3] Citrus acreage includes bearing and non-bearing acreage and was adjusted to reflect the 2024 Commercial Citrus Inventory Preliminary Report from USDA National Agricultural Statistics Service (NASS). [4] The acreage of pecan in the Fruit and Tree Nuts group is adjusted with the county level bearing and non-bearing acres of pecan from USDA 2022 Census of Agriculture data.

Over 5.7 million acres of agricultural lands were affected by Hurricane Milton, of which over 68% was grazing land. Across all commodity groups, around 61.6% of impacted acreage experienced low-intensity weather conditions (HCII levels 1-3), 37.7% of impacted acreage experienced moderate-intensity weather conditions (HCII levels 4-9), and only 0.7% of impacted acreage experienced high-intensity weather conditions (HCII levels 10-15). The commodity groups that were most affected (in terms of overall acreage impacted) by Hurricane Milton (not including grazing land) were Field and Row Crops (968,362 acres, including hay and sugarcane), Citrus (274,705 acres), and Vegetables, Melons, and Potatoes (201,444 acres).

Table 3 shows the estimated annual value of production on the affected acreage areas 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 2019-2023 (converted to 2024 dollars using the GDP implicit price deflator, published by the St. Louis Federal Reserve Bank), where available. When not available,

value per acre was estimated using data on 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 2018-2022 from IMPLAN, converted to 2024 dollars) to estimate the value of production on impacted acreage.

In estimating the annual production value for acreage impacted by Hurricane Milton, we have excluded the final estimates of the dollar-value losses caused by Hurricane Debby, which affected the same region less than two months prior. The close timing of Hurricanes Helene and Milton made the process of excluding losses associated with Hurricane Helene more difficult. To account for remaining uncertainty associated with Hurricane Helene, we have used the low and high scenarios provided in the UF/IFAS EIAP's preliminary assessment of the agricultural losses and damages associated with Hurricane Helene to adjust values for Hurricane Milton, as described in the next section. This approach ensures our assessment accurately reflects the incremental losses attributable solely to Hurricane Milton, thereby avoiding any double-counting (or triple-counting) within agricultural areas impacted by more than one of these events.

Table 3. *Estimated value of annual production (2024$, Thousands) on impacted acreage by commodity group and HCII level.*

Commodity Group	Hurricane Composite Intensity Index (HCII)					Total
	1-3	4-6	7-9	10-12	13-15	
Greenhouse/Nursery	$1,232,871	$964,502	$175,351	$13,576	$-	**$2,386,299**
Vegetables, Melons, and Potatoes	$1,592,590	$353,795	$349,200	$2,363	$17	**$2,297,966**
Animals and Animal Products	$1,076,142	$440,415	$123,242	$13,006	$294	**$1,653,099**
Field and Row Crops	$1,388,849	$46,125	$9,095	$1,045	$8	**$1,445,122**
Citrus	$210,136	$235,745	$87,083	$11,765	$770	**$545,499**
Fruit and Tree Nuts	$114,518	$133,294	$78,553	$1,395	$1	**$327,762**
Total	**$5,615,106**	**$2,173,876**	**$822,524**	**$43,150**	**$1,091**	**$8,655,746**

Hurricane Milton impacted agricultural lands that produce over $8.6 billion dollars of agricultural products (crops, livestock, aquaculture, etc.) throughout a calendar or marketing year, some across multiple growing seasons (e.g., Vegetables, Melons, and Potatoes) and others that might produce year-round (e.g., Greenhouse/Nursery, Animals and Animal Products). Considering impacts of all intensities, the commodity groups that were most affected in terms of annual value of production on lands affected by Hurricane Milton include Greenhouse/Nursery, Vegetables, Melons, and Potatoes, and Animals and Animal Products. A majority, 90%, of the estimated value of annual production across all commodities, was impacted by low-intensity conditions (HCII levels 1-3) and moderate-intensity conditions (HCII levels 4-9). The annual value of agricultural products grown or raised in areas experiencing high intensity conditions (HCII levels 10-15) is estimated to be $44.2 million, including Greenhouse/Nursery ($13.6 million), Animals and Animal Products ($13.3 million), and Citrus ($12.5 million).

AGRICULTURAL LOSSES IN FLORIDA

On October 30, 2024, completed survey responses from both the English- and Spanish-language versions of the UF/IFAS "Assessment of Losses and Damages to Florida Agriculture from Hurricane Milton" were downloaded and prepped for analysis by investigators from the UF/IFAS EIAP.

The survey tool collects information on county and Zip Code of the agricultural operation associated with each response but does not ask for an address or exact location. Also, a survey respondent can complete the survey by detailing impacts to one agricultural operation that spans multiple parcels, and in some cases, multiple counties. Due to difficulties related to knowing the exact location of each survey respondents' operation, and in turn, the exact hurricane conditions that they experienced at their operation, the project team calculated an HCII level for each impacted county to relate respondents' reported damages and losses with a weighted average of hurricane conditions on agricultural parcels at the county level. The HCII level

of affected agricultural lands was overlaid on the Florida county boundary shapefile from the U.S. Census Bureau. This process determined the percentage of agricultural land in each county impacted by the different HCII levels. An area-weighted method was then applied to calculate the composite index for wind, precipitation, and flooding for each county, as shown in Figure 5.

The area-weighted HCII level of each affected county was used to connect with the results of the survey data analysis as well as observations from previously analyzed tropical cyclone events (Ian [2022], Idalia [2023], Debby [2024], and Helene [2024]) to estimate a credible range on production losses (%) by commodity group for each HCII level by producing a "Low Scenario" and "High Scenario". These "Low" and "High" estimates of percentage production losses by commodity group and HCII level were then combined with available agricultural baseline data for the most recent year. Baseline data include information on acreage, value per acre, and season or growth stage for specific commodities. The baseline data are compiled from sources such as the USDA's 2022 Census of Agriculture, annual surveys by USDA-NASS, IMPLAN, Ask IFAS, as well as data published within the FDACS FSAID Geodatabase.

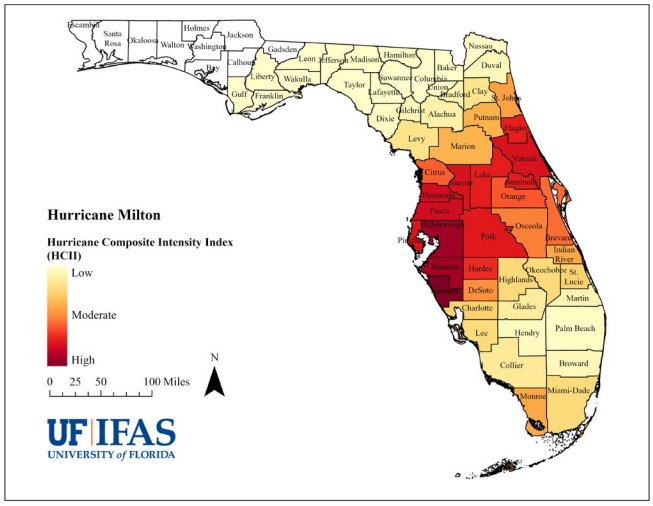

Figure 5. *Area-weighted HCII levels of affected counties in Florida.*

Table 4 displays the estimated annual production loss percentages (%) by commodity group and HCII level. Note that these estimates of production loss percentages are preliminary and might change as additional information specific to Hurricane Milton is collected. Production loss estimates (%) convey the percentage of annual production (calendar year 2024 or marketing year 2024-2025) that has been lost due to Hurricane Milton. Note that some producers (e.g., vegetable farms) have multiple growing seasons in Florida and others sell products year-round, which has been roughly accounted for in estimated loss percentage values. Additionally, adjustments have been made to estimated loss percentage values to account for planting and harvesting progress for some commodity groups but further adjustments might be made as information on early harvesting prior to the event, delayed planting in the face of Hurricane Milton, or the potential for growers to replant damaged or destroyed acreage is shared.

At this point in time, we are providing ranges on potential production losses as opposed to point estimates to reflect the uncertainty surrounding percentage production losses in the different areas that have been impacted by this event. The Low and High scenarios should be interpreted as low and high estimates of average losses for the relevant commodity group and HCII level combination and should not be interpreted as minimum and maximum values for individual producers or for commodity groups. Production losses that might occur in calendar year 2025, marketing year 2025-2026, or beyond as a result of the damages experienced by Hurricane Milton are not assessed and would be "in addition to" these estimates. Importantly, production loss estimates do not include the value of damages or destruction to stored inputs, stored harvested products, or infrastructure (including perennial plantings and lost/deceased animals not intended for sale this year). Finally, 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.

Given the close timing of Hurricane Helene and Hurricane Milton, it remains a significant challenge to isolate Helene's impacts from those attributed to Milton. To address this uncertainty, we integrated the low and high scenarios for both hurricanes to establish a comprehensive range of potential production losses associated with Milton. These scenarios were combined into four composite scenarios: "Helene Low - Milton Low," "Helene Low - Milton High," "Helene High - Milton Low," and "Helene High - Milton High." The lowest loss value across these four scenarios was designated as the lower bound, while the highest loss value was used as the upper bound. This method provides a robust and inclusive range, capturing the full extent of potential losses resulting from the overlapping impacts of both hurricanes. Considering all of this information, the production losses for agricultural producers (crops, livestock/aquaculture, and animal products) resulting from Hurricane Milton are estimated to be between $190.4 million and $642.7 million. Estimated agricultural losses by commodity group and HCII level are displayed in Table 5.

Table 4. *Estimated annual production loss percentages for Low and High scenarios by commodity group and HCII level.*

Commodity Group	Hurricane Composite Intensity Index (HCII)									
	2-3		4-6		7-9		10-12		13-15	
	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario
Animals and Animal Products	0%	5%	5%	10%	5%	10%	10%	20%	15%	25%
Citrus	0%	5%	5%	10%	10%	20%	20%	50%	40%	80%
Field and Row Crops	0%	10%	5%	15%	15%	30%	25%	60%	40%	70%
Fruit and Tree Nuts	0%	10%	5%	20%	10%	30%	25%	60%	40%	80%
Greenhouse/ Nursery	0%	5%	5%	10%	10%	15%	10%	25%	15%	25%
Vegetables, Melons, and Potatoes	0%	10%	5%	15%	10%	20%	20%	30%	20%	40%

Source: Authors' own calculations based on preliminary analysis of survey data for Hurricane Milton along with observations from previously analyzed tropical cyclone events (Ian [2022], Idalia [2023], Debby [2024], and Helene [2024]).

Table 5. *Estimated potential range of agricultural losses due to Hurricane Milton by commodity group and HCII level (2024$, Thousands).*

Commodity Group	Hurricane Composite Intensity Index (HCII)										Total	
	2-3		4-6		7-9		10-12		13-15			
	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario
Vegetables, Melons, and Potatoes	$-	$109,533	$17,486	$53,067	$34,547	$69,840	$470	$709	$3	$7	$52,506	$233,156
Greenhouse/ Nursery	$-	$51,153	$48,131	$96,450	$17,439	$26,303	$1,353	$3,394	$-	$-	$66,923	$177,300
Animals and Animal Products	$-	$27,504	$21,902	$44,037	$6,122	$12,324	$1,286	$2,601	$43	$73	$29,353	$86,539
Fruit and Tree Nuts	$-	$6,612	$6,603	$26,659	$7,668	$23,566	$339	$837	$-	$1	$14,610	$57,675
Citrus	$-	$7,664	$11,764	$23,574	$8,672	$17,417	$2,345	$5,882	$307	$616	$23,088	$55,153
Field and Row Crops	$-	$22,638	$2,282	$6,916	$1,344	$2,728	$258	$627	$3	$6	$3,887	$32,915
Total	**$-**	**$225,104**	**$108,168**	**$250,703**	**$75,792**	**$152,178**	**$6,051**	**$14,050**	**$356**	**$703**	**$190,367**	**$642,738**

Source: Authors' own calculations based on preliminary analysis of survey data for Hurricane Milton along with observations from previously analyzed tropical cyclone events (Ian [2022], Idalia [2023], Debby [2024], and Helene [2024]).

Production losses estimated for Vegetables, Melons, and Potatoes in the affected area ($52.5 million - $233.2 million) are heavily dependent on the time since planting as well as the ability (or inability) to harvest prior to the hurricane event or to replant damaged or destroyed crops after the event. 71.1% of vegetable, melon, and potato crops experienced low hurricane condition (HCII levels 1-3) and 28.8% experienced moderate hurricane condition (HCII 4-9). In the affected region, Vegetables, Melons, and Potatoes were reported to have suffered varying levels of losses due to heavy winds and flooding. Substantial losses were reported on certain crops, including beans and potatoes from flooding, toppled cabbage and cauliflower, damaged peppers, wind-stunted tomatoes, and torn leafy greens like choi, collards, kale, and baby greens, all compromising quality and yield. In additon, some growers have delayed winter crop planting due to Helene and Milton, disrupting the production schedule and potentially affecting the value of future harvests.

Estimated production losses associated with Greenhouse/ Nursery operations in the affected area ($66.9 million - $177.3 million) are expected due to damaged physical structures as well as loss of electricity, which is critically important for cooling and irrigation. Multiple operations reported severe structural damage to hoop houses,

greenhouses, and nursery infrastructure, with some losing entire structures. Significant crop losses were reported due to wind and flooding damage.

Production losses associated with animal operations (beef and dairy cattle, poultry, sheep, horse shellfish aquaculture, honey bee colonies, etc.) and producers of animal products (meat, milk, eggs, honey) in the affected area ($29.4 million - $86.5 million) are expected as a result of damaged livestock structures (barns, poultry houses, etc.) and watering points, damaged fencing, damaged aquaculture and apiculture structures, widespread power outages, and loss of feed. Beef and dairy cattle operations impacted by Hurricane Milton reported stressed or injured cattle due to flooding, lack of food, and inadequate water supply. Shellfish aquaculture operations reported salinity and water quality issues, stressed fishes, and closure of access to aquaculture lease areas during the hurricane.

Estimated production losses for Fruit and Tree Nuts in the affected area ($14.6 million - $57.7 million) are expected due to damages from wind, heavy rainfall, and flooding. Reported losses include destruction of plants or plant beds, branch breakage, fruit loss, and scarring. Some crops like blueberries, even though out of season, were reported to have plants uprooted or damaged. In addition, extended power outages led to issues with cold storage and delays in planting schedules, affecting the production cycle.

Estimated production losses for Citrus in the affected area ($23.1 million - $55.2 million) are expected due to fruit drop caused by high winds and physical damage to trees. Significant fruit drop was reported, especially on varieties that were ready for harvest, such as early oranges, tangerines, hamlins, and tangelos. Some growers also reported broken branches and structural damage to trees, with some young citrus trees splitting, compromising their health and future productivity.

Production loss estimates for Field and Row Crops in the affected area range from $3.9 million to $32.9 million. Direct reports of significant or widespread losses for Field and Row crops due to Hurricane Milton were limited, though some respondents mentioned that stored hay rolls were damaged due to flooding.

Results for production losses estimated by commodity group and HCII level respectively for the Low and High scenarios are visualized in Figure 6, which highlights how the Vegetables, Melons, and Potatoes experienced the largest levels of losses. Both scenarios show that the majority of losses occurred within areas experiencing moderate-intensity conditions (HCII 4-9). The large differences in the production losses experienced by all commodity groups within the regions that experienced lower-intensity hurricane conditions are driving the large difference in total production losses estimated across the Low and High scenarios. This is due to the fact that many producers in this region are reporting minimal to no losses (hence, 0% losses modeled for the Low scenario) but even low-level losses for a large number of acres of high value crops can result in significant loss values.

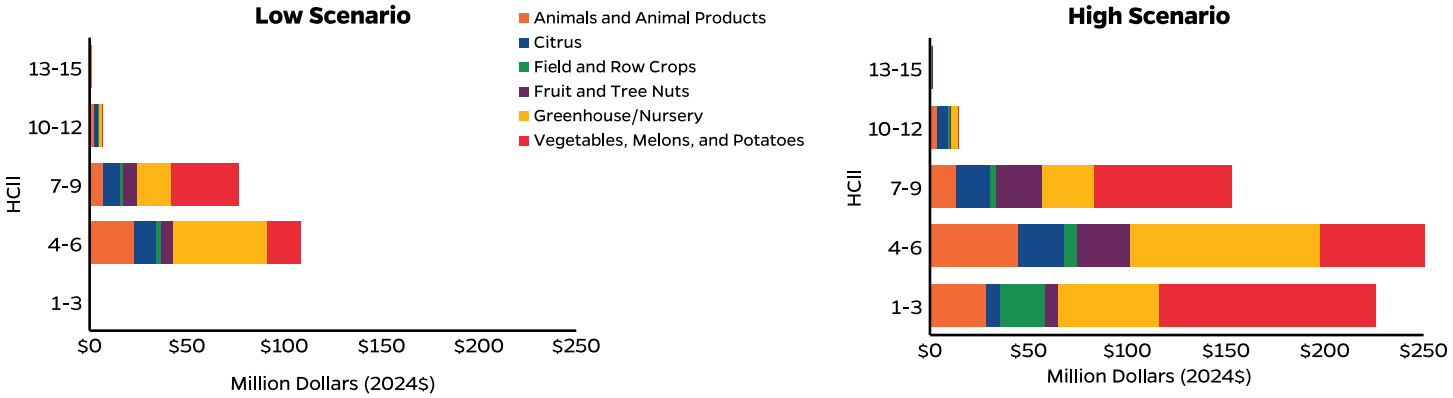

Figure 6. *Estimated potential range of agricultural losses due to Hurricane Milton by commodity group and HCII level.*
Source: Authors' own calculations based on preliminary analysis of survey data for Hurricane Milton along with observations from previously analyzed tropical cyclone events (Ian [2022], Idalia [2023], Debby [2024], and Helene [2024]).

AGRICULTURAL DAMAGES IN FLORIDA

Agricultural damages include asset damages and production damages. Asset damages could 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. Production damages include damages to stored inputs such as fuel for farm equipment, fertilizer, and other agricultural chemicals, and previously harvested

crops that were stored on-farm and not yet sold. Currently, data limitations associated with baseline conditions (current number, location, type, and value) on agriculture-related infrastructure (buildings, fencing, machinery, and equipment) as well as stored inputs and harvested products cannot support an estimate of the exact (or close to exact) hurricane conditions experienced by each building, machine equipment, stored products, etc., preventing an accurate assessment of the extent and value associated with agricultural damages.

The survey assessing the impacts of Hurricane Milton has questions on agricultural damages (agricultural infrastructure, stored inputs, and harvested products) as a supplementary section, which comes after collecting information on production losses. Respondents were asked to share additional information only if they affirmed their willingness to answer supplemental questions. Therefore, not all respondents provide information on damages to agricultural infrastructure, stored inputs or harvested outputs. The reported damages to infrastructure include fences, honey bee boxes, livestock sheds and watering points, perennial plantings, conservation ponds, greenhouse structures, homes, pallets, irrigation systems, farm equipment, and aquaculture structures. The reported damages to stored agricultural inputs include bird scratch/feed, feed grain, honey bee feed,fingerlings, fish feed, and aquaculture medicine. The reported damages to stored harvested products include eggs, honey, meat, and food fishes.

AGRICULTURAL INFRASTRUCTURE

Data availability limit our ability to extrapolate to area-, county-, or state-wide estimates of the value of damaged/destroyed infrastructure or associated repair/replacement costs; however, some publicly available data do exist related to the quantity and potential value of agricultural infrastructure in Florida, which provide some level of understanding of the potential impacts to agricultural infrastructure due to Hurricane Milton.

Structure Footprint Data

The Federal Emergency Management Agency's (FEMA) USA Structures geospatial data, which includes an inventory of all structures with a footprint larger than 450 square feet, provides a data source for estimating the number and square footage of agricultural structure footprints within the path of Hurricane Milton. These data can provide an estimate of the square footage of structure "at risk" of significant damage during this event. A summary of the square footage of agricultural structure footprints by HCII level is provided in Figure 7. Note that the square footage represents only the structures' footprints and does not account for square footage on floors above the first level in multi-story structures.

As many agricultural structures are single-story structures, we assume that the square footage of the agricultural structure footprints is a reasonable proxy for overall square footage of agricultural structures. The footprint of structures on the Florida agricultural lands impacted by moderate intensity conditions (HCII levels 4-9) and high intensity conditions (HCII levels 10-15) is 72.2 million square feet and 0.66 million square feet, respectively. As a comparison, this 72.8 million square feet footprint of agricultural structures in the path of Hurricane Milton is about 58 times larger than the footprint of The Pentagon in Arlington, VA, including the area encompassed by the central courtyard. Since there are many different types of structures on agricultural lands with a wide variety of values and the FEMA USA Structures geo-database does not provide information on the type of agricultural structure, it is not possible to accurately convert from area (square feet) to estimated current value (or to estimated repair/replacement costs).

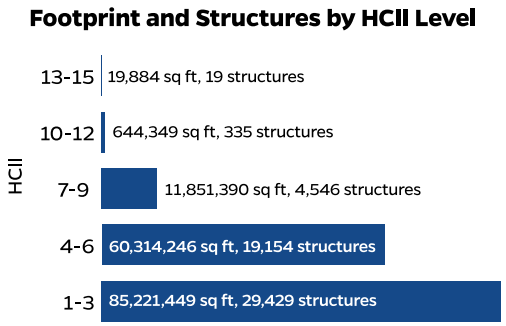

Figure 7. *Number of structures and footprint of structures on Florida agricultural lands by HCII level.*
Note: Square footage represents the building footprint only and does not account for square footage on floors above the first level in multi-story structures. Structures with a footprint of less than 450 square feet are not included in the database.
Source: FEMA USA Structures geospatial data (https://gis-fema.hub.arcgis.com/pages/usa-structures).

Data on Value of Agriculture-Related Buildings and Machinery/Equipment

The 2022 Census of Agriculture, published by the USDA, contains county- and state-level data on the current value (2022$) of land and buildings, machinery and equipment on farms as of 2022. The value of buildings was estimated using the average ratio of the value of improvements and

lands in Florida, as detailed in the parcel tax database (2023) released by the Florida Department of Revenue. Combined with the event data of Hurricane Milton, these data can be used to estimate the value of buildings, machinery, and equipment that were at risk of damage/destruction in areas experiencing strong wind, heavy rainfall, or flooding. Importantly, this value is not an estimate of the value of damaged/destroyed buildings, machinery, and equipment nor is it an estimate of the repair/replacement costs for damaged/destroyed buildings.

In the areas of Florida impacted by Hurricane Milton, the estimated value of the buildings that were present in 2022 on the agricultural lands impacted by high-intensity weather conditions (HCII level 10-15) was $1.30 billion (2022$), which would be valued at $1.38 million (2024$) after adjusting for inflation (Figure 8). The estimated value of the machinery and equipment present in 2022 on the agricultural lands impacted by high-intensity weather conditions (HCII level 10-15) was $0.77 billion (2022$), which would be $0.81 billion (2024$) after adjusting for inflation (Figure 9). Similarly, the estimated value of the buildings that were present in 2022 on the agricultural lands impacted by moderately intense weather conditions (HCII level 4-9) was $28.5 billion (expressed in 2022$), which would be valued at over $30.1 billion (2024$) after adjusting for inflation. The estimated value of machinery and equipment present in 2022 on the lands impacted by moderately intense weather conditions (HCII level 4-9) was $1.54 billion (2022$), which would be $1.63 billion (2024$) after adjusting for inflation.

Note that these estimates do not capture the value of buildings, machinery, or equipment built or acquired after the 2022 Census of Agriculture was completed. These values are also not adjusted for buildings, machinery, or equipment that were demolished or are no longer present/used and they are not adjusted for depreciation over the period 2022-2024. It is also important to note that the accuracy of these values for 2022 might be influenced by the response rate on the 2022 Census of Agriculture.

Irrigation Equipment

The Irrigated Lands Geodatabase (ILG) that is published within the FDACS FSAID Geodatabase provides information on irrigated agricultural lands in Florida as of 2022, including information on the type of irrigation system used. Over the agricultural land impacted by Hurricane Milton (approximately 5.7 million acres), there were over 1.6 million acres of irrigated agricultural lands, shown in Table 6. The irrigation systems adopted in the impacted region have diverse vulnerabilities to strong wind, heavy rainfall, and flooding. For example, center pivot/lateral move and traveling guns are highly vulnerable to strong wind. On the other hand, micro spray, gravity systems, and drip are more resistant to wind but face a higher risk of damage from flooding.

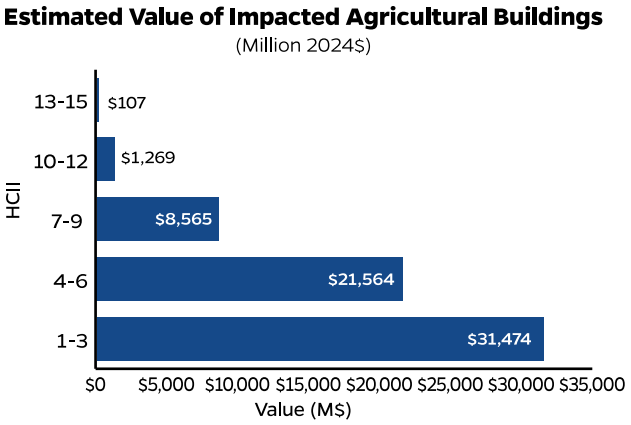

Figure 8. *Estimated value of impacted agricultural buildings by HCII level.*

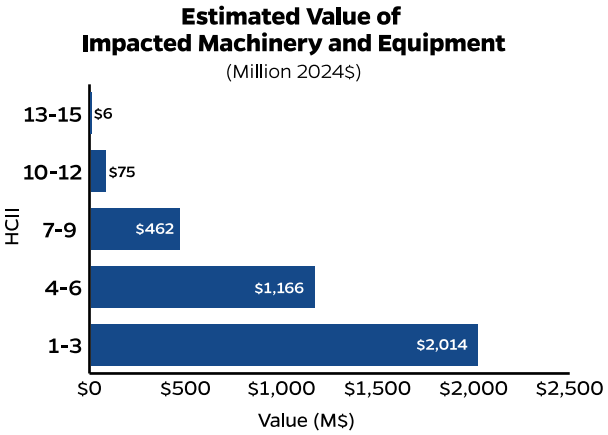

Figure 9. *Estimated value of impacted agricultural machinery and equipment by HCII level.*

This database suggests that there are over 260,000 acres of irrigated agricultural lands impacted by hurricane wind conditions, about 5% of which employ center pivot/lateral move irrigation systems, which are vulnerable to wind damage. Around 96,000 acres of irrigated agricultural lands were impacted by flooding, 87% of which employ micro spray, gravity systems, or drip irrigation systems. As irrigation systems come in different sizes and are used to irrigate a wide range of farm/field sizes, there is not a good method of converting from acreage irrigated by center pivot/lateral move systems to number of center pivots or lateral move systems or to further convert from number of systems impacted to the current value of those systems or an estimated value of damage to them (or repair/replacement costs associated with damage/destruction).

Table 6. *Estimated impacted irrigated acreage by irrigation system and HCII level.*

Irrigation System	Hurricane Composite Intensity Index (HCII)					Total
	1-3	4-6	7-9	10-12	13-15	
Gravity Systems	791,527	67,444	11,424	173	2	**870,571**
Micro Spray	211,014	161,156	10,363	213	-	**382,746**
Center Pivot/ Lateral Move	170,362	19,086	1,714	23	-	**191,185**
Drip	74,332	35,217	23,482	233	-	**133,264**
Impact Sprinkler	12,607	14,337	1,077	39	-	**28,061**
Container Nursery	17,123	8,236	1,145	112	-	**26,616**
Traveling Gun	12,587	7,766	1,056	93	-	**21,501**
Total	**1,289,552**	**313,243**	**50,262**	**887**	**2**	**1,653,945**

ADDITIONAL CONSIDERATIONS

This report focuses on a rapid assessment of statewide production losses for the current season (calendar year 2024 or marketing year 2024-2025) for agricultural operations in Florida due to Hurricane Milton. The value of the following categories of damages or losses are not included in these estimates and should be considered in addition to production losses suffered by impacted agricultural producers:

- Value of damages to agriculture-related infrastructure (including perennial plantings and lost/deceased animals that are used to produce animal products) that will need to be repaired or replaced.
- Value of stored inputs (seed, fertilizer, etc.) or stored harvested products that were damaged or destroyed.
- Expenses related to Hurricane Milton-specific preparations ahead of the storm and expenses related to clean-up after the storm.
- Value of production losses that might carry over into calendar year 2025, marketing season 2025-2026, or beyond due to damages to agriculture-related infrastructure or other effects of the storm.
- Production losses for agricultural operations that specialize in post-harvest processing, packing, or distribution that might be impacted as a result of impacts to production agriculture operations (e.g., operations specializing in citrus packing and juice processing, fruit and vegetable packing houses, fluid milk manufacturing, seafood packaging and distribution, etc.).
- Value of timber- or forestry-related losses, which were assessed by the Florida Forest Service at nearly $25 million.
- Value of production losses to capture fisheries.

Production loss estimates in this report do include shellfish and finfish aquaculture as these operations are considered agriculture. Capture fisheries might be covered by surveys conducted by other organizations. It is also important to note that the estimates of production losses represent the estimated total value of agriculture-related production losses due to Hurricane Milton 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.

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