

Preliminary Assessment of
**AGRICULTURAL LOSSES
AND DAMAGES**
Resulting from
HURRICANE HELENE

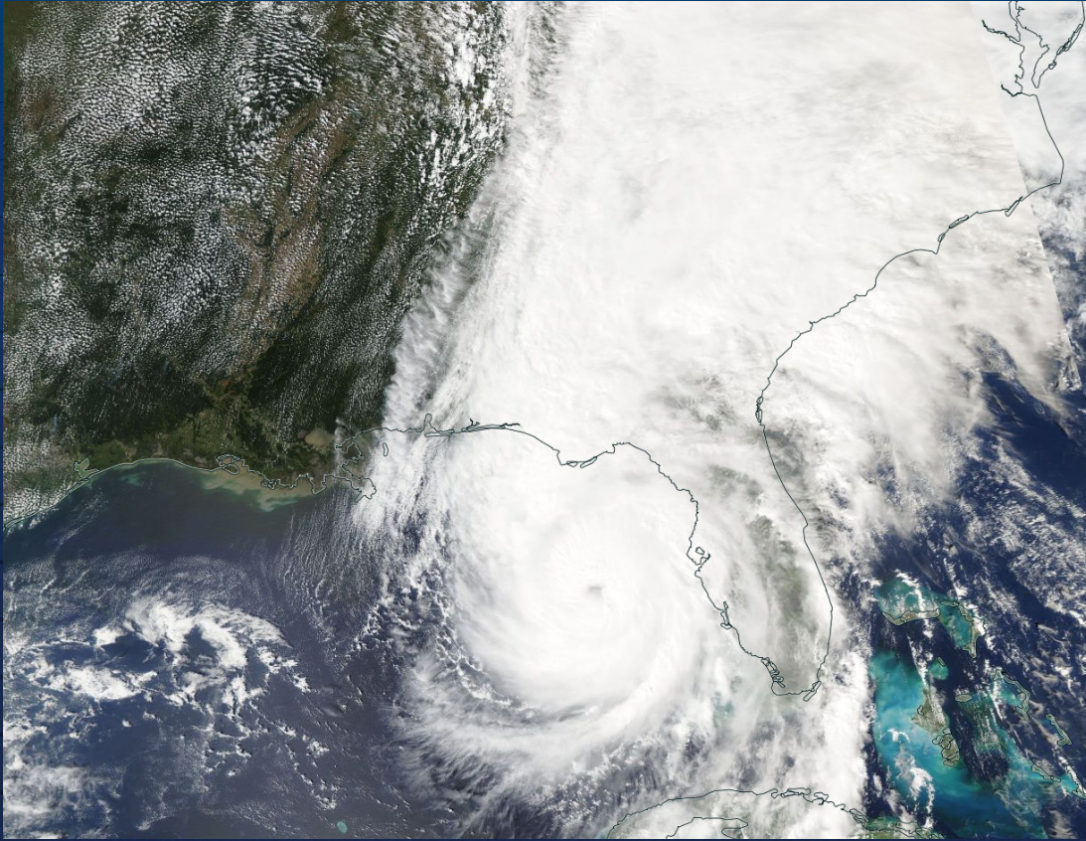


Image courtesy of NASA Worldview

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(Table 6 updated on December, 9, 2024)

INTRODUCTION

The tropical system that would become Hurricane Helene developed into a tropical storm on September 24, 2024 in the northwest Caribbean Sea near the Yucatán Peninsula and then strengthened into a hurricane the next day as it moved into the Gulf of Mexico. It rapidly intensified, attaining Category 4 strength with 140 mph winds prior to making landfall near Perry, FL (Taylor County) on September 26. After landfall, Helene continued moving north-northeast, impacting north-central Florida and the southwestern peninsula. It weakened to a Category 2 hurricane after crossing into Georgia, and then further downgraded as it moved through the Appalachian region, affecting parts of South Carolina, North Carolina, Virginia, and Tennessee.

Tropical cyclones, such as Hurricane Helene, can significantly affect production agriculture via wind-, precipitation-, and flooding-related impacts. Producers can experience both losses (changes in economic flows) resulting from changes in the level or value of sales or increased input costs, and they can also experience damages (changes in economic stocks) resulting from impacts to physical assets that might require repair or replacement. Agricultural losses might result from situations such as wind-damaged vegetable crops, flooded fields, crop losses in a pecan grove due to high winds, water quality or mortality issues for shellfish aquaculture operations, lower milk production at a dairy farm due to stressed dairy cattle or the need to dump milk due to issues with cold storage during a power outage, or even a lower sales price for a beef cattle rancher that had undernourished cattle 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, livestock animals that produce animal products or are not intended

for sale this calendar/marketing year, and perennial plantings such as pecan or citrus trees and vineyards.

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 September 27, 2024, the UF/IFAS EIAP distributed a survey titled “Assessment of Losses and Damages to Florida Agriculture from Hurricane Helene” to begin assessing losses and damages associated with Hurricane Helene. 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 presents the preliminary findings of the UF/IFAS EIAP’s efforts in assessing state-level losses for specific commodity groups due to Hurricane Helene. Data collection will continue through marketing season 2024-2025 via the “Assessment of Losses and Damages to Florida Agriculture from Hazard/Disaster Events” tool to be used in the final report and for broader studies on the agricultural impacts of disaster events like Hurricane Helene, and to improve assessments of future events.

EVENT DATA

Figure 1 shows the wind swath of Hurricane Helene published by the National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center (NHC). Eight counties in Florida experienced hurricane conditions: Suwannee, Taylor, Lafayette, Dixie, Wakulla, Hamilton, Madison, and Jefferson. A large swath of the Florida peninsula experienced tropical storm force winds, which extended across 55 additional counties.

Figure 2 shows the 7-day cumulative precipitation amounts (September 23-29, 2024) for Florida. The most intense rainfall, exceeding 12 inches, occurred in parts of the Big Bend region, in particular in Gulf, Franklin, and Liberty counties. This region of heavy precipitation is west of the

path of the hurricane’s center, where hurricane- and tropical storm- force wind conditions were most severe.

Figure 3 shows the estimated flood inundation depths caused by Hurricane Helene in north-central Florida. 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 September 25 to October 2. The results suggest Hurricane Helene caused widespread storm surge along Florida’s Gulf Coast, reaching up to 15 feet in the barrier islands and along the coastline of the Big Bend region. Inland areas experienced less intense flooding conditions, generally 1-2 feet or less than 1 foot, though localized areas near major rivers saw deeper floodwaters.

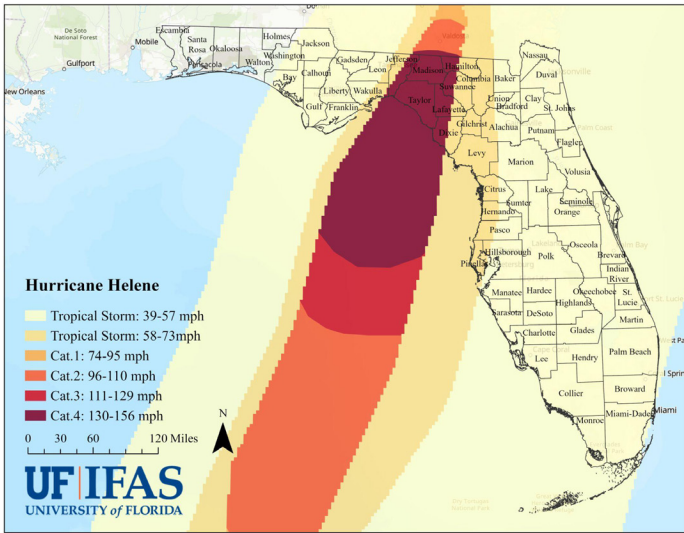


Figure 1. Wind swath pattern of Hurricane Helene as it impacted Florida.
 Source: Geospatial data on the wind swath of Hurricane Helene are derived from NOAA NHC (<https://www.nhc.noaa.gov/gis/>).

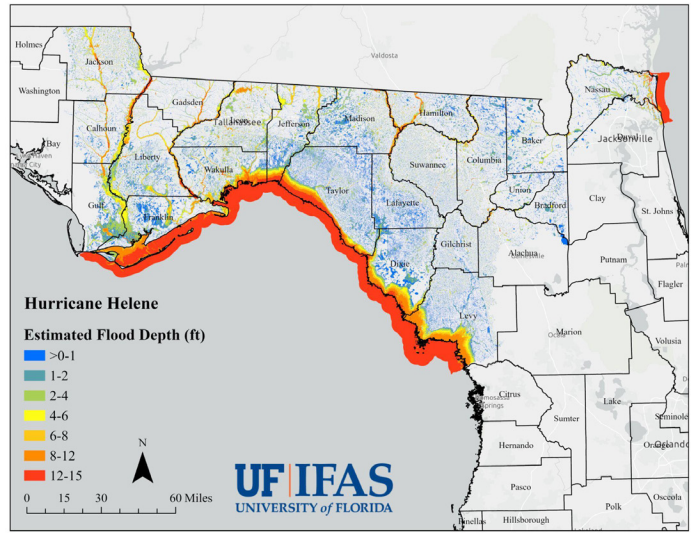


Figure 3. Estimated flood inundation depth caused by Hurricane Helene in north central Florida.
 Source: Estimated flood inundation data are retrieved from Pacific Northwest National Laboratory's Rapid Infrastructure Flooding Tool (<https://open-rift-pnnl.hub.arcgis.com/documents/Odcc98b06bb8478c8ff708df796fe047/about>).

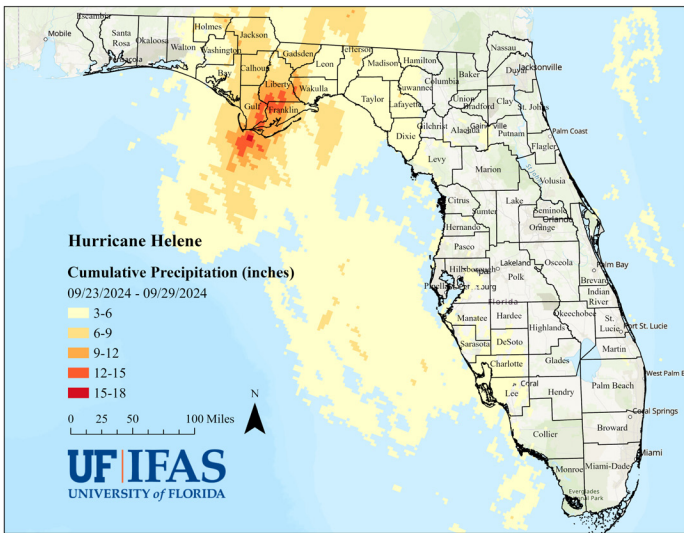


Figure 2. Cumulative precipitation totals in Florida (September 23-29, 2024).
 Source: Precipitation data are derived from NOAA National Weather Service (<https://water.weather.gov/precip/download.php>).

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

To quantify the comprehensive impacts of Hurricane Helene in terms of wind, rainfall, and flooding, a Hurricane Composite Intensity Index (HCII) was derived. This index is calculated as the sum of the intensity index of wind,

rainfall, and flooding, which are all categorized into 6 levels respectively based on wind speed (measured in mph), cumulative precipitation (measured in inches), and flood depth (measured in ft), as shown in Table 1.

IMPACTED AGRICULTURAL LANDS

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

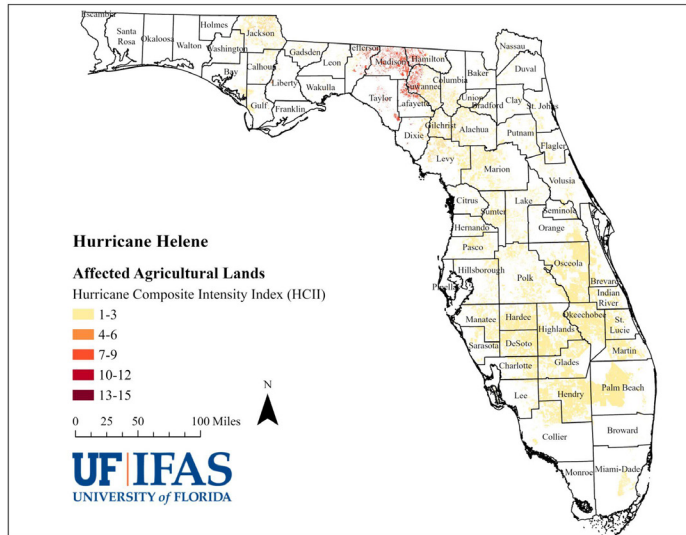


Figure 4. Hurricane Composite Intensity Index (HCII) level of impacted agricultural lands in Florida for Hurricane Helene.

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 agricultural lands impacted by Hurricane Helene, categorized by commodity group and HCII level.

Commodity Group	Hurricane Composite Intensity Index (HCII)					Total
	1-3	4-6	7-9	10-12	13-15	
Animals and Animal Products ¹	4,132,315	51,871	128,704	9,124	1,035	4,323,048
Field and Row Crops ²	1,022,006	37,954	102,222	6,161	571	1,168,914
Citrus ³	274,705	-	-	-	-	274,705
Vegetables, Melons, and Potatoes	195,243	887	7,208	637	199	204,174
Greenhouse/Nursery	78,413	1,032	1,771	84	2	81,302
Fruit and Tree Nuts ⁴	16,221	664	1,745	315	95	19,040
Total	5,718,902	92,407	241,650	16,322	1,901	6,071,183

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 data. ³ Citrus acreage includes non-bearing acreage and was adjusted to reflect the 2024 Commercial Citrus Inventory Preliminary Report from USDA 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 data.

More than 6 million acres of agricultural lands were affected by Hurricane Helene, of which over 68% was grazing land. Across all commodity groups, around 94.2% of impacted acreage experienced low-intensity weather conditions (HCII levels 1-3), 5.5% of impacted acreage experienced moderate-intensity weather conditions (HCII levels 4-9), and only 0.3% of impacted acreage experienced high-intensity weather conditions (HCII levels 10-15). The commodity groups that were most affected by Hurricane Helene, in terms of acreage impacted by moderate- or

high-intensity weather conditions (HCII levels 4-15), were Field and Row Crops (including hay and sugarcane, 146,908 acres), Animals and Animal Products (not including grazing land, 10,135 acres), and Vegetables, Melons, and Potatoes (8,931 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 Helene, we excluded the estimated value of production losses caused by Hurricane Debby, which affected the same region less than two months prior. This approach ensures our assessment accurately reflects the incremental damage attributable solely to Hurricane Helene, thereby avoiding any double-counting of previously impacted values.

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	\$2,408,743	\$8,090	\$16,983	\$540	\$10	\$2,434,366
Vegetables, Melons, and Potatoes	\$2,232,307	\$8,031	\$78,881	\$8,010	\$2,876	\$2,330,105
Animals and Animal Products	\$1,477,766	\$46,369	\$161,822	\$12,329	\$966	\$1,699,252
Field and Row Crops	\$1,513,088	\$25,205	\$68,866	\$4,209	\$293	\$1,611,661
Citrus	\$545,499	\$-	\$-	\$-	\$-	\$545,499
Fruit and Tree Nuts	\$96,274	\$6,475	\$17,020	\$3,084	\$927	\$123,780
Total	\$8,273,676	\$94,171	\$343,572	\$28,172	\$5,072	\$8,744,663

Hurricane Helene impacted agricultural lands that produce roughly \$8.7 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 at risk” by Hurricane Helene include Greenhouse/Nursery, Animals and Animal Products, Vegetables, Melons, and Potatoes. A majority, 99.6%, 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 4-9), and 0.4% of estimated value were impacted by high-intensity conditions (HCII levels 10-15). The annual value of agricultural products grown or raised in areas experiencing high intensity conditions (HCII levels 10-15) is estimated to be \$33.2 million, including Animals and Animal Products (\$13.3 million), Vegetables, Melons, and Potatoes (\$10.9 million), and Field and Row Crops (\$4.5 million), after adjusting for production losses attributable to Hurricane Debby.

AGRICULTURAL LOSSES IN FLORIDA

On October 25, 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 Helene” 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 event data shapefiles (such as wind, precipitation, and flooding) were overlaid on the Florida county boundary shapefile from the U.S. Census Bureau. This process determined the wind, precipitation, and flooding index for each agricultural parcel, as well as the percentage of agricultural land in each county impacted by the different index categories. 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 (Michael [2018], Idalia [2023], and Debby [2024]) affecting the region 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.

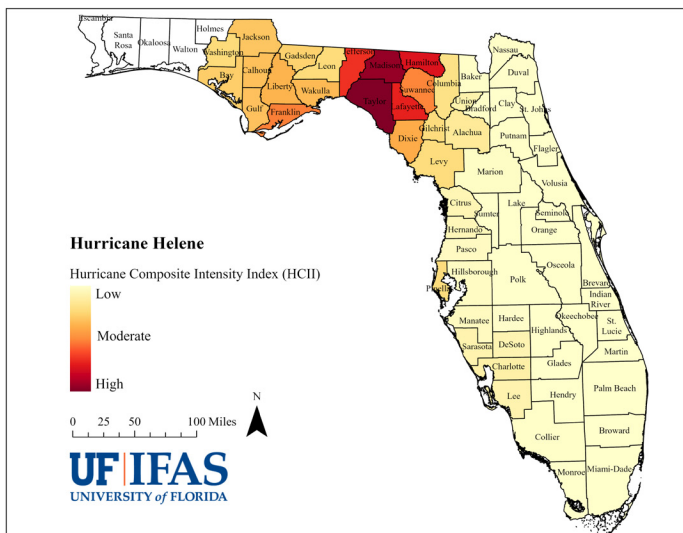


Figure 5. Area-weighted HCII levels of affected counties in Florida.

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 Helene 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 Helene. Agricultural parcels classified as HCII level 1 were assumed to experience 0% loss based on responses from these regions showing minimal or no impact from Hurricane Helene across all commodity groups.

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 Helene, 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 Helene 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). 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.

Considering all of this information, the production losses for agricultural producers (crops, livestock/aquaculture, and animal products) resulting from Hurricane Helene are estimated to be between \$40.3 million and \$162.2 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%	5%	5%	10%	10%	20%	20%	30%	20%	40%

Source: Authors' own calculations based on preliminary analysis of survey data for Hurricane Helene along with observations from previously analyzed tropical cyclone events (Michael [2018], Idalia [2023], and Debby [2024]).

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

Commodity Group	Hurricane Composite Intensity Index (HCII)										Total	
	1-3		4-6		7-9		10-12		13-15		Low	High
	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario	Low Scenario	High Scenario
Field and Row Crops	\$0	\$20,990	\$1,260	\$3,781	\$10,330	\$20,660	\$1,052	\$2,526	\$117	\$205	\$12,759	\$48,162
Animals and Animal Products	\$0	\$20,877	\$2,318	\$4,637	\$8,091	\$16,182	\$1,233	\$2,466	\$145	\$241	\$11,787	\$44,403
Vegetables, Melons, and Potatoes	\$0	\$18,096	\$402	\$803	\$7,888	\$15,776	\$1,602	\$2,403	\$575	\$1,150	\$10,467	\$38,228
Greenhouse/ Nursery	\$0	\$11,542	\$405	\$809	\$1,698	\$2,547	\$54	\$135	\$1	\$2	\$2,158	\$15,035
Fruit and Tree Nuts	\$0	\$3,138	\$324	\$1,295	\$1,702	\$5,106	\$771	\$1,850	\$371	\$741	\$3,168	\$12,130
Citrus	\$0	\$4,263	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$-	\$4,263
Total	\$0	\$78,906	\$4,709	\$11,325	\$29,709	\$60,271	\$4,712	\$9,380	\$1,209	\$2,339	\$40,339	\$162,221

Source: Authors' own calculations based on preliminary analysis of survey data for Hurricane Helene along with observations from previously analyzed tropical cyclone events (Michael [2018], Idalia [2023], and Debby [2024]).

Production loss estimates for Field and Row Crops in the affected area (\$12.8 million - \$48.2 million) are expected, largely due to strong wind that bent, lodged, or completely flattened crop stalks, reducing yield and quality. There were also reports that infrastructure damaged by Hurricane Helene, such as broken irrigation systems, flipped semi-trailers, and damaged fences impeded the ability of producers to water or harvest some fields as scheduled. Delays and disruptions of harvest can impact overall crop yields and quality in these fields.

Production losses associated with animal operations (beef and dairy cattle, poultry, shellfish aquaculture, honey bee colonies, etc.) and producers of animal products (milk, eggs, honey) in the affected area (\$11.8 million - \$44.4 million) are expected as a result of damaged fencing, livestock sheds (barns, poultry houses, etc.) and watering points, damaged aquaculture and apiculture structures, and widespread power outages and loss of feed. Operations of beef cattle, dairy cattle, poultry, and goats impacted by Hurricane Helene also reported stressed or injured animals. Shellfish

aquaculture operations reported salinity issues, water quality issues, and closure of access to aquaculture lease areas during the hurricane.

Production losses estimated for Vegetables, Melons, and Potatoes in the affected area (\$10.5 million - \$38.2 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. A majority (99.6%) of Vegetables, Melons, and Potatoes crops experienced low or moderate hurricane conditions (HCII levels 1-9). There were reports of stripped fruit and blooms due to high winds. Many growers hadn't yet planted due to previous impacts from Hurricane Debby, while those who planted but faced only lower-intensity tropical conditions report minimal losses; however, low levels of losses over large areas of high-value crops can be significant.

Estimated production losses associated with Greenhouse/Nursery operations in the affected area (\$2.2 million - \$15.0 million) are expected due to damaged or collapsed hoop houses, broken greenhouse structures, and nursery infrastructure as well as loss of electricity, which is critically important for cooling and irrigation.

Estimated production losses for Fruit and Tree Nuts in the affected area are projected between \$3.2 million and \$12.1 million, primarily due to fruit drop and tree or plant damage caused by strong wind, as well as damaged infrastructure

(irrigation equipment, storage sheds, etc.) reducing overall farm productivity.

Estimated production losses for Citrus in the affected area are minimal, though these values might not fully incorporate losses to cold-tolerant citrus varieties in the north-central region such as Satsuma due to limitations within the baseline data. There were no reports of significant or widespread losses for oranges and grapefruit due to Hurricane Helene, but the result of low level production losses across a wide swath of citrus acreage that experienced tropical storm force winds and flooding conditions could reach up to \$4.3 million.

Results for production losses estimated by commodity group and HCII level are visualized in Figure 6, which highlights the fact that the Field and Row Crops and Animals and Animal Products commodity groups experienced the largest levels of losses. The significant difference in total production losses estimated between the Low and High scenarios is primarily driven by commodity groups within regions that experienced weak hurricane conditions (HCII 1-3). In these regions, many producers report minimal or no losses (resulting in a 0% loss model for the Low scenario); however, even minimal losses across a large area of high-value crops can accumulate into substantial total losses. Outside of HCII 1-3 regions, both scenarios indicate that the majority of losses for this storm were experienced in areas experiencing moderate intensity conditions (HCII 7-9).

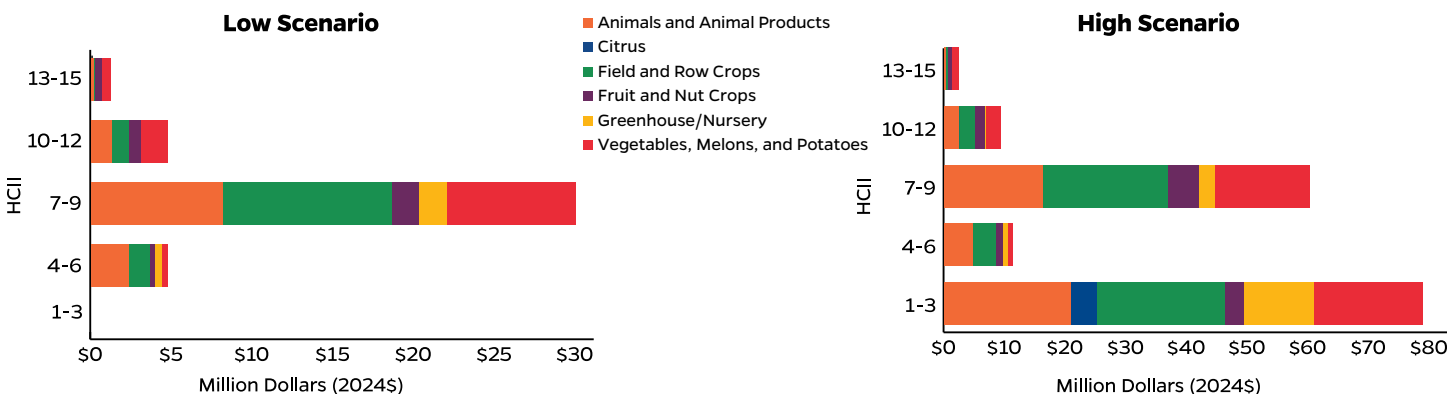


Figure 6. Estimated agricultural production losses in Florida due to Hurricane Helene by commodity group and HCII level. Source: Authors' own calculations based on preliminary analysis of survey data for Hurricane Helene along with observations from previously analyzed tropical cyclone events (Michael [2018], Idalia [2023], and Debby [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 on the caused agricultural damages.

The survey assessing the impacts of Hurricane Helene 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 conservation structures, farm equipment, fences, perennial plantings, greenhouse and other growing structures, homes, irrigation systems, livestock sheds, livestock watering points, pallets, and storage structures. The reported damages to stored agricultural inputs include fertilizer, feed grain, pesticides, animal medicine, and seeds. Some respondents also reported seeds being blown off fields by strong winds and erosion of pastureland. The damages to stored harvested products from the survey include reported damages to stored meat, eggs, milk, hay, and millet.

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 Helene.

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 Helene. 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 14.6 million square feet and 0.36 million square feet, respectively. As a comparison, this 15 million square feet footprint of agricultural structures in the path of Hurricane Helene is

about 12 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).

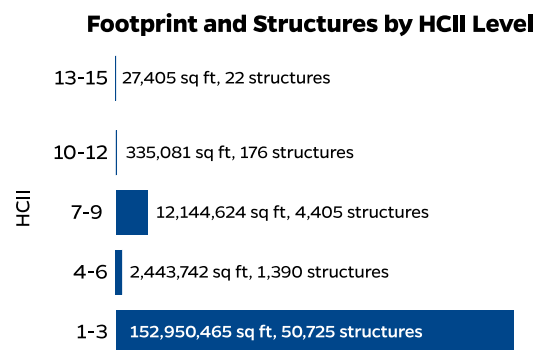


Figure 7. Number of structures and area of footprint on Florida agricultural lands by HCII level.

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 Helene, 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 Florida areas affected by Hurricane Helene, the estimated value of buildings located on agricultural lands impacted by high-intensity weather (HCII levels 10-15) in 2022 was \$338.2 million (2022\$), which would be \$357.5 million in 2024 dollars after adjusting for inflation (see Figure 8). For agricultural lands exposed to moderate-intensity weather conditions (HCII levels 4-9), the value of buildings in 2022 was estimated at \$3.6 billion (2022\$), rising to \$3.8 billion (2024\$) with inflation adjustment.

The estimated value of machinery and equipment on agricultural lands affected by high-intensity weather (HCII levels 10-15) was \$27.7 million in 2022, equivalent to \$29.3 million in 2024 dollars (Figure 9). For lands impacted by moderate-intensity conditions (HCII levels 4-9), machinery and equipment were valued at \$312.1 million (2022\$), increasing to \$329.9 million (2024\$) with inflation adjustment.

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 the infrastructure-related impacts of events such as Hurricane Debby or for buildings, machinery, or equipment that were later demolished or are no longer present/used for other reasons and they are not adjusted for depreciation over the period 2023-2024. 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 2021, including information on the type of irrigation system used. Over the agricultural land impacted by Hurricane Helene (approximately 6.1 million acres), there were about 1.7 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

Estimated Value of Impacted Agricultural Buildings
(Million 2024\$)

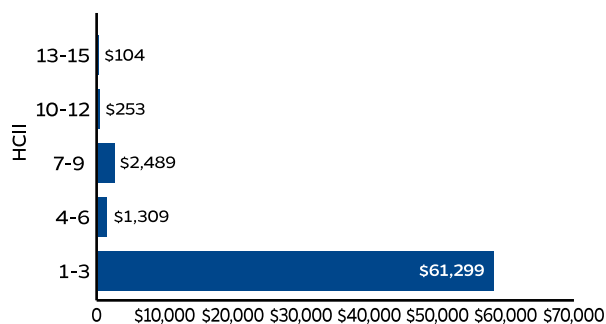


Figure 8. Estimated value of impacted agricultural buildings by HCII level.

Estimated Value of Impacted Machinery and Equipment
(Million 2024\$)

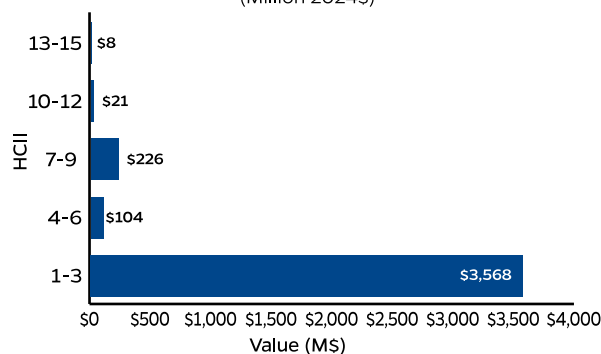


Figure 9. Estimated value of impacted agricultural machinery and equipment by HCII level.

rainfall, and flooding. For example, center pivot/lateral move and traveling guns are highly vulnerable to strong wind and there were many reports of damage to these irrigation systems within the UF/IFAS EIAP assessment. On the other hand, micro spray, gravity systems, and drip are more resistant to wind but face a higher risk of damage from flooding.

This database suggests that there are over 66,000 acres of irrigated agricultural lands impacted by Category 4 hurricane conditions, over 90% of which employ center pivot/lateral move irrigation systems, which are vulnerable to wind damage. Around 34,000 acres of irrigated agricultural lands might have experienced flooding, less than 6% 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 Hurricane Helene, categorized by irrigation system by HCII level.

Irrigation System	Hurricane Composite Intensity Index (HCII)					Total
	1-3	4-6	7-9	10-12	13-15	
Gravity Systems	867,011	-	38	-	-	867,049
Micro Spray	382,384	117	372	4	-	382,879
Center Pivot/ Lateral Move	155,543	14,711	56,524	4,274	409	231,461
Drip	130,997	1,194	3,712	137	1	136,041
Impact Sprinkler	27,577	495	134	3	-	28,210
Container Nursery	26,581	142	203	21	2	26,949
Traveling Gun	21,355	436	1,339	70	-	23,200
Total	1,611,448	17,095	62,323	4,510	412	1,695,788

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 Helene. 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 Helene-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 peanut drying, cotton ginning, seafood packaging and distribution, etc.).
- Value of timber- or forestry-related losses, which were assessed by the Florida Forest Service at \$114 million. The [preliminary Florida Forest Service report](#) has been published by the Florida Forestry Association.
- 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 Helene 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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