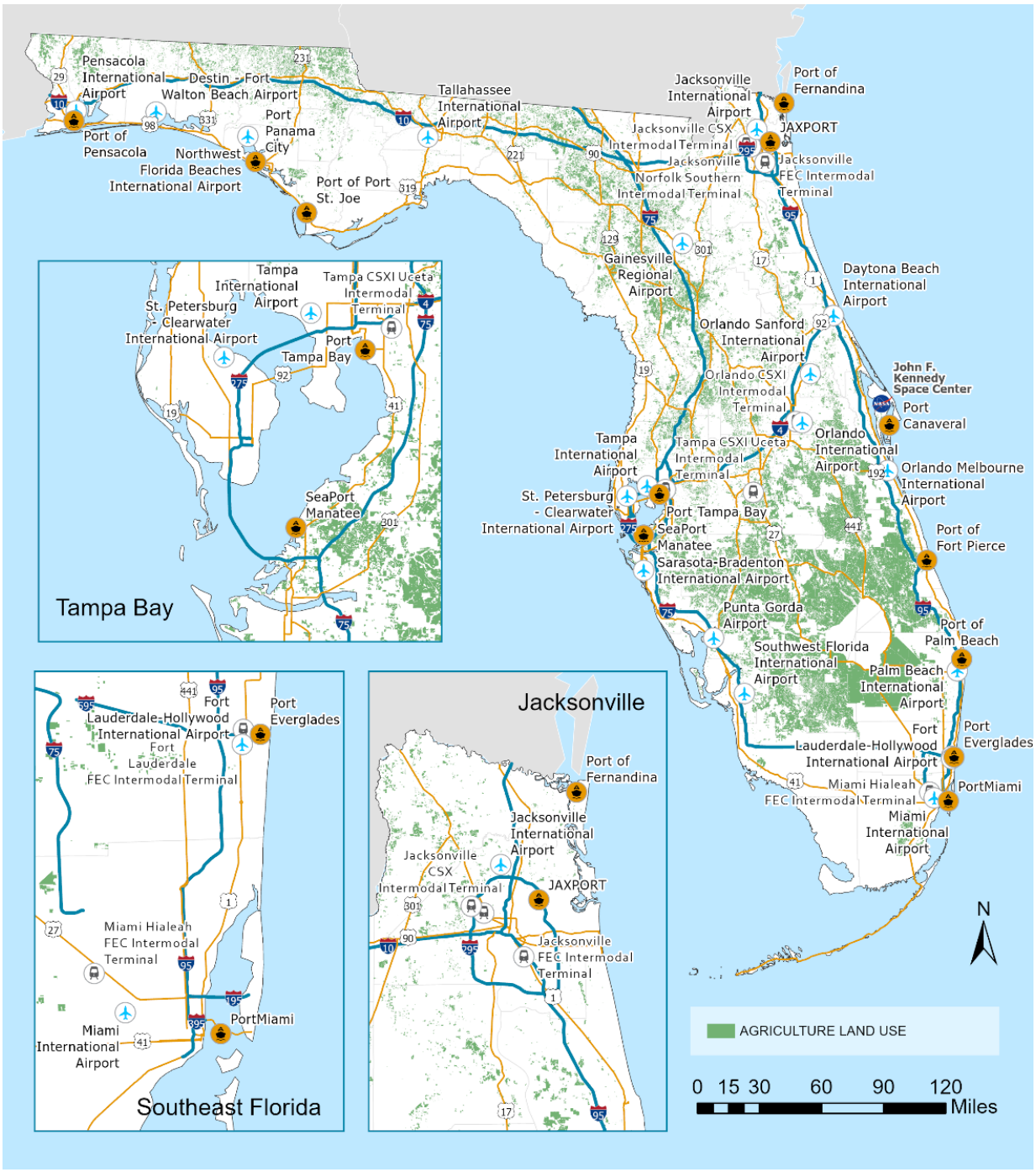
4. Agriculture Supply Chain

4.1 Supply Chain Economic Contribution

Agriculture is a key sector for the Florida economy and resilience. This sector includes the following sub-sectors: crop production; animal production and aquaculture; forestry and logging; fishing, hunting, and trapping; and support activities for agriculture and forestry. Figure 30 shows how the agricultural sector covers 9.7 million acres, or 28 percent of Florida land area, encompassing 47,300 farms and ranches.[1]

[1] Florida Field Office- USDA's National Agricultural Statistics Service. 2023 Annual Statistical Bulletin. Florida Field Office- USDA's National Agricultural Statistics Service

FIGURE 1. FLORIDA AGRICULTURAL LAND USE IN 2023



Source: Statewide Land Use Land Cover, Florida Department of Environmental Protection Geospatial Open Data, 2023.

In 2022, the agriculture sector ranked 22nd in agricultural production in the country[2], however, several subsectors are leaders in national production. Crop production includes farms, orchards, nurseries, and greenhouses growing grains, oilseeds, fruits, vegetables, nuts, cotton, and hay. Livestock breeding focuses on raising animals for human consumption, typically on ranches and feed yards. Table 24 shows the agriculture, forestry, fishing, and hunting supply chain contribution to Florida's economy in 2022.

TABLE 1. CONTRIBUTION OF THE AGRICULTURE SUPPLY CHAIN TO THE FLORIDA ECONOMY IN 2022

Industry	Employment (jobs)	Wages (Millions of USD)	GSP (Millions of USD)
Crop production (NAICS 111)	46,537	$1,850	$4,543
Animal production and aquaculture (NAICS 112)	5,415	$239	$529
Forestry and logging (NAICS 113)	2,001	$110	$334
Fishing, hunting and trapping (NAICS 114)	506	$23	$84
Support activities for agriculture and forestry (NAICS 115)	13,434	$558	$2,241
Agriculture Supply Chain	**67,893**	**$2,780**	**$7,731**
Florida All Industries	**9,358,228**	**$596,788**	**$1,439,065**
Agriculture Supply Chain Share (%)	**0.73%**	**0.47%**	**0.54%**

Source: Cambridge Systematics Analysis using data from BLS and BEA 2022. U.S. Bureau of Labor Statistics. Quarterly Census of Employment and Wages (QCEW). NAICS-Based Data Files https://www.bls.gov/cew/downloadable-data-files.htm

Notes: Employment (jobs) corresponds to the annual average of monthly employment levels. Employment wages is the sum of the four quarterly total wage levels in a year. GSP is the total market value of the final goods and services produced by the industry within Florida.

Table 25 lists Florida's top five major crops with the value of production in 2022 totaling more than $4 billion.

TABLE 2. FLORIDA'S TOP FIVE CROPS BASED ON VALUE OF PRODUCTION IN 2022

Major Crops	Production Value (Millions of USD)	Production Value (Share of Top Five Industries)
Vegetables and melon farming	$1,930	47%
Nursery and floriculture production	$1,160	28%
Citrus	$851	21%
Noncitrus fruit and tree nut farming	$147	4%
Total Top Four	**$4,088**	**100%**
Sugarcane farming	Not Available*	Not Available*

Source: Cambridge Systematics Analysis using data from 2023 Annual Statistical Bulletin. Florida Field Office- USDA's National Agricultural Statistics Service.

[2] USDA, Farm finance indicators, state ranking, 2022. Economic Research Service.

Notes: Production Value represents the dollar value of the commodities produced on the farm in a given year, excluding commodities used on the farm. *The USDA's National Agricultural Statistics Service ranks sugarcane as one of the top crops in Florida but their statistics do not include the production value for this crop.

Table 26 lists the top five crop production companies in Florida based on employment. These five companies accounted for 13 percent of the total employment in the crop production sector in the State in 2020.

TABLE 3. FLORIDA'S TOP CROP PRODUCTION COMPANIES BASED ON EMPLOYMENT IN 2020

Top Crop Production Companies	Total Jobs	Share (%)
United States Sugar Corporation	1,400	4%
Chiquita Brands International Inc.	1,000	3%
Tkm-Bengard Farms LLC	800	2%
Aris Horticulture Inc.	730	2%
Agro Power Development Inc.	650	2%
Top Five Crop Production Companies	**4,580**	**13%**
All Crop Production Companies	**34,739**	**100%**

Source: Cambridge Systematics Analysis using data from D&B Database (Jan 2020).

Citrus Production

Florida stands out as a top US producer, not only of oranges but also of other citrus crops, solidifying its position as a citrus-growing state. Table 27 shows Florida's leading counties for citrus production employment as well as the top employers in each county.

TABLE 4. FLORIDA'S TOP CITRUS PRODUCER COUNTIES BASED ON EMPLOYMENT IN 2020

County	Employment (Jobs)	Top Employers
Polk	487	• Holly Hill Fruit Products Co Inc, • Oakley Groves Inc.
Highlands	347	• Encino Harvesting LLC • C. Elton Crews Incorporated
DeSoto	342	• Orange-Co of Florida Inc. • VCH Management Inc
Indian River	250	• Edsall Groves Inc. • Peace River Citrus Products Inc.
Sarasota	219	• Valencia Harvesting Inc

Source: Cambridge Systematics Analysis using data from D&B Database (Jan 2020).

Conclusion

Several key findings are associated with the agriculture supply chain's contribution to the Florida economy in 2022.

Overall Strength of Florida's Agriculture Sector

- The Florida agriculture, forestry, fishing and hunting supply chain contributed $7.7 billion to Florida's Gross State Product (GSP), representing .5% of the state GSP.
- The agriculture sector contributed to .7% of job creation statewide and supported over 68,000 direct jobs.

Agriculture and Crop Production Impacts

- The top five crops in Florida's agriculture sector had a combined value of production totaling over $4 billion in 2022, signifying a robust subsector within the state's economy.
- Vegetables and melons contributed $1.9 billion or 47% of the total value, nursery and floriculture production added $1.2 billion or 28% to the production value and citrus fruits added $0.8 billion or 21% of the total production value.

Citrus Production

- Citrus groves, including oranges, grapefruit, and specialty fruits like temple oranges, tangerines, and tangelos, are predominantly found in the southern two-thirds of Florida, with Polk County being the top producer.

4.2 Supply Chain Market Analysis

Commodity Flow Analysis

Table 28 shows the 2022 overall agriculture supply chain flows in tonnage and value. Table 31 shows the 2022 crop production subsector supply chain flows in tonnage and value.

TABLE 5. FLORIDA'S AGRICULTURE SUPPLY CHAIN - DIRECTIONAL COMMODITY FLOWS BY TONNAGE AND VALUE IN 2022

Directional	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Intra	46,338	72%	31,201	49%
Inbound	10,256	16%	20,471	32%
Outbound	8,017	12%	11,692	18%
Total	64,611	100%	63,363	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey,

and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

TABLE 6. FLORIDA'S AGRICULTURE SUPPLY CHAIN - CROP PRODUCTION DIRECTIONAL FLOWS BY TONNAGE AND VALUE IN 2022

Directional	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Intra	39,150	81%	$13,070	57%
Inbound	5,816	12%	$5,258	23%
Outbound	3,649	8%	$4,556	20%
Total	48,615	100%	$22,883	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include cereal grains (SCTG 2) and agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3)

Table 30 presents Florida imports and exports and total trade for the agriculture supply chain, including the breakdown between domestic and international trade.

TABLE 7. FLORIDA'S AGRICULTURE SUPPLY CHAIN – DOMESTIC AND INTERNATIONAL TRADE IN 2022

Trade	Commodity Tonnage (Thousand Tons)	Commodity Tonnage (%)	Commodity Value (Million USD)	Commodity Value (%)
Domestic Exports	7,069	34%	$9,868	26%
International Exports	1,134	6%	$1,962	5%
Total Exports (E)	8,203	40%	$11,831	31%
Domestic Imports	7,718	38%	$16,822	44%
International Imports	4,660	22%	$9,794	25%
Total Imports (I)	12,378	60%	$26,616	69%
Total Trade = (E) + (I)	20,581	100%	$38,447	100%

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity flows include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Top Domestic Trading Partners

Table 31 shows Florida's top 10 domestic trading partners by tonnage for the agriculture supply chain.

TABLE 8. FLORIDA'S AGRICULTURE SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY TONNAGE IN 2022

State	Domestic Exports (Thousand Tons)	State	Domestic Imports (Thousand Tons)
Georgia	2,135	Illinois	1,204
Alabama	1,386	Georgia	1,033
New York	906	Alabama	788
Pennsylvania	448	Indiana	731
Texas	244	North Carolina	365
North Carolina	219	Tennessee	282
South Carolina	191	Washington	280
Kentucky	164	Ohio	274
Ohio	147	California	252
Tennessee	128	Texas	226
Top 10 (Tonnage)	5,968	*Top 10 (Tonnage)*	*5,435*
Top 10 (Percentage)	84%	*Top 10 (Percentage)*	*70%*
Total	7,069	Total	7,718

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity trade flows include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Table 32 shows Florida's top 10 domestic trading partners by value for the agriculture supply chain.

TABLE 9. FLORIDA'S AGRICULTURE SUPPLY CHAIN - TOP 10 DOMESTIC TRADING PARTNERS BY VALUE IN 2022

State	Domestic Exports (Million USD)	State	Domestic Imports (Million USD)
Alabama	$1,445	Georgia	$2,230
Georgia	$1,411	Illinois	$1,314
Texas	$967	California	$1,216
California	$518	Texas	$1,006
New York	$476	Nebraska	$938
Pennsylvania	$464	North Carolina	$926
North Carolina	$376	Alabama	$881
Louisiana	$326	Kansas	$858
Illinois	$269	Ohio	$833
Indiana	$260	Tennessee	$705
Top 10 (USD)	*$6,512*	*Top 10 (USD)*	*$10,907*
Top 10 (Percentage)	*66%*	*Top 10 (Percentage)*	*65%*
Total	**$9,972**	Total	**$16,822**

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity trade flows include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Top Foreign Trading Partners

Table 33 shows Florida's top foreign trading partners for agricultural imports and exports in 2022 based on value (USD).[3]

[3] USA Trade Online is a comprehensive trade database from the U.S. Census Bureau that provides more granularity compared to FAF5 data. In addition, USA Trade Online data provides real trade data while FAF5 data is estimated from commodify flow survey data.

TABLE 10. FLORIDA'S AGRICULTURE SUPPLY CHAIN – FOREIGN TRADING PARTNERS BY VALUE IN 2022

Foreign Trading Partners	International Exports ($ Million USD)	Foreign Trading Partners	International Imports ($ Million USD)
Canada	$ 744	Chile	$2,415
Bahamas	$ 91	Colombia	$1,350
Dominican Republic	$ 59	Mexico	$1,079
China	$ 54	Ecuador	$1,022
Cayman Islands	$ 42	Guatemala	$1,022
Barbados	$ 27	Peru	$ 832
Colombia	$ 26	Costa Rica	$ 711
Mexico	$ 25	India	$350
Aruba	$ 25	Canada	$337
Trinidad and Tobago	$ 24	Honduras	$303
Top 10 (Million USD)	*$1,118*	*Top 10 (Million USD)*	*$9,421*
Top 10 (Percentage)	*77%*	*Top 10 (Percentage)*	*79%*
Total	**$1,457**	Total	**$11,937**

Source: USA Trade Online data, 2022

Note: Commodity trade values (USD) include all sub-sectors within the agricultural sector (NAICS 11) which includes crop production (NAICS 111), animal production (NAICS 112), forestry and logging (NAICS 113), fishing, hunting, and trapping (NAICS 114), and support activities for agriculture and forestry (NAICS 115).

Table 34 shows Florida's top foreign trading partners for crop production imports and exports in 2022 based on value (USD).

TABLE 11. FLORIDA'S CROP PRODUCTION – FOREIGN TRADING PARTNERS BY VALUE IN 2022

Foreign Trading Partners	Total Exports Value (Million USD)	Foreign Trading Partners	Total Exports Value (Million USD)
Canada	$573	Colombia	$1,237

Foreign Trading Partners	Total Exports Value (Million USD)	Foreign Trading Partners	Total Exports Value (Million USD)
Bahamas	$59	Guatemala	$1,010
Dominican Republic	$41	Mexico	$958
Cayman Islands	$34	Peru	$675
Trinidad and Tobago	$18	Costa Rica	$662
Colombia	$18	Ecuador	$579
Barbados	$16	Canada	$252
Mexico	$14	Honduras	$203
Aruba	$13	Chile	$183
Turks and Caicos Islands	$13	Dominican Republic	$111
Top 10 (Million USD)	*$799*	***Top 10 (Million USD)***	***$5,869***
Top 10 (Percentage)	*86%*	***Top 10 (Percentage)***	***91%***
Total	**$924**	**Total**	**$6,457**

Source: USA Trade Online data, 2022

Note: Commodity trade values (USD) include crop production (NAICS 111) only.

The July 2020 United States-Mexico-Canada Agreement (USMCA), which replaced the North American Free Trade Agreement (NAFTA), is a key factor in the high volume of agricultural imports and exports between Florida, Mexico, and Canada. The USMCA retains the zero-tariff benefits established under NAFTA and continues the tradition of fostering agricultural sector growth in all three member countries.

Conclusion

Several key findings are associated with the supply chain market analysis of the agriculture supply chain.

Directional Flows in the Agriculture Supply Chain (2022):

- Intra-state flows dominated the 2022 overall agriculture supply chain, with 46 million tons (72%) staying within Florida.
- Inbound and outbound flows comprised 10 million tons (16%) and 8 million tons (12%) respectively, indicating a strong internal demand.
- A significant 81% of crop tonnage was both produced and consumed within the state.

Trade Imbalance within Florida's Agriculture Supply Chain:

- Florida's agriculture supply chain is import-heavy, with imports accounting for 60% of total trade by tonnage and 69% by value (USD).
- A significant majority of imports, 62% by tonnage and 63% by value (USD), are sourced from domestic partners.
- Exports comprise 40% of total trade by tonnage and 31% by value (USD), with domestic trade making up 34% of the export tonnage and 26% of the export value (USD).

Florida's Domestic Agriculture Trade:

- Florida agricultural exports to its top 10 domestic partners accounts for 84 percent in tonnage, and 66 in value of total domestic exports.
- Agricultural imports from Florida's top 10 domestic partners accounts for 70 percent in tonnage, and 65% in value of total domestic imports.
- Primary export partners in value and tonnage include Alabama, Georgia, Texas, and New York.

Florida's International Agricultural Trade

- In 2022, Florida's agricultural imports were eight times the value of its exports, with imports totaling $11,937 million and exports at $1,457 million.
- The state's top 10 foreign trading partners for imports represent 79% of the total import value, with Chile, Colombia, and Mexico being the primary importers.
- Conversely, Florida's top 10 foreign trading partners for exports make up 77% of the total export value, with Canada, Bahamas, and Dominican Republic being the leading export countries.

Reliance on Domestic Imports:

- The value (USD) of crop production imports is seven times higher than the value of crop production exports which indicates reliance on crop imports from other countries to meet its own demand.

4.3 Supply Chain Dominant Freight Modes

The agriculture supply chain requires a wide range of transportation modes and logistics services to move raw agricultural commodities (e.g., grains, vegetables, fruits, livestock) and agricultural inputs (e.g., fertilizer, pesticides). Some products, such as grain, are bulky, low-value commodities that are mostly transported at lower unit costs by water and rail modes. Other commodities, such as fresh fruits, vegetables, meat, and seafood are highly perishable and often high-value goods relying on refrigerated trucks and railcars, refrigerated cargo ships, or air cargo to protect the integrity and freshness of the shipments.

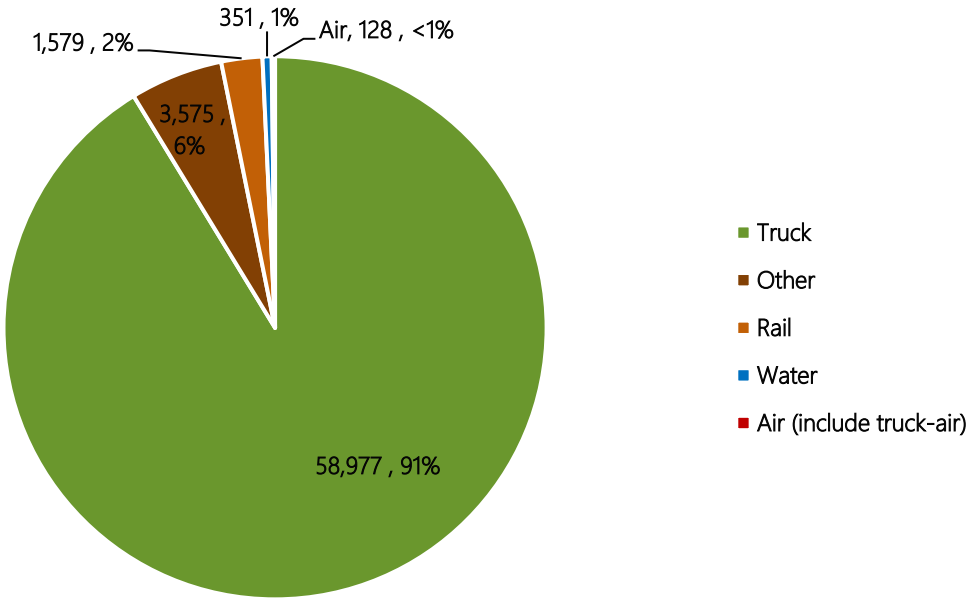
The mix of transportation modes demanded by the agriculture supply chain has experienced significant changes in the last 40 years. A study conducted by the U.S. Department of Agriculture (USDA) found that on a tonnage basis trucks are moving a larger share of grain than railroads and barges.[4] Prior to 1985, rail was consistently the dominant mode for grain shipments in the U.S. By the early 1990's, trucks surpassed rail as the predominant mode for grain transportation. An analysis of the commodity flows indicates that the movement of grain in

[4] Chang, Kuo-Liang "Matt", Peter Caffarelli, Jesse Gastelle, and Adam Sparger. Transportation of U.S. Grains: A Modal Share Analysis, October 2021. U.S. Department of Agriculture, Agricultural Marketing Service.

Florida has followed a similar trend.[5] Another significant change is the movement of high-value agricultural products and time-sensitive shipments by truck today compared to decades ago because of the improved roadway network and faster and more flexible operating characteristics offered by trucks.[6]

Figure 22 and Figure 23 show the mode split by tonnage and value for the combined intra, inbound, and outbound flows for the agriculture supply chain in Florida.

FIGURE 2. FLORIDA'S AGRICULTURE SUPPLY CHAIN - TONNAGE (THOUSAND TONS) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS, 2022

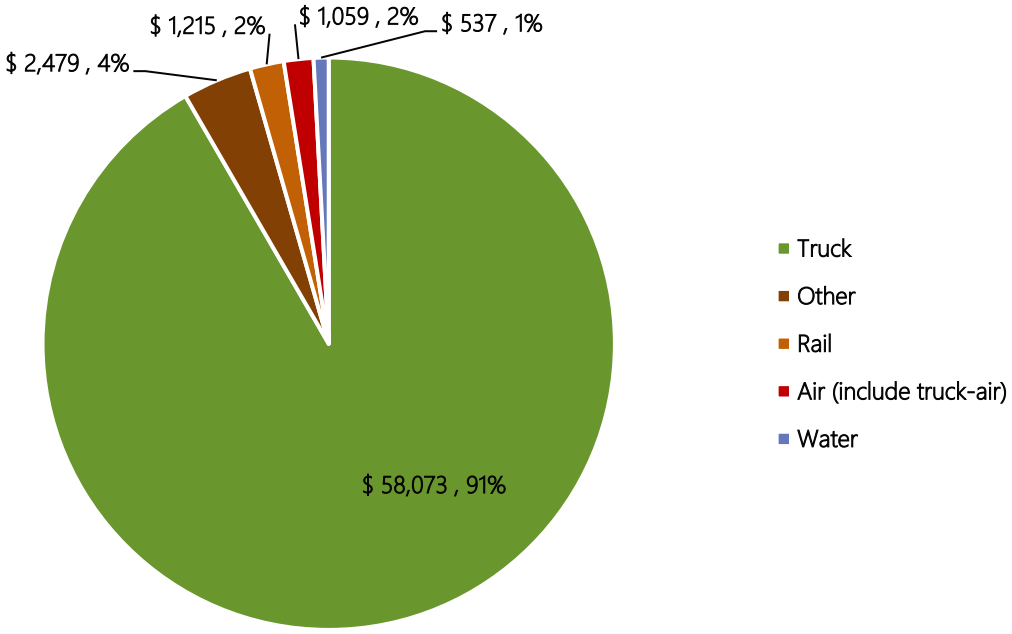


Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity tonnage include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

[5] Federal Highway Administration (FHWA). Freight Analysis Framework version 5.6 (FAF 5.6).
[6] Chip Millard. FHWA-HRT-19-004. Vol. 83 No. 2. Public Roads – Summer 2019.

FIGURE 3. FLORIDA'S AGRICULTURE SUPPLY CHAIN - VALUE (MILLION USD) AND PERCENTAGE BY MODE FOR COMBINED MOVEMENTS, 2022



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity values (USD) include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Table 35 and Table 36 show the mode split by tonnage and direction for each freight mode for the agriculture supply chain.

TABLE 12. FLORIDA'S AGRICULTURE SUPPLY CHAIN - MODE SPLIT BY TONNAGE IN 2022

	Tonnage (Percentage)			
Mode	Intra	Inbound	Outbound	Total by Mode
Truck	45,933 (99%)	7,139 (70%)	5,905 (74%)	58,977
Other	177 (<1%)	1,663 (16%)	1,736 (22%)	3,575
Rail	128 (<1%)	1,143 (11%)	308 (4%)	1,579
Water	100 (<1%)	248 (2%)	3 (<1%)	351
Air (include truck-air)	<1 (<1%)	62 (1%)	66 (<1%)	128

	Tonnage (Percentage)			
Mode	Intra	Inbound	Outbound	Total by Mode
Total by Direction	46,338 (100%)	10,256 (100%)	8,017 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity tonnage include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

TABLE 13. FLORIDA'S AGRICULTURE SUPPLY CHAIN - MODE SPLIT BY VALUE IN 2022

	Value (Percentage)			
Mode	**Intra (million USD)**	**Inbound (Million USD)**	**Outbound (Million USD)**	**Total by Mode**
Truck	$30,489 (98%)	$17,480 (85%)	$10,104 (86%)	$58,073
Other	$280 (1%)	$1,244 (6%)	$955 (8%)	$2,479
Rail	$240 (1%)	$835 (4%)	$139 (1%)	$1,215
Water	$191 (1%)	$340 (2%)	$6 (<1%)	$537
Air (include truck-air)	<$1 (<1%)	$571 (3%)	$488 (4%)	$1,059
Total by Direction	$31,201 (100%)	$20,471 (100%)	$11,692 (100%)	-

Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.6 data for Florida,

Note: Commodity values (USD) include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Conclusion

Several key findings are associated with the dominant freight mode analysis of the agriculture material supply chain.

Mode Split in the Agriculture Supply Chain

- Truck transportation dominates, accounting for 91% of total tonnage and total value (in USD).
- Rail handles a smaller share, representing 2% of tonnage and value.
- Water transport, while important, contributes only 1% to both tonnage and value in the construction materials supply chain.

Intra Flows (Within Florida):

- Trucks are pivotal in Florida's agriculture, handling 99% of intra-state tonnage and 98% of value.

Inbound Flows (Originating Beyond Florida):

- For commodities entering Florida, trucks carry **70%** of tonnage and **85%** of value,
- Other (flyaway aircraft shipments, shipments with undetermined mode, multiple mode shipments and parcel delivery services or couriers) accounted for **16%** of agricultural inbound shipments in tonnage and **6%** of value shipments.
- Rail moves **11%** of tonnage and **4%** of value.

Outbound Flows (Originating Within Florida):

- Trucks also dominate outbound logistics, transporting **74%** of tonnage and **86%** of value.
- Rail and air provide supplementary roles.

4.4 Initial Qualitative Assessment of Areas of Risk

Critical Florida Transportation Network Components

Florida's SIS ensures that agriculture products from international, national, and statewide markets arrive to local grocery stores, favorite restaurants, and household kitchen tables. As identified in the 2023 Florida Rail System Plan, the agriculture, forestry, fishing, and hunting industrial sector is forecasted to grow by volume in 2045, supporting an estimated 2,467,484 in total rail tonnage.[7] Agriculture movements by rail are mainly supported by CSX Transportation (Class 1), Norfolk Southern (Class 1) and the Florida East Coast (Class 2) railroad lines that transverse across and beyond the state. CSX, the largest railroad in Florida, provides connection through Jacksonville, Orlando, Lakeland, Tampa, Okeechobee, West Palm Beach, Fort Lauderdale and Miami, including two transload facilities specifically designated for agriculture commodities in Orlando and Jacksonville.[8] In the northeastern portion of the state, Norfolk Southern Railway delivers agricultural products to several markets along the east coast between New York City and Jacksonville. Additionally, the Florida East Coast railway, ships refrigerated food products and farm products (including corn and hay) along the eastern portion of the state from Jacksonville to Miami.[9]

A review of Florida's 2024 Seaport Profiles indicates the most critical SIS seaports for the agricultural supply chain include Port Everglades, Jaxport, Seaport Manatee, Port of Palm Beach, and PortMiami. For seaport imports, fruits and vegetables are ranked as the first top commodity imported into the PortMiami and second top commodity imported into Seaport Manatee. Additionally, edible fruit and nuts are ranked as the third top commodity imported into Port Everglades and fourth top commodity imported into the Port of Palm Beach. For

[7] Florida Department of Transportation (FDOT) Rail System Plan (2023): https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/rail/plans/rail/rail-system-plan-2023/rsp-october-version/fdot_rsp_ch-2_ada-(oct).pdf?sfvrsn=d4351c09_2

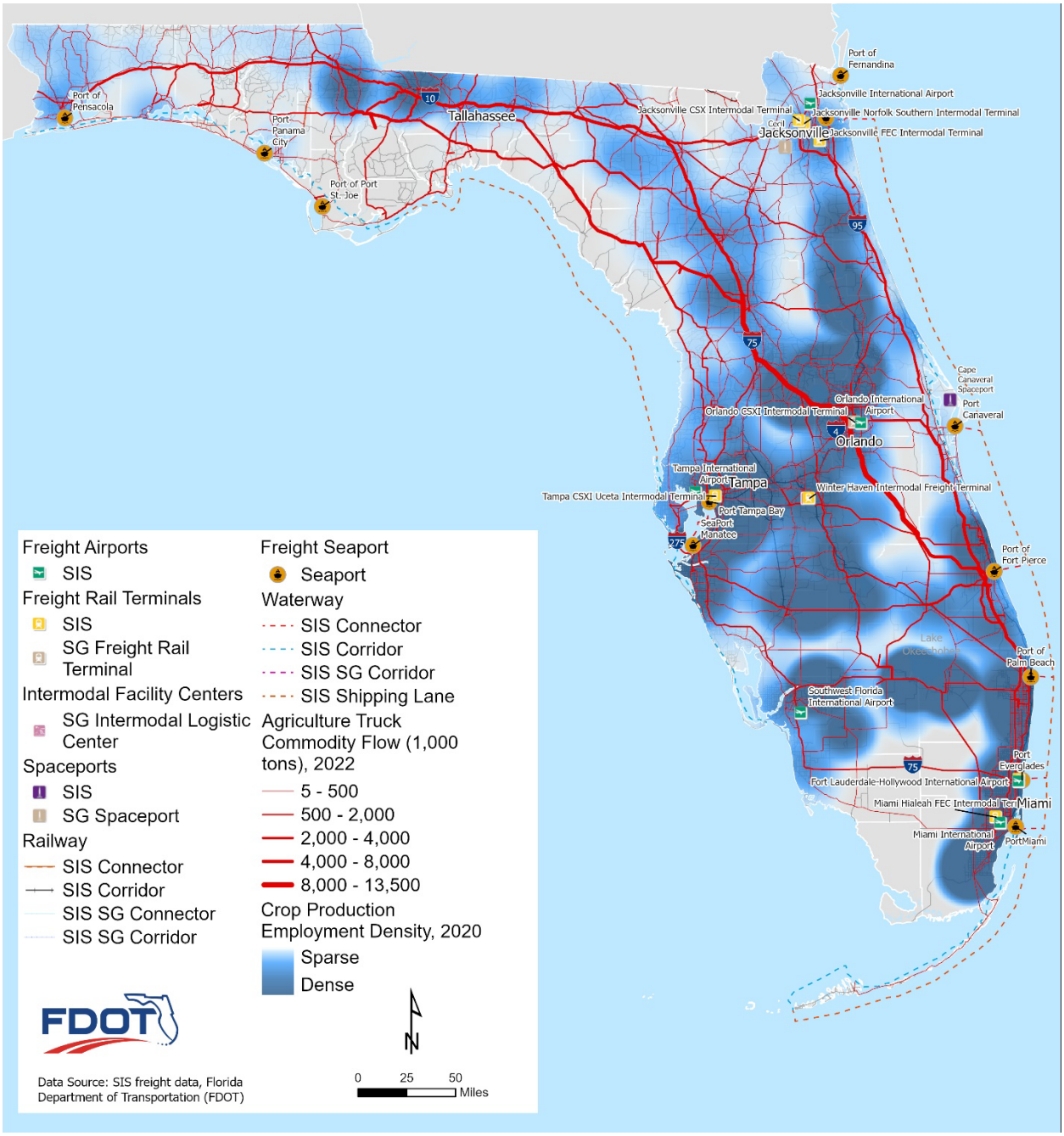
[8] Florida Department of Transportation (FDOT) Rail System Plan (2023): https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/rail/plans/rail/rail-system-plan-2023/rsp-october-version/fdot_rsp_ch-2_ada-(oct).pdf?sfvrsn=d4351c09_2

[9] Florida East Coast Railway: https://fecrwy.com/what-we-ship/

exports, meat is ranked as the fifth top commodity leaving both Port Everglades and the Port of Palm Beach, whereas the export of other food products is ranked as the fourth top commodity at JaxPort.

Figure 22 illustrates truck commodity flows and employment density (or clusters) for the agriculture supply chain. These clusters include a range of crop production establishments, from small companies with one employee to large corporations with 1,400 employees. Among the 12,574-agriculture supply chain business establishments in Florida, close to 99 percent have between 1 and 50 employees. The rest have between 51 and 500 employees and only 2 businesses have over 500 employees. Crop production businesses in Florida are concentrated not only in the main metro areas of Miami, Tampa, Orlando, and Jacksonville but also in rural areas. Truck flows on I-75 highlight the pivotal role of this interstate in connecting these clusters across state. I-10 serves as a critical corridor connecting the clusters in Northwest Florida, while US 98 serves as a major connector between North Florida and Central Florida. I-95 emerges as a significant interstate facilitating substantial movements on the east coast.

FIGURE 4. FLORIDA'S AGRICULTURE SUPPLY CHAIN - COMMODITY FLOWS BY TRUCK AND EMPLOYMENT DENSITY



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

Disruptor Events and Areas of Risk

The recent COVID-19 pandemic exposed several vulnerabilities and sources of resilience within the agriculture supply chain. For example, pandemic-related illness resulted in significant workforce strains, and the shift to "eat at home" consumption forced the supply chain to pivot from foodservice and restaurant sales toward grocery delivery.[10] These conditions lead to empty grocery store shelves and farmers terminating crops due to lack of available markets, storage facilities, and transportation backlogs.[11] According to the USDA, long-term vulnerabilities include risks posed by:

- aging transportation infrastructure,
- impacts of changing climate conditions on farm products and resources,
- cybersecurity threats,
- animal disease outbreaks, and
- labor supply challenges facing farms and food industries.[12]

Florida's climate-related hazards disrupt agriculture harvesting, distribution, and the labor force. For example, increasing high temperatures can impact the health and safety of labor workers and cause a rise in water temperatures, which may contribute to the frequency of disease outbreaks.[13] Additionally, severe storms and heavy rainfall have the potential to destroy agricultural lands, halting the production of commodities, and cause delays or disruptions to distribution movements across Florida's transportation network.

Potential Impacts to Florida's SIS

The following section assesses how and where disruption events including storm surge, floodplain, wildfire, sinkhole, sea level rise, strong wind, lightning, and extreme heat impact SIS infrastructure supporting the agriculture supply chain. A description of these disruptions, particularly regarding loss of transportation network and supply chain reliability, is provided below.

Storm Surge

The agricultural supply chain relies on local roadways, major highways, and interstates to connect agriculture land uses to distribution routes. Depending on storm severity, storm surge poses a significant risk to local roadways and farmlands near Okeechobee, as well as in the Northwest, Northeast, Southwest, and Southeast regions.

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[10] U.S Department of Agriculture, USDA Agri-Food Supply Chain Assessment: https://www.ams.usda.gov/sites/default/files/media/USDAAgriFoodSupplyChainReport.pdf

[11] Journal of Agriculture, Food Systems and Community Development: https://www.foodsystemsjournal.org/index.php/fsj/article/view/938/911

[12] U.S Department of Agriculture, USDA Agri-Food Supply Chain Assessment: https://www.ams.usda.gov/sites/default/files/media/USDAAgriFoodSupplyChainReport.pdf

[13] U.S Department of Agriculture, USDA Agri-Food Supply Chain Assessment: https://www.ams.usda.gov/sites/default/files/media/USDAAgriFoodSupplyChainReport.pdf

As shown in Figure 25, the Northwest and Southwest regions may experience the highest levels of storm surge in the state, impacting U.S 98. While these areas contain a minimal crop production employment density, U.S 98 remains a critical connector between the Northwest region and the rest of the state, providing access to I-10, I-4 near Orlando, I-75 and I-275 in Tampa. The highest density of crop production employment is located in the Bradenton area, just south of Tampa, so storm surge has the ability to impact major crop production facilities, fam land, connection to I-75, and operations to the nearby Seaport Manatee. Other areas with dense crop production employment density potentially impacted by storm surge include Southeast Florida near Fort Lauderdale and Northwest Florida in Jacksonville. In the Fort Lauderdale area, I-95 is susceptible to coastal storm surge, which could delay agriculture shipments at JaxPort. In Jacksonville, I-95 could also be impacted heading north towards Georgia, as well as I-295 around the city.

Floodplain

The 100- and 500-year floodplains have the potential to affect the vast majority of the state, including areas of crop production manufacturing employment density, such as Bradenton, Southeast Florida, and Northeast Florida. Similar to storm surge, flooding events may cause road closures, traffic delays, and potential cargo delays. Major critical interstates serving the agriculture supply chain, including I-10, I-75, and I-95 are located within the 100-year floodplain. Additionally, as shown in Figure 26, the 500-year floodplain has the potential to significantly impact Southeast Florida, causing disruptions to agriculture shipments at the Port of Palm Beach and PortMiami.

Wildfire

As shown in Figure 27, the risk of wildfires is constant across Florida. However, a wildfire event may pose the greatest risk to both the Central and South Florida regions, because these areas have a high density of agricultural lands and crop production manufacturing employment. In particular, I-75 providing connection to SeaPort Manatee and I-10 may be impacted by wildfires, causing degradation of roadways and bridges, resulting in traffic delays or congestion.

Sinkhole

As shown in Figure 28, sinkholes are most prevalent and cause the greatest risk to roadways in and around the Northwest region. Sinkholes have the potential to cause disruptions along I-10 I-4, I-75, U.S 19, U.S 98, and U.S 90 and may impact crop production employment areas near Tallahassee, Gainesville, and the northern portion of Tampa. While only a crop production employment density clusters may be impacted by sinkholes, a sinkhole event impacts a major interstate could cause delays to agriculture freight shipments.

Sea Level Rise

The risk of sea level rise does not affect many high-volume agriculture trucking roadways. However, it has the potential to impact several seaports transportation agriculture commodities. In particular, sea level rise may impact agricultural import and export operations at JaxPort, Port Everglades, SeaPort Manatee, Port of Palm Beach and Port Miami, and will have less of an impact on intrastate movements. The depth and risk of sea level rise on the agriculture supply chain is evident in Figure 29.

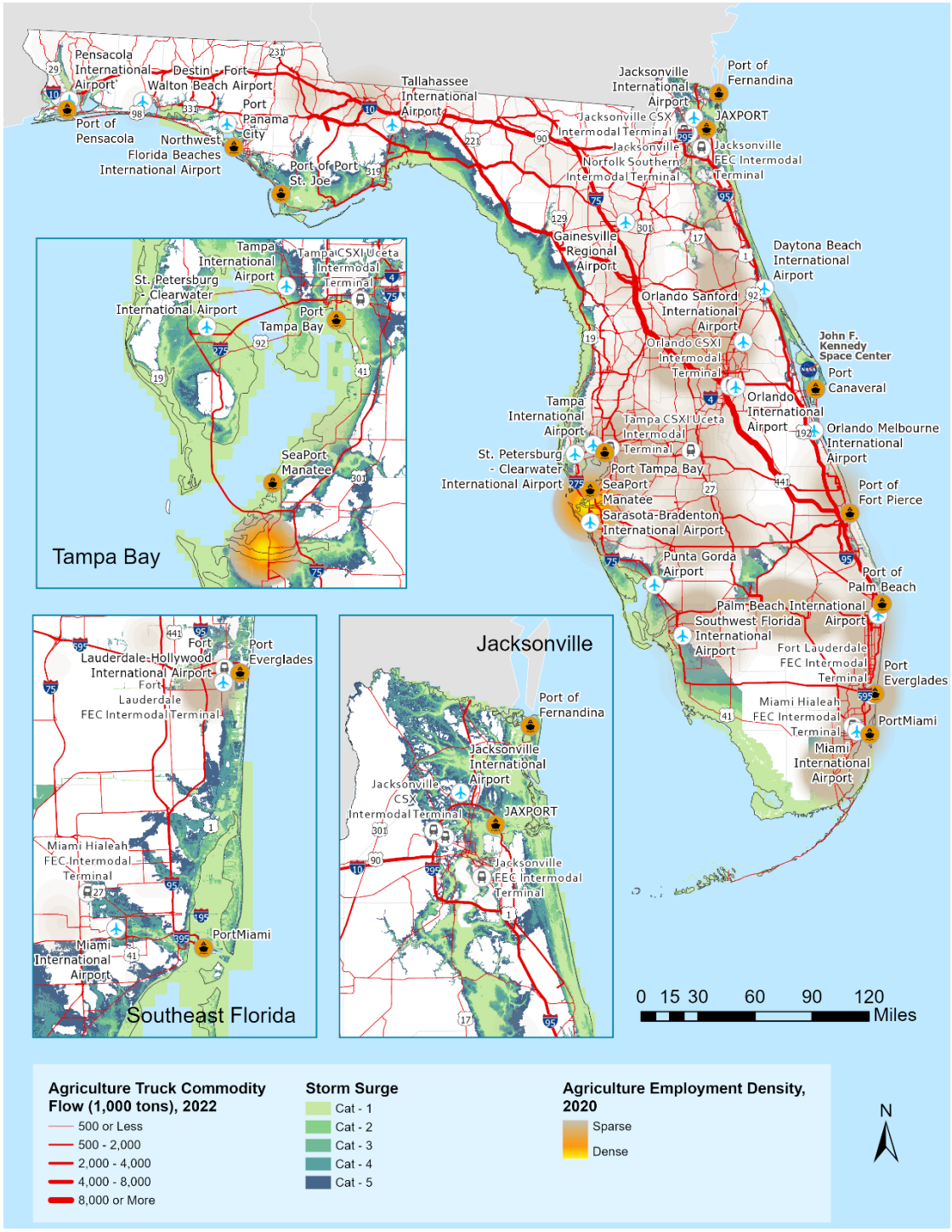
Severe Thunderstorm and Strong Winds

Severe thunderstorms can disrupt the agriculture supply chain, bringing the potential for lightning and strong winds. As shown in Figure 30, the risk of lightning is consistent and high across the state and high-volume agriculture manufacturing truck routes. These routes include the major interstates and highways as well as rail lines and seaports. The lightning risk is very high in dense agriculture manufacturing employment areas of Bradenton, Fort Lauderdale, inland Southeast Florida around the Miami Hialeah FEC Intermodal Terminal, Lake Okeechobee, and Jacksonville. As shown in Figure 31, the risk for strong winds is concentrated in the Northwest and down the center of the state. This area includes the high-volume agriculture manufacturing truck routes of I-4, I-10, I-75, I-95, U.S. 19 and U.S. 98. Strong wind has the potential to disrupt truck travel along these routes and delay the supply chain. Strong wind risk is relatively low in dense agriculture manufacturing employment areas.

Extreme Heat

Extreme heat can potentially degrade roadways and cause the asphalt to deteriorate or buckle. This effect on roads can disrupt the agriculture supply chain if the roads are under construction or closed. Figure 32 shows the highest risk areas for extreme heat effects are Central and Southwest Florida. This area includes Port Tampa Bay and Seaport Manatee. The high-volume agricultural trucking interstates of I-4, I-10, and I-75 cross areas with 41-50 days with temperature of 95 degrees. If these major interstates experience construction or delays due to extreme heat effects, the agriculture supply chain could experience delays throughout the state. Additionally, as temperatures rise, agriculture production may be delayed due to unsafe human labor conditions or increased risk of livestock disease outbreaks.

FIGURE 5. FLORIDA'S AGRICULTURE SUPPLY CHAIN – STORM SURGE HAZARD



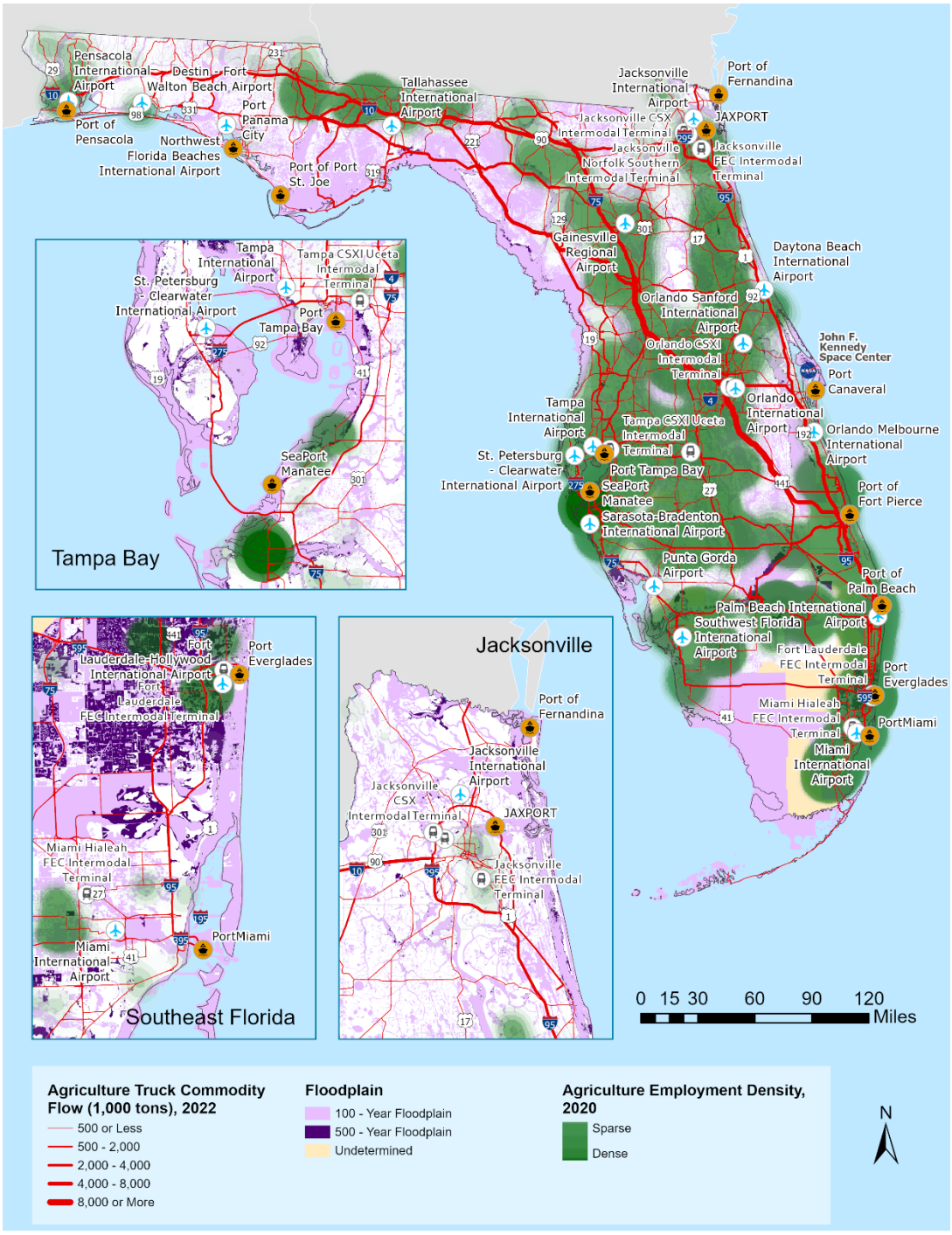
Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed,

eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

FIGURE 6. FLORIDA'S AGRICULTURE SUPPLY CHAIN – FLOODPLAIN HAZARD

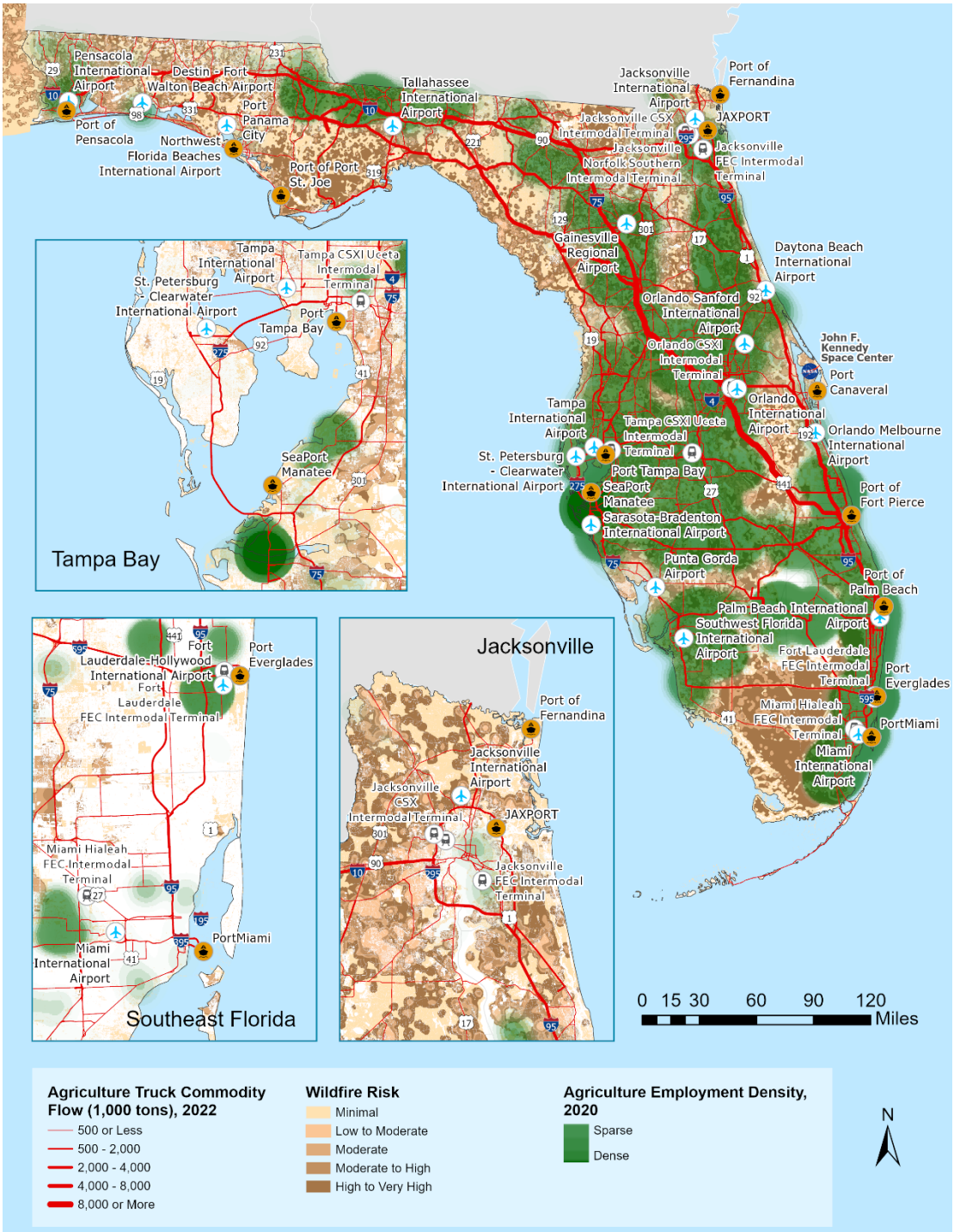


Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

FIGURE 7. FLORIDA'S AGRICULTURE SUPPLY CHAIN – WILDFIRE HAZARD



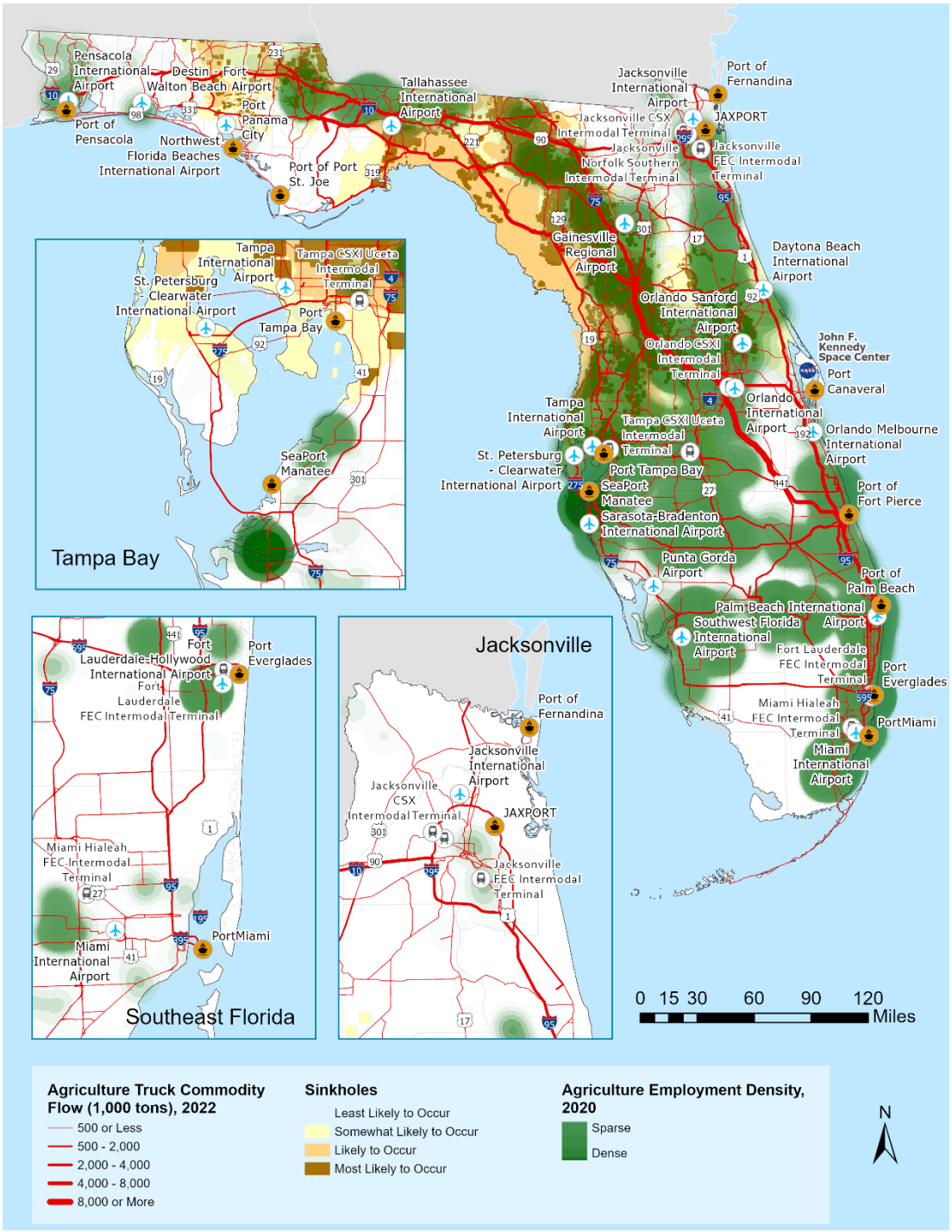
Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed,

eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

FIGURE 8. FLORIDA'S AGRICULTURE SUPPLY CHAIN – SINKHOLE HAZARD

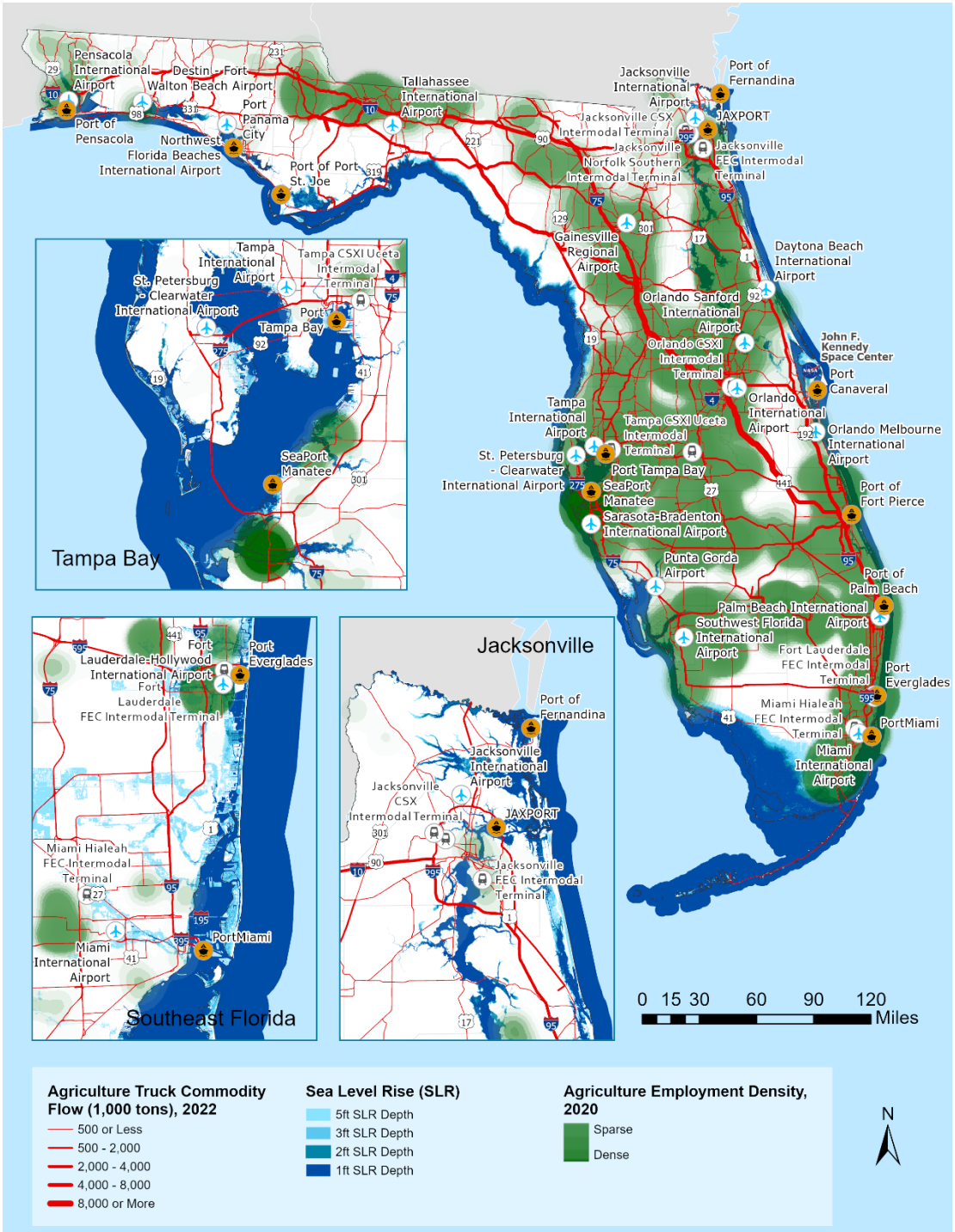


Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

FIGURE 9. FLORIDA'S AGRICULTURE SUPPLY CHAIN – SEA LEVEL RISE HAZARD



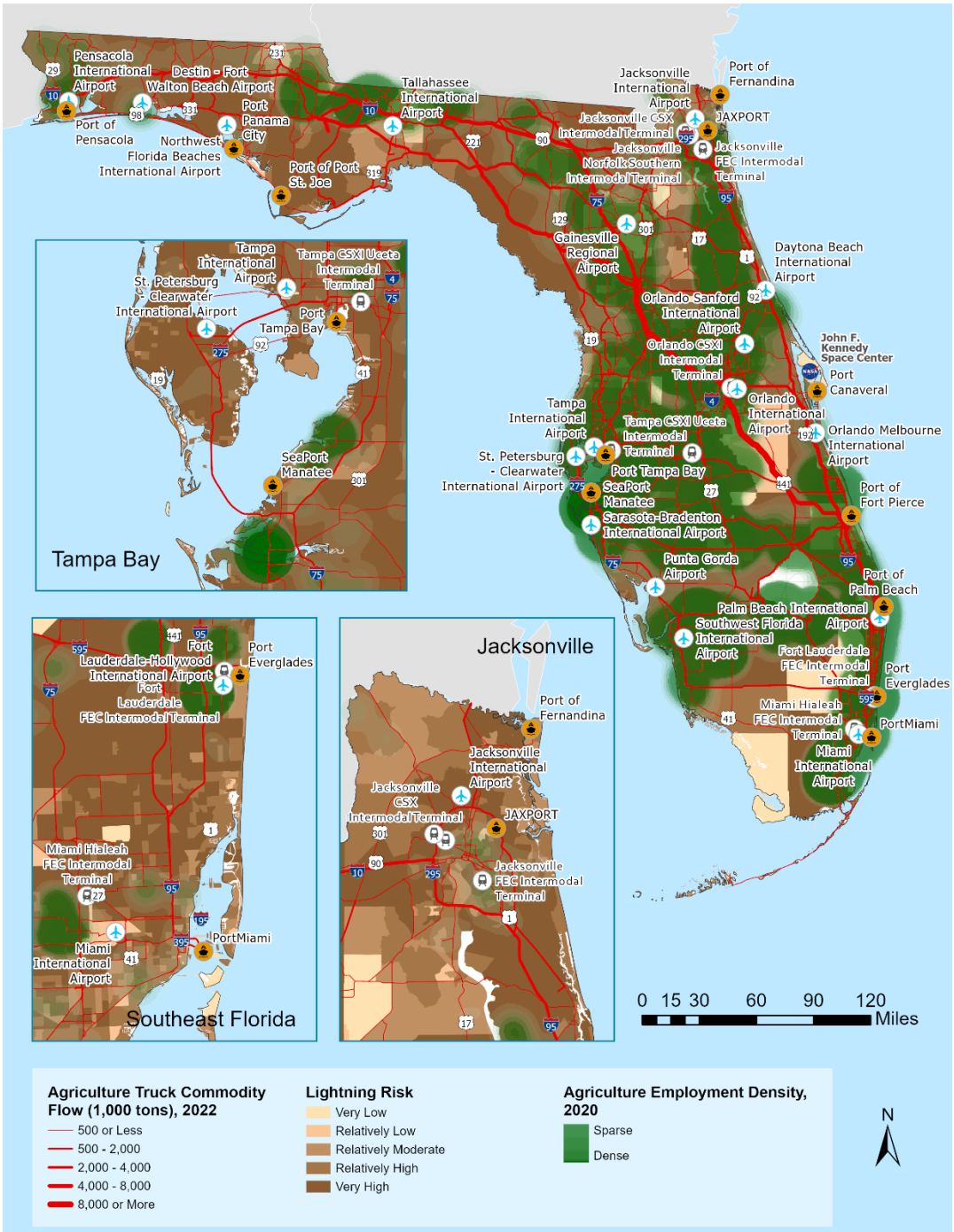
Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed,

eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

FIGURE 10. FLORIDA'S AGRICULTURE SUPPLY CHAIN – LIGHTNING HAZARD

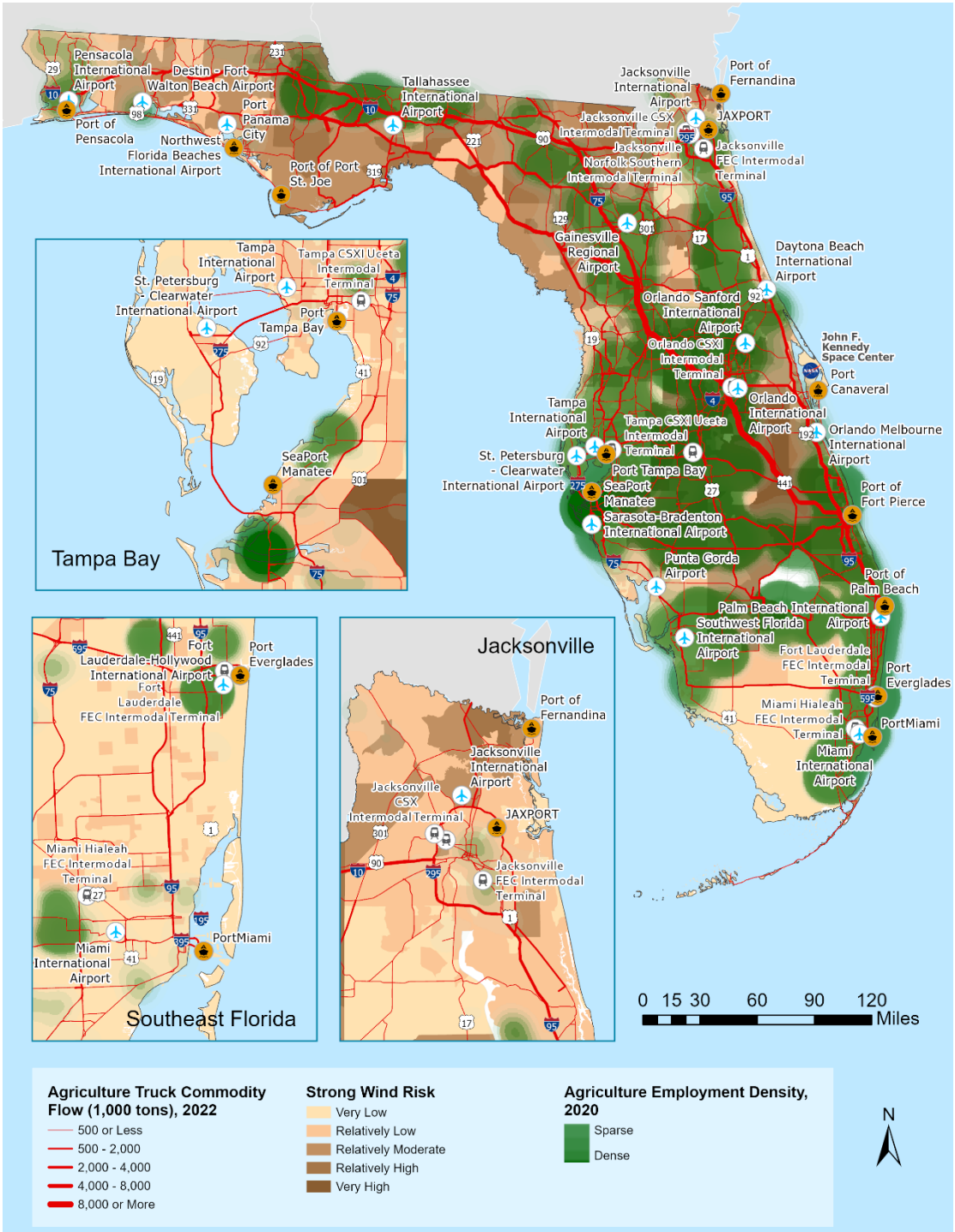


Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

FIGURE 11. FLORIDA'S AGRICULTURE SUPPLY CHAIN – STRONG WINDS HAZARD



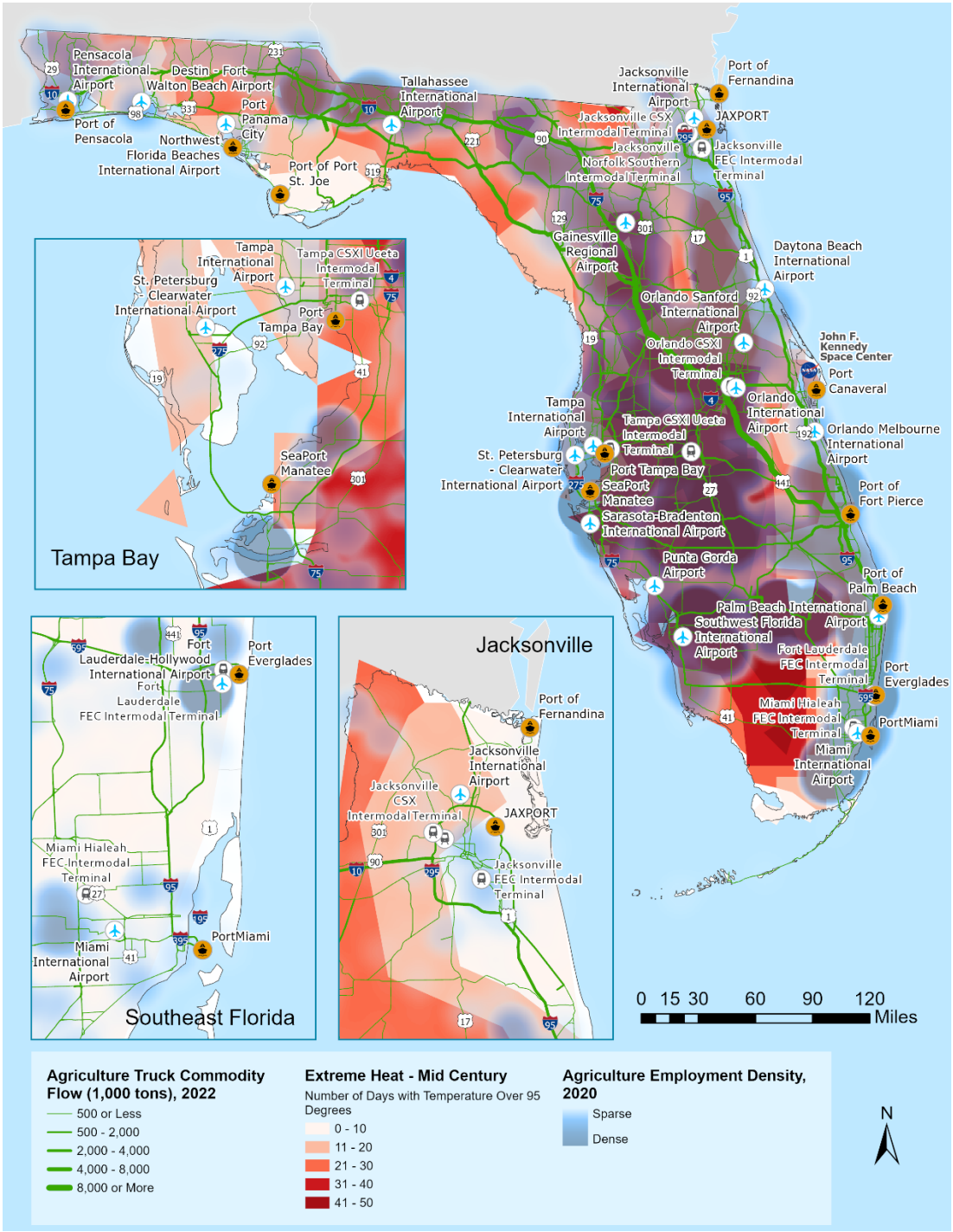
Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed,

eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

FIGURE 12. FLORIDA'S AGRICULTURE SUPPLY CHAIN – EXTREME HEAT HAZARD



Source: Cambridge Systematics Analysis of the Freight Analysis Framework 5.5.1 data and Dun & Bradstreet (D&B) database (January 2020) for Florida.

Note: Agriculture truck commodity tons include live animals/animal products (SCTG 1), cereal grains (SCTG 2), agricultural products (excludes animal feed, cereal grains, and forage products) (SCTG 3), animal feed, eggs, honey, and other products of animal origin (SCTG 4), and meat, poultry, fish, seafood, and their preparations (SCTG 5).

Employment density includes employment in crop production (NAICS 111).

4.5 Supply Chain Structure and Diagram

The supply chain structure analysis of the Florida agriculture supply chain focuses on citrus production which is a crop deeply engrained in Florida's identity and economy. Figure 42 offers a graphical illustration of the citrus supply chain with each node in the diagram representing a key stage/facility in the citrus supply chain lifecycle. Color-coded arrows between each node represent the modal transport that moves the commodity from one conceptual node to another, with each color representing a different modal transport as shown in the legend. The diagram focuses on adequately capturing major commodity flows and modal usage. The diagram is meant to capture general flows and will not fully capture the nuances of the supply chain within a specific industry.

The production phase begins with the procurement of inputs for citrus farming including fertilizers, pesticides, seedlings, plant protection materials, irrigation equipment, and soil conditioners acquired local nurseries and regional and national agrochemical companies. Inputs for citrus crops are predominantly transported by truck, other (multiple modes/parcel, etc.), and rail.

The next phase occurs after harvesting when citrus produce is transported, mainly by truck, from the citrus groves to packing houses or processing facilities. At these facilities, citrus fruits are washed, brushed, and treated in a way that leave them ready for the next stage. Ninety three percent of Florida citrus production goes into juice processing and only seven percent is sold as fresh fruit.[14] Florida citrus processors also produced byproducts of citrus pulp, meal, molasses, and the essential oil d-Limonene.[15]

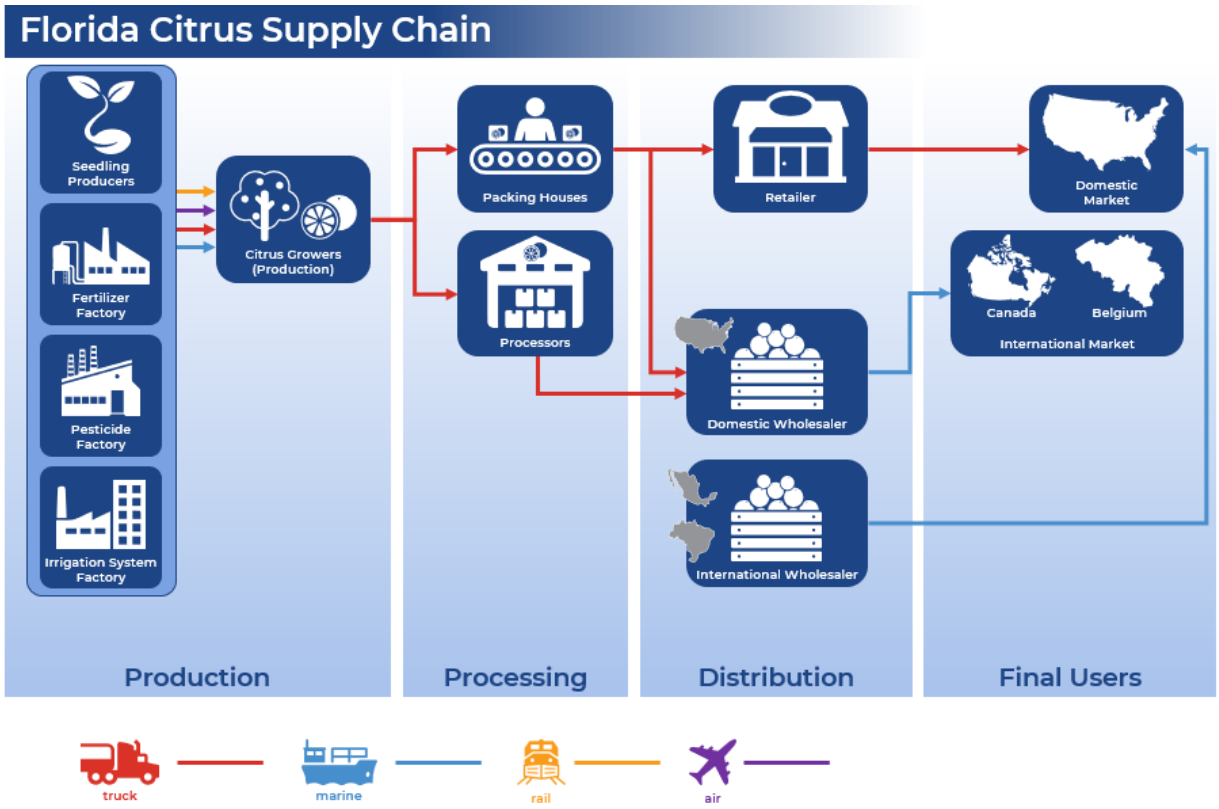
Processed citrus production enters the distribution phase. Cargo trucks transport the product to retailers and domestic wholesalers. The transportation process must ensure that the oranges remain fresh and unspoiled during transit. Temperature-controlled containers are usually used to prevent spoilage. Retailers distribute oranges to other domestic retail outlets, supermarkets, grocery stores, and farmers markets, while domestic wholesalers predominantly export their share. Florida citrus main exports include Canada, Belgium and Japan.[16] Even though Florida is a top citrus producer, nation and worldwide, the State imports some citrus juice and pulp primarily from Mexico and Brazil.[39]

The final stage of the supply chain occurs once the product reaches the domestic and international markets. Citrus products are transported by truck if the market is domestic and by cargo ships if the market is

[14] FLORIDA'S Agriculture and Food System Fast Facts
[15] Cruz, J., Court, C.D., & Ferreira, J.P. (2023, February). *2020-2021 Economic Contributions of the Florida Citrus Industry*. UF/IFAS Economic Impact Analysis Program, Food and Resource Economics Department, University of Florida.
[16] Florida Citrus Statistics 2022-2023. Florida Department of Agriculture and Consumer Services (FDACS), USDA.

international. Domestic markets get both, citrus juice and fresh fruit, while international markets mainly get citrus juice from Florida.

FIGURE 13. FLORIDA CITRUS SUPPLY CHAIN DIAGRAM



Source: Cambridge Systematics.