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FLOOD DAMAGE ASSESSMENT OF AGRICULTURAL CROPS IN SOUTH DADE COUNTY AS A RESULT OF TROPICAL STORM GORDON

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Abstract. **Agriculture in Dade County has an annual economic impact of over $834 million. The agricultural area in Dade County is bounded by urban development in the north, Biscayne National Park to the east, Everglades National Park to the west, and Biscayne and Florida Bays to the south and southeast. The elevations range from sea level to about 25 ft above sea level. Flooding in the agricultural area during Tropical Storm Gordon (November 12-17, 1994) caused damage to agricultural crops. Crop damage data from the Farm Services Agency (FSA) were compiled by crop and acreage. The FSA reports after Tropical Storm Gordon suggest at least 1,300 acres, 8,612 acres, and 2,087 acres of fruit, vegetable, and ornamental plantings, respectively, were flooded as a result of Tropical Storm Gordon. This represented about 16.7% (11,999 acres) of the total agricultural acreage in the county during 1994 (71,955 acres). Twenty-one and 40 different fruit and vegetable crops were affected, respectively. Sixteen different categories of ornamental nursery crops were also damaged. Damage to plants included defoliation, stem and limb dieback, plant death, crop loss, and delay in harvest and cultural practices. Damage was estimated at $89.7 million. The general location of damage due to flooding during Tropical Storm Gordon is reported.**

The agricultural industry of south Dade County, Florida is situated in a unique geographic, climatic, ecological and sociological area. The agricultural area is located at the southern end of the Florida peninsula at 25°35' longitude north and 80°30' west latitude. The climate is marine subtropical with a yearly mean of 73°F, 65 inches of annual rainfall, mean annual RH of 62%, and average constant winds of 5-10 mph (Butson and Prine, 1968; Getz, 1979, Barrick and Black, 1980; Qualyle et al., 1995). The growing season is approximately 320 days, with the main vegetable season from August to May and fruits and ornamental crops (field and containerized) grown year-round.

The agricultural area is bounded by urban development to the north, Biscayne National Park to the east, Everglades National Park to the west, and Florida Bay to the south. The entire area is underlain by the Biscayne Aquifer. The indigenous fauna and flora, surficial aquifer, varied and extensive wetlands, marine coastal waters (bays and ocean), along with the marine climate, are highly sensitive to human activities. The warm climate, high humidity, and ample rainfall allow the production of tropical and subtropical crops year-round and traditional vegetable crops 8 out of 12 months of the year.

Agriculture in Dade County is worth over $521 million annually in gross sales and has an economic impact of over $834 million to Dade County (Degner et al., 1997). Most of the agricultural products produced in Dade County are exported out of the county throughout the U.S. and to foreign markets. Over 23,000 people in the county are employed in the agricultural and related industries (Moseley, 1990).

Tropical Storm Gordon occurred from 12 to 17 November 1994 in the south Dade County area. During the storm, the amount of rainfall reported in the area ranged from 6.89 to 9.48 inches (Anonymous, 1994; Krome, 1994). Flood damage varied by commodity and included crop loss and delay in planting and/or harvest of vegetable crops including potato, malanga, beans (bush green, bush wax, pole), squash, boniato (sweet potato), and tomato. Vegetatively propagated plant-

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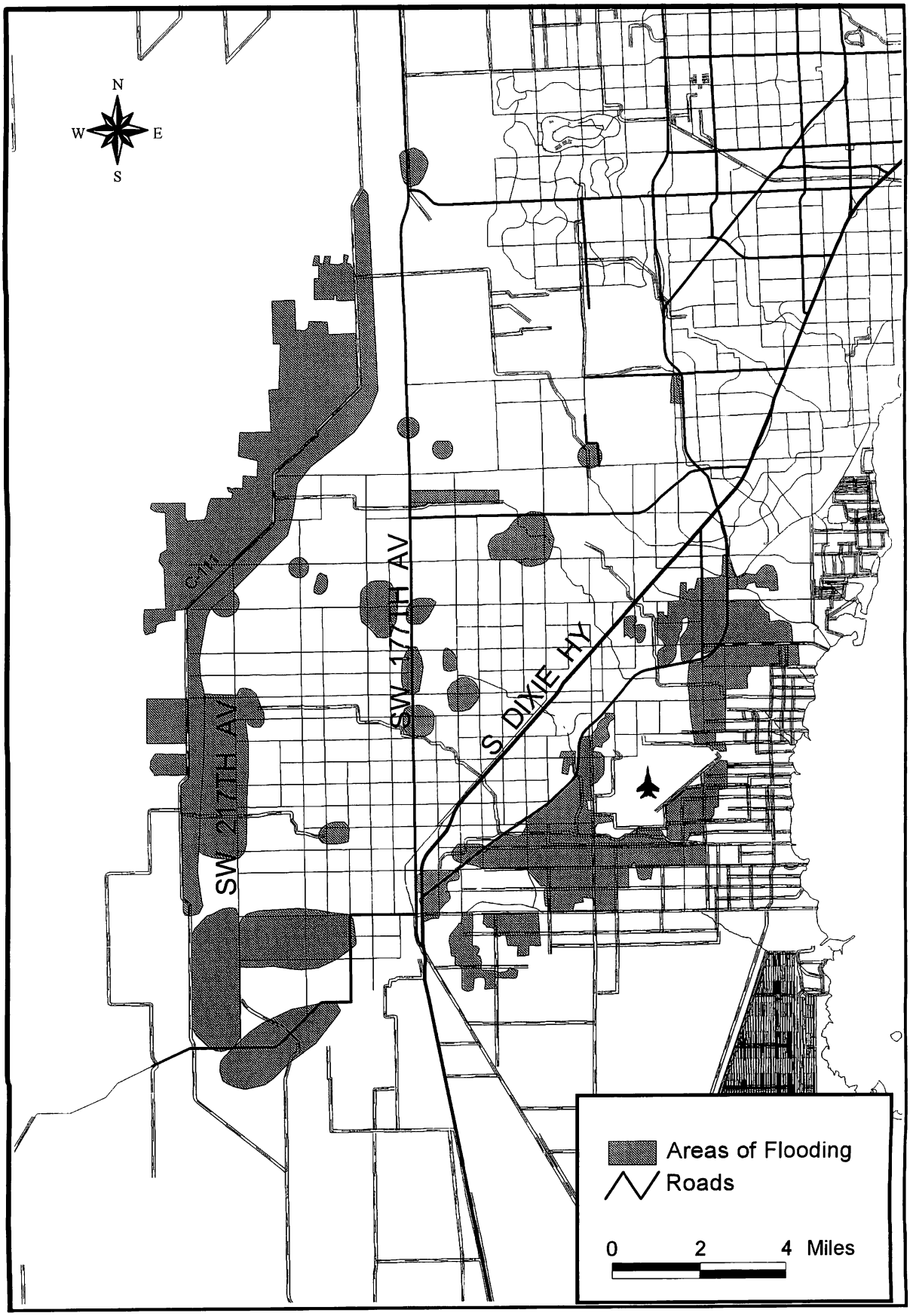

Figure 1. Map of the general areas of south Dade County flooded during Tropical Storm Gordon (map courtesy Brian Sheahan, TREC, Homestead). Differentiation among fruit, vegetable, and ornamental fields could not be shown, nor exact locations of flooding because of the diversity of operations in the area and map scale.

ing stock for potato, malanga, and boniato were destroyed by flooding. Flooding of field nurseries was observed to result in stem and limb dieback, defoliation, tree death and a delay in cultural practices (e.g., weed control, fertilization) and harvest. Flooding of fruit orchards resulted in stem and limb dieback, defoliation, crop loss, tree death and a delay in cultural practices and harvest. Crops observed to be flooded included avocado, banana, lime, mango, carambola, papaya, lychee, longan and mamey sapote. In addition to the direct damage caused by flooding, excessively wet soil and flooding increased weed growth and delayed their control due to the inability to get into the fields to spray and mow. Flooding also increased root disease problems.

The purpose of this report was to compile and document crop damage and loss due to the excessively wet and flooded soil conditions in south Dade County as a result of Tropical Storm Gordon.

Material and Methods

Information pertaining to flood damage claims from Tropical Storm Gordon was obtained from the local USDA Farm Services Agency (FSA) (Homestead, Fla.). Symptoms of flood damage have been described by producers, professional horticulturists, and plant physiologists during and after flooding events in the south Dade agricultural area and were used as the criteria upon which flood damage assessments were made. The FSA acreage and crop data were compiled into three main categories, fruits, vegetables, and ornamental crops. The FSA reports only include producers whose gross income was less than $2 million annually (Karen Eskelin, FSA, personal communication). Thus some crops produced on large acreages were not included. The areas of flooding due to Tropical Storm Gordon were summarized in Fig. 1.

Results and Discussion

Damage to subtropical and tropical fruit crops, vegetable crops, and ornamental crops after Tropical Storm Gordon was moderate to severe (Tables 1, 2, and 3). More than 21 tropical fruit crops were adversely affected by flooding and/or excessive soil moisture content as a result of Tropical Storm Gordon (Table 1). The FSA reported that 1,300 acres of tropical fruit crops were damaged. However, some acreage was counted more than once in the FSA reports due to intercropping or multiple cropping of different tree species within the same orchard. On the other hand, the lack of mango and avocado damage claims and reports and the low acreage of lime reported in the claims to FSA indicated that damage to orchards of large-scale commercial producers was not counted. This was because of FSA regulations which exclude large scale producers. Thus damage due to flooding may have been substantially higher than reported here.

Forty different vegetable crops suffered flood damage due to Tropical Storm Gordon (Table 2). Overall, damage was reported for 8,612 acres, however, damage to some acreage was reported more than once due to planting of multiple crops. However, major producers did not file claims because of eligibility rules of the FSA; so the aggregate acreage estimated to be damaged may have been low.

Flood damage was reported for 16 categories or species of nursery crops after Tropical Storm Gordon (Table 3). Overall damage was reported for 2,087 acres but some acreage was reported more than once because of multiple crops in the same nursery. However, major producers did not file claims; therefore acreage figures reported here may be low.

Estimates of the acreage figures from the Dade County Extension Service for the three commodity groups during 1994 (tropical fruits, 13,116 acres; vegetable crops, 46,912 acres; ornamental crops, 11,927 acres) indicate that at least 9.9%, 18.4%, and 17.5% of the acreages of fruits, vegetables, and ornamentals, respectively, were adversely affected by flooding during 1994. These percentages may be low because

Table 1. Acreage summary of flood damage to tropical fruit crops reported after Tropical Storm Gordon.

Crop	Acres reported damaged
Annona[z]	23.0
Sugar apple	22.5
Atemoya	10.0
Banana flower	4.0
Banana	119.1
Barbados cherry	31.7
Coconut	127.6
Grapefruit	87.0
Guava	38.6
June or hog plum	24.6
Jujube	0.03
Lime	62.0
Longan	11.0
Lychee	33.3
Mamoncillo	1.5
Mamey sapote	133.6
Orange	25.0
Papaya	288.5
Plantain	252.8
Pummelo	5.0
Total	1,300.79

[z]Annona is a generic name for sugar apple or atemoya.

Table 2. Acreage summary of flood damage to vegetable crops reported after Tropical Storm Gordon.

Crop	Acres reported damaged	Crops	Acres reported damaged
Basil	49.13	Marjoram	0.3
Black bean	5.0	Bitter melon	26.3
Cranberry bean	70.0	Mint	8.3
Green snap bean	1,770.5	Okra	326.2
KY bean	119.5	Oregano	0.3
Long bean	8.5	Southern peas	26.0
Winged bean	20.5	Rosemary	0.6
Yellow/wax bean	587.5	Pumpkin	5.0
Boniato/sweet potato	1,146.0	Pepper	85.9
Chives	7.0	Pigeon pea	4.1
Cilantro/coriander	22.0	Potato	2,181.0
Sweet corn	65.0	Tarragon	0.1
Cucumbers	3.0	Thyme	0.4
Eggplant	23.7	Sugar cane	207.0
Lemon balm	5.2	Zucchini squash	253.0
Lemongrass	21.4	Yellow crookneck or straightneck squash	873.0
Jalapeno pepper	17.5	Tomato	144.0
Lettuce	2.0	Asian vegetables	13.0
Horseradish tree/moringa	2.0	Yucca/cassava	31.8
Malanga/tanier	479.5	Jute mallow/corchorus leaves	1.0
		Total	8,612.13

Table 3. Acreage summary of flood damage to nursery crops reported after Tropical Storm Gordon.

Crop	Acres reported damaged
Air layered plants	82.0
Bougainvillea	47.0
Cactus	1.0
Ferns	23.4
Flowering plants	69.0
Foliage plants	256.9
Ground cover plants	75.5
Hibiscus	23.9
Jasmine vine	6.9
Liners	49.9
Palms	596.4
Shrubs	262.6
Woody trees	579.1
Vines	13.5
Total	2,087.1

large-scale agricultural operations were not taken into account.

Estimates of economic damage to the agricultural commodities and support industries (e.g., chemical and irrigation companies) were not available. However, taking into account the percentage of total agricultural acreage adversely affected by Tropical Storm Gordon (16.7%; 11,999 acres), the total agricultural acreage reported in 1994 (71,955 acres), and the 1990 annual gross sales estimate of Dade County agriculture of $538 million (Moseley, 1990), a monetary loss was estimated to be about $89.7 million.

Flooding in the agricultural area of south Dade County has not been systematically quantified. This was due in part, to the lack of ground water monitoring wells to determine the water table depth (Graham et al., 1997) and precise ground surface elevation data for the agricultural areas in south Dade County. South Dade County topography gently undulates with elevations ranging from sea level to 25 ft. Small differences in elevation can affect where water logging of plants occur when the water table is elevated.

Many large-scale producers have not reported flood damage because of the exclusive regulations in Federal agricultural disaster assistance programs. However, a general outline of the flooded areas reported after Tropical Storm Gordon may highlight those areas not reported elsewhere (Fig. 1).

Flooding of vegetable fields and landscape field nurseries was observed both east and west of U.S. Highway 1 especially in areas with marl soil. Many vegetable fields and field nursery areas east and southeast of Homestead Air Base were also flooded. Flooding has been observed in scattered fruit orchards growing on the rocky soil east and west of S.W. 177 Ave. Areas especially prone to flooding lie along eastern side of the C-111 and L-31N canals to S.W. 217 Ave. Flooding also occurred west of the L-31N canal in the Rocky Glades area.

Summary. Flood damage reports suggest at least 16.7% or 11,999 acres of the total agricultural acreage reported in 1994 (71,955 acres) was adversely affected by Tropical Storm Gordon. A monetary loss of $89.7 million was estimated.

There has been a lack of documentation concerning the extent of flood damage to commercially grown crops in the agricultural areas of Dade County. However, information provided in this report, though incomplete, does provide some information on the type and extent of damage and location of flood-prone areas in the south Dade agricultural area. This information should be useful in identifying areas for water monitoring that could be used in water management modeling on a local scale, and for managing water resources in the area.

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