POTENTIAL ROLE FOR TECHNOLOGY TO ENHANCE FLORIDA COMPETITION WITH IMPORTS OF CUCUMBERS IN 1980[1]

TEUNIS DEBOON and CHRIS O. ANDREW

IFAS Food and Resource Economics Department
Gainesville

Abstract. **Florida can not meet the total U.S. quantity demanded of fresh winter cucumbers primarily because of the declining ability to compete with imports. These imports have expanded from 32.9 percent of U.S. winter cucumber consumption in the 1956-60 period to 65 and 58%, respectively, for 1971 and 1972. Based upon current wage and cost of production trends, both in Mexico and Florida, it appears that Mexico's share of this market by 1980 could be 92% leaving 7% to other imports and only 1% to Florida.**

Two basic competition problems for Florida are increasing labor costs and frost conditions, which lower yields in February and March. Based upon a linear programming market allocation analysis, a frost-free cucumber variety could regain a maximum of 25% of the market for Florida. Similarly, if mechanized harvesting could be developed to such a point that the harvesting costs including wages could be maintained at present levels, then Mexico's share of the 1980-81 market would drop from 91 to 27% with Florida gaining the difference. While the total effects of a frost resistant variety and mechanized harvesting might not be achieved, the magnitude of the total effects indicate the need for research in these areas.

The Problem

Florida cucumber growers have experienced a declining share of the U.S. winter cucumber market. Florida's declining market share has been replaced by imports, primarily from Mexico (Table 1). Protection from imports would be beneficial to Florida growers; however, such protection would be counter to consumer interests and the expressed goals of government policies.

In 1960 the total U.S. consumption of fresh winter cucumbers was 2.9 million bushels. Of this total quantity, 1.4 million bushels were produced in the United States, mainly in Florida; 175,758 bushels came from Mexico and 1,159,596 bushels came from other countries (4). Ten years later, in 1970, total U.S. consumption had increased to 5.1 million bushels of which 2.2 million bushels were produced in the United States. About 90 percent of this quantity came from Florida. Mexican shipments, the primary source for imports, amounted to 2.5 million bushels and other imports totaled 426,263 bushels. From 1956-1960 to 1966-1970, cucumber imports as a percentage of total U.S. winter consumption rose from 33 percent to 49%, whereas Florida production as a percentage of U.S. production decreased slightly from 92% to 89%. The ratio of Florida production to imports has also declined sharply since the 1956-1960 period. The concern for the future of winter cucumber production in Florida may be expressed in the form of several questions. Should winter vegetable imports be restricted by trade barriers to protect Florida producers? How do wage costs and mechanization influence competitive relationships and prices for alternative vegetable producing areas? Is Mexico's comparative advantage so great, due to labor and climatic conditions, that Florida cannot compete successfully in the U.S. market even with substantial protection from imports?

Method of Analysis

Using linear programming techniques, two analytical models were developed to study the potential effects of various alternative tariff and technological changes on market shares, incomes to growers and laborers, and expenditures by consumers. Of particular interest in this paper are possible impacts of technological advances in production and harvesting winter cucumbers. Model I provides a partial equilibrium simulation of the 1970-71 U.S. cucumber production and distribution system including three production regions (West Mexico, Central America and Florida), and 12 U.S. consumption regions delineated on the basis of geographic location and existing trade patterns. The objective function of Model I is to minimize delivery cost at the wholesale level.

The 1970-71 cost data include land, labor and capital charges for Florida and Mexico (Table 2). For Central America, cost data were not available. Consequently, the f.o.b. prices at Pompano Beach,

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Table 1.--U.S. Market shares for producers and importers of spring cucumbers

	U.S. Consumption Million Tons	U.S. Production	Imports	Florida Production	Florida Production	Ratio of Florida Production to Imports
		(% of total U.S. consumption)			(% of U.S. production)	
1956-60[a]	1.4	67.1	32.9	61.7	92.0	1.88
1961-65[a]	1.7	65.9	34.1	59.8	90.8	1.77
1966-70[a]	2.1	51.9	49.1	46.2	89.0	0.96
1971	2.6	35.2	64.8	29.1	82.8	0.45
1972	2.7	42.1	57.9	35.4	84.0	0.61

[a]five year average.

Source: Based on calculations from (3,5,6)

Florida were used. The cost coefficients are the sum of the production costs per bushel in the production region increased by the transfer costs of one bushel from the production regions to the consumption region. The production costs are the total of growing, harvesting, and marketing costs. The latter two items include expenses for picking, grading and packing, containers, hauling and selling (1). Transfer costs for Florida are the transportation costs. In the case of imports from Mexico and Central America, transfer costs incorporate transportation costs, export duties, import tariffs and all other expenses incurred while moving the produce from the points of origin to points of destination. Transfer costs for Mexico include all costs to move the product from Culiacan to the market center of the consumption region.

A second model (Model II) is used to develop projections for the winter season 1980-1981. Model II is similar to Model I, except that it is used to estimate the share of the U.S. fresh cucumber market for each of the three production regions under various tariff levels and production and harvesting alternatives. This paper emphasizes the potential changes in competitive relationships under the assumption that production and harvesting costs can be reduced through technological advances in the form of frost resistant varieties as well as varieties and equipment that permit mechanical harvesting of cucumbers for the fresh market.

Technology in Florida and Mexico

The most important factors in the production of winter cucumbers in Mexico as well as Florida are climate, land, labor, and capital. The winter climate offers conditions more suitable to the production of winter vegetables in certain areas of Mexico than in any area in the United States. Moreover, all Mexican areas that are suited to production of vegetables also contain adequate soil and water resources for further expansion of production. A disadvantage for Florida is that, in some of the State's vegetable production areas, urbanization is competitive with vegetables for land use.

The technology used in the production of cucumbers has changed considerably over the past three decades. Varieties have been improved, application of fertilizer increased sharply, and other production methods, such as mulching, have been introduced or changed. In recent years Mexico has adopted many of the cucumber varieties and the production techniques that are used in the United States. As a result, Florida's technological advantages have diminished, or disappeared, over short periods of time.

Despite technological advances in production of winter vegetables in general, and cucumbers in particular, substantial amounts of hand labor are employed. Moreover, the winter vegetable pro-

Table 2.--Cost of producing and marketing fresh winter cucumbers in Mexico and Florida[a], 1970-1971 season

Item	Florida		Mexico	
	----------Dollars----------			
Producing	Per Acre	Per Bushel	Per Acre	Per Bushel
Labor	134.66		39.78	
Equipment	133.67		70.74	
Materials	104.13		86.51	
Cash overhead	12.49		54.62	
Noncash overhead	38.67		26.88	
Total	423.62	1.91	278.53	1.21
Marketing				
Harvesting		1.50		.41
Packing and selling		.56		.89
Mexican export to Nogales		--		2.26
Sales commission and promotion		.14		.44
Shipping and selling		.16		2.70
Total f.o.b.		2.36		4.00
Total producing and marketing		4.27		5.21

[a]Florida costs do not include that cost associated with the risk of frost.

Source: (1,3).

ducers must compete with the citrus industry and flower growers for a limited supply of labor, especially at harvest time. It is possible that mechanization of the citrus harvest in the near future and of tomatoes in the more distant future may help relieve the pressure on the demand for labor during critical periods. Thus, availability of labor as well as labor cost is a source of concern to cucumber growers in Florida.

The West Coast of Mexico, with the principal growing areas around Culiacan, has a plentiful supply of relatively inexpensive farm labor compared to Florida. In Mexico, in January, 1973, a laborer was paid $2.80 per day, while the wage rate in Florida was $2.31 per hour (3, 4). Mexico has a large rural labor force relative to its demand for labor, while Florida growers must pay higher wages and piece rates to attract farm workers from taking advantage of nonfarm employment opportunities.

Prices of other production inputs, such as fertilizers, tractors, packing house equipment, and so on are higher in Mexico than in Florida. Many of those inputs must be imported from the U.S.

Since cucumber varieties, at present, are not resistant to frost, they cannot be grown successfully as a mid-winter crop anywhere in the U.S., except in southern Florida. In southern Florida a cucumber crop is occasionally destroyed or heavily damaged by cold weather.

Because of climatic differences between Florida and Mexico, there are several differences in the fresh winter cucumber production system. Florida cucumber growers attempt to minimize the risk of frost by planting in such a way that the most active harvest periods are from November 1 to December 31 and from April 15 to May 31. In the Culiacan area in West Mexico planting is done from October through February. To account for some of the weather differential the production

Table 3.--Projection of production, by regions, Florida resource use, and production and distribution costs for fresh cucumbers in the 1980-1981 winter season

Simulation	Production[a]				Florida resources used		Cost per bushel
	Mexico	Central America	Florida	Florida % of total	Labor	Land	
	----------1,000 bushels----------			Percent	1,000 hours	Acres	Dollars
I. 1970-1971 simulation	2,079	201	893	28.1	993[c]	4,108	6.06
II. 1980-1981[b] labor cost unchanged	2,937	296	893	21.6	993[c]	4,108	6.13
III. 1980-1981[d] labor cost changed	3,786	296	44	1.1	49	202	8.11
IV. 1980-1981[e] mechanized harvest	1,140	0	2,985	72.4	1,282	13,432	5.78
V. 1980-1981[f] mechanized harvest and new varieties	100	0	4,025	97.6	1,729	18,112	4.62

[a]Total production is fixed at 4,125,588 bushels in each of the 1980-1981 simulations; for Mexico and Central America, production includes only that produced for export to the United States.

[b]Compared to 1970-1971, the only changes are in the regional demands.

[c]Labor constraints are effective

[d]Compared to 1970-1971, Florida labor is further restricted and wage rates relative to Mexico are higher, and there is no change in technology.

[e]Tariffs and wage rates were at the 1970-1971 levels.

[f]Includes assumption of frost resistant varieties in Florida.

Source: (2).

cost coefficients for Florida in this study were adjusted for the risk of frost.[2]

Frost Resistant Varieties and Mechanized Harvesting: Potential Benefits

The potential impact of technological advances, leading to a frost resistant cucumber variety and to mechanical harvesting, are evaluated by comparing the results of the five simulations as given in Table 3. The 1970-1971 simulation (Model I) is a reasonably accurate attempt to simulate actual conditions in 1970-1971. This basic model was used to develop the alternative 1980-1981 simulations under various labor and production situations. Tariffs for this analysis were held constant at the 1970-1971 level.

The 1970-1971 simulation attributes 28.1% of the U.S. cucumber market to Florida compared to the actual share of 29.1%. Simulation II predicts 1980-1981 based upon changes in regional demand but assumes that labor cost remain constant, e.g., that no change occurs relative to labor costs in Mexico. The amount of labor is also constrained on the basis of predictions derived from trends throughout the 1960's. Florida's share in this simulation drops to 21.6% primarily because of the limited labor supply. If labor is both limited and wage costs are allowed to follow the trends of the 1960's by increasing in the U.S. relative to Mexico, then Florida's share of the U.S. winter cucumber market drops to 1.1 percent in simulation II. This projection, thus, assumes that all trends continue throughout the 1970's as they were in the 1960's without major changes in production and harvest technology and in tariffs. The precise

[2]The frequency of frost during the last 30 years was ascertained. There were several freezes in either December, January, February, or March. The average yield per acre in the "frost" years was deducted from the average yield per acre in the "frost free' years. The results were divided by 15 for the month of December (two severe freezes in 30 years) and by 4.3 for January, February and March (seven light freezes in 30 years). The average yield per acre in December was reduced by 4.51 bushels (to 217.5 bushels) and for January, February, and March by 15.74 bushels (to 206.3 bushels). The adjusted cost coefficients were calculated as follows: for December $4.27 (222/217.5) = $4.35 per bushel; for January to March $4.27 (222/206.3) = $4.59 per bushel. No adjustment for weather was made in production costs for imports.

percentage share may be somewhat inaccurate due to errors in prediction or in fact the 1.1% might not become true precisely in 1980-1981. The direction and general magnitude of change, however, is probably accurate and sufficient to concern those who wish to maintain a viable fresh cucumber industry in Florida.

This analysis suggests that the major factors that limit Florida's competitive position are the risks of cold weather damage, and the restricted labor supply and higher wage rates in comparison with supply areas in Mexico and Central America. Simulations IV and V illustrate the potential impact of completely removing these two barriers. While this impact probably could not be completely realized, these simulations illustrate the maximum potential value of research and action programs directed toward the removal of these limiting conditions. If the labor constraint is lifted so all needed labor becomes available, and if total wage and machine costs through mechanized harvesting could be held equal in terms of proportionate relationships for the 1980-1981 and 1970-1971 wage bills for Florida relative to Mexico, then Florida would obtain 72.4% of the U.S. market. By also developing a frost resistant variety which would permit yields and production costs in the high risk frost months to be equal to those in other months, the share would advance another 25.2%. Thus, with mechanized harvest methods coupled with a better structured labor market and a frost resistant variety Florida's share could reach a maximum potential of 97.6%.

Resource requirements for each simulation along with per bushel production costs are also given in Table 3. The production costs do not account for future inflation rates so direct comparisons are possible.[3]

[3]The validity of such comparisons, however, assumes that changes in inflation rates will be proportional in the two countries. This assumption is unsafe yet without better information than is currently available, no other can be made.

Conclusion

The political potential for sharp increases in tariff rates seems unlikely in the face of current trends to free world trade and consumers' resistance to food price inflation. Measures other than tariffs are likely to be necessary in order for Florida vegetable growers to hold or expand their share of the U.S. cucumber market. The need for labor replacing technology is much less urgent in Mexico than in southern Florida. Some efforts have been made to mechanize the harvesting of slicing cucumbers. Several experiment stations and private companies are trying to solve the technical difficulties involved in developing a mechanical harvester. The biological, physical, and economic feasibility of developing frost resistant cucumber varieties, and varieties and equipment for mechanical harvesting need further research. This somewhat cursory and aggregate analysis suggests that the potential impact of such research does merit further consideration. Transfers of potential technology to Mexico evolving from this research, to again reduce a competitive advantage, seem less likely than in the past particularly for a frost resistant variety because cold weather is not a problem for Mexican growers.

Literature Cited

1. Brooke, Donald L. 1972. Cost and Returns From Vegetable Crops in Florida, Season 1970-1971 with Comparisons. *University of Florida*, February.

2. DeBoon, Teunis. 1974. "Influence of Trade Barriers: The Florida and Mexico Experience with Winter Cucumbers", unpublished Ph.D. Dissertation, University of Florida.

3. Fliginger, J. C. and E. E. Gavett, *et. al.* 1969. Supplying U.S. Markets with Fresh Winter Produce: Capabilities of U.S. and Mexican Production Areas. Agricultural Economics Report No. 154, *U.S. Department of Agriculture, Government Printing Office*, April.

4. ————, and ————. Supplying U.S. Markets with Fresh Winter Produce: Capabilities of U.S. and Mexican Production Areas. Supplement to Agricultural Economics Report 154, *U.S. Department of Agriculture, Government Printing Office*, September 1971.

5. U.S.D.A. *Agricultural Statistics*, 1973. (Production estimates).

6. U.S.D.A. Foreign Agricultural Service. (Import estimates).