EVALUATING VEGETABLE PRODUCTION FOR MARKET WINDOWS AS AN ALTERNATIVE FOR LIMITED RESOURCE FARMERS

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Increased vegetable production for the fresh market often has been suggested as an agricultural alternative that will improve the income situation of small-scale farmers. Because vegetable production is an intensive activity and high incomes per acre are possible, it has political appeal as a quick solution to the low income levels generally associated with small farm operations. This study was developed from the small farm program of the University of Florida, which has concentrated on the northern and panhandle areas of Florida. Trials conducted by the Vegetable Crops Department of the University of Florida in 1974 and 1975 indicate that by variation of the planting season and control of insects and diseases, vegetables can be produced during periods of the year when the north Florida area has not historically competed in the fresh vegetable market [4].

In addition to yield potential, economic feasibility depends on the availability of outlets for the produce, the market price, and the cost of production. Potential for retail marketing in the local area and by direct-to-consumer methods is evaluated for a five-county area in north Florida by Fuller and Andrew [3], and potential expansion of regional terminal markets surrounding the area is discussed by Colette and Arias [1]. Preliminary studies on production costs and yield expectations are now underway. In this article, price expectations and the variability of prices facing the producer are examined. Some expectation of price is necessary for planning before a limited resource producer decides to undertake fresh vegetable production. This article illustrates the extent to which price expectation depends on the choice of planting dates.

Price expectation is one of the primary factors considered in formulating production goals and is an especially important factor with nonstorable commodities. As it is not uncommon for prices to vary dramatically from week to week, seasonal price expectations may not be adequate as a planning horizon. Often growers use only a "naïve" price expectation model such as the price received the previous year or the fresh market price just prior to the planting season. The simple cobweb model is one illustration of this practice. Year to year fluctuation in production often results from the partial adjustment reaction of producers using these "naïve" planning tools. The effect of price variability between years and even between weeks of the same season often appears to be overlooked. Because marketing alternatives for fresh market vegetables are limited, price variability translates directly into income variability for the grower. Limited resource farmers often lack sufficient reserves to carry them over a bad year; therefore, it is more important for them to consider price variability when developing their price expectations and production plans than it is for other agricultural producers.

Whenever possible producers take advantage of their relative position and produce for the season with the highest price. The vegetable producing region of northern Florida and southern Georgia is an area which does not have a well defined temporal market advantage. This area's production period bridges the gap between the well defined winter and early spring markets, dominated by south and south-central Florida, and the early summer season which is dominated by domestic producing areas closer to the major terminal markets than northern Florida (Figure 1). With increased supplies from these areas, the favorable season prices for Florida growers drop rapidly and remain below first quarter prices throughout the summer season.

Regional production in northern and panhandle Florida is aimed at capturing the last vestiges of the winter and spring market before the early season price advantages deteriorate. This market "window" differs yearly in onset and duration. The length of the market window, price expectations in the

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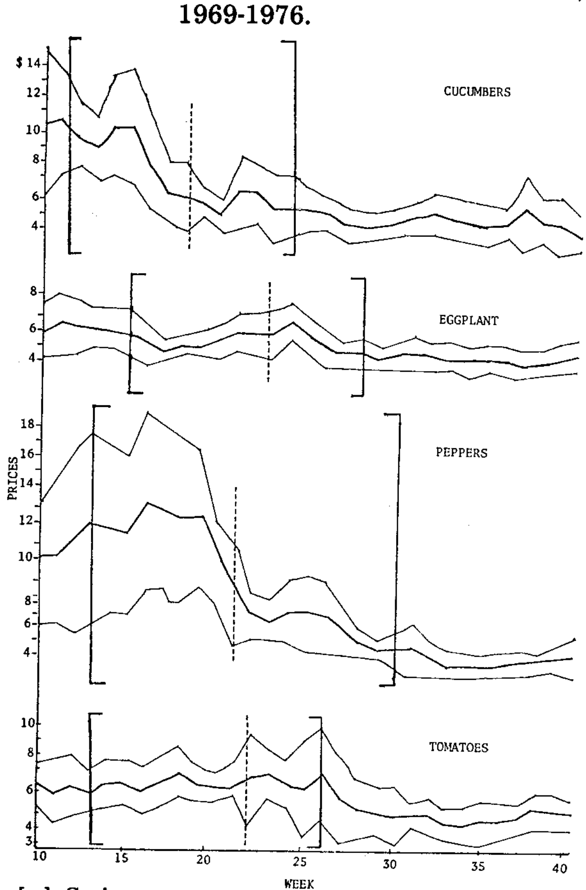
spring and summer seasons, and price expectation in the market window period are important factors in developing production plans.

Three factors are considered in evaluating the feasibility of producing for this market window. The first is the actual length of the possible window. A second factor is the relative price variability of the various crops, and the final factor is the price-quantity flexibility for area production. The last factor permits some judgment of whether increased production would drastically alter the prices received. The possibility of severe price alterations with increased quantities would rule out market entry by large scale commercial producers.

PROCEDURES

To analyze the three factors stated in the introduction, a variety of methods are incorporated. The price data consist of weekly farm level prices for selected fresh vegetables for the years 1969 through 1976. Analysis of variance of first and second differences in weekly prices is used to indicate the amount of price variation within the seasons for the selected crops. It is necessary first to test for homogeneity of price variation before any measure of relative variation can be conducted. If the null hypothesis of homogeneity is rejected, the crops can be ranked in order of their degree of variance. Bartlett's test [5] is used to test for homogeneity of variance and a ranking method presented by David [2] is used to rank the crops in order of decreasing variability depending on the results of the Bartlett test. The Bartlett test is conducted for both the full calendar year and for a late spring and summer season defined as week 22 through week 40 of the calendar year.

FIGURE 1. WEEKLY AVERAGE FOB PRICES WITH 90% CONFIDENCE INTERVALS FOR CUCUMBERS, EGGPLANT, PEPPERS, AND TOMATOES PRODUCED IN FLORIDA AND SHIPPED TO ATLANTA, 1969-1976.



[ ] - Spring season

- start of North Florida harvest

To determine the price-quantity relationships of the vegetables, simple linear models are estimated by using standard least squares procedures. The Durbin-Watson method is used to test for autocorrelation in the time series and Cochran-Orcott iterative techniques are used as corrective methods where autocorrelation problems are identified.

For this procedure it was necessary to aggregate the weekly prices used to indicate price variability into monthly weighted average prices to correspond with the monthly reported unload data. Because the degree of variability between crops within seasons had been tested and appropriately addressed, at this point it was not believed that the aggregation would bias the results of the estimated procedure.

The same model was used with each of the four vegetables and was stated as:

$$P_{it} = b_o + B_1 Q_{it} + b_2 I_t$$

where

P_{it} = weighted average price per unit of i^{th} vegetable during month t, deflated by wholesale price index, 1967=100

Q_{it} = per capita consumption in pounds of the i^{th} vegetable during month t, based on total civilian population

I_t = per capita real personal income in thousands of dollars during month t, deflated by CP1, 1967=100

i = commodities, 1, ..., 4

t = month 1, ..., n (January 1969=1).

The occurrence of the market windows was perhaps the most naively determined factor.

Average weekly prices with corresponding 90 percent confidence limits, the normal spring season, and the earliest week north Florida growers can consistently expect to enter the market are shown in Figure 1. The length of the market windows is determined as the time period in which the weekly average price is consistently above the seasonal average.

RESULTS

Analysis of average weekly prices paid to Florida growers between 1969 and 1976 for cucumbers, eggplant, peppers, and tomatoes delivered to the Atlanta market, combined with Halsey's work, indicates that in the case of eggplant and tomatoes a market window does occur, but that the average prices for cucumbers and peppers will already have fallen from the winter and early spring levels before production in north Florida is possible. Thus no market window is feasible for these two vegetables.

The second factor measured is the degree of relative price variability. A simple but effective measure of price variability is the coefficient of variation which shows that the degree of price variability is much greater during the spring than the summer (Table 1). The coefficient of variation expresses the normal distribution of prices as a percentage of the average price. For example, the coefficient of variation for peppers of 0.49 indicates that 66 percent of the time the price of peppers during the spring season will be within plus or minus 49 percent of the mean. The coefficients of variation for the spring season indicate that peppers have the most variable prices with a coefficient of 0.49, followed by cucumbers, 0.42; tomatoes, 0.27; and eggplant, 0.25. During the summer the coefficients of variation range from a high of 0.29 for tomatoes to a low of 0.18 for eggplant. Tomatoes is the only vegetable in the study that has a higher coefficient of variation in the summer than in the spring.

TABLE 1. SPRING AND SUMMER SEASON AVERAGE WEEKLY PRICES, STANDARD DEVIATION AND COEFFICIENT OF VARIATION FOR CUCUMBERS, EGGPLANT, PEPPERS AND TOMATOES IN THE ATLANTA MARKET, 1969-1974.

Crop	Average Weekly Price	Coefficient of Variation	Standard Deviation	Expected Price Range (Mean ± 1 Standard Deviation)	
Spring					
cucumbers	7.12	0.415	2.95	4.17	10.07
eggplant	5.60	0.246	1.38	4.22	6.98
peppers	10.33	0.493	5.09	5.24	15.42
tomatoes	6.05	0.266	1.61	4.44	7.66
Summer					
cucumbers	4.72	0.219	1.03	3.69	5.75
eggplant	4.20	0.187	0.79	3.41	4.99
peppers	4.26	0.237	1.01	3.25	5.27
tomatoes	4.08	0.287	1.17	2.91	5.25

The standard deviation can be used to establish ranges of price expectation to avoid limiting the expectation to a single value estimate. Two thirds of the time the observed price should be within plus or minus one standard deviation of the mean; i.e., for spring season tomatoes, price will be between $4.44 and $7.66 (Table 1).

Average weekly prices are much higher during the spring season than during the summer. Average summer prices range from 75 percent of spring prices for eggplant to only 41 percent of spring prices for peppers. The difference is even greater when summer prices are compared with the prices received early in the spring season, as can be seen in Figure 1.

A sophisticated grower can use the mean and the standard deviation to compute the percentage of the time he can expect to get at least the target price he determines is necessary to cover all costs and return a profit. This is accomplished by computing the value:

$$Z = \frac{\text{target price} - \text{mean}}{\text{standard deviation}}.$$

This computed value is used with a standard cumulative probability table to determine the proportion of the time a value greater than the target value can be expected.

The standard Bartlett test is used to test for homogeneity of variances. The null hypothesis of homogeneity of variances is rejected in all cases and the crops are ranked as shown in Tables 2 and 3.

On an annual basis green peppers show the greatest degree of price variability followed by cucumbers, tomatoes, and eggplant. The only change in that order occurs in the summer season where the observations are biweekly differences in price. In this instance, tomatoes are found to be more price variable than cucumbers. These findings are consistent with those developed in the analysis of price flexibility. The tables imply that if the grower's aim is to stabilize his income flow by eliminating the risk of price variance, he would be more likely to do so by planting eggplant; eggplant does not return a consistently high or low price, but it is more consistent than the others.

The final factor studied is the price-quantity relationship for the selected vegetables. Simple linear models were estimated by using standard least squares regression techniques where the major exogenous variables are per capita consumption and real disposable personal income. The equations are price dependent with the reported prices being appropriately deflated.

The results of the statistical analysis are shown in Table 4. Both coefficients and standard errors are shown, the standard errors in parentheses. It can be readily seen from Table 4 that the two variables, per capita consumption and real personal income, explain most of the long-term price variations for cucumbers, peppers, and tomatoes during the spring season. The coefficient of determination, R^2, ranges from 0.81 for cucumbers to 0.84 for tomatoes and 0.95 for peppers. The price of eggplant is the most stable of the vegetable prices and is not as closely related to changes in quantity and income as the other prices. During the summer season per capita consumption and personal income do not explain as much of the price variation as during the spring season. The coefficients of determination range from 0.51 for tomatoes to 0.55 for the other three vegetables.

Except for tomatoes, all crops show a much greater price flexibility during the spring season than in the summer. Increases in per capita consumption of cucumbers, peppers, and tomatoes during the spring months can be achieved only by a more than proportional reduction in price. In contrast, the very low price flexibility for cucumbers, eggplant, peppers, and tomatoes during the summer indicates that increases in per capita consumption can be achieved with a less than proportional reduction in price.

Another interesting result is the occurrence of negative signs on the income coefficients associated with several of the vegetables in both seasons. Only one, spring cucumbers, is statistically significant at the 5 percent level, and one therefore must be wary of attempting to use the income coefficient to indicate consumer behavior on the basis of the negative relationship between real income and prices paid.

CONCLUSION

The ability of producers to hit the market window is determined mainly by the physiology of the crop, climatic conditions, and cultural practices. The alternative considered is

TABLE 2. CROP RANKING BY DEGREE OF PRICE VARIABILITY OF SINGLE WEEK DIFFERENCES FOR FLORIDA PRODUCED VEGETABLES DELIVERED TO ATLANTA, GEORGIA.

Crop	Yearly Variance	Yearly Ranking	Summer Variance	Summer Ranking
Peppers	.0674	(1)	.0504	(1)
Cucumbers	.0584	(2)	.0477	(2)
Tomatoes	.0310	(3)	.0392	(3)
Eggplant	.0273	(4)	.0235	(4)

TABLE 3. CROP RANKING BY DEGREE OF PRICE VARIABILITY OF BI-WEEK DIFFERENCES FOR FLORIDA PRODUCED VEGETABLES DELIVERED TO ATLANTA, GEORGIA.

Crop	Yearly Variance	Yearly Ranking	Summer Variance	Summer Ranking
Peppers	.1400	(1)	.0938	(1)
Cucumbers	.1150	(2)	.0744	(3)
Tomatoes	.0663	(3)	.0883	(2)
Eggplant	.0544	(4)	.0471	(4)

TABLE 4. EQUATION COEFFICIENTS AND STANDARD ERRORS, R^2 VALUES, PRICE FLEXIBILITY AND DURBIN-WATSON STATISTICS FOR THE SPRING AND SUMMER SEASONS FOR CUCUMBERS, EGGPLANT, PEPPERS AND TOMATOES IN THE ATLANTA MARKET, JANUARY 1969 - JUNE 1975.

Season Crop	Price equations $P_{it} = b_0 + b_1Q_{it} + b_2I$	R^2	Price Flexibility	D.W.
Spring				
cucumbers	0.36 - 19.27Q + 3.81I (4.30) (3.10) (1.22)	0.81	-1.55	2.97
eggplant[a]	11.06 - 94.69Q - 0.99I (3.07) (32.37) (0.90)	0.45	-0.91	2.51
peppers	19.11 - 58.98Q + 0.53I (6.29) (4.35) (1.92)	0.95	-1.53	4.19
tomatoes[b] (1)	7.96 - 1.14Q - 0.44I (2.18) (0.16) (0.57)	0.87	-0.63	3.05
(2)	9.64 - 2.29Q - 0.42I (2.29) (0.51) (0.57)	0.84	-1.33	3.90
Summer				
cucumbers	5.50 - 5.78Q - 0.26I (1.79) (2.20) (0.57)	0.55	-0.36	3.31
eggplant[a]	5.41 - 24.59Q - 0.32I (1.08) (8.13) (0.30)	0.55	-0.28	2.27
peppers	7.72 - 10.99Q - 0.38I (1.68) (2.99) (0.59)	0.55	-0.72	0.72
tomatoes	4.30 - 0.80Q + 0.18I (1.45) (0.29) (0.41)	0.51	-1.61	2.34

[a]Represents relationship from 1969 through 1973 season only. A definite shift in the relationship is indicated following the 1973 season, but insufficient information is available for estimation of parameters.

[b]Equation (1) represents the relationship for tomatoes before the large influx of Mexican produce, 1972, while equation (2) represents the relationship after that time.

between traditional planting schedules and increased plantings designed to take advantage of market windows. Under normal conditions the prices of cucumbers and peppers will already have fallen before the area can come into production (Figure 1). A market window for these two fresh vegetables does not occur on a regular basis and so there is little chance for income enhancement. The situation is a little better for eggplant and tomatoes. Under normal conditions, area producers can be delivering eggplant for 2 to 3 weeks and tomatoes for 4 to 6 weeks before prices decline to the low summer levels.

The large negative price flexibility values indicate that expansion of marketing of cucumbers, peppers, and tomatoes during the spring months can be achieved only by accepting greatly reduced price. The choice then should be one of earlier, not increased, plantings. However, except for tomatoes, the lower summer prices are not very responsive to changes in quantities of fresh market vegetables in the Atlanta Terminal Market.

The tests for homogeneity of variance indicate that price variability does indeed differ among vegetable crops and that these crops can be ranked on the basis of increasing variability. To do so illustrates that eggplant has the most stable price. Tomatoes and cucumbers follow in degree of variability and peppers have the greatest degree of price variability of the four crops.

If regional production is to be aimed at market windows of short and varying duration, some means of estimating probable success must be developed. This work indicates that measure of relative price variances are useful in estimating the stability of such windows, but increased price variability implies increased risk. The assumption of increased risk necessary to capture the market window might not be economically worthwhile. Further study is necessary to determine the expected relative returns from such risk assumption. In any event, the advocation of fresh market vegetable production as an alternative for income enhancement of limited resource farmers must be weighed against the risks associated with the price variations of such regional markets.

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