Agronomic and Economic Barriers to Expanding Fruit and Vegetable Production

A producer who is considering a shift or move into producing fruit and vegetables needs to consider potential demand (or revenue) and cost factors, particularly the specialized costs for the select commodity. For new growers, demand and cost factors can be substantial barriers to entry into fruit and vegetable production (table 3).

For farmers not constrained by program restrictions, planting decisions are based on the expected net return (revenue minus cost) for various crops that can be grown on a given parcel of land. Risks are also relevant to planting decisions; for risk-averse producers, higher risks must be balanced by higher expected returns.

We frame the discussion in terms of expected net return (ignoring risk aspects, a topic to which we return later). For a land parcel not subject to planting restrictions, the optimal crop is the one that maximizes expected net revenue. Alternatives might include fruit and vegetables, in addition to other crops. Suppose the farmer has n different cropping alternatives (i = 1, 2, …, n). The optimization problem can be represented as follows:

(1) $$\underset{i}{Max}\,(Net\ returns_i) = revenue_i - cost_i,$$

Now consider the effects of planting restrictions. For a land parcel subject to restrictions, the cropping alternatives have to be divided into two sets: fruit and vegetables and other "unrestricted crops." If the farmer elects to plant a fruit or vegetable, a payment reduction applies. The optimization problem becomes:

(2) $$\underset{i}{Max}\,(net\ returns_i) = \begin{cases} For\ fruit\ and\ vegetables: \\ Revenue_i - cost_i - payment\ reduction \\ \\ For\ unrestricted\ crops: \\ Revenue_i - cost_i \end{cases}$$

Government payments are reduced when fruit and vegetables are planted on base acreage. The size of the payment reduction depends on a number of factors. Farmers with an established history of growing fruit or vegetables usually incur a smaller payment reduction, as discussed earlier.

Cropping choices thus depend on the relative magnitude of market revenue, cost, and any payment reductions that apply. In some situations, payment reductions would be expected to have no effect on planting decisions. First, this situation could occur if comparisons of expected net returns did not favor production of fruit or vegetables. Production costs for these crops could be high relative to revenue, which amounts to a supply-side barrier to entry.

Second, payment reductions have little or no effect on planting decisions if they are small relative to the prospective gains from planting fruit or vegetables. The expected net return for a fruit or vegetable might exceed that for an unrestricted crop—by more than the value of payments foregone.

Table 3
Market and production barriers for new fruit and vegetable producers

	Market/demand factors			Production costs/supply factors					
Commodity	Market growth	Import competition	Contracting	Production expertise	Labor	Irrigation	Field preparation	Other production costs	Other
Processed market:									
Pickling cucumbers	N	L	M	M	L/M[1]	M	M	L	
Processed tomatoes	L/M	L	H	H	L[2]	H	M[3]	H	Need good yields due to low processor price offerings
Dry edible beans	N	M	M	M	L	L	L	L	Specialized handlers
Sweet corn	N/L	L	H	L	L	L/M	L	L	Mechanical harvest by processor
Green beans	L/M	L	H	L	L	L	L	L	Mechanical harvest by processor
Green peas	N	L	H	L	L	L	L	L	Mechanical harvest by processor
Potatoes	M/H	M	M/H	M	L	M	M	M/H	Custom harvest would save on machinery cost
Fresh market:									
Tomatoes	M/H	H	L	H	H	H	H	H	High capital requirement.
Bell peppers	M/H	H	L	H	H	H	H	H	High capital requirement.
Potatoes	L/M	L	L	M	L	M	M	M/H	Custom harvest would save on machinery cost
Pumpkins	L/M	L	L	L	M	L	L	L	Labor needs are heavy at harvest
Green beans	M/H	M	L	L	M/L[1]	L	L	L	Can be harvested by machine, if available in area
Broccoli	M/H	L	L	H	H	H	M	M	
Sweet corn	M/H	L	L	L	M/L[1]	L/M	L	L	Can be harvested by machine, if available in area
Strawberries	M/H	L	L	M	L[4]/H	H	M	H	Pick-your-own operation lowers labor cost, but requires higher insurance. Capital requirement high
Fruit:									
Apples	N	L	L	M	M/H	M/H	M/H[5]	M/H	Mostly hand harvested
Cherries	M/H	L	L	M	M/H	M/H	M/H[5]	H	Mostly hand harvested
Grapes	M/H	M	L	H	M/H	M/H	M/H[5]	H	Mostly hand harvested
Citrus	L/M	L/M	L	H	M/H		M/H[5]	H	Mostly hand harvested

N = Negative; L = Low; M = Medium; H = High.
[1]Depends on availability of custom machine harvest in area.
[2]Assuming processor responsible for harvest.
[3]Unless drip irrigation used, in which case H.
[4]Assuming pick-your-own operation.
[5]Depends on whether planted on previously planted orchards (M) or establishing a new orchard (H).

Source: Economic Research Service, USDA, assessment of market factors.

Third, farmers may choose not to plant fruit or vegetables because of constraints on demand. Access to a market (or buyer) may be controlled through contracting arrangements, for example, so that farmers can expect a given (favorable) return only on limited acreage. In that situation, payment reductions might have no practical significance for entry or expansion decisions.

The following snapshot of the fruit and vegetable sector illustrates key market factors, especially the costs of producing and selling fruit and vegetables. It illustrates the difficulty of generalizing about the likely impacts of eliminating planting restrictions for these diverse and specialized crops.

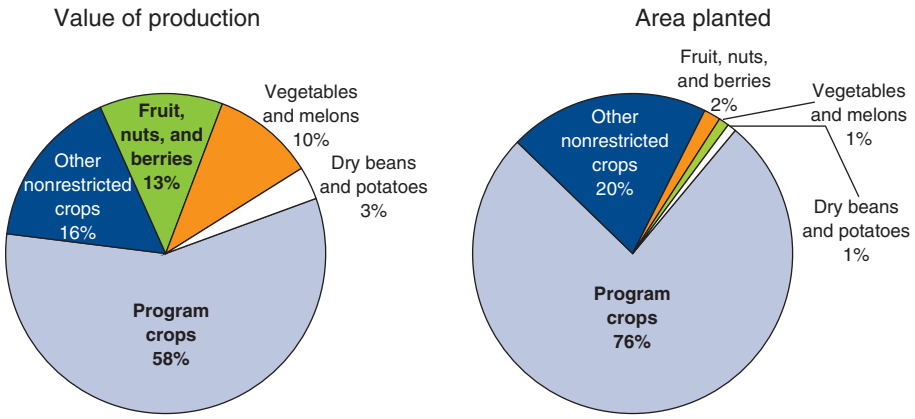
Fruit and Vegetable Sector Is Diverse[11]

The fruit and vegetable industry accounts for over one-quarter of U.S. crop cash receipts (fig. 3) and one-fifth of U.S. agricultural exports. Although the fruit and vegetable share of crop receipts is relatively large, these high-value crops are produced on less than 13 million acres, or less than 4 percent of U.S. planted cropland. This acreage produces a wide range of agricultural products (see Appendix: Area Planted and Value of Production for Selected Fruit and Vegetables). A window into this diversity is offered by the census of agriculture. The 2002 Census of Agriculture reports area and production for more than 100 fruit and vegetable commodities or groups of commodities. Some commodities are annuals (e.g., snap beans, tomatoes, and potatoes), while others are perennials (e.g., oranges, apples, and almonds). Some are grown for direct consumption, such as fresh-market apples, tomatoes, and onions, while others are grown for processing into such products as orange juice, tomato sauce, and frozen sweet corn.

Vegetables are produced throughout the United States, with the largest overall acreage (excluding that for potatoes and dry beans) in California and Florida (fig. 4). The upper Midwest (Michigan, Minnesota, and Wisconsin) and the Northwest (Washington and Oregon) report the largest vegetable acreage for processing, while California, Florida, and Texas harvest the largest share of fresh vegetable and melon acreage. The eastern seaboard States (from Georgia to New York) also report substantial vegetable

[11]For additional information on the fruit and vegetable sector, see the ERS Fruit and Tree Nuts Briefing Room at http://www.ers.usda.gov/Briefing/FruitAndTreeNuts/ and the Vegetables and Melons Briefing Room at http://www.ers.usda.gov/Briefing/Vegetables/.

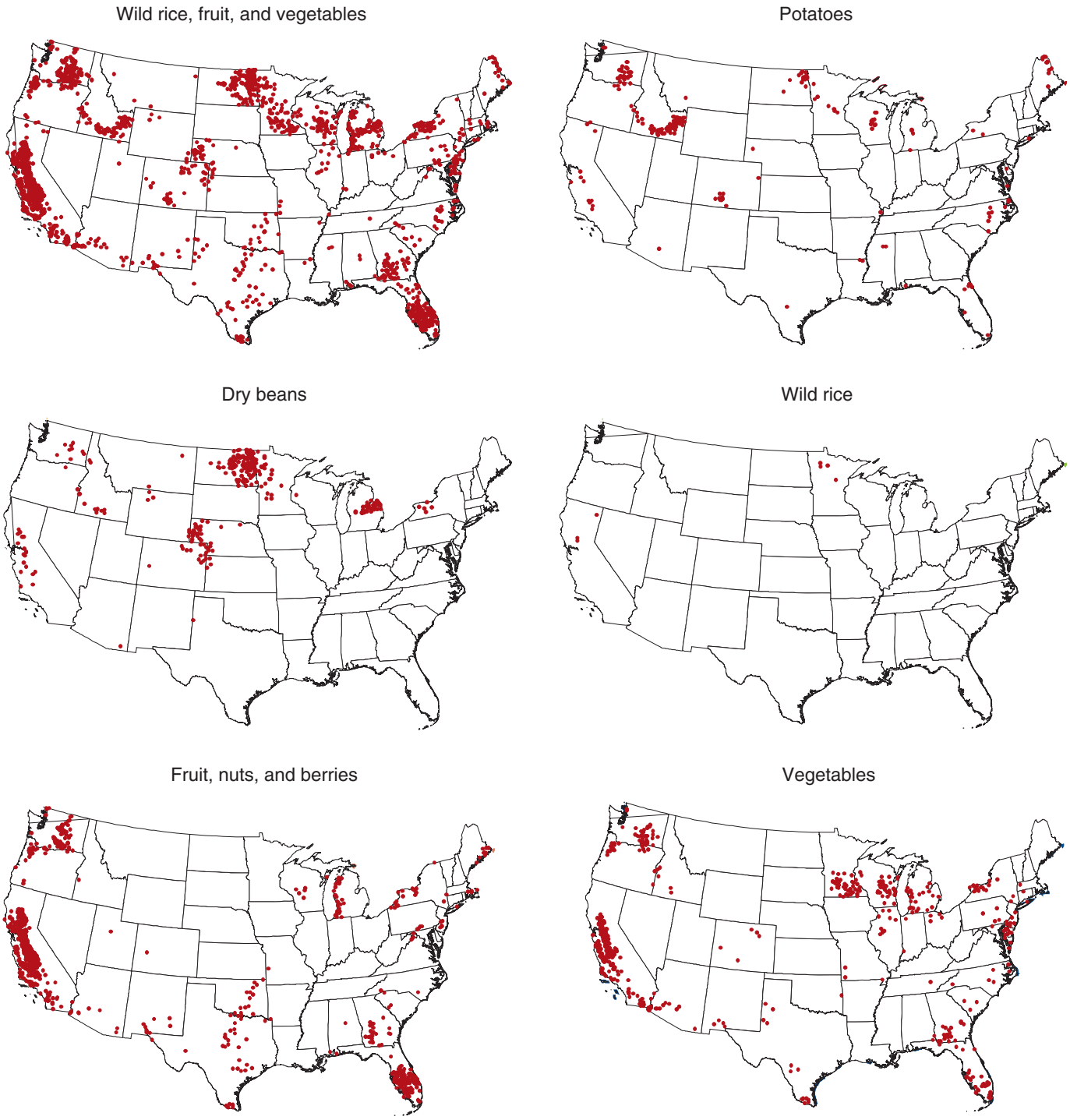
Figure 3
Share of crop's value of production and area planted, 2003



Source: National Agricultural Statistics Service, USDA, 2003.

Figure 4

Location of fruit and vegetable production, 2002



1 dot = 5,000 harvested acres

Source: National Agricultural Statistics Service, USDA, 2002.

acreage. With continuous strong output of cool-season crops, such as lettuce, broccoli, and celery, California remains the major producer of fresh vegetables even during the winter. Florida, however, is the top producer of warm-season crops (e.g., tomatoes, peppers, snap beans). Potato production is concentrated in the Northwest (Idaho, Washington, and Oregon), but Colorado, North Dakota, California, Wisconsin, and Maine are also key suppliers. North Dakota, the top dry pea and lentil producer, is also the largest producer of dry beans (about one-third of national output in 2002-04), followed by Michigan, Nebraska, Minnesota, and Idaho.

California, Oregon, Washington, Florida, Texas, Michigan, and New York lead in fruit orchard acreage. California alone accounts for nearly one-half of the Nation's fruit acreage, Florida almost one-fourth, and Washington close to one-tenth. California's mild climate gives it an advantage over other fruit-producing States. California is the Nation's largest producer of grapes, strawberries, peaches, nectarines, avocados, and kiwifruit. It also leads in production of fresh-market oranges and tree nuts, including virtually all almonds, pistachios, and walnuts. Washington is the largest apple producer for both fresh use and processing. Washington is also a leading producer of grapes (mostly for wine and juice), pears, and sweet cherries. Midwestern and Northeastern States are key producers of processed fruit products, such as canned tart cherries and apple sauce, while Florida, the primary citrus producer, leads in production of oranges for juice, grapefruit, and tangerines.

Market Considerations

Producers who are expanding fruit and vegetable production need to consider potential product demand; the need to locate, develop, and secure markets; the prevalence of contracting in the sector; and import competition (table 3). Market competition can be intense for many fruit and vegetables. Because demand for most fruit and vegetables is relatively inelastic, small changes in quantity supplied can induce large price changes. Diverting a small share of program crop acreage into fruit or vegetable production could represent a large acreage shift. For example, consider the shortrun price response in the fresh tomato market resulting from hurricane damage in Florida and rains in California during fall 2004. Because there are few substitutes for tomatoes on a sandwich or in other fresh uses, the resulting drop in November tomato supplies caused the free-on-board shipping point price for tomatoes to jump 274 percent over year-earlier levels (Lucier et al.).

Most vegetables destined for processing are grown under contractual arrangements between growers and processors. Contracting shifts a portion of the decisionmaking related to production from the grower to processors, such as juice processors, canning firms, and salad processors. Contracting is especially prevalent in the production of vegetables (tomatoes, sweet corn, green beans, and green peas), as processors require assurances of a crop's volume, specific characteristics (e.g., variety, size, color), and timing for delivery to the factory. Area grown under contract ranges from close to 100 percent for green peas to about 85 percent for cucumbers (Lucier et al.)

For a producer who wants to shift into processed vegetables, negotiating a production contract with a processor (or through an established bargaining

association) is virtually a prerequisite. Proximity to processing plants can limit the effective range of some vegetable crops (due to transport costs), with some regions, such as the Northeast, having few processing plants.

The longrun demand for many processing crops (especially canning crops) is stagnant or declining and offers little chance for industry acreage expansion. For example, per capita use of sweet corn for canning has declined 19 percent over the past decade (Lucier et al.). Removing acreage restrictions in such markets may reduce costs for some processors who may be able to contract acreage that is closer to the plant, thereby reducing transportation costs. Increasing acreage available to vegetable processors also could put downward pressure on contract prices that processors offer growers. With the potential for lower grower prices and stagnant or declining demand, incentives for new growers to enter the market may be small unless they have a price advantage from lower transportation costs or other factors.

Another consideration in deciding whether to enter the fruit and vegetable industry is competition from imported, and many times less costly, products. Imports play a substantial role in the fruit and vegetable industry, particularly for fresh-market fruit. Excluding banana imports, imports as a share of fresh fruit consumption have doubled, rising from 12 percent in 1992-94 to 24 percent in 2002-04 (Lucier et al.). Summer fruit, especially grapes, from the Southern Hemisphere account for much of the increase, although the popularity of tropical fruit, such as mangoes and papayas, has helped expand the level of imports in the U.S. market. Other fruit, such as apples, are facing stagnant demand and import competition.

Production Costs

While returns per acre can be substantial, costs of producing many fruit and vegetables (especially fresh-market crops) are high, creating significant barriers to switching land use from program crops to fruit and vegetables (table 3). A number of products have high labor requirements that are often difficult to meet. Other products require specialized harvesting equipment. Irrigation needs, high herbicide and pesticide costs, and specialized production and marketing expertise all contribute to high production costs.

The complexity of growing and marketing fresh-market produce can be much greater than that of most field crops. For example, producing cantaloupes in Arizona may require shaping beds, laying plastic mulch, hand thinning and weeding, pollinating (renting and setting out beehives), several passes with chemical control agents (herbicides, insecticides, and fungicides), irrigating half a dozen times during the season, and removing and disposing of the plastic mulch. At harvest, growers must arrange for harvest labor (likely a contractor), haul the melons to a cooler where field heat is removed, and sell the melons. Marketing fresh produce can be even more daunting than growing it because delivery of the product has to be quick.

Operating costs for some fresh fruit and vegetables are substantially greater than for field crops, and farmers may need to provide solid documentation of a marketing plan before receiving lender approval. For example, the cost of planting, harvesting, and packing an acre of bell peppers ranges from $5,000 to $13,000 (Smith and Taylor).

For a farmer switching to processing vegetables, such as dry beans, sweet corn, or green beans, startup and operating costs are much less onerous than for such crops as cantaloupes, strawberries, tomatoes, and peppers. Harvesting equipment used in soybean operations would be more adaptable for dry beans, for example, and local processors provide harvesters for most processing vegetables.

For example, the per acre cost of hand harvesting and sorting snap beans (green or wax) for fresh market in North Carolina is about 70 percent greater than harvesting by machine (and hand sorting and grading). However, the net return per acre is currently greater with hand harvesting because of higher yields. Hand harvesting allows growers to make multiple passes in a field over several days, while machine harvesting allows just one pass because plants are destroyed in the process (Estes, Sanders, and Sampson). Such products as fresh fruit, berries, and fresh-market pumpkins are largely harvested by hand, which can significantly raise labor costs. Although virtually all vegetables, and several fruit and tree nuts, for processing are machine harvested, several fresh-market crops now offer a choice of harvest method.

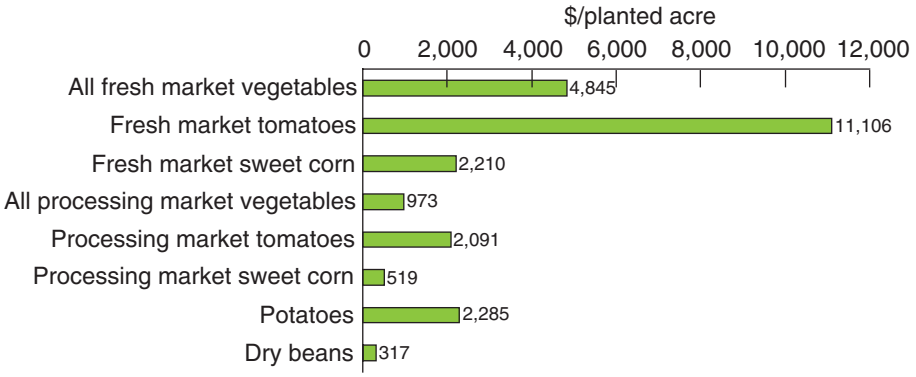
Planting fruit and nut trees and vines on base acreage may be less likely than planting vegetables and melons because trees and vines take several years to mature, and thus receiving a commercial fruit or nut crop from them takes longer.

Fruit and Vegetables Have Higher Value and Costs per Acre

The per acre value and production cost of fruit and vegetables are generally much higher than for program crops. We calculated value per acre for all vegetables, fresh and processed vegetables, and select vegetable categories (fig. 5 and appendix). For fresh-market vegetables, average revenue per planted acre during 2003-05 was about $4,800—five times that for processing vegetables. For comparison, we calculated the per acre value of production plus marketing loan benefits and direct and countercyclical payments for five program crops in 2003 (fig. 6).[12] The value for the program crops ranges

[12]Countercyclical payments are paid when prices fall below legislated levels, helping to maintain revenue when market prices are low.

Figure 5
Value of production per acre for selected fruit and vegetables, 2003



Source: Compiled by the Economic Research Service, USDA, from Farm Service Agency, USDA, data.

from about $144 per acre for wheat to about $835 per acre for rice. Fruit and vegetable crops have no national cost-of-production budgets, which makes it difficult to compare net returns for them with those for program crops.

Given the high cost of production for some fruit and vegetables, lower cost crops may garner more interest from new growers. Strawberries (for fresh and processing), fresh tomatoes, and bell peppers had the highest value (and by extension, the highest cost) per planted acre, with strawberries having by far the greatest value at nearly $27,000. Pumpkins, sweet corn, and watermelon had the lowest per acre value for fresh crops.

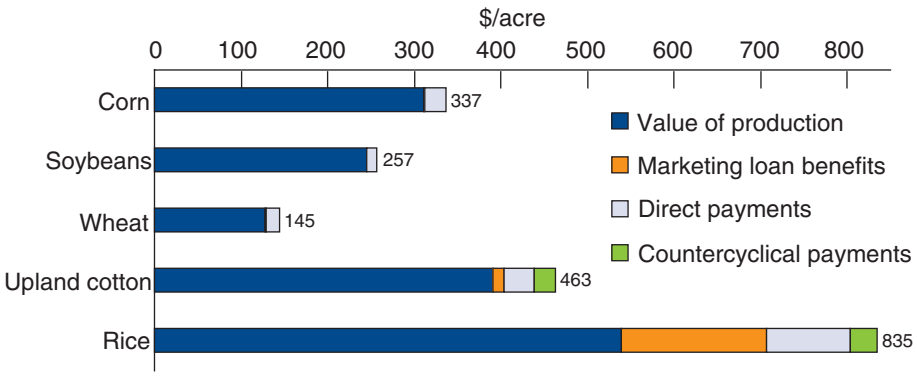
Green peas, sweet corn, and snap beans had the lowest per acre value among processing crops, with tomatoes (used to make such products as paste, sauces, and ketchup) having the highest. California produces 95 percent of the processing tomato crop—the single largest processing vegetable other than potatoes.

Seasonal Aspects May Limit Expansion

In evaluating the market effects of relaxing current restrictions, we must be aware of the seasonal dimension, especially for fresh vegetables and fruit. Outside of California, Florida, Arizona, and Texas, most market impacts would be limited to warm-season months (July-September) due to temperature and light conditions. An exception would be New Jersey and Georgia, where harvests of selected crops can extend from May through November. Supply shifts could affect the market for storable crops, such as potatoes, cabbage, and dry edible beans, until the next harvest when changes in market prices dictate the appropriate acreage response.

Most fruit and vegetables used for processing are harvested and processed during the summer and fall. However, because most canned, frozen, and dehydrated products are produced under contract, changes in market volume would largely be dictated by the needs of processors responding to market

Figure 6
Value per acre of production and marketing loan benefits plus direct and countercyclical payments per base acre for selected program crops, 2003[1]



[1]Assumes national average payment yields for direct payments.
Source: Compiled by the Economic Research Service, USDA, from data from the Farm Service Agency and the National Agricultural Statistics Service, both USDA.

demand for finished products, such as catsup, frozen corn, and canned peaches. Additional growers looking for processing contracts may push contract prices lower, but the volume contracted may not expand greatly (if at all) due to limited markets for most of these products.

During the late fall, winter, and early spring, domestic sources for warm-season fresh crops, such as tomatoes, peppers, cucumbers, squash, and snap beans, are limited. Florida, with a limited number of base acres, produces 40 percent of the U.S. fresh tomato crop and other warm-season crops. Imports are an important component of the market for most warm-season crops during the three seasons, while greenhouse products continue to snare an ever-growing share of the tomato and bell pepper retail market. Thus, summer to early fall, when most States have vegetable crops, is the period that is most at risk from any crop acreage shifts.

Seasonal factors complicate the national picture. For example, a surge in fresh-market tomato supplies harvested during the summer and early fall in Northern States could affect prices and revenues during the summer tomato season and the early portion (October and early November) of Florida and California's fall tomato market. However, these supplies would not directly affect Florida's (and the United States') winter- and spring-season tomato markets. Thus, the impact of changing acreage and output may be much more limited when viewed from a seasonal perspective because only a portion of a year's crop and the producing States may be affected.