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Economic Value of Home Vegetable Gardens in an Urban Desert Environment

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Abstract. **Two home vegetable gardens (77.4 and 58.3 m^2) in Tucson, Ariz., yielded an average of 1.24 and 2.31 kg/m^2 of produce per year over 3 and 2.5 years, respectively. Average net returns were $109 and $123 per year, $0.72 and $1.11 per hour, or $8.80 and $7.75 per dollar of water used. Thus, in the southwest desert, a weekly investment of 2-to-3 hours in a home garden can provide savings.**

Recent popularity of home vegetable gardens in the United States has been correlated with decreased consumer buying power (3, 4, 5, 6). One analysis of the 1977 National Food Consumption Survey concludes that "savings were an important consideration in the decision to garden" (1). Data from a survey of rural home gardens in Florida (10), from demonstration garden plots in 3 Florida cities (7, 8), and from an experimental plot in Ohio (10) showed net returns per garden from $44 to $652, and net hourly returns to labor from $1.14 to $13.60 (Table 1).

We studied 2 home gardens in Tucson for 3 years (Garden A) and 2.5 years (Garden B) to estimate net returns that could be expected from gardening by average- or low-income households. We did not seek to maximize yields or net returns. Our case study approach has several advantages and disadvantages in comparison with the other types of studies previously reported for U.S. gardens. The case study is not replicable, as is the experimental plot study. Data resemble those of the survey in that they are from actual home gardens and may reflect household conditions. Unlike the survey, however, inputs and outputs were measured by gardeners rather than estimated. In contrast to the other studies cited, our study continued for longer than one season.

To our knowledge, no economic studies of home vegetable gardens have been reported for the southwest desert, an environment quite different from that of most of the United States. The Sonoran desert soils of the Tucson area are typical of arid regions (i.e., highly alkaline, low in organic matter, and high in salts). A calcium carbonate hardpan (caliche) often exists in the root zone. Tucson receives an average of 283 mm of rain annually, with more than 50% falling between 1 July and 15 Sept. and over 20% from December through March. Potential evapotranspiration is high throughout the year, especially in spring and summer when it exceeds precipitation.

Many Tucsonans are inexperienced in gardening in this difficult environment. Only 30% of Tucson residents of all ages were born in Arizona, while 50% came from the northeast, north central, or southern United States (9). Techniques developed for other conditions, such as French Intensive raised beds, rows on flat land, or an emphasis on summer gardening, may support a common assumption that vegetable gardening in Tucson costs more than the value of the produce. We believed that methods of soil modification, cultivation, and water management appropriate for Tucson might produce economic returns comparable to those for other regions of the United States.

The study gardens were about 2 km apart in central Tucson. They consisted of rectangular sunken beds separated by walkways and were prepared using pick, shovel, and digging bar. Average maximum annual size was 77.4 and 58.3 m^2. Both gardens were about 40% growing area and 60% walkways, with growing area per bed averaging 1.7 m^2. Beds were dug to about 0.5 m below ground level, and high clay and caliche subsoils were removed and packed around the beds to form berms used for walkways. Berms were about 30 cm wide and 5 to 15 cm high. Top soil was returned to the beds with added organic matter. Manure was applied to the growing area at a yearly rate of 60 kg (Garden A) to 65 kg (Garden B) per m^2. It usually was composted first with garden refuse and kitchen scraps.

Inter-, mixed- and relay-cropping minimized exposed soil surface. Straw, compost, or manure was used as mulch. Watering was done using a hose, soaking the soil to the bottom of the bed (0.5 m). Water was applied at an annual rate of 55 cm in Garden A and 78 cm in Garden B, or 153 cm and 217 cm for the growing area only. No pesticides or herbicides were used; we controlled major pests manually or mechanically.

The cost of the gardens was defined as household expenses incurred because of the gardens. Thus, there was no cost for land rental or for the monthly city water delivery, because those charges occur with or without a garden. Manure was obtained free. Labor included time to establish and manure garden beds, to transplant, water, control pests, and harvest. Every water application was measured to the nearest 0.1 cubic foot, using the standard water meter provided by the utility

Table 1. Comparison of economic performance of U.S. gardens.

Site	Area (m^2)	Cost[z] ($)	Gross return ($)	Yield (kg/m^2)	Net returns ($)	Net returns ($/$m^2$)	Net returns ($/hr)
South Florida (7) (Homestead)	56	96[y]	496	6.8	400	7.18	n.a.
North Florida (8) (Tallahassee)	130	71[y]	384	2.7	314	2.41	13.63
North Florida (8) (Jacksonville)	59	83[y]	416	5.4	333	5.61	4.90
Florida[x] (4) (Gilchrist and Levy Counties)	2,338	148[w,v]	800[u]	n.a.[t]	652	0.27	3.16
Columbus, Ohio[s] (10)	14	46[y]	90	6.9	44	6.50	1.14
Tucson Garden A[r]	77[q]	45[w]	154	1.2	109	1.41	.72
Tucson Garden B[p]	58[q]	56[w]	178	2.3	123	2.10	1.11

[z]Does not include labor or land rental.
[y]Tools depreciated over 5 years.
[x]Data are averages for 21 row gardens.
[w]Tools depreciated over 10 years.
[v]Does not include costs of preservation of produce (see note u).
[u]Derived from value of preserved produce, as if all garden produce were preserved. Fresh produce values are used in all other studies.
[t]Not available.
[s]Data are averages form 4 replications.
[r]Data are annual averages for 36 months, Jan. 1980–Dec. 1982.
[q]Area is yearly average of the maximum area taken by the garden (growing area plus walkways) in each year of the study. Much of the growing area was fallow at different times of the year.
[p]Data are annual averages for 30 months, July 1981–Dec. 1983.

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Table 2. Average annual yield and retail value of crops grown.

Crop	Garden A			Garden B		
	Yield (kg)	Total value ($)	Avg. ($/kg)	Yield (kg)	Total value ($)	Avg. ($/kg)
Amaranth	1.3	1.49	1.15	0.8	2.06	2.65
Basil	0.4	0.61	1.53	0.5	0.83	1.53
Beans, green	3.5	5.48[z]	1.57	1.0	1.49	1.52
Beans, faba	0.4	1.18	2.95	---	---	---
Beet roots and leaves	5.8	6.44[z]	1.11	6.3	7.63[z]	1.21
Broccoli	7.3	10.54[z]	1.44	3.2	5.15[z]	1.62
Broccoli leaves	1.6	0.63	0.39	---	---	---
Cabbage	1.6	1.10	0.69	8.2	4.42	0.54
Cantaloupe	0.2	0.27	1.35	0.5	0.37	0.73
Carrots	3.4	2.40	0.71	8.1	8.16[z]	1.01
Cauliflower	---	---	---	1.1	1.42	1.35
Chard	2.5	4.12[z]	1.65	7.5	14.34[z]	1.92
Cilantro	0.1	0.42	4.20	0.1	0.61	16.24
Corn (kernels only)	4.2	11.52[z]	2.74	0.1	0.27	2.20
Cucumbers	6.1	7.73[z]	1.27	9.7	8.26[z]	0.86
Eggplant	---	---	---	13.6	15.98[z]	1.17
Garlic	---	---	---	0.1	0.18	4.29
Greens[y]	12.3	14.78[z]	1.20	14.6	17.44[z]	1.20
Jerusalem artichoke	---	---	---	2.4	5.86[z]	2.44
Kohlrabi	0.7	0.85	1.21	0.6	1.01	1.72
Lettuce[x]	0.9	1.53	1.70	11.4	25.32[z]	2.23
Okra	8.8	17.12[z]	1.95	0.1	0.09	1.63
Onions, green	1.6	2.14	1.34	5.0	11.08[z]	2.21
Onions, dry	3.6	2.73	0.76	2.9	3.77	1.30
Parsley	0.4	0.93	2.33	---	---	---
Peas	3.0	17.73[z]	5.91	0.6	0.97	1.54
Peas, edible pod	---	---	---	0.1	0.14	1.22
Peppers, chili	0.9	2.71	3.01	2.8	6.14[z]	2.17
Peppers, bell	6.2	10.42[z]	1.68	1.1	0.96	0.88
Purslane	---	---	---	0.1	0.09	2.93
Radish	---	---	---	2.5	4.63	1.84
Spinach	1.7	2.38	1.40	---	---	---
Squash, summer	4.4	6.12[z]	1.39	3.4	3.67	1.09
Squash, winter	---	---	---	0.2	0.11	0.47
Sweet potato	1.9	1.57	0.83	---	---	---
Tomatillo	---	---	---	0.7	0.93	1.29
Tomato, ripe	14.1	19.20[z]	1.36	10.0	13.93[z]	1.40
Tomato, green	---	---	---	12.7	10.62[z]	0.84
Watermelon	---	---	---	2.8	0.43	0.15

[z]Twelve vegetables with highest value (tomatoes and green tomatoes counted as one).
[y]Greens include bok choy, kai choy, wong bok, kale, turnip greens, and a variety of young winter vegetable sprouts harvested during thinning.
[x]Lettuce includes romaine, red and green leaf, escarole, endive, mustard, and rocket salad.

or using calibrated buckets for small amounts.

To determine the economic return, harvested produce was valued separately for each garden, using retail prices at local stores (Table 2). Area planted to each vegetable was not recorded, since 2 or more crops usually were mixed. All prices were for fresh vegetables as commonly purchased, since we consumed almost all produce fresh. Produce was not graded. We did not try to increase the value of production by growing high-value vegetables, and we assigned market value conservatively. Thus, we hoped to make results applicable to low-income households. When prices were not available, for example for broccoli leaves, we used prices of inexpensive, comparable vegetables, in this case cabbage. The differences in average price per kg between Gardens A and B ($1.60 and $1.33 respectively, Table 3) reflect differences between stores where price data were collected, seasonal differences in prices, and different seasonal patterns of harvesting.

Retail value was assigned to herbs and exotic vegetables (e.g., basil and rocket salad) not at the retail price, but at prices for common, similar vegetables (in this case summer greens and leaf lettuce). One herb, cilantro (corriander), was valued at its retail price, since it is commonly used in Tucson and is widely available in stores.

We grew 38 vegetables or types of vegetables in the 2 gardens (Table 2). The top 12 value producers for each garden accounted for about 85% of the gross value of $154/yr in Garden A and $178/yr in Garden B. Six vegetables — beets, broccoli, chard, cucumbers, greens and tomatoes — were in the top 12 in both gardens. The rest of the top 12 vegetables differed for the 2 gardens, reflecting different tastes, planting strategies, and yields. Vegetables were harvested every month of the year.

An annual summary of the economics of our 2 gardens is presented in Table 3. As might be expected in a desert environment, water was the largest single expense, almost 30% of the total costs in each of the gardens. This proportion was slightly more than that used in north Florida studies (8), and was much more than the 1% to 3% reported in other areas of Florida (4, 7) and in Ohio (10). Market value of the produce, however, was more than 10 times the cost of water and more than 3 times total costs. The net return on each dollar spent on water was $8.80 and $7.75 in Gardens A and B, respectively. We conclude that vegetable gardening will continue to make economic sense in Tucson, even if the cost of water rises significantly, as long as appropriate water conserving techniques are used.

The average yields for the gardens were 1.24 and 2.31 kg/m^2 for an average gross return of $1.99 and $3.06 per m^2, and an average net return of $1.41 and $2.10 per m^2 per year over 3 and 2.5 years respectively for Gardens A and B. Space was not a limiting factor for the gardens, and the proportion of growing area (40%) could be increased significantly. Yields also could be improved through careful planning to minimize fallowed growing area, which reached high proportions in some seasons. Yields were lower than those reported in other studies.

Net returns were $109 and $123 per year, or $0.72 and $1.11 per hour. These are the lowest rates of return to labor of any study, because much time was required to establish permanent sunken beds and to water the gardens. We estimate that we spent over 50% of our time watering.

Water conservation efforts in our gardens were modest. Net returns for gardens in Tucson probably could be increased by shutting them down during the hottest period, from mid-May till mid-August (2). Other conservation techniques that could reduce irrigation costs include catching rain from rooftops or other areas, and increasing shading, wind protection, mulching, and growing heat-tolerant crops.

Gardening in the desert using simple, appropriate techniques can save money for households when the opportunity cost of labor is not included. For most households an average weekly investment of 2.1 to 2.9 hours will return more than the market value of the vegetables produced.

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Table 3. Economic summary for Tucson home vegetable gardens (annual average).

Category	Garden A Jan. 1980–Dec. 1982	Garden B July 1981–Dec. 1983
Expenses ($)		
Seeds and transplants	7.52	9.96
Fish emulsion	6.05	2.56
Soil sulfur	1.06	1.79
Miscellaneous	3.33	1.67
Straw mulch	0	6.17
Hauling manure[z]	2.33	9.22
Water[y]	12.38	15.87
Tools[x]	12.20	8.20
Total expenses	44.67	55.60
Other inputs		
Land area (m^2)[w]	77.4	58.3
Water applied (m^3)	42.2	45.2
Labor (hrs)	152.7	110.7
Gross returns		
Total yield (kg)	96.2	134.4
Yield per unit area (kg/m^2)	1.24	2.31
Total retail value ($)	154.14	178.32
Average retail value ($/kg)	1.60	1.33
Value per unit area ($/$m^2$)	1.99	3.06
Net dollar return		
Total ($)	109.47	122.72
Per unit labor ($/hr)	0.72	1.11
Per unit land ($/$m^2$)	1.41	2.10

[z]$0.17/k ($0.28/mile).
[y]Calculated as actual cost of water applied to garden as addition to each monthly water bill for Garden B; average cost for Garden B for 1982 was used to calculate cost for Garden A.
[x]Pick, pointed shovel, rake, caliche bar, trowel, hose, and bubbler for Garden B; Garden A tools also include a wheelbarrow and hoe. Depreciated linearly over 10 years.
[w]Area is yearly average of the maximum area taken by the garden (growing area plus walkways) in each year of the study.

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