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Economic Feasibility of Organic Greenhouse Cucumber Production: The Case of Menderes

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Abstract: The cost and return of organic greenhouse cucumber production was determined. An organic greenhouse cucumber budget was developed for growers in a selected area from Turkey. In this study, total costs were subtracted from total gross revenue to calculate the net return of organic greenhouse cucumber production. The cost items of organic greenhouse cucumber production were the initial investment costs to construct, variable costs, fixed costs and land rent. According to study, net return per square was determined to be 0.98 dollars for organic greenhouse cucumbers. Besides, net return per kg was calculated to be 0.07 dollars. But, production and market risks both affect profitability and economic viability of organically grown vegetables. Therefore, growers must evaluate circumstances.

Key words: Greenhouse, organic cucumber, cost, profitability, grower, vegetable

Introduction

Organic farming is one of several approaches to sustainable agriculture. Indeed, many of the techniques used in organic farming - such as inter-cropping, mulching, and integration of crops and livestock - are practiced under various agricultural systems. What makes organic agriculture unique is that, under various laws and certification programs, almost all synthetic inputs are prohibited, and "soil building" crop rotations are mandatory. Properly managed, organic farming reduces or eliminates the water pollution and helps to conserve water and soil on the farm. Since the use of intensive synthetic chemicals such as pesticides, fertilizers, plant growth regulators threaten human health as being carcinogenic, there is a requirement to adapt organic practices in greenhouse vegetable growing recently. But it is very difficult to manage organic production within a closed environment (Tuzel, 2000).

There are many approaches and methods for growing and marketing organic vegetables. This overview is meant to guide the reader through the critical topics and issues that growers need to address. Some of the most important variables affecting the characteristics of a particular farm are its size, soil type and fertility, available water resources, the selection and rotation of crops, labor and equipment requirements, and market options.

In recent years, many studies have been made on economics of organic vegetable production in field (Heissenhieber and Ring, 1992; Akgungor *et al.*, 1999; Diver *et al.*, 1999; Estes *et al.*, 1999) and greenhouse (Miles and Peet, 2000; Greer and Diver, 2000; Tuzel, 2000; Engindeniz and Tuzel, 2001). Though, there is still need for study, especially in local level.

The primary purpose of this study is to provide a guide for organic greenhouse cucumber growers so that they can estimate their operational bottom line, that is, calculate the difference between gross revenue and total cost. At the end of this study, an organic greenhouse cucumber budget was developed. The budget identifies specific cost categories and estimates a net return for the production and sale of organic greenhouse cucumber crop. Growers can utilize the budget to develop their own cost and return estimate.

Materials and Methods

Organic cucumber production was realized as on farm trial under unheated greenhouse conditions. The land of the farmer was located at the long distance protection area of Tahtali Dam, Menderes. A new galvanized and polyethylene (PE) covered greenhouse (12x32 m²) with side and roof ventilation was erected for organic production. Cucumber was grown for spring season production in 2001. Yield data and observations were recorded throughout the production period. Thus, income and expense data

were collected on time.

The general cost items of greenhouse production accepted classification initial investment costs to construct, variable costs, fixed costs and land rent (Al-Abdulkador, 1992; Schatzer *et al.*, 1996; Hood and Snyder, 1999; Engindeniz and Tuzel, 2001).

Greenhouse construction costs can vary, obviously depending on materials and equipment used. Organic greenhouse cucumber was produced in construction with galvanized steel tubing. Water is available to the greenhouse. Thus, it might not require additional investment for the drilling of a water well. A water pump was used for irrigation.

The variable costs associated with crop production are all inputs that directly relate to the production of cucumbers. Variable costs identified as operating expenses, are charges paid only if cucumber production occurs. Variable costs change in proportion to the amount of production. In this study, variable costs covered labour, fertilizer, seedling, electricity, certification, marketing, hauling, etc. costs. Variable costs were calculated using current input prices and labour wages.

In this study, fixed costs included interest on total initial investment costs, annual initial investment costs, interest on total variable costs and administrative costs. Interest on total initial investment costs and total variable costs was calculated by charging a rate of 14 percent (annual average nominal interest rate) on one-half of total initial investment costs and total variable costs (6 months). Administrative costs were estimated to be 3 percent of total variable costs. Depreciation was estimated using the straight-line method. Assets were divided by their useful life expectancies to determine annual costs for depreciation. The greenhouse was exempted from property tax and was not insured.

This study assumes that land is rented by the grower at annual cost of total 58 dollars (29 dollars for two crops per year). This figure can vary highly and depends on the parcel location. Additional factors affecting the cost to land rent may include soil type and water availability.

Fixed costs plus variable costs equal total production costs. In this study, total costs were subtracted from total gross revenue to calculate the net return.

Results and Discussion

Yield: Total yields of greenhouse cucumber were determined to be 5 184 kg for 384 square meter. Therefore, yield per square meter was calculated to be 13.5 kg.

Due to the limitations on the used inputs increasing the yield, it is expected a yield loss in organic agriculture (Heissenhieber and Ring, 1992). Just as, a study conducted in San Joaquin Valley was assumed a yield 61280 kg on bag culture for 1 860 square meter greenhouse (Hickman and Klonsky, 1993).

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Table 1: Initial investment costs for greenhouse construction (12 x 32 m²)

Item	Initial cost (\$)	%	Useful life years	Annual cost (\$)	%
Galvanized frame and kit	1821	26.7	20	91	14.8
Base locking rail	1565	23.0	20	78	12.7
PE (covering material) (110 kg)	264	3.9	2	132	21.5
Ground cover (65 kg)	54	0.8	2	27	4.4
Roof sprinkler (for frost protection)	198	2.9	20	10	1.6
Water pipe (PVC) (50 m)	30	0.4	15	2	0.3
Water pipe (dropping) (800 m)	103	1.5	10	10	1.6
Plastic filter	17	0.3	10	2	0.3
Metal filter	34	0.5	10	3	0.5
Niple	10	0.2	10	1	0.2
Elbow (PVC)	15	0.2	15	1	0.2
Valve	40	0.6	15	3	0.5
Dilatation tank	62	0.9	15	4	0.6
Water pump	326	4.8	15	22	3.6
Site preparation and ground gravel	440	6.4	-	(*) 44	7.2
Assembly and installation	1835	26.9	-	(*) 184	30.0
Total	6 814	100.0	-	614	100.0
Per square meter	17.7	-	-	1.6	-

(*) It was calculated over 10 years (Hickman and Klonsky, 1993; Estes *et al.*, 1999).

Table 2: Variable (direct) costs for organic greenhouse cucumber production

Operations	Total cost (\$)	%
Ploughing (machine labour)	11	2.3
Hoeing (labour)	6	1.3
Fertilize (labour)	6	1.3
Organic fertilizer (chicken) (350 kg)	2	0.4
Organic fertilizer (cattle) (300 kg)	2	0.4
Bioplasm (2.2 lt)	13	2.8
E-2001 (0.012 lt)	1	0.2
Planting (labour)	5	1.1
Seedling (480 seed)	66	13.9
Irrigation (labour)	11	2.3
Electricity (80 KW/h)	11	2.3
Pruning and training (labour)	20	4.2
Fungicide and insecticide application (labour)	10	2.1
Neem oil (0.80 lt)	16	3.4
Neem azal (0.12 lt)	3	0.6
Pyrethrum (0.22 lt)	8	1.7
Soft soap (9 kg)	10	2.1
Alcohol (3 lt)	2	0.4
Sulphur (1.4 kg)	1	0.2
Yellow trap (2 kg)	2	0.4
Glue (for traps) (4 tube)	4	0.9
Inspection and certification	129	27.2
Packaging (labour)	47	9.9
Wrapping (labour)	7	1.5
Nylon wrapping (20 kg)	44	9.3
Hauling	37	7.8
Total	474	100.0
Per square meter	1.23	-

Table 3: Total costs of organic greenhouse cucumber

Items	Total costs (\$)	%
Variable costs (1)	474	35.5
Fixed costs (2)		
Interest on total initial investment costs	477	35.8
Annual initial investment costs	307	23.0
Interest on total variable costs	33	2.5
Administrative costs	14	1.0
Total	831	62.3
Land rent (3)	29	2.2
Total (1+ 2+ 3)	1 334	100.0
Per square meter	3.47	-

Table 4: Total gross revenue obtained from organic greenhouse cucumbers

Marketable yield (kg)	Price (\$/kg)	Gross revenue (\$)
1555	0.4	622
3629	0.3	1 089
Total		1711
Per square meter		4.45

Table 5: Net return obtained from organic greenhouse cucumbers

Items	Total (\$)	Proportion of revenue (%)
Total gross revenue	1711	100.0
Variable costs	474	27.7
Fixed costs	831	48.6
Land rent	29	1.7
Total costs	1334	78.0
Net return	377	22.0
Net return per square meter	0.98	-

Costs: In this study, itemized expenses associated with the production of organic greenhouse cucumbers are given in Tables 1, 2 and 3.

Table 1 presents initial investment costs to construct the organic cucumber producing greenhouse. Initial investment costs were determined to be 6 814 dollars for 384 square meter. Initial investment costs per square meter were calculated to be 17.7 dollars. Galvanized frame and kit, base locking rail and assembly and installation costs were 76.6 percent of the total initial investment costs. Annual initial investment costs were calculated to be 614 dollars. But most farmers grow two crops per year in the region. Thus, annual initial investment costs were estimated to be 307 dollars for organic cucumber production in spring.

Greenhouse production is more expensive than producing the same crop in the field, but it is difficult to generalize about how much more expensive. In estimating construction cost of a new greenhouse range, different factors may be included: greenhouse frame and cover, environmental control system, head houses and plant growing systems. A commercial greenhouse (279 square meter) with complete heating, cooling and ventilation systems will cost between 10 000 and 30 000 dollars to erect and equip. Low cost greenhouses - like hoop houses and attached solar greenhouses - can be constructed for as little as 500 to 1 500 dollars (Greer and Diver, 2000). In 1993, a modern greenhouse, exclusive of land was estimated to be 90-100 dollars per square meter when the hydroponics plant growing system was included. Cost for some glasshouse ranges are as high as 140 dollars per square meter (Jensen and Malter, 1995). For just the greenhouse structure and equipment, 1998 estimates for California were 52 dollars per square meter (Hickman, 1998).

In San Joaquin Valley of California, equipment and building costs were calculated to be 95 850 dollars for 1 860 square meter greenhouse, metal with double-layer polyethylene covering (Hickman and Klonsky, 1993). In Virginia, pipe-frame greenhouse and heating-ventilating equipment were 22 dollars per square meter (Odell, 1995).

Total and annual investment costs could differ from the specified amount if a grower decide to install a more elaborate environmental control system, different substrate materials were used, or multiple gutter-connected houses were built. Multiple

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greenhouse would increase the total expenditure but likely would reduce the prorated cost per square meter because economy gains would be realized and bulk quantity purchases would reduce the price paid per item.

Table 2 focuses on variable costs associated with the production of organic greenhouse cucumbers. Total variable costs for growing organic greenhouse cucumber were determined to be 474 dollars. Variable costs per square meter were calculated to be 1.23 dollars. Inspection and certification costs were 27.2 percent of total variable costs. In addition, labor and seedling costs were 23.7 and 13.9 percent of total variable costs, respectively. However, variable costs per square meter were determined to be 36 dollars for cucumber crop in 1 860 square meter greenhouse for California (Hickman and Klonsky, 1993). On the other hand, variable costs per acre of production for organic cucumber were determined to be 2 618 dollars in New Jersey.

Table 3 summarizes cost information. Total costs of organic cucumber tomato production were determined to be 1 334 dollars. Total costs were calculated to be 3.47 dollars per square meter. Variable and fixed costs and land rent were 35.5, 62.3 and 2.2 percent of the total costs, respectively.

In this study, cost to produce 1 kg of organic greenhouse cucumber was calculated to be 0.26 dollars (1 334 dollars / 5 184 kg = 0.26 dollars). However, cost to produce 1 kg of greenhouse cucumber was determined to be 1.5 dollars in 1 860 square meter greenhouse for California (Hickman and Klonsky, 1993).

Marketing and pricing: The harvested organic greenhouse cucumbers were marketed at specific organic shops and supermarkets after packed in PE bags.

Most greenhouse cucumbers are marketed locally at grocery stores and roadside stands, but some growers retail a portion of their crop. Greenhouse cucumbers are considered to have higher quality cucumbers than field grown cucumbers and do not compete directly on price. The market price for most greenhouse cucumbers is around 1.65 dollars per kg (Greer and Diver, 2000). Organic vegetables, like many fresh market commodities, are highly perishable product. Growers must harvest, pack and sell their products in an expedient manner to receive satisfactory returns. Therefore, from a marketing perspective vegetables carry a greater risk than such storable commodities as nuts and grains (Diver *et al.*, 1999).

Commodities that are produced organically can often be sold for a premium price over conventionally grown products. However, the industry is extremely competitive and returns to growers are dictated by the total supply, consumer demand and the available organic outlets. Market saturation often occurs. Growers may then be forced to accept lower returns and/or market their product without the organic designation at conventional prices. In addition, growers may chose to sell their products through organic produce brokers, wholesalers, or direct markets in surrounding areas. On the other hand, for smaller growers, direct sales at their greenhouse, grower cooperatives, farmers markets, or special outlets, such as organic and health food stores are all viable options (NCCE, 1999).

On the other hand, Organic greenhouse production is also attractive because many greenhouses are already virtually pesticide free. However, developing fertility practices acceptable to certifying agencies, while at the same time maintaining current yields is a major obstacle (Miles and Peet, 2000).

In Turkey, most organic vegetables are marketed at supermarkets and hypermarkets. Organic vegetables must be certified. In addition, they are packed and stamped. Consumers paid higher price for organic products than conventionally grown products. Organic cucumbers are produced with contract. Customer and proceeding firms provide some technical help to growers (credit, input, advisory, etc.). Thus, the selling guaranty is offered to growers by firms. However, firms pay to growers encourage

premium per kg of organic product. In this study, it was determined that 30 percent of the cucumbers were sold for 0.4 dollars per kg and the rest was 0.3 dollars/kg.

However, organic products can be sold with a higher price than the conventional ones. Commodities that are produced organically can often be sold for a premium price over conventionally grown products. Buyers were found willing to pay a 25-35 percent price premium for organically grown vegetables (Estes *et al.*, 1999; Akgungor *et al.*, 1999).

Gross revenue and net return: Total gross revenue obtained from organic greenhouse cucumbers was determined to be 1 711 dollars. Thus, gross revenue per square meter was calculated to be 4.45 dollars (Table 4). Total costs of organic greenhouse cucumber production were determined to be 1 334 dollars. Therefore, net return was calculated to be 377 dollars (Table 5). Net return per square meter was estimated to be 0.98 dollars. However, net return per kg obtained from organic greenhouse cucumber was calculated to be 0.07 dollars (377 dollars / 5 184 kg = 0.07 dollars).

For readers convenience, the figures listed in right side column of Table 5 are the percentage amounts that each item represent of gross revenue. For example, variable costs were 27.7 percent of gross revenue while fixed costs were 48.6 percent of gross revenues.

Organic cucumbers are not easy crop to grow in a greenhouse and success depends on how well the growers can manage the crop and make the right decisions at the right time. In addition, total supply, consumer demand, pricing, perishable of the product, and market structure are all factors that contribute to a grower's ability to sell his/her product. Therefore, production and market risks both affect the profitability and economic viability of organically grown vegetables. In all cases the risks associated with organic vegetable operations should not be minimized.

On the other hand, a greenhouse facility is an expensive structure to build, equip and operate while greenhouse cucumbers are expensive to grow, harvest and handle relative to many other agricultural commodities. High investment and production cost require that volume and/or price must be sufficiently large to ensure economic feasibility.

Growers must evaluate circumstances to determine if the lower price usually paid by wholesalers and supermarkets is sufficient to cover production and handling costs so that a profit is realized. Most greenhouse cucumber growers recognize that marketing and cost interact and failure to consider both in a business plan will result in economic failure.

According to study, organic greenhouse cucumber production is profitable for growers. But growers should gather all the economic data they can about the greenhouse vegetable business and market conditions of organic products before building a greenhouse. Also, take a look at other greenhouse business enterprises and determine if organic greenhouse vegetables are really the best deal.

Cost and return information should be viewed as only one of many possible outcomes. Although cost and return estimates are believed to be typical and realistic, individual grower should adjust values to represent their specific situation and circumstances.

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