THE ECONOMICS OF IRRIGATED FRESH MARKET VEGETABLE CROP PRODUCTION IN SOUTHEASTERN OKLAHOMA

By

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CHAPTER I

PROBLEM SITUATION

Introduction

The economy of southeastern Oklahoma relies heavily on agriculture (U.S. Army Corps of Engineers, 1982). Most farmers in the area operate relatively small acreages and use low levels of management and technology (Williams and Badger, 1982). In 1982, more than one- third of the farms in the region had less than 100 acres (U.S. Department of Commerce, 1984). Nearly 55 percent of the farms had sales less than $5000, while just 14 percent of the farms had sales greater than $20,000 (U.S. Department of Commerce, 1984).

The economy has not experienced the level of development that is evident in other areas of Oklahoma. Manufacturing, trades, and services have not compensated for depressed farm income, hence the entire economy of the region is depressed (Williams and Badger, 1982).

Per capita income of southeastern Oklahoma in 1980 was 70 percent of the state average and 67 percent of the national average. Working age residents tend to leave the area in search of better livelihoods, due to a lack of higher paying jobs (U.S. Army Corps of Engineers, 1982).

In southeastern Oklahoma a transition to a pasture and hay farming pattern from a substantial reliance on row crops began immediately following World War II and accelerated during the 1960's and 1970's (U.S. Army Corps of Engineers, 1982). The result was increased unemployment and substantial declines in rural communities.

Part-time farming now predominates among agricultural operations in the region. Approximately 60 percent of farm operators in southeastern Oklahoma have an occupation other than farming. Over one-half of the farm operators spend more than 200 days of the year working off of the farm. The typical operator is between 50 and 53 years of age (U.S. Department of Commerce, 1984).

The region does have substantial, undeveloped natural resources. Among these are abundant water, fertile bottomland, and a long growing season, favorable for the production of crops. One way that southeastern Oklahoma residents could increase their standard of living is by more fully utilizing these resources to improve the productivity of local agriculture (Williams and Badger, 1982). Opportunities exist for the production of traditional crops and high value vegetablecrops on the numerous bottomlands in the region (Schatzer, et al., 1986a).

American diets are shifting toward a low calorie intake and foods low in saturated fats. U.S. per capita consumption of high-quality fresh vegetables is increasing, which generates upward pressure on prices for vegetables (U.S. Department of Agriculture, 1985).

The introduction or expansion of vegetable enterprises in southeastern Oklahoma is dependent on irrigation (Williams and Badger, 1982). While southeastern Oklahoma is a region with a relatively high amount of rainfall, timely application of water is necessary in vegetable production. Irrigation is needed to supplement rainfall during part of the growing season in southeastern Oklahoma (Schatzer, et al., 1986b).

Ground water, water that has percolated downward from the surface to subsurface storage basins (aquifers), is available for irrigation in many locations in southeastern Oklahoma. Major ground water basins, or aquifers, in southeastern Oklahoma are the Antlers Sandstone along the southern border of the area, the Arbuckle Group and the Simpson Group in the western counties of the area, and the Alluvium and Terrace Deposits of the Canadian River in northern counties of the area. The Antlers Sandstone is a large deposit with average yields of 100-150 gallons per minute. The quality of the water is suitable for irrigation and other uses. The Arbuckle Group has been known to produce large yields, 200-500 gallons per minute, of good quality water. Wells in the Simpson Group can yield 100-200 gallons per minute, and the water is good quality at most of its locations (Oklahoma Water Resources Board, 1984).

Currently, a lack of information on the economics of irrigation of vegetable crops in southeastern Oklahoma exists and is a major barrier to development of the use of water resources in the area. Emphasis in this study is given to evaluating the economics of various irrigation systems in fresh market vegetable production on a representative farm in southeastern Oklahoma.

The study region of this thesis includes fourteen counties in southeastern Oklahoma (Figure 1). Roughly, the boundaries of the region are Interstate 40, U.S. Highway 177, and the eastern and southern borders of Oklahoma. The study region is not homogeneous. Each county in the region contains different resources, problems, and opportunities. But some potential for irrigated vegetable crop production exists in each county, and in some counties the potential is great.

Objectives of the Study

The overall objective of the study is to develop a decision framework for farmers to use to determine whether to include irrigated fresh market vegetable

OKLAHOMA

Figure 1. Study Area

crop systems in their farm enterprise mix. Specific objectives addressed in this thesis are as follows:

1. To estimate the relative costs and returns of irrigated fresh market vegetable crop systems.
2. To estimate the cash flows that result from the introduction of irrigatedfresh market vegetable crop systems into farm enterprise mixes.
3. To evaluate the relative economic feasibilities of incorporation of irrigated fresh market vegetable crop systems into a southeastern Oklahoma farm operation.

Procedures

Enterprise costs, returns, and cash flows are highly dependent upon an individual farmer's resources. Since this study cannot duplicate every farm in the study region, a representative southeastern Oklahoma farm was specified and analyzed. The soils and topography of this farm were specified based on soil survey information from the study region. The crop mix and the livestock situation of the farm were specified based on southeastern Oklahoma information published by the United States Census Bureau and the Oklahoma Department of Agriculture, and from personal interviews with Co-operative Extension personnel.

The costs of irrigation systems, including furrow (surface), sprinkler (handmove), and drip (biwall pipe) systems, were estimated for irrigated fresh market vegetable crop systems. The costs of the different irrigation systems were used to update selected southeastern Oklahoma vegetable budgets.

Nonvegetable crop and livestock budgets were developed based on the crop mix and the livestock situation of the representative farm. Using a simulation model, projected cash returns for the farm, with and without the investments in alternative irrigated vegetable crop systems, were generated and compared to evaluate the economic effects of potential vegetable enterprises on the representative farm.

CHAPTER II

LITERATURE REVIEW

Important decisions which must be made by an existing crop and livestock producer contemplating the addition of vegetable enterprises include how to produce, how to market, and what type of irrigation system to use. Scientists at various institutions have performed research and developed information on the production and marketing of vegetable crops as well as on the irrigation of vegetable crops. Findings on the topics of production, marketing, and irrigation of vegetable crops, along with sources for additional information, are discussed in this chapter.

Production

Williams and Badger (1982) obtained a profile of southeastern Oklahoma's agricultural resources and its people. A survey was used to solicit input from people in the project area. The study determined that traditional enterprises are poor prospects for increasing farm incomes, so interest in alternative enterprises such as vegetable production was growing.

In a study of the characteristics of Oklahoma vegetable producers, Tilley and Schatzer (1985) found most Oklahoma vegetable producers operate diversified farms. These producers also had a wide range of gross farm incomes. A large portion of the producers had less than five years of experience producing horticultural crops. Therefore, vegetable production was fairly new to a sizeable portion of the producers in Oklahoma. Most Oklahoma vegetable producers were more experienced in producing traditional crops than in producing horticultural crops.

Some producers in Oklahoma may find vegetable production highly profitable on a small scale, according to a study by Schatzer, et al. (1986a). In that study, costs and returns were estimated for selected fresh market vegetables that can be grown commercially in Oklahoma. Potentially large profits may be obtained from bell peppers, cucumbers, eggplant, broccoli, spinach, sweet corn, and staked tomatoes; but risks are also quite high, according to the study.

Schatzer, et al., (1986a) stated that quality of vegetables can greatly affect prices and may be influenced by many factors, including weather, soil conditions, handling, storage, weeds, insects, and disease. The control of these factors by management was specified as being very important to successful vegetable production.

Marketing

In a study to determine buying behavior of different market participants, Tilley, et al. (1986a) found southeastern Oklahoma has the potential to become a major regional supplier of fruits and vegetables. The major factors determined to influence purchases from new supply areas are (1) the ability of producers in the supply area to provide consistent quality (near 95 on a 99-point scale), and (2) the ability to provide proper grading, packaging and temperatures. Markets for Oklahoma producers are accessible if these criteria are met.

Tilley, et al. (1986b) were interested in characteristics of Oklahoma horticultural producers and in locations of new packing facilities. Their study determined new packing facilities have been established in Oklahoma.

Furthermore, operators of these packing facilities have been working with farmers that have limited production experience.

Quality may be influenced by many things, including many management practices. Good quality is necessary to insure profitable prices; profits in vegetable production depend on marketable yield. High yields are desirable, but in addition high quality is necessary to insure marketability (Schatzer, et al., 1986b).

High yields without quality can be unprofitable, as marketable yield is the key to profits in vegetable production (Schatzer, et al., 1986a). Marketable yield is the amount of production that is of adequate quality to be marketed.

In summarizing results of a survey of vegetable producers in Oklahoma in 1984, Tilley and Schatzer (1985) found present producers of vegetable crops in Oklahoma are using many different market outlets, including roadside stands, direct sales to grocery stores and restaurants, brokers and wholesalers, pick-your-own outlets, farmers' markets, processors, and terminal markets. The last two options are the least used markets. Brokers and wholesalers are the most popular outlet of full-time producers. Producers have two main considerations when seeking a market---reliability or consistency and favorable prices.

They also found evaluation of potential buyer needs is important before making production decisions. Quality, packaging, and delivery requirements of various buyers are important producer considerations for determining marketing strategies.

In addition, they determined marketing is a key to future development of the fresh vegetable industry in Oklahoma. Marketing outlets are in demand. As the outlets have become available in Oklahoma, farmers have been eager to begin production of vegetables to supply them (Tilley and Schatzer, 1985).

Coordination of production expansion with marketing expansion is critical in the development of the industry.

Tilley, et al. (1986a) determined market access to be critical to the success of Oklahoma vegetable enterprises. Southeastern Oklahoma has the potential to produce crops at times when wholesalers within a 300- mile radius have an interest in the crops. Most wholesaler interest was found to be in cantaloupes, cucumbers, bell peppers, peaches, tomatoes, and squash; least interest was indicated for spinach, okra, blackberries, and asparagus.

Irrigation

The introduction or expansion of horticultural enterprises in southeastern Oklahoma is largely dependent on irrigation possibilities (Williams and Badger,1982). Irrigation is needed to supplement the rainfall during part of the growing season in southeastern Oklahoma if vegetable producers are to produce vegetables that meet the quality, quantity, and timing requirements of non-direct fresh markets (Schatzer, et al., 1986b).

Good management is necessary in designing and financing an irrigation system. The wide variety of equipment and components for the many types of irrigation systems makes final selection difficult (Berry Patch). There are three major types of irrigation systems which are commonly used with vegetable enterprises--furrow, sprinkler, and drip types.

Dale, et al., (1987) evaluated the economics of surface water irrigation of vegetables in southeastern Oklahoma from constructed ponds. In the study, alternative irrigation systems for vegetable production in southeastern Oklahoma were also evaluated. A conclusion of the study was that substantial increases in ending cash flows and net returns could be generated by a producer joining a six member irrigation district instead of investing in an individually owned surface water collection structure. This finding resulted because of economies of size associated with construction of large surface water impoundment structures. Dale, et al., (1987) assumed no costs associated with forming irrigation districts. Such costs could offset the economies of size in structure construction.

Bajwa (1985) performed a study in Florida to observe the advantages of various irrigation technologies. Trickle irrigation systems were heavily adopted in Florida for citrus production, because of advantages of both lower initial investment costs and lower operating costs as compared with permanent sprinklers and traveling gun systems (Bajwa, 1985).

Schwab (1981) lists six basic requirements for a successful irrigation project. They are (1) an adequate water supply, (2) suitable water quality, (3) an irrigable soil, (4) a responsive crop, (5) a favorable market, and (6) capable management.

For irrigation to be successful, water supply must be adequate in quantity and dependability. The amount of water required depends on climate, weather, soil type, kind of crop and stage of growth of the crop. Water quality refers to the chemical suitability of water for irrigation use. Salt concentration is a major consideration. Water intake rate, available soil moisture, soil profile characteristics, and basic fertility are the determinants of an irrigable soil. Irrigation should be beneficial, affecting the yields and quality of a responsive crop (Schwab, 1981).

Additional Information

Numerous fact sheets are available at Oklahoma State University on topics dealing with vegetable production. Most of the information on the production and marketing of various vegetable crops is available in an

Oklahoma State University Cooperative Extension reference notebook entitled Alternative Agricultural Enterprises: Fruits and Vegetables (OSU Cooperative Extension Service, 1988). The purpose of this notebook is to serve as a reference source for Oklahoma State University Cooperative Extension personnel and other agricultural professionals as they work with Oklahoma farmers.

CHAPTER III

ANALYTICAL PROCEDURES AND DATA

This section includes descriptions of the analytical procedures used to address the objectives, the necessary data to carry out the procedures, and related resource assumptions.

A representative farm was developed for the study region. The initial crop mix was specified for the representative farm. The associated costs, net returns, and cash flows of the farm were then developed. The representative farm's economic and financial situation was then analyzed for thirty-six irrigated fresh market vegetable systems. These thirty-six systems were developed considering four vegetable acreages (1.0, 2.5, 5.0, and 10.0 acres), three irrigation technologies (furrow, sprinkler, and drip), and three vegetable crop activities.

A computerized financial analysis package, Integrated Farm Financial Statements (IFFS) (Mapp, et al., 1985), was used to analyze the possible activities. Personal and family cash inflows and outflows that do not directly relate to farm cash flow were not considered.

Enterprise budgets were selected based on the initial crop mix of the representative farm and vegetable crop activities considered in this study. Cash flow information from the budgets was summarized by month with the IFFS financial analysis package.

Budgets selected for vegetable crop activities require irrigation cost information. Irrigation systems were designed, and costs of the components of the systems were determined from irrigation supplier's catalogs (Berkeley Pump Catalog, 1987; General Irrigation Catalog, 1987; Better Way to Water, A, 1986-87; Cozad, 1987). These costs were then included in the vegetable crop budgets used in this study.

Representative Farm

The soil and topography situation of the representative farm were determined from Oklahoma soil surveys of the counties in the study region (U.S. Department of Agriculture, Soil Conservation Service, 1979). The crop mix and livestock situation of the farm was determined from southeastern Oklahoma information published by the United States Census Bureau (U.S. Department of Commerce, Bureau of the Census, 1984) and the Oklahoma Department of Agriculture (Oklahoma Department of Agriculture, 1984), as well as from interviews with Cooperative Extension personnel (Hobbs, 1987; Maxson, 1987).

Table I contains the acres of crops and numbers of livestock on the representative farm. To develop the farm description, data were collected by county. Collected data included acres harvested by crop, numbers of livestock, and occupation and age of the farm operator. The appropriateness of the acres of crops and numbers of livestock were reviewed by area agricultural extension personnel (Hobbs, 1987; Maxson, 1987).

Further information developed for the farm included soil and topography information. Soil survey publications (U.S. Department of Agriculture, 1979) were used for this information, as well as information from personnel with the United States Department of Agriculture, Soil Conservation Service (Mosley, 1987). From these sources, the amount of bottomland and unusable land were determined. The amount of bottomland was determined to be adequate for the introduction of vegetable crop production in the study region.

TABLE I

CROP ACRES AND LIVESTOCK NUMBERS
ON REPRESENTATIVE FARM

Farm Size (acres)	160				
Harvested Cropland (acres)		43			
Wheat			20		43
Soybeans			5		
Hays			18		
Alfalfa				5	18
Bermuda				13	
Improved Pasture, Bermuda (acres)		20			
Native Range, Unimproved (acres)		72			
Pastured Woodland (acres)		15			
Woodland (acres)		5			
Farmstead (acres)		5			
Beef cows (number of head)		25			

Enterprise Budgets

Nonvegetable enterprise budgets were selected from the OSU Enterprise Budget Book (Farm Management Extension, 1987) for the representative farm. These budgets contain detailed input and output information for producing crops and livestock. Input information includes units, quantities, and costs. Costs are divided into operating costs and fixed costs. Operating costs include items such as fertilizer, lime and chemicals, rental of machinery, labor, annual operating capital, fuel and lube of owned machinery, seeds, plants, other supplies, and variable machinery costs (repairs, fuel, and lube). Fixed costs include items such as interest, depreciation, taxes, and insurance on machinery, and taxes on land. Output information contained in the budgets includes items such as production units, quantities, and prices. The budgets contain detailed information on production practices, including dates and levels of required field work, chemicals, supplies, irrigation water, labor, and machinery. The budgets were adapted to climatic and agronomic conditions of southeastern Oklahoma. The appendix contains all budgets used in this study.

The machinery and equipment set used in the budgets was modified to represent that for a typical situation in southeastern Oklahoma. It was assumed that machinery and land are owned. The machinery was assumed to be between eight and fifteen years of age. Machinery values were determined from National Farm Tractor and Implement Blue Books (1981-86), depreciation schedules, and information from local implement dealership personnel (Albright, 1987; Kirby, 1987). Fencing and barns are associated with repair and maintenance costs in land-based budgets. In crop and hay budgets, custom baling and custom harvesting were assumed. Current custom work charges were determined from "Oklahoma Farm and Ranch Custom Rates, 1986-87" (Nelson and Kletke, 1987).

Production data comprise a large portion of the data requirements in the vegetable budgets. Production data, including fertilizer, pesticides, seed, and harvesting costs used in this study, are based on crop enterprise budgets developed by Schatzer, et al. (1986a) (Appendix).

Many vegetable crop varieties are well adapted to the climatic and agronomic conditions of southeastern Oklahoma. Vegetable activities were selected to be incorporated into the existing farm plan based on projected profits, level of irrigation water usage, level of management required, and marketability. Previous research in these areas was considered (Dale, et al., 1987; Tilley, et al., 1986a; Schatzer, et al., 1986b) as well as information from Oklahoma State University Extension Horticulture personnel (Motes, 1988). Vegetable crops were not considered if determined to have low profits, an extremely high level of management required, or low marketability in the study region. Table II contains a list of the vegetable crop activities considered in this study.

Management practices contained in the vegetable budgets were reviewed by horticulture specialists (Motes, 1988). This information included dates for field work and times and amounts of applications of chemicals and irrigation water.

The additional machinery used in the vegetable budgets was based on the minimal needs of a farmer on a representative farm introducing vegetable enterprises. After introducing vegetable crops, the farmer may need to purchase some additional machinery such as a cultibedder tiller, a planter, a transplanter, a flatbed trailer, a rototiller, and an additional sprayer. The additional machinery needed will vary, depending on the vegetable crop activity

TABLE II

VEGETABLE CROP ACTIVITIES CONSIDERED

1. **Spring Broccoli (Transplanted) followed by Fall Spinach**
2. **Okra, alone**
3. **Tomatoes followed by Fall Broccoli (Seeded)**

added to the farm plan. Current prices for insecticides, fungicides, nematicides, bactericides, and herbicides were included in the budgets (Criswell, 1988). These prices were based on current prices obtained from chemical suppliers.

For purposes of calculating the water needs of the vegetable enterprises considered, irrigation periods were specified on a quarter-month basis. Irrigation water requirements were calculated based on total needs of the vegetable crop and expected rainfall by irrigation period.

Precipitation amounts were collected by irrigation period from Atoka county reporting station information (National Climatic Data Center, 1976-85). This information was collected for a ten-year period and averaged for each irrigation period. Evapo- transpiration (ET) requirements, the total requirements of a vegetable plant due to evaporation of water into the air and transpiration of water by vegetable plants, were used as the minimum total requirements of water for the vegetable crops considered. Total needs of vegetables considered (ET) were obtained from horticulture research information (Motes, 1988). Rainfall per irrigation period was subtracted from the vegetables' total irrigation period requirements (ET). The resulting amount is the amount required to be added by irrigation. These resulting amounts are shown in Table III, according to the irrigation period when the amounts are likely to be needed. The total amount of irrigation water needed by month for each vegetable is listed in parentheses below the irrigation period amounts. It was assumed that actual application of irrigation water will be no less than one acre inch per irrigation period. The times and amounts of application of irrigation water will vary as precipitation times and amounts vary from year to year.

Post-harvesting expenses such as cooling, packaging, washing, and transportation increase production costs for producers. Transportation costs vary greatly depending on freight supply and demand. Assumed harvesting

TABLE III

APPROXIMATE SUPPLEMENTAL WATER APPLICATION AMOUNTS, BY VEGETABLE CROP (IN INCHES)

	MAR	APR	MAY	JUN	JUL
Fll. Brocc.(seeded)					
Fall Spinach					
Okra			.5 (0.5)	.5 1 .5 .25 (2.25)	1 1 2 1 (5.0)
Spr. Brocc.(transpl.)	.5 .5 (1.0)	1 .5 .5 (2.0)	1 (1.0)		
Tomatoes		1 .5 .5 (2.0)	1 (1.0)	1 1 1 1.25 (4.25)	2 2 2 1 (7.0)

	AUG	SEP	OCT	NOV	TOTAL
Fll. Brocc.(seeded)	1 1 1.5 1 (4.5)	1 1 1 1 (4.0)	1 1 .5 (2.5)		11
Fall Spinach		1 1 (2.0)	1 .5 (1.5)		3.5
Okra	.5 .5 1.5 1 (3.5)	.5 .5 1 1 (3.0)			14.25
Spr. Brocc.(transpl.)					4
Tomatoes					14.25

and marketing costs are shown in the budgets (Appendix). Variability can also occur in prices received for produce. Assumed prices are shown in the budgets (Appendix).

Irrigation Costs

Three types of irrigation systems are considered: a furrow (surface) system, a sprinkler (handmove) system, and a drip (biwall pipe) system. Large variation exists in the investment costs of these systems, as well as in their efficiencies of application of irrigation water. Furrow systems are characteristically the type of system with lowest investment costs, followed by sprinkler systems, with drip systems requiring the highest investments. However, drip systems are the most efficient in applying irrigation water followed by sprinkler systems and then furrow systems.

Irrigation System Descriptions

In a furrow irrigation system, water is applied through furrows between the rows of plants. Water runs down the furrows and filters into the soil to refill the soil moisture reservoir. It generally requires a smaller initial investment than other types of systems. Furrow irrigation may have a problem of unsteady, nonuniform flow. A flat terrain and fields of regular shapes are preferred for this type of system. This system is not suitable for sandy soils.

Water is delivered through a mainline from the source of water supply to lateral lines in a sprinkler irrigation system. Water is discharged above the crop or soil surface through sprinkler heads on riser pipes attached to the laterals. Each sprinkler head applies water to a circular area with the diameter controlled by nozzle size and pressure (Rain Bird, 1971). A sprinkler system requires a moderately high initial investment. Erosion can be controlled, and efficient irrigation is possible on sloping soils with this system. More even application of water is possible than with surface systems. Less interference with other field operations is possible, as is a higher water application efficiency.

In a drip irrigation system, water is applied frequently at a slow rate near the plant. Water is used most efficiently with this system, due to limited evaporation, reduced water runoff, increased ability of the soil to store water from rainfall, and deposition of water near the roots of the plant. This system is sensitive to stoppages and clogging, so filtration is necessary. A relatively high initial investment is required for a drip irrigation system.

Irrigation System Designs

Potential irrigation system layouts were designed for each of the system types, for each of the acreages of vegetable crop production considered in this study (1.0, 2.5, 5.0, and 10.0 acres). Designs for these systems are contained in Figures 2, 3, and 4.

System costs were calculated by estimating and aggregating costs of individual components. Prices of each component for each system for each acreage were determined from current catalogs of irrigation system equipment suppliers (Berkeley Pump Catalog, 1987; General Irrigation Catalog, 1987; Better Way to Water, A, 1986-87; Cozad, 1987). These component costs were aggregated to estimate investment costs of irrigation systems (Table IV).

Special consideration, while designing the systems, was given to efficiencies of the systems in applying water. Efficiencies assumed, based on agricultural engineering information (Kizer, 1987), were furrow--50 percent; handmove sprinkler--70 percent; and biwall pipe drip--90 percent. Special consideration was also given to gallons per minute requirements of the systems to meet the typical needs of vegetable crops. Current power costs for the

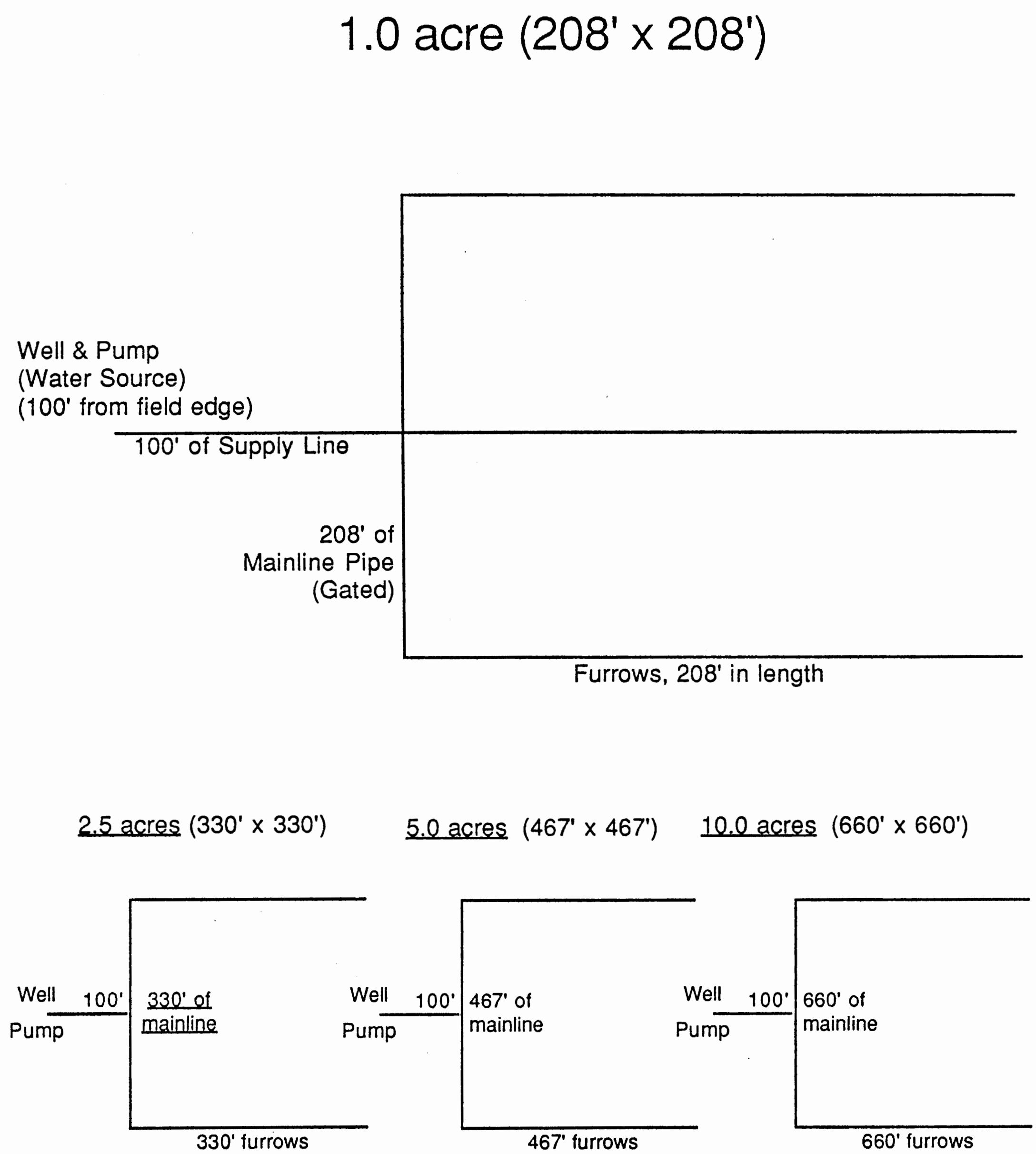


Figure 2. Designs of Furrow Irrigation Systems

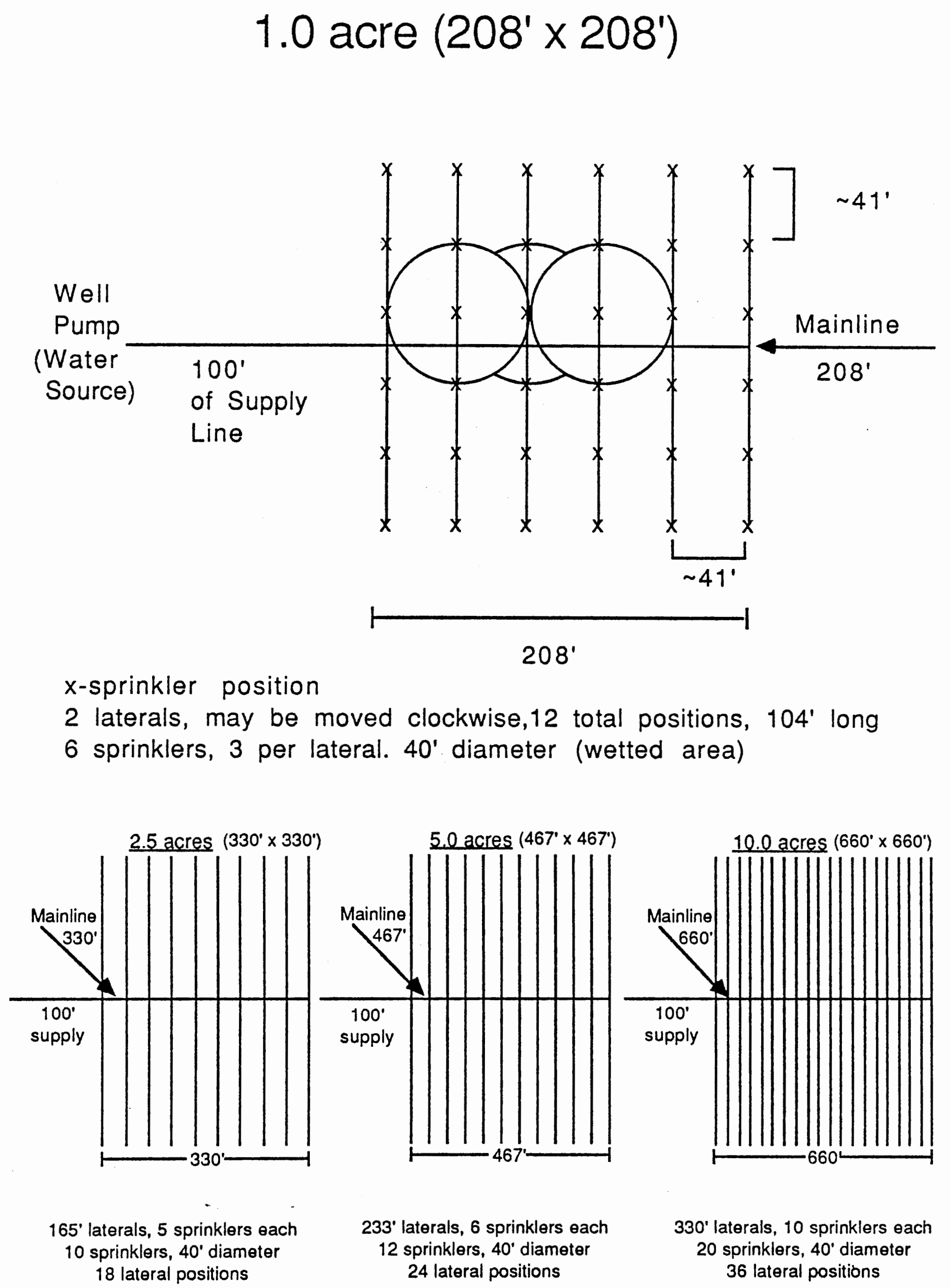
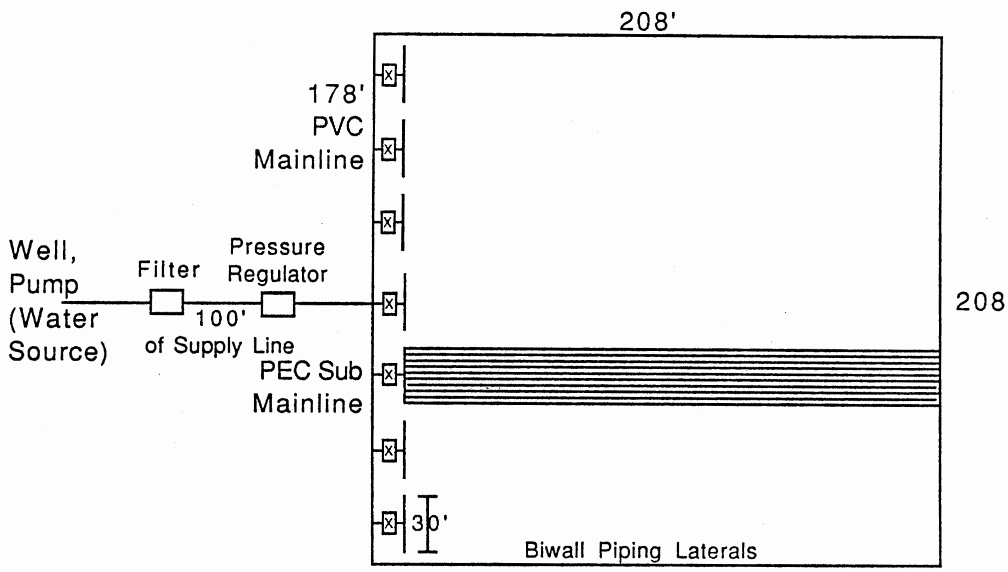


Figure 3. Designs of Sprinkler Irrigation Systems

1.0 acre (208' x 208')



- Valve

30' PEC Segments

~70 total rows

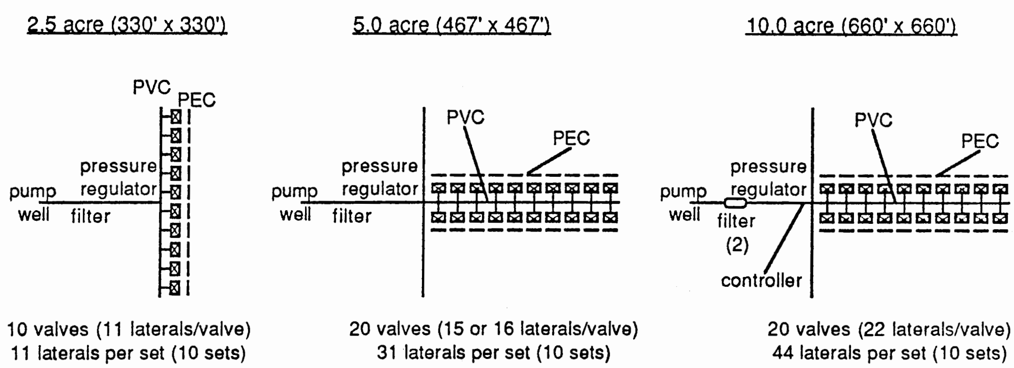


Figure 4. Designs of Drip Irrigation Systems

TABLE IV

INVESTMENT COSTS OF IRRIGATION SYSTEMS, BY IRRIGATION SYSTEM, BY VEGETABLE SYSTEM ACREAGE, TOTAL INVESTMENT AND TOTAL INVESTMENT PER ACRE

	Total Investment	Total Investment Per Acre
Drip (Biwall Pipe) Systems		
1.0 acre	$3,830	$3,830
2.5 acres	6,143	2,457
5.0 acres	12,088	2,418
10.0 acres	21,156	2,116
Sprinkler (Handmove) Systems		
1.0 acre	2,269	2,269
2.5 acres	4,031	1,612
5.0 acres	5,281	1,056
10.0 acres	7,478	748
Furrow (Surface) Systems		
1.0 acre	1,733	1,733
2.5 acres	2,143	857
5.0 acres	2,336	467
10.0 acres	3,287	329

southeastern Oklahoma region were used to calculate charges for electrical power (Kizer, 1987).

Specific procedures in the operation of the irrigation systems, such as rotations of laterals in handmove sprinkler systems, were considered in designing and determining costs of the systems (Figures 2, 3, and 4). Typical application rates and times were also considered in determining the adequacy of components of the systems such as power units and pipe capacities.

Other information was derived from the investment information. The enterprise budgets require cost information for depreciation, interest, insurance, taxes, repairs, and power. Based on the total acre inches required for each of the three vegetable activities considered in this study, per acre inch costs for the above items were calculated. These costs were included in the vegetable budgets used in the study.

The Integrated Farm Financial Statements Package

The Integrated Farm Financial Statements Package (IFFS) was used to analyze the scenarios considered in this study. The main concern in this study is with costs and returns directly related to farm activities, especially irrigation. The IFFS package includes a net worth statement, a cash flow statement, an income statement, and a debt worksheet. The IFFS package combines the monthly cash flows obtained from the budgets for the farm's enterprises to determine an aggregated cash flow for all enterprises on the farm.

Key Decision Variables

The interest in this study is the change in cash returns to operations and the change in cash returns to the family for family living expenses, due to the introduction of irrigated vegetable production into the farm plan. These changes are important because the family can improve its standard of living by generating increases in cash returns to farm operations and cash returns to family from the farm. Therefore, the two key decision variables for this study are cash returns to operations and cash returns to family.

To calculate the cash returns to operations, net cash farm income is determined from the IFFS system. Then additional principal and interest payments, due to investments in irrigation systems and additional machinery needed for vegetable production, are subtracted from net cash farm income to calculate a value that is designated as cash returns to operations.

Cash available to the family for family living expenses may be increased if the farm family provides some of the labor for the vegetable crop operation. Some problems with labor shortages may be avoided if available unpaid family labor is used, especially in smaller vegetable crop operations. Irrigated vegetable enterprises may be used to provide labor wages to otherwise unemployed or underemployed family members while generating economic returns to land resources and management skills. Labor charges provided by the family plus cash returns to operations are designated as cash returns to family.

For scenarios considered in this study, labor charges represent substantial expenses. The maximum amounts of labor assumed to be provided by the farm operator and family in this study are: 20 hours per week during the months of January, February, March, November, and December; 40 hours per week during the months of April, May, September, and October; and 100 hours per week during the months of June, July, and August. Amounts of labor available from November through March are least, because the amount of daylight during these months is less than any other time during the year, and the farm operator and family are likely to have other obligations for their time such as part-time jobs and school. Labor available during the months of April, May, September, and October is greater, because of more daylight hours per day. During the months of June, July, and August, the family will likely have the most time available to supply labor for the operation due to days with many daylight hours and few, if any, outside obligations for time.

CHAPTER IV

RESULTS

Using procedures and data discussed in Chapter III facilitated calculation of estimates of cash returns to operations and cash returns to family for the original farm scenario. Thirty-six alternative southeastern Oklahoma vegetable crop production scenarios were also considered by varying type of irrigation system, vegetable crop activity, and acres of vegetable crop production.

The original farm scenario represents a farm operation without the introduction of vegetable crop production. On the original farm, cash returns to operations are $942, and total labor charges are $1,826. The sum of cash returns to operations and total labor charges is $2,768, which is cash returns to family for the original or base farm scenario.

Comparison of Furrow Irrigation System Scenarios to the Original Farm Scenario

The furrow irrigation system scenarios address the economics of irrigated vegetable crop production for an individual vegetable crop producer using furrow irrigation. Estimates were made for four different acreages and three different vegetable activities, resulting in twelve total scenarios. Results for the furrow irrigation system scenarios are contained in Table V.

Among the three vegetable activities, the double crop of tomatoes followed by fall broccoli shows the highest cash returns to operations and cash returns to family. One acre of production of tomatoes-fall broccoli results in an increase in

TABLE V

CASH RETURNS TO OPERATIONS, CHANGE FROM BASE FARM IN CASH RETURNS TO OPERATIONS, CASH RETURNS TO FAMILY, AND CHANGE FROM BASE FARM IN CASH RETURNS TO FAMILY FOR THE FURROW IRRIGATION SYSTEM SCENARIOS

Vegetable Activity	Acres in Veg.	Cash Returns to Operations	Change in CR to Operations	Cash Returns to Family	Change in CR to Family
No Vegetables (Base Farm)	0	942	0	2,768	0
Spr. Broc,	1	1,261	319	4,235	1,467
Fll Spin	2.5	3,221	2,279	6,569	3,801
	5	6,076	5,134	10,010	7,242
	10	12,715	11,773	17,137	14,369
Okra	1	221	(621)	3,512	744
	2.5	433	(509)	5,486	2,718
	5	540	(402)	6,698	3,930
	10	1,394	452	8,093	5,325
Tom,	1	1,871	929	6,030	3,262
Fll Broc	2.5	5,072	4,130	10,930	8,162
	5	10,102	9,160	16,494	13,726
	10	20,988	20,046	27,361	24,593

cash returns to operations of $929. One acre of production of the spring broccoli-fall spinach double crop results in an increase in cash returns to operations of only $319. A single acre of okra production actually causes a decrease in cash returns to operations (Table V). This general pattern of changes in cash returns to operations is demonstrated for larger vegetable acreages. Notable economies of size are evidenced for all three crop activities considered throughout the acreages considered. For example, one acre of production of the spring broccoli-fall spinach double crop results in an increase in cash returns to operations of $319; two and one-half acres results in an increase in cash returns to operations of $2,279 or $912 per acre of vegetable production; ten acres results in an increase in cash returns to operations of $11,773, or $1,177 per acre of vegetable production. These results occur due to economies of size for the irrigation system. The impacts of economies of size cause estimated changes in cash returns to operations for okra to change from being negative at small acreages of vegetables to being positive for the 10 acre scenario. For all acreages and crop activities considered, changes in cash returns to family were greatest for tomatoes-fall broccoli and least for okra (Table V).

The tomato-fall broccoli double crop results in the highest cash returns to operations and cash returns to family, even though it is the activity that requires the highest amount of irrigation water to be applied. Expected yields and prices cause cash returns from production of the tomato-fall broccoli double crop to be much larger than cash returns from production of other vegetable activities considered in this study. Thus the tomato-fall broccoli double crop is the most profitable alternative activity considered in this study.

Increases in cash returns to family for the representative farm may be achieved with the addition of vegetable production of any of the three vegetable activities considered in this study. Production of okra may result in lower cash returns to operations than expected with the original farm, while at the same time yielding higher cash returns to family than the original farm, if the family is willing to supply available labor to the vegetable crop operation. The family may receive significant economic benefits from production of any of the vegetable activities considered in this study.

Comparison of Sprinkler Irrigation System Scenarios to Furrow Irrigation System Scenarios

Comparison of results from the sprinkler and furrow irrigation system scenarios facilitates the evaluation of the potential economic benefits to a farm operator from introducing vegetable crop production with the use of a sprinkler technology versus a furrow technology. Results for the sprinkler irrigation system scenarios are contained in Table VI.

Among all vegetable activities and acreages considered, cash returns and changes in cash returns are greater for the furrow system scenarios than for the sprinkler system scenarios. Cash returns to operations and cash returns to family for the production of five acres of tomatoes-fall broccoli are $9,160 and $13,726, respectively, using furrow technology, but just $8,181 and $12,747, respectively, using sprinkler technology (Tables V and VI).

When comparing the sprinkler system scenarios, within a vegetable activity, production of a larger acreage of vegetables results in larger cash returns to operations and cash returns to family than result with production of a smaller acreage of vegetables. Again, economies of size for the irrigation systems are experienced. The per acre vegetables returns increase as number of acres in vegetable production increase.

TABLE VI

CASH RETURNS TO OPERATIONS, CHANGE FROM BASE FARM IN CASH RETURNS TO OPERATIONS, CASH RETURNS TO FAMILY, AND CHANGE FROM BASE FARM IN CASH RETURNS TO FAMILY FOR THE SPRINKLER IRRIGATION SYSTEM SCENARIOS

Vegetable Activity	Acres in Veg.	Cash Returns to Operations	Change in CR to Operations	Cash Returns to Family	Change in CR to Family
No Vegetables (Base Farm)	0	942	0	2,768	0
Spr Broc,	1	1,172	230	4,146	1,378
Fll Spin	2.5	2,932	1,990	6,280	3,512
	5	5,462	4,520	9,396	6,628
	10	11,875	10,933	16,297	13,529
Okra	1	132	(810)	3,423	655
	2.5	149	(793)	5,202	2,434
	5	(213)	(1,155)	5,945	3,177
	10	376	(566)	7,075	4,307
Tom,	1	1,779	837	5,938	3,170
Fll Broc	2.5	4,794	3,852	10,652	7,884
	5	9,123	8,181	15,515	12,747
	10	19,677	18,735	26,050	23,282

As in the furrow system scenarios, within each acreage, the tomato-fall broccoli double crop results in the largest cash returns to operations, change in cash returns to operations, cash returns to family, and change in cash returns to family, even though it is the activity that requires the largest amount of irrigation water. The spring broccoli-fall spinach double crop results in the second largest cash returns figures. The okra activity results in the lowest cash returns figures. Although negative effects in cash returns to operations are expected with the introduction of okra production, the family may benefit from production of okra due to increased cash returns to family if the family supplies labor to the operation.

Comparison of Drip Irrigation System Scenarios to Sprinkler and Furrow Irrigation System Scenarios

Comparison of results from the drip irrigation system scenarios and the sprinkler and furrow irrigation system scenarios facilitates the evaluation of the potential economic benefits to a farm operator from introducing vegetable crop production with the use of a drip technology versus a sprinkler or furrow technology. Results for the drip irrigation system scenarios are contained in Table VII.

Cash returns to operations, change in cash returns to operations, cash returns to family, and change in cash returns to family are smaller with the use of a drip technology than with the use of a sprinkler technology or furrow technology (Tables VI and VII). Within the drip system scenarios, the larger acreages of vegetable production, as expected, result in larger cash returns figures. Also, the tomato-fall broccoli double crop shows largest cash return figures, followed by the spring broccoli-fall spinach double crop, and then the okra activity. Again, okra production may result in negative changes in cash

TABLE VII

CASH RETURNS TO OPERATIONS, CHANGE FROM BASE FARM IN CASH RETURNS TO OPERATIONS, CASH RETURNS TO FAMILY, AND CHANGE FROM BASE FARM IN CASH RETURNS TO FAMILY FOR THE DRIP IRRIGATION SYSTEM SCENARIOS

Vegetable Activity	Acres in Veg.	Cash Returns to Operations	Change in CR to Operations	Cash Returns to Family	Change in CR to Family
No Vegetables (Base Farm)	0	942	0	2,768	0
Spr Broc,	1	443	(499)	3,417	649
Fll Spin	2.5	2,629	1,687	5,977	3,209
	5	4,459	3,517	8,393	5,625
	10	9,668	8,726	14,090	11,322
Okra	1	(102)	(1,044)	3,189	421
	2.5	(139)	(1,081)	4,914	2,146
	5	(1,088)	(2,030)	5,070	2,302
	10	(1,675)	(2,617)	5,024	2,256
Tom,	1	1,573	631	5,732	2,964
Fll Broc	2.5	4,533	3,591	10,391	7,623
	5	8,458	7,516	14,850	12,082
	10	17,853	16,911	24,226	21,458

returns to operations but may result in positive changes in cash returns to family.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Summary and Conclusions

Southeastern Oklahoma is a region with small acreages of level cropland suitable for fresh market vegetable production. Many bottomlands in the region have fertile soils, and water is available in adequate quantity and quality for irrigation of vegetable crops.

The region has labor that is underemployed. Little opportunity exists for off-farm employment. Diversification into irrigated fresh market vegetable production is an option for farm operators in the region to increase cash returns to their farm operations.

Three irrigation systems are appropriate for irrigation of fresh market vegetable crops in the region: furrow systems, sprinkler systems, and drip systems. Costs related to use of these irrigation systems are important considerations of farm operators considering the addition of fresh market vegetable production to existing operations.

Assuming the utilization of such irrigation systems, the economics of incorporating vegetable crops into a representative southeastern Oklahoma crop and livestock farm were evaluated in this study. Three vegetable crop activities (spring broccoli-fall spinach, okra, and tomatoes-fall broccoli) and four vegetable acreages (1.0, 2.0, 5.0, and 10.0 acres) were considered for each type of irrigation system.

Results of this study indicate the introduction of vegetable crop production into a representative southeastern Oklahoma farm could substantially increase cash returns to operations for some vegetable crops and cash returns to family for all vegetable crops considered. As acreage of vegetables increases, benefits due to introduction of vegetable crops increase.

Differences in results due to use of the various irrigation systems occur because of variation in investment, power, and repair costs of the irrigation systems. Largest economic benefits in estimated producers' cash returns to operations and cash returns to family result with the use of furrow technology, followed by the sprinkler technology, and then the drip technology, due largely to the amount of investment costs required for the irrigation systems. It is conceivable that diversification of the agricultural sector into fresh market vegetable production could lead to substantial economic development for southeastern Oklahoma.

In this study, to introduce vegetable production on a representative farm, land was assumed to be taken out of production of wheat. Similar increases in cash returns due to introducing vegetable production into an existing operation may be experienced on farms of any size. However, the same increases in cash returns that are reported in this study are expected only if land currently in wheat production on a given farm is used for production of the vegetable crops.

The results of this study indicate that although sprinkler and drip irrigation systems have higher application efficiencies, producers may benefit most from using furrow irrigation systems that require lower investment costs. In this study, vegetable yields and input costs were assumed to be invariate over irrigation systems. These results might have been different if yields or input costs had been allowed to vary over irrigation technologies. However, no production information was available to support such assumptions. Also, furrow and sprinkler systems require more water than do drip systems. If water is in sufficiently short supply, furrow and sprinkler systems may not be technically feasible.

The use of family labor in the production of vegetable crops was discussed in Chapters III and IV. Projected cash available to the family for family living can vary significantly, depending on the amount of family labor that can be provided for the vegetable crop operation. Unprofitable enterprises may become profitable if part or all of the required labor is supplied by family members to whom other jobs, especially other higher paying jobs, are not available. In addition, less profitable enterprises may yield higher cash returns to family than more profitable enterprises if the less profitable enterprises have labor requirements that are spread over extended periods of time, instead of labor requirements that occur in a peak period, if family members can more nearly meet the more spread-out labor requirements, and if higher paying jobs are not available.

Recommendations

This study is based on several assumptions that may vary greatly by individual situations, causing significant differences in actual results. Variation from assumptions in this study may occur in labor charges, yields, prices, and application of chemicals.

This study does not address yield variations that may occur due to use of various irrigation technologies. Horticulturists suggest that such variations may occur; however, adequate information is not available on the magnitude of yield variations that may be experienced with the various irrigation technologies.

Application of chemicals and other production practices may also vary as irrigation technologies vary. Due to variations in methods of application of irrigation water in the production of vegetable crops, different disease problems may result in a vegetable field. If this occurs, variations in types and amounts of chemicals to be applied would be necessary, causing additional differences in costs related to use of the different irrigation technologies.

Yield and price variability unrelated to irrigation technologies can be substantial in vegetable production. Sensitivity analyses dealing with changes in yield and price would yield useful information to producers considering additions of vegetable enterprises. Such information could have significant implications in relation to this study.

Sufficient information in the above areas is not available at this time. Further information in these areas could be very helpful to farmers contemplating introduction of vegetable crop production into existing operations.

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APPENDIX

TABLE VIII

WHEAT BUDGET

WHEAT - LOAM SOILS

46490101
08/01/85
ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
WHEAT SEED	BU.	4.500	1.500	6.75	________
NITROGEN (N)	LBS.	0.170	51.000	8.67	________
PHOSPH (P205)	LBS.	0.150	46.000	6.90	________
RNTFERTSPRD/TON	ACRE	4.600	2.000	9.20	________
CUSTOM HARVEST	ACRE	13.710	1.000	13.71	________
ANNUAL OPERATING CAPITAL	DOL.	0.130	22.467	2.92	________
LABOR CHARGES	HR.	4.900	1.222	5.99	________
MACHINERY FUEL, LUBE, REPAIRS	ACRE			9.30	________
TOTAL OPERATING COST				63.44	________

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	4.288	________
DEPR., TAXES, INSUR.	DOL.	4.139	________
LAND			
INTEREST AT 0.0%	DOL.	0.000	________
TAXES	DOL.	0.000	________
TOTAL FIXED COSTS		8.43	________

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
WHEAT	BU.	2.700	30.000	81.00	________
PASTURE	AUMS	0.000	0.800	0.00	________
TOTAL RECEIPTS				81.00	________
RETURNS ABOVE TOTAL OPERATING COSTS				17.56	________
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK AND MANAGEMENT				9.13	________

100# OF 18-46-0 FERT. APPLIED — NELSON, YINGST

05/18/88 000000110

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TABLE IX

SOYBEANS BUDGET

SOYBEANS, BOTTOMLAND 98490101
OWNED EQUIPMENT 01/17/86
ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
SOYBEAN SEED	LBS.	0.250	45.000	11.25	________
NITROGEN (N)	LBS.	0.170	32.000	5.44	________
PHOSPH (P205)	LBS.	0.150	48.000	7.20	________
POTASH (K20)	LBS.	0.100	48.000	4.80	________
HERB-SOYBEANS	ACRE	6.750	1.000	6.75	________
BROAD LEAF HERB.	ACRE	2.500	1.000	2.50	________
CUSTOM HARVEST	ACRE	15.490	1.000	15.49	________
ANNUAL OPERATING CAPITAL	DOL.	0.130	4.832	0.63	________
LABOR CHARGES	HR.	4.900	1.775	8.70	________
MACHINERY FUEL, LUBE, REPAIRS	ACRE			11.40	________
TOTAL OPERATING COST				74.15	________

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	5.755	________
DEPR., TAXES, INSUR.	DOL.	5.490	________
LAND			
INTEREST AT 0.0%	DOL.	0.000	________
TAXES	DOL.	0.000	________
TOTAL FIXED COSTS		11.25	________

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
SOYBEANS	BU.	5.850	35.000	204.75	________
		0.000	140.000	0.00	________
		0.000	140.000	0.00	________
TOTAL RECEIPTS				204.75	________
RETURNS ABOVE TOTAL OPERATING COSTS				130.60	________
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK AND MANAGEMENT				119.35	________

PRE-PLANT IS INCORPORATED WITH DISCING OPERATION. NELSON, YINGST
POST-EMERGE IS FOR BROAD LEAF WEED CONTROL
200# OF 16-24-24 APPLIED AT PLANTING TIME 05/18/88 0000000110

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TABLE X

ALFALFA HAY BUDGET

ALFALFA HAY - DRYLAND 81490101
CUSTOM HARVEST 01/17/86
CONVENTIONAL BALE ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
NITROGEN (N)	LBS.	0.170	30.000	5.10	________
PHOSPH (P205)	LBS.	0.150	80.000	12.00	________
POTASH (K20)	LBS.	0.100	80.000	8.00	________
RNTFERTSPRD/ACRE	ACRE	2.000	1.000	2.00	________
INSECTICIDE	ACRE	0.000	1.250	0.00	________
ESTAB PRORATE	ACRE	95.000	0.200	19.00	________
CUSTOM BALE	ACRE	16.800	4.000	67.20	________
ANNUAL OPERATING CAPITAL	DOL.	0.130	2.294	0.30	________
LABOR CHARGES	HR.	4.811	11.282	54.28	________
MACHINERY FUEL, LUBE, REPAIRS	ACRE			62.00	________
TOTAL OPERATING COST				229.88	________

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	14.711	________
DEPR., TAXES, INSUR.	DOL.	16.542	________
LAND			
INTEREST AT 0.0%	DOL.	0.000	________
TAXES	DOL.	0.000	________
TOTAL FIXED COSTS		31.25	________

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
ALFALFA HAY	TONS	65.000	4.000	260.00	________
RETURNS ABOVE TOTAL OPERATING COSTS				30.12	________
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK AND MANAGEMENT				-1.13	________

HAY SOLD IN THE FIELD NELSON, YINGST
ESTABLISHMENT CHARGE BASED ON BUDGET #81900001
05/18/88 0000000110

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TABLE XI

BERMUDA HAY BUDGET

BERMUDA GRASS PASTURE & HAY — 83490301
CONVENTIONAL BALE — 01/17/86
CUSTOM HARVEST & HAUL — ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
NITROGEN (N)	LBS.	0.170	200.000	34.00	________
PHOSPH (P205)	LBS.	0.150	80.000	12.00	________
POTASH (K20)	LBS.	0.100	120.000	12.00	________
RNTFERTSPRD/ACRE	ACRE	2.000	1.000	2.00	________
CUSTOM BALE	ACRE	16.800	5.000	84.00	________
ANNUAL OPERATING CAPITAL	DOL.	0.130	4.841	0.63	________
LABOR CHARGES	HR.	4.806	13.282	63.83	________
MACHINERY FUEL, LUBE, REPAIRS	ACRE			74.00	________
TOTAL OPERATING COST				282.46	________

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	15.486	________
DEPR., TAXES, INSUR.	DOL.	18.061	________
LAND			
INTEREST AT 0.0%	DOL.	0.000	________
TAXES	DOL.	0.000	________
TOTAL FIXED COSTS		33.55	________

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
BERMUDA HAY	TONS	45.000	5.000	225.00	________
PASTURE	AUMS	40.380	1.250	50.48	________
		0.000	120.000	0.00	________
		0.000	120.000	0.00	________
TOTAL RECEIPTS				275.47	________
RETURNS ABOVE TOTAL OPERATING COSTS				-6.98	________
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK AND MANAGEMENT				-40.53	________

NELSON, YINGST

05/18/88 0000000110

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TABLE XII

BERMUDA PASTURE BUDGET

BERMUDA GRASS MAINTENANCE 83490201
01/17/86
ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
NITROGEN (N)	LBS.	0.170	200.000	34.00	________
PHOSPH (P205)	LBS.	0.150	60.000	9.00	________
POTASH (K20)	LBS.	0.100	120.000	12.00	________
RNTFERTSPRD/ACRE	ACRE	2.000	5.000	10.00	________
	ACRE	2.500	0.330	0.82	________
ESTAB COST	ACRE	109.730	0.100	10.97	________
HERBICIDE	ACRE	5.500	0.330	1.81	________
ANNUAL OPERATING CAPITAL	DOL.	0.130	39.315	5.11	________
LABOR CHARGES	HR.	4.900	1.060	5.20	________
MACHINERY FUEL, LUBE, REPAIRS	ACRE			22.15	________
TOTAL OPERATING COST				111.07	________

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	3.763	________
DEPR., TAXES, INSUR.	DOL.	3.638	________
LAND			
INTEREST AT 0.0%	DOL.	0.000	________
TAXES	DOL.	0.000	________
TOTAL FIXED COSTS		7.40	________

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
PASTURE	AUMS	0.000	11.600	0.00	________
RETURNS ABOVE TOTAL OPERATING COSTS				-111.07	________
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK AND MANAGEMENT				-118.47	________

HERBICIDE IS PARAQUAT, APPLIED EVERY 3 YEARS FOR WINTER ANNUALS. NELSON, YINGST
2,4-D APPLIED EVERY 3 YEARS.

05/18/88 0000000110

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TABLE XIII

NATIVE PASTURE BUDGET

NATIVE PASTURE, MAINTENANCE

85480104
01/17/86
ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
	ACRE	1.400	0.250	0.35	______
ANNUAL OPERATING CAPITAL	DOL.	0.130	0.041	0.01	______
LABOR CHARGES	HR.	4.900	0.035	0.17	______
MACHINERY FUEL,LUBE,REPAIRS	ACRE			0.14	______
TOTAL OPERATING COST				0.67	______

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	0.151	______
DEPR.,TAXES,INSUR.	DOL.	0.165	______
LAND			
INTEREST AT 0.0%	DOL.	0.000	______
TAXES	DOL.	0.000	______
TOTAL FIXED COSTS		0.32	______

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
PASTURE	AUMS	0.000	1.580	0.00	______
RETURNS ABOVE TOTAL OPERATING COSTS				-0.67	______
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD,RISK AND MANAGEMENT				-0.98	______

2-4-D APPLIED EVERY FOURTH YEAR NELSON, YINGST

05/18/88 0000000110

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TABLE XIV

COW CALF BUDGET

COW CALF COST & RETURNS PER COW 25 COW UNIT
SPRING CALVING FEB-MARCH

11480218
01/17/86
ATOKA

LIVESTOCK INVESTMENT	UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE
BEEF COW	CWT.	9.50	1.00	624.000	624.00
BEEF HEIFER	CWT.	8.00	0.16	550.000	88.00
BEEF BULL	CWT.	16.00	0.03	900.000	27.00
TOTAL LIVESTOCK INVESTMENT					739.00

PRODUCTION	UNITS	QUANITY	WEIGHT	PRICE	VALUE/UNIT	VALUE
STR CALVES (4-5)	CWT.	0.43	4.50	102.000	459.00	197.37
HFR CALVES (4-5)	CWT.	0.28	4.20	92.000	386.40	108.19
AGED BULLS	CWT.	0.14	9.75	58.000	565.50	79.17
COMMERCIAL COWS	CWT.	0.01	16.00	49.000	784.00	7.84
TOTAL RECEIPTS						382.57

OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE
PASTURE	AUMS	9.00	1.20	10.800	0.00	0.00
PRAIRIE HAY	TONS	1.02	1.20	1.224	41.00	50.18
26-30% PROT.SUP.	LBS.	380.00	1.20	456.000	0.08	36.48
SALT & MINERALS	LBS.	24.00	1.20	28.800	0.09	2.59
INSPECTION FEES	DOL.	1.00	1.00	1.000	7.50	7.50
ESTAB COST	HD.	1.00	1.00	1.000	3.50	3.50
MACH. FUEL & LUBE						12.24
MACHINERY REPAIR COST						1.81
EQUIPMENT REPAIR						6.53
TOTAL OPERATING COST						120.83

RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT	271.74

CAPITAL COST	PRICE	AMOUNT	VALUE
ANNUAL OPERATING CAPITAL	0.130	41.295	5.37
MACHINERY INVESTMENT	0.130	74.654	9.71
EQUIPMENT INVESTMENT	0.130	522.000	67.86
LIVESTOCK INVESTMENT	0.130	739.000	96.07
TOTAL INTEREST CHARGE			179.00

RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT	92.74

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)	UNITS	VALUE
MACHINERY	DOL.	9.92
EQUIPMENT	DOL.	51.26
LIVESTOCK	DOL.	11.90
TOTAL OWNERSHIP COST		73.08

RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT	19.66

LABOR COSTS	PRICE	HOURS	VALUE
MACHINERY LABOR	4.900	3.024	14.82
EQUIPMENT LABOR	4.650	0.620	2.88
TOTAL LABOR COST		3.644	17.70

RETURNS TO LAND, OVERHEAD RISK AND MANAGEMENT	1.96

NATIVE PASTURE
PROTEIN 30% CUBES NATIVE HAY
ASSUME 88% CALF CROP

NELSON, YINGST
05/18/88 0010100110

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TABLE XV

FALL BROCCOLI BUDGET

FALL BROCOLLI, SEEDED, SOUTHEAST OKLAHOMA — 99490615
SANDY LOAM SOILS, IRRIGATED, OWNED EQUIPMENT WITH HAND HARVEST — 08/01/85
22 LB. CARTONS, ADJ. DALLAS WHOLESALE PRICE. — ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
HERBICIDE	ACRE	3.130	1.000	3.13	______
15-15-15 FERT	CWT.	9.750	3.000	29.25	______
RNTFERTSPRD/ACRE	ACRE	1.250	3.000	3.75	______
SEEDLINGS	LBS	200.000	1.000	200.00	______
THIN SEEDLINGS	HR.	4.650	6.000	27.90	______
NITROGEN (N)	LBS.	0.170	80.000	13.60	______
INSECTICIDE	ACRE	6.370	4.000	25.48	______
CARTONS	CART	1.020	400.000	408.00	______
MANAGEMENT CHRGE	HR.	4.650	120.000	558.00	______
GRADING & MKTG	CART	1.330	400.000	532.00	______
ANNUAL OPERATING CAPITAL	DOL.	0.130	89.101	11.58	______
LABOR CHARGES	HR.	4.819	7.204	34.72	______
MACHINERY FUEL, LUBE, REPAIRS	ACRE			37.41	______
IRRIGATION FUEL, LUBE, REPAIRS	ACRE			81.33	______
TOTAL OPERATING COST				1966.16	______

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	17.725	______
DEPR., TAXES, INSUR.	DOL.	18.029	______
IRRIGATION			
INTEREST AT 13.0%	DOL.	109.923	______
DEPR., TAXES, INSUR.	DOL.	270.567	______
LAND			
INTEREST AT 0.0%	DOL.	0.000	______
TAXES	DOL.	0.000	______
TOTAL FIXED COSTS		416.24	______

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
BROCCOLI		7.010	400.000	2804.00	______
RETURNS ABOVE TOTAL OPERATING COSTS				837.84	______
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK AND MANAGEMENT				421.60	______

SUGGESTED TREFLAN .5 LB. AI; — MOTES, YINGST, SCHATZER
LANNATE 10 OZ. AI; — 2ND COMP
SIDEDRESS 120 OBS. 34-0-0 FERT. TWICE. — 05/18/88 — 0000000110O

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TABLE XVI

FALL SPINACH BUDGET

FALL SPINACH 99259211
SANDY LOAM SOILS, IRRIGATED, OWNED EQUIPMENT WITH HAND HARVEST 01/17/86
BUSHEL BASKETS, ADJ. DALLAS WHOLESALE PRICE. ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
HERBICIDE	ACRE	27.500	1.000	27.50	
15-15-15 FERT	CWT.	9.750	5.000	48.75	
RNTFERTSPRD/ACRE	ACRE	1.250	2.000	2.50	
SEEDLINGS	LBS.	4.000	15.000	60.00	
INSECTICIDE	ACRE	1.800	1.000	1.80	
INSECTICIDE	ACRE	6.370	3.000	19.11	
FUNGICIDE	ACRE	3.500	3.000	10.50	
NITROGEN (N)	LBS.	0.160	102.000	16.32	
BASKETS	BU.	1.020	350.000	357.00	
MANAGEMENT CHRGE	HR.	4.650	175.000	813.75	
GRADING & MKTG	BU.	1.200	350.000	420.00	
ANNUAL OPERATING CAPITAL	DOL.	0.130	33.655	4.38	
LABOR CHARGES	HR.	4.792	7.781	37.29	
MACHINERY FUEL, LUBE, REPAIRS	ACRE			35.54	
IRRIGATION FUEL, LUBE, REPAIRS	ACRE			91.99	
TOTAL OPERATING COST				1946.42	

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	16.433	
DEPR., TAXES, INSUR.	DOL.	16.820	
IRRIGATION			
INTEREST AT 13.0%	DOL.	148.715	
DEPR., TAXES, INSUR.	DOL.	366.074	
LAND			
INTEREST AT 0.0%	DOL.	0.000	
TAXES	DOL.	0.000	
TOTAL FIXED COSTS		548.04	

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
SPINACH	TONS	7.650	350.000	2677.50	
RETURNS ABOVE TOTAL OPERATING COSTS				731.08	
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD, RISK AND MANAGEMENT				183.04	

SUGGESTED: MANZATE 1.5 LB. AI: MOTES, YINGST, SCHATZER
RO-NEET 3 LBS. AI: CYGON 4 OZ. AI: LANNATE 10 OZ. AI: 2ND COMP
SIDEDRESS 300 LBS. 34-0-0 FERT. WHOLESALE PRICE. 05/18/88 0010100110

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TABLE XVII

OKRA BUDGET

OKRA 99009516
SANDY LOAM SOILS, IRRIGATED, OWNED EQUIPMENT WITH HAND HARVEST 01/17/86
18 LB. CARTONS, ADJ. DALLAS WHOLESALE PRICE. ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
HERBICIDE	ACRE	3.130	1.000	3.13	________
15-15-15 FERT	CWT.	9.750	2.000	19.50	________
RNTFERTSPRD/ACRE	ACRE	1.250	2.000	2.50	________
SEEDLINGS	LBS.	1.000	10.000	10.00	________
BOX AND BAG	HR.	4.650	6.000	27.90	________
NITROGEN (N)	LBS.	0.170	20.000	3.40	________
INSECTICIDE	ACRE	5.100	3.000	15.30	________
CARTONS	CART	1.020	500.000	510.00	________
MANAGEMENT CHRGE	HR.	4.650	300.000	1395.00	________
GRADING & MKTG	CART	0.580	500.000	290.00	________
ANNUAL OPERATING CAPITAL	DOL.	0.130	12.714	1.65	________
LABOR CHARGES	HR.	4.819	9.894	47.68	________
MACHINERY FUEL,LUBE,REPAIRS	ACRE			44.04	________
IRRIGATION FUEL,LUBE,REPAIRS	ACRE			149.25	________
TOTAL OPERATING COST				2519.35	________

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	22.220	________
DEPR.,TAXES,INSUR.	DOL.	22.371	________
IRRIGATION			
INTEREST AT 13.0%	DOL.	219.051	________
DEPR.,TAXES,INSUR.	DOL.	539.224	________
LAND			
INTEREST AT 0.0%	DOL.	0.000	________
TAXES	DOL.	0.000	________
TOTAL FIXED COSTS		802.87	________

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
OKRA	CART	5.240	500.000	2620.00	________
RETURNS ABOVE TOTAL OPERATING COSTS				100.65	________
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD,RISK AND MANAGEMENT				-702.21	________

SUGGESTED: TREFLAN .5 LB. AI, MOTES, YINGST, SCHATZER
SEVIN 1 LB. AI; 2ND COMP
SIDEDRESS 60 LB. 34-0-0 FERT. 05/18/88 1111111110

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TABLE XVIII

SPRING BROCCOLI BUDGET

SPRING BROCCOLI, TRANSPLANT, SOUTHEAST OKLAHOMA 99490217
SANDY LOAM SOILS, IRRIGATED, OWNED EQUIPMENT WITH HAND HARVEST 08/01/85
22 LB. CARTONS, ADJ. DALLAS WHOLESALE PRICE. ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
HERBICIDE	ACRE	3.130	1.000	3.13	
15-15-15 FERT	CWT.	9.750	3.000	29.25	
RNTFERTSPRD/ACRE	ACRE	1.250	3.000	3.75	
TRANSPLANTS	THPL	30.000	14.500	435.00	
TRANSPLANT LABOR	HR.	4.650	18.000	83.70	
NITROGEN (N)	LBS.	0.170	80.000	13.60	
INSECTICIDE	ACRE	6.370	6.000	38.22	
CARTONS	CART	1.020	350.000	357.00	
MANAGEMENT CHRGE	HR.	4.650	105.000	488.25	
GRADING & MKTG	CART	1.330	350.000	465.50	
ANNUAL OPERATING CAPITAL	DOL.	0.130	109.436	14.23	
LABOR CHARGES	HR.	4.875	8.316	40.54	
MACHINERY FUEL,LUBE,REPAIRS	ACRE			48.56	
IRRIGATION FUEL,LUBE,REPAIRS	ACRE			66.90	
TOTAL OPERATING COST				2087.63	

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	29.389	
DEPR.,TAXES,INSUR.	DOL.	30.897	
IRRIGATION			
INTEREST AT 13.0%	DOL.	108.156	
DEPR.,TAXES,INSUR.	DOL.	266.236	
LAND			
INTEREST AT 0.0%	DOL.	0.000	
TAXES	DOL.	0.000	
TOTAL FIXED COSTS		434.68	

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
BROCCOLI	CART	7.290	350.000	2551.50	
RETURNS ABOVE TOTAL OPERATING COSTS				463.87	
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD,RISK AND MANAGEMENT				29.20	

SUGGESTED: TREFLAN .5 LB. AI; MOTES, YINGST, SCHATZER
LANNATE 10 OZ. AI; 2ND COMP
SIDEDRESS 120 LBS. 34-0-0 FERT. TWICE. 05/18/88 0000000110

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TABLE XIX

TOMATOES BUDGET

STAKED TOMATOES — 99009515
SANDY LOAM SOILS, IRRIGATED, OWNED EQUIPMENT WITH HAND HARVEST — 01/17/86
30 LB. LUGS, ADJ. DALLAS WHOLESALE PRICE. — ATOKA

OPERATING INPUTS:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
HERBICIDE	ACRE	3.130	1.000	3.13	
15-15-15 FERT	CWT.	9.750	3.350	32.66	
POTASH (K20)	LBS.	0.100	200.000	20.00	
RNTFERTSPRD/ACRE	ACRE	1.250	2.000	2.50	
TRANSPLANTS	THPL	50.000	5.000	250.00	
TRANSPLANT LABOR	HR.	4.650	8.000	37.20	
Stakes	EACH	0.250	834.000	208.50	
STRING	LBS.	1.250	30.000	37.50	
	HR.	4.650	50.000	232.50	
	HR.	4.650	180.000	837.00	
BOX AND BAG	HR.	4.650	9.000	41.85	
INSECTICIDE	ACRE	6.690	10.000	66.90	
BACTICIDE	ACRE	9.940	10.000	99.40	
FUNGICIDE	ACRE	3.500	4.000	14.00	
NITROGEN (N)	LBS.	0.170	50.000	8.50	
FUNGICIDE	ACRE	10.500	6.000	63.00	
LUGS	LUGS	0.610	700.000	427.00	
MANAGEMENT CHRGE	HR.	4.650	200.000	930.00	
GRADING & MKTG	LUGS	0.750	700.000	525.00	
ANNUAL OPERATING CAPITAL	DOL.	0.130	259.340	33.71	
LABOR CHARGES	HR.	4.833	11.221	54.23	
MACHINERY FUEL,LUBE,REPAIRS	ACRE			51.30	
IRRIGATION FUEL,LUBE,REPAIRS	ACRE			91.44	
TOTAL OPERATING COST				4067.33	

FIXED COSTS		VALUE	YOUR VALUE
MACHINERY			
INTEREST AT 13.0%	DOL.	26.906	
DEPR.,TAXES,INSUR.	DOL.	27.347	
IRRIGATION			
INTEREST AT 13.0%	DOL.	116.964	
DEPR.,TAXES,INSUR.	DOL.	287.935	
LAND			
INTEREST AT 0.0%	DOL.	0.000	
TAXES	DOL.	0.000	
TOTAL FIXED COSTS		459.15	

PRODUCTION:	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
TOMATOES	LUGS	7.500	700.000	5250.00	
RETURNS ABOVE TOTAL OPERATING COSTS				1182.67	
RETURNS ABOVE ALL COSTS EXCEPT OVERHEAD,RISK AND MANAGEMENT				723.52	

SUGGESTED: REPLACE 173 OF STAKES PER YR, BRAVO 1.5 LB. AI;MOTES,YINGST,SCHATZER
KOCIDE 3 LB. AI; MANZATE 1.5 LB AI; TREFLAN .5 LB, AI; 2ND COMP
05/18/88 1111111110

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VITA

Julie Augusta Yingst

Candidate for the Degree of

Master of Science

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