Resource Category: Agricultural Economics

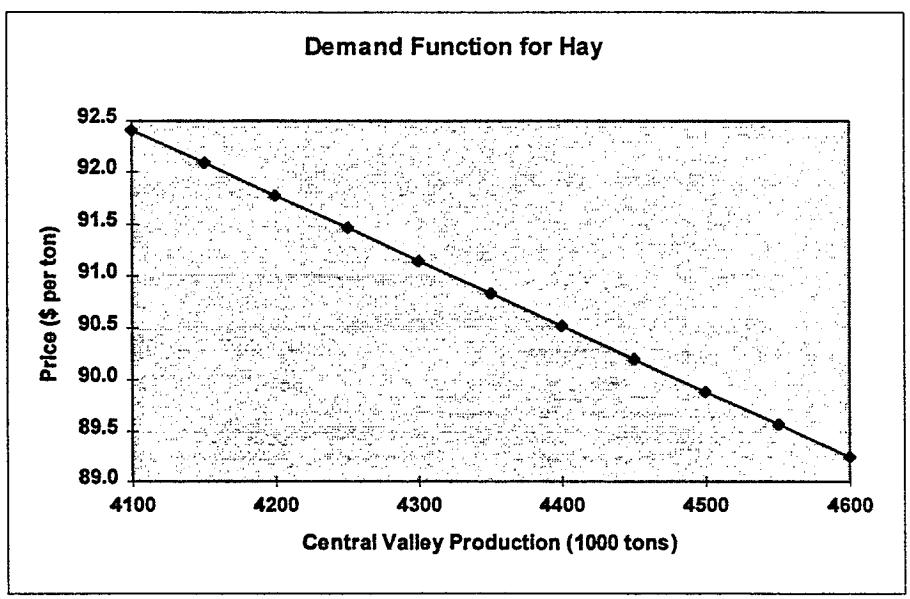
Relationship: Crop Price vs. Crop Production

Description: The economic demand for a particular crop is a description of how much buyers are willing to pay for different total amounts sold. All else equal, the market price and quantity bought will generally move in opposite directions. Thus, prices rise when there is a crop failure or shortage. The relative rate at which price and quantity change is measured either as an elasticity or a price flexibility.

Assumptions: Price elasticities or flexibilities from existing empirical studies can be adapted to reflect the price effect of a given change in production. A linear relationship between price and production is an adequate representation of demand.

Basis: (1) Literature review of existing studies.

Reference: (1) Numerous crop demand and price flexibility studies reviewed for CVPIA Programmatic EIS. (2) Central Valley Production Model: Supporting Documentation and Data. USBR. November, 1994.



Resource Category: Agricultural Economics

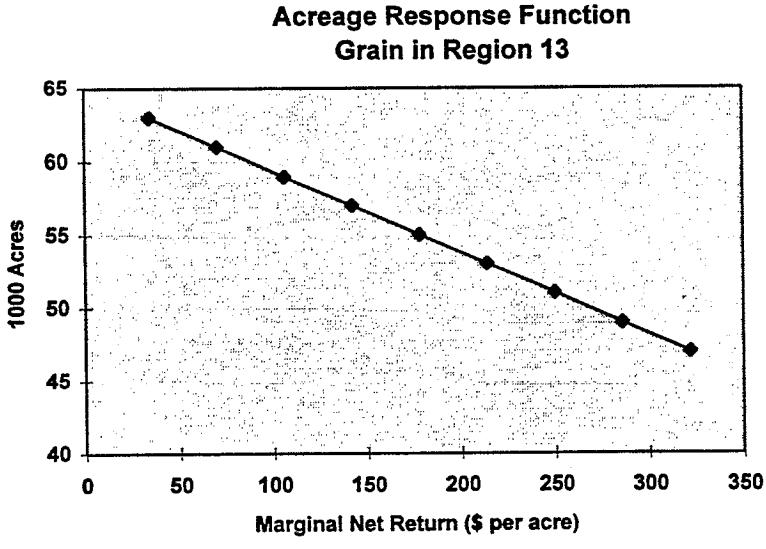
Relationship: Declining Marginal Returns to Crop Production

Description: Economic analysis typically assumes that producers in a region will use the most productive land first, followed by less productive land as total acreage expands. Productivity differences can reflect differences in crop yield, crop quality, or per unit cost of production. Therefore as acreage of a given crop expands (all else equal), total net returns increase but at a declining rate. Marginal returns decline as acreage increases. The rate at which marginal returns decline is usually based on empirical data or, absent appropriate data, on reasonable assumptions.

Assumptions: Producers use land in order of declining productivity. A linear relationship between unit net returns and acreage produced can be approximated based on observed yield or cost variation in a region or on estimated acreage response elasticities.

Basis: (1) Literature review of existing studies and estimates using database of Central Valley Production Model

Reference: (1) Existing studies reviewed for CVPIA Programmatic EIS. (3) Central Valley Production Model: Supporting Documentation and Data. USBR. November, 1994.



Resource Category: Agricultural Economics

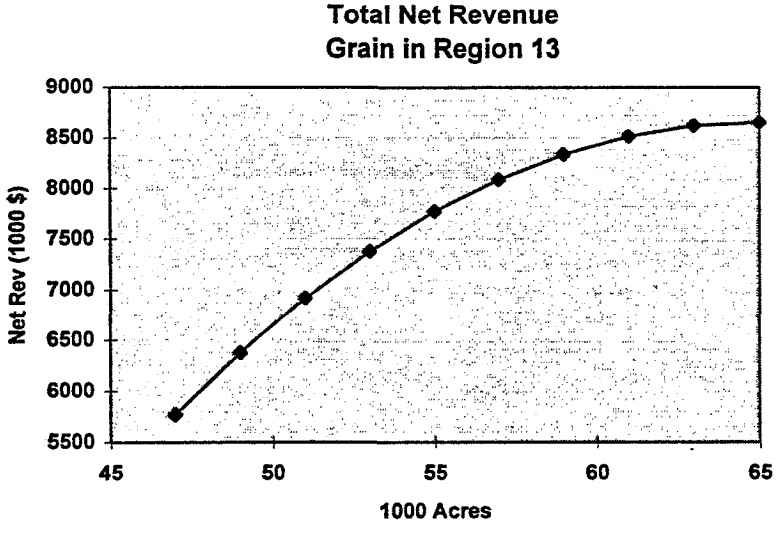
Relationship: Net Revenue of a Crop vs. Level of Production

Description: For a given crop and set of growing conditions, the net revenue per unit (acre) produced declines as production increases.

Assumptions: Growers in general use the best available land to grow a crop. If resources such as water supply are constrained, the best land will be used. As more resources (water) become available, less suitable land will be brought into production. Land quality can affect the crop yields and/ or the unit costs of production.

Basis: (1) Average unit costs, yields, and net revenues can differ substantially from the corresponding marginal values. (2) Quadratic cost and/or revenue functions can be used to estimate these relationships.

Reference: (1) Howitt, R. Positive Mathematical Programming. American Journal of Agricultural Economics. 1995. (2) Central Valley Production Model: Supporting Documentation and Data. USBR. November, 1994.



Resource Category: Agricultural Economics

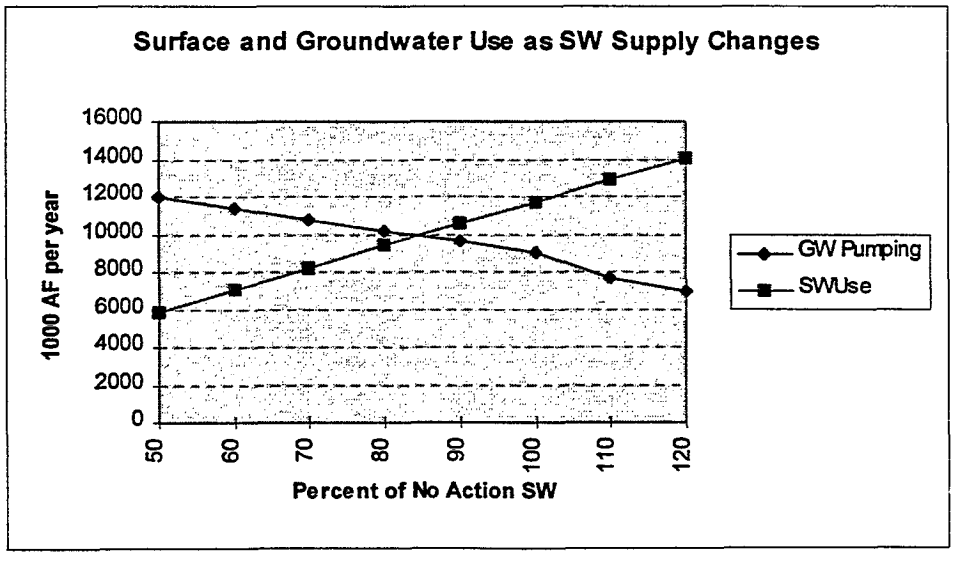
Relationship: Irrigation Water Use vs. Water Cost and Availability

Description: The demand for a particular source of irrigation water (e.g. CVP water or groundwater) depends on the underlying market demand for the crops grown, the profitability of irrigated production, the cost of the water, and the availability and cost of substitute sources.

Assumptions: A regional optimization approach can represent the interaction of the factors listed above, and can estimate how changes may affect the use of irrigation water. Cost of groundwater depends on the pumping lift, which depends on the net rate of groundwater extraction/recharge. Information from or iteration with a groundwater model is recommended.

Basis: Central Valley Production Model (CVPM). Water use by source is jointly dependent on other results of CVPM. Water use, irrigated acres, irrigation efficiency, and other variables are calculated simultaneously within CVPM.

Reference: Central Valley Production Model: Supporting Documentation and Data. USBR. November, 1994.



B-003154

Resource Category: Agricultural Economics

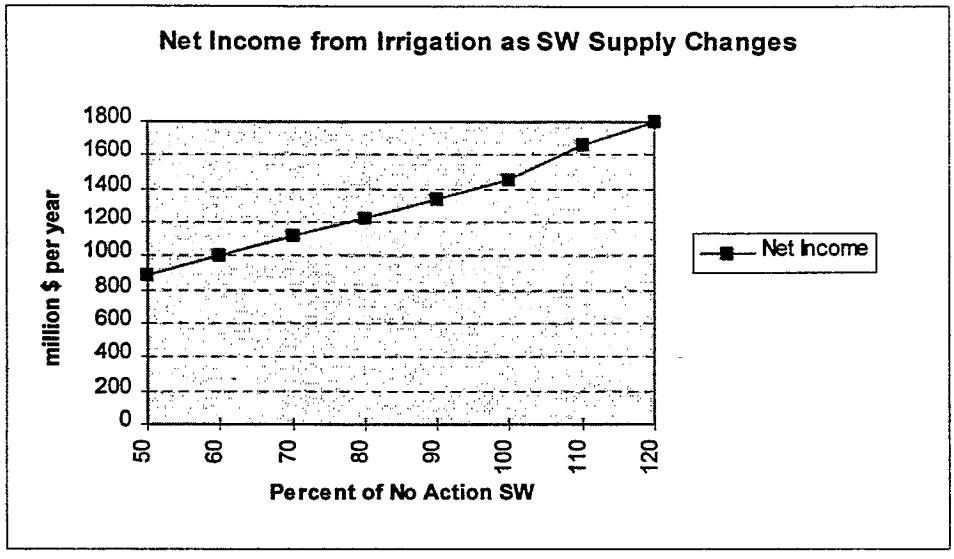
Relationship: Irrigated Acres, Irrigation Efficiency, Value of Production, Net Revenue from Irrigation vs. Water Delivery, Water Cost, Conservation Requirements, etc.

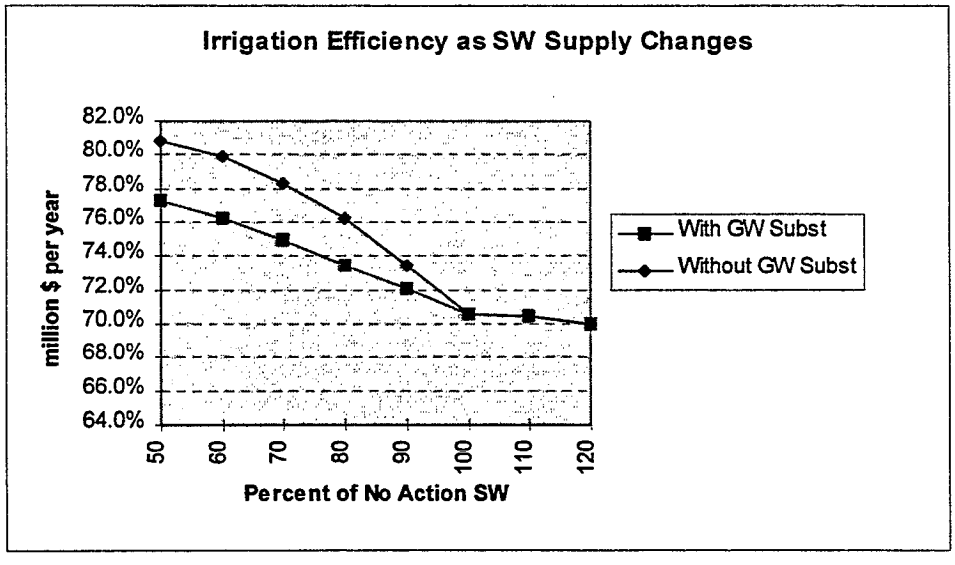
Description: Changes in irrigated acres, irrigation efficiency, value of production, and net revenue are the joint, or simultaneous, responses made by farm decision-makers when economic or resource conditions change. The mixture of responses can be forecast based on statistical estimates of past behavior, or it can be based on models that try to capture the underlying mechanism of agricultural decision-making.

Assumptions: For purposes of describing the relationships, a mechanistic optimization model is used. Central Valley Production Model (CVPM) incorporates more of the potential control variables, response variables, and key relationships than any other known model. The attached graphs result from sensitivity analysis of CVPM, with surface water delivery varied by 10 percent increments.

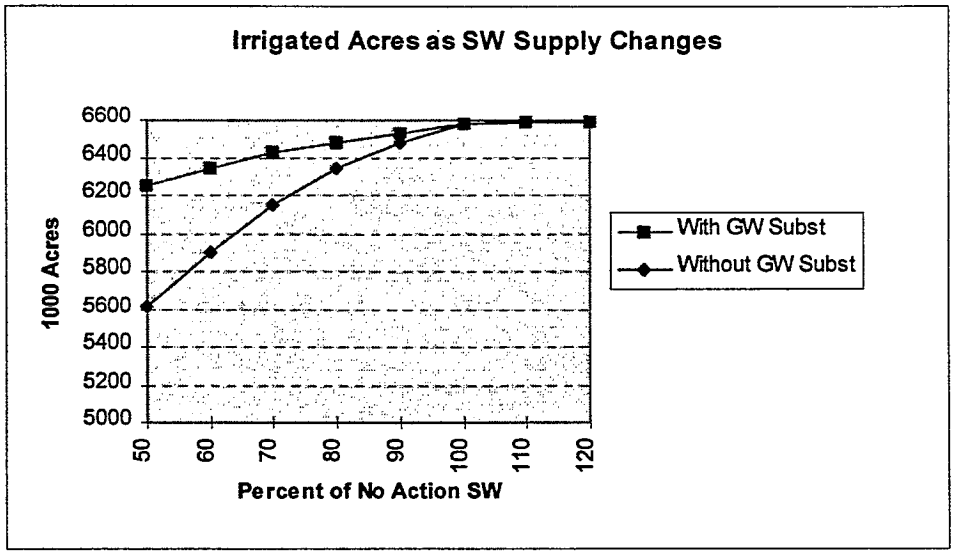
Basis: Long-run profit maximization is the dominant assumption used in economic policy analysis of agriculture and many other sectors.

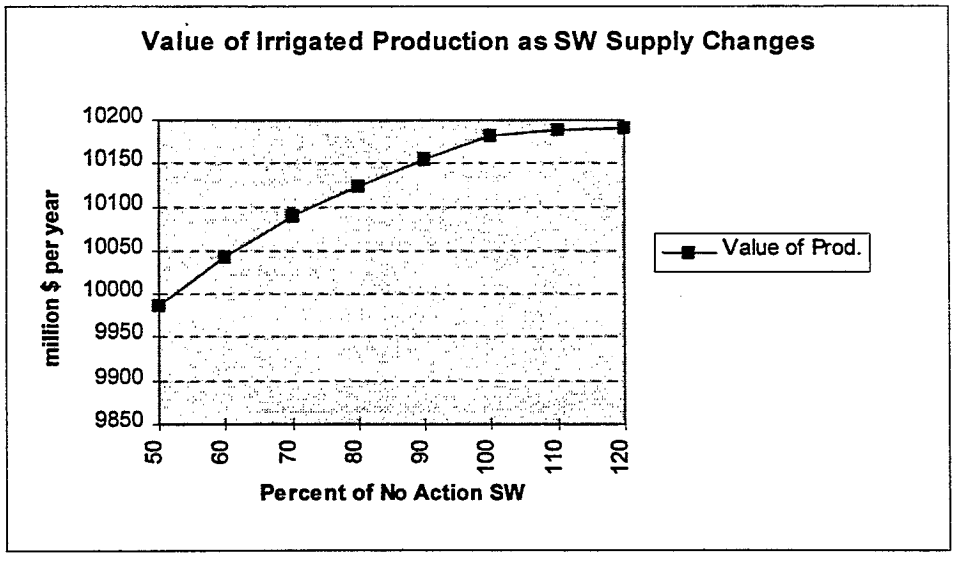
Reference: (1) See, for example, Dinar, and Zilberman. Economics and Management of Water and Drainage in Agriculture. 1991. (2) Central Valley Production Model: Supporting Documentation and Data. USBR. November, 1994.


Net Income from Irrigation as SW Supply Changes
1800
1600
1400
1200
1000
800
600
400
200
0
million $ per year
50
60
70
80
90
100
110
120
Percent of No Action SW
Net Income


Irrigation Efficiency as SW Supply Changes
82.0%
80.0%
78.0%
76.0%
74.0%
72.0%
70.0%
68.0%
66.0%
64.0%
million $ per year
50
60
70
80
90
100
110
120
Percent of No Action SW
With GW Subst
Without GW Subst

B-003156


Irrigated Acres as SW Supply Changes
6600
6400
6200
6000
5800
5600
5400
5200
5000
1000 Acres
50
60
70
80
90
100
110
120
Percent of No Action SW
With GW Subst
Without GW Subst


Value of Irrigated Production as SW Supply Changes
10200
10150
10100
10050
10000
9950
9900
9850
million $ per year
50
60
70
80
90
100
110
120
Percent of No Action SW
Value of Prod.

B-003157

Resource Category: Agricultural Economics

Relationship: Irrigation Efficiency vs. Cost of Irrigation System

Description: For a given crop and set of growing conditions, a tradeoff exists between the efficiency of water application (measured as ETAW/AW) and the cost of applying irrigation water. Costs increase because of investment in hardware to apply water more precisely and greater levels of management and information.

Assumptions: Higher cost results in greater efficiency and lower water use, but at a diminishing rate of return. The relationship between water use and irrigation system cost is generally a convex function: higher costs achieve declining incremental reductions in water use. A further implication is that the cost of achieving an efficiency target increases at an increasing rate (e.g., the cost of improving efficiency from 60% up to 65% is lower than to improve it from 65% to 70%).

Basis: (1) Both water and irrigation systems are costly, so growers attempt to minimize costs by trading off the two costs. When attempting to save water, growers will choose the cheaper system modifications first. (2) A convex functional form called the Constant Elasticity of Substitution (or CES) function provides a flexible and reasonable representation of the tradeoff.

Reference: (1) On-Farm Irrigation Systems and Management. Technical Memorandum. San Luis Unit Drainage Program. USBR. January, 1991. (2) Irrigation Cost and Performance. Technical Memorandum. CVPIA Programmatic EIS. USBR. June, 1994. (3) Central Valley Production Model: Supporting Documentation and Data. USBR. November, 1994.

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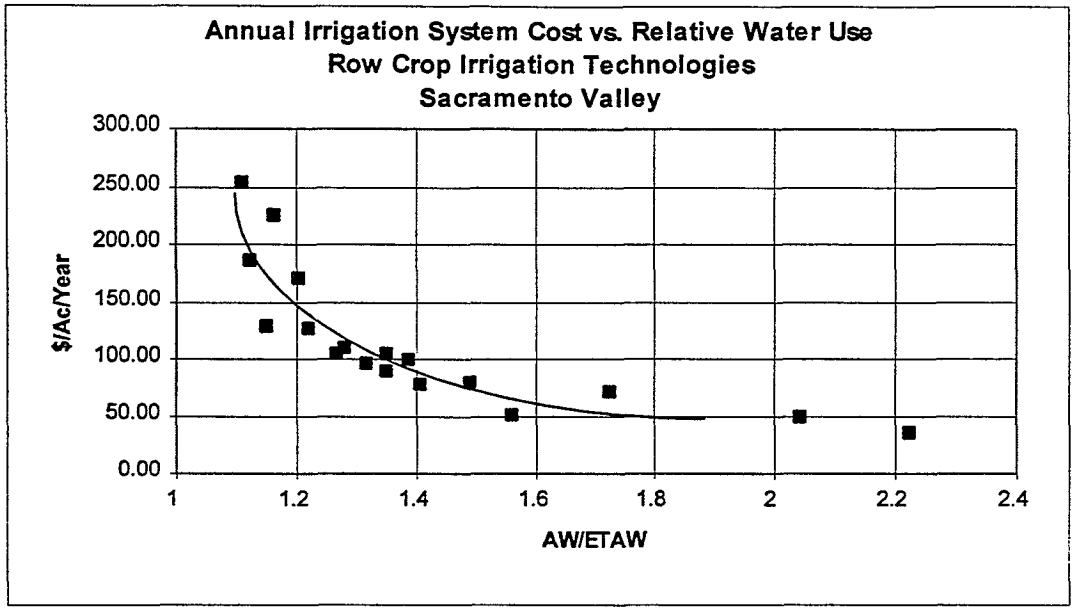

Estimated Isoquant:

$a \cdot [b \cdot (AW/ETAW)^p + (1-b) \cdot (ICcost)^p]^{v/p} = 1$

CES Parameter Estimates

p =	-0.702	F statistic	2637.643
b =	0.133		
a =	0.062	Elasticity of Substit. =	0.587

B-003159