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FURTHER EVIDENCE ON THE EFFECTIVENESS OF THE CALIFORNIA LAND CONSERVATION ACT

by

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ABSTRACT

The effectiveness of use-value assessment provided under the California Land Conservation Act in maintaining open space and in deterring the conversion of prime agricultural land to urban uses is evaluated in the San Joaquin subbasin for the period 1958-1974. Results from the prime land resource use-stock model indicate that the Act is a significant policy variable exhibiting the intended effects upon idle and agricultural land stocks, but that it is ineffective in controlling the growth of urban stocks on prime land.

INTRODUCTION[1/]

As contemporary U.S. agriculture has faced continued high levels of aggregate demand for agricultural commodities with resultant increases in cropland used for crops and as continued population and economic growth have fueled the expansion of urban areas onto lands previously dedicated to agricultural production, land is receiving increasing attention as a potentially binding constraint on productive capacity. These concerns were brought into sharp focus by the world food crisis precipitated in 1973 by adverse weather conditions in India, Australia, Africa, and the USSR, compounded by production control programs in many of the developed countries and exacerbated by simultaneously high demand levels within these same developed nations (University of California Food Task Force).

Concerns of this latter sort and others relating to the quality of the environment--open space, recreation opportunities and wildlife habitat, and the continued viability of rural agricultural communities--competition with nonagricultural uses, higher taxes and development pressures, and increased public service costs associated with urban sprawl, have elicited several legislative proposals for agricultural land use planning. The Associated Press recently billed the preservation of farmland as California's newest hot issue. However, the state has had legislation since 1965 which is designed to protect designated farmlands from development. The California Land Conservation Act (Williamson Act) employs a use-value assessment mechanism to base property taxes upon income rather than market value within the framework of a 10-year contract for lands within

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1/ The authors wish to express their appreciation for the thoughtful review comments of B. Delworth Gardner and Hoy F. Carman.

designated agricultural preserves. Hansen describes the objectives of the Act as the preservation of agricultural lands, the deterrence of urban sprawl and the maintenance of open space. He argues that the Act has been successful with respect to the preservation objective, but has had uncertain impacts in deterring urban sprawl. Carman and Smith in a study of CLCA contract adoption rates found adoption inversely related to the opportunities for conversion at a profit. Gustafson in an examination of contracts within the San Joaquin Valley found that land quality was not a significant factor in adoption, that the percentage of land under contract increased with distance from incorporated areas, that tax benefits were concentrated among the very large landowners and that a state level review of cancellations should be required. Schwartz, Hansen and Foin found that contracts were not economically rational where the owner's time horizon is short or his target rate-of-return too high.

While existing research on the California Land Conservation Act has examined the effectiveness of the Act in attaining its objectives, this has not been done in an explicitly intertemporal context. In particular, the research reported here attempts to assess the impact of CLCA contract acreage upon the pattern of land use over time in the San Joaquin subbasin of California. This subbasin, located in the Central Valley, is comprised of 11,260 square miles and may be approximated by five counties: Stanislaus, Merced, Madera, Mariposa and Tuolumne. Its definition is given by the area drained by the San Joaquin River which flows north to the Sacramento-San Joaquin Delta. In 1974, this area contained 15 percent of the state's total irrigated acreage and produced 11 percent of the state's $8.5 billion gross agricultural revenue (California Department of Food and Agriculture). Thus the area represents a significant portion of California's agricultural economy.

CHARACTERIZATION OF PRIME LAND

Legislative, regulatory and administrative definitions of prime land abound. These definitions have been extremely variable in their scope ranging from criteria sets very narrowly defined to those that provide virtually no guidance to those charged with implementation of prime land policies. One of the earliest attempts to delineate the prime concept was made in the California Land Conservation Act of 1965. The CLCA defined prime land as soils with land capability classes I and II, or 80-100 in the Storie Index rating, or an annual carrying capacity of one animal unit per acre, or perennial cropland with a return during the bearing period of at least $200 per acre or other cropland which has yielded $200 gross revenue per acre in three out of five years. This melding of physical and economic factors into a set of prime land criteria is typical of the approach taken in those legislative proposals subsequantly introduced in California.

Prime land within the context of this study will be construed to be land capability classes I and II. The pervasiveness in use of this definition both within the state and nationally, its compatability with current state law and the ready availability of data to identify these lands have all conditioned this decision. The USDA California River Basin Planning Staff in the course of conducting a regional river basin analysis in the San Joaquin subbasin delineated 66 soil groups[1/], 18 of which are relevent for crop production. These soil groups were mapped at a scale of 1:250,000 during the resource inventory phase of the study. The linearization of the boundaries describing the distribution of these soil groups into regular polygons produced a set of subregions, termed cells, which are homogeneous with respect to the underlying soil groups and consequently productivity. The distribution of the cells resulting from this process is shown in Figure 1. Obviously the cells are not homogeneous with respect to size. There are 169 cells defined for the San Joaquin subbasin covering 4.65 million acres. The range in cell size is from cell 40's 1,498 acres to cell 60's 95,056. The mean cell size is 27,492 acres.

Since soil groups represent the aggregation of several underlying soils and since soil groups per se do not have a land capability class assignment, it was necessary to consult the published detailed soil surveys for the area. By weighting the land capability classifications of the individual soil mapping units within counties within the subbasin by their acreage, a correspondence between soil groups and land capability classes was established. On the basis of this classification scheme and the availability of California Department of Water Resources land use survey information, cells were designated as either prime, nonprime or outside of the study area.

1/ Soil groups are comprised of one or more extensive soils similar in general soil characteristics and including minor areas of soils that may or may not be like the dominant soils within the area. As such, soil groups are modifications of soil resource groups which are defined as groups of land capability units having similar cropping patterns, yield characteristics, responses to fertilizers, management, and land treatment measures (USDA).

FIGURE 1

PRIME AND NONPRIME CELLS IN THE SAN JOAQUIN SUBBASIN

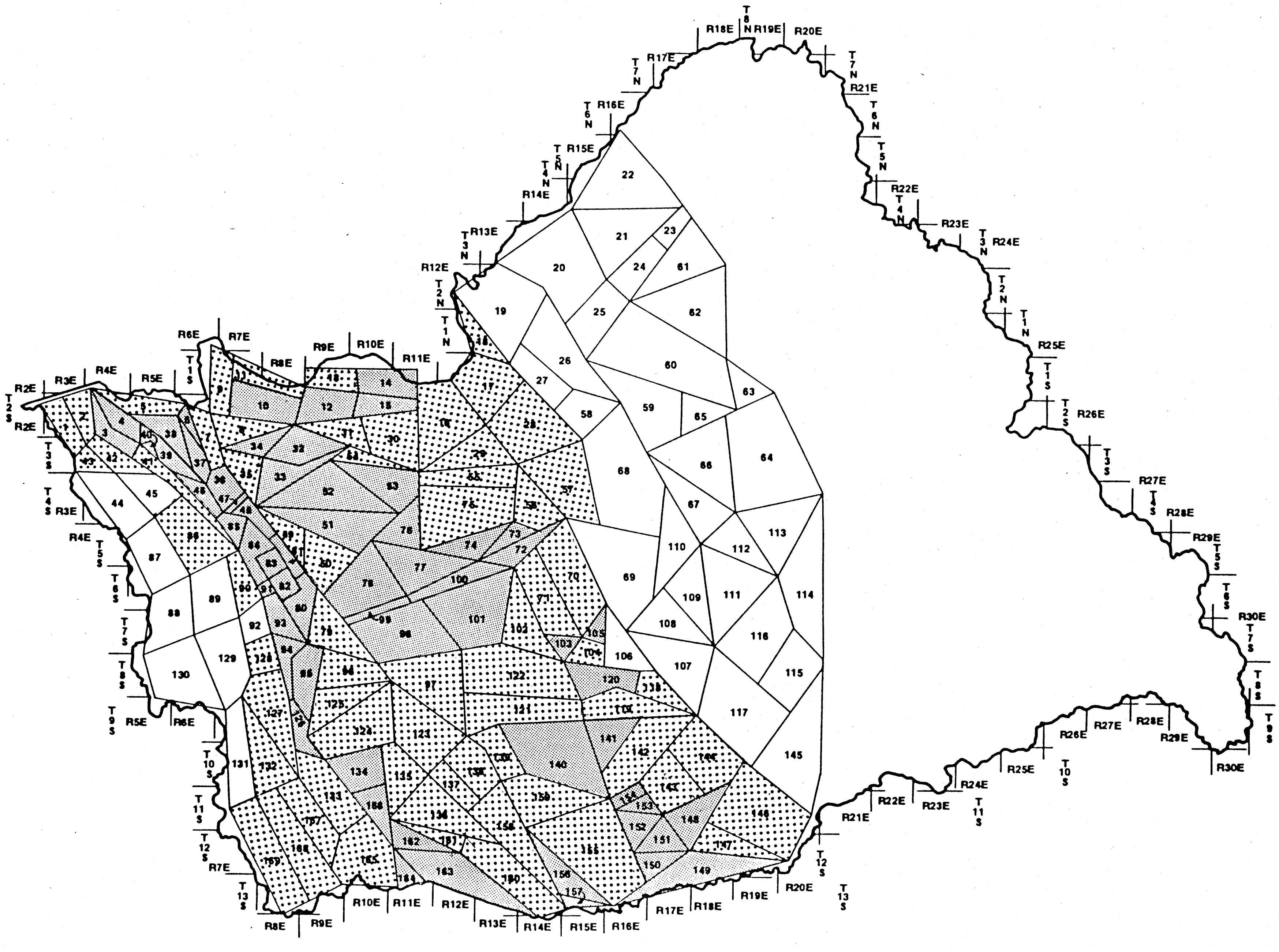

Figure 1 displays the distribution of cells by type and the extent of the study area (the shaded area). The 61 prime cells, indicated by dark shading cover 1,048,335 acres while the 65 nonprime cells displayed in lighter shading represent 1,733,867 acres for a total of 2,782,202 study area acres or 60 percent of the cell area shown. Prime cells range from 1,498 acres (cell 40) to 65,181 acres (cell 140). The mean prime cell size is 17,186 acres which is approximated by the size of cell 76. Nonprime cells have a larger mean size--26,675 acres or the area encompassed by cell 70. Their range is from 6,379 acres (cell 128) to 78,711 acres (cell 155).

In order to verify that the assignment of prime and nonprime designations to cells reasonably reflects the actual land distribution by capability class within the subbasin, acreages by county and capability class were obtained from the Conservation Needs Inventory. For the six counties, Merced, Mariposa, San Joaquin, Stanislaus, Madera and Tuolumne, all of which are either wholly or partially contained within the study area, class I and II lands represent 23.9 percent of the total area inventoried. The cell assignment process previously described resulted in the definition of slightly more than one million primes acres (classes I and II) or 22.6 percent of the total cell area. While the areas covered by the six counties and the 169 cells are not completely comparable, they are sufficiently close approximations for the purpose of validating the prime-nonprime split specified for the study area.

CHARACTERIZATION OF LAND USE-STOCKS

In the late 1940's, recognition of the need for land use data for statewide water planning by the California Department of Water Resources

(DWR) engendered a survey process that identified land suitable for irrigation development and continuously monitored the changes in land use on a 5-10 year cycle. The land classification portion of the survey process "involved field examination of soil characteristics such as depth, texture, salinity, etc., and land features such as slope, micro-relief, physiographic position, etc." (DWR, p. 3). Land use is monitored through the interpretation of aerial photography which is verified by a sample of field inspections. The information from each of these two types of surveys is coded on maps of standard U.S. Geological Survey 7-1/2 minute quadrangle areas at a scale of 1:24,000. Quadrangles at these latitudes range in size of coverage from 37,600 to 38,200 acres.

Since the DWR's objectives of assessing the level of land developed for irrigation and those quantities of land available for future development are closely allied with the purposes of this research, the precise extent of the study area could be determined on the basis of survey data availability. The surveys accomplished in the San Joaquin subbasin for the period 1957-1977 tended to cluster about three years: 1958, 1966 and 1974. These three years were adopted as reference years for the different survey periods despite the fact that all portions of the study area were not all surveyed in those years. The study area is spanned by 88 7-1/2 minute quadrangles. Since the classification survey for the area was completed in 1957, it contains all of the potentially irrigable land within the subbasin.

The aerial photographs of the study area have been interpreted at an extraordinary level of detail. The interpreted uses were then aggregated up to a level suitable for this research. In particular, the land resources have been grossly partitioned into four use classes: idle, nonperennial, perennial and urban. Idle lands, in general, include those lands devoted to wildlife habitat, grazing of the natural grassland biome, and other extensive uses which do not require substantial transformations of the natural landscape. Nonperennial and perennial agricultural lands are those irrigated areas producing crops. Urban lands include residential, commercial, industrial, and other intensive uses involving substantial capital investment. These categories were selected as representative of the expected length of tenure in use, the level of investment in that use and the value of the use. Productivity differences among the land resources have been denoted by two categories: prime and nonprime. By combining these use and productivity classifications, the land resources of the study area are partitioned into eight resource use-stocks: prime idle, nonprime idle, prime nonperennial, nonprime nonperennial, prime perennial, nonprime perennial, prime urban and nonprime urban. These resource use-stocks were then further differentiated on the basis of their drainage condition, i.e., each cell was identified as being either adequately (depth to groundwater > 10 feet) or poorly (depth to groundwater < 10 feet) drained.

The acreages of each use by cell portion in each quadrangle for each of the index years was then measured with an electronic planimeter and recorded. The measurements were tabulated by use, cell and time period. While the total urban use of land in the study area ranged from only 2-4 percent in this period, its importance in the study is not in proportion to the total acreage occupied, for it is the growth of urban areas that has engendered "perceived" use conflicts. From a spatial display of urban areas in cells, these conflicts appear real. First, urban areas are concentrated on prime land (66.5 percent) which is precisely the concern expressed in the agricultural land use planning legislation. Secondly, the spatial correlation between growing urban areas and those areas of concentrated perennial use is almost perfect. Thus, the lands under most intense potential urban conversion pressure are those same lands that yield the highest values of the agricultural uses and represent the greatest intensity of capital investment. Furthermore, urban areas have expanded rapidly during the study period, total acreage having doubled.

Table 1 indicates, as a percentage of the study area, the distribution produced by the union of the three basic land characteristic sets—productivity, drainage and use. As expected, the heaviest concentrations of irrigated agricultural use (nonperennial and perennial) are found to occur on prime adequate land. In particular, the highest value crops, the perennials, are principally associated with prime adequate land (56 percent in 1974). Urban development as well is concentrated on prime adequate which further underlines the urban-perennial use conflict previously observed. Due to the intensity of use, it is also not surprising to observe the stock of prime adequate declining over time. That the stock of nonprime adequate is rising is largely due to the spatial shift in the drainage problem area. This particular characterization of the land resources of the study area represents the basic elements that are used to build an empirical model to examine these resource use changes over time.

TABLE 1

Land Use by Drainage Condition and Land Productivity Type[a/]

Land productivity type	Drainage condition	Land use	Percent of all land--1958	Percent of all land--1966	Percent of all land--1974
Prime	Adequate	Idle	4.84	4.13	2.96
		Nonperennial	13.17	12.10	9.02
		Perennial	4.55	7.20	8.05
		Urban	1.28	1.70	1.91
			23.84	25.13	21.94
	Poor	Idle	2.39	1.97	1.48
		Nonperennial	8.45	7.45	10.01
		Perennial	1.60	1.75	2.51
		Urban	.45	.43	.74
			12.89	11.60	14.74
Nonprime	Adequate	Idle	16.69	19.38	18.84
		Nonperennial	7.67	8.73	9.75
		Perennial	.76	1.40	3.49
		Urban	.41	.59	.86
			25.53	30.10	32.94
	Poor	Idle	15.62	10.48	6.55
		Nonperennial	10.42	10.33	12.29
		Perennial	.37	.79	.44
		Urban	.31	.35	.47
			26.72	21.95	19.75

a/ The land percentages reported by year do not include those portions of the study area which are unsuitable for irrigation development.

THE PRIME LAND RESOURCE USE-STOCK MODEL

The intertemporal model of land resource use described in this section of the paper has its microeconomic foundations in a neoclassical treatment of the agricultural firm investment decision process. Then by assuming a social perspective and aggregating over firms, a regional characterization is achieved. The addition of salient parameters describing critical aspects of the physical setting of the study completes the specification of the model (Dudek).

The land resource use-stocks previously described were structured into a simultaneous block of structural equations as indicated in Table 2. This structure is based upon the assumption that the prime-nonprime delineation of land resources is physically based, and that once so classified they remain so. It was hypothesized that the land resource use-stocks would be functionally related to their current and past values, the levels of policy or control variables, such as CLCA contract acreages, and exogenous variables which affect the system but are not susceptible to manipuation. The data, previously described, were first differenced since it was further hypothesized that an assessment of the relationship between changes in urban stocks and changes in the acreages contracted under the Act would better test the effectiveness of the program. The system was estimated by three stage least squares.

RESULTS AND CONCLUSIONS

The parent project from which these research results are abstracted addresses several comprehensive land use policy questions; thus only those

TABLE 2. -- PRIME LAND RESOURCE USE-STOCK MODEL - SIMULTANEOUS BLOCK STRUCTURAL FORM 3SLS ESTIMATES†

	Constant	Endogenous Variables							Lagged Endogenous Variables						
		IA_t	IP_t	NPA_t	NPP_t	PA_t	PP_t	U_t	IA_{t-1}	IP_{t-1}	NPA_{t-1}	NPP_{t-1}	PA_{t-1}	PP_{t-1}	U_{t-1}
IA_t	3082.78637 (0.1465)	-1	-0.94030* (-19.8073)	-1.03656* (-17.5309)	-1.07058* (-18.3739)	-0.98859* (-20.2270)	-0.99156* (-16.9229)	-1.03090* (-9.1481)	0.01923 (0.6406)		0.00168 (0.1296)		-0.02798* (-2.0627)		
IP_t	75575.89338 (0.4878)		-1	-0.16254* (-2.0195)		0.00921 (0.0530)		1.02361 (1.1942)	-0.00388 (-0.0157)	0.43392 (1.2542)	0.19519 (0.7713)	0.11213 (0.4428)	-0.05634 (-0.3167)	-0.07785 (-0.4041)	
NPA_t	221.80800** (1.5258)	-0.93464* (-17.3047)	-0.87519* (-11.8818)	-1	-1.02736* (-40.9399)	-0.96091* (-20.4031)	-0.97233* (-23.3462)	-1.10073* (-7.3655)	-0.00026 (-0.0060)	-0.02277 (-0.3436)	-0.00115 (-0.0192)	-0.00290 (-0.0471)	-0.01250 (-0.2562)	0.01920 (0.2657)	
NPP_t	-431.02380 (-0.3578)		-0.13477 (-0.2313)	-0.84920 (-5.7707)	-1	-0.15615 (-0.5497)		1.85925** (1.4459)	-0.07228 (-0.2227)		0.54315 (0.6081)	0.50789 (0.5541)	-0.01783 (-0.0254)	0.07983 (0.0787)	
PA_t	182.46143 (1.1481)	-0.98015* (-23.1373)	-0.93897* (-14.0707)	-1.04902* (-26.2606)	-1.07782* (-32.0779)	-1	-1.00604* (-20.4758)	-1.07748* (-7.6500)	0.00282 (0.0801)	-0.01421 (-0.2782)	0.00397 (0.0712)	0.00050 (0.0086)	-0.01954 (-0.4468)	0.01173 (0.1850)	
PP_t	902.26301 (0.6611)		-0.42957 (-1.0253)	-0.46970* (-2.0281)	-0.18973 (-0.6931)	-0.44560* (-1.6891)	-1	-1.95375* (-1.9147)	-0.24136 (-1.1643)		0.01388 (0.1605)		0.09727 (0.4774)	0.14116 (0.4840)	
U_t	53.22510 (0.4917)							-1	0.05179 (0.8920)	0.05823 (0.7862)	-0.00241 (-0.0424)	0.01031 (0.1786)	0.08769* (2.0416)	0.08046* (1.7282)	0.65343* (3.3359)

Control Variables							Exogenous Variables								
SA_{t-1}	WA_t	TDI_{t-1}	GW_{t-1}	SW_{t-1}	TAX_{t-1}	PD_{t-1}	DEC_t	PCI_{t-1}	EXP_t	$PRCP_t$	POP_t	DCP_t	$NPPR_{t-1}$	PPR_{t-1}	CNTY
-0.02602 (-0.4469)	0.01427* (1.9576)				26.36730 (0.8332)		-0.06311 (-0.8574)	0.53726 (0.1629)	-56.30969 (-0.1368)	-49.44671* (-2.6154)					-17.67834 (-0.1088)
0.01717 (0.0525)	0.01256 (0.2401)				-221.44026 (-1.2387)		0.41492 (0.9109)	-14.03849 (-0.4303)	-1509.12878 (-0.4972)	65.52785 (0.5509)					623.87445 (0.7036)
	0.01201 (1.2104)	0.02703 (0.4122)	-0.00532 (-0.3133)	-0.00233 (-0.1760)	24.90363 (0.6310)		-0.04738 (-0.6373)			-48.87616* (-2.2758)			-0.07766 (-0.0252)		-22.07671 (-0.1312)
	0.00068 (0.0062)	0.58590 (0.6806)	-0.04188 (-0.2047)	-0.00012 (-0.0006)	-336.27393 (-0.8627)		-0.14201 (-0.2266)			-20.87024 (-0.1048)			-19.75238 (-0.5492)		1767.47383** (1.3828)
	0.01267** (1.4478)	0.02326 (0.3857)	-0.0041 (-0.2593)	-0.00146 (-0.1258)	18.41210 (0.5081)		-0.04025 (-0.5792)			-48.71856* (-2.2488)				-0.8473 (-0.1081)	0.77746 (0.0048
	0.04939 (0.9204)	-0.19049 (-0.4215)	0.5649 (0.5002)	-0.07518 (-1.0889)	-41.53645 (-0.1919)		0.01593 (0.0315)			-130.64929 (-0.8570)				6.99913 (0.5941)	170.13469 (0.1450)
	0.00650 (0.8147)				38.58409 (1.1217)	-5.86369 (-0.5996)					0.00373 (0.4130)	1.27578 (0.3891)			-142.70587 (-0.8510)

The values in parentheses are t - values
* Denotes significance at the 5% level.
** Denotes significance at the 10% level.
† Variable definitions:

IA	idle land adequately drained
IP	idle land poorly drained
NPA	irrigated nonperennial cropland adequately drained
NPP	irrigated nonperennial cropland poorly drained
PA	irrigated perennial cropland adequately drained
PP	irrigated perennial cropland poorly drained
U	urban
SA	set-aside programs
WA	Williamson Act (CLCA) acreage
TDI	total drainage installations
GW	groundwater
SW	surface water
TAX	property tax
PD	population density
DEC	depth to E-Clay layer
PCI	percent of cell irrigated
EXP	exports
PRCP	precipitation
POP	population
DCP	distance to central place
NPPR	nonperennial price index
PPR	perennial price index
CNTY	county dummy variable

results pertaining to the CLCA will be discussed in detail (Dudek; Horner, Dudek, and McKusick). Of the four general groups of variables indicated in Table 2, current endogenous variables were more significant in the regression than their lagged counterparts. This is as expected since each period represents eight years and changes in the levels of the land resource use-stocks should be determined to a greater extent by current period changes rather than by past changes. The Williamson Act (CLCA) variable in the control group was significant in two equations: idle land adequately drained and irrigated perennial cropland adequately drained. The remainder of the policy variables specified in the system exhibited no significance. Of the exogenous variables, only precipitation was significant.[1/] Changes in the annual quantity of rainfall is strongly related to changes in the subsurface drainage conditions of the study area. Consequently, above normal precipitation results in an increase in the poorly drained area and a concomitant decrease in the adequately drained area.

The results of the estimation of the effects of CLCA contract acreage on land use changes is consonant with the conclusions achieved in previous research. In particular, the Act exhibits a positive effect upon the stock of idle land that is adequately drained, i.e., positive increases in contracted acreage are positively correlated with increases in the idle adequate stock. Similar results are observed with respect to the perennial adequately drained state. These results are further strengthened by the

1/ The specification used in Table 2 was designed to test hypotheses pertinent to CLCA policy effectiveness, first differencing of the data restricts the policy interpretations in other areas.

inclusion of a dummy variable to account for the fact that not all counties within the study area offered the program. As is indicated in Table 2, the county dummy variable was significant only in the prime nonperennial poor equation. Significance of the Merced county dummy variable in this particular equation is explained by a high concentration (approximately 40 percent) of prime nonperennial poorly drained land and a 4.5 percent growth in this use-stock between 1966 and 1974 in the county. These conclusions then are consistent with those from previous research that indicated that the Act was successful in attaining the open space component of its objectives. Contracted acreage changes are not significant in determining changes in the urban stock. The intent of the program, however, was that contracts under the Act would retard the conversion of prime agricultural land to urban uses so that as contracted acreage changes increased, the expectation was that urban stock increases on prime land would decrease. This would indicate that current legislative and administrative concern in California with the conversion of prime land to irreversible urban uses is not misplaced and that mechanisms for effective control need to be improved.

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