CALIFORNIA GEOGRAPHICAL SOCIETY

SINCLAIR'S "VON THUNEN AND URBAN SPRAWL": THE CONVERSION OF AGRICULTURAL LAND TO SUBURBAN USES IN SONOMA COUNTY, CALIFORNIA, 1950-1970

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Introduction

The outer edge of the metropolitan region is often one of the most dynamic areas of the urban realm with respect to the changing use of land. Pressure for the conversion of agricultural land to urban and suburban uses in the rural-urban fringe has been particularly great in California. Sonoma County, California, offers an excellent example of the processes and problems associated with such transitions in land use. This paper will focus on the evolution of the suburban landscape of Sonoma County through consideration of a model of land-use change proposed by Professor Robert Sinclair.

Sonoma County Within the Context of the San Francisco Metropolitan Region

An understanding of the change in the use of land in a given area comes from two principal considerations: the internal organization of the study area and the influences which come from beyond that region. The fact that agricultural lands are

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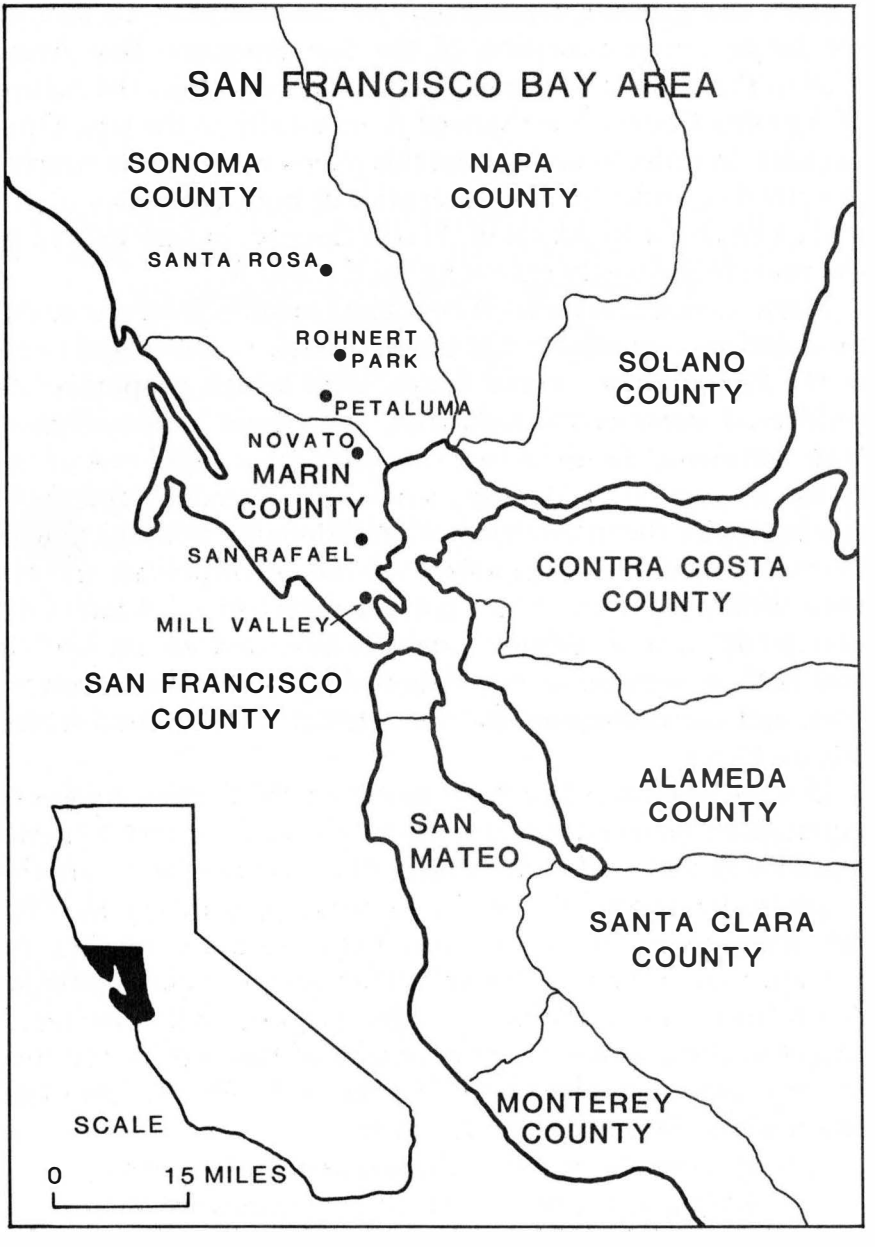
succumbing to urban uses and that cities within Sonoma County are growing rapidly may be considered to be part of the larger urban evolution of the San Francisco Bay Area. Within the context of this regional morphogenesis, the nature of Sonoma County has changed dramatically in the past three decades. In order to understand this phenomenon more clearly, one must consider the characteristics of both Sonoma County and its neighbor to the south, Marin County, as they existed in the years immediately following World War II.

Marin County, in terms of per capita income, long one of the most affluent counties in the United States, is considered to be in the San Francisco urban fringe, with a high proportion of residential, commercial, industrial, and vacant land as distinct from farmland. These factors coupled with a rapid rate of increase in population density, land-use conversion, and commuting typify the urban fringe.[1] Traditionally, Sonoma County exemplified that component of the metropolitan mosaic most distant from the urban core, the rural fringe.[2] A high proportion of farm as distinct from non-farm and vacant land, a low rate of increase in population density, land-use conversion, and commuting are all characteristics of the rural fringe (Figure 1).

The San Francisco Bay Area, as did much of urban America, experienced tremendous growth in population and a rapid spatial expansion of both small urban centers and suburbs following the Second World War. It was during this period that the landscape of Sonoma County began to show the signs of transition from the rural fringe to the home of rapidly growing urban areas and suburbs. In order to grasp fully the rapid nature of this transition, the evolution of land use in Sonoma County may be placed in the most basic of historical perspectives. This overview includes:

1. A pre-agricultural era which lasted until the early 1800's and the beginnings of significant Spanish and Mexican influence.
2. An era of agricultural development during which

Figure 1


SAN FRANCISCO BAY AREA
SONOMA COUNTY
NAPA COUNTY
SANTA ROSA
ROHNERT PARK
PETALUMA
SOLANO COUNTY
NOVATO
MARIN COUNTY
SAN RAFAEL
CONTRA COSTA COUNTY
MILL VALLEY
SAN FRANCISCO COUNTY
ALAMEDA COUNTY
SAN MATEO
SANTA CLARA COUNTY
MONTEREY COUNTY
SCALE
0
15 MILES

time the flavor of Sonoma County was distinctly rural agricultural: a period lasting approximately from 1820's to the 1930's.

3. The formative years of a typical rural landscape as measured by the definition of the rural-urban fringe beginning in the 1930's. This stage may be viewed in light of Howard Gregor's observation on the development of the transportation system of the Bay Area:

   "...not until 1927 were any of the several intersecting bays connected by bridges. Then, within ten years five crossings were constructed, enabling the increasingly cramped populations of the Bay Area to spill out into most distant reaches several of which had been comparatively sparsely populated."[3]

4. The years following the Second World War during which pressure on agricultural land was exerted only randomly and marginally at first but with incentives for land-use conversion becoming systematic and powerful by the 1960's.
5. Although beyond the scope of the paper, the current stage in the drama of land-use decision making and landscape evolution: the era of growth restriction beginning in 1972 with the inception of the much discussed "Petaluma Plan."

It is apparent from this simple outline that the fundamental nature of land use has changed in Sonoma County,as indeed it has in much of California, at an accelerating rate. In light of this assumption the question then becomes how does one begin to assess and analyze the processes involved in the complex and often chaotic web of processes that have led to such a profound turn from the traditional use of the land.

Perspectives on the Study of the Conversion of Land at the Edge of the City

Efforts to bring order to the dynamics of land-use change at the periphery of the metropolitan region involve techniques

covering the range of methods employed in academic investigation. Early studies were generally empirical, and many were directed toward regions of California. In one of the early looks at the suburbanizing landscape, Jan O. M. Broek examined the sequence of occupance of the Santa Clara Valley, especially as it was manifested in patterns of land use. Broek's work, published in 1932, dealt with the region in the early stages of the major change from agricultural to urban land use.[4] In a further study of this same area, Howard Gregor found that by 1957 approximately 70 percent of the prime agricultural land of the Santa Clara Valley had been converted to urban uses.[5] Gregor highlighted one of the leading causes of the rapid suburbanization of California lands when he noted that of the 222 annexations made prior to 1957 by the city of San Jose, 207 were accomplished after World War II.[6]

In another consideration of the Santa Clara Valley, Griffin and Chatham considered empirical evidence and determined that population pressure, transportation inputs, and poor planning were the major causes of the decline in agricultural acreage.[7] They described how such urban related factors as pilferage of crops, a sinking water table, and the fact that farmers could not spray near subdivisions caused agricultural land use to diminish.

Studies of land-use change at the edge of the urban region were not confined, quite obviously, to California. Major investigations of this phenomenon took place in the Eugene-Springfield, Oregon, area in the early 1940's, southern Wisconsin in the mid and late 1940's, and the southeastern United States in the 1950's and 1960's, to cite but a few examples.[8]

By the 1960's American geographers, sociologists, and planners had written to some extent on the rural-urban fringe of most major American cities. Additionally, examination of foreign, English-language publications reveals research pertaining to the fringe areas of cities such as Sydney, Adelaide, Melbourne, London, and Johannesburg during the same period.[9] Studies undertaken beyond the United States tended to

treat the rural-urban fringe in terms of an area of spill-over of urban populations which were removed from the central city spatially, but with nearly all activity still focused on the city. This would imply that the fringe was directly connected, through a complex of linkages, to the urban center socially, politically, and economically. Foreign scholars describe rural-political maturity and adequate planning as factors controlling land utilization and land use-change at the urban perifery.

Historically, American academic study has considered the rural-urban fringe in terms of uncontrolled, sprawling, residential areas representing a vast, spatial expansion of the urban realm. In contrast with foreign scholars, especially the British, American researchers seldom saw meaningful, functional control over land use patterns in the rural-urban fringe. The epitome of this concern for uncontrolled sprawling growth patterns is reflected in the terms Megalopolis and conurbation, both suggesting vast networks or urban places linked in part by their respective, urbanized fringes. Generally, American scholars have concluded that, for the most part, the rural-fringe of U.S. cities had far less political and social dependence on the urban center than their foreign counterparts. In the realm of economic dependence, however, there was a commonality between the situation in the United States and non-U.S. cities.

Contrasts worthy of further elaboration exist between the American urban condition and other areas of the world, especially when considering suburbs and the rural-urban fringe. There are, however, a number of similarities which also rate additional investigation. Basically, these commonalities exist in the topics considered and method of study employed. The common themes of research on land-use change on the rural-urban fringe include the topics of: transition and adjustment in the rural community; transition and adjustment in the urban community; transportation and economic problems associated with dispersed settlement; demographic factors; and, land use and environmental considerations. The most

commonly used research methodologies produce descriptive results, often with little in the way of development of underlying theory. A significant and logical reason for this latter point in the case of United States cities is the fact that although on the macro-scale (the general elements of the dynamics of land use) most fringe areas are basically the same, on the micro-scale (the particular components of each study area) there are vast differences between regions. This results in researchers using relatively broad generalizations, rather than developing complex principles to explain land-use change in the rural-urban fringe. It is troublesome that the theoretical foundation which does exist has been infrequently tested for validity. The remainder of this paper, therefore, will focus on (a) discussion of a model of land use designed, in part, to explain land-use change at the edge of the city and (b) a test of that method of analysis by using as a time frame the 1950-1970 period of transition from rural fringe to suburban landscape in portions of Sonoma County, California.

Von Thunen and Urban Sprawl

The methodology that is of primary importance in this study was developed by Robert Sinclair. Sinclair employed concepts first developed in 1826 by J. Henirich von Thunen[10] as a basis for his model of the impacts of urban sprawl on rural land use.

Empirical observations in the Hamburg region of Northern Germany led Von Thunen to develop a method of assessment of patterns of agricultural land use. Von Thunen's ideas did not necessarily constitute a pure theory of location, but rather a method of analysis which could be generally applied to a number of situations. Von Thunen's observation was that on any particular segment of land the activity which yielded the greatest net return would prevail. It is important to note that this net return was measured in profit per unit of land, not in profit per production unit. For example, in considering competition between wine grapes and apples, the significant element would be financial return per acre of land for either crop,

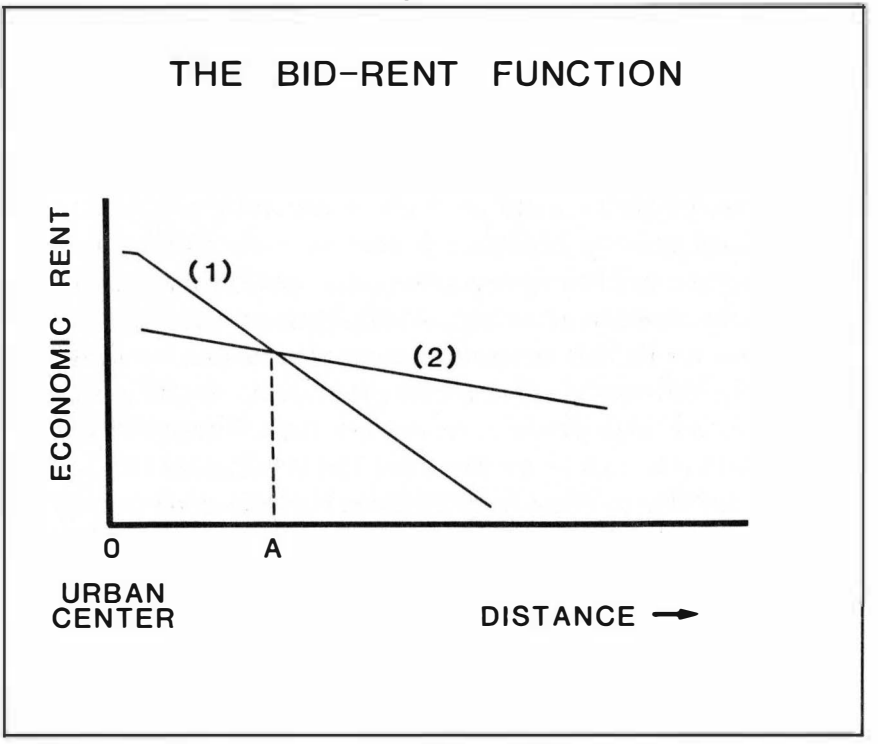
rather than financial return per ton of product.

In order to explain this competition, Von Thunen used the term economic rent. As Chisholm notes, economic rent is not the same concept as the term rent in ordinary usage. Economic rent denotes the payment which a tenant makes for the right to occupy a farm or dwelling or other property.[11] Economic rent in the case of agricultural land use is a combination of factors such as soil quality and transportation costs as they relate to the net return of profit per acre of land. Economic rent is, then, all costs involved in growing and marketing a product.

The nature of this economic competition can be illustrated by a basic, bid-rent diagram (Figure 2). Land use (1) is an enterprise in which high profit is generated; thus, this activity is able to locate in the high cost zone near the urban area (0). In competition for the particular space near the urban center, practitioners of land use (1) are able to out-bid those involved in land use (2). As distance from the urban center increases, practitioners of land use (1) are unwilling to continue to pay high rent; thus, land use (2), which may bid more to be at that particular distance from the city, becomes the dominant use of that space. In this case, such a transition would occur at point (A). The land from the urban area outward to distance 0-A features land use (1); and from point A outward, land use (2) prevails as a function of economic competition.

Von Thunen put forth this theory using as an example the *"Isolierte Staat,"* that is, the ideal or isolated state. Given an area of flat, tillable land of uniform physical characteristics, a single transportation system, agriculturalists flexible as to their use of the land, and a centrally-located and uniformly-accessible central market, Von Thunen postulated six concentric zones of agricultural activity around the city. Given the technology and needs of the day, zone one consisted of dairy and perishable vegetable production and zone two forest land, since the need for wood as both fuel and building material was great. The remaining four zones, in order as they would be found with increasing distance from the city, were: intensive

Figure 2



crop farming; crop farming with pasture; three-field rotation; and, livestock grazing.

Von Thunen considered the boundaries of the urban area to be static and not dynamic as in the case of modern, metropolitan regions. The dynamic nature of the urban boundary is one factor that has produced contemporary agricultrual land-use patterns quite different from those suggested by Von Thunen. The utility of the concept proposed by Von Thunen in the assessment of modern urban expansion and suburbanization, however, is found in the notion of economic competition for land as related to zones of agricultural production. Robert Sinclair, for instance, postulated that the fundamental principle proposed by Von Thunen could be applied to the explanation of land-use change at the rural-urban fringe.[12]

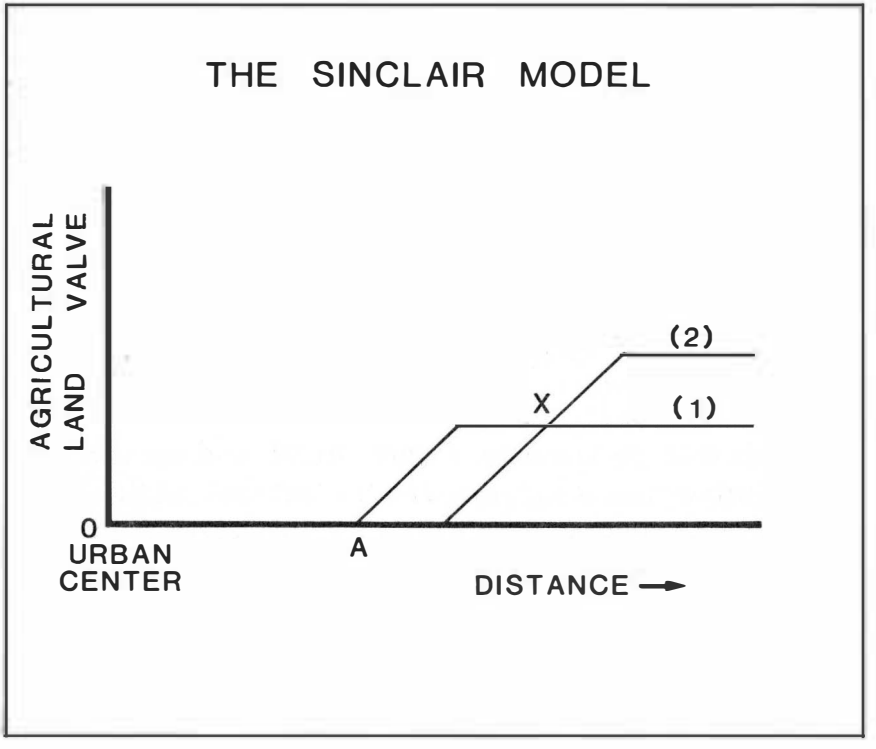
Sinclair suggested that agricultural land use would become more intense with increasing distance from the city, owing largely to the cost of land and the role of speculations on the rural-urban fringe. In essence,

> Urban land today is much more valuable than rural land, so that where there is direct competition between urban and rural land use, urban uses generally take over. Further, land where urbanization is expected also is more valuable than rural land. Such land rises in value, and either is purchased from the original owner by developers and speculators or held by the original owner as speculation.[13]

The thesis that the intensity of agricultural land use decreases near the urban area is supported by the fact that "as the urbanized area is approached from a distance, the degree of anticipation of urbanization increases."[14] This produces an ever-increasing ratio of urban to rural land and thus "...although the absolute value of the land increases, the relative value for agricultural utilization decreases."[15] Sinclair tied the decreasing intensity of agricultural land use found near the urban center to land speculation when he observed: "Obviously the greater the chances of urban land uses taking over, the less practical it becomes for the owners to invest highly in capital and labor for agricultural purposes."[16] This meant that near the urbanizing zone of the rural-urban fringe agricultural pursuits such as irrigated pasture or low-input grain crops would be found, while high-input activities such as orchards or vineyards would be found at a greater distance from the urban area. Sinclair's hypothesis was that the activity requiring the least economic input would be near the urban edge and that this zone would be the least valuable for agriculture.

A simple bid-rent diagram of economic competition between two crops illustrates the nature of this reverse of the Von Thunen pattern (Figure 3). Extending from the urban area (0) there is a zone (0-A) in which speculation is so great that there is, in a relative sense, no value for agriculture because of

Figure 3



the impending land-use change. At point (A) there is some value for agriculture; and a very low-intensity, low-input agricultural land use (1) is found in this region, for example, grain crops or pasture. Intense speculation in land decreases with distance from the city; therefore, greater capital and labor inputs become more practical with distance since there is an increasing stability to the agricultural future. In this case, at point (X) low input crops may be replaced by orchard or vineyard crops which are typical of land use (2). Like Von Thunen, Sinclair postulated a series of expanding, concentric rings surrounding the city; and in these zones the following agricultural activities would be found: urban farming, vacant and temporary grazing land, field crops, dairying and field crops, specialized crops.[17]

Sinclair's intial hypothesis, the effect of speculation on land-use change, was a meaningful contribution to land-use theory. However, the concentric zone aspect of his proposal, when applied to the North American city, may not have direct, universal applicability. It may be noted, for instance, that the rural fringe or rural hinterland of many North American urban regions is characterized by dynamic, multicenter urban growth much like the pattern of urban-suburban land-use conversion suggested by Gottmann in *Megalopolis*.[18] Sinclair's model does provide, in any case, a most useful way to consider land-use change.

Land-Use Change in Sonoma County, California

In order to apply the Sinclair model to land-use change in Sonoma County, several basic types of data were employed. First, statistical information relating to population growth, regional demographics, housing starts, and agricultural land-use practices were examined. The second phase of the study involved coupling the statistical information with the interpretation of aerial photographs taken between the years 1950 and 1970. Finally, the wedding of statistical data to spatial patterns as seen from the air formed the basis from which further examination of planning documents, land-use maps, and other records was undertaken.

The dynamics of population growth and the expansion of nearly all forms of economic activity into the suburbs following World War II has been well documented.[19] One expression of this growth is found in a comparison of the share of the total population increase of the Standard Metropolitan Statistical Areas (SMSA's) of the United States that went to the cities, as compared to the percentage of growth found in the suburban element of SMSA's. Between the years 1950 and 1960, 23.8 percent of the growth of SMSA's was in cities, while 76.2 percent of all SMSA growth took place in suburbia. The cities' share of SMSA growth between 1960 and 1970 was 4.4 percent, thus an astounding 95.6 percent of the population increase of SMSA's

occurred in the suburbs.[20] The cities of Sonoma County were not immune to this rapid growth (Figure 4) (Table 1).

Figure 4

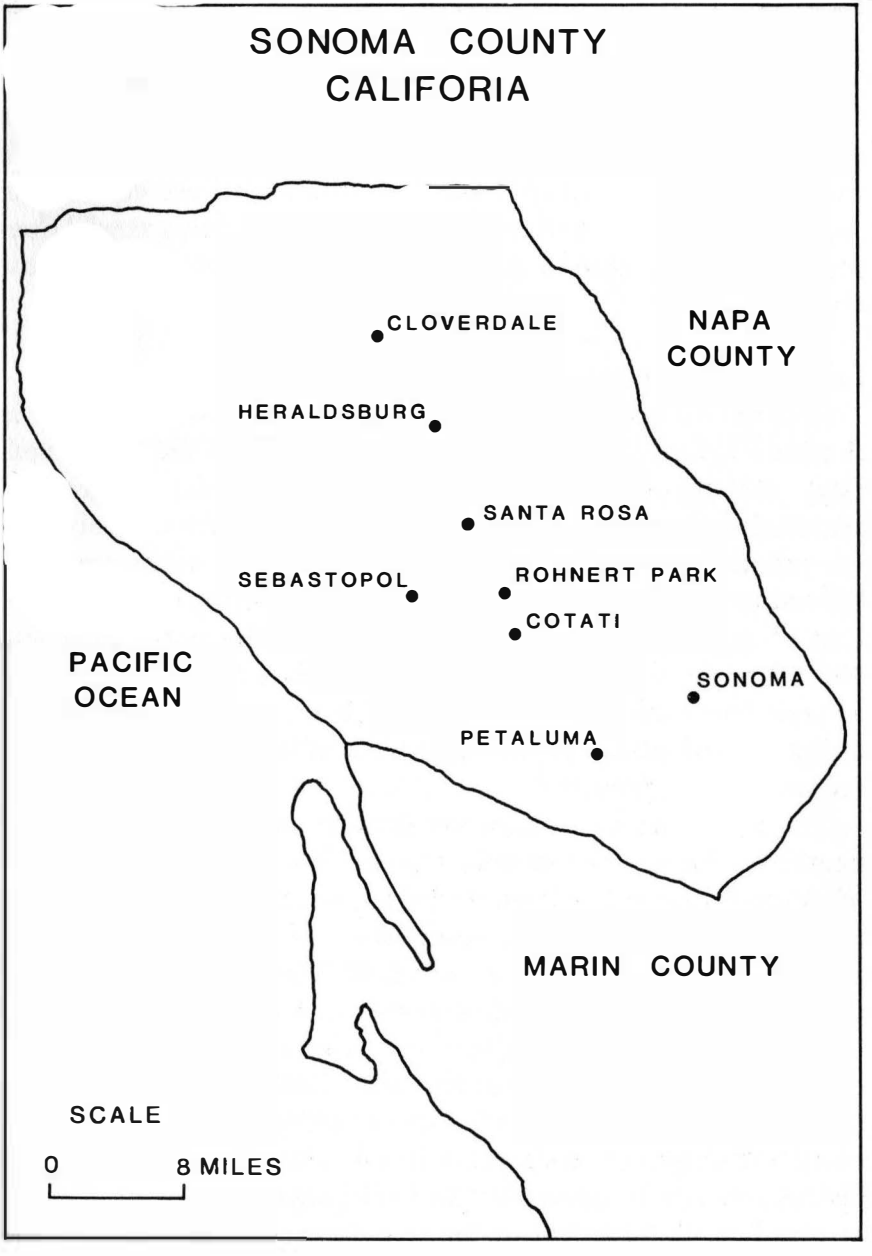


Table 1
POPULATION TRENDS BY CITY, SONOMA COUNTY
1920-1970

City	1920	1930	1940	1950	1960	1970
Cloverdale	718	759	809	1,292	2,848	3,251
Cotati						1,368
Healdsburg	2,412	2,296	2,507	3,258	4,816	5,438
Petaluma	6,226	8,245	8,034	10,315	14,035	24,870
Rohnert Park						6,133
Santa Rosa	8,758	10,636	12,605	17,902	31,027	50,006
Sebastopol	1,493	1,762	1,856	2,601	2,694	3,993
Sonoma	801	980	1,158	2,015	3,023	4,112

Source: 1920-1970 figures from the United States Census of the years 1920-1970.

It is not surprising that cities located on the main, north-south arterial from San Francisco (Petaluma, Cotati, Rohnert Park, and Santa Rosa) experienced the most dramatic growth. That much of their development was related to the establishment of relatively low-cost, tract-housing subdivisions is reflected in their median-age statistic (Table 2).

Table 2
MEDIAN-AGE STRUCTURE FOR CITIES IN SONOMA COUNTY, 1970

Sonoma County	
Cotati	24.6
Petaluma	26.4
Rohnert Park	20.4
Santa Rosa	29.1
Sebastopol	40.5
Sonoma	45.3

Source: *The San Francisco Bay Area 1970 United States Census* (San Francisco: San Francisco Bay Area Council of Governments, 1973) Vol. 1, Table 4.

The "freeway cities" fall in the relatively low median-age category. Rohnert Park with a median age of 20.4 has an exceptionally low median-age value. The cities not impacted by commute flows and new subdivisions showed evidence of some

of the highest median-age structures of any California cities: note Sonoma and Sebastopol with median-age statistics of 40 plus years.

In short, such indicators of rapid growth translate into pressure on agricultural lands. As was the case in the Santa Clara Valley, the most suitable sites for subdivision in southern Sonoma County were also the location of orchards, vineyards,

Table 3
PASTURE AND GRAIN ACREAGE, SONOMA COUNTY 1950-1969 (Acres)

Year	Pasture-Permanent Irrigated	Grain
1950	5,500	13,000
1951	7,000	18,059
1952	10,000	22,469
1953	11,000	21,465
1954	11,500	12,800
1955	12,000	22,400
1956	12,500	25,500
1957	14,614	26,000
1958	15,000	25,500
1959	15,000	30,000
1960	15,000	31,000
1961	15,000	31,000
1962	15,500	30,600
1963	17,000	26,000
1964	19,000	25,000
1965	19,000	24,000
1966	15,000	26,000
1967	15,000	26,000
1968	15,000	21,600
1969	15,000	22,700

Source: Percy F. Wright, *Agricultural Crop Reports 1950-1969*, (Santa Rosa: County of Sonoma), pp. 1-5.

seed farms, and prime pasture lands. The Sinclair model suggested that demands for suburban development and the attendant land speculation would likely result in the transition from high-capital and labor-intensive crops to low-intensity agriculture. Comparision of Tables 3 and 4 illustrates the change in the intensity of agricultural land usage in Sonoma County during the study period.

Table 4
ORCHARD CROPS, SONOMA COUNTY 1950-1969 (Acres)

Year	Pear	Plum	Prune	Total
1950	2072	174	18,338	20,584
1951	2076	174	18,071	20,321
1952	1975	169	16,914	19,058
1953	1802	132	16,140	18,074
1954	1778	119	16,141	18,038
1955	1783	120	16,127	18,030
1956	1783	115	16,032	17,930
1957	1728	0	14,795	16,523
1958	1735	0	14,893	16,628
1959	1765	0	15,090	16,855
1960	1621	0	13,918	15,539
1961	1629	0	14,197	15,826
1962	1633	0	14,711	16,344
1963	1631	0	15,156	16,787
1964	1754	0	15,743	17,497
1965	1848	0	16,243	18,091
1966	2044	0	15,807	17,851
1967	2056	0	15,821	17,877
1968	1992	0	16,146	18,138
1969	2001	0	15,997	17,998

Source: Percy F. Wright, *Agricultural Crop Reports 1950-1969,* (Santa Rosa: County of Sonoma), pp. 1-5.

Table 3 provides clear evidence that between 1950 and 1969 a substantial increase occurred in the land area devoted to grain crops and pasture. The peak and valley pattern of increase followed by decrease in acreage found in the years 1962-1965 was the result of a period of rather widespread planting, followed by years in which several very large housing tracts were developed. The urban growth of the Rohnert Park-Cotati region provided a dramatic example of Sinclair's contention that land could lose all value for agriculture. The *Sonoma County Agricultural Crop Report* for 1962 stated that:

> Seed crops for a number of years were produced in large quantities on the Rohnert Seed Farms and were an important segment of the agricultural economy of the County. Many kinds of vegetable, flower, and grass seeds were produced. This farming operation has been discontinued as it lies in the path of urban expansion.[21]

The demise of this segment of the agricultural industry was a significant economic loss (Table 5).

Seed farms appear to have disappeared completely from the Rohnert Park area by 1970 and were directly replaced by the city of Rohnert Park, one of the most rapidly growing cities in California.

Table 5
SEED FARM ACREAGE AND COMMERCIAL VALUE

Year	Agreage	Commercial Value in Dollars
1950	1,800	630,000
1955	1,700	311,000
1960	1,600	157,000
1962	372	16,000

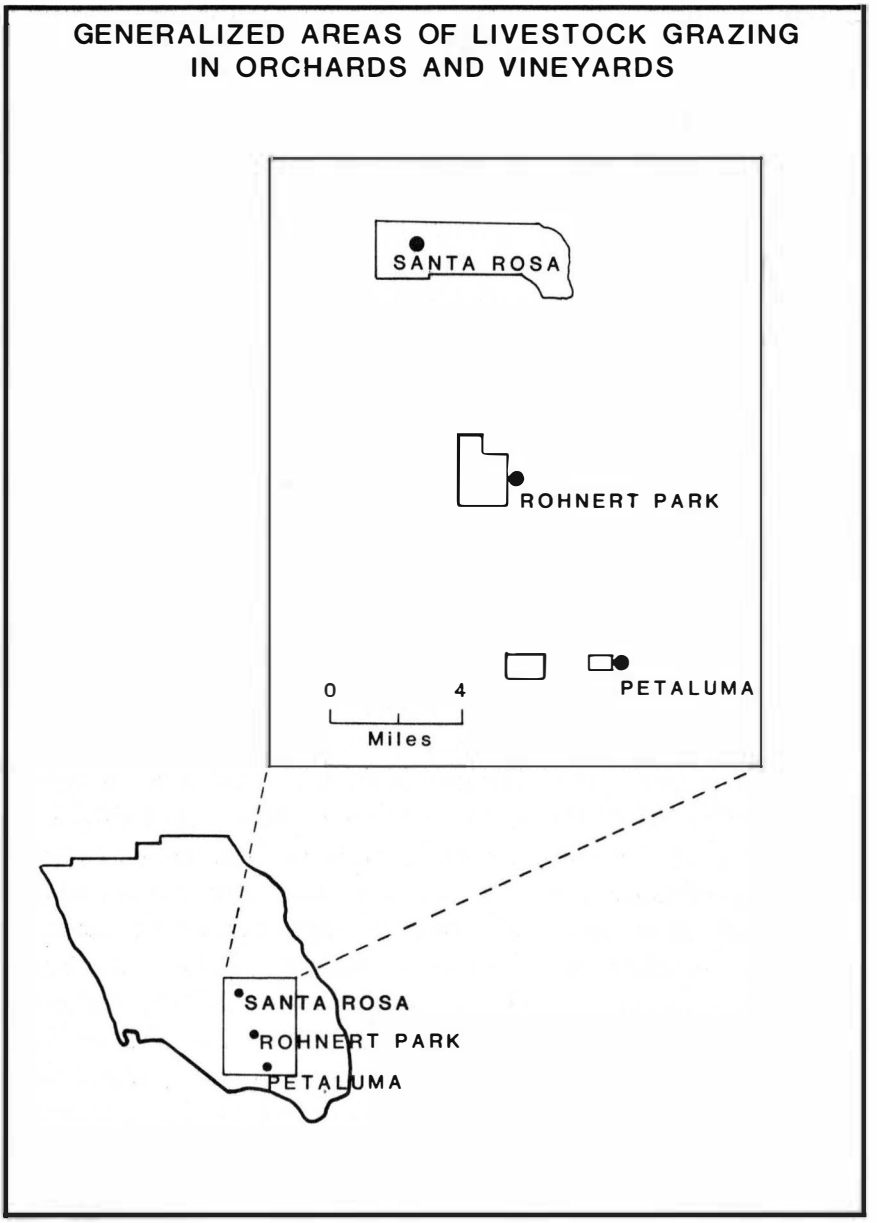
Source: County of Sonoma, *Agricultural Crop Reports*, 1950, 1955, 1960, 1962, (Santa Rosa: County of Sonoma).

Examination of Table 4 indicates a general, downward trend in one of the higher intensity agricultural land uses. At least one caviet with respect to these data is necessary. Market conditions and local weather anamolies play a role in the production of these orchard crops. Based on county agricultural records, however, it can be generally inferred that the economy and micro-climatological patterns were not responsible for broad changes in the occurrence of the crops listed in Table 4. The establishment of new orchards in the valleys far removed from the zone of competition between agricultural and urban uses was responsible for preventing a far more drastic drop in acreage used for orchard crops.

Agricultural statistics and census data alone do not provide sufficient data upon which to gauge the applicability of Sinclair's theory to this region. In order to achieve a fuller measure of the spatial dimension of this statistical information, interpretation was made of aerial photographs taken in 1951, 1962, and approximately 1970.

Through examination of aerial photographs it became evident that much of what Sinclair postulated about the patterns of agricultural land use did occur in the southern part of Sonoma County. Aerial photographs provided clear evidence of orchards going into disuse, with the total area involved largely reflected in the acreage changes listed in Table 4. In some cases, on the immediate edge of the urban fringe, orchard and vineyard lands were converted to grazing uses while potentially productive trees and vines still remained on the land. In the areas surrounding Petaluma, Rohnert Park, and Santa Rosa, evidence was found of approximately 200 acres being involved in this most direct transition in land use (Figure 5). It should be recognized that this 200-acre figure undoubtedly understates the amount of land included in this particular aspect of conversion, as it is an approximation arrived at through personal photo-reconnaisance flights, sampling, and use of archival photographs and records. The southeastern Sonoma County valley in which the town of Sonoma is located

Figure 5


GENERALIZED AREAS OF LIVESTOCK GRAZING
IN ORCHARDS AND VINEYARDS
SANTA ROSA
ROHNERT PARK
PETALUMA
0
4
Miles
SANTA ROSA
ROHNERT PARK
PETALUMA

as well as the county's extreme northern valleys, all far removed from the most active competition for land during the study period, were the sites selected for new, high-capital and labor-intensive agricultural pursuits.

Conclusion

Much of what Sinclair expected from his model of land-use change occurred in Sonoma County between 1950 and 1970. High-cost agricultural practices did give way to lower-input uses or no agricultural use of the land at all. Zones of land without value for agriculture developed. The highest capital- and labor-intensive agricultural uses were found at greater distances from the expanding urban fringe. A substantial portion of this movement took place long before actual suburban encroachment forced agriculturalists to relocate. Sinclair's observation that mere perception of potential speculation was an important factor in the location of agricultural activities was seemingly borne out as some agricultural practices were reduced from high- to low-intensity fully a decade before suburbs began to bound fields, orchards, or vineyards.

Attempts to model land use, especially land-use change, are always fraught with dangers of over-generalization, restatement of the obvious, and failure to account for spurious influences. Sinclair's model generally avoided these pitfalls and provided an interesting and useful way in which to view the upheaval in the use of land near rapidly-growing cities. In any event, the Sinclair model of land-use change worked well in the particular case of Sonoma County, California, and was of great assistance in helping to provide an observation point from which to view this most dynamic period in the evolution of the Sonoma County landscape.

NOTES

1. Robin J. Pryor, "Defining the Rural-Urban Fringe," in Larry S. Bourne, ed., *Internal Structure of the City:*

Readings on Space and Environment (New York: Oxford University Press, 1971), p. 62. Continuing a long-standing trend of being among the leaders, Marin County, with an average of $17,428 per inhabitant, led California in per capita income in 1981. According to data provided by the Bureau of Economic Analysis, United States Department of Commerce, for that same year per capita income for California was $11,968 with the national per capita income standing at $10,495.

2. Ibid., p. 62.
3. Howard Gregor, "Urban Pressures on California Land," *Land Economics*, 33 (1957), p. 315.
4. Jan O.M. Broek, *The Santa Clara Valley, California: A Case Study in Landscape Changes* (Ph.D. dissertation, University of Utrecht, 1932).
5. Gregor, op. cit., pp. 311-325.
6. Gregor, op. cit., p. 322.
7. Paul F. Griffin and Ronald L. Chatham, "Urban Impact on Agriculture in the Santa Clara Valley, California," *Annals*, The Association of American Geographers, 48 (1958), pp. 195-208.
8. For example see: L.M. Faust, "The Eugene, Oregon, Rural-Urban Fringe," *The Rural-Urban Fringe, Proceedings of the Commonwealth Conference* (Eugene: University of Oregon, 1942), pp. 5-12; Richard B. Andrew, "Urban Fringe Studies of Two Wisconsin Cities, A Summary," *Journal of Land and Public Utility Economics*, 21 (1945), pp. 375-382; Malone Young, "Some Geographic Features of the Urban Fringe," *The Southeastern Geographer*, 2 (1962), pp. 1-6.
9. For example see: N.R. Wills, "The Rural-Urban Fringe: Some Agricultural Characteristics with Specific Reference to Sydney," *Australian Geographer*, 5 (1945), pp. 29-45; R.J. Johnston, "The Population Characteristics of the Urban Fringe: A Review and Example," *Australian and New Zealand Journal of Sociology*, 2 (1966), pp. 71-82; R.E.

Pahl, "Urbs in the Rure: The Metropolitan Fringe in Hartfordshire," *London School of Economics and Political Science, Geographical Papers*, 2 (1962), pp. 52-63.

10. J. Heinrich von Thunen, *Der Isolierte Staat in Beziehung auf Landwirtschaft und National Okonomie* (Rostock, 1826). The translation used in the study is from Peter Hall, ed., *Von Thunen's Isolated State* (New York: Pergamon Press, 1966).
11. Michael Chisholm, *Rural Settlement and Land Use* (Chicago: Aldine Publishing Company, 1972), pp. 21-32.
12. Robert Sinclair, "Von Thunen and Urban Sprawl," *Annals*, The Association of American Geographers, 57 (1967), pp. 72-87.
13. Ibid., p. 80.
14. Ibid., p. 78.
15. Ibid.
16. Ibid.
17. Ibid., p. 80.
18. Jean Gottman, *Megalopolis: The Urbanization of the Northeastern Seaboard of the United States* (Cambridge, Mass.: The M.I.T. Press, 1964 ed.).
19. For an excellent treatment of this subject see: Peter Muller, *Contemporary Suburban America* (Englewood Cliffs: Prentice-Hall, 1981).
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21. Percy F. Wright, *Sonoma County Annual Crop Report* (Santa Rosa: County of Sonoma, 1962), p. 5.