POPULATION-ECONOMIC DATA ANALYSIS RELATIVE TO GEOTHERMAL FIELDS, IMPERIAL COUNTY, CALIFORNIA

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1. INTRODUCTION

Social statistics aid in the understanding of current energy demands and in projecting energy utilization. Energy derived from nuclear, fossil fuel, and coal resources may be placed on an electric power grid, and for small increment costs may be conveyed to localities hundreds of miles away (Fowler, 1975). Such power grid relationships may alter according to season, regional supplies, alternate forms of energy, utility regulating decisions, international pricing developments, and so on. Thus the analyst may have difficulty in assessing demand.

Solar and geothermal energy sources differ from the others in predictability of locational supply-demand relationships. For solar, the current small capacity relative to major energy sources means that supply and demand locations are the same. Geothermal power stations are virtually nonexistent in the U.S. Regional use of geothermal power has the complication of changeable and distant dispersions by power grids, as well as plant capacity.

Regional relationships may be assessed, however, for nonelectrical uses of geothermal power. Geothermal energy production is based on subsurface hot water or steam, which in turn is heated by elevated magma layers. In geothermal power development, wells are drilled into the optimal three-dimensional geologic strata; hot water or steam is withdrawn and used to produce steam to turn generators which yield electricity. The regionally-fixed product of hot water may be used within about 60 km of the power plant periphery for heating, air conditioning, industrial plant processes, for agricultural purposes, and recreational use.

The purpose of this paper is to analyze the socio-economic characteristics of Imperial County, California, in relation to known locations of geothermal fields (KGRA's). Interpretation of these findings will be presented in a separate article by the authors. Socio-economic data are from the 1970 U.S. Census. Analytical methods used are graphic displays, demographic techniques and discriminant analysis. Before describing these it is important to examine relevant studies on energy development in the U.S., as well as past research on the population of Imperial County.

There have been few studies of socio-economic effects of energy development. A recent study (Vollintine and Weres, 1976) examined public opinion on geothermal energy development in Lake County, California, the major existing site of geothermal energy production in the U.S. Generally population variables were concluded to be uncorrelated with opinion on geothermal energy development. Kjos (1974) investigated the potential for industrialization in Calexico, the county's sister city of Mexicali. He drew essentially negative conclusions about the industrial development of Calexico due to lack of incentives for new businesses, a lack of governmental planning, local tensions in regard to border worker issues, and a lack of an industrial park, among other reasons.

2. POPULATION STATISTICS

Imperial County is located in the southeast corner of California; its central valley portion geologically is part of the Salton Trough. Before 1901, the valley consisted of Sonoran desert, with only several thousand residents in a land area of 4284 square miles. An increase in population was caused by the 1901 diversion of Colorado River water for irrigation. The northern drainage flow of residual irrigation water resulted in the formation of the Salton Sea.

As seen in Table 1, population rapidly increased to 60903 persons in 1930. At this time the population reached a plateau and in the next forty years increased only 22% compared to 251% for the state. Even with inclusion in 1970 of the 9000 estimated Mexican border commuters, population only increased 37%. A trend which paralleled total numbers was a decrease from a 1910 sex ratio of 1.9, 52% higher than the state, to a steady level 18-26% higher than the state's from 1930 to 1960. If international commuters (nearly all males) are included, the relative sex ratio continued 28% higher than the state's for 1970.

Since agriculture has consistently been the base industry of the county, the fundamental economic support for additional persons has not been significantly altered since 1930. The draw of large amounts of industry and commerce, which altered other formerly agricultural counties like Orange in this period, was probably precluded by labor and locational factors. The county's unusual sex ratio is interpreted as a lack of female occupations and amenities during the pioneering years of 1910-30, followed by an employment need for more males in agriculture since 1930.

A fundamental factor in Imperial's population is the presence of the border with Mexico and large numbers of Mexican Americans (henceforth abbreviated as MA). Although sparsely populated in the early 1900's, the northern region of Mexico has increased in population sharply since 1950 to a 1970 level of 857000, with 390000 in Mexicali. Table 2 shows comparative data on the MA population 1930-70. Comparison of the broadest definitions, "Mexican" for 1930 and "Spanish language" for 1970, again reveals greater equilibrium 1930-70 for the county. Imperial County's five-fold larger MA percentage than the state's in 1930 was likely due to border proximity and maximal Mexican emigration (Samora, 1971).

The stabilized nature of the county's agricultural economy set in 1930, has not offered an employment structure able to accommodate a skill mix of increased MA workers since that time. Noncitizen Spanish-origin persons have been present during this history. These are legal Mexican aliens (LMA's) and illegal Mexican aliens (IMA's). The detailed history of LMA and IMA trends and fluxes since 1900 is well-delineated in Samora (1971). LMA numbers have been influenced by economic demand for cheap labor which resulted in a federally-approved contract labor program in the 50's--the Bracero program. This program peaked with 400,000 contract workers in the U.S. during the late 50's. Since U.S. place of residence alone determines the census, a substantial number of Braceros were counted in the 1960 census for the county. With the ending of this program in the mid-60's, some 4500 to 6000 (U.S. Senate, 1971) farm workers established residence in Mexicali and commuted to jobs in the county daily, and are estimated to presently number 6,000-12,000. The Immigration and Naturalization Service estimated county LMA's at 8000 in 1973. Recent literature (Stoddard, 1976) has pointed out the extreme inaccuracy in estimates of IMA's.

Table 3 summarizes crude vital rates for the county from 1930-70. If we apply the average rate of natural increase (1930-70) of 1.65% we arrive at a compounded natural increase of 66% over the forty years (the process is assumed additive because the base population is only changing slightly). Under the assumption that border commuters should be counted as county residents in 1970, the forty year outmigration rate is 29%, or a compounded annual outmigration rate of .7%.

A standard demographic feature of MA population is higher fertility (Bradshaw, 1973). However, while the county's annual rate of natural increase is about 65% higher than the state's, this differential is only partly due to MA fertility. For completed cohort fertility in 1970 for ever-married women age 35-40, Imperial has a 49% additional increment for MA over non-MA fertility. When this is applied to the entire population, the fertility increment due to MA's is only 23%. The 42% differential is readily explained by the young age distribution of the county, especially of the MA population, since it is well-known that such youthful age distributions tend to inflate standardized fertility and deflate standardized mortality. Table 3 also shows life expectancies comparable to California's.

3. ENERGY CAPACITY AND CONSUMPTION

This steady level of total population of the county is presently supported by an ample local energy capability, which has evolved since the mid-1930's. Since the first energy installation in 1936 of a 2.2 mW diesel generator, installed capacity increased nearly linearly (at a smoothed linear rate of 3.4 mW/year) to 47.9 mW in 1950. From 1950-75, power plant installation again increased about linearly (at a smoothed linear rate of 12.0 mW/year) to 347.3 mW capacity in 1975. From 1940 to 1970, U.S. electrical energy production increased by a factor of 8.8 and per capita electrical production increased by 5.3 times (Fowler, 1975). By comparison, these factors for Imperial County energy capacity are respectively 12.9 and 10.4. Thus, while the county's population growth has lagged, its growth in energy capacity has greatly exceeded national rates. In fuel mix, the county has changed from steam-diesel-hydro proportions of 0:100:0 in 1940 to 52:7:41 in 1960 and to 68:11:21 in 1975. This latter compares to an estimated 1975 national mix of 76% petroleum and gas, 4% hydro, and 20% in other forms of energy (Penner et al., 1974). Thus the most unusual present feature of the county fuel mix is an enlarged component of hydroelectric power.

Per capita energy consumption was estimated by discounting national consumption in 1973 and county consumption in 1975 to 1970 by the national energy consumption growth rate of 5.6% per year (Fowler, 1975). Per capita estimates are 8272 kW hrs for the nation and 7325 kW hrs for the county (6530 kW hrs if border commuters are included).

Lower comparative per capita consumption contrasts with higher installed capacity per capita. Whereas the 1970 total and peak demand capacities are 1.67 kW/capita and 1.35 kW/capita for the U.S. (Fowler, 1975), they are 3.59 kW/capita and 1.89 kW/capita for the county (3.20 and 1.69 with border commuters). A final crude energy consideration is the current use of county electrical generation. The 1975 ratios of residential to commercial to industrial are 42:39:14 compared to 1973 national figures of 34:24:41. The housing fuel mix of the county reveals a major difference from the statewide pattern--reduced use of utility gas (37% below the state level) and increased use of electricity (271% above the state). A possible explanation is the low price of electricity due to the relatively large component of hydroelectricity in the county.

4. AGE STRUCTURE AND AGE SPECIFIC MIGRATION

As far as can be determined, there have been no past relationships between crude county population and energy development. Age structures and age-specific migration for the county have had very distinctive patterns, but seem unaffected by energy resources. However, age structures likely will be important for geothermal energy by determining present and potential labor force.

Age group data were obtained from the U.S. Census (1910-73), and data on births and deaths were gathered from state sources (California Dept. of Public Health, 1930-75). These were studied by the PYRAMID demographic display program (Pick, 1974).

In comparison to the nation, the county is significantly younger. Forty-five percent of males and 44.3% of females are below age 20, compared to national figures of 37.6% for both sexes. However, this youthfulness reflects only the MA population. While the above respective figures are 35% and 34.5% for anglos--levels below national ones--they are 56.4% and 53.6% for the MA population. This extreme youthfulness exaggerates fertility; since it also influences population projections, it will be discussed subsequently in the context of geothermal energy.

To study age specific migration between 1950-70 it is convenient to aggregate ages by three larger categories: 0-29, 30-64, and 65+. Age structures for 1960 and 1970 are distorted by border commuters previously referred to. Since these workers were nearly all males, comparisons of female age structures are more accurate. In 1960 female migration rates (based on past projected population with direction indicated) were -14.3, -11.5 and +10.0 for aggregated ages. In 1970 these rates were -10.3, +.4, and +9.2. Thus female children and young women have been leaving the county, while retirement age women have been returning. The middle age segment has changed from a strong outmigrating tendency in 1960 to neutrality in 1970. Because of the youthful age pyramid, numerically most migrants (counting in- and outmigrants equally) are in the 0-29 age category (65.2% in 1960 and 89.9% in 1970). The greatest female outmigration was for those ages of 20-24, with rates of -.257 and -.261 in 1960 and 1970. For the young, the draw of employment, educational, and life style forces in more urban, sophisticated regions of the West appear to account for such significant departure. Because of possible data unreliability, males' rates were done for ages 0-20 and 65-79. In 1960 rates were -6.5 and +12.0 for them; in 1970 rates were -4.6 and +9.7. Hence male migratory patterns also show the departure of the young and return of the old.

5. SOCIO-ECONOMIC CHARACTERISTICS

The economy of Imperial County, primarily based on agriculture, will be a critical element in possible geothermal development. The income distribution of the county was studied from 1950-70 by inflating all incomes by the ratio of the mean incomes by ten-year periods. To achieve a somewhat larger economic area for these inflators, Imperial's inflators were averaged with those for Los Angeles County. Incomes were inflated by 87% for 1950-60 and by 53% for 1960-70. Table 4 shows comparable income classes after multiplication by the above weights. The percent of top family incomes (above $28,611 in 1970) appears to be rather stable over twenty years. However, the second highest and lowest income brackets consistently decreased over the period, whereas the middle groups increased by 10%. This trend toward middle-class categories also appears for employment; there was an increase for 1950-70 of 11% in clerical and professional-managerial employment, compared to an increase of only 4% for California. In 1970, poverty levels were 35% higher than for California, and male and female unemployment were 7.1% and 6.4%, 69% and 129% above the state level.

Industrial classifications were examined for Imperial County, Kern County, and California. These can be best analyzed by separating occupational divisions by sex, and by eliminating the agricultural component entirely. In Table 5 are shown the nonagricultural industrial distributions by sex for 1950-70. In Imperial County, the most significant change in industrial classification for males is an 8% rise in public administration and government education (versus a 2.8% increase in these for California and a 3.7% increase for Kern). This increase reflects growth in the middle class. For males, a significant difference is a county manufacturing component only 57% smaller than the state, but a greatly increased utility and sanitary category (304% larger than the state). For females in Imperial, the most important longitudinal trend is an increase of 4% in government education workers. On the female side, compared to California, there is an even more sharply reduced manufacturing component (77% less than the state). Again the utility work force is larger. In summary, eliminating the effects of agriculture and sex ratio, two agricultural counties, Kern and Imperial, appear highly similar in industrial distribution but contrast with the state.

The above analysis controls for the influence of the labor force sex ratio. For the state, this ratio fell from 2.40 in 1950 to 2.03 in 1960 and finally to 1.64 in 1970. For Imperial County the figures were 4.12, 3.37, and 1.90 respectively. It is assumed that the labor force sex ratio will continue to decrease. Thus in considering labor market potential for geothermal-related industrialization, an important source of labor, presently only partially utilized, is females. The large gap with the state in female manufacturing employment would appear particularly important.

6. REGIONAL SOCIO-ECONOMIC COMPARISONS

In order to elucidate important county trends, socio-economic characteristics relevant to energy were studied by computer mapping and then by discriminant analysis between energy regions. Data for county enumeration districts (henceforth called ED's) were obtained from the fifth count of the 1970 Census (U.S. Bureau of the Census, 1974). These data were displayed using Automap II, a standard computer mapping program (Environmental Systems Research Institute). Five levels of data values were chosen, with extremes approximately eighths or sixteenths. Since 58.6% of the county's population resides in the towns of Brawley, Calexico, and El Centro, and another 35.7% lives in the central irrigated valley, the central valley and the largest three towns were mapped separately.

Geothermal energy is legally located underneath surface areas called Known Geothermal Resource Areas (KGRA's). Figure 1--a map of percent Spanish-speaking for the central valley--has superimposed on it a map of the three presently reported central valley KGRA's. For all analyses an ED was identified as geothermal if more than 50% of its surface area was contained within a KGRA. In addition, because of their size and location just outside the Heber KGRA border, ED's in the towns of Calexico and El Centro were identified as geothermal. Although not mapped, an ED in the lower East Mesa contains a promising KGRA which is being actively drilled by Republic Geothermal Corporation. However, this ED contains extensive land area and few of its 259 residents are likely to be affected; hence it was not identified as geothermal.

Using computer mapping technology, regional and geothermal results are presented below for the following characteristics: Spanish language, dependency ratio, labor force availability, mobility, income, and rental market over $100. Spanish-language residents show a concentration in Calexico and periphery (31% of MA's in county) and in Brawley and periphery (22.9%). Thus in the Heber KGRA and Brawley-Salton Sea KGRA's, the Spanish-speaking are of particular importance. Within towns, a directional axis of MA composition is apparent: southeast (high) to northwest (low) for Brawley; northeast (high) to southwest (low) for El Centro; and south (high) to north (low) for Calexico. In drilling and geothermal plant locations near these towns, such well-defined axes may be a consideration.

A dependency ratio was calculated and mapped (persons aged under 18 plus persons 65 and over/persons 18 to 64). This measure is ethnically biased because of the very large portion of children and adolescent MA population. Thus dependency closely corresponds to percent MA (r = .44), with a greater than average concentration in KGRA's. Directional axes for the towns are not apparent for dependency, but areas of highest concentration are present in east-central Brawley, northeast El Centro, and north Calexico. The opposite locations of high dependency and high percent MA for Calexico is due to the large percentage of young family housing for both ethnic groups in the north.

Male labor force availability is defined as the number of males 17-64/total number of males. By definition, it is inversely related to dependency, although the latter includes both sexes. For the northern combined KGRA, male labor force availability is very low in peripheral areas, but high in Brawley. For the southern KGRA, a medium level is apparent with El Centro medium and Calexico low. Brawley, which contains the preponderance of persons in the northern geothermal areas, clearly offers in addition an age structure favoring male work availability. Within the towns, this characteristic is highest in the two northern corners and west central part of Brawley, the northeast corner of El Centro, and the southwest corner of Calexico.

Female labor force availability is very highly correlated ($r = .58$) with that of males. Major differences are the reduction in female relative to male level in the highest income areas of southwest Brawley, El Centro and north Calexico. A similar reduction in the southwest part of Calexico, an area of farm labor activity, may be due to a reduced availability of married housing.

Regional mobility patterns were studied by 1965 residence in a different house (household mobility), different county (county mobility), and different state (state mobility). These data are for in-movement rather than out-movement. Hence for a county in which out-movement has predominated, the bulk of total moves is ignored. However, since town populations were very stable between 1960-70, it may be assumed that regional out-movement levels are highly correlated with in-movement levels as measured. These data show that mobility up until now does not correspond to KGRA boundaries. Household mobility has high rates in rural and peripheral areas in the eastern third and southern third of the central valley, except for the southeast corner; relatively high mobility in the northeast third; and medium to low levels in major towns. County mobility in nonurban areas in the northwest third is low in level, with moderate levels for the remainder; the cities of Calexico and Brawley had moderate rates while El Centro was high.

Since interregional mobility has been found to be an important correlate of other social variables including vital rates and prospective mobility (Butler, 1969; Pick, 1975), planners concerned with the labor force in El Centro should note the high mobility, with a decreasing gradient from west to east. Since interstate inmigrants compose only 30% of intercounty inmigrants, they are of less importance. The most notable feature, again, is elevated levels for El Centro and adjacent areas to the east and west.

Regional income differentials are very sharply defined, with higher incomes in El Centro, western rural El Centro, Holtville, and rural Calexico to the east. Rural parts of the Salton Sea and Brawley KGRA's and the town of Heber are at the lowest level of income. A general countywide gradient for rural areas runs from north (high) to south (low). Clear income axes exist in Brawley (west-high to east-low), El Centro (southwest-high to northeast-low), and in Calexico (north-high to south-low). Regionally, the location of rentals in the rental market above \$100 corresponds very closely to income--r (percent rentals \$100-149 in the rental market, percent family income \$9-25,000) = -.48, while r (percent rentals \$200-249, percent family income \$9-25,000) = .4.

Discriminant Analysis

As discussed earlier, for pollution by-products of non-electrical applications of geothermal energy, eventual effects from various field locations may be related to differences in the socioeconomic characteristics of the surface areas above the fields. To attempt to establish what characteristics differentiate fields and relate these to geological features, a linear step-wise discriminant analysis was performed, using ED data. A standard step-wise program was used (Dixon, 1973), with an F criterion for inclusion of .01. In addition to the variables discussed in Section 6, the following variables were included for possible selection (all except the first three are in percent for the population considered): white fertility ratio (persons under 5/females 15-45), Spanish fertility ratio, persons now married, international mobility (persons age 5+ abroad in 1965), unemployment (white), unemployment (Spanish), white collar workers in the labor force (professional, managers, clerical, and sales), blue collar workers (craftsmen, operatives, service and laborers), farm laborers-farm foremen, families with income <\$3,000, rentals \$150-199 in the \$100+ rental market, crowding factor of 3 or less persons in a unit, density of 1- persons/rm for the entire population and for the Spanish-speaking, house heating by utility gas, by bottled gas, and by electricity.

As seen in the KGRA base map, there are three major KGRA's in the central valley: the Salton Sea, Brawley, and Heber. Since only one ED is classified as geothermal for the Salton Sea field, it was decided to combine the Brawley and Salton Sea KGRA's, forming a larger area henceforth referred to as the Salton Sea consolidated KGRA. An inconsistency involves the three major towns, all of which touch KGRA boundaries--Brawley on the inside of the Salton consolidated KGRA, and El Centro and Calexico on the outside of the Heber KGRA. This irregularity was resolved by performing a discriminant analysis including the three major towns and another analysis including only rural ED's.

Results are summarized in Table 7. The first analysis grouped all geothermal ED's together; "non-geothermal" refers to the remainder of the county. The variable utility gas for house heating was by far the most important in separating geothermal from non-geothermal areas. Utility gas was also the best discriminant when the geothermal areas were classified into two groups. However, although the non-geothermal area was significantly separated, the Salton Sea consolidated and Heber fields were not significantly differentiated. Variables of less importance are percent Spanish-speaking, and percent of higher priced rentals (\$200-249).

The importance of utility gas, higher rentals, and ethnicity is possibly due to a combination of geologic and human settlement reasons. The geothermal fields are contained in the Salton Trough, which extends from the Gulf of California to north of the Salton Sea, and are more likely to be on the central part of the trough. Likewise the irrigated valley is centrally located above the trough; and from a transportation and labor force standpoint, the county's towns were historically more likely to be centrally settled in the valley. Hence the significance of the utility gas and rental variables stems from the concentration of utility gas and higher rents in urban areas. MA preference for urban residence (Grebler et al., 1970) leads to the importance of the MA variable.

When a two-area analysis was performed for the rural portion of the county, Spanish-speaking was dominant--the above reasoning is still valid because of MA preference for areas near towns over more outlying areas.

7. POPULATION PROJECTIONS

Population projection was performed for the county, with special emphasis on geothermal energy. A set of four projections was made utilizing modified standard projection routines. The first two fifty-year projections (Table 6) were performed in a standard manner as follows: (I) fertility and mortality rates assumed constant at 1970 values; migration rates for both sexes assumed at the average rates 1950-70, with the sexes pooled and 1970 male rates for age group 20-65 assuming the values for females in 1970 to adjust for border commuters; and (II) fertility and mortality rates assumed constant at 1970 values; no migration allowed.

The potential stimulus of the county's present youthful age structure is clearly demonstrated by year 2020 projections of 71195 persons for (I) versus 175081 for (II). On a crude rate basis, the 1% difference in 1970 crude migration rates between (I) and (II) would account on a constant 1970 age structure for only about a 60% difference in 2020 totals. The actual 146% difference in these totals is attributable to a combination of the youthful age structure, high fertility, and the fertility dampening due to the high rates of outmigration prior to age 25 assumed in (I).

Possibilities for geothermal developments were incorporated into projections (III) and (IV). The key assumption for these is a linear increase in crude net migration rates calculated on the 1970 stationary age distribution (henceforth abbreviated as CNSMR = crude net stationary migration rates) until the time point of final installed capacity is achieved, with that time point's rate assumed thereafter. Geothermal development time scales were estimated from the only significant U.S. historical case--Lake County, California--and from known tentative corporate plans for geothermal development in Imperial County. Lake County's initial 11 mW of geothermal capacity has been added since 1971 at the approximate rate of 100 mW/year. Assuming in Lake County a total field capacity of 1500 mW and a constant future trend, one arrives at an estimated time scale of 25 years for complete development. Davis (1976) details present corporate plans for installation of power plant capacity running from 1978 to 1995. The spans of these two development scenarios were averaged to obtain a capacity installation span of 21 years for projection purposes.

Thus in projections (III) and (IV), CNSMR was increased linearly from 1970 to 1995 so that migration change is a function of power plant capacity. Year 1995 CNSMR was assumed at 20% for (III) and 30% for (IV) of the average crude migration rates 1950-70 for the five fastest growing California counties (these respective rates are 1% and 1.42% annually). The age distribution of inmigrants was a weighted average of 1) the county pattern 1950-70 used for (I)--weighted .3; and 2) the U.S. age structure for intercounty mobility (Bogue, 1959)--weighted .7. Results of these geothermal projections again reveal the county's high potential for rapid increase.

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Table 1. Population and Sex Ratios for California and Imperial County for 1910 to 1970

	Imper.	SR1	Calif.	SR2	SR1/SR2	Mexico
1910	13591	1.90	2377549	1.25	1.52	15 160 369
1920	43453	1.48	3426861	1.12	1.32	14 334 780
1930	60903	1.36	5677251	1.08	1.26	16 552 722
1940	59740	1.23	6907387	1.04	1.18	19 653 552
1950	62975	1.19	10586223	1.00	1.19	25 791 017
1960	72105	1.24	15720860	.99	1.25	34 923 129
1970	74492	.98	19953134	.97	1.28	48 313 438
1970	83492*	1.24				

* Includes border commuters
SR1 = Imperial County sex ratio
SR2 = California sex ratio
Source: U.S. Bureau of the Census, 1910-1970

Table 2. Spanish-Speaking Population in Imperial County 1950-1970

Spanish-speaking definition	Imperial	Kern	California
1930: Mexican	.355	.086	.065
1950: Mexican Birth	.135	.015	.015
1960: Mexican Origin	.272	.050	.044
1970: Mexican Birth			.020
Mexican Origin	.304	.071	.055
Spanish Language	.449	.155	.137

Source: U.S. Bureau of the Census, 1950-1970

Table 3. Measures of Fertility and Mortality for Imperial County from 1950 to 1974

Year	Births Imper.	Birth Rate Imper.	Birth Rate Ca.	Total Fertility Rate Imper.	Total Fertility Rate Ca.	Deaths Imper.	Death Rate Imper.	Death Rate Ca.	Imper. Life Expec. Male	Imper. Life Expec. Female
1950	1878	29.8	23.1	3836	3007	446	7.0	9.3	62.8	69.0
1960	1885	26.1	23.7	4347	3622	498	6.9	8.6	74.2	73.4
1970	1662	22.3	18.2	3211	2352	582	7.8	8.3	66.3	75.2
1974	1536	18.7	14.9			615	7.4	8.1		

Note: Imper. stands for Imperial County; Ca. stands for California; Life Expec. stands for life expectancy from age 0.

Source: State of California, various publications, 1930-1975

Table 4. Income Distribution for Imperial County 1950-1970 With Classification Subject to Inflation

Income Class 1950	Percent	Income Class 1960	Percent	Income Class 1970	Percent
10000+	3.1	18700+	3.7	28611+	2.9
5000-9999	21.2	9350-18699	19.3	14305-28610	15.3
3500-4999	15.0	7479-9349	14.8	10013-14304	19.6
1000-3499	44.8	1870-6544	50.5	2861-10012	50.8
-999	15.7	-1869	11.4	-2860	10.6

Note: Inflation of classifications calculated by average inflation of mean incomes for Imperial and Los Angeles Counties.

Source: U.S. Bureau of the Census, 1950-1970

Table 5. Non-Agricultural Industrial Distributions for Imperial County, Kern County, and California, 1950-1970

	1950 M	1950 F	1960 M	1960 F	1970 M	1970 F
Imperial County						
Construction-Mining	11.7	.7	8.4	.4	10.0	1.1
Manufacturing	12.5	2.2	12.8	2.0	11.3	3.5
Utilities-Sanitary	8.5	2.2	7.0*	4.4*	9.3	3.8
Wholesale-Retail	31.4	36.1	28.6	30.2	29.8	31.5
Public Admin.	6.9	5.4	8.8	5.9	10.7	6.0
Educ. (Gov.)	1.8	9.5	3.3	11.4	5.6	13.8
Other	27.6	44.6	29.0	63.2	22.2	40.2
Kern County						
Construction-Mining	26.7	2.0	20.0	1.6	21.9	2.4
Manufacturing	12.2	3.3	15.1	4.1	11.6	3.5
Utilities-Sanitary	2.4	.65	2.0*	1.4*	2.4	1.4
Wholesale-Retail	21.0	31.3	19.5	26.8	23.0	27.6
Public Admin.	10.8	9.5	12.0	8.4	12.3	7.2
Educ. (Gov.)	2.3	12.3	3.8	12.7	4.5	14.67
Other	39.1	49.0	36.1	47.3	24.5	43.3
California						
Construction-Mining	12.9	1.0	10.1	1.3	9.1	1.1
Manufacturing	23.9	15.3	29.3	17.4	26.5	15.3
Utilities-Sanitary	2.3	.7	1.6*	1.0*	2.3	.7
Wholesale-Retail	23.1	26.6	18.8	21.3	21.5	22.0
Public Admin.	7.3	6.7	6.9	5.5	7.5	5.2
Educ. (Gov.)	1.8	5.8	2.9	7.8	4.2	9.7
Other	28.7	43.8	28.9	46.0	28.9	46.1

*Sex division estimated from 1970 data.

Source: U.S. Bureau of the Census, 1950-1970

Table 6. Population Projections

Series	Year 1970	1980	1990	2000	2010	2020
I	74492	75466	77448	76783	74270	71195
II	74492	88568	106194	124603	148124	175081
III	74492	76803	91387	119335	165981	233964
IV	74492	77381	95456	132525	198698	301989

Table 7. Discriminant Analysis of Geothermal Regions by Socio-Economic Characteristics

Grouping	Variables Included (F to remove in paren.)	F Matrix	Apparent Error Rate
Entire County [80] 2 groups	Utility gas (27.8††) Rents $200-249 (11.5†) Spanish-speaking (11.1†)	Geo. [48] Non-geo. [32] 21.1††	Geo. .167 Non-geo. .281
Entire County [80] 3 groups	Utility gas (15.4††) Spanish-speaking (3.6*)	Salton [18] Heber [30] Heber [30] 2.1 Non-geo. [32] 16.7†† 16.8†† (Approx. F = 11.2††)	Salton .389 Heber .467 Non-geo. .344
Rural Portion [31] 2 groups	Spanish-speaking (12.9††)	Geo. [6] Non-geo. [25] 12.9††	Geo. .333 Non-geo. .120
Rural Portion [31] 2 groups Spanish-speaking variable excluded	Income $9-25000 (8.5†) Bottled gas (5.6**)	Geo. [6] Non-geo. [25] 5.7†	Geo. .333 Non-geo. .240

[ ] = number of ED's
* Signif. at .95
** Signif. at .975
† Signif. at .99
†† Signif. at .9995

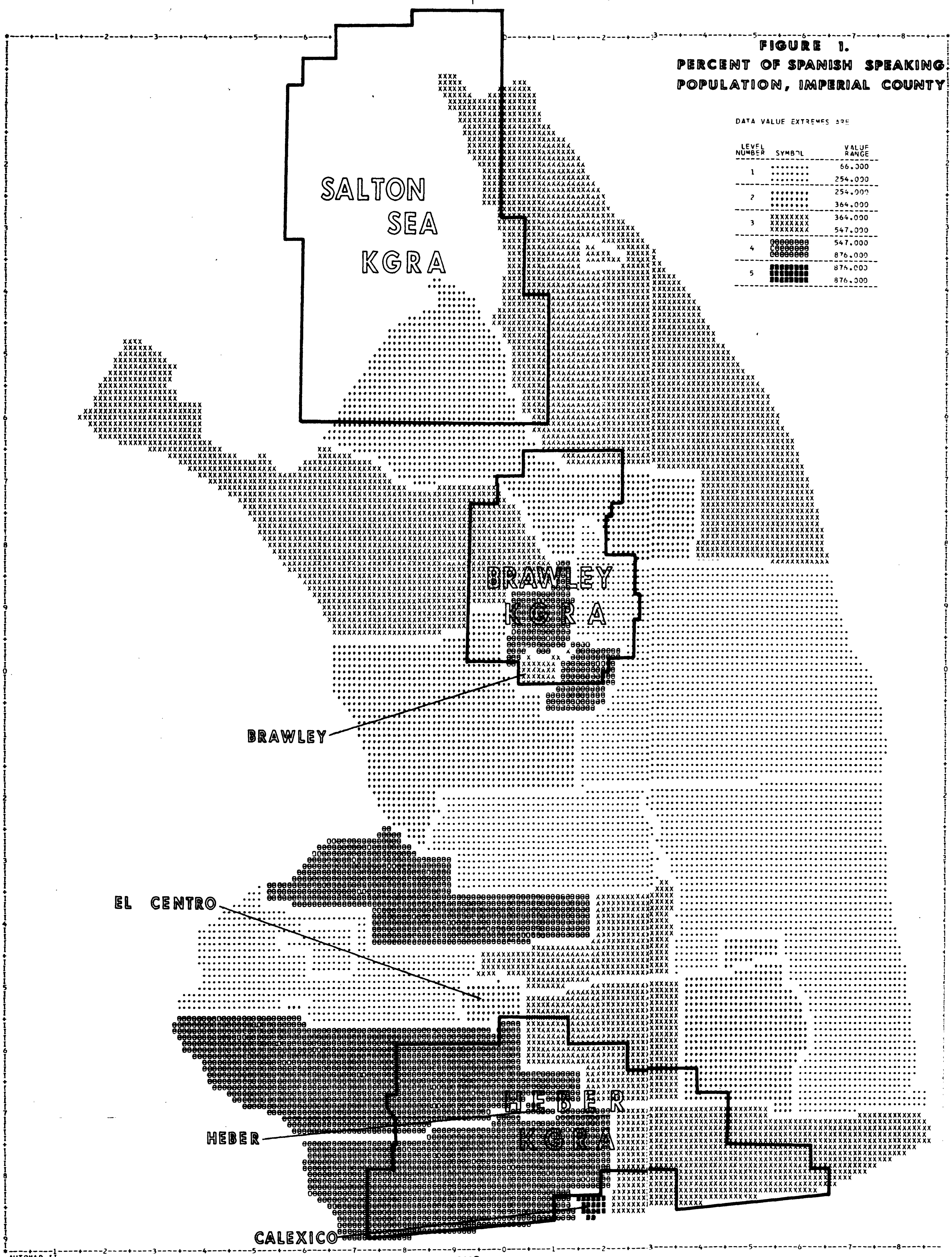

FIGURE 1.
PERCENT OF SPANISH SPEAKING POPULATION, IMPERIAL COUNTY