APPLYING GIS FOR SOCIAL SERVICES: A CASE STUDY OF MONTEREY COUNTY'S CHILDCARE NEEDS

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Abstract: Geographic Information Systems (GIS) has been widely used to assess the quality and necessity of social services by various government agencies and community organizations. Most of the existing approaches start with mapping the current demographic characteristics and the distribution of related social services, then identify service gaps and spatial mismatches between the demand and supply. In this article, we introduce a more comprehensive approach to examine and forecast the needs of a particular social service. Our analysis employs cartographic modeling in GIS, which is based on a variety of social, economic and demographic variables. We will illustrate our modeling process with a case study of assessing Monterey County's childcare service priorities.

INTRODUCTION

One of the most important issues concerned by both the public and government in a community is the availability and quality of social services such as childcare support, health care, and housing. In recent years, Geographic Information Systems (GIS) has been increasingly used to assess the adequacy and quality of social services by various government agencies and community organizations (for reviews, see Queralt and Witte, 1998b; Warnecke, 1998). GIS helps to reveal the dynamics that underlie the demand, supply, and use of services across space at regional, local and neighborhood scales. The accurate, timely, relevant and clear demographic and social service information have become a powerful tool that enables decision makers to do the monitoring, planning, and evaluation more rationally and effectively.

In this paper, we present the methodology and result of a collaborative project that has been carried out by the Institute of GIS and Spatial Analysis at California State University Monterey Bay in association with the Monterey County Information Systems Division, on behalf of the Monterey County Childcare Planning Council and Department of Social Services. The primary goal of this project is to determine priorities for childcare assistance. The priorities identify areas and populations within the county that are most underserved by current state and federal funds for general childcare services for infants, toddlers, and preschool age children. We have developed a comprehensive approach to examine and forecast the needs of childcare services based on cartographic modeling in GIS. Data to support our analysis are obtained from the Monterey County Information Systems Division and Department of Social Services. The result of our study directly affects the allocation of state and federal funds to county wide center-based and family-based childcare facilities as well as State preschools.

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THE NECESSITY FOR ASSESSING CHILDCARE SERVICES

Childcare is usually a family's third largest expenditure after food and housing. In Monterey County, the cost of childcare is already among California's most expensive. Full time care costs an average of $100 per week per child. Currently more than 11,000 Monterey County children spend at least half day in a childcare facility. The county has more than 800 licensed childcare establishments -- nearly 700 family day-care homes and more than 100 centers. Under the new welfare law, more public assistance recipients are being pushed into the job market. As a result, it is estimated that another 13,000 children will be added to the childcare system. This has raised the concerns over the adequacy of the current supply of childcare services, particularly those out-of-home, formal childcare centers.

In response to the call for high quality and accessible childcare services, especially given the onset of welfare reform, the Monterey County Child Care Planning Council (CCPC) has set out to develop a Child Care Master Plan. The CCPC, appointed by the County Board of Supervisors, is composed of childcare providers, public officials, parents and other concerned citizens from around the county. Mandated by California State Law (AB 1542), the CCPC must first conduct a childcare needs assessment to identify underserved areas/communities. The State Law explicitly defines underserved area as "a county, school district, community, or Zip Code area where the ratio is low for the publicly subsidized child care and development program services to the need for these services". The emphasis on the spatial dimension of childcare services has placed Geographic Information Systems (GIS) at the center stage of needs assessment. The use of GIS, as envisioned by the CCPC, allows for the integration of social service records collected by various local government agencies and the census demographic information. The result can be analyzed and presented in an interactive, meaningful, and visually appealing way through the use of digital maps.

THE RESEARCH AGENDA

The main thrust of the study was twofold. First, to identify key issues relating to the demand/supply of childcare services and to gather and assemble data records from different agencies and organizations. Second, to explore the spatial relationship between service provision (i.e. the location of childcare facilities and the range of services offered) and service demand, with an emphasis on social deprivation (i.e., low income families, single mothers, and welfare recipients).

Previous research on childcare service assessment has shed some light on broader issues concerned with the need of children and equity of provision and access to services. Noble and Smith (1994) summarized that 'children in need' are typically those who are experiencing socioeconomic disadvantages in their area. Queralt and Witte (1998a) examined a variety of sociodemographic variables that may have influences on neighborhood supply of childcare in Massachusetts. They concluded that the number of children under 5 is the most important factor. Other key factors include the level of socioeconomic 'distress' in a neighborhood, the community's level of residential stability, ratio of males to females, proportion of infants and toddlers in the child population, ratio of young children to adults and retirees, and employment patterns, particularly of the women.

Since our project is to target underserved areas and communities as candidates for state funding, we decided to focus on two crucial elements. One is capacity of childcare services and how it varies across regions. Another is children and parents who need greater support from the government. Specifically, we felt that the following considerations need to be directly addressed or reflected in our research:

a) capacity levels for child population in different age groups;

b) the waiting list for programs funded by the California Departments of Education and Social Services;
c) children who are receiving public assistance;
d) children from all identifiable linguistic and cultural backgrounds;
e) children of migrant workers;
f) children who are at risk of abuse or neglect;
g) children in the rural area;
h) children with special needs;
i) low income families with pre-school or school age children;
j) single parent families.

Given these concerns, the following questions are defined for our study:

a) What is the geographical distribution of childcare facilities in Monterey County by the size of practice and by range of services provided?
b) Are the existing services adequate for the areas they are located in? Will they be able to support the expected growth due to the welfare reform?
c) Are there differences between the more affluent and poorer areas in the way in which childcare services are organized?
d) What are the extent and whereabouts of the underserved children?
e) How to rank the funding priorities for childcare assistance?

Undoubtedly, answers to these questions will form the basis for the Monterey County Child Care Master Plan and will have a great impact on the action steps to meet the gaps and needs in local childcare services.

DATA AND METHODOLOGY

Based on the research agenda, efforts were made to assemble the following categories of data:

- Birth data in Monterey County from 1992 to 1997;
- Background information on the socioeconomic status of population (age, gender, ethnic background, household income, etc.);
- Housing authority section 8 and public housing data;
- Current licensed and non-licensed child care and youth recreation providers;
- Current childcare programs subsidized by California Department of Education Child Development Division;
- Number of children on the waiting lists of childcare providers;
- Data on childcare capacity levels.

One critical issue came out from the data collection process was: at which geographical scale that data should be assembled and compiled? Although we preferred a neighborhood scale such as census tract or census blockgroup, we had to settle for zip code data as most of the childcare related data sets are not available at the neighborhood scale.

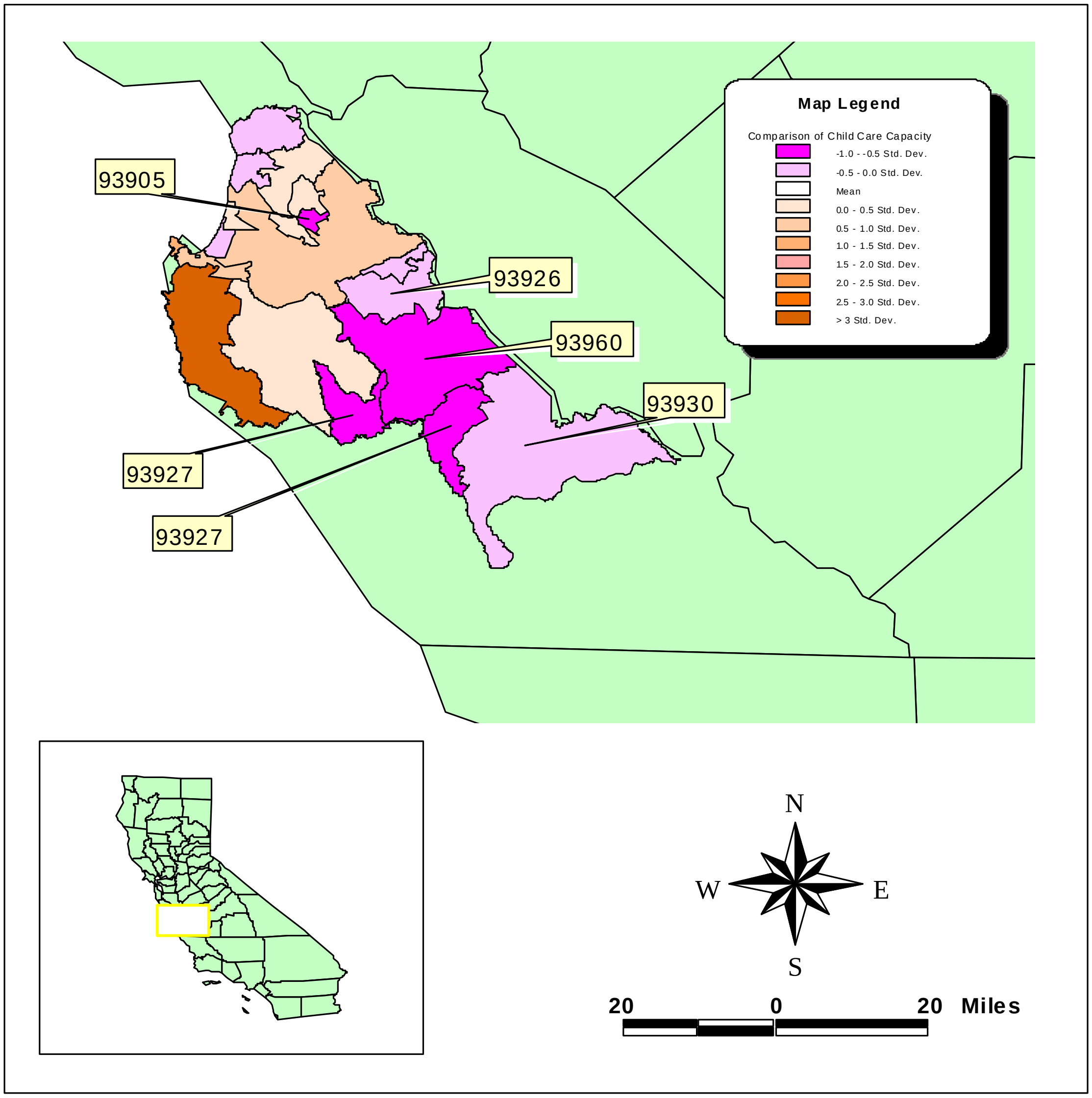
Given a wealth of powerful spatial reasoning and modeling tools in today's GIS, there are many possible ways of analyzing and presenting the data sets. We have considered and experimented with several methods that could help to discover underserved areas. The first approach is to simply map the spatial statistics of current childcare capacity levels. Table 1 reveals zip code based childcare capacity levels in Monterey County for children between 0 and 5 years old. There are two kinds of childcare facilities here: formal licensed childcare centers and family childcare homes (FCCHs). The capacity is standardized for regular child population as well as children in temporary aid needy families (TANF) between 0 and 5 years old. It provides a quick overview of how well children are served in different zip code areas. One may point to areas where capacity level is well below the average and designate them as 'underserved' regions (Map 1).

The second approach is called *constrained catchment area analysis*, a frequently used method in facility planning and retail marketing (see, for example, Parsons, Chalkley, and Jones, 1996; Jong and Krygsman, 1998). It allocates all potential customers to the nearest service center, provided that these customers are within certain distance of the service center, and the center's capacity is not exceeded. The allocation process will identify the market area for service centers as well as customers that are outside the service range of the existing facilities. In our case, we did not feel this was an appropriate method due to the fact that we had no data on children's addresses and could not pin point their locations. Using aggregated data such as zip code centroid would not work because each mapped centroid may represent hundreds of children and could not be allocated to a single childcare facility.

Table1. Monterey County's Childcare Capacity Levels By Zip Code Standardized For Child Population Between 0 and 5 Years

Zip Code	Centers: Capacity for Preschool Children pe 100 Resident Children 0 to 5 Years Old	FCCHs: Total Capacity per 100 Resident Children 0 to 5 Years Old	Centers: Capacity for Preschool-age Children per 100 Resident TANF Children 0 to 5 Years Old	FCCHs: Total Capacity per 100 Resident TANF Children 0 to 5 Years Old
93901	15.19	21.42	98.73	138.75
93905	8.8	6.65	38.92	29.4
93906	7.95	28.48	51.04	182.79
93907	7.44	15.66	100.65	211.76
93908	13.09	6.82	1023.81	533.33
93920	<10		<10	<10
93921	<10		<10	<10
93922	<10		<10	<10
93923	35.29	1.52	<10	<10
93924	9.89	11.24	209.52	238.1
93926	5.5	9.8	33.82	60.29
93927	13.51	1.7	67.31	8.46
93930	14.72	9.77	82.45	54.69
93933	7.51	6.04	82.41	66.21
93940	18.54	8.27	722.22	322.22
93950	20.1	17.69	535.9	471.79
93953	<10	8.33	<10	<10
93955	15.48	4.14	169.89	45.39
93960	17.29	6.95	106.98	43.02
93962	<10	68.09	<10	<10

Source: California Childcare Resources & Referral Network, 1998



Map 1. The Assessment Childcare Capacity

The third approach, named *cartographic modeling*, is the one that we focused on. This method was first developed by Tomlin (1983; 1990) and has since been widely used for GIS related spatial analysis and modeling. The main idea of cartographic modeling is to logically or mathematically overlay geographically distributed factors (i.e. map layers) so that meaningful spatial patterns and relationships can be revealed. We have chosen to use this method because it allows us to combine a variety of socioeconomic variables for comprehensive spatial reasoning. Also the overlay processes can be implemented in either vector or raster domain.

The design of a cartographic model is essentially a 'divide-and-conquer' process. It starts by defining a problem or an overall objective that lends itself to a set of related concerns and issues. Each concern or issue is considered a sub-goal and is further divided. This process continues until each sub-goal can be measured by an existing data set (usually a map). The result is a goal hierarchy that shows how the problem or overall objective can be structured and linked to the raw data. Next, each of these data measurements is ranked with regard to a common *synthetic scale*, which is an artificial interval scale designed to reflect the level of user satisfaction (utility) with model data. This procedure creates the so-called goal utility measures (e.g. a value between 1 and 9 for each data measurement). It ensures that all the raw data set are transformed into goal utility measures with compatible units. Finally, each goal utility measure is assigned an appropriate weight indicating the importance of that sub-goal. The weighted sub-goals are combined together according to pathways defined in the goal hierarchy. This results in an integrative measurement for the overall objective. It represents the quantitative assessment of the role played out by all the model factors at each sub-region of the study area.

Figure 1 illustrates how we applied cartographic modeling for the assessment of childcare services in Monterey County. First of all, our objective is to obtain an overall measurement score, defined as S, for each zip code. The score will have a value between 1 and 9. Higher score suggests higher rank as an underserved area, therefore deserves higher priority for receiving government funding. Second, we divided the objective into three sub-goals – demand, supply, and special factors. Under each sub-goal, we identified relevant zip code based data sets that we believed to be objective measures to the sub-goal. Demand is measured by three elements: the population of children between 0 and 5 years old, the number of children on the waiting list of childcare providers, and the average income of welfare recipients. Supply is measured by two elements: the current childcare capacity level, and the number of subsidized programs. Special factors are measured by the number of teen moms, the number of low income household, the number of women who did not receive prenatal care until third trimester, and the number of single parents. These special elements are used to target population that usually requires special attention or needs more public assistance.

Having created the goal hierarchy and linked raw data sets with sub-goals, we then had to convert raw measures into goal utilities (defined as U). This was a relative easy process as we could use the readily available reclassification function in GIS. Column 1, 2, 4, 5, 7, 8 in Table 2 illustrates how this was done for the demand data. Column 1, 2, 4, 5 in Table 3 shows how the demand data were transformed. Notice the demand data are positively related to the rankings on the artificial scale, whereas the supply data are negatively related to the rankings.

Finally, we must assign weights (defined as W) to all the goal utility measures and combine them into an objective score for each zip code. This was a very subjective process prone to human errors or misinterpretations. We consulted experts from Monterey County Child Care Planning Councils asking their opinions on the importance of each goal utility measure. This proved to be a very useful step and had yielded a weight system (See Figure 1) that people agreed upon. The equation that calculated the objective score can be expressed as:

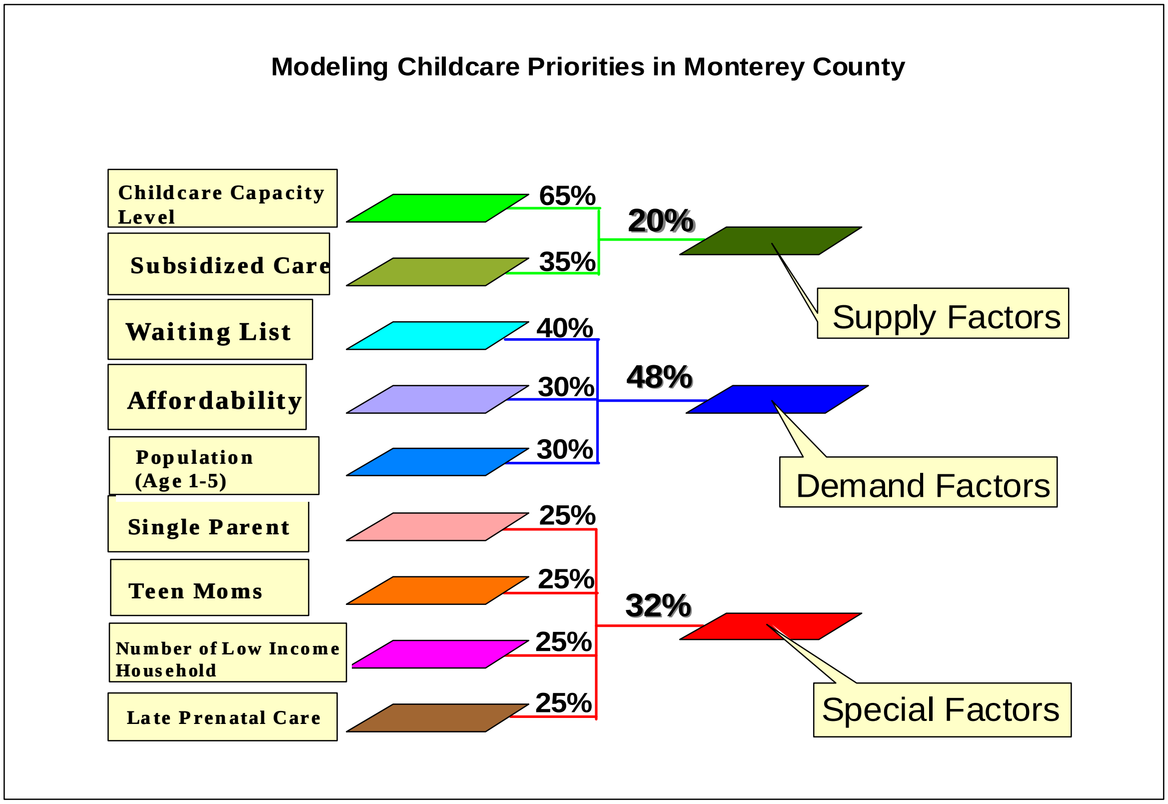


Figure 1. The Cartographic Modeling Process

$$S = \sum_i W_i \sum_j W_{ij} \cdot U_{ij} \qquad i = 1, 2, 3; j = 1, 2, 3, 4 \qquad (1)$$

Subject to:

$$\sum_i W_i = 1 \qquad (2)$$

$$\sum_i W_{ij} = 1 \qquad (3)$$

Where:

S: the objective score;
I: index of higher level goals;
J: index of lower level goals;

W: Weight;
U: the value of goal utility measure.

The above equations can be translated to:

$$S = W_1 \cdot (W_{11} \cdot U_{11} + W_{12} \cdot U_{12} + W_{13} \cdot U_{13}) + W_2 \cdot (W_{21} \cdot U_{21} + W_{22} \cdot U_{22}) + W_3 \cdot (W_{31} \cdot U_{31} + W_{32} \cdot U_{32} + W_{33} \cdot U_{33} + W_{34} \cdot U_{34}) \quad (4)$$

Subject to:

$$W_1 + W_2 + W_3 = 1 \quad (5)$$
$$W_{11} + W_{12} + W_{13} = 1 \quad (6)$$
$$W_{21} + W_{22} = 1 \quad (7)$$
$$W_{31} + W_{32} + W_{33} + W_{34} = 1 \quad (8)$$

Notice the constraints reflect the pathways in the goal hierarchy. They ensure that the resulting values by combining sub-goal utility measures always fall within the synthetic scale. The weights can be changed to reflect different perspectives and to generate alternative assessment plans.

RESULTS

The cartographic modeling process described above has produced very useful outputs. It allowed us to visually and statistically examine and compare the distribution of a variety of elements associated with childcare services in Monterey County. These elements, when combined systematically, generate a clear spatial view of underserved areas.

The assessment of demand factors is presented in Table 2 and Map 2. It is clear that the two zip codes – 93905 and 93906 – have considerably higher demand compared to other areas. They both have very high births, more children on the waiting list, and relatively low income. These two zip codes belong to Salinas, a city whose economy is dominated by agriculture and whose population contains many migrant workers and a large percentage of Latinos. The next three areas ranked high in childcare demand are Greenfield (93927), Salinas (93901), and Watsonville (95076).

The assessment of childcare supply is based on two factors: the childcare capacity per 100 children, and the number of subsidized programs. As shown in Table 3 and Map 3, areas that are short of childcare supply and government assistance appear to be mostly in the central part of Monterey County, including Greenfield (93927), Soledad (93960), Gonzales (93926), and King City (93930). Watsonville (95076) is the only northern region among the top five ranks. However, we should point out that the outcome of the assessment is not as accurate as we had desired due to several reasons. Ideally, we would like to see how service capacity varies between infants, toddlers, and pre-school children. But such information, particularly the data related to family based childcare centers, are not available. The other element is that not all the children are served by the childcare facilities in their neighborhood (i.e. within the same zip code). Many parents send their kids to childcare centers close to their workplace. This is not incorporated in our capacity assessment.

Table 4 and Map 4 illustrate how the special factors are examined. The special factors include: the number of teen moms, the number of low income household, the number of women who did not receive prenatal care until third trimester, and the number of single parents. They point to the segment of population that needs additional childcare assistance, especially in light of the welfare reform. Not surprisingly, areas with high population and low income turn out to have high rankings. The top five zip codes are Salinas (93905, 93906, 93901), Seaside (93955), and Greenfield (93927).

When the above assessment scores are further combined using predefined weights (Table 5), an integrative view of the childcare demand, supply and special factors emerges. Map 5 displays the top five zip codes that represent the most underserved areas. These areas all scored 6 or above and should definitely receive assistance in childcare support. They are: the three sub-areas of Salinas (93905, 93906, 93901), Greenfield (93927), and Soledad (93960). Several places also came very close to the top five: Watsonville (95076), Gonzales (93926), and Seaside (93955). They are very likely to be ranked in top five if a different weight system is adopted. Therefore, we recommend that they too be given high priorities for government funding. If one compares the assessment results in Table 5 with that in Table 1, it is obvious that the cartographic modeling process offers a more comprehensive approach that produces convincing rankings.

CONCLUSION

One direct impact of the welfare reform is the call for more affordable and accessible childcare services. In this paper we have presented a cartographic model that assesses the childcare funding priorities in Monterey County, California. The results are rankings of underserved areas in terms of availability of childcare services. Our study has provided valuable information for local authority and policy makers to operationalize the county wide Child Care Master Plan.

Our approach has several distinct advantages. First, it explores a variety of socioeconomic and demographic variables in a GIS environment, allowing for objective and integrative analysis of different aspects associated with an area’s childcare needs. Second, the weighting scheme for various demand, supply and special factors is generated based on the knowledge and opinions of local childcare experts. It can be easily adjusted and modified to reflect different perspectives or to produce alternate rankings. Third, the cartographic modeling process is simple to implement in a GIS. It could be carried out in either vector or raster domains, and at different geographical scales. We did the assessment only at the zip code level due to the fact that data at other geographical scales are not currently available.

There is much room for improvement. Current study is focused on assessing the *availability* of childcare services. One challenge for us in the future is to assess both the *quality* and *accessibility* of childcare services. We would also like to carry out our analysis at neighborhood scales such as census tract or blockgroup level. Further, we need to develop models that could predict regional childcare needs based on forecasts of population growth and changes in local job market.

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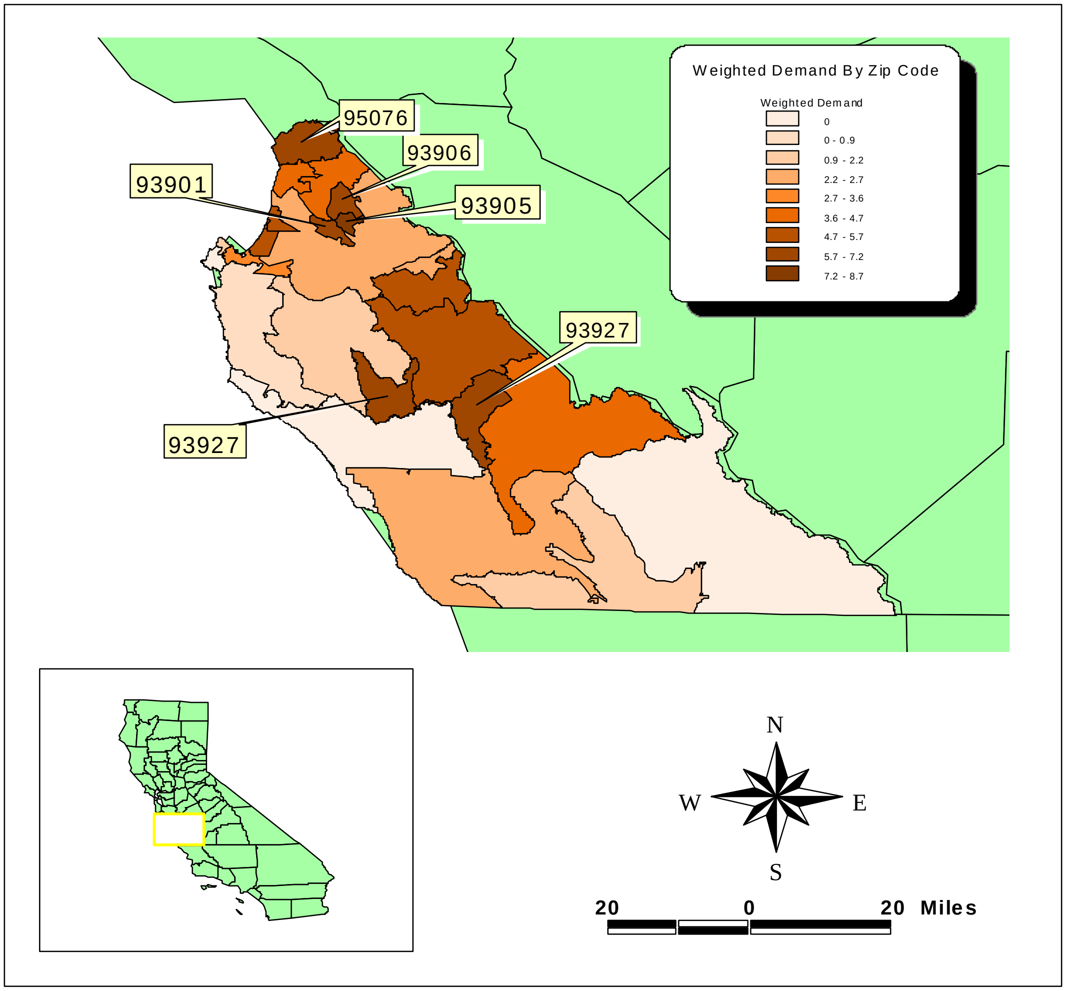


Map 2. The Assessment of Demand Factors

Table 2. The Demand Factors

Zip Code	Number of Children on the Waiting List (Weight = 40%)			Total Birth Between 1992 and 1997 (Weight = 30%)			Average Income of Welfare Recipients (Weight = 30%)			Total Weighted Demand
	Raw Data	U11	W11U11	Raw Data	U12	W12U12	Raw Data	U13	W13U13	W11U11+W12U12+W13U13
93905	212	9	3.600	6033	9	2.700	3535	8	2.400	8.700
93906	169	9	3.600	3883	8	2.400	4386	4	1.200	7.200
93927	24	5	2.000	1220	6	1.800	3022	9	2.700	6.500
93901	80	8	3.200	1834	7	2.100	4694	3	0.900	6.200
95076	39	7	2.800	741	4	1.200	3842	7	2.100	6.100
93933	32	6	2.400	1230	6	1.800	4167	5	1.500	5.700
93926	23	5	2.000	641	4	1.200	3589	8	2.400	5.600
93955	26	5	2.000	2889	8	2.400	4495	4	1.200	5.600
93960	20	4	1.600	1145	5	1.500	3297	8	2.400	5.500
93907	27	5	2.000	1154	5	1.500	4381	4	1.200	4.700
93930	4	2	0.800	1192	6	1.800	3700	7	2.100	4.700
95012	20	4	1.600	768	4	1.200	3971	6	1.800	4.600
93940	11	3	1.200	1600	7	2.100	8027	1	0.300	3.600
93925	8	3	1.200	83	1	0.300	4319	4	1.200	2.700
93908	3	2	0.800	456	3	0.900	4673	3	0.900	2.600
93932							3370	8	2.400	2.400
95004	2	1	0.400				3968	6	1.800	2.200
93426							4862	7	2.100	2.100
93924	3	2	0.800	153	2	0.600	6301	2	0.600	2.000
93950	2	1	0.400	552	3	0.900	8010	1	0.300	1.600
93923				137	2	0.600	8796	1	0.300	0.900

Table 3. The Supply Factors

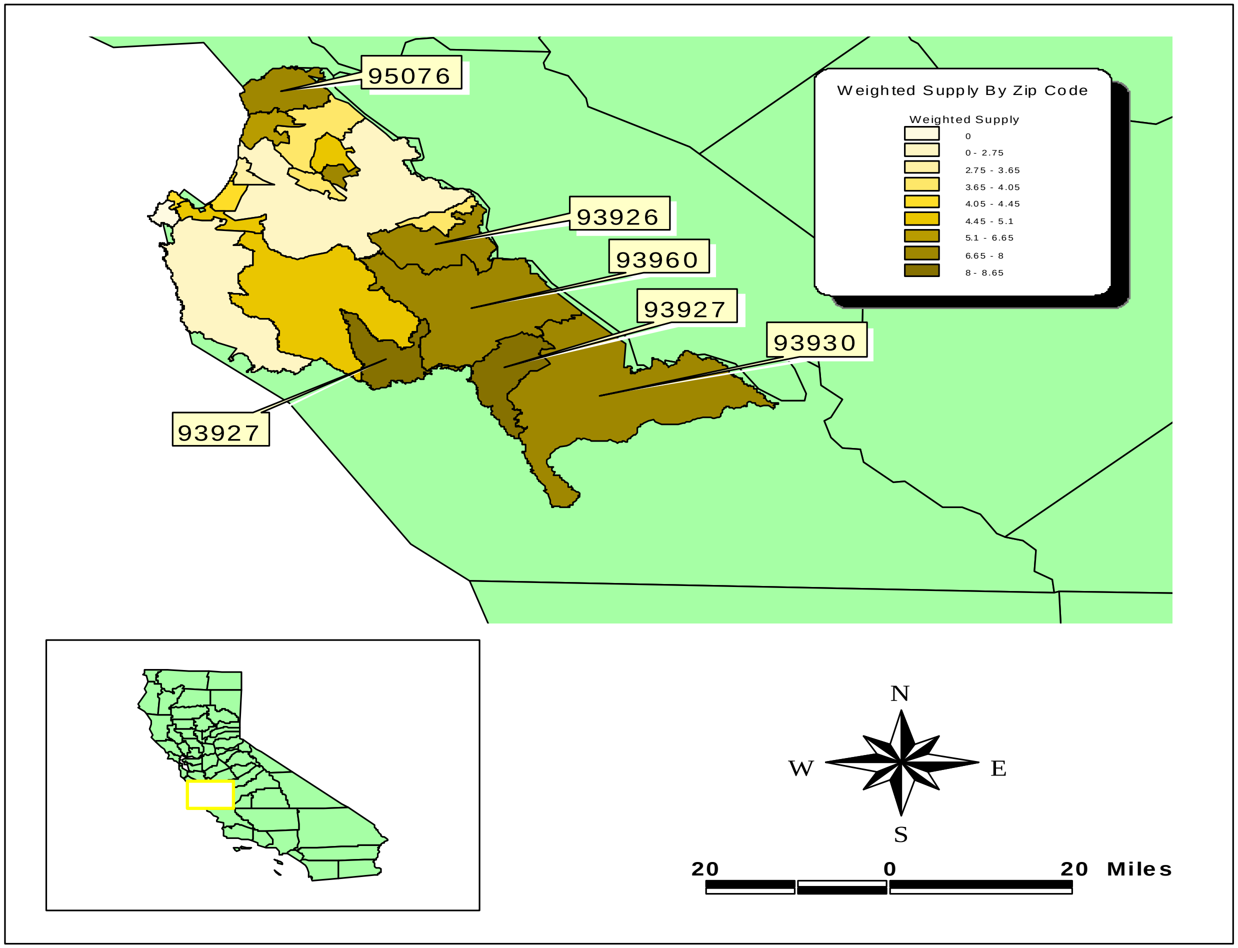
Zip Code	Childcare Capacity Level per 100 Children (Weight = 65%)			Number of Subsidized Programs (Weight = 35%)			Total Weighted Supply
	Raw Data	U21	W21U21	Raw Data	U22	W22U22	W21U21+W22U22
93927	12.46	9	5.85	2	8	2.80	8.65
93960	24.02	8	5.20	2	8	2.80	8.00
95076	32.39	7	4.55	1	9	3.15	7.70
93926	29.02	7	4.55	1	9	3.15	7.70
93930	31.46	7	4.55	1	9	3.15	7.70
93905	19.49	8	5.20	4	6	2.10	7.30
95012	33.46	7	4.55	4	6	2.10	6.65
93940	58.44	3	1.95	1	9	3.15	5.10
93924	54.25	3	1.95	1	9	3.15	5.10
93906	50.58	4	2.60	3	7	2.45	5.05
93950	85.33	2	1.30	1	9	3.15	4.45
93955	40.33	5	3.25	7	3	1.05	4.30
93907	52.08	3	1.95	4	6	2.10	4.05
93901	54.53	3	1.95	4	6	2.10	4.05
93925	38.55	6	3.90				3.90
93933	47.89	4	2.60	7	3	1.05	3.65
93923	162.04	1	0.65	4	6	2.10	2.75
93908	60.09	3	1.95				1.95

Table 4. Special Factors

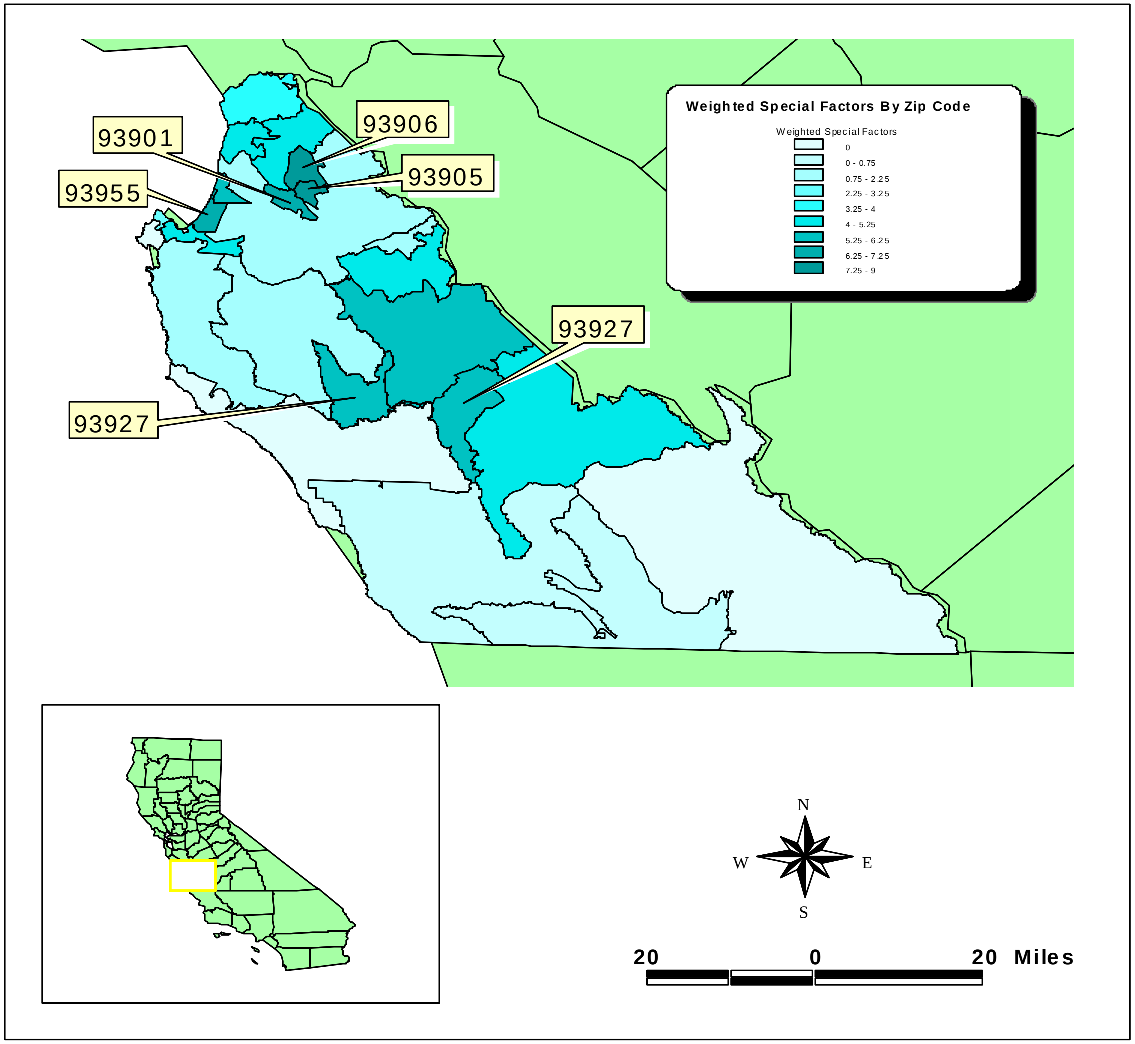
Zip Code	Number of Single Parent (Weight = 25%)			Number of Teen Mom (Weight = 25%)			Number of Low Income Families (Weight = 25%)			Number of Women with Late Prenatal Care (Weight = 25%)			Total Weighted Special Factors
	Raw Data	U31	W31U31	Raw Data	U32	W32U32	Raw Data	U33	W33U33	Raw Data	U34	W34U34	WEIGHTED_S
93905	436	9	2.25	874	9	2.25	2806	9	2.25	483	9	2.25	9.00
93906	480	9	2.25	418	8	2.00	2000	9	2.25	165	8	2.00	8.50
93901	343	8	2.00	194	6	1.50	1048	8	2.00	93	7	1.75	7.25
93955	199	7	1.75	281	7	1.75	637	8	2.00	123	7	1.75	7.25
93927	45	6	1.50	137	6	1.50	369	7	1.75	68	6	1.50	6.25
93933	146	7	1.75	121	5	1.25	634	8	2.00	46	5	1.25	6.25
93960	45	6	1.50	174	6	1.50	255	5	1.25	89	7	1.75	6.00
93926	40	5	1.25	94	5	1.25	303	6	1.50	54	5	1.25	5.25
95012	34	4	1.00	102	5	1.25	228	5	1.25	55	5	1.25	4.75
93930	40	5	1.25	154	6	1.50	177	4	1.00	33	4	1.00	4.75
93907	36	4	1.00	97	5	1.25	157	4	1.00	48	5	1.25	4.50
93940	152	7	1.75	36	3	0.75	212	5	1.25	16	3	0.75	4.50
95076	13	3	0.75	50	4	1.00	146	4	1.00	49	5	1.25	4.00
93950	48	6	1.50	4	2	0.50	62	3	0.75	9	2	0.50	3.25
93908	3	2	0.50	4	2	0.50	12	2	0.50	12	3	0.75	2.25
93925	4	2	0.50	5	2	0.50	48	3	0.75	5	2	0.50	2.25
93923	12	3	0.75				18	2	0.50	1	1	0.25	1.50
93924	3	2	0.50	2	1	0.25	4	1	0.25	5	2	0.50	1.50
95004	1	1	0.25				12	2	0.50				0.75
93932	1	1	0.25				9	1	0.25				0.50
93426	1	1	0.25				4	1	0.25				0.50

Table 5. The Final Ranks

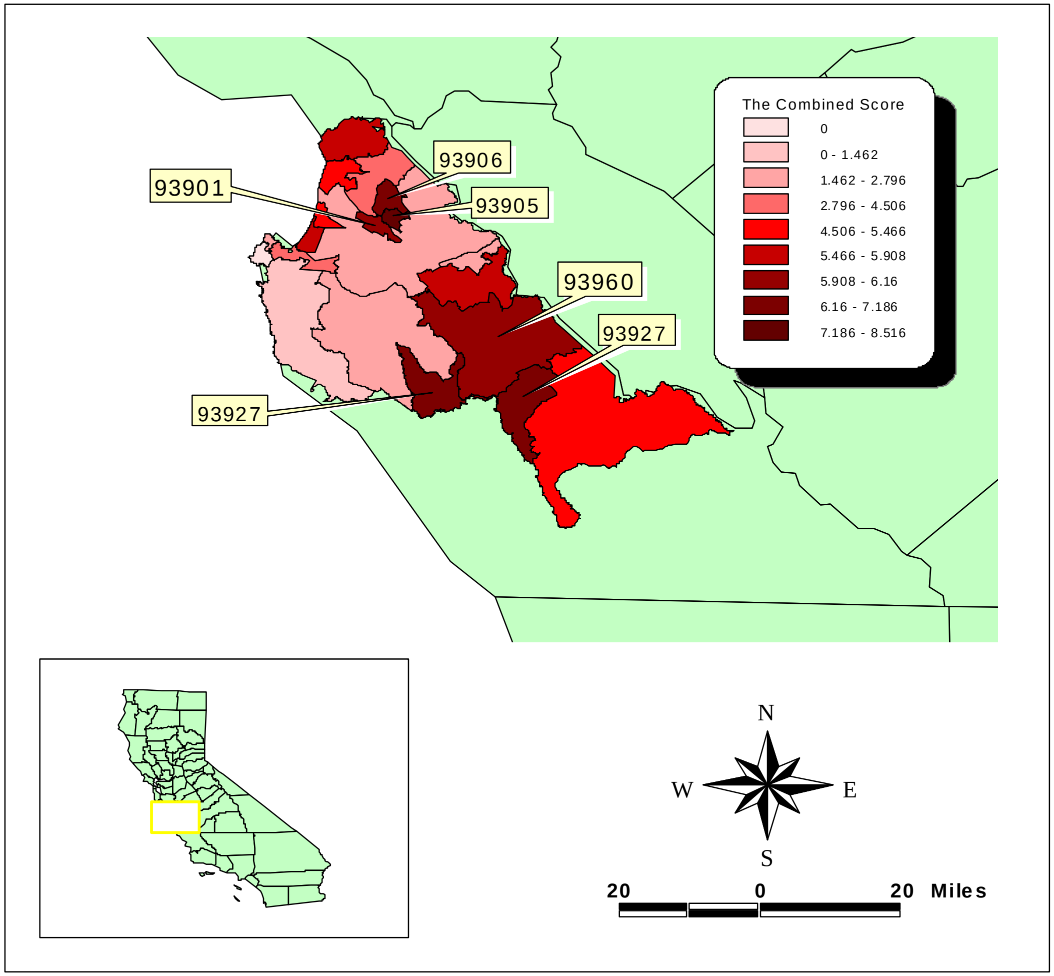
Zip Code	Place Name	Weighted Demand (Weight = 48%)	Weighted Supply (Weight = 20%)	Weighted Special Factors (Weight = 32%)	Final Assessment Score
93905	SALINAS	8.700	7.30	9.00	8.516
93906	SALINAS	7.200	5.05	8.50	7.186
93927	GREENFIELD	6.500	8.65	6.25	6.850
93960	SOLEDAD	5.500	8.00	6.00	6.160
93901	SALINAS	6.200	4.05	7.25	6.106
93926	GONZALES	5.600	7.70	5.25	5.908
93955	SEASIDE	5.600	4.30	7.25	5.868
95076	WATSONVILLE	6.100	7.70	4.00	5.748
93933	MARINA	5.700	3.65	6.25	5.466
93930	KING CITY	4.700	7.70	4.75	5.316
95012	CASTROVILLE	4.600	6.65	4.75	5.058
93907	SALINAS	4.700	4.05	4.50	4.506
93940	MONTEREY	3.600	5.10	4.50	4.188
93925	CHUALAR	2.700	3.90	2.25	2.796
93950	PACIFIC GROVE	1.600	4.45	3.25	2.698
93924	CARMEL VALLEY	2.000	5.10	1.50	2.460
93908	SALINAS	2.600	1.95	2.25	2.358
93923	CARMEL	0.900	2.75	1.50	1.462
93932	LOCKWOOD	2.400		0.50	1.312
95004	AROMAS	2.200		0.75	1.296
93426	BRADLEY	2.100		0.50	1.168
93953	PEBBLE BEACH	0.000	0.00	0.00	0.000
93920	BIG SUR	0.000		0.00	0.000
93450	SAN ARDO	0.000		0.00	0.000



Map 3. The Assessment of Supply Factors



Map 4. The Assessment of Special Factors



Map 5. The Integrated Assessment