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A Spatial Strategy in Effective Social Service Provision for the Urban Poor*

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1. Introduction

1) Research Context

The last decade witnessed a growing number of extremely poor[1)] people in the U.S. Across the country, individuals without adequate food, clothing, housing, and income have struggled to survive. Extremely poor people need a variety of human services to get back into the mainstream society. The locational configuration of the shelter/service system greatly infuences local service access as well as the efficacy of the entire service system.

However, traditional public facility location analysis does not provide adequate guidance to planners charged with developing networks of human service delivery.

Conventional public facility location theories are mostly devoted to the location of either ordinary services(e.g., schools, parks), emergency service facilities/vehicles(e.g., fire stations, emergency medical services), public service centers(e.g., health centers, waste treatment plants), noxious facilities (e.g., toxic dumps, nuclear power plants), or large-scale infrastructure investments (e.g., aviation fields, shipping ports)(see review by Brandeau and Chiu, 1989). Thus traditional public facility location analysis tends to ignore the study of shelter/service, and does not incorporate the unique characteristics of extremely poor population(such as limited mobility, multiple service needs) and peculiarities of human service resoures(such a diverse service types, strong functional linkages, community opposition).

Moreover, most of the traditional efforts has been skewed to user-side location decisions, using criteria designed to produce minimum transportation costs(P-median), a minimum number of facilities and locations(set covering), or maximum demand realized by the facilities involved (maximum covering)(ReVelle, 1987; Brandeau and Chiu, 1989; Friesz et al, 1988). Effective location of public facilities, however, must take into account not only the user side, but the needs of the service suppliers and host communities. In reality, facility location is constrained by the politics of provision and community response to different types of service facilities.

The equitable distribution of public faclities has been a major objective in public facility location-allocation modeling efforts (White and Ratick, 1989; Hansen et al, 1983). Achieving a desirable level of equity, however, can significantly vary with differing scales of spatial aggregation (Boyne et al, 1991). A just ditribution in one spatial scale does not necessarily lead

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to a just distribution at another. Thus an effective service distribution, for example, must not only consider the intra-urban scale but also the regional(inter-municipality) scale of service allocation simultaneously. This important multi-tier decison context has hardly been used to frame traditional public facility location-allocation models (Johansson and Leonardi, 1986), much less shelter/service systems for the poor.

In the simultaneous location of multiple service facilities, a dispersed distribution of facilities in a region can improve accessibility for clients and thus minimize total average distance or time in travel. This scheme provides for distributional equity of service resources from the view of fair-share planning objectives; for instance, it distributes the burden of caring for the extremely poor among communities and minimized the likelihood of community opposition from excluding facilities.

The extremely poor is generally characterized by limited means of transportation and access to social services because of their financial, physical, and psychological problems, and for some, socal alienation. Thus they tend to congregate near the facilities designed to serve them(Dear and Wolch, 1987; Wolch and Gabriel, 1985). In addition to this user agglomeration tendency, support facilities have strong technical and administrative linkages with each other, such as forward and backward relationships in a client's typical career path(Dear, 1987). An adequate shelter/service system for the poor, therefore, should include diverse service programs that have sufficient functional linkages and geographical proximity to secure effective use of the system.

What should such an optimal shelters/service facility configuration look like? This research extends public facility location theory and analysis, and applies newly developed approaches to the case of human service planning. An underlying premise that this study seeks to interrogate is that a shelter/service system which is at once regionally(inter-municipality) dispersed and locally(intra-commnity) concentrated mode is the best way to meet the needs of extremely poor population. This leads to a combination of regional fair-share and local service hub ideas.

2) Research Purpose, Methods, and Data

How can service distributions be improved to achieve efficiency and equity goals? This is the central question of the research, explored through an empirical analysis of Los Angeles, California, the nation's second largest metropolis. Based upon the above question, present paper focuses on one task: specification of an effective service location-allocation model for the urban extremely poor, using the service hub and fair-share concepts as guiding principles.

Data used in this study are divided into shelter/service provision and need data. Provision data are mainly drawn from Info-line(the Los Angeles County Information and Referral data base) and other major human service directories for Los Angeles County Service need information (extremely poor) is extracted from the 1990 U.S. Census of Population and Housing(Summary Tape File 1a and 3a)

In this research, service components for the extremely poor are categorized as gatekeeper services, coping services, and an amalgamation of other human service. Gatekeeper services are defined as an immediate network of poor relief, thus are described as points of entry into the broader human service system. Coping services can be defined as subsistence level services which facilitate survival on a regular, day-to-day basis. All other human services are the last part of the service continuum, including the full range of services to meet diverse clients needs. These three sectors of services are used as basic functional denominators of service resources analyzed in this study.

A spatial division of Los Angeles County is conducted with various spatial hierarchies to examine many different facets of the geographically-contingent service and need distribution. Four aggregation methods are applied, the broad subregional scale, the city/community level;the census tract level;and an economic class grouping of cities and communities. The subregional division is principally based on the major statistical areas(city or census tract boundaries). Six mutually exclusive subregions(Central, Westside, North County, South Bay, San Fernando Valley, and San Gabriel Valley) were identified as encompassing geographical components. The community level division is based upon three standard:incorporated city, community plan area(CPA) of Los Angeles City, and unincorporated clusters. A total of 128 cities/communities were identified(83 incorporated cities, 35 community plan areas, and 10 unincorporated clusters)(see, Figure 1). Census tracts are used as the smallest components(building blocks) to create the county's communities and subregions because census tracts cover the entire county area and do not cross county boundaries(1990 U.S. Census Population and Housing, Technical Documentation). Communities are also grouped according to four income levels (Poverty, Working, Middle, and Upper Class) to identify how the economic status of constituent commmunities influences the location and distribution patterns of different service categories. Income divisions were based upon quartiles of the media household income distribution from the 1990 decennial census.

The research comprises a range of descriptive, statistical and inferential analyses to fully comprehend the spatial organization of shelter/service resources as well as spatial relationships and determinants.[2) Only the mathematical models are presented here which imbued with fair-share and service hub ideas allowed us to experimentally design what may be more effective location/allcations of human service resources.

The following section reviews literature on trends in public facility location theory and modeling development during the last two decade. The adequacy of existing theory and modeling efforts for the present research is also examined. Section 3 develops a normative human service location/allocation models for optimal distribution of Los Angeles human service resources. The section consists of two subsections; the first subsection is concerned with the allocation of service resources across cities/communities based upon fair-share and minimum service criteria;the second subsection is concerned with micro-level service distribution across census tracts in each community, based on the service hub idea and maximum accessibility criteria.

2. Synoptic Review of Public Facility Location Theory and Its Relevance

Contemporary public facility location theory originated in Teitz's seminal paper "Toward a theory of urban public facility location"(1968). Three distinctive features(facility functions, their geometric properties, and both technical and administrative hierarchies) were emphasized in his description. By assuming that consumers' behavior was already known, Teitz asked what location design would maximize the utilization of services given both investment and operating budget constraints. He also suggested that monetary constraints should include annualized investment costs as well as those operating costs that are a function of the level of utilization. Finally Teitz suggested the consideration of political variables in the formulation of public facility location models.

Following Teitz's theme, many studies

have been conducted in the field of public facility location modeling. The most distinctive advance was to convert Teitz's microeconomics based model into the more tractable mathematical programming framework(Dear and Taylor, 1982). This made possible a variety of improvements in actual facility location modeling, including a more specific incorporation of location variables, a wide range of social welfare surrogates, and the addition of a hierarchical organization in the facility set (see reviews by Johansson and Leonardi, 1986; ReVelle, 1987; Hansen et al, 1980; Lea, 1973; Freeston, 1977; Hodgart, 1978).

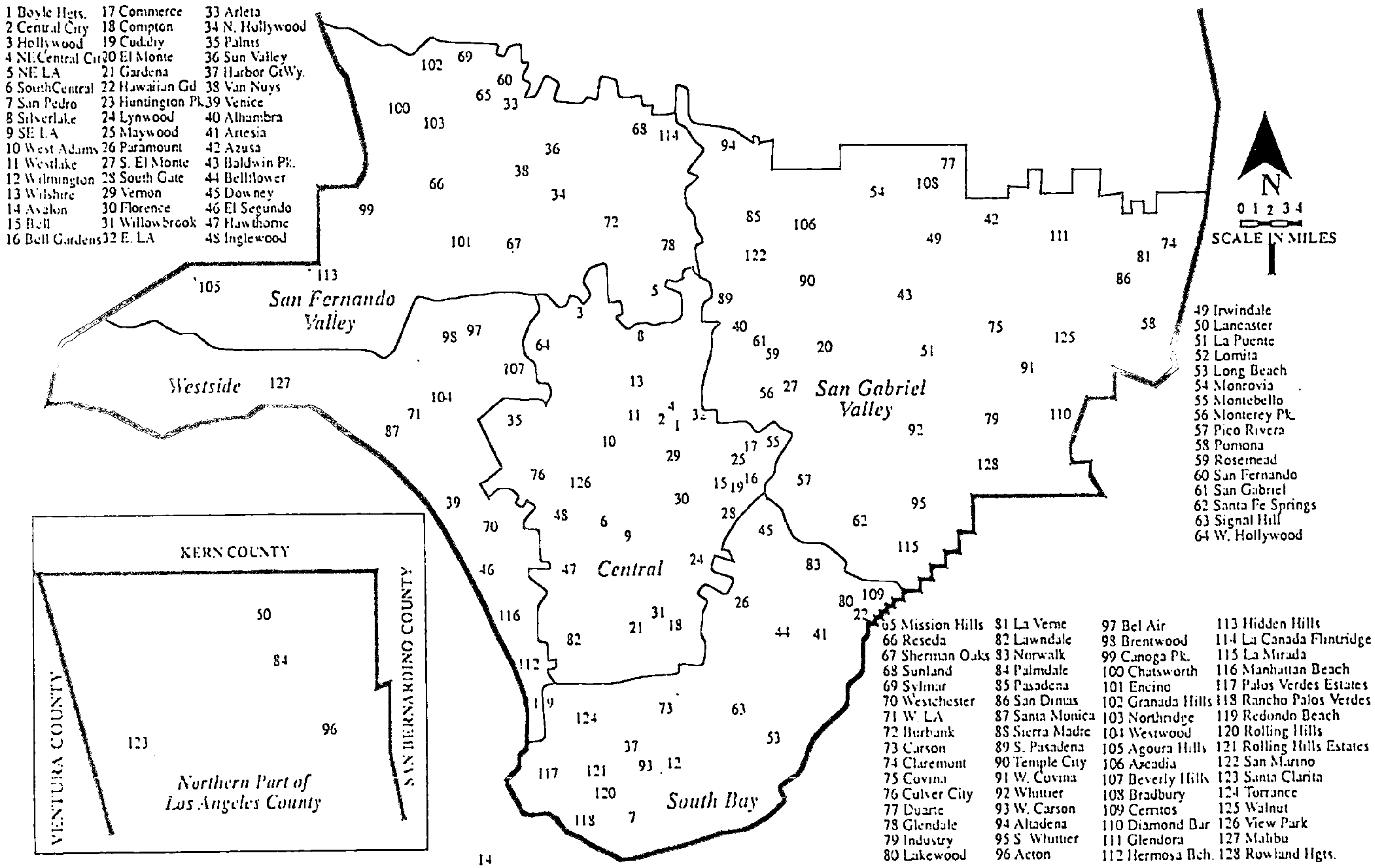
Weber-type programming models take a given set of users(or group of users) whose locations are known and defined by points on the plane, and determine the location of the facility at which the total cost(demand) will be minimized(maximized). In this case the total cost is the sum of the costs borne by the users, and this is in turn a linear function of distance and number of visit. This type of programming model minimizes the sum of the weighted distances from an endogenous location to exogenous locations on a plane. These models have been widely recognized as efficiency-oriented facility location theories(ReVelle and Swain, 1970; ReVelle and Church, 1977; Wagner et al, 1975; McAllister, 1976).

More realistically, a client does not use one unique facility but distributes her/his trips among different related facilities in a fashion described by a gravity type model (Wilson 1970). A client's travel behavior is influenced by many aspects of facility attractiveness, including size, quality, and degree of agglomeration. Therefore a simple least-cost allocation rule is unrealistic. To achieve a realistic solution to the location-allocation problem, actual user travel and demand behavior should be accounted for(Hodgson 1978). In fact, various location-allocation models that treat the users' actual travel and demand behavior have been developed based on spatial interaction theory(Leonardi, 1981; Beaumont, 1980; Goodechild, 1978).

External social and economic effects of facility location decisions have resulted in conflicts, such as when communities oppose the siting of controversial public facilities(Taylor et al, 1984; Dear, 1976; Wolpert et al, 1976; Austin et al, 1970). Austin et al(1970) proposed a dynamic model that incorporates compensation costs induced by the negative externalities of a noxious facility. This 'facility package' includes a main public facility and auxiliary facilities which are designed to alleviate the external effects of the noxious main facility. Austin's model minimizes the costs of a facility package, defind to the sum of the fixed costs of the main facility plus the costs of the auxiliary facilities.

Due to the political nature and redistributive consequences of public facility location decisions, equity considerations in location decision-making have received considerable attention(Jennings, 1993; Pereira, 1993). The minimization sum of the costs supported by the users can be viewed as an aggregate measure of 'efficiency' in so far as it focuses on the situation of the 'average' users. This type of social objective function usually favors users who are spatially clustered, and is detrimental to isolated users. Equity criteria have emerged with regard to differing accessibility or quality of delivered services. A typical form is the minimization of the maximum costs borne by any users, i.e., the minimax or maxmin criterion(Hansen et al, 1983; Hodge and Gatrell, 1976; Pereira, 1993). Another significant equity consideration has been the distribution of the burden for caring services among host communities. In this argument, the focus is mainly placed on fair-share planning objectives in the siting of human service facilities(Dear and Wolch, 1987, 1988;

Figure 1. Subregions and Communities in LosAngeles County



Dear, 1987).

However, the objectives of client efficiency and community equity are typically in conflict and function as mutual constraints. The conflict between these goals can be alleviated in the political sphere by devising concession or compensation payments to the losers affected by locational choices(Mumphrey and Wolpert, 1973). In the real world, the location of a facility is frequently determined by the compromise between the two objectives:efficiency and equity. It is desirable, in this case, to formulate a bi-objective problem. The solution consists in the set of Pareto-optimal locations for these two criteria; the planner chooses a location out of a set of alternatives on the basis of her/his relative preferences for the two criteria (Leonardi, 1981).

In the case of simultaneous location of several facility sets, agglomeration economies may arise. Proximate siting of facilities which have high functional linkages with one another can create various agglomeration advantages. These agglomeration economies may benefit both users and suppliers. Users benefit from reduced transportation costs and a wider choice of services, while suppliers may benefit from reduced operation costs and an enhanced transportation/communication network. White(1979) examined locational interdependence between services in public facility systems via a co-locational analysis. Through empirical evidence and theoretical argument, he emphasized the role of facility linkage, i.e., agglomeration economies, in location decisions for public facilities.

Most of these studies have related to conventional public facilities, such as parks, libraries, hospitals, fire stations, and so on. There have been few attempts to address the peculiar problems of human service facilities for the homeless or service-dependent populations(for example, Wolpert and Wolpert, 1976; Wolch, 1979, 1980, 1981; Dear and Talor, 1982; Dear and Wolch, 1987, 1988; and Dear, 1978, 1987). Moreover, these studies are mostly skewed to user-side location decisions that are based, for example, on minimum transportation costs or maximum demand realized by the facilities involved. Effective location of public facilities, however, must take into account not only the demand side, but the needs of suppliers such as public service agencies or non-profit organizations. In reality, service providers usually want to locate their facilities in the least cost areas(e.g., areas with relatively low rent or less community opposition).

In the siting of public service facilities, the goals of efficiency and equity in providing public services are typically in conflict, and function as mutual constraints (Mumphrey and Wolpert, 1973). Dispersed distribution of social services in a region can improve accessibility of clients and thus can minimize total average distance or time in travel. Further, this scheme provides distributional equity of shelter/service resources from the view of fair-share planning objectives; in other words, it distributes the burden of caring for the extremely poor among communities and prevents NIMBYism from excluding facilities.

Recent development of a 'service hub' approach suggests an artful location of facilities that can create decentralized service and housing opportunities to service-dependent populations throughout urban areas, encourage a fair-share distribution of burdens arising from host facilities for dependent populations, and benefit from the various agglomeration economies associated with co-location. To secure the two objectives of cost-effectiveness and accessibility, a reasonable regionalization(geographical-functional hierarchy)of service organizations is emphasized(Dear, 1987; Dear and Wolch 1988, 1987).

By considering the multiple dimensions

of social welfare and the complexity of normative design, multi-objective programming models have been developed for public facility location decision making. These models can provide the best compromise solutions for the multiple and often conflicting objectives represented by efficiency(i.e., minimizing travel costs or distance), equity(i.e., equalizing utilization) and other outcomes(Bigman and ReVelle, 1978; Dokmeci, 1979; Charnes and Storbeck, 1980; Nelson and Wolch, 1985; Sutcliffe and Board 1986). These models have not as yet incorporated the service hub notion, however.

3. An Improved Spatial Configuration for the Los Angeles Human Service System

As reviewed in previous section, existing public facility location(PFL) theories and models proposed by scholars and analysts have examined a range of issues including Weber-type efficiency, Rawls-type equity, and other important location/allocation questions. The efforts were usually directed to the location of ordinary public facilities rather than adapted to the distinctive characteristics of extremely poor population and service facilities which support the population.

In order to best utilize the merits of both concentrated and dispersed shelter/service configurations presented in Table 1, I propose here a shelter/service system which is at once regionally dispersed(between municipalities) and locally concentrated(within communities) as the best way to meet the needs of extremely poor population(Table 1).

Table 1. Two Geographic Components of Shelter/Service Distribution

	Regional Fair-Share	Local Service Hub
Advantages	• Fair-Share Burden Sharing • Increased Accessibility • Prevent Homeless Dislocation • Prevent Free-Riders • Prevent Ghettoization • Community-Based Service • Client Normalization	• Homeless Coping Network • Decentralized Service Mix • Functional Linkages • Agglomeration Economies • Multi-Purpose Trip
Obstacles	• Community Opposition • Conflict of Community and Client Rights • Political Will of Regional Planning Body	• NIMBY and/or LULU • Uncontrollable Private Service Sector • Different Local Situation and Resources
Strategies	• General Land Use Planning • Supply and Demand Estimation • Establish Fair-Share Formula • Community Education • Arbitration, Bargaining, Incentives	• Land Use Planning • Education • Conflict Mediation • Proper Regionalization and Hierarchical Service Hub • Avoid Deleterious Effects of Proximity

Source: Adopted from Dear and Wolch 1987, Dear 1987a, b, Wolch 1987, 88.

Greater accessibility for local clients and increased agglomeration economies for both users and providers are obtained through allocating service opportunities in decentralized concentrations. Other advantages of regional dispersion include lowered probability of the poor displacement from home communities, prevention of large ghettoization, mitigation of freerider problems, and fair burden sharing in the provision of human services.

Local concentration of services can provide access to a diverse service mix, easy referral and linkages between services, and multi-purpose trip making.

The modeling effort focused on two different geographical scales: inter-municipality and intra-community. The basic guidelines of the models are as follows:

a) From the view of fair-share planning, each community ought to have at least one service hub within its boundary. Each service sector should be provided in every cities/communities by at least one provider, and no community should be excluded from the assignment. In each service sector, total service programs assigned to a community should comply with the need levels of the community.

b) In each community, the location of service hub(s) should make best use of the distribution of existing service programs and the incidence of service needs in constituent locales to save relocation costs and to minimize aggregate travel distances by service users.

c) In any geographical programming model whether it is macro(inter-community level) or micro scale(intra-community), service programs can be allocated to communities(or, census tracts) in accordance with levels of need to maximize realized demand, and to minimize aggregate travel costs. In the micro scale programming model, service programs should also be pinpointed at the location where rent is minimized to minimize facility costs.

At least three different types of location-allocation simulation approaches can be applied; 1) assignment of m service programs, assuming that no service programs already exists in the area; 2) location of k additional facilities, taking the existing centers into account; 3) reorganization of the system by closing(relocation) any badly located service programs, and opening a certain number of new service programs, given m existing programs(Hodgart, 1978). The programming models in this research applied the first and third empirically.

1) Optimal Allocation of Shelter/Service Programs at the Inter-Community Level

The following macro model optimizes the number of service programs for each service type in a community based upon a set of normative criteria with a given budget constraint (number of existing programs). The main goal is to allocate the shelter/service resources equitably by matching the level of service need in each community, so as to maximize aggregate users' welfare in the county. This formulation can achieve a fair-share distribution of shelter/service resources with reference to the distribution of existing service needs(extremely poor population), and thus avoid surplus or lack of service resources in any community.

(1) Model Specification

Since the composition of service clients and their diverse preference and behavior in consuming the different service types are rarely if ever obtainable(especially at the community and census tract levels), the following two basic assumptions are contructed to allow building a tractable macro-level model. First, number of visits (which can affect aggregate welfare levels of clients) for the services are constant and equal across different subgroups and service types. Second, the size of service programs in each service type is identical.

With these assumptions, the number of services programs that should be allocated in each community is a function of the level of service need. Welfare level for a client is also constrained by increasing distance between a service site and the user's residence. However, exact locations of users and service programs, and distances between the two varibles of supply and need in a community are unknown. Assuming that service clients are uniformly distributed within each community boundary(this assumption will be released in the microlevel model), the number of service programs distributed in a community is also a function of territorial size since a vast territorial size would constrain usage of the limited resources through imposing travel time and costs. Thus:

$$W=f[X]=f(P, N, Q, S)$$

where W is welfare of users, X is number of programs(decision variables), P is number of users, N is number of visits, Q is size of programs, and S is territorial size. All variables are positively related to the welfare function of the users, except territorial size which is negatively related with welfare level by a distance decay parameter. Thus the objective function to be maximized based upon aggregate clients welfare is structured:

$$\sum_{i=1}^{m}\sum_{j=1}^{n} W_{ij} = \sum_{i=1}^{m}\sum_{j=1}^{n}\{P_{ij}N_{ij}Q_{ij}\exp(\lambda S_j)\}X_{ij}$$

where, i is service type index and j is community index, respectively, λ is the decay parameter in the negative exponential function($\lambda<0$). Following the assumptions 1 and 2, N and Q are constant across the users and communities, and the final objective function can be reduced:

$$\sum_{i=1}^{m}\sum_{j=1}^{n} W_{ij} = \sum_{i=1}^{m}\sum_{j=1}^{n}\{P_{ij}N_{ij}Q_{ij}\exp(\lambda S_j)\}X_{ij}$$

$$\text{st. 1) } \sum nj=1X_{ij}=T_i \qquad \forall_i$$

$$\text{2) } X_{ij}\geq 1 \qquad \forall_{ij}$$

The sum of programs in any service type to be allocated to all communities should equal the total number of programs of that service type(Ti). The second constraint ensures that any community has at least one or more programs of any service category. This makes possible a diverse service mix by providing a minimum service level for all communities and service categories.

The values of the coefficient vector {(Pijexp(λSj)} of the decision variables (Xij) are determined by two exogenous variables(i.e., extremely poor population, territorial size of community) and a distance decay parameter(λ) which implies decreasing welfare levels through imposing travel costs. Since the number of extremely poor population and territorial size of the community are given, the decision variable coefficients are affected by various sets of $\lambda(<0)$. In other words, determination of the decay parameter will affect the values of decision variable coefficients by altering shares of the territorial size variable(exp(λSj).

One critical point here is how to set the distance decay parameter. The need level variable is the most critical factor in determining a fair-share shelter/service distribution, and in previous examples of decay parameter setting(see, Noronha and Goodchild, 1992, 94−5), the λ was set to −1.0 by which minimizes the decay slope (i.e., variance of territorial size are not significantly change the optimal allocation). For this optimization model, Integer Programming in the Linear Interactive Discrete Optimizer(LINDO) package was applied.

(2) Results and Discussion

Model results suggest a prevailing spatial disparity between existing service resources and optimal model allocations. As Table 2 shows, communities can be grouped into two distinctive clusters according to the comparison statistics of service programs between existing and model distributions: over-provision, and under-provision communities.

Table 2. Comparison between Model Results and Existing Service Distribution in Three Shelter/Service Sector

Community	A1	A2	A3	Model# of Programs(Existing Programs)		
				M1	M2	M3
Arleta	12,338	10.73	12.21	9(8)	52(19)	264(134)
Boyle Heights	18,636	6.0	18.52	13(10)	79(68)	400(341)
Central City	5,519	2.59	5.50	4(44)	23(64)	119(363)
Compton	19,520	12.92	19.27	14(10)	82(48)	416(203)
E.Los Angels	18,477	7.20	18.34	13(7)	78(81)	396(324)
Florence	14,076	4.50	14.01	10(2)	60(9)	303(37)
Glendale	16,829	30.49	16.32	12(11)	70(96)	353(445)
Hollywood	30,818	24.95	30.06	22(27)	128(110)	650(537)
Inglewood	11,102	8.93	11.00	8(8)	47(69)	238(284)
Lancaster	7,146	803.39	3.20	2(22)	14(57)	69(255)
Long Beach	46,218	51.70	43.89	32(40)	187(217)	949(1,080)
NE.Los Angeles	30,320	24.09	29.60	21(3)	126(70)	640(402)
Norwalk	5,787	9.73	5.73	4(12)	24(31)	124(157)
Pasadena	13,464	23.42	13.15	10(24)	56(124)	284(711)
Pomona	15,560	23.36	15.20	11(10)	65(33)	329(127)
San Pedro	6,482	9.92	6.42	5(18)	27(54)	139(240)
Santa Monica	5,748	8.27	5.70	4(11)	24(115)	123(548)
SE.Los Angeles	65,079	15.98	64.05	46(49)	273(91)	1,384(491)
South Central	55,753	15.39	54.90	40(27)	234(67)	1,187(384)
Torrance	4,937	20.52	4.84	3(5)	21(54)	105(324)
Van Nuys	12,075	12.92	11.92	9(13)	51(101)	258(599)
Venice	3,957	3.99	3.94	3(6)	17(36)	85(143)
Westlake	27,832	3.34	27.74	20(19)	118(71)	599(377)
Wilshire	38,868	14.00	38.33	28(16)	163(167)	828(1,013)
County Total	886,632	405.99	866.52	626	3,691	18,727

A1 : Number of Extremely Poor Population(person)
A2 : Territorial Size(Mile^2)
A3 : Coefficient of Decision Variable
M1 : Gatekeeper Service Programs M2 : Coping Service Programs M3 : Other Human Service Programs

Many of the over-provision communities(existing service programs>model service programs) were relatively service-rich and major nodes of the county subregions. Major underprovision communities (existing service programs<model service programs) represent dense African-American and/or Hispanic areas with lower socio-economic status. Other county cities/communities not included in these two typical types represent coordinated (silmilar) service distribution patterns between existing and model programs. Model results suggest the following problems and implications for Los Angeles's human service system.

First, the community scale service distribution in Los Angeles county is not likely to reflect the distribution of service need (extremely poor population). Many communities with enormous service needs (such as Compton, Boyle Heights, Northeast LA, Florence, Southcentral LA, Westlake) do not have their fair-share of service resources.

Second, there is the need to relocate existing shelter/service programs across the county's constituent communities. In the present service distribution, it is anticipated that service congestion(and surplus) occurs in under-provision(and over-provision) communities. According to the optimal model distribution of services, unprivileged minority localities mostly located in central LA-fringe areas(such as Boyle Heights, Compton, Florence, Southcentral LA, Westlake) should be provided with more programs to comply with existing need levels. Correcting this injustice in the existing service resource distributions would greatly expand the efficacy of the present service system in Los Angeles county.

2) Effective Allocation of Shelter/ Service Programs at the Micro Geographical Seale(Census Tract Level)

Extremely poor people are either not in the labor force, or tend to be unemployed or under-employed. The extremely poor usually rely on minimal cash income transfers from the government, in-kind services such as shelters, health care services, food programs, consultation/referral services and other support services, and income from casual/subsistence labor (such as day labor, subsistence prostitution, recycling). Due to fiscal, physical, social or psychological constraints, they are often highly immobile and thus tend to congregate near facilities which provide needed service(Dear, Wolch and Akita, 1988). In addition to user agglomeration, support programs have strong technical and administrative linkages with each other, such as forward and backward relationships(Dear, 1987). Therefore, an adequate support system for the extremely poor population can include various types of service programs that have sufficient functional linkages and geographical proximity to assure effective use of the system. This leads to the concept of community-based service hub.

Because of the various service needs of the extremely poor, high functional linkages among human service programs, together with the limited mobility of the service-dependent poor population, the service hub seems the most appropriate strategy to meet client needs in local level service provision. When designing an ideal system of service hub, following points might be considered as a basic set of caveats.

First, the number of service hubs in the entire county largely depends upon the available shelter/service resources in the region, including federal, state, and local programs and facilities, and private/non-profits and voluntary organizations that provide needed services.

Second, there may be hierarchically inclusive service hubs. Some types of service programs that have finite numbers or have a regionally important function(e.g., a regional recreation center, DPSS regional office) can be located in the central portion of the region or where users are agglomerated in the county. Due to limited resources and their hierarchical importance, regional service hubs should be located in large nodal communities that can be easily accessible by the public transit system.

Third, private service agencies cannot be under the full control of any relevant governing body(or planning authority) in terms of their location decisions. Thus private sector service delivery, in particular, location decisions may be directed to human service needs as well as other operational amenities, such as better working environments, low rents, less NIMBYism.

Fourth, in the intra-municipality siting of service hubs, location of assigned service elements in a community should take advantage of the existing spatial configuration of resources. Employing the geographical center of existing service locations(as a model service hub) can reduce relocation or moving costs, and minimize the need for rezoning or special use permits for introduction of new facilities in nearby premises.

Finally, a service hub should have a set of comprehensive and diverse programs ranging from gatekeeper to coping to other human services, as discussed in the preceding functional taxonomy of services. Service elements across service hubs can vary due to the differing extent and characteristics of needy populations, available service programs, and other local land use and institutional constrains across the localities.

Locational incentives between users and service providers can be differentiated and are often in conflict. Ceteris paribus, clients tend to use the nearest service programs to maximize their welfare through minimum travel costs and time. From service providers' viewpoint, where to locate a fixed(limited) human service resource is apt to be a matter of both facility cost(fixed and/or operational cost) minimization and maximum coverage for users, with given legal, financial and institutional constraints.

The following intra-community level (census tract scale) model employs the important advantages of the service hub concept : agglomeration economies, user proximities, and multi-purpose trips. For the programming of census tract level distributions, a derivative of p-median type integer programming with a normative multi-objective function(criterion variable) and budget constraints(assigned number of service programs) was applied which is installed in the SAS OR system package.

(1) Model Specification

The sensus tract level programming model incorporates several critical factors shown in the literature(Wolch 1982, 19－25) and the caveats discussed earlier:spatial distribution of existing services and service-dependent population, and rent variation. Specifically, the locations of model service hubs in a community are determined by the number of existing service programs. Thus the more a census tract has existing service programs, the more the census tract has model shelter/service programs. Second, service programs are sited at the center of gravity in the distribution of service need(number of the extremely poor). More model shelter/service programs are allocated in census tracts with substantial need level to minimize aggregate travel costs of all users incurred to utilized the resources. Third, service programs also can be sited in the zone of minimum operating cost(proxied by the median gross rent in census data) from the view of service providers. These three exogenous variables seem to be the most crucial factors in determining optimal location of service hub in the community.

Thus

$$T = f\ (ESP, RENT, ESN)$$

where, T is the number of service programs in a service type to be assigned, ESP is the number of existing service programs, RENT is median gross rent, and ESN is the quantity of existing service need(number of extremely poor population).

However, each of these three exogenous variables has diverse measurement units (i.e., person for extremely poor number of programs for service level, dollar for median gross rent) and differing significance in determining optimal service hub location in the community. Standardized Z-scores and weights are employed and assigned to each of the three input variables. An application of Z-scores$[(X_i-\bar{X})/\sigma]$ can adjust varying measurement units and thus standardize the influences of the variables in the construction of the decision variable coefficients. In determining the weight set for the location of optimal service hub, there were no predetermined exemplary weighting criteria(the setting of weights can be decided by the researcher).

The objective function maximizes shelter/service system efficacy for each community by optimiziing three normative model criteria(i.e., minimum agency relocation and operating costs by service providers, minimum travel distances for all users). Thus the objective function to be maximized is structured:

$$MaxZ = w_1ZESP \times X_{ik} + w_2ZRENT^{-1} \times X_{ik} + w_3ZESN \times X_{ik}$$

where, i is service type index and k is census tract index, respectively. X_{ik} is the number of service type i programs assigned to census tract k(decision variable). ZESP is a Z-score column vector of existing service programs, ZRENT is Z-score column vector of median gross rent, and ZESN is a Z-score column vector of extremely poor population, W_i is the weight set($\Sigma w_i = 1$). The objective function can be reformulated as:

$$MaxZ = (w_1ZESP + w_2ZRENT^{-1} + w_3ZESN)X_{ik}$$
$$\text{st. } \Sigma X_{ik} = TSP_{ij} \qquad \forall ij$$
$$w_1 + w_2 + w_3 = 1$$

where, TSP_{ij} is the number programs in service type i in community j assigened by the intercommunity model.

Coefficients of the decision variable can be expressed as the sum of the weighted Z-scores of there input variables($w_1ZESP + w_2ZRENT^{-1} + W_3ZESN$) for each census tract. Each of the three input variables was assigned a weight according to perceived significance of the variables with respect to the decision variable(X_{ik}); $w_1 = 0.5$, $w_2 = 0.1$, and $w_3 = 0.4$. The highest weight(0.5) was given to the existing service program variable(ZESP), and a little low weight(0.4) was given to the existing service need variable(ZESN). Since variations of census tract scale median gross rents in any county community are relatively minor, the rent variable (ZRENT) is the least influential factor in determining optimal locations of service hubs for each community.

(2) Results and Discussion

The location and boundary of optimal census tracts, and their relative ranks on the three input variables for each of the selected communities are presented in Table 3.

Table 3. Location of Model Service Hub

Community	Optimal Census Tract	Location of Model Service Hub				Input Variables(rank of the census tract/number of census tract in each community)		
		East	West	South	North	A1	A2	A3
Arleta	104102	Hansen Dam Park	Van Nuy Bl.	Glenoaks Bl.	FootHill Fwy.	1884 (1/17)	57 (1/17)	446 (3/17)
Boyle Heights	2034	Mission Rd.	LA River	1st St.	AmTrack Rail	1784 (1/17)	47 (3/17)	239 (1/17)
Central City	2073	Main St.	Hill St.	5th St.	Temple St.	1094 (2/8)	183 (1/8)	279 (5/8)
Compton	5425	Alameda St.	Wilmington Av.	Alondra Bl.	Compton Bl.	1856 (3/19)	48 (2/19)	419 (1/19)
E.Los Angeles	5310	Long Beach Fwy.	Sunol Dr.	3rd St.	Floral Dr.	1058 (7/21)	50 (4/21)	429 (5/21)
Florence	5350	Long Beach Av.W.	Central Av.	Nadeau St.	Florence Av.	2039 (1/14)	34 (1/14)	429 (7/14)
Glendale	3022	Adams St.	Brand Bl.	Maple St.	Broad-way	1824 (1/28)	75 (2/28)	553 (4/28)

Community	Optimal Census Tract	Location of Model Service Hub				Input Variables(rank of the census tract/number of census tract in each community)		
		East	West	South	North	A1	A2	A3
Hollywood	1907	Vine St.	Highland Av.	Fountain Av.	Holly-wood Bl.	931 (14/39)	82 (2/39)	473 (8/39)
Inglewood	6011	Prairie Av.	La Brea Av.	Century Bl.	Arbor Vitae St.	966 (3/24)	104 (1/24)	554 (9/24)
Lancaster	900802	Sierra Hwy.	20th St. W.	Av.J	Av.I	598 (5/17)	121 (1/17)	437 (5/17)
Long Beach	5762	Alamitos Av.	Pine Av.	Broadway	7th St.	704 (23/87)	128 (2/87)	395 (4/87)
NE.Los Angeles	1991	Soto St.	Thomas St.	N.Main	Mercury Av.	1128 (4/47)	65 (2/47)	420 (4/47)
Norwalk	5522	Santa Ana Fwy.	Pioneer Bl.	Roscrans Av.	Imperial Av. Hwy	615 (2/17)	19 (4/17)	571 (2/17)
Pasadena	4616	Fair Oaks Av.	Prospect	Orange Grove Bl.	Washing-ton Bl.	1024 (3/30)	42 (7/30)	417 (1/30)
Pomona	402302	Garey Av.	Dudley St.	Pomona Bl.	San Bernadino Fwy.	1264 (3/21)	9 (5/21)	467 (5/21)
San Pedro	2962	LA Main Channel	Pacific Av.	6th St.	Channel	1357 (2/18)	97 (1/17)	390 (2/17)
Santa Monica	7014	Lincoin Bl.	Pacific Ocean	Wilshire Bl.	Montana Av.	499 (3/19)	112 (1/19)	533 (14/19)
SE.Los Angeles	2264	Central Av.	Maple Av.	27th St.	21th St.	2223 (4/46)	38 (4/46)	390 (15/46)
South Central	2383	Broad-way	Vermont Av.	Manches-ter Av.	79th St.	3023 (1/49)	34 (1/49)	414 (15/49)
Torrance	650901	Western Av.	Crenshaw Bl.	Carson St.	190th St.	451 (1/27)	61 (2/27)	572 (1/27)
Van Nuys	128301	Van Nuys Bl.	San Diego Fwy.	Bessemer St.	Victory Bl.	1317 (1/27)	136 (1/27)	520 (1/27)
Venice	2732	Lincoln Bl.	6th Av.	California Av.	Marine St.	473 (2/13)	30 (4/13)	587 (2/13)
Westlake	2083	Harbor Fwy.	Union Av.	3rd St.	Temple St.	1513 (7/21)	58 (3/21)	391 (7/21)
Wilshire	2133	Vermont Av.	Normandi Av.	Pico Bl.	San Marino St.	1359 (11/53)	34 (9/53)	402 (1/53)

A1 : Number of Extremely Poor Population
A2 : Total Number of Existing Service Programs
A3 : Median Gross Rent

Model results suggest that optimal locations of service hubs make best use of the existing services and need distributions, and variation of median rent in the city/community. The model service hub locations(census tracts) in the list(Table 3) ranked high standing in the ordering of the existing service program and extremely poor population variables, and relatively low standing in the median rent variable because low rent is desirable in service facility siting.

For example, historic core and its neighboring streets of Central City East(CCE) and East Industrial Area(EIA) (defined by Hill St. 7th St. Alameda St. 3rd St. and included in census tract 2063, and part of 2062 and 2073) is selected as one preeminent region-wide service hub located in downtown Los Angeles. This Skid Row service hub comprised more than half(53 %) of the existing service resources distributed in downtown Los Angeles. The extremely poor residents(approximately 3, 000 persons) in this service hub area comprised more than seventy per cent of the population group in downtown Los Angeles.

In Santa Monica, the optimal service hub is assigned to north of the Santa Monica Mall(3rd St. Promenade) which is delineated by Lincoln Boulevard to the east, Montana Avenue to the north, and Wilshire Boulevard to the south(census tract : 7014). This census tract ranked first and third on the list in census tract level distributions of existing services and extremely poor population for the municipality. Santa Monica's two other service hub candidates are allocated to two adjacent census tracts of the Colorado Avenue service cluster(census tract : 7019) and the Ocean Park Community Center and vicinity(census tract : 7020). These two potential service hubs constitute Santa Monica's biggest service accumulation delineated by Lincoln Boulevard to the east, and Ocean Park Boulevard to the south, and is bisected by the Santa Monica Freeway.

Pasadena's optimal model service hub location is bounded by Fair Oaks Avenue, Prospect, Orange Grove Boulevard, and Washington Boulevard(census tract : 4616). This minimum rent neighborhood ($417) is located east of the Rose Bowl, and is bisected by a section of the Foothill Freeway(Interstate 210). Two neighboring census tracts(4619, 4622) constitute reasonable second best service hub containing large amount of existing service resources and needs, and relatively low rent($470−500). Union Station and Pasadena Memorial Park are in this neighborhood, and the Foothill Freeway passes through the center of the hub.

Reviewing all optimal model service hubs in Table 3 reveals a set of common peculiar spatial attributes in the location of the model service hubs. First, most of the model service hubs are likely to locate in inner city areas or in their immediate vicinity, in those cities/communities where existing service resources and service needs are abundant. These neighborhoods are characterized by relatively low rent and mixed land uses compared to suburban neighborhoods of the community. Many optimal census tracts across the county are bordered and/or bisected by major Freeways. Major communities where optimal service hubs are bounded by primary freeways include Arleta(Foothill Fwy.), Boyle Heights(Golden State Fwy.), East LA(Long Beach Fwy.), Lancaster(Sierra Hwy.), Norwalk(Santa Ana Fwy.), Pomona(San Bernadino Fwy.), Van Nuys(San Diego Fwy.), Westlake (Harbor Fwy.), Communities where optimal service hub are divided by major freeways include East LA(Pomona Fwy.), Norwalk(Santa Ana Fwy.), Pasadena (Foothill Fwy.), San Pedro(Harbor Fwy.), and Southcentral LA(Harbor Fwy.). This implies that particular neighborhood characteristics and zoning parctices exist along the freeways(such as lower socio-economic status, inclusionary zoning, strip multi-family or commercial land uses), and these features in turn facilitate chances of human service siting. Another explanation for this spatial pattern is that historically freeways were sited in poor neighborhoods, which in turn further reduced residential values over time in areas surrounding the freeways.

4. Concluding Remarks

One suggestive spatial property of the distribution of optimal model service hubs is their spatial proximity to other service hub candidates(second-or thrid-best) in most cities/communities. This implies that service programs and/or populations in need are congregated in several adjacent census tracts, which is not surprising. This pattern suggests the possibilities of service complementarity and/or substitution(according to the service continuum, proper referral and case management) across the service hubs. Nearness of model service hubs to one another can also provide various benefits to service providers and users through enhanced levels of agglomeration economies(e.g., inter-facility linkage, convenient information/referral, staff sharing) and increased service access(e.g., multi-purpose trip making, reduced travel distance and time). From a broader regional viewpoint, proximate service hubs in the community creates decentralized service clusters across county municipalities, thus producing benefits from the advantages of both fair-share and service hub ideas. In local level service provision, however, proximate service hubs in the community would create ghettoization in the most decayed inner cities.

Note

1) Extremely poor represents the persons living below 75 percent of poverty line defined by the 1990 U.S. Census. Federal poverty income level in 1990 was $13,359 for a family of four(Bassuk, 1991, 68).
2) The sequential process of the original research includes five broad methodological categories; (i) univariate analysis using distribution and concentration measures such as coefficient of variation, localization coefficient, and location quotient analysis; (ii) bivariate inquiries to reveal the relative distribution of shelter/services in relation to need configurations, such as Gini coefficients, territorial justice measures; (iii) prerequisite spatial analyses which support interpretation and multivariate statistical analyses, such as spatial autocorrelation, threshold analysis; (iv) multivariate statistical tests which examine the degree of spatial associations among the service types and characterization of shelter/service location, including factor analysis, regression and logit models. Detailed analyses and results are provided in the orginal research.

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