BETWEEN POLICY AND PRACTICE: A SPATIAL DECISION SUPPORT SYSTEM-BASED ASSESSMENT OF FACILITY LOCATION PLANNING IN NIGERIA

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ABSTRACT

The absence of basic social services is a major impediment to rural development in Nigeria. Moreover, the imbalance in service distribution patterns within rural areas may be significant, especially when government service provision objectives are related to delivery patterns. Two factors are responsible for these. One, the absence of a coherent location policy for the delivery of services and two, the lack of a normative framework for facility location planning. This research used a spatial decision support system (SDSS) framework to identify the extent to which service provision objectives are being realized; and to model alternative patterns consistent with stated policies and objectives in service delivery planning.

A SDSS provides a framework for the computer storage and analysis of data necessary for facility location planning; the representation of the objectives of interest groups as a series of "rules" to be accomplished; and the application of spatial models that utilize data and rules in arriving at rational location scenarios from which decision-makers can choose.   The empirical application of the SDSS framework reveals that with the present distributional pattern of secondary schools and dispensaries, 11.4% and 7.1% of the population and 55.5% and 37.8% of the settlements are not accessible to these services respectively. This is indicative of government policy failure in achieving equitable access to these services. In contrast, the SDSS generated scenarios to resolve specific objectives of government in service provision out-performed the present pattern. With fewer numbers of facilities, the location patterns arrived to resolve stated objectives achieved total coverage of the population and settlements that would utilize secondary school and dispensary services.

 Keywords: Rural Development, Social Services, Location Planning, Spatial Decision Support Systems

1   Introduction

Rural deprivation has remained a topical issue among development planners for more than three decades (Rondinelli and Evans, 1983; Rushton, 1988). In the developing economies, the problem of rural deprivation is compounded by the often-biased concentration of growth stimulating services in urban areas to the detriment of rural areas. In Nigeria, although significant policies have been articulated to ameliorate the problems of rural areas (Nigeria, 1979; 1988), however, development initiatives are still in favor of urban areas whose population constitutes less than 30% of the nation. This protracted neglect of the rural majority has dire consequences. Primarily, the inadequate provision of services and amenities in the rural areas has estranged them from the national space economy (Idachaba, 1985; Okafor, 1991, Ayeni, 1996). Besides, rural areas are being exploited for resources to service urban centers, further depleting their resource base. These push factors have led to massive migration of the productive population to urban centers, thereby worsening the socioeconomic conditions of rural areas. Moreover, all this factors combine to make any purposeful integrated development in the country an uphill task.

In Nigeria, development planning readily translates into rural development planning involving the location of activities that contribute to improving rural welfare. The activities have included the provision of public services such as education, health, banks and similar services in rural areas. However, the critical missing link in this initiative remains the lack of a coherent policy regarding the location and distribution of these services coupled with the absence of an appropriate normative framework within which policy can be formulated and executed.

Existing attempts at providing quantitative basis for the analysis of public services provision for influencing policy formulation and execution through traditional approaches such as linear programming (Ikporukpo, 1987); and location-allocation modeling (McNulty et al, 1984; Ayeni, 1989, 1996) have proved inadequate. Principally, these methods often fail

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to capture the complexity of real-life location planning problems. Besides, these widely used methods cannot replace human decision-making judgment in assessing the results of model runs to arrive at optimal location plans. In addition, mapping of model results is not built within their framework (Malczewski, 1990). A spatial decision support system (SDSS) provides an alternative normative approach that overcomes these shortcomings (Owoola, 1996).

This empirical research developed and applied a SDSS framework for assessing policy and practice in public services provision as a solution to rural deprivation in Nigeria. Emphasis was on secondary schools and dispensaries. In this application, we hypothesized that a SDSS provides a more consistent approach to: (i) the identification of distribution imbalances in service provision; (ii) the assessment of pre-stated objectives and the extent to which these differ from or conform with existing service location patterns; and (iii) the generation of service location scenarios consistent with pre-stated objectives. Besides, the implications of the framework for policy evaluation and re-formulation are discussed.

2   The Study Area

Three local government areas in the northern part of Oyo State, Nigeria are involved in the study. These are Kajola, Iseyin and Ifedapo local government areas. The three councils constitute the Oke Ogun area of the state. It is an area perceived as being deprived of basic facilities and infrastructures compared to other places in the state. 492 settlements with a population of 836,985 are identified for this research. The bulk of the population - 367,581 or 43.92% in the study area is found in only three settlements, namely Shaki, Iseyin and Okeho, incidentally the headquarters of Ifedapo, Iseyin and Kajola local government areas respectively.

The statistics of infrastructure provision in this area is disturbing. A decade-long national inventory of community based infrastructures (Nigeria, 1991), identified twenty-five dominant settlements in Ifedapo local government area, of which in only three are found significant proportion of rural facilities such as potable water, health and educational facilities, cottage industries and hotels. In all, 10.2% of the settlements are found to have potable water; 2.7% enjoy electricity supply; 3.3% have health facilities; only 1.3% enjoy banking facilities; while 2.2% have communication and agricultural facilities. Similar situation obtains in the other two local government areas. The above suggests the existence of a dispersed settlement system in the area making it ideal for this study. It is recognized that in dispersed settlement systems, service location planning presents difficult challenges. Moreover, the perceived need and request of inhabitants for facilities, coupled with the fact the area is theoretically suitable for (i) testing hypotheses about facilities provision and (ii) evaluating the roles of rural areas in the development process makes it suitable for the research.

3   Education and Health Services Provision In Nigeria

Two types of hierarchical considerations affect the provision of education and health care facilities in Nigeria (Ayeni, 1989, 1996; Okafor 1991). The first type is characterized by the levels of service provision, based on types, sizes and importance of the facilities.   The second relates to the levels of administration such as local, state and federal governments responsible for service provision. In practice, particular levels of administration are responsible for specific levels of services.

Constitutionally, education and health services are on the concurrent list.   This implies that decisions regarding the provision of these facilities are the joint responsibility of the three levels of government - Local, State and Federal. A hierarchical organization also occurs in terms of the types and sizes of these facilities.   For example, there are three levels of educational services - primary, secondary and tertiary.   The local governments are currently managing the primary school system (although this level of education is often subjected to federal policy changes) while secondary schools are exclusively under state governments except for the federal government colleges which are managed by the Federal government. Tertiary education is also jointly provided/managed by State and Federal governments.

The provision and management of health services more or less follow the same pattern as those of educational services. At the apex is the Federal government who owns and manages the teaching and other specialist hospitals.   The state government also owns and manages some specialist hospitals in addition to the community and primary health centers. Local governments on the other hand, are responsible for dispensaries and maternity centers.

Articulated objectives of secondary schools and dispensary services provision can be categorized into two. On one hand, are the population thresholds to be met for the provision of these services, and on the other, are the accessibility criteria. For population thresholds, it is assumed that settlements of 10,000 people meet the requirement for a secondary school

(Oyo State of Nigeria, 1982) while settlements with 20,000 people meet the condition for dispensary provision (Ayeni, 1989). In terms of accessibility, policy statements imply that a minimum threshold of 2km and a maximum of 5km journey-to-school distances are desirable while a minimum distance of 8km and a maximum of 10km for journey to dispensary centers would be the objectives to be realized in providing these services. These criteria are instructive of the technocrats' position in service location planning (Agunlejika, 1994; Urey, 1999).

4   The SDSS Framework/Methodology

The SDSS concept is well articulated in the literature. A typical SDSS (Figure 1) consists of three main components: the data component, the model component and the user interface (Lolonis, 1990). The SDSS framework resolves the three objectives of this research. Distribution of settlements, number and types of facilities within each settlement, population of each settlement, transport network and decision rule constitute the main data sets collected and integrated within the geographic information systems (GIS) component of the framework. The GIS utilizes the ARCVIEW GIS software by ESRI, 1998. The software facilitates the development of spatial and attribute databases that are critical to the SDSS framework. The model component of the framework uses the Location-Allocation Decision Support System (LADSS) developed at the University of Iowa, U.S.A.
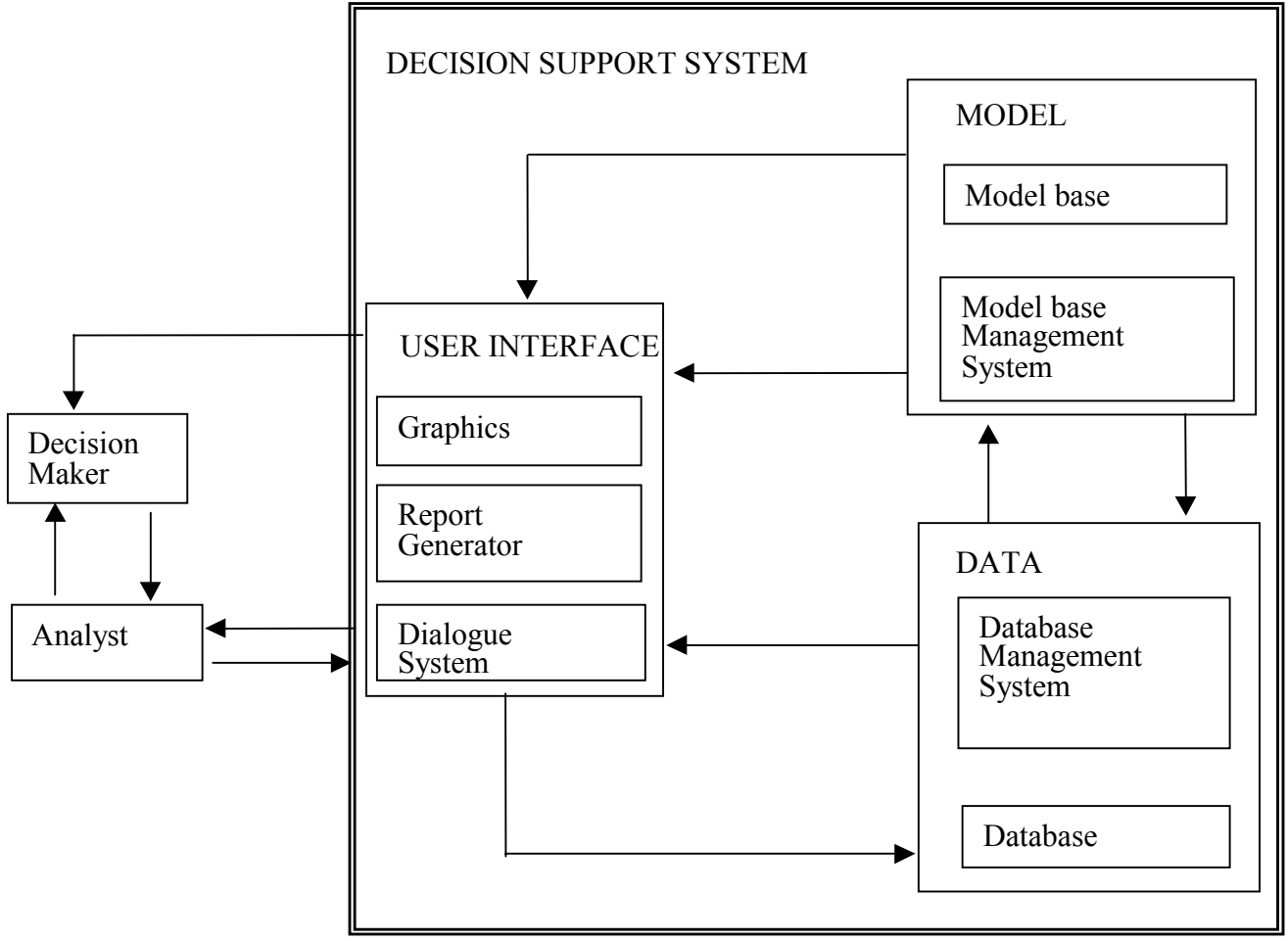

Figure 1: A Typical SDSS Framework

The implicit objectives of the government as a service provider as contained in policies relating to the broad areas of development planning are examined using this framework. These objectives can be summarized into three. One, the need to provide services such that equity in distribution is not compromised; two, the need to make services accessible within reasonable travel distances; and three, the need to achieve the first two objectives within the limits of available resources.

5   RESULTS

5.1   Spatial Distribution of Education and Health Services

One primary objective for locating facilities to match the spatial distribution of population is to achieve egalitarianism. The argument is that if consideration is given to population distribution patterns in locating facilities, the number of people without access to facilities would be minimized. In this stage of the analysis, changes in the number and distribution patterns of education and health services over time are examined vis-à-vis and evaluated against the dispersed population distribution in the study area. The hypothesis that the location of services does not match the dispersed pattern of population distribution is examined.   The analysis employs descriptive statistical indices such as ratios, percentages and averages using descriptive functionality of the SDSS framework and the results summarized on Table 1. The Table depicts some salient statistics on the spatial distribution of secondary schools and dispensaries between 1985 and 1996 respectively. These statistics include number of facilities and the number and percentage of the settlements in which these facilities are located. The Table also shows the average number of settlements served by each service center and the facility to population ratio for the two periods.

Table 1: Spatial Distribution of Secondary Schools and Dispensaries by 1985 and 1996 in the Study Area

	Secondary Schools		Dispensaries	
	1985	1996	1985	1996
Number of Facilities	73	92	40	48
Settlements with Facilities	19	28	31	35
Percentage of Total Settlement	3.8%	5.6%	6.23%	7.04%
Facility to Settlement Ratio	1:26	1:18	1:16	1:14
Population with Facilities	500,188	544,610	600,735	603,473
Facility to Population Ratio	1:11,463	1:9,095	1:20,918	1:17,432

In 1985, the study area had 73 secondary schools located in 19 settlements having a combined population of 500,188 people. These represent 59.8% of the total population. By 1996, 19 more secondary schools were established in the study area in 19 settlements (Table 1).   This represents a 20.6% improvement over the 1985 ratio. Out of these 19 settlements, 10 already had this service in them. The choice of 9 new locations for secondary schools by 1996 improved location accessibility (defined as accessibility of non-service settlements to service centers) in the study area as shown by a fall in the average number of service settlements to settlements without services to 1:18.

Moreover, in 1985 there were 40 dispensaries in 31 settlements representing only 6.2% of the settlements but containing 71.8% of the total population in the study area. By1996, 8 more dispensaries were built in 6 settlements in the study area. Of these 6 settlements, 2 were already dispensary locations, increasing the number of settlements with dispensaries to 35. These settlements contain 72.1% of the total population in the study area. Thus by 1996, the dispensary to population ratio improved to 1:17,433.

Certain inferences can be drawn from these patterns. It terms of absolute level of geographic coverage defined as actual population and settlements served with services, it is obvious that government had given practically no consideration to the dispersed nature of settlement distribution in the study area in locating these services. This is because whereas 65.1% and 72.1% of the population have access to secondary schools and dispensaries respectively, these figures represent only 5.6% and 7.04% of the settlements served with these facilities. Besides, there was little or no spread in the locations chosen as service centers even when new facilities were being established. Consequently, 94.4% and 93% of the settlements have no

secondary schools and dispensaries respectively. This situation has made location accessibility more or less fixed in the study area and negates the objective of equity in facility distribution.

To statistically validate these assertions, it is hypothesized that the distribution of education and health facilities does not follow the dispersed pattern of population distribution. Using the product moment correlation coefficient (r) between the number of facilities and the population size of facilities locations, r values of 0.67 and 0.71 were obtained between the population size of settlements and the number of secondary schools in them for the two time periods.   Similarly, r-values of 0.73 and 0.84 were obtained between the population size of settlements and the number of dispensaries located in them for the two periods. The test of significance of r at 0.05 level indicates that the critical t of 1.96 and is less than the calculated t of 20.13 and 22.55 for secondary school services in the two period respectively. Furthermore, at the same level of significance, the critical t of 1.96 is less than the calculated t of 23.88 and 34.42 for dispensary services in the two periods respectively.

These t tests of significance indicate that the observed association between population size of settlements and the number of facilities located in them is too significant to be adduced to chance. Thus, one can conclude that the present distribution of services is indicative of deliberate action of decision-makers in locating facilities in areas of high population concentration. This tendency negates the claims that government is concerned with providing an equitable pattern of service delivery.

5.2   Modeled Scenarios of Education and Health Services Delivery

A critical obligation of government is the welfare of its citizens. The provision of public facilities for the benefit of all is an attempt to fulfill this obligation. However, where these facilities are located without regard to the distribution of population, government could be ineffective in meeting its obligation. Likewise, government may have to spend a disproportionate amount of resources to provide services. The burden of fulfilling various obligations within the limits of scarce resources suggests that service planning to ensure accessibility and equity in a cost effective way is desirable to governments.

In this stage of the analysis, we argue that government would have been able to meet its obligations efficiently if use had been made of a planning framework that allows policy objectives to be assessed vis-à-vis modeled patterns of service delivery to resolve stated objectives. Additionally, it would also be possible to re-evaluate existing service delivery patterns when new location decisions need to be taken in order to eliminate wastage. To generate and evaluate such scenarios, the LADSS component of the SDSS framework was applied and results presented on Table 2.

Table 2: Modeled Scenarios of Secondary School and Dispensary Services Delivery in the Study Area

	Secondary School		Dispensaries	
	Existing Pattern	Modeled Pattern	Existing Pattern	Modeled Pattern
Number of facility	92	44	48	30
Number of Service Centers	29	44	35	30
Coverage				
Population Served	741,521	836,985	777,354	836,985
Settlements Served	221	497	309	497
Accessibility to Services (km)				
Population	1.01	1.93	1.92	3.12
Settlement	6.95	6.96	6.69	7.9

5.2.1   Secondary School Service Delivery

The total number of secondary schools in the study area presently stands at 92 (Table 2) all located in 29 settlements. If the population to school ratio of 1:10,000 is used for secondary school provision, only 84 schools need be built. Alternatively, one can argue that if government had paid attention to optimum pattern of secondary school delivery, there would have been no need for the proliferation of secondary schools in the study area. A cost effective way of secondary school provision would have been to find the minimum number of secondary schools needed and their locations such that pupils would travel on the average, only 2km to school sites or that no pupil should travel more than 5km to schools. Table 2 shows the results of implementing this scenario in an SDSS and compares result with the existing delivery pattern.
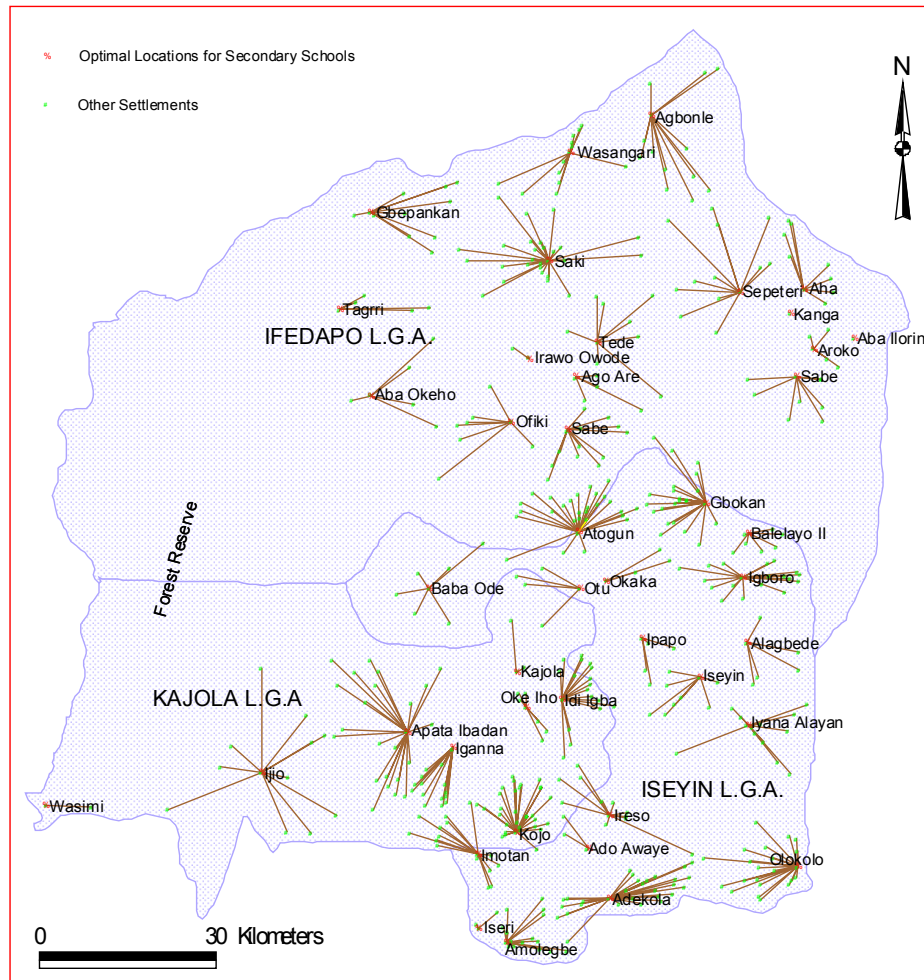

Figure 2: SDSS Generated Pattern for Secondary Schools Provision

The 44 school locations arrived at by the model provide total coverage of the population and settlements in the study area (Figure 2). This contrasts with the 92 secondary schools in 29 locations that still leave 95,464 people without access to secondary schools. Moreover, in the present delivery pattern of secondary schools, only 221 settlements are served (Table 2).   It is also implicit from the Table that by 1985, the study area already had more than the minimum number of secondary schools required to provide total population coverage. Since government seems to be unaware of this fact, 19 more secondary schools were established after 1985. Even then, if government had paid more attention to normative location-decision making in secondary school delivery, 19 new optimal locations should have been found for these new secondary schools. Instead, only 9 new locations were selected for secondary school delivery. Out of these 9 new

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locations, the model shows that 5 were not optimal. By building 44 schools in the locations chosen by the model, government could have saved about half of the total costs expended in building the 92 schools presently in existence; moreso that the accessibility criterion is not violated by the model pattern despite the fewer number of services returned.

5.2.2 Dispensary Service Delivery

From Table 2, 48 dispensaries are presently in the study area located in 35 settlements. Similarly, as is the case with secondary schools, this figure is already enough to meet the population to dispensary ratio of 1:20,000. Moreover, if government were to locate dispensaries to achieve total coverage within its limited resources, one can specify the lower and upper distance limits of 8km and 10km that users should travel to and must not travel beyond to utilize dispensaries respectively within the model.

From Figure 3, the distribution pattern of the 30 dispensary provision centers as selected by the model indicates that all the settlements are served with dispensaries. This implies that the total population of 836,985 would have access to dispensary services in the study area. In contrast, the existing spatial pattern of the 35 dispensary locations requires additional dispensary locations to serve the 59,631 people or 139 settlements that are presently not served.
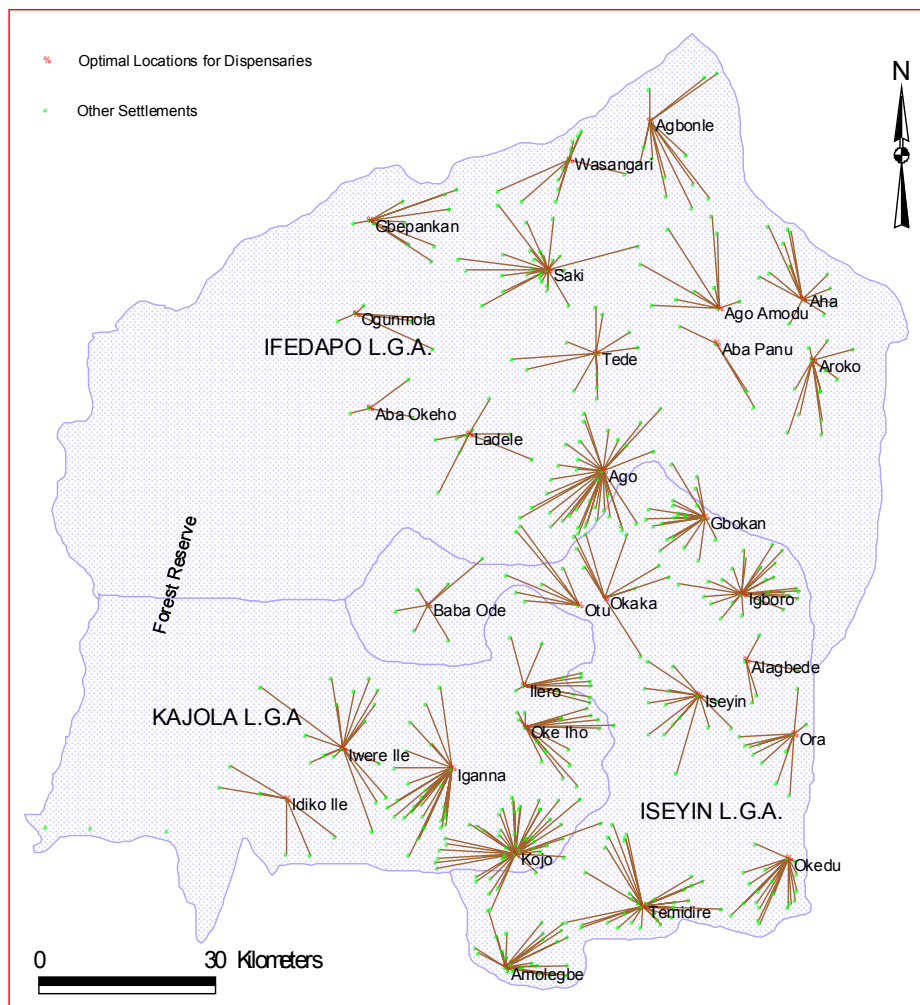

Figure 3: SDSS Generated Pattern for Provision of Dispensaries

This scenario is also indicative of lack of attainment of stated objectives of government in dispensary service delivery. Thus, the present delivery of dispensaries is wasteful in two ways. First, the sub-optimal location pattern of dispensaries indicates that government had probably expended more resources than necessary in building the number of dispensaries in existence. Second, government would still have to expend more resources building dispensaries to serve the population that could not be served in the present distribution pattern.

6   Implications of the Research for Service Location Planning

A recurrent theme in geographic research is the exploration of universality of locations and location considerations in human spatial behavior. The concern with spatial decision-making may aim at predicting outcomes of alternative location plans. It equally aims at determining the extent to which stated objectives are met by the choice of a plan. Many spatial decision-making problems thus require decision-makers to consider the impacts of choice alternatives along multiple dimensions in order to select the best alternative (Malczewski, 1990). Unfortunately, in most developing countries, no consideration is given to these factors in service location planning initiatives.

This paper shows that it is possible to make operational, using a SDSS framework, many of the problems facing decision-makers in service development planning as a rural development strategy. A major implication of this research is that continuous reliance on traditional paradigms by decision makers for service location planning makes it impossible for an accurate assessment of the degree to which delivery patterns is consistent with stated objectives. Moreover, since such planning initiatives are non-participatory, it is difficult to articulate and incorporate objectives of other interest groups. The latter may lead to perceived deprivation even when service providers have acted sincerely, albeit using strategies that may be considered sub-optimal. This often leads to claims and counter claims of deprivation by service-users and providers alike when actually, the problem may simply be sub-optimal service delivery patterns.

Another notable implication is that generating alternative scenarios of service delivery often reveals the degree to which intervention may be needed to improve current delivery levels. Likewise, evaluating alternative scenarios of service delivery shows that what is often needed when the current level of service delivery could not meet stipulated objectives may be a re-organization of service locations rather than establishment of new facilities.

Finally, the framework highlights the critical role of a SDSS as a supportive tool in decision-making. In this regard, decision-makers have the opportunity to explore alternative location plans and determine their consistency with pre-formulated objectives. These can prove invaluable in problem re-definition, generation of other location alternatives and eventual choice of a plan that is most acceptable to all.

7   Conclusion

In developing countries generally, service providers have made little effort to identify suitable spatial units and location patterns from which social services could be efficiently and effectively provided. This may be attributed to ignorance on the part of development planners of methods that allow rigorous spatial analysis for the provision of facilities. In another sense, the neglect may be due to lack of appreciation of location issues and consequences of adopting particular spatial patterns of service delivery by the decision-makers. However, it is pertinent to note that, in facility location planning, policy priorities, tradeoffs and uncertainties, must of necessity, be integrated in the locational choice process. A SDSS framework as described in this empirical application, makes possible the consideration of these factors in service delivery planning. It is hoped that service development planners especially in developing countries would make such a framework the basis for spatial planning efforts as they enter the new millennium.

Acknowledgements

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