A GIS DATABASE DESIGN FOR URBAN POVERTY MANAGEMENT

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Key words: Data base, Urban poverty, GIS, GTGIS.

ABSTRACT

Poverty is a socio-economic scourge raging at varying degrees throughout the African continent. Its prevalence is most pervasive in the cores of African traditional cities than in the urban peripheries which tend to be more modernized. Non-recognition of the heterogeneous nature of urban poverty and the many players involved in its management has only helped to aggravate the problem. Consequently, a holistic planning, implementation and control approach is imperative. This should involve all tiers of government, non-governmental bodies, donor agencies, international organizations with the research community on one hand, and a combination of historical, economical, sociological, anthropological and spatial perspectives on the other hand. The spatial perspective, which is the main focus of this paper, serves to interface with the other perspectives since people are used to space and they live in space. In this regard, Geographic Information technology (GIT) is of utmost importance with the Spatial Database Management System (DBMS) as its heart. The essence of any DBMS is that data should be stored in an organized manner for easy retrieval to aid decision-making. Moreover, the use of GIS for poverty-related data handling is superior not only to manual (traditional) data handling methods, but advantageous over other information systems as it admits data coming from different sources. This is because GIS derives effective results on making decisions on alleviating poverty by analysis and mapping via efficient spatial and attribute data storage and handling. This paper centres on the design of a GIS database for urban poverty assessment and inventory mapping. It is concerned with improving the effectiveness of managing urban poverty by designing a generic model showing the datasets and the relationships required for poverty appraisal application. In a bid to carry out this objective the database for poverty assessment and mapping in the Geographic Targeting GIS (GTGIS) is planned for the city of Ibadan, Nigeria (a UNCHS (Habitat) "Sustainable Urban Management Programme" case study in 1996).

1. INTRODUCTION

Establishing a direct relationship between information and their geographical location is a unique characteristic of GIS, a versatile tool that also enables information to be displayed as maps. As a decision-support tool, GIS helps to integrate several data sets, and unravel complex relationships between phenomena within an ordered spatial framework. The former capability is of utmost importance since data sources for poverty management are multifarious as reflected in the varied poverty indicators in use. GIS has strong analytical potential for understanding the 'where', 'how' and 'why' of poverty as it varies from place

to place, especially in an urban setting. All these capabilities coupled with the ability of GIS to quickly update information, make it much suited as a timely and reliable tool for improving data handling for urban poverty management.
With the phenomenal urban growth rate of six percent in sub-Saharan Africa which is twice faster than in Latin America or East Asia (Netherlands, 1994), urban municipalities are in dire need of reliable, current and accessible spatio-temporal data. In particular, a city municipal authority stands to benefit more from spatial information since the incidence, intensity and severity of poverty are not the same all over the city (see Bigman and Fofack 2000). Much disparity in the quality of life (welfare) occurs within and between different neighbourhoods, especially between predominantly residential and commercial neighbourhoods.

2. URBAN POVERTY IN SUB-SAHARAN AFRICA

Urban poverty, which is rapidly increasing, is due to receive more attention although the poor in sub-Saharan Africa are still mainly concentrated in rural areas. With the escalation in urban poverty in recent years, urban dwellers are faced with constraints quite different from that of their rural counterparts. For example, urbanites pay higher rent for accommodation and transportation, seek work where employment opportunities are scarce and deal with abysmal sanitation facilities. In addition the urban poor pay higher prices for urban land when it is available at all – even land that receive no services. Many urban poor people have no access to formal land markets in peri-urban areas. The influx of rural poor people into the cities coupled with inadequate planning and provision of employment opportunities lead to increased poverty in our cities (see World Bank, 1997).

The World Bank estimates suggest that around 330 million urban dwellers or 28% of the urban population of the developing world were poor in 1989, with the number of the poor doubled in year 2000 and the percentage share increased to 57% (see World Bank, 1989). According to the UNCHS predictions in 1991, 2.2 billion people are expected to live in the cities of the third world in year 2000, with the bulk of the population living in unplanned squatter settlements, without water and electricity, in an environment of squalor, poverty, crime and disease (see table 1).

Table 1: Incidence of Urban Poverty

Regional Aggregates	Urban population below poverty level (%)	Urban population below poverty (millions)
Asia (excl. China)	23	136.5
Africa (sub-Sahara)	42	55.5
Europe/Middle East/N. Africa	34	59.5
Latin America	27	77.3
Developing world	28	329.8

Source: Devas and Rakodi, 1993 in Mosha, 1997

Moreover, some 7.9 million urban households, that is, about 42% of the total number of households in Africa, are living in poverty. See table 2 for the breakdown of poverty by sector in selected sub-Saharan African countries.

Table 2: Population below the Poverty Line (percentage)

Country	Survey Year	Headcount Ratio	
		Rural	Urban
Cameroon	1983-1994	71	25
Gambia, The	1992	66	33
Guinea-Bissau	1991	58	24
Kenya	1992	47	30
Lesotho	1993	54	28
Nigeria	1992	68	77
Sierra Leone	1989-1990	76	53
Uganda	1989-1990	57	8
Zambia	1991	88	46
Zimbabwe	1990-1991	31	10

Note: Different poverty lines were used for the estimates, thus the percentages across countries are not comparable (Source: FOS, 1996 and World Bank, 1997).

Taking an overall look at the situation in Nigeria, about seventy-seven percent (77%) of the urban households are poor while 68% of rural households are poor (FOS, 1996). A recent study by Canagarajah (1997), documented the distribution of household income and expenditure in Nigeria in the period of 1985-1992. It tried to indicate in which regions and states the poor are located in and the extent and severity of their poverty. Figure 1 shows population living below the ₦395 poverty line in Nigeria by state in 1992.

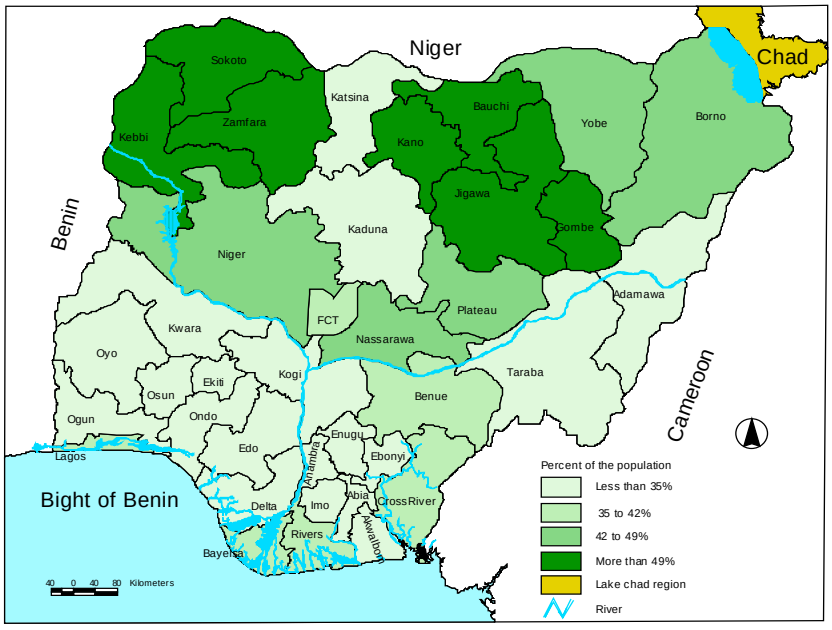

Figure 1: Population living below the poverty line (₦395) by state in 1992 (Source: Poverty and Welfare in Nigeria in Canagarajah, 1997)

3. URBAN POVERTY MANAGEMENT

Data on urban dynamics in sub-Saharan African are not readily available and where available, they are in a disparate form. According to Mabogunje (1990):

> Urban processes and their attendant problems are often poorly defined and inadequately understood. The situation is further compounded by the very poor state of statistical information available on African cities.

Manansala (1997) developed and demonstrated a GIS-based poverty monitoring system for the city of Angeles in the Philippines. This would enhance the planning, formulation and focussing the allocation of their poverty alleviation programmes. The system was developed in a GIS environment because of its three major advantages, namely, data organization, spatial analysis, and visualization. The system involved integrating and structuring different poverty data sets from various sources in a common database. This facilitated data analysis and their integration to the geo-information of the city to provide for their spatial dimension. Furthermore a simple interactive graphic user interface was designed so as to enable users with limited knowledge of computing to operate and interact with the system.

Martinez (1999) developed a GIS 'Bi-level model' database that enables GIS to be used for informal settlement (squatter) upgrading applications. The main feature of her work is the ability of the model to incorporate informal areas that have no cadastral framework with formal areas. With the calculation of settlement density and growth rate as well as the qualitative settlement patterning, new informal settlements and key areas of growth in the Cape Town Metropolitan Region (CMR) were detected. A low-end GIS platform was used which enabled the end-user to contribute to the database building process directly.

4. HOLISTIC APPROACH TO URBAN POVERTY MANAGEMENT

As earlier mentioned, the heterogeneity of the urban setting does not lend itself to one approach in its management. A holistic and more generic approach to urban poverty management is most suitable (see figure 2). It is clearly shown that the local government council (city municipality) plays the most important role in alleviating poverty within its area of jurisdiction (Wegelin and Borgman, 1995). Moreover, the foregoing necessitates more urgently the provision of urban mapping and land information as the spatial basis for administration and the provision of infrastructure and social services to satisfy the rising expectations of urban dwellers (Leatherdale, 1992).

It must be noted that the adoption of the use of GIS by the council is a costly investment, since investment includes spending on hardware, software, humanware and the institutional framework. However to recover the full or partial cost of such investment, information can be sold to users especially the agencies and researchers. If the necessary policies and standards are set, then the data at the council level can be aggregated to higher regional levels such as the state and federal (central) to form the National GIS (NGIS).

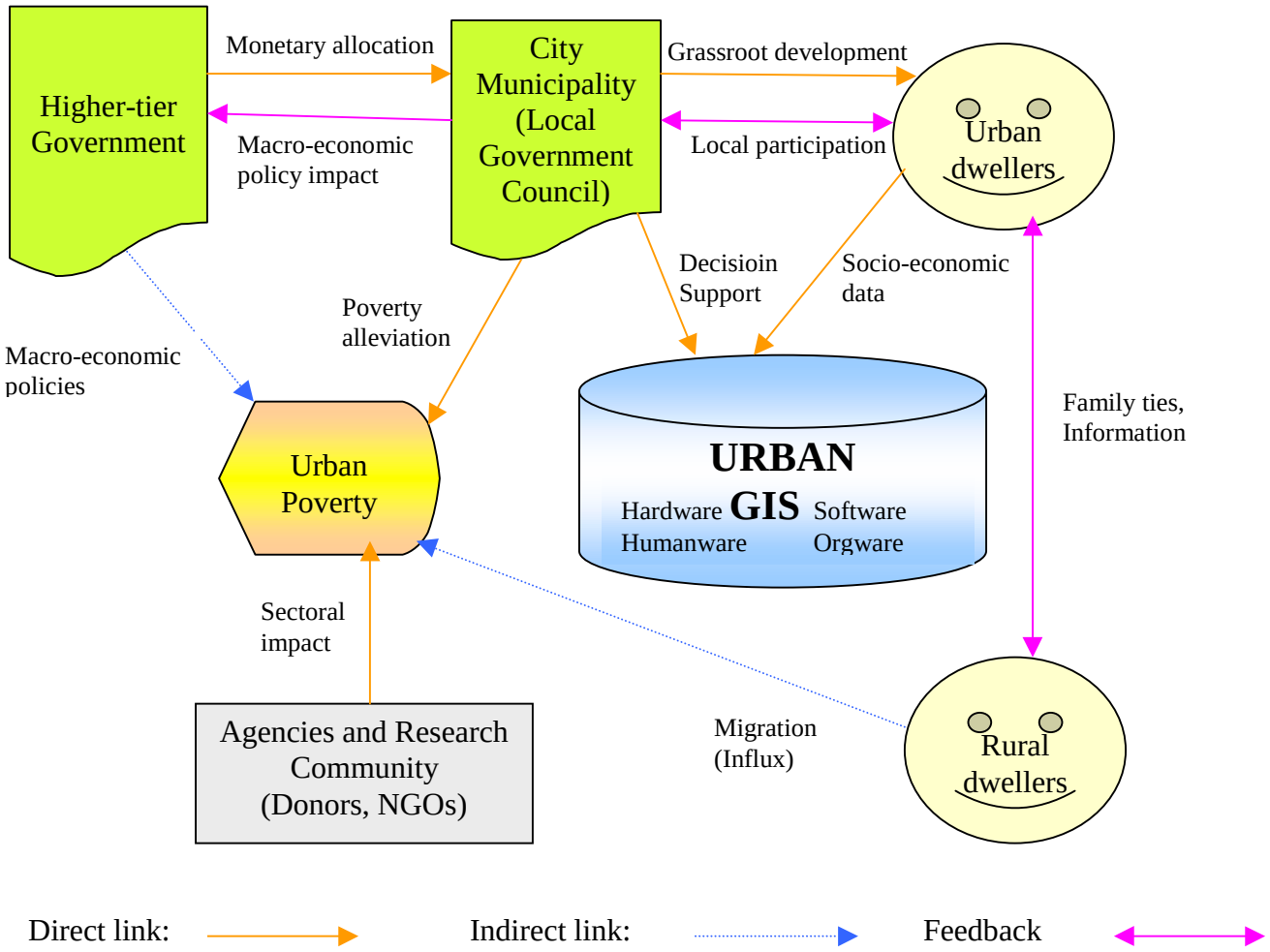

Figure 2: Players and roles in urban poverty generation and management

However laudable any urban poverty alleviation program is, its success will depend much on being able to answer these questions: 'who are the poor?' and 'where are they to be found?' Unfortunately there are no reliable statistical records directly defining the distribution of the poor in space (Mosha, 1997). This is where GIS would be of utmost usefulness since it helps to relate results of poverty measures to their actual geographic location.

5. POVERTY ASSESSMENT COMPONENT OF THE GTGIS

Urban poverty management necessitates assessing poverty differentials occurring in different neighbourhoods making up the city. This study used GIS primarily for poverty inventory mapping in Ibadan metropolis. Poverty inventory mapping involves assessing and mapping the various levels of poverty as it occurs in households and aggregating household poverty to derive poverty levels in neighbourhoods. Figure 3 shows the conceptual model for poverty assessment in the GTGIS.

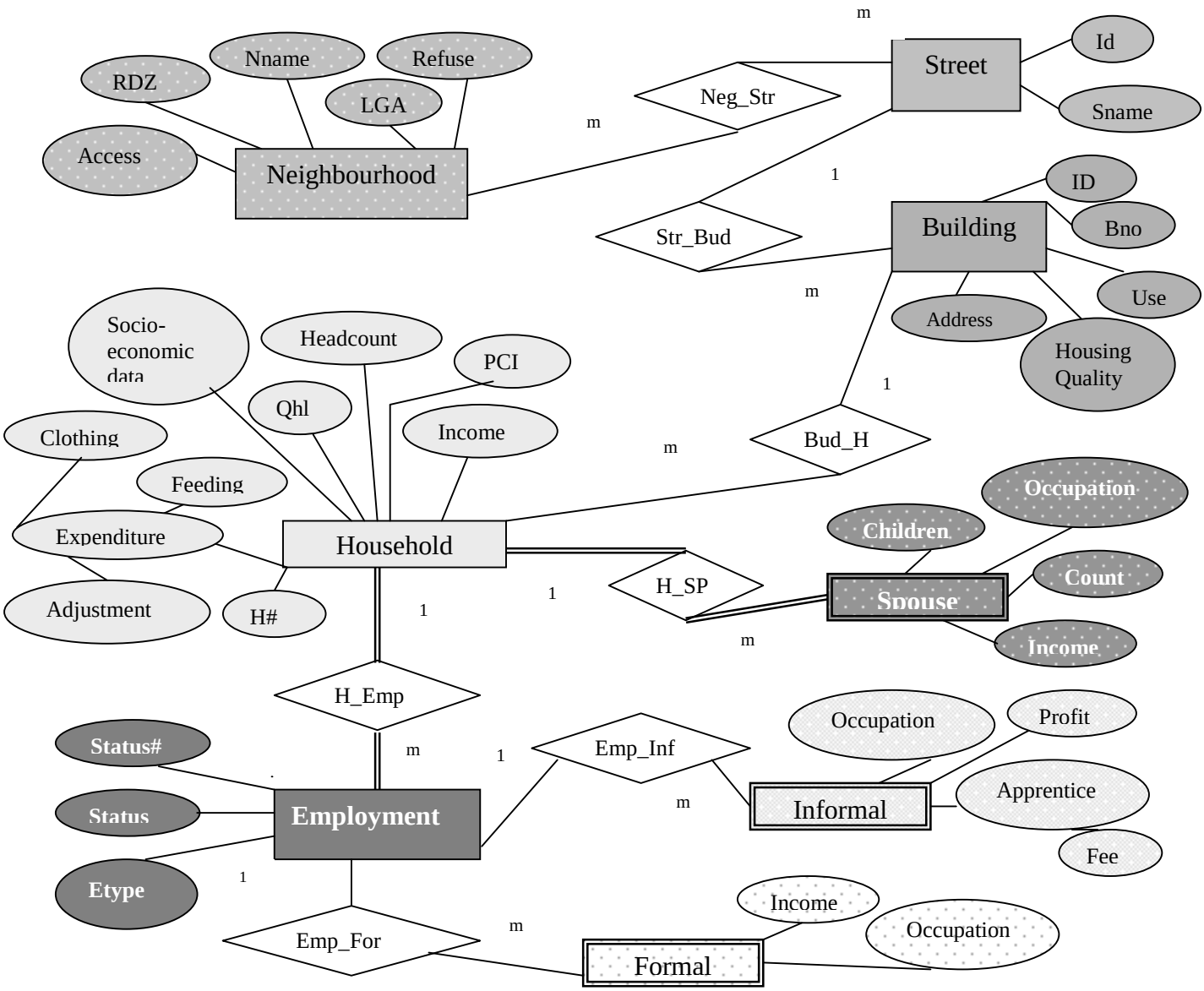

Figure 3: Conceptual data model for the GTGIS (Etype-employment type, RDZ-residential density zone,

For the design of the conceptual model, an entity-relationship (ER) approach was adopted (see Date, 1995). All the socio-economic variables needed in measuring poverty using a standard income-based poverty measure such as the Foster-Greer-Thorbecke (FGT) index or anthropometric measure of poverty such as household quality of life (welfare) are covered by the datasets housed in the GIS database. All these datasets and the relationships between them as required for the poverty assessment application are shown in the model. The conceptual schema was then defined in the database using a relational data structure.

The flow of activities from the creation of urban poverty database design through poverty inventory mapping to poverty alleviation simulation is shown in figure 4.

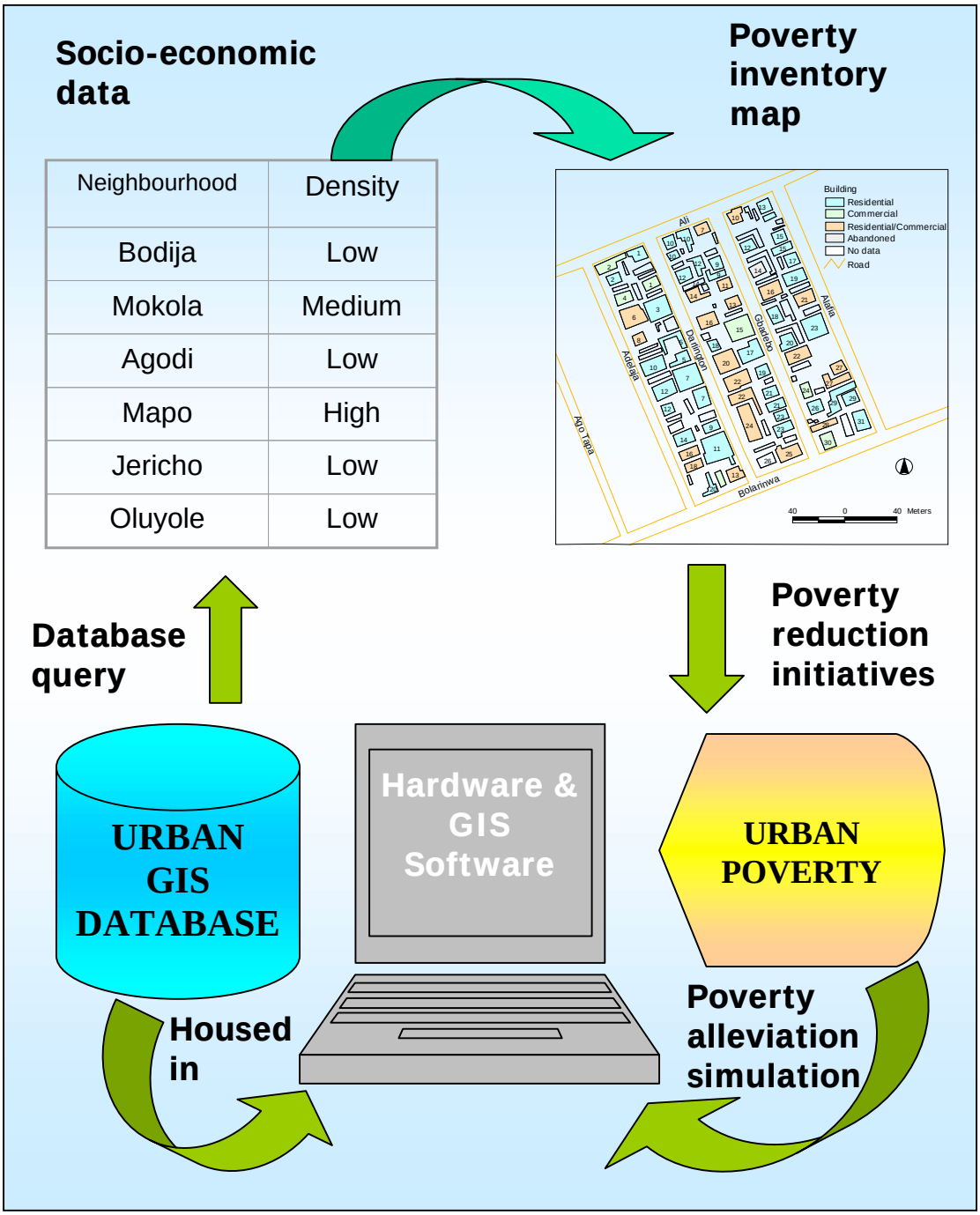

Figure 3: GIS as tool for urban poverty inventory mapping and alleviation simulation

6. CONCLUSION

This study has demonstrated the spatial perspective to poverty management at a micro-economic urban scale. Developing an urban GIS database is of utmost importance to any local urban municipal authority in tackling the various levels of poverty occurring at the household and neighbourhood levels. Such a database should house disaggregated household data since it is best for urban poverty management. This is because as the targeting of a given poverty reduction initiative becomes more precise geographically, under-coverage and leakage rates fall and the impact on urban poverty improves (see Halls, 1998). However the use of disaggregated data is plagued by some inhibitions such as its non-existence in many sub-Saharan countries. Moreover it is costly and time consuming to generate and manage such data since working at such detailed level will definitely require greater information and confidentiality.

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