

Free case study on review of gis in housing and the effect of educational level

[Sociology](#), [Population](#)



Abstract

Shelter is one of the basic human necessities. Provision of decent-quality and affordable housing is one challenge that various authorities have been faced with, and Sheffield is not left behind. Though she has surpassed her average annual housing needs, Sheffield is still struggling to mitigate housing problems. This research project reviews the use of Geographic Information System (GIS) in Sheffield's housing and how education level affects the adoption of GIS in affordable housing initiatives. In order to achieve this objective, the current state of Sheffield's housing is exhaustively considered. Using the boundary data from EDINA and the current housing state, ArcGIS 10 has been used to generate maps that relate different housing variables. Questionnaires were also administered to the local councils in UK to aid in realizing the above aims. The analysis of the maps depict that, indeed the potentials of GIS can be optimized in Sheffield's housing initiatives. The Statistical analysis also reveal the possibility of adopting GIS softwares in housing as most of the council employees have the required knowledge and experience in these softwares.

Chapter One

1. 0 INTRODUCTION

1. 1 Background of Study

Housing, in the human context, refers to the provision of a human being or beings with a physical structure which is constructed with the primary purpose of providing the occupant with security from the vagaries of weather, scum of the earth and other organisms; and with the secondary purpose of providing comfort and privacy to the resident. The quality of

housing is thus determined by these factors. Some housing units, like shanties, provide barely the most basic of these while others, like palaces, provide all these. And in all known human societies, housing along with food is considered a primary need. With complexity of the current human society, much has changed. But much has equally remained the same.

In today's complex human societies, the need to provide decent housing to populations is a challenge faced by governments and other concerned authorities the world over. The ostensibly disparate political, social and economic factors at play make the task even more daunting. For though pure political and social considerations demand that all social classes and geographic regions be provided with housing of more or less similar costs and quality, economic and geographic considerations negate this. Yet, like in any venture, the concerned authorities cannot adopt an "either-or" attitude. The authorities must take the arguments from all sides into account and arrive at a compromise that is socially sound and economically prudent. More importantly, their decisions must always be based on scientifically collected data and facts, not on emotions and populist sentiments.

Though she has surpassed her average yearly housing needs of 1, 425 net additional houses over the period extending from 2008 to 2026 (DCA 2007), Sheffield, like many other administrative units in the world, faces the problem of housing. Though official figures suggest that well above half the population report adequate satisfaction with their housing and that the number of those considered as homeless is about 10 in a population of more than half a million (DCA 2007), the quality of some of these houses, especially the ones in private hands, is questionable. Additionally, the cost of

the housing units are exorbitant and above the reach of most Sheffield residents. It is of note that Sheffield may be unique in at least one way. On the economic front, it recorded a decline in the part of the 1970s, the 1980s and part of the early 1990s. This explains the decline in Sheffield's population from 570 000 in 1974 to 512 242 in 2002 as out-migration became inevitable to most people during this recession. It is also significant to note that Sheffield's population has been on the rise since 2002 and is projected to reach the 560 000 mark by 2029 according to Dr. Roland Lovatt in a report titled *Developments in the Sheffield Population*. A survey carried out in 2007 further reveals that the net in-migration to Sheffield stood at 2419 putting even greater pressure on the housing demands of Sheffield. It is also of note that the number of households in Sheffield has been on the rise since 1981. Since this rise in the number of households corresponds to a period when the net Sheffield population was decreasing implies that households have been having fewer members since 1981; that is, there has been smaller households since 1981. With such and other figures - some contradictory on face value - it is clear that housing initiatives in Sheffield cannot be based on simplistic methods but on comprehensive multi-faceted approach taking into account the geography, economy and demography of Sheffield.

As already intimated, good housing initiatives should take scientifically collected facts and figures into account. One tool that is used extensively in planning - from urban planning to healthcare to infrastructure development - is the Geographical Information System (GIS). GIS is such powerful a tool due to its ability to capture real world data and figures, even natural phenomena

and do simulation using computer programmes in such a way that analysis and review is made much easier.

Given the immense success of GIS in many areas, this study primarily intends to find out whether these vast potentials of GIS can be used to better the outcome of housing initiatives, specifically in Sheffield. The research questions, thus, are;

1. Is it possible to adopt GIS technology in Sheffield housing initiatives?
2. Does the required expertise to implement the adoption of GIS in Sheffield housing initiative exist and how does education level affect it?

The first question is answered by reviewing the relevant literature on the applications of GIS in related fields and by considering what other scholars have said. In addition, by entering the required parameters in ARCGIS 10 and doing simulation (in addition to administering questionnaires on policy makers), we will be able to observe the strengths and weaknesses of GIS in this specific task. The other question will be answered primarily by the questionnaire which will be sent to at least 325 of the 433 local councils in the United Kingdom.

1. 2 The Aims and Objectives

Based on the research questions, it follows that the three objectives of this study are:

1. To determine how GIS can be adopted in affordable housing initiatives
2. To examine and consider if there is enough expertise in the UK 433 local council in the adoption of GIS in affordable housing initiatives
3. To analyze how the level of education encourage the adoption of GIS in housing department in the affordable housing.

1. 3 Geographical Information System (GIS)

Decision making based on geography is very basic to every human thinking.

Understanding geography and how we relate to locations is very important

especially in making informed decisions about how we live on earth. A

geographic information system (GIS) is an important technological tool in comprehending geography and in making such intelligent decisions.

GIS is a tool that simulates real world data and figures (including physical ones) for easy analysis by the end user. It is a highly powerful, successful

tool and is used extensively in planning. Of interest in this study is the

spatial modeling capability of GIS. This capability makes it possible to relate

the demographic changes and variations with the unique housing needs of

people in different locations. Since localities are often associated with certain

social classes, ethnic groups and age groups, the simulation generated by

GIS software can be of great importance to the authorities concerned with

the issue of housing. In Sheffield, for example, an impressive 86% of

residents say they are either very satisfied or fairly satisfied with the

conditions of their houses. If taken on face value, this figure can be grossly

misleading since it does not cut across all regions of Sheffield, neither does it

apply equally to both privately and council owned houses. By feeding all the

determining factors into a GIS software, this study intends to show that a

much more accurate and representative picture can be obtained; a picture

more appropriate for housing planning and initiatives.

1. 4 Introduction to GIS and Housing

Geographic Information System is mainly considered as a mapping tool

which can delineate land parcels. Maps alone can only provide the

contextual information or project the possible results of a sustained analysis e. g. the demand pressure; however, in the GIS context, maps are basically a display device: the database assumes the information storage function of maps while a body of spatial analysis software replaces the map's traditional role of supporting measurement.

A database, in itself, is tremendously useful and may contain the information referring to a particular property within a local authority ownership; however, the use of GIS adds value to the database in that it shows the actual location of the property and allows the interrogation of the map in order to reveal the underlying database records. In a situation where several attributes of the individual property are to be exhibited at the same time, the main requirement is a wide and richer range of cartographic options. In this manner, there is the possibility of showing, say, the location of the properties whose occupants are in receipt of Housing Benefit. Through the use of co-ordinates, GIS can be used in determining the properties that fall within a given potential area for spatial treatment. Such operations can be repeated at a higher level of geographic areas instead of individual properties. A map can be used in illustrating the variation in pressure of demand for the social housing from place to place.

GIS possibilities are endless, and this gives it the strengths and weaknesses. It is important that we not only be realistic about the capacity and capability of any software package, but also identify from the wide range of all the possibilities an appropriate and most effective approach to analyzing the housing needs.

It is worth noting that in other areas, for example healthcare and general

urban planning, where GIS has been used, it has proved highly successful. It has led to building of schools and hospitals and other social amenities where they really ought to be and not where partisan and, sometimes misguided, political interests want them to be. This, obviously, lowers the risk of white elephants projects and thus better accountability for public money which should be the goal of any public office (or officer) anyway. This research intends to find out whether GIS can be adopted to help in housing planning for our time and the future.

1. 5 Limitation of the Study

This study will be limited to housing in Sheffield but for the questionnaire which will be administered to at least 325 local councils across the UK. It seeks to find out how GIS can be adopted in Sheffield's housing initiatives and determine whether there is the required expertise for its adoption.

1. 6 Problems envisaged in this research

Like is always with human endeavors, challenges are inevitable in research projects. Some are spontaneous while others can be foreseen and remedies sought where they prove unavoidable. In investigating the research questions and meeting the research objectives, the problems encountered in the study include:

1. In some cases, there was difficulty in obtaining the requisite literature and data. Some of the information were considered by the authorities as highly sensitive and could not be revealed even for the purpose of learning.
2. Official data from the authorities tend to exaggerate the strong points while ignoring the weak ones. This may have a negative impact on the research findings of this study since official government data informed a

major part of this paper.

3. As is the case with questionnaires, cases of reluctance, even outright refusal, to give answers were encountered.

4. The issue of logistics, especially with regard to administration of questionnaires was a challenging and expensive one.

Certain mitigating actions were taken to offset the impacts of these problems. For example, caution was taken when dealing with data from the authorities. Where the authorities made the bold claim that Sheffield's population would be 561 300 by 2029, the study took into consideration the fact that both the economic and social factors that may engender the attainment of such a figure tend to change radically and that such a change has the impact of affecting this projected figure significantly.

In addition, though attempts were made to get as much requisite data as possible where crucial data was unavailable, this report acknowledges as much. Moreover, despite the logistic challenges encountered as well as that of reluctance by some respondents to answer the questionnaires, adequate amount of data was collected for this study. With the required data, it was possible to investigate the research objectives and answer the research questions.

Chapter Two

2. 0 LITERATURE REVIEW

2. 1 Overview

This chapter explores and revises the existing literature on Geographic Information System and housing. It tends to investigate how GIS can be

adopted in affordable housing initiatives.

2. 2 Affordable Housing

A decent-quality and affordable housing (defined as a housing that consumes less than 30% of the family's total income) enables the family to enjoy improved life outcomes on such dimensions as family stability, household wealth, labor market participation, neighborhood quality, mental and physical health, and educational achievements (Rohe, McCarthy and Van Zandt 2001). In addition, decent-quality and affordable housing contributes to the improvement of physical, environmental, economic, and social health, which defines the sustainability of communities. This is especially important for the lower-income households and the underserved populations.

Where an individual stays (home) is a gateway to services, educational, and employment opportunities, health, and social services. Home is a reflection of who the occupants are, and is an influence on who they can become.

Making a spatial decision for affordable housing concern where middle and low families live in the city and what they can facilitate to get from the city. Affordable housing policy in UK has undergone a development in the recent past.

According to the UK government, Social housing is needed to provide affordable homes in terms of rent with security of tenure for the families on low incomes, people with severe disabilities, frail older people, and for other people for whom home ownership is unlikely to be the right option (CLG 2007). It is the role of the government to assist the vulnerable and to ensure that everyone has access to a decent home at a price they can afford (King 2008). Social housing is not for everyone, rather to assist those who cannot

afford to own decent homes. Policy-makers have never intended to make social housing available for all households or for a majority, as in the case with health and education in the UK (King 2008).

2. 3 How Geographic Information System (GIS) can be adopted in Affordable Housing Initiatives

A GIS is a form of information system that combines geographically (spatially) referenced data, and non-spatial attribute data. It is capable of storing and managing the political boundaries of regions, in addition to the attribute information. This enables one to identify and view each region on the surface of the earth. In addition, GIS analysis functionality allows for neighboring regions to be identified through boundary evaluation. This is the major contrasting feature of GIS, because geographic extent is an explicit and important component of all information being stored, managed, and processed. Thus, GIS may be considered a hybrid information system that structures data and summarizes features based on the inherent characteristic of the data being managed (Church and Murray 2009).

Many researchers have identified the significance of GIS in urban policy initiatives that have a spatial component, like the housing initiatives, informal settlement upgrade, selection of appropriate site for affordable housing, and neighbourhood revitalization among others. These initiatives are currently being implemented by policy makers and governments the world over by exploiting the excellent capabilities of geographic information system in the form of spatial decision support system of which the main engine is GIS (Beer and Baker 2000; Batey and brown 2007). In affordable housing initiatives, GIS can vastly be used in site selection and in policy

formulation, as discussed hereunder.

2. 3. 1 Site Selection

Housing is fixed in a geographic space, and therefore, the importance of the environment is beyond any reasonable doubt. The location of a house (geographic location) is a major determinant of such activities as shopping, recreation, and access to employment, proximity to environmental amenities, and the level and quality of public services. The household residential satisfaction and the patterns of household mobility are majorly determined by the geographic location. The location choice results in the geographic segmentation of housing stock along such dimensions as quality, price, type, and ownership as well as household characteristics like income, ethnicity, race, and lifestyle (Rohe, McCarthy and Van Zandt 2001). GIS can therefore be used in identifying the low-income sites for affordable housing initiatives.

In many business practices, the importance of geographic location is inherent concerning housing supply, financing and marketing. For the real estate practitioners, location is of utmost importance as it determines the premium which households are willing and able to pay for the comparable properties. The locational factors and the past trends in sales are used to determine the market value of properties. For the mortgage lenders and insurers, the geographic location of the property for such purposes as loan security is a major determinant of the credit risk exposure. For the policy makers, the main interests are the programs to neighborhoods where desirable outcomes can be derived from the housing investments.

For the planners to perform their tasks effectively, it calls for the integration

of the socioeconomic characteristics of sites and the constraints of physical layout, available area, and land suitability. In housing and urban planning, one main advantage of GIS, especially in rapidly growing areas, is that the combination of digital map and database information allows for great flexibility in assessing alternative scenarios, making GIS an important tool in selecting the low-income sites for affordable housing initiatives.

Unfortunately, compiling an urban GIS takes a major resource commitment in time and funding.

Zhang and Li (2009) explored the vast capabilities of GIS in affordable housing initiatives in Thailand- through the model approached using spatial decision support systems to analysed geographic data towards aiding decision making. For any affordable housing project, low-income site is the initial consideration since housing is any structure attached to land, and low income people are those whom the conventional housing market marginalized. In locating the low income site in the area of interest, (Zhang and Li 2009) proposed that the low income sites values be collected to form a database in the area of interest. In addition, other criteria such as accessibility are to be analysed against the low income sites in order to arrive at decisions that meet the objectives of low income housing. In selecting the low income site for housing, Zhang and Li (2009) considered the different site values and size of land in square metres, amongst other criteria, and created the polygons of these data in GIS which is the basis for spatial analysis towards decision making on the best affordable size.

Site selection also employs the use of spatial overlay technique, which is one of the principal functions of GIS. The technique tries to extract useful

information from geographic data distributed across space by joining and viewing together separate dataset that share all or part of the same characteristics on a digital map in a stack of transparent layer. Overlaying each thematic map against one another to determine between the best matches on the map gives an insight on the best alternative sites for the affordable housing (Demers 2005). Spatial overlay tries to study the spatial relationship that exist between geographic data so that it can be understood and predicted.

Another technique used in site selection is the Digital Elevation model (DEM), which is basically a topographic map in digital form obtained from various sources such as from remote sensing, ground surveys, and photogrammetry among others. DEM shows the surface parameters of the landform in terms of height, slope, curvature, gradient, aspect and contours (Podobniker 2009). It is possible to model the DEM in order to reflect the varying land values of a given location or neighbourhood using a variety of analytical means such as visualization and statistical analysis to enhance decision. Visualization is a powerful tool and has been the traditional role of GIS; its weakness lies in the fact that it is qualitative in nature and can neglect some hidden fact unlike the statistical method, which is more objective and quantitative. Be that as it may, it can be adopted to enhance decision making process in housing initiatives.

Land values in the area of interest can be obtained through varieties of spatial analysis techniques. Policy makers would be happy to commit resources to the best sites for affordable housing that meets the requirements in terms of the topographical parameters and land value, and

housing DEMs can be useful in this area of analysis to aid decision making. In this regard, 2-Dimensional visualization or 3-Dimensional visualization can be of great help. Low income land/housing DEM maps show the relationships between spatial locations and land/housing values enabled by the powerful capability of visualization, and guides the policy makers on where to identify the relevant locations against the topographic parameters and how to calculate what to pay (Li et al 2009). This approach has been adopted successfully by the housing authority in china in providing affordable housing for the low income population in the urban areas.

Remotely sensed data are been increasingly used for low income site selection process through the analysis of land cover. Satellite image data are been adopted because of their relative cost and timesaving and the broad range of land cover information from which other land use information can be extracted for decision making purposes. Remote sensing enables data to be captured and gathered without being in direct contact with the object (Lilesand, kiefer and Chapman 2008).

Factors Influencing Site Selection

In selecting the appropriate sites for affordable housing, the factors that are considered include the location, the physical environment, and the accessibility characteristics. These factors may result in positive or negative externalities on residents. Of these factors, accessibility plays the major role. Physical environment deals with the physical characteristics of the house and the proximity to the environmental hazards. The neighborhoods differ in types, levels, and qualities of public service offered, and are stratified on the grounds of social, economic, and demographic features.

1. Location

Neighborhood plays a very important role in social and economic outcomes for individuals, the associated housing market, and the institutional behavior. According to Goodman (1989, 53), this is a major research area in analysis of housing initiatives. Housing has two unique qualities that link housing purchase and residential satisfaction to the geographical location of the housing. The two qualities are special fixity and durability. In addition to these physical characteristics of housing, neighborhood characteristics enter into housing bundle due to geographic location of the house.

The role of geographic location can be looked at in two ways in terms of the individual and market level behavior and outcomes. One form involves the localized externalities associated with the location or site of the house. These externalities form the adjacency effects as they capture the spatial spillover effects. As an example, a dump site is a source of negative externality to the adjacent properties. The situation or the overall neighborhood characteristics like accessibility and socioeconomic context, among others, greatly affect the decision making and the resulting market outcomes.

A neighborhood can be defined as a discrete special entity or a physical area that contains the households and the housing structures that have similar characteristics. Typically, households within neighborhoods exhibit similar characteristics (social, economic, demographic, among other characteristics). The similarities in the housing structures are observed in the tenure type i. e. owner-occupied or rent-occupied; the ownership i. e. private or public; the type of structure i. e. single-family or multifamily; and the design i. e. town house, rambler, or colonial; together with the general

quality of the stock. The extent of the similarity, i. e. the spatial continuity among the households and the housing units, varies across the neighborhoods resulting in the homogenous difference among the neighborhoods.

2. The Accessibility Characteristics

The geographic position of a neighborhood or a house determines access to opportunities like employment and transportation. Zhu, Lui and Yeow (2005) stated that accessibility play a significant role in housing planning as it determines the opportunity that the occupant is exposed to in a given location, such as access to communal facility and services like hospital, post office, school, etc. The microeconomic theories of the land use, the residential location, and the resulting house prices or rent are based on the differential access to workplaces (Alonso 1964; Muth 1969). This explains the major spatial regularities that are observed in the allocation of the urban residential land e. g. near the city centre, there is the high-rise, high-density development, while in the peripherals, and there is the low-rise, low-density development. According to Straszheim (1975), differential access to workplaces, as the foundation of the economic theories of land use, is insufficient in investigating the spatial detail in housing characteristics at different locations. Straszheim postulates that the limitation given above is the major motivating factor for econometric investigations of the housing markets.

The limitations in the accessibility to the employment opportunities in the suburban from the inner-city neighborhoods have serious economic impacts to the low-income earners and the disadvantaged households. However,

neighborhoods with easier access to the public transportation are very much advantaged. Other than easy access to jobs, the location of neighborhood determines the general access to amenities. Easy access to facilities like parks, shopping malls, medical centers, public libraries, and recreational facilities has positive impact on the residents.

In relation to housing initiatives for low-income households, accessibility is viewed from the perspective of travel cost over time, which the low-income households would be able to maximize if they lived closer to public transport routes, and travel in a less amount of time. In considering affordable housing initiatives, accessibility is one of the major factors as it directly influences house affordability in terms of rent.

3. The Physical Environment

Depending on the historical patterns of development, there is a substantial variation in the physical characteristics of the residential stock across the urban landscape. Neighborhoods are differentiated according to type, density, the architectural style, and the landscape's physical characteristics. The construction technology, the prevailing economies of scale, the ease and cost of land assembly, and the customer preference determine the degree of spatial clustering in the production of housing through housing type. Majority of the new housing are constructed on urban periphery and there is a substantial decrease in the dwelling age in concentric style moving outwards from the centre of the city. With the depreciation of the quality of the housing stock due to aging process, there emerges the importance of rebuilding and revitalization in altering spatial distribution of physical stock. The topography and physical characteristics of certain neighborhoods is a

source of negative externalities and low demand for housing. The proximity to sites like airports, toxic waste sites, highways, and subsidized housing projects are all determined by the house location. The landscape's physical patterns and the accessibility of houses, the housing production, and the redevelopment are the key sources of social and economic variations in neighborhoods within the urban areas.

Regardless of the impeccable importance of geographic location for policy, business, and regulatory policies, its integration into housing initiative research has been limited. There are few studies which have applied the special analytical tools in examining the location effects on housing prices (Pace and Gilley 1997; Can and Megbolugbe 1997; Can 1990, 1992b; Dubin, 1992), in mortgage market outcomes (Anselin and Can 1995) and in population density models (Griffith and Can, 1995). Lack of the appropriate software tools, inadequate availability of comprehensive and accurate information on housing and locations, and lack of research environments for the computation and facilitation of geoprocessing needs of data have greatly formed the major hindrances to the housing initiatives.

With the GIS technology, there is significant contribution towards overcoming the operational impediments that forms the major hindrances stated above. GIS capabilities extend far much beyond facilitating the organization and management of geographic data to enabling the researchers in taking full advantage of the locational information contained in the databases. The GIS research infrastructure in conjunction with the recent advances in special research offers vast opportunities for investigating the mortgage market research and the housing initiative.

Depending on the research application purposes, the commercial analytical functionality of GIS should be complemented by the external analytical tools (Anselin and Getis 1992; Anselin, Dodson, and Hudak 1993). External Software tools like SPSS have therefore been developed and are either interfaced with or embedded in the existing GIS software environments (Can 1992a, 1996).

2. 3. 2 Housing Policy Formulation

The Struggle for a decent home and the desire for the shelter, comfort, privacy and independence that a house provides, are familiar the worldwide. Nonetheless, not everyone can obtain the housing at the market prices. The local governments thus supply the affordable houses to those with the inability to obtain access to housing at market prices (Brian 2006). Many countries provided affordable housing in different ways to middle or low classes, e. g. council housing in U. K., section 8 housing in U. S., and public housing in Singapore.

The UK housing policy has two dominant themes: the choice and the affordability. Households should be able to make choices about where they live, and this should apply regardless of tenure: social tenants should be able to choose just as much as owner-occupiers should. In the same way individuals chose from a wide range of products in the supermarkets, housing should not be an exception (DETR 2000). Everyone should also have access to a decent home at a price they can afford (CLG 2007).

Access to affordable housing is a concern for policy makers in many developed countries (Barton et al. 2005). Most of the housing policies are formulated based on the accessibility analysis, especially the housing

planning and the facilities and service planning. Soles (2003) used the accessibility as a measure to evaluate the housing needs in North Saskatchewan, Canada. In this evaluation, emphasis was put on accessibility to transportation and community facilities, and appropriate policies developed. Lee et al (2002) in the case study in Portland, Oregon, explored the concept of policy formulation based on accessibility in the context of access to healthcare services. Guy (1983), on the other hand, considered the policy formulation in terms of accessibility to shopping opportunities from the supply-side and demand-side perspectives. Another important study is Halden et al (2002) where accessibility was used as a criterion to measure the level of service provision in the rural areas of Scotland. In this study, they examined the travel-time and analysed the patterns of accessibility to urban centres, shopping opportunities and to regional health care facilities. This study resulted in a policy review in Scottish Executive to prioritize service provision. The services included employment, public and community transport, health and social care, information and advice services, education and training, shops, banks, post offices, libraries, community halls, sports and leisure facilities, childcare centres, chemists, and local government offices.

According to Johnson (2006), housing initiative and sustainable development is divided into three: the descriptive research, the prescriptive research, and the decision support system. The descriptive research is where the results are used to support the specific strategies or policy initiatives; the prescriptive research is where the results, based on the most preferred set of alternatives, are assumed to be determinative; and the decision support

system generates policy recommendations based on information technology applications that uses both descriptive and prescriptive research. The use of GIS falls under decision support system, which I undertake to explore.

Geographic Information Systems technologies and Spatial Decision Support Systems have made essential contributions to site selection and local and regional planning. Population flows can be used in formulating multiple partial differential equations and the transient solutions of the equations used in evaluating different public housing policies and model validation against the real-world geographical data (Nikolopoulos and Tzanetis 2003). According to Caulkins et al. (2005a, b), a single-state model of housing mobility can be formulated in a stylized metropolitan area. In such a model, the level of the middle-class families forms the state while the level of the poor families introduced from the high-poverty neighborhoods as part of a policy initiative forms the control variable. The solutions to the optimal control model where there is maximization of the discounted net present value subject to the differential equation describing the system dynamics allows the identification of both stable and unstable long-term equilibrium associated with housing policies.

In some of the prescriptive housing models, the motivation directly comes from the specific policy initiatives in the specific geographic regions; however, the specific spatial characteristics of the study area are of less importance, or even unimportant in some cases. According to Frech and Thyagarajan (1975), formula-based allocations and gravity models can be used to derive the proposed allocations of the affordable housing to sections of metropolitan statistical area. Households can also be located to zones so

that the housing costs and the commuting costs can be minimized (Kim 1979). This helps in generating potential allocations of housing (low-income housing) that satisfies the requirements of the fair housing policy.

Alternative potential allocations of households can also be done through the use of rental vouchers to Census tracts across a city or a country to optimize jointly the measures of net social benefit and equity (Johnson and Hurter, 2000; Johnson, 2003). A multi-objective model can be used for the location of project-based subsidized rental housing so that the social efficiency and equity measures are optimized (Johnson 2006c). Johnson (2006b) proposes a general model for affordable housing that can be developed by either a non-governmental organization or a public housing authority. Spatial concerns can also be ignored (Tiwari, Parikh and Sharma 1996) in construction process for affordable housing. The level of production activities should be chosen in order to minimize the total costs subject to the constraints on both input and output levels, construction technology requirements, and the environmental impacts.

Another team of researchers has developed regional planning strategies using representation of programs and planning units. Programs for urban renewal that assign the specific building types, the levels, and the prices to all the land parcels in the study area, have been developed by Atkins and Krokosky (1971) using a simulation model, and then choosing the solution that optimizes user-defined measures of net social benefit. According to Gabriel, Faria and Moglen (2006), a planning problem for smart growth can be solved using actual, non-uniform land packages and multiple objectives that reflect the opinions and or perspectives of the government planner, the

environmentalist, the land developer, and the conservationist. Production scheduling programs can also be formulated so that the design policies that minimize the total development time are arrived at (Kaplan, 1986; Kaplan and Amir, 1987; and Kaplan and Berman, 1988).

It is important to note that the operational models for real estate are relatively rare. Kaplan (1987) has used the queuing theory to evaluate the effects of both race-based and non-race based policies in tenant assignment of public housing on the levels of racial segregation and the waiting times for the available units.

Chapter 3

3. 0 Sheffield City

3. 1 Introduction

This chapter takes a digestive look of the Sheffield City. Essentially, the context of the city is looked into with respect to its location, coverage area, level of population and types of economic activities carried out. In addition, parameters like type of education the city provides and population pattern have been explored to help understand the city better. In regard to the housing in Sheffield, the main reference material is the DCA's " Strategic Housing Market Assessment Report of 2007". This report brings into focus the local housing market, and explores and evaluates the housing situation in Sheffield. Another document of importance, which Sheffield's housing literature has also been sourced from, is the " State of Sheffield 2010."

Because housing and population are inseparable, it is of great importance to consider the Sheffield's population and the " Developments in the Sheffield

Population report” has greatly helped. A good number of resurgent literatures have also been explored to help understand the context of the city.

3. 2 Location and coverage

Sheffield (Figure 1) is a city of England, UK. It is located within the South Yorkshire sub region. Its set up is urban in nature, but with scanty rural settlements to the North and West of the city. Even though its local authority stretches out within the Peak District National Park, the mass of the population resides within the more urban areas. It is located North and North of the equator respectively, famously known as South Yorkshire and the climatic condition is mostly temperate. The city covers a total of 36, 800 hectares. It is surrounded by Rotherham to the East and Barnsley to the North. Derbyshire Dales, High Peak, and North East Derbyshire also surrounds Sheffield.

Figure 1: Sheffield City: Location and Wards

3. 3 Population

Sheffield is England’s fourth largest local authority in terms of population (Winkler 2007). According to Dr. Roland Lovatt (2007) in the report “ Developments in the Sheffield Population,” Sheffield’s population started increasing in 2002 and in 2005, the population was 520, 700. By the year 2029, the population is projected to rise to 561, 300. Based upon the ONS (2004) population change estimates between 2004 and 2029, the Sheffield’s population is ageing. The population between the age 0 and 14 was projected to shrink until 2011, which has been the case; it is projected to rise

from 2014. In the next 20 years, the population size between the ages 65 and 79 is projected to increase by 20 percent while that of 80 years and over is projected to increase by 40 percent. It is also worth noting that the size of the Sheffield's student population is in the rise. In 2005, the city had 40, 000 students compared to 32000 students in 1996. Generally, ONS projections propose that in the next 20 to 30 years, Sheffield's population size shall have an overall increase. The projected increase in population necessitates an increase in housing needs.

The city's in-migrants majorly come from Yorkshire. The Sheffield's in-flow of households from Rotherham contributes to 6. 3%, and the in-flow of households from Barnsley contributes to 4. 3%. Considering the surrounding influence, the 2003 Rotherham Housing Needs Survey discloses that 28% of the households moved to Rotherham from Sheffield and some to Doncaster and Barnsley. In addition, the survey reflects that 9% of the existing households were planning to move from Rotherham to Sheffield. 15% of the concealed households also had a similar movement plan.

3. 4 Major Economic Activity

Manufacturing is the major economic activity of Sheffield city. The city gained recognition in the 19th century for its manufacturing and production of steel. The city has since embraced the innovations in the steel industry. Besides iron and steel industries, coal mining is also taking center stage, especially in the outlying areas. The intensity of economic activity at Sheffield of 74. 5% is to some extent lower than the Yorkshire and Humber region at 78. 1% and the national average of 78. 4%. The Annual Population Survey indicates that the level of employment in Sheffield is at 92. 6%. This

has however increased over the past 10 years as indicated by other literature.

3. 5 Sheffield's Housing

After experiencing a long period of decline in population figures (1974 - 2002), Sheffield's population has been on the rise since 2002. While the decline was attributed to out-migration occasioned by Sheffield's, then, dwindling economic fortunes, the rise is attributed to in-migration due to Sheffield's promising economic prospects. With a rising population that is expected to rival the 1974 figure of 570 000 by 2029, there is need to have proper housing policies in Sheffield. This is important more so because the population is rising with a corresponding disproportionate increase in number of households. This lack of proportion is clear from the fact that though the population was in decline in the period between 1981 and 2002, the number of households has been on the increase since 1981. This implies that the number of people per household has been equally reducing since 1981. It is thus a cinch that any increase in Sheffield's population - as is being witnessed now - will put immense pressure on Sheffield's housing sector. As at March 2007, the total number of Sheffield's household was 231, 562 as compared to the 2001's 217, 622. This constitutes an increase of 6. 4% of the households (an increase of 14, 140 households) thus the increasing need to put up more housing.

From various research surveys, the household types in Sheffield keep on changing and this has implications for housing demands. From 1991 to 2001, there has been a remarkable decrease in the number of couples without children. Within the same ten-year period, there was a significant increase in

the level of lone parent households and single person households. The lone parent households increased by 9.4% and single person households increased by 1.5%.

Sheffield intends to ease the pressure by having at least 1425 net additional dwellings put up every year for the period between 2008 and 2029. So far, this target is being met - even surpassed - with 2000 net additional dwellings put up yearly. Yet, though Sheffield has exceeded its own target, it still records an annual housing shortfall of 729 dwellings per year. This can be explained in several ways. One is the issue of affordability. Most of the houses are beyond the reach of ordinary Sheffield residents. In a Council where vast majority of houses are in private hands, there is need to check on housing costs if Sheffield is to be secure in housing matters. And the issue of affordability is so serious that more and more are applying for social housing. Official figures reveal that more than 90 000 households have already registered for social housing. This just confirms the already repeated phrase that new, efficient, cheaper technologies are required for fruitful housing initiatives in the city.

Housing prices have, of course, decreased ever since 2008 when the credit crunch took its toll. But since the credit crunch affected individuals as well as corporations, the reduced housing prices did little as far as affordability of housing is concerned since individual's pockets were already dented. In short, the crunch affected all sectors of the economy thus restricting individuals' access to finance facilities such as mortgages and loans. One of the objectives of this study is to determine if GIS technology can help come up with cheaper ways of providing housing at the right locations for the right

people. In a council as diverse as Sheffield, such a consideration is important. The disparate economic, social, ethnic and age groups that comprise Sheffield have different housing needs. This study aims to find if these varying needs can be met satisfactorily using GIS.

The quality or hazard level is also a major factor in Sheffield. Reports indicate that houses in private hands are (or are perceived to be) of lower quality than government owned houses. This despite the fact that an impressive 86% of Sheffield residents recorded satisfaction with the quality of their houses. Whether these houses meet the Decent Homes Standard of being weatherproof, warm and having reasonable facilities is another issue altogether. What is certain is that 92% of government housing meets this standard. This is impressive put against the fact that only 63% of private housing meet this standard and that only 55% of privately rented housing meet the standard already described above.

3. 5. 1 Sheffield's Forecast Change in Households (2004-2026)

The Sub-Regional Household Projections for England forecasts that there shall be a remarkable change in Sheffield's household. The area population and the future changes in household size are seen as the major factors that shall dictate Sheffield's future developments in housing. The longer life expectancy, the higher labor mobility, the reduction in the inter-generational households, and the increased social aspirations are seen as the major contributors to the decline in the average household size. Table 1 shows the forecast by the CLG.

3. 5. 2 The Economic Drivers of Sheffield's Housing

According to Goodman (1989), housing demand depends majorly on the

economic developments of the area in the same way as it depends on the population changes. Sheffield city is not an exception. It is approximated that the number of jobs within Sheffield is 255, 700. Since 1995, Sheffield's number of jobs has increased by 20. 1%. Considering the regional and national averages, Sheffield has a higher unemployment rate of 7. 4%. This necessitates the provision of affordable housing. With the increase in employment levels in Sheffield, there is a high likelihood that the mobile households relocate to the region, putting pressure on the housing stock. Reports also indicate that 27. 2% of heads of households are retired and this figure is projected to increase further. The housing needs of the older people therefore calls for a strategic approach.

3. 5. 3 Sheffield's Housing Strategy: focused on neighborhoods

The city council of Sheffield has applied neighborhood-based approach in local housing renewal. As the council's housing stock decays, the national government has substantially funded the council through Decent Homes and Housing Market Renewal Programmes (Sheffield Homes, 2007; Winkler 2007). Through the Housing Market Renewal (HMR) Programme of 2002, Sheffield got substantial funding for the improvement of her most deprived neighborhood's housing. This was part of the central government's policy to lobby work of core cities group to improve the housing markets in the northern cities of England which have experienced low levels of market demand.

The programme attempts to either upgrade or clear low demand property. One of Sheffield's major problems has been an oversupply of social housing coupled with a mismatch between local people's housing aspirations and the

type of housing available. Over one third of Sheffield's housing (63, 000 homes) is classed as in need of ' market renewal' and is therefore included in the programme area. Over a 15-year period, this housing will receive part of the £2. 5 billion of investment designated for the South Yorkshire sub-region (Sheffield City Council 2004, p 19). By 2006, the HMR programme had already invested £100m in Sheffield (EKOS, 2006, p 7).

The Council has developed three Area Development Frameworks (for North, East and South Sheffield), and Masterplans for the nine housing areas included in Sheffield's HMR programme, as a way of ensuring continuity in spite of the short-term nature of government funding. All these plans were opened to community consultation before being implemented. The Masterplans include action on a wide range of factors affecting neighbourhoods such as housing, education, transport, and local green spaces.

3. 6 The characteristics and structure of the housing supply in Sheffield
Highlighted hereunder are facts on the housing supply in Sheffield as given in the Strategic Housing Market Assessment Report of 2007.

In 2001, the number of the housing stock was 217, 622 units, and by 2007, the number increased to 231, 562. The owner occupation level in Sheffield's housing is at 59. 6% lower than the country's regional and international standards. According to the 2001 census, 30 percent of the city's stock is social rented housing as compared to 19. 3 percent nationally and 21. 1percent across the Yorkshire and Humber. However, the figure decreases and by 2006, it stood at 23. 1% for Sheffield. 8, 301 residents in Sheffield in the year 2001 lived in 292 communal establishments; however, the figure

decreases. It has been noted that in the Council rented sector and in the HA rented sector, there is over occupation as compared to the owner occupied sector. 6. 3 percent and 4. 5 percent of the households are over occupied in HA rented homes and Council rented homes respectively. Most of the residents consider their houses as adequate for their needs. This is shown by 86. 7%. Only 13. 3% consider their houses as inadequate.

Technology is dramatically changing the way public affairs are managed and Sheffield should not be left behind in this regard. For though Sheffield records a relatively low, and reducing number of the homeless people (only ten in 2009), what the future portends for Sheffield's economy is difficult to determine - especially with the unpredictability of the world economy in our time. This coupled with the fact that the recent global financial crunch affected Sheffield in more ways than one means that the affordability of houses in Sheffield is at a low. Indeed, most residents of Sheffield " are now struggling with their mortgage repayments and are in danger of repossession" according to the report State of Sheffield 2010. Good planning will thus be required for the benefit of posterity.

Chapter Four

4. 0 METHODOLOGY

4. 1 Introduction

The primary aim of this chapter is to provide comprehensive information on the methods of data collection, research design, the data sources and methods of analyzing the data. The statistical techniques used herein are also highlighted. The data obtained are presented on maps using GIS

software and analysed through statistical methods in the preceding chapter.

4. 2 Research Design

This research was carried out as a case study. The study area was Sheffield City. For the statistical analysis, the entire UK was taken as the study area and questionnaires administered to all the local councils in UK. The case study approach enabled an in-depth and contextual analysis that was deemed fit for the investigation of the study problems.

4. 3 Target Population

The target population refers to the group of people or study subjects who are similar in one or more ways and which forms the subject of the study in a particular study. The study targeted a total population of 433 local councils in the UK. This population was aimed at identifying whether there is required expertise in the councils to adopt the use of the GIS as a technology in housing initiatives and how this is affected by the level of education.

4. 4 Data Collection Instrument

This study employed the use of both primary and secondary data. The main primary data collection tool was the questionnaires. The questionnaires contained both open ended and closed ended questions. Questionnaires were used to gain the general picture of an investigation of whether there is the required expertise to implement the adoption of the vast potentials of GIS as a technology in affordable housing initiatives in Sheffield, and how education level affects it. The questionnaire contained questions derived from the objectives of the study. The secondary data was obtained from CASWEB, UKBORDERS, and the ordnance survey website of EDINA.

4. 5 Methods of Analysis

The study employed two types of analysis in order to realize the objective of the study.

The questionnaires were administered to the 433 local councils in the UK through emails. The councils were informed earlier through phone calls before sending the questionnaires. This was to help the council authorities identify the most relevant individuals in the position to complete the questionnaires with the most relevant information. Some of the information, as the researcher was later made to know, were highly sensitive and could not be revealed, even for the purpose of learning.

GIS analysis was undertaken alongside statistical analysis. The software package ArcGIS 10 was used to run the GIS analysis by mapping the different categories of data that represented different attributes, among which were shared and unshared ownership houses, the Council rented houses and other Social rented houses. The data categories also represented the housing type such as bungalows, detached houses, semi-detached houses, terrace houses, flat apartments, and tenement houses. The data was worked out as percentages in spreadsheet file for all the wards in the Sheffield city. These figures were then translated into maps in ArchGIS 10 simply by linking the spreadsheet files to the base map. This was done to help identify the distribution of these houses across the wards of Sheffield, thus their availability and accessibility.

A perfect approximation of the actual housing situation in Sheffield was sourced from the Census data, which mainly included the population and distribution of social houses across Sheffield. These houses are provided by the council, Housing Association (HA) and other private developers. The

census data was of utmost importance as it gave useful information about population distribution in Sheffield. Another important data that has been used in this study is the boundary data. The data was downloaded from UKBORDERS and the ward map extracted from Edina. A road network data was sourced from the ordnance survey website of EDINA.

Statistical analysis was carried out using SPSS 12.

4. 6 The procedure

As stated above, the study employed two types of analysis: the GIS analysis, and the Statistical analysis. The GIS analysis procedure started by defining the geographical space of interest. To achieve this, the files that included the geographical boundaries and spatial features of interest in the format required by the software were sourced. These files are called “ shapefiles” in ArcView and ArcGIS platforms; however, they are called differently for different platforms e. g. “ data layers” in MapInfo and “ coverages” in ArcInfo. Shapefiles contain different attributes, i. e. they may include point features, such as households, schools, or factories; linear features, such as streets, railway tracks or streams; and polygonal features, like county and state boundaries or census blocks, zip codes, and parcels.

The focus of this study was Sheffield and the shapefiles defining the boundary was used in generating the map of Sheffield. The population map was then generated by plotting the population of each ward on the map.

Linear features of the shapefiles were used to display the roads within Sheffield. The Sheffield’s map together with the road network was used as the base map for the subsequent mapping. The points denoting all shared and unshared ownership houses/dwellings, the Council Rented Houses, and

Other Social Rented Houses were plotted on the base map for the analysis. Also plotted for the analysis was the housing type such as Bungalows, Detached Property/Houses, Semi-Detached Property/Houses, Terrace Houses, Flat Apartments, and Tenement Housing. This gave rise to the maps discussed and analysed in the subsequent chapter.

The statistical analysis was based on the questionnaires. Questionnaires were administered to the 433 local councils in UK and feedback received from 331 councils. Based on the nature of the data, the variables considered and their effects in housing initiatives included level of education, hierarchy within the organization, GIS softwares used by the organizations, level of experience for the GIS softwares, use of remotely sensed imagery in spatial data analysis for housing initiatives, among other variables. With these variables, a crosstab analysis on the level of dependence and correlation of the variables was performed using SPSS 12. This analysis is provided in the following chapter.

The questionnaire and the feedback from the questionnaires are provided in the appendix section of the report. This primary data was very crucial in analyzing the possibilities of implementing GIS technology in Sheffield housing initiatives based on the needed expertise, and how it is affected by education level.

Chapter Five

5. 0 ANALYSIS

5. 1 Introduction

This chapter presents an in depth and broad analysis of the data. Essentially,

the analysis herein takes into account the aim and objective of the research—to establish whether the vast potentials of GIS as a technology can be made use of in housing initiatives. The focal point of the analysis is housing accessibility and affordability. Besides, analysis looks at all social rented, all shared ownership, all council rented, all other social rented, all unshared dwelling among other housing attributes in Sheffield city. Data set analysis categorically employs the GIS spatial procedures like the location base analysis, which has been used to identify the location of houses and their different categories. Different maps have been presented to show the population distribution, all social rent, all shared ownership, all council rented, all other social rented, all unshared dwelling among other housing attributes.

5. 2 GIS in Housing and the Effects of Educational Levels

As mentioned earlier, this paper examines the use of GIS in Sheffield's housing initiatives, and how the education level affects it. The succeeding sections investigate these objectives. First, the potentials of GIS in housing are highlighted based on mapping. This employs the use of GIS software to analyze the accessibility and affordability of Sheffield's houses. Finally, the last section examines the available know-how on GIS softwares and how this is affected by the individual's level of education.

5. 3 Implementation of GIS in Housing

From the data, various maps were generated, which in turn were used for better understanding of the housing initiatives in Sheffield wards. Each map provides a description of the various attributes that housing is dependent on; the effect of which determines the result of the housing initiatives. The

attributes presented in these maps describes the population and the different types of house ownership. Social housing in Sheffield is provided by the council, Housing Association (HA) and other private developers.

5. 3. 1 The Population

The population information herein, according to the Census, is the population of usual residents. A usual resident is one who spends most of his/her time at a specific address. The population includes those who usually at a particular address and were temporarily away on the census day, those who work away from home on part time basis, and students during the term-time. The information does not include any other person who was present on the counting day, whose address is usual. GIS has been used to give a clear visualization of the population in the map discussed hereunder.

Figure 2: Population of Sheffield City

The map above presents the population distribution in the various wards of the Sheffield city. From the map it is evident that population of Sheffield is high to the north. The map also shows that a smaller part of the city to the south has high population. It can as well be observed that the city is somehow highly populated to the centre of output areas. This has been represented by the the dark brown coloured areas in the map. The city has however low population mostly to the south as shown by the the yellow and light brown colourations in the map. From the map, it is clear that the population of Sheffield city is unevenly distributed. This should thus be one of the major attributes that need consideration when establishing housing initiatives. This is because the different housing initiatives should be such

that each initiative is evenly employed as per the population densities in various wards and locations. Determination of population size will thus help solve unrealistic housing initiatives from ward to ward. From the population distribution of every ward, it can be easily established whether housing ownership should be shared or unshared; whether ownership should be detached share ownership; or whether share ownership in an unshared dwelling should be adopted.

5. 3. 2 Dwellings

The accommodation of a household or the household space can be defined to be a shared dwelling if the accommodation type “ part of a converted or shared house,” and not all the rooms, including toilet and bathroom, if any, are all behind a door which only that household can use. There should also be at least one other such household space within the same address, which can be combined to the former household space to form an unshared dwelling. If these conditions are not met, then the household space forms an unshared dwelling. A dwelling can thus consist of two or more household spaces (referred to as shared dwelling) or one and only one household space (referred to as unshared dwelling).

Household Space is defined as the accommodation occupied by only one household (an individual household) or, if unoccupied, then it must be available for only an individual household.

a) All shared ownership houses/dwellings

Figure 3: All shared ownership houses/dwellings

The above map shows the distribution of all shared dwellings in Sheffield. From the map, it can clearly be observed that the concentration of the shared houses is highest at the centre of the output. The concentration however decrease