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Methods for the Spatial Analysis of Community Wellbeing, Resilience and Vulnerability

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Abstract

This paper proposes an approach for targeting priority areas for community engagement using data held by local authorities relating to local taxation, housing, education, public health outcomes and derived measures of vulnerability. It seeks to identify the relevant variables that are held by the local authority, to model community or neighbourhood trajectories by examining changes in such data over time as the first steps in a hierarchical approach for analysing community resilience and well-being. The outputs of these steps allow community engagement activities to be targeted. Initial results are described and key discussion points are outlined..

Keywords: Spatial Analysis, GIS, Mixed Methods, Community Engagement

1 Introduction

The concepts of community Resilience and Wellbeing are important for developing / promoting sustainable communities. Research on 'wellbeing' has historically focused on the importance of personal factors (e.g. family relationships, financial situation, health, friends, work, freedom and values). It has sought to explore the links between biological, psychological and socio-cultural factors that enable some individuals to successfully manage changes to their environment but not others. Other, less well developed research has shown that community level factors are also important [1] and that analysis of community-level well-being and resilience may be more important [2], and that neighbourhood spatial factors are critical [3].

The concept of community resilience is grounded in the links between competence, adversity and wider interactions and defines resilience primarily in terms of how people relate to and interact with family and the wider social environment, alongside their individual characteristics [4].

Resilience and wellbeing are linked and positive feelings of wellbeing associated with resilience have been found to result in greater feelings of wellbeing [5]. At a community level concepts of community / neighbourhood wellbeing and resilience includes social capital and structural features, where social capital describes relationships and levels of support [6] and structural features include transport links, proximity and equity of services (primary schools, GP surgeries and local hospitals) and community facilities.

The aim of this paper is to present a method for the exploration of the extent to which initial measures of community well-being and resilience can be generated through the spatial analysis of data held at a local government level. Data is assembled for Leicester, a city in the English midlands. In social sciences, traditional methods for measuring reliance and wellbeing (at either the community or the individual level) focus on surveying representative

samples of the population, using questionnaires. In this research, a hierarchical methodology is described, where indicators of the spatial distribution of different levels of community well-being are identified as a first stage in the analysis, subsequent time series data are used to model community trajectories and to target the location of community engagement activities to finesse the assessments of community wellbeing and resilience.

2 Background

There is much interest in developing approaches for identifying communities that may be vulnerable to decreased levels in local government services. Of particular interest is desire to identify and quantify population 'assets' (community resilience, social capital) and the impacts of recent changes in the cost of living. Additionally there is a need to develop temporally dynamic measures of community wellbeing and resilience in order to quantify trajectories of communities associated with different types of vulnerability. In the longer term, the local authority would like to develop sustainable mechanisms for increasing community engagement in order to improve the funding, planning and delivery of local services.

Tobin (1999) presents a conceptual framework for analysing community sustainability and resilience based on three theoretical models (mitigation, recovery model and structural-cognitive aspects) [7]. This area of research has been extensively explored within the context of resilience to natural disasters and environmental hazards (for example, [8-9]. However, the concepts of community well –being and resilience have evolved recently to include approaches for measuring the level socio-economic disenfranchisement such as the Wellbeing and Resilience Measure (WARM) framework for measuring wellbeing and resilience at a local level [10]. Such approaches involve extensive questionnaire surveys and interviews in order to determine levels of

resilience and wellbeing and are thematically comprehensive but require extensive resources to measure for all areas.

3 Methods

3.1 **Data and Pre-processing**

In the UK, local governments (also known as local authorities) hold, collect and update data on a number of relevant factors. These include:

- the property based Council Tax which includes information on the number of claimants and exemptions to the tax such as students or those in receipt of social security benefits;
- applications for social housing with the stated reason for the application (e.g. overcrowding, health reasons, etc);
- post-16 destinations for all 16-19 year olds which include further education, training, employment unemployment.

This study uses this data for Leicester, held by Leicester City Council (LCC) at the post-code level. In the UK there are ~1.8 million post-code areas, which typically cover up to 80 houses. In addition to the above, LCC have generated 5 level vulnerability index associated with each property. These describe vulnerability associated with Age, the Property, Income, Disability and the Household composition.

The LCC data were summarised over census Output Areas (OAs) of which there 890 in Leicester. Output areas are the finest level of detail over which the UK census data is reported. They typically contain a mean population of ~300 people.

3.2 **Access Analysis**

The spatial locations of different types of community facilities were used to calculate access based on road distance to the nearest facility for each OA. The facilities included Community Centres, Children Centres, Community Health Centres, Local Government Access points, Police stations Post Offices, Primary Schools Youth Centres, Neighbourhood Offices, Libraries and Leisure Centres.

3.3 Statisitical analysis

The distribution of values for different types of variables across census areas was determined from the interquartile range of values in the study area for each variable. A traffic light system was used to identify potential problem area sin different domains order to identify target areas for community engagement activity.

4 **Results and Discussion**

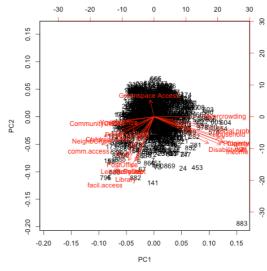
An initial exploratory analysis involved combining different types of variables into groups. The groups were Vulnerability, Access to Facilities (post offices, greenspaces libraries etc), Access to community oriented facilities (youth centres, community centres etc) and Social Problems (overcrowding and number of social security claimants). The distances and scores were rescaled to a range between 0 and 1, summed and

rescaled. By way of example, Figure 1 shows the composite vulnerability score and its components. Figure 2 shows the 4 different dimensions characterising the distribution of these community resilience proxies. Figure 3 shows the relative performance of the neighbourhoods in the study in terms of their vulnerability, resilience and wellbeing. This data will be used to identify community engagement areas.

The aim of this research is to develop a hierarchical methodology that uses GIS to target community engagement activities. One of the considerations that is of critical concern is that the methodology does take a didactic approach incorporating 'professional' or 'external expert' characterising of the city, and the spatial distributions of different types of community wellbeing and resilience and their inverses expressed through vulnerabilities. Rather, the analysis presented here is a first cut. The results will be used by members of the team as way to targeting community engagement activities which will seek to determine how reliable such broad brush characterisations of communities are. The spatial analysis presented here is the beginning of mixed methods approach that will seek to use the results of community engagement to refine the spatial analysis, to generate weights for different layers, perhaps with different weights in for the same layer in different parts of the city.

In the future, PCA will be used to analyse the changing impact of the different variables at different time slices. This will allow the contribution made by different variables to the variation in the data to be quantified, how it changes and its spatial distribution changes. An example is given in Figure 4 of a biplot showing the first 2 components. Approaches such Geographically Weighted PCA [11] will be applied.

Figure 4: A biplot of the principal components



Community engagement aims to understand community needs. It seeks to test citizen perceptions of space and to question the assumptions underpinning the broad brush stories arising from the data analysis. There may be other dimensions to community resilience and well-being that are not reflected in current approaches. The community engagement will involved non-geographic communities. The information gathered during community engagement will be used to feedback into the GIS analysis, the design of data collection and analysis. It will also be used to inform approaches for community engagement based around different forms of new media engagement. The integration of new media for data collection and community engagement (e.g. via SMS message) offers new opportunities (especially with location enabled smart phones).

5 Summary

This short paper described an outline methodology for measuring community well-being and resilience that is novel, evolutionary, ongoing and iterative. It uses the analysis of spatial data to develop an initial stratification of neighbourhoods, but then uses community engagement to finesse and refine the data collection and the analysis. The purpose of this iterative process is to ensure the relevancy of the data that is captured (are the right questions being asked?, are questions being asked that existing data do not answer?), to increase community ownership of the survey (are the technical approaches to gathering and representing data relevant?) and to enhance the community involvement in the policy process

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Figure 1: Vulnerability distributions.

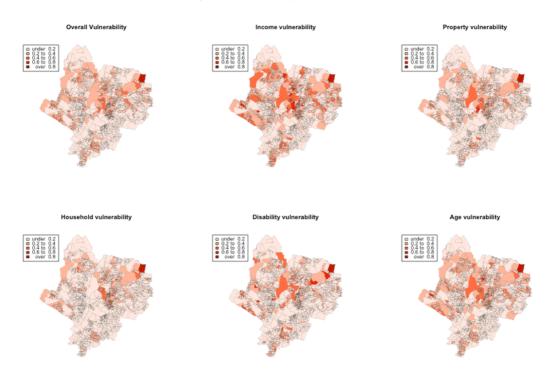


Figure 2: Spatial distribution of Community Resilience proxies

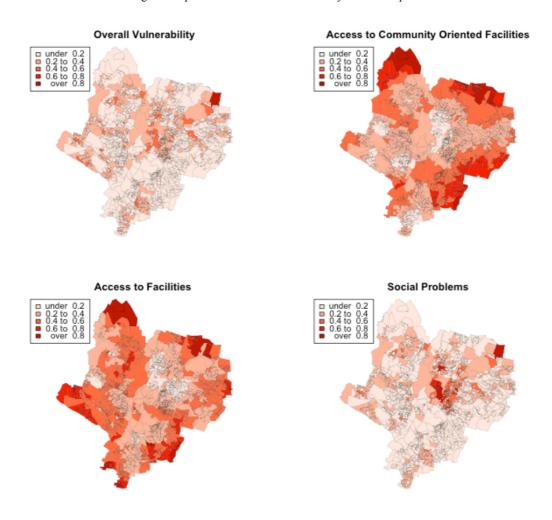


Figure 1: Resilience, Vulnerability and wellbeing scores for Neighbourhoods in Leicester

	Income	Property	Disability	Overcrowding	Claimant	Medical	IMD	KS4_11	Children Centre	Schools	Youth Centre	Leisure Centre	Post Office	Library	PCT	Community Centre	Training Centre	Local Greenspace
South Knighton																		
West Knighton																		
Braunstone West																		
Saffron																		
Rushey Mead																		
Beaumont Leys																		
Northfields																		
Netherhall/Thurnby Lodge																		
Castle Hill																		
St Matthews & St Peters																		
Abbey																		
Evington																		
Mowmacre/Stocking Fm																		
New Parks East																		
Stoneygate																		
Latimer North																		
City Centre/St Andrews																		
Humberstone																		
Spinney Hill																		
Hamilton																		
Latimer South																		
Aylestone																		
Clarendon Park																		
New Parks West																		
Newfoundpool																		
Eyres Monsell																		
St Saviours																		
Aylestone Park																		
Charnwood																		
Braunstone East																		
Rushey Fields																		
Crown Hills																		
Belgrave																		
Rowley Fields																		
West End																		
Western Park																		