

# Urban form and social sustainability: the role of density and housing type

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**Abstract.** In the United Kingdom planning favours a more compact, high-density, and mixed-use urban form. Many of the claims made for such compact forms in terms of the sustainability benefits are contested, and few have been rigorously researched. Drawing upon policy and academic literature we identify two key dimensions of social sustainability: social equity and sustainability of community. Using data from the Survey of English Housing this paper analyses the relationship between key aspects of urban form, density, and housing type, and selected social sustainability outcomes. Simpler analyses suggest strong relationships between urban form and a range of outcomes, although in opposite directions for the equity and community dimensions. However, the impact of urban form on these outcomes is substantially modified once we control for exogenous and intervening demographic and socioeconomic factors. In addition, outcome patterns relating to access to services and facilities favour denser urban forms at the same time as outcomes relating to sustainability of community remain adverse in denser areas. This suggests trade-offs within the social dimensions of sustainability, as well as between the social, environmental, and economic dimensions.

## 1 Introduction

Land-use planning is the principal policy intervention which seeks to influence the physical form of towns and cities, but to what end is this intervention directed? Over the last decade and a half, 'sustainability' has come to be the overarching goal of urban planning. Sustainability emerged from an essentially environmental discourse, which pointed to the many ways in which current development might degrade the environment and compromise the heritage bequeathed to future generations (World Commission on Environmental Development, 1987). Consideration of the most obvious examples of the relationship between these environmental impacts and urban form, notably around energy use and the need to travel, has led to a strong association in planning thinking between sustainability and more compact forms of urban development (CEC, 1990; Jenks et al, 1996). However, consideration of the concept of sustainability and its role in policy has led many to seek to broaden the concept to embrace economic and social dimensions, as well as the original environmental concerns.

This paper is concerned with the relationship between *residential density*, and the associated types of housing, and 'social sustainability', as part of a wider study of sustainable urban form.<sup>(1)</sup> Adopting a definition of social sustainability informed

<sup>(1)</sup>The CityForm project is a consortium of five universities in the cities of Edinburgh, Glasgow, Sheffield, Leicester, and Oxford. The consortium aims to examine and test the claims made that more compact, high-density, and mixed-use forms will be environmentally sound, efficient for transport, socially beneficial, and economically viable. Through empirical neighbourhood research, based particularly on three case study areas in each of these five cities, the CityForm project explores the nature and extent of the relationship between urban form and sustainability. Further information on the CityForm project can be obtained at <http://www.city-form.com>

by both academic and policy literature, we consider how this might be affected by urban form. The paper then addresses ways of measuring social sustainability and testing the hypothesised relationships between selected aspects of social sustainability and urban form. The measures used draw primarily on UK secondary sources, the Survey of English Housing (SEH), and the Census of Population in England and Wales. Empirical relationships are examined using variant statistical techniques, including OLS (ordinary least squares), ordinal, and bivariate logit models. This analysis highlights the importance of controlling for exogenous and intervening variables—such as housing tenure and the social composition of neighbourhoods—as well as possible nonlinear relationships, in testing and calibrating these relationships.

## 2 The concept and relevance of social sustainability

### 2.1 Definitions and context

Debates within the wider sustainable development literature have moved beyond considering sustainability solely as an environmental concern, to the inclusion of economic and social dimensions. A significant proportion of sustainable development rhetoric now stresses the importance of social equity (Burton, 2000a cites the following references: CEC, 1990; Elkin et al, 1991; Sherlock, 1990; Yiftachel and Hedgcock, 1993). The importance of a social dimension of sustainability has also been stressed at policy level (DETR, 1997; 2001; see also below). UK policy parallels international sustainability development agreements, with poverty eradication seen as an essential requirement (United Nations, 2002, page 2).

Whilst the sustainable development agenda emphasises the importance of ‘social’ aspects of sustainability, there has been little agreement as to what this consists of. Polese and Stren (2000, pages 15–16) have put forward the following definition of social sustainability:

“development (and/or growth) that is compatible with harmonious evolution of civil society, fostering an environment conducive to the compatible cohabitation of culturally and socially diverse groups while at the same time encouraging social integration, with improvements in the quality of life for all segments of the population.”

The above definition discusses social sustainability in terms of the collective functioning of society as well as in terms of individual quality-of-life issues. Yiftachel and Hedgcock (1993, page 140) have further defined *urban* social sustainability as: “the continuing ability of a city to function as a long-term, viable setting for human interaction, communication and cultural development.”

### 2.2 Sustainability, quality of life, and government policy

The UK government has made efforts to link sustainability to quality of life, particularly through the indicators known as ‘quality-of-life counts’ (DETR, 1999a; 2001). This provides the bridge between sustainability and the urban ‘liveability’ agenda which has emerged in UK urban policy (DCLG, 2006; ODPM, 2003). The DETR (2001) approach seeks to reconcile the obvious tensions by adopting an extended economic concept of ‘capital’. This identifies three broad classes of ‘capital’—economic, social, and environmental—and defines sustainable development as a process of growth or development in which total capital (the combination of these three kinds) is ‘nondecreasing’.

That sustainability, including its social dimension, is central to current planning and urban policies in the UK is evidenced by the title of the overarching policy document known as the *Sustainable Communities Plan* (ODPM, 2003). The most recent

policy statement by H M Government (2005, see Annex A of that document<sup>(2)</sup>) set out its policy definition of 'what is a sustainable community' in terms of eight headings: (1) active, inclusive, and safe; (2) well served; (3) well designed and built; (4) well run; (5) environmentally sensitive; (6) well connected; (7) thriving; and (8) fair for everyone. We would regard this all-embracing definition as encompassing all three main 'legs' of the broader sustainability concept, including the environmental dimension, in (5), the economic dimension, in (7), transport, in (6), and matters of governance, in (4), and planning/design, in (3), that go beyond the usual outcome focus into means rather than ends. The aspects of social sustainability with which we are concerned are located particularly within headings (1), (2), (3), and (8). The first heading includes identity and belonging, tolerance of difference, friendly and cooperative communities, leisure and cultural opportunities, crime/antisocial behaviour, and a good quality of life. The second heading identifies a range of accessible services including health, education, and social care. The third reiterates issues around sense of place, friendliness, healthiness, and safety of spaces, as well as accessibility by non-motorised transport and the issue of affordable housing. If nothing else this document serves to underline the apparent policy priority given to the issues addressed in this paper.

### 2.3 Social capital, social cohesion, and social inclusion

While there is a relatively limited literature that focuses specifically on social sustainability, there is a much broader literature on the overlapping concepts of 'social capital', 'social cohesion', and 'social exclusion'. It is beyond the scope of this paper to provide an adequate review of these concepts as they are discussed in this literature, but we do draw on key reviews (Forrest and Kearns, 2001; Hills et al, 2002; Kearns and Forrest, 2000; Pantazis et al, 2006; Pierson, 2002). We recognise that they are not very tightly or consistently defined and also that they are, in important respects, contested concepts.

It may be argued that the underlying premise to all of these concepts is that individuals within society need to work together and interact in order for societies to be socially 'sustained'. *Social networks* clearly provide a common thread between the three concepts as set out here. These concepts recognise the importance of people being involved and having a vested interest in society, as well as individuals having equal access to societal benefits. However, beyond this it may be observed that the third concept (social exclusion) is more distinct, focusing more on access to economic opportunities and services, whilst the first and second concepts have more areas of overlap. In addition to social networks and association, one can also discern common clusterings of concern with norms, values, and culture, with sense of belonging (to place), and with safety and trust which may be seen as the positive side of social control and order.

### 2.4 A working definition of social sustainability

From the above review of the literature there are two recognisable, overarching concepts at the core of the notion of social sustainability within an area context. These are *social equity* issues (access to services, facilities, and opportunities) and issues to do with the *sustainability of community* itself. Whilst social equity issues are powerful political and policy concerns, and centre upon a distributive notion of social justice (Burton, 2000a, page 1970), the more collective 'sustainability of community' dimension may be seen as more nebulous. However, we would argue that this clearly maps onto the concerns both of the government and of academic writers, particularly those

<sup>(2)</sup> This formulation was subsequently adopted by the EU as 'the Bristol accord'.

addressing issues of social capital and cohesion. These concepts are contested, in terms of their value loadings and also in terms of how important these phenomena are for the achievement of wider social goals, but there is quite wide agreement that at least some aspects are potentially important.

With regard to the first dimension, we are particularly interested in access to local services, while recognising that a fuller account of the equity dimension would also encompass access to jobs and affordable housing. In practice, we focus in this paper on a limited representative selection of services (eg convenience shopping, primary health-care), although in our wider study we will examine a broader range [see, for example, Fisher and Bramley's (2006) analysis of poverty and local services].

Turning to the second dimension, and drawing on both academic and policy literature, we argue that the following aspects are likely to be significant in helping to sustain communities at the neighbourhood level:

- interaction with other residents or social networks;
- participation in collective community activities;
- pride or sense of place;
- residential stability (versus turnover);
- security (lack of crime and disorder).

Informal social ties may be distinguished from active participation in formal community activities and organisations, frequently used as an indicator of local social capital; we would argue that both are potentially significant. We are also interested in whether people use facilities within their neighbourhood, and their attitudes towards these facilities. The social premise is that, if people participate in activities within their local community, then they will have stronger ties to the community—this is distinct from the environmental benefit of reduced travel, and the equity benefit from improved access. A similar argument applies to the concept of pride or sense of place, the idea being that, if people feel attached to the neighbourhood, they will want to stay living in the area and contribute to its continued development (Woolever, 1992). Within some of the literature, areas of high turnover are perceived to be unsettled and undesirable areas, although this is not always the case (Bailey and Livingstone, 2007; Bramley and Morgan, 2003; Bramley et al, 2000). High outflows of residents combined with low or no inflows can mean that an urban community will be literally unsustainable over time (Bramley et al, 2000; Power and Mumford, 1999). Community stability is often associated with higher levels of social cohesion and associated benefits such as lower crime (Hirschfield and Bowers, 1997), and government policy is increasingly stressing the need and ability of communities to combat crime for themselves while also recognising the role played by urban design (Atkinson and Flint, 2003; ODPM, 2004; Shaftoe, 2000).

## 2.5 The relationship between social sustainability and urban form

Jenks et al (1996, page 11) described the relationship between urban form and sustainability as “one of the most hotly debated issues on the international environmental agenda.” Density is the aspect of urban form that has received the most attention in the literature with regard to its social impact, as in the ‘compact city’ versus ‘sprawl’ debate (Barton, 2000; Breheny, 1992a; 1992b; DETR, 1999b; Ewing, 1997) and in the related ‘new urbanism’ literature (Calthorpe, 1993; CNU, 2004; Katz, 1994).

The density of urban development has the potential to impact upon all of the dimensions of social sustainability. For example, higher densities may make access to services and facilities both easier and more economically viable (Bunker, 1985; Burton, 2000b; Collie, 1990; Haughton and Hunter, 1994; ODPM, 2003), although this may vary between services and other issues (eg job access) (Burton, 2000a; 2000b; Williams, 2000).

Higher densities may also mean that people are more likely to meet each other on the street than in lower density areas (Duany and Plater-Zyberk, 2001; Talen, 1999). In contrast, lower densities reduce the potential for spontaneous interaction and lead to an orientation towards car travel (Transit Cooperative Research Program, 1998). Glynn (1981) and Nasar and Julian (1995) both found 'sense of community' to be higher in neighbourhoods that facilitated face-to-face interaction. There are, however, alternative arguments that, in higher density societies, people may withdraw from social contact and experience stress (Bridge, 2002; Freeman, 2001; Simmel, 1995; Wirth, 1938). These apparently contradictory views may suggest nonlinear relationships. It is further argued that, in a compact city, communities are likely to be more mixed/less segregated than in typical 'suburban sprawl' (Bramley and Morgan, 2003; Burton, 2000a; CEC, 1990). However, it is not axiomatic that social mix correlates with density or use mix in this way; in our empirical work below we distinguish these factors.

The density of development may also affect the appearance and aesthetics of places, and hence people's sense of attachment to and pride in place, although it is far from clear whether this relationship is positive rather than negative (Audirac and Zifou, 1989; Diamond and Noonan, 1996; Nelessen, 1994; Shore, 1995; Transit Cooperative Research Program, 1998). Gordon and Richardson (1997) argue that, given the choice, people prefer low-density suburban living, as confirmed by consumer preference surveys.

This literature suggests reasons to expect access to services to be better in denser urban forms, while the quality of neighbourhood environment, community, and social interaction may be less good in denser areas. The latter relationship is less clear-cut a priori from the literature, and could well vary, contingent upon the social/demographic groups considered and interactions between urban form and social composition factors, including those associated with housing tenure. Further, there is a dearth of analysis at a small-scale local level. In order to address this gap this paper draws upon secondary data sources to examine evidence on some aspects of social sustainability and their relationship to urban form.

### 3 Data sources and measures

#### 3.1 The Survey of English Housing

The SEH is an interview survey carried out with 20 000 households across England each year, and started in 1993/94. The SEH has elements of commonality with other official surveys, but is particularly relevant to housing and the neighbourhood environment around it. In this paper we report data from just one recent year of the survey (2003/04).

For the purposes of this research the Office of the Deputy Prime Minister (ODPM) made the data available with the usual attached area codes and attributes (region, local authority, urban–rural indicator, deprivation indicator) but also (possibly for the first time) with the unit postcode still attached. This enabled the researchers to link data from the recent (2001) Census at the smallest geographical level possible, the census output area (COA for short). COAs in England have an average population of 300 and an average number of households/dwellings of around 125. A COA typically comprises a street or block, or part thereof. This is clearly quite an appropriate scale at which to measure urban form. Because of the way that (most) residential areas were developed, streets or blocks very often have a common building form, so that these units are relatively homogeneous internally while differing markedly one from another. Through the incorporation of this data linkage, it has become possible for the first time to analyse the impact of relatively small elements of urban form within these large-scale household surveys.

### 3.2 Urban form measures

The elements of urban form which can be measured at COA level from census data are

- density (gross residential), measured (preferably) in terms of dwellings ('spaces'), or habitable rooms, per hectare;
- house type mix, expressed as the proportion of flats, detached, semidetached, or terraced houses;
- presence of high(er) residential buildings, proxied by households whose lowest floor of accommodation is above various floor levels;
- density of cars, relative to space, dwellings, or households, can also be measured—we regard this as an 'intervening variable' (characterising how people live in and use the environment) rather than strictly as an element of urban form, but it may still have considerable physical impact on neighbourhoods and how people experience them; the density or ratio of children may be regarded in a similar light.

It must be noted that there are some limitations to these measures. Net residential density cannot be measured from census data, because COAs cover all land uses, not just housing, and they may comprise widely varying quantities and qualities of nonhousing land uses. Aspects of urban form which the census cannot measure include quality of design, type of building and street layout, open space, and mixed use. This said, by combining the census data with a large-scale household survey like the SEH it is possible to include measures for individuals which imply a certain urban form at the microscale—for example, whether the household has a garden or a yard/patio, and the type of parking facilities available.

The most important single aspect of urban form is probably density, because it is a general summary measure which many other features will be partly correlated with. The 'compact city' concept implies relatively high density. We initially focused on room density (habitable rooms per hectare), because this arguably captures best the intensity of the built structures. However, further examination of correlations and factor analysis outputs for urban-form-related measures, as well as examination of relationships with certain key outcomes, suggested that dwelling unit density would be better used as a single best representative measure. Nevertheless, the very high correlation between dwelling and room density ( $r = 0.974$ ) should be noted. All the density measures are subject to a degree of imprecision and we control for extreme high outliers—for example, we set arbitrary maximum values of 400 rooms per hectare for room density and 250 dwellings per hectare for dwelling density, based on inspection of the distribution of COA values.<sup>(3)</sup>

### 3.3 Outcome measures

Turning to the measures of social sustainability 'outcomes', the most important are arguably those reflecting people's overall satisfaction with their local area. These capture the dimensions of attachment to/pride of place and (indirectly) residential stability, insofar as people who are less satisfied are more likely to move on.<sup>(4)</sup> Satisfaction with area is based on a five-point scale from 'very satisfied/fairly satisfied' through to 'very dissatisfied'; the overall distribution of responses is shown in table 1, and indicates relatively low numbers recording dissatisfaction. By focusing on the significant minority who register some level of dissatisfaction we expect to draw attention to the urban form features which are more problematic or less popular for at least some residents. However, there

<sup>(3)</sup> The particular way COA boundaries are drawn, combined with rounding of COA area data, may combine to produce extremely low values of the area denominator for density indicators, leading to extremely high values for density ratios. The rounding of areas also imparts a degree of noise to the density variable.

<sup>(4)</sup> On the basis of CityForm consortium household survey evidence, Bramley et al (2007) show that the area (dis)satisfaction measure represents the best overall summary measure of the range of social sustainability aspects, as defined in this paper.

clearly are choices about how responses on these scales are summarised; and in modelling we compare OLS regression of scores (assuming a linear scale), bivariate logistic regression (for very/fairly dissatisfied), and ordinal logit models.

A further group of measures flag when respondents think particular negative features or behaviours are 'a serious problem in this area'. Five items (or grouped items) are examined: crime; vandalism or graffiti; traffic or noise; dogs or litter; neighbours or harassment (including racial and other forms). These may be seen as illuminating possible reasons for the general dissatisfaction captured in the first measure above, or indeed the reasons why an area may be perceived as having become worse. However, they also develop some of the other dimensions of social sustainability. For example, crime problems and neighbour/harassment problems contribute to general feelings of unsafety, insecurity, and lack of trust. In addition, these measures provide some evidence on the incidence of certain environmental problems which could undermine pride in place or place attachment.

Attachment to an area may also be measured by objective data on residential stability/turnover, or by more subjective measures of intention to move, wish to move, or having taken steps towards moving. The indicators currently available from the SEH in this respect are not ideal, and we do not discuss them further here.

The survey also enables us to look at the other main dimension of social sustainability, which is concerned with equity of access to services and opportunities within the urban realm. Our approach here is deliberately selective, and is intended to illustrate broader patterns. We look at three subjective measures, based on respondents reporting it as being fairly or very difficult to get to (a) a corner shop or a large food supermarket; (b) a post office; (c) a doctor (general practitioner). One could in principle measure access to these facilities in a more objective fashion, using GIS techniques to measure travel distances or times. This is the approach adopted in the IMD (index of multiple deprivation) indicator for geographical access to services, so we also report scores for this index alongside the more subjective SEH-based measures. However, it should be noted that the IMD access indicator scores are for somewhat larger geographical units, namely 'super output areas' (SOAs, population size in the range 500–1000). We also refer to SEH variables for the walking time to bus stops and the bus service frequency; these are, however, used as supplementary urban form variables, as is the IMD access indicator.

### **3.4 Other relevant and control variables**

In seeking to understand the relationships between urban form and social sustainability outcomes, it is necessary to take account of the influence of other variables which may be important in determining these outcomes. For example, dissatisfaction with an area or a propensity to move may be systematically related to a wide range of factors, including age, household composition, socioeconomic status, or the type and size of housing occupied. Many of these variables may be regarded as exogenous, while some might be regarded as 'intervening' factors which mediate the effects of urban form. Most of the variables of this kind available for this analysis are attributes of the individual households in the survey or the individual dwellings which they occupy. There are also some variables available in the analysis which describe characteristics of the areas in which people live, other than urban form per se, such as the socioeconomic and tenure profile of the area, including the general level of deprivation versus affluence. Broadly, for the purposes of this analysis, these other variables are essentially playing the role of controls. We need to take account of their influence before we can isolate the particular influence of urban form. For example, people may appear to be more satisfied with their neighbourhood in the lower density suburbs, but this may be mainly because their neighbours are not poor.

4 Analysis of relationships

4.1 Descriptive patterns

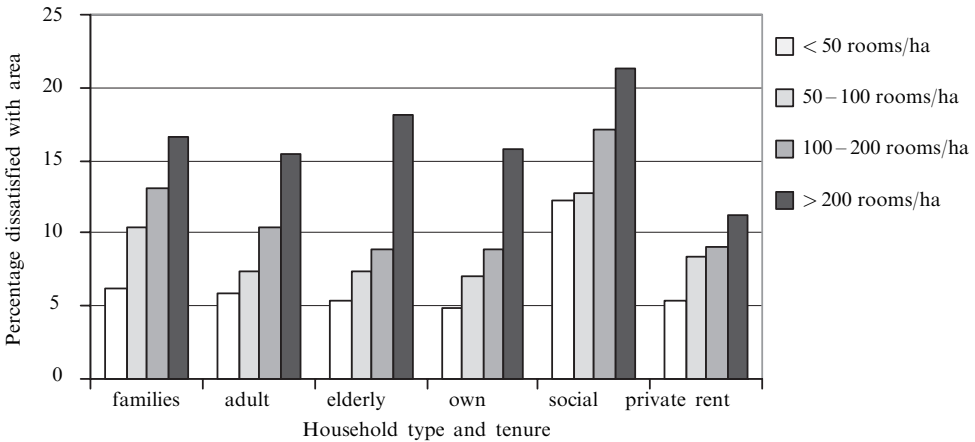
To provide focus in the limited confines of this paper, we report models for three representative measures of social sustainability: dissatisfaction with area; neighbourhood problems (five categories, including crime); and difficulty of access to three local services (convenience shop, post office, doctor). On the basis both of the earlier literature-based discussion and of the descriptive data, we believe that these represent key dimensions of social sustainability. In addition, when performing a factor analysis on the available outcome measures in this dataset, these measures correspond closely to the first, second, and fourth factors, respectively (the third factor is housing dissatisfaction). Table 1 shows the frequency distributions of responses for these three variables. It can be seen that being slightly or very dissatisfied with the area has a lower incidence (9.6%) than reporting any of the five neighbourhood problems as being serious (33.1%), while reporting access difficulties to any of the three services considered has an intermediate level of incidence (18.9%).

**Table 1.** Frequency distributions for three key social outcome measures (source: Survey of English Housing 2003/04).

	Number	Percentage
<i>Area satisfaction</i>		
Very satisfied	9 678	48.3
Fairly satisfied	7 515	37.5
Neither satisfied nor dissatisfied	920	4.6
Slightly dissatisfied	1 272	6.3
Very dissatisfied	670	3.3
Total	20 055	100.0
<i>Neighbourhood problem number</i>		
0	13 706	66.9
1	3 698	18.1
2	1 703	8.3
3	859	4.2
4	361	1.8
5	161	0.8
Total	20 487	100.0
<i>Service access difficulties</i>		
0	16 620	81.1
1	2 423	11.8
2	768	3.8
3	676	3.3
Total	20 487	100.0

Simple descriptive data on the patterns of our key outcome indicators present an apparently clear picture. Dissatisfaction with area is quite strongly related to small neighbourhood level density, the dissatisfaction rate rising quite strongly with density. Figure 1 shows that this applies even after controlling for household type or tenure. Similar patterns apply to common neighbourhood problems, and to a number of other indicators of satisfaction/attachment not reported further here. The more adverse picture for higher densities may reflect a greater incidence of problems, but also a greater tendency for any problems to impinge on residents when they live much closer together. Many (if not all) of these problems reflect negative interactions between some residents and other residents.



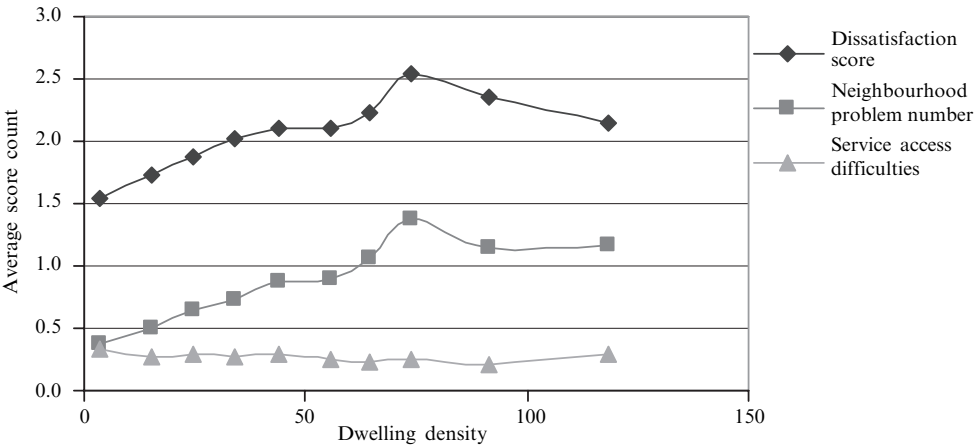


**Figure 1.** Dissatisfaction with area according to density, household type, and tenure.

The highest density category stands out (in figure 1) more for elderly households and for owner-occupiers. Social renters are generally much more dissatisfied at all levels of density, while private renters seem more tolerant of higher densities. Two general reasons for social renters’ adverse scores are (a) that they are a group who generally have less choice of where to live, and (b) that social renting areas tend to be more deprived, and (as we show below) deprivation is a strong predictor of dissatisfaction and neighbourhood problems.

However, the pattern with regard to access to services is, as expected, rather different. Here the problems are greatest in the most sparsely populated rural areas, where services are either absent, inaccessible, or of limited quality and scope. There is a weaker negative relationship with density within the more ‘urban’ range of densities.

Figure 2 traces scores on the three selected outcome measures across finer graduations of density (gross dwellings per hectare, dph). This shows that the profile is relatively similar for area dissatisfaction and area problems, but different for service access. Some earlier discussion suggested that the relationship between density and certain outcomes may be nonlinear and figure 2 suggests that this may be the case, although not in a very simple way. The first two indicators rise to a first plateau



**Figure 2.** Dissatisfaction and problem scores according to density.

between about 40 and 55 dph, then rise rather more steeply to a peak around 75 dph, with a further plateau above that level. For access to local services these problems show a fall from the lowest (essentially rural) to the next-lowest density band, then a relatively stable level, then a fall between 45 and 65 dph, with an apparent rise in the very highest density band.

#### 4.2 Modelling the determinants of key outcomes

The next step in the analysis is to carry out modelling to see how far these outcome patterns can be explained by systematic relationships with all of the variables available to us. In particular, we are interested in what effect urban form characteristics such as density and predominant housing type have, once we have controlled for a raft of other exogenous and intervening variables. The techniques used include both OLS regression and logistic regression analysis,<sup>(5)</sup> including both the common bivariate logit model and, in one instance, an ordinal logit model<sup>(6)</sup> (depending on the form of the outcome variable). Owing to the limited range of the count scores, we place more emphasis on the logit results.

Within these analyses we can look at the effects of not only density but also housing-type mix and measures relating to cars and car parking. The neighbourhood-level variables also include tenure mix (at OA level) and deprivation (at SOA level). A very large number of individual household attributes are available for the analysis, but those which turn out to be insignificant in all models are weeded out of the models reported here.

In each case we compare four models: (1) with (dwelling) density as the sole explanatory variable; (2) including density and a range of demographic and socio-economic control variables (at individual or neighbourhood level); (3) including also some other variables relating to urban form; (4) including a further set of urban form and location indicators. Model (1) corresponds to figure 2, a simple bivariate relationship, while model (2) represents a more sophisticated version of figure 1, controlling for many sociodemographic factors simultaneously. Model (3) goes further by testing the role of distinct aspects of urban form related to density or perhaps intervening between density and outcome: housing types, car/dwelling ratios, parking adequacy, and distance from bus stops. Model (4) introduces further locational/urban form variables, particularly factors capturing urban fringe and rural locations and job accessibility. As we move from models (1) to (4) we expect the apparent contribution of density to the model to fall, (a) because some of its apparent effects are better attributed to sociodemographic factors, and (b) because some of the density effect may be attributed to a more specific aspect of urban form, such as housing type or parking adequacy.

Table 2 reports the effects of urban form variables on area dissatisfaction for each of the four successive models explained in the previous paragraph, using three variant estimations: bivariate logit (for very or slightly dissatisfied), ordinal logit, and OLS regression of simple score (1 = 'very satisfied' to 5 = 'very dissatisfied'). The table shows the coefficients and significance levels, and also provides an indication of the units for each variable. Models (2), (3), and (4) also include twenty-three control

<sup>(5)</sup> Logit models are more appropriate for categorical variables, but these variables can also be expressed as counts or scores, albeit with limited range; the counts/scores contain more information, but owing to the prevalence of zero scores OLS estimation is less satisfactory and we rely mainly on the logit results.

<sup>(6)</sup> The ordinal logit model is implemented using the PLUM procedure in SPSS; the model predicts a log-odds ratio and gives threshold values for each value on the area dissatisfaction scale.

**Table 2.** Effects of urban form variables in three models for area dissatisfaction, where (1)–(4) refer to the models discussed in the text.

	Coefficients				Significance			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
<i>Bivariate logit models</i>								
ddens	0.017	0.006	0.003	0.001	0.000	0.000	0.098	0.500
pdetoa			−0.006	−0.003			0.016	0.166
pteroa			0.007	0.007			0.000	0.000
parkadeq			−0.356	−0.360			0.000	0.000
cardwgoa			−0.328	−0.176			0.080	0.368
nearbus			0.016	0.020			0.004	0.000
townfrg				−0.260				0.027
villisol				−0.724				0.000
geogbar				−0.109				0.033
ldjobac				1.162				0.016
controls (number of variables)	0	23	23	23				
Cox and Snell $R^2$	0.013	0.053	0.061	0.062				
Nagelkerke $R^2$	0.029	0.113	0.128	0.132				
<i>Ordinal logit models</i>								
ddens	0.020	0.007	0.003	0.002	0.000	0.000	0.003	0.086
pdetoa			−0.006	−0.004			0.000	0.000
pteroa			0.005	0.005			0.000	0.000
parkadeq			−0.301	−0.308			0.000	0.000
cardwgoa			−0.241	−0.116			0.015	0.264
nearbus			0.004	0.006			0.242	0.048
townfrg				−0.323				0.000
villisol				−0.540				0.000
geogbar				−0.001				0.974
ldjobac				0.483				0.059
controls (number of variables)	0	23	23	23				
Cox and Snell $R^2$	0.042	0.130	0.145	0.149				
Nagelkerke $R^2$	0.047	0.145	0.161	0.165				
McFadden $R^2$	0.019	0.061	0.068	0.070				
<i>OLS regression models</i>								
ddens	0.010	0.003	0.002	0.001	0.000	0.000	0.002	0.050
pdetoa			−0.001	−0.001			0.026	0.231
pteroa			0.003	0.003			0.000	0.000
parkadeq			−0.149	−0.152			0.000	0.000
cardwgoa			−0.113	−0.063			0.021	0.213
nearbus			0.004	0.005			0.016	0.003
townfrg				−0.116				0.000
villisol				−0.178				0.000
geogbar				−0.008				0.568
ldjobac				0.266				0.033
controls (number of variables)	0	23	23	23				
Adjusted $R^2$	0.039	0.127	0.139	0.141				

Note: Variables are as follows—ddens: dwelling density (dwelling/ha); pdetoa: percentage detached housing; pteroa: percentage terrace housing; parkadeq: dummy for adequate parking; cardwgoa: number of cars per dwelling; nearbus: proximity to a bus stop (minutes); townfrg: dummy for town fringe location; villisol: dummy for village/isolated location; geogbar: geographical barriers (IMD index); ldjobac: change in ln of job accessibility.

variables whose coefficients are not shown. Most of these are individual household attributes, including age (quadratic), household types, household size, length of residence, income, ethnicity, and some dwelling attributes (bedrooms, crowding, detached house), mainly in dummy form. These variables are included because we would expect these characteristics to affect people's experience of their neighbourhood and the needs which it may or may not satisfy. Control variables included are generally significant in at least one of the models. Apart from a group of five sociodemographic area characteristics, which are discussed below, these control variable effects are not considered further in this paper.

In general there is a fairly high degree of consistency between the results of the three estimation procedures. The basic dwelling density variable has a strong and significant positive effect on area dissatisfaction when included on its own, but the size and significance of this effect drops as we include first the controls and then the other urban form measures. Nevertheless, it remains just significant in the ordinal logit and OLS models (4). Having more detached houses reduces dissatisfaction, but this is not significant in all models, while having more terraced houses consistently increases dissatisfaction. Perceived parking adequacy has a consistently significant effect in reducing dissatisfaction. The effect of cars per dwelling is in the same direction but of marginal significance—this may be picking up an affluence effect. Dissatisfaction tends to increase with distance from bus stops, but this is not always significant. Being located on the fringe of towns or in village/isolated locations reduces dissatisfaction significantly. These variables clearly tend to displace the explanation associated with density in model (3), as well as probably most of the potential effect of the IMD geographical barriers variable, which is an alternative rural proxy. Areas with better or improving job access appear to show slightly more dissatisfaction—this may indirectly reflect environmental factors, such as congestion or conflicting uses.

Table 3 looks at the size of the marginal impacts implied by these coefficients, for values of each explanatory variable at minimum, maximum, and mean plus one standard deviation levels, expressed as percentage-point differences in dissatisfaction incidence from a base case. These are based on the bivariate logit model, comparing with the predicted dissatisfaction incidence of a base case household with 'typical' (average or modal) characteristics. This presentation overcomes differences of units between different variables and enables us also to compare the size of effect with certain other 'area effects' of interest. It is noteworthy that the effect of density in the simple model (1) appears quite sizeable (36 percentage points higher dissatisfaction for one standard deviation higher density), but that this falls sharply in models (3) and (4) (to 5% and 2%, respectively) with the introduction of control variables and other urban form measures. However, other urban form variables, when included, have effects which are typically as large as, or larger than, the remaining density effect. The maximum difference effects may be distorted in some cases by extreme values, so the effects of one standard deviation difference may be a better guide, particularly for continuous variables. On this basis, the effect of density appears to be small in model (3) (5%), but the effects of detached and terraced housing are rather larger (−3%, +17%).

The bottom of table 3 shows the comparable size of five other neighbourhood-area-level effects in models (3) and (4). These are noticeably larger than the density effect, although more similar to the house-type effects (although still larger for maximum values). In particular, neighbourhood poverty (IMD low income score) has a strong effect in increasing dissatisfaction—larger than any of the urban form variables. The effect of the ratio of children to dwellings is also large and in the same direction.

**Table 3.** Size of impact of urban form and other area variables on area dissatisfaction (marginal effects on the percentage dissatisfied, relative to the base percentage, based on the bivariate logit model).

	Model								
	(1)			(3)			(4)		
	min	max	+1SD	min	max	+1SD	min	max	+1SD
ddens	−29.9	202.7	36.1	−5.2	20.3	4.9	−2.2	8.1	2.0
pdetoa				13.3	−33.9	13.4	7.5	−21.1	−7.9
pteroa				−14.7	58.9	16.9	−14.7	58.5	16.8
parkadeq				39.3	0.0	−15.2	39.7	0.0	−15.3
cardwgoa				34.6	−32.3	11.6	17.3	−18.8	−6.4
nearbus				−4.8	226.5	7.6	−6.0	325.9	9.6
townfrg							0.0	−21.9	−7.4
villisol							0.0	−50.0	−16.0
geogbar							29.9	−25.6	−7.9
ldjobac							−41.5	36.8	9.2
<i>Other area effects</i>									
incscr04				−24.2	177.1	21.5	−24.0	173.0	21.1
chlddwg				−27.4	381.7	15.3	−25.9	338.6	14.2
pvacoa				−5.4	140.8	7.0	−6.0	164.0	7.8
psrentoa				−17.0	75.8	19.3	−20.4	98.8	24.2
pnwhitoa				−4.7	65.8	8.8	−4.2	55.9	7.6

Note: Variables are as follows—ddens: dwelling density (dwelling/ha); pdetoa: percentage detached housing; pteroa: percentage terrace housing; parkadeq: dummy for adequate parking; cardwgoa: number of cars per dwelling; nearbus: proximity to a bus stop (minutes); townfrg: dummy for town fringe location; villisol: dummy for village/isolated location; geogbar: geographical barriers (IMD index); ldjobac: change in ln of job accessibility; incscr04: percentage low income; chlddwg: number of children per dwelling; pvacoa: percentage vacant; psrentoa: percentage social renting; pnwhitoa: percentage nonwhite. +1SD denotes the mean plus one standard deviation.

This is often discussed in terms of child density, which may be thought of as an urban form measure, but our formulation here emphasises that it is an occupancy rather than a physical urban form effect. The proportion of social renting also has a sizeable impact on dissatisfaction; this may reflect the lack of locational choice which social renters typically have, as well as any effects of their housing or behaviour on other residents. A higher nonwhite population share goes with higher dissatisfaction, even though Black and Asian individuals tend to register less dissatisfaction. Vacancy rates may be in considerable measure a symptom of unpopular areas, but they can also create some blight on neighbourhoods themselves.

It is a general characteristic of the results in table 3, and similar tables presented below, that the impacts appear to be asymmetrical (eg often much larger for maximum values than for minimum values of the variable). This reflects two factors: (a) the skewed distribution of values of some key factors—for example, poverty; (b) the inherently nonlinear relationship between the outcome and key drivers, as embodied in the logit model, but reflecting the underlying ‘minority incidence’ of this negative outcome.

Table 4 presents essentially equivalent sets of model results for variations in the incidence of serious neighbourhood problems reported by respondents, concentrating on the marginal effects and again based on bivariate logit. The explanatory variable sets are the same. Many of the findings with respect to urban form variables are similar.

**Table 4.** Size of impact of urban form and other variables on neighbourhood problem incidence (marginal effects on the percentage reporting a problem, compared with the base percentage, based on the bivariate logit model).

	Model								
	(1)			(3)			(4)		
	min	max	+1SD	min	max	+1SD	min	max	+1SD
ddens	−24.2	98.7	24.6	−7.2	27.7	6.8	−3.4	12.5	3.1
pdetoa				0.9	−2.8	−1.0	−1.8	6.1	2.1
pteroa				−6.5	21.0	6.7	−6.7	21.6	6.9
parkadeq				36.1	0.0	−3.2	36.0	0.0	−3.2
cardwgoa				54.9	−49.0	−18.4	35.0	−35.3	−12.5
nearbus				1.0	−23.0	−1.5	0.3	−6.8	−0.4
townfrg							0.0	−2.3	−1.0
villisol							0.0	−8.7	−2.9
geogbar							48.1	−39.8	−12.7
ldjobac							11.2	−6.3	−1.8
<i>Other area effects</i>									
incscr04				−19.2	96.8	15.4	−17.1	84.2	13.5
chlddwg				−17.2	122.3	8.4	−15.6	109.3	7.6
pvacoa				−3.4	64.8	4.2	−3.9	75.3	4.8
psrentoa				−5.9	19.8	5.9	−10.4	37.1	10.7
pnwhitoa				−0.9	9.5	1.5	−0.5	5.7	0.9

Note: The logit model is for the outcome of any of five problems being serious in neighbourhood. The problems are (1) traffic/noise; (2) vandalism/graffitti; (3) dogs/litter; (4) neighbours/harassment; (5) crime. Variables are as follows—ddens: dwelling density (dwelling/ha); pdetoa: percentage detached housing; pteroa: percentage terrace housing; parkadeq: dummy for adequate parking; cardwgoa: number of cars per dwelling; nearbus: proximity to a bus stop (minutes); townfrg: dummy for town fringe location; villisol: dummy for village/isolated location; geogbar: geographical barriers (IMD index); ldjobac: change in ln of job accessibility; incscr04: percentage low income; chlddwg: number of children per dwelling; pvacoa: percentage vacant; psrentoa: percentage social renting; pnwhitoa: percentage nonwhite. +1SD denotes the mean plus one standard deviation.

Density increases problem incidence, but the size and significance of this effect drops as we introduce controls and other urban form variables. The positive effect of terraced housing occurs in the same way, but the effect of detached housing is less clear. Parking adequacy and cars per dwelling have the same effects (reducing problems), but proximity to bus stops is no longer significant. Of the locational variables introduced in model (4) it is only the geographical barriers index which is significant in reducing problems in this case.

In general the effect of density on problems is larger in magnitude than the effects previously discussed for dissatisfaction. However, the impacts of detached housing and of nearness to bus stops are smaller. There is clearly a strong negative rural effect on problem incidence (the geogbar variable). Most of the other area effects, particularly from poverty, child ratios, and social renting, are also larger in magnitude than their effects on dissatisfaction. Thus, it remains true that such social factors have a relatively bigger effect on these problem outcomes than does urban form, even though the effects of urban form are rather larger.

Tables 5 and 6 present a similar analysis of the incidence of problems of access to three local services. This time the models include a different set of variables, with considerably fewer controls but the introduction of some additional location/access

**Table 5.** Effects of urban form variables in the bivariate logit model for difficulties of access to three local services (convenience shop, post office, doctor), where (1)–(4) refer to the models discussed in the text.

	Coefficients				Significance			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
<i>Bivariate logit model</i>								
ddens	−0.001	−0.009	−0.007	−0.003	0.099	0.000	0.000	0.032
pdetoa			0.000	−0.005			0.849	0.000
pflatoa			−0.003	−0.003			0.002	0.009
parkadeq			−0.234	−0.206			0.000	0.000
nearbus			0.039	0.036			0.000	0.000
busday				−0.007				0.000
ldist150				−0.074				0.017
c1503km				0.148				0.066
ldjobac				0.224				0.423
geogbar				0.418				0.000
Controls (number of variables)	0	15	15	15				
Cox and Snell $R^2$	0.000	0.053	0.062	0.075				
Nagelkerke $R^2$	0.000	0.086	0.099	0.120				

Note: Variables are as follows—ddens: dwelling density (dwelling/ha); pdetoa: percentage detached housing; pflatoa: percentage flats; parkadeq: dummy for adequate parking; nearbus: proximity to a bus stop (minutes); busday: number of buses per day; ldist150: ln of distance in km to nearest major retail centre (> 150 000 m<sup>2</sup>); c1503km: dummy for within 3 km of a major retail centre; ldjobac: change in ln of job accessibility; inscr04: percentage low income; geogbar: geographical barriers (IMD index). +1SD denotes the mean plus one standard deviation.

measures relating to bus frequency and to proximity to large retail/service centres. This time the hypothesised direction of urban form effects is generally the opposite of that expected and found with dissatisfaction and neighbourhood problems. We expect and find that density reduces the incidence of access problems. It is also noteworthy that the size and significance of the density effect increases from model (1) to model (2), with the introduction of sociodemographic controls, and is maintained in model (3), although it falls off somewhat in model (4) when other location/access variables are introduced. A greater number of flats also goes with better access, but so too does adequate parking. The effects of the bus variables are as expected—more difficulty the further from bus stops, and less difficulty with more frequent services. However, the effects of proximity to large retail/service centres are not as expected, although these are not always significant. Rural areas proxied by geographical barriers to access report much more difficulty of access, as expected.

Table 6 shows the size of marginal effects from minimum and maximum values and from one standard deviation difference, in the same general format as tables 3 and 4. This confirms the sizeable impact of density, the large impact of rurality, and the substantial effect of closeness to bus stops, with additional effects from flats and parking adequacy. A very noticeable difference in this table is the relatively small effects of poverty [except to some extent in model (4)] and other area factors, although social renting areas are associated with greater access difficulties. Such areas, particularly peripheral estates, may well be less well served locally and by transport infrastructure.

**Table 6.** Size of impact of urban form and other area variables on service access difficulty (marginal impacts on access difficulty percentage, relative to the base percentage, based on the bivariate logit model).

	Model								
	(1)			(3)			(4)		
	min	max	+1SD	min	max	+1SD	min	max	+1SD
ddens	2.7	−9.0	−2.4	13.3	−36.5	−10.8	5.8	−18.2	−5.0
pdetoa				0.4	−1.4	−0.5	9.5	−26.5	−10.0
pflatoa				5.2	−20.7	−6.9	4.6	−18.6	−6.1
parkadeq				21.2	0.0	−1.9	18.6	0.0	−1.7
nearbus				−10.4	424.8	17.5	−9.6	412.8	16.0
busday							19.1	−9.8	−9.1
ldist150							31.9	−12.7	−5.8
c1503km							0.0	13.2	5.6
ldjobac							−8.8	5.6	1.5
geogbar							−61.9	142.5	31.5
<i>Other area effects</i>									
incscr04				−2.7	11.1	2.0	−11.2	54.3	8.6
psrentoa				−7.8	27.6	8.0	−3.7	12.1	3.6
pnwhitoa				−0.63	6.85	1.10	−2.28	26.84	4.05

Note: Variables are as follows—ddens: dwelling density (dwelling/ha); pdetoa: percentage detached housing; pflatoa: percentage flats; parkadeq: dummy for adequate parking; nearbus: proximity to a bus stop (minutes); busday: number of buses per day; ldist150: ln of distance in km to nearest major retail centre (>150 000 m<sup>2</sup>); c1503km: dummy for within 3 km of a major retail centre; ldjobac: change in ln of job accessibility; incscr04: percentage low income; geogbar: geographical barriers (IMD index); psrentoa: percentage social renting; pnwhitoa: percentage nonwhite. +1SD denotes the mean plus one standard deviation.

5 Conclusions

In this paper we have discussed how social aspects of sustainability have come to be an increasingly important part of the sustainable development agenda. We have mapped out the development of our understanding of the concept of ‘social sustainability’, which incorporates both social equity issues (with a particular focus on access to services and facilities), and sustainability of community issues. We discuss some of the possible relationships to the different urban form elements discussed in the literature. It is necessary to explore the individual relationships between dimensions of urban form and specific social impacts, for, otherwise, the social outcomes taken together may appear to cancel each other out (Burton, 2003).

We are conscious that the broader concepts of sustainability, including their social dimensions, are not universally accepted, and that many propositions about the effects of urban form on social sustainability and their value connotations are contested. In part these disputes may be about terminology, and we would have no objection to the kinds of effects examined in this paper being termed ‘social impacts’ rather than necessarily being bracketed with ‘sustainability’. However, we note the increasing policy emphasis on a broad conception of sustainability which embraces the kinds of social impacts which we address and believe this provides a further justification for this investigation.

In the empirical part of the paper, using data from the SEH linked to census and other sources, we examined some of these relationships. This examination mainly took the form of statistical models using variants of regression and logit analysis to refine our picture of the effects of different aspects of urban form, while taking account of



other relevant influences. This modelling focused on the three representative measures of area dissatisfaction, neighbourhood problems, and access to local services.

The messages from this analysis are complex in some respects but do permit broad generalisations. Broadly, taking simple bivariate relationships, area dissatisfaction and neighbourhood problems are positively related to density, whilst access to services is inversely related. This pattern of outcomes relative to urban form is confirmed when subjected to modelling which controls for many other sociodemographic factors. However, the size of the urban form effects is often reduced and placed in perspective, once we have controlled for these factors. Nevertheless, the urban form effects generally remain significant and in some cases quite sizeable.

More dense (compact) urban forms, and their associated housing types, tend to be associated with somewhat worse outcomes in relation to dissatisfaction with the neighbourhood and perhaps more strongly with the incidence of neighbourhood problems. At the same time, it is clear that the sociodemographic composition of neighbourhoods, particularly in terms of concentrations of poverty and social renting, has a larger impact on these outcomes than urban form. Some outcome patterns point in different ways, however. In particular, access to services is generally better in denser urban forms, and this effect is confirmed rather than weakened by taking account of other factors. Furthermore, in this case urban form is more important than sociodemographic composition.

Within the social aspect of the sustainability agenda, therefore, we can say that urban form works in different ways on different aspects of the agenda. Compact forms worsen neighbourhood problems and dissatisfaction, while improving access to services. Thus, the effects on our two main dimensions of social sustainability—social equity and sustaining communities—work in opposite directions. Policy must therefore think in terms of trade-offs between social objectives. At the same time, it is likely to need to address broader trade-offs between social goals and environmental and economic goals.

This leads one to question whether there is any way in which the disparate dimensions of social sustainability can be brought together into a single measure which enables one to arrive at an overall balance of advantage/disadvantage. If one could do this, a plausible outcome might be that the balance would be different for different groups. It is also clear that, in any such balancing exercise, issues of possible nonlinearities in relationships would be particularly important in pointing towards more optimal solutions. While there is some evidence of nonlinearities, these do not necessarily take a simple form.

There is evidence that how different urban forms cope with cars is an important issue which affects social sustainability outcomes. This requires closer investigation. The study also confirms other work in showing that neighbourhood concentrations of poverty, and social rented housing, are often more strongly associated with adverse social outcomes than urban form per se. In other words, who lives where within the urban form, and with what resources and choices, may be more critical to making urban communities work.

It is also clear that there is much more work to be done on the measurement and analysis of social outcomes and their relationships with urban form. This study provides some new evidence and insights, but its limitations must be acknowledged. The measurement of urban form remains crude in some respects and incomplete, and at the same time we have not been able to operationalise all aspects of the social sustainability outcomes agenda which we derived from the literature.<sup>(7)</sup>

<sup>(7)</sup> Current research within the CityForm consortium is addressing both of these issues, particularly through the integration of purpose-designed household surveys with map/GIS-based and site-survey-based measures of urban form and neighbourhood quality within case-study areas.

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