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THE SEGREGATED CLASSES: spatial and social relationships in slums

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Abstract

This paper studies a range of issues concerning slums using examples in the Indian city of Agra and the Saudi Arabian city of Jeddah.

Processes of slum formation, and the impact this has on present day morphology are discussed, with a view to outlining a basic spatial measure which can allow the widely recurring slum typology of the squatter settlement to be identified through spatial modelling alone. The measure of very local scale (60m) node count is tested in two of Jeddah's unplanned settlements, (one of which is a squatter settlement) and found to give results that could distinguish these areas from the wider city and other slum types.

At the city-scale, spatial analysis tests whether Agra's slum areas share similar syntactic characteristics to those identified in slums in Jeddah, and other countries - where a lack of overlap between scales of spatial accessibility limits the social and economic interaction of these areas with the wider city. The paper finds that these conditions are also found in Agra's slums, but that the smaller typical block size in Agra means the slum's local structures emerge at a smaller scale radius than in Jeddah.

Finally, at the local-scale, the paper uses the findings from the field work of London Metropolitan University student's to ask whether the socio-economic segregation which has been observed at the wider scale in other Indian cities are also reflected in the slums themselves. Linking these findings with spatial analysis show that micro-scale patterns of activity and occupation within slums are closely related to local spatial structures. The paper discusses whether the spatial mechanisms which allow a highly segregated society to live within close physical proximity to each other - and which brings economic and environmental benefits in these circumstances - can off set the longer-term impact of social segregation.

1.0 INTRODUCTION

This paper aims to link three areas of study which have been carried out separately over the last five years, to help further develop the spatial understanding of slums and informal settlements.

The foundations of this paper lie in the unplanned settlements of Jeddah, Saudi Arabia, where the development of strategies to improve more than 50 unplanned settlements has formed a major component of Space Syntax Limited's work of the past five years. In unplanned settlements, including Jeddah's, a set of spatial characteristics have been identified which appear similar across unplanned settlements; while the edges of the settlements are often "active" through their exposure to movement at the city-scale (Greene, 2003), their internal spatial structures are almost entirely separate from the wider structure of the city (Karimi, Amir, Shafei, Raford, Abdul, Zhang, Mavridou, 2007).

The experience of Jeddah provided the opportunity to understand some of the formation processes which have contributed to the development of the current spatial conditions, and the chance to consider these in relation to a set of slum typologies identified by Mike Davis in his book "Planet of Slums" (Davis, 2006). These conditions and formation processes have not been studied through the work of Space Syntax Limited, but have provided background knowledge to draw on in considering whether each slum typology has its own specific spatial characteristics.

In late 2010, an opportunity arose to study Agra, and some of its 350+ slums. This study was carried out remotely to contribute to the work of students in the Architecture of Rapid Growth and Scarce Resource (ARGSR) studio at the London Metropolitan University (LMU), who were based in Agra for a period of time. This enabled work to be carried out initially to test whether the spatial characteristics identified by Greene and Karimi et al. are consistent in Agra's slums.

Through a process of literature review, the study was developed further to test whether the relationships identified between the socio-economic segregation of inhabitants by Caste at the scale of the city (Vithayathil, Singh, 2011), and in Delhi, at the scale of the ward (Dupont, 2002), are also present in Agra. It also provided the chance to understand whether there are any further relationships to the local scale spatial structure of slum areas.

These three areas of study are structured through the following geographically linked series of questions:

- Can the widely recognised slum typology of the squatter settlement, which is known to occur in Jeddah, be identified through syntactic modelling alone?
- Are the spatial conditions of slums identified by Karimi et al. in Jeddah also present in Agra?
- What are the socio-economic conditions of, and are these related to, the spatial characteristics of Agra's slums?

Part one uses two examples in Jeddah to discuss whether the processes that lead to the formation of slum typologies, and in particular the squatter settlement, can be identified only through analysis of the current spatial structure, and why this might be a useful technique to improve these areas.
Having identified that it is possible to identify particular types of slum through spatial analysis of the entire city, part two then broadens its focus to look at Agra's slums and the spatial relationships with the wider cities they occupy. This section examines whether Agra's slums share the same general characteristics by comparing them to Jeddah's 50+ unplanned settlements.

The final part uses the findings of a literature review (where relationships between Caste and slum occupant are identified at the scale of the city and the ward), and the results of spatial analysis, to compare them with qualitative, observational, socio-economic surveys carried out by ARGSR students from a set of six case study areas.

2.0 IDENTIFYING SQUATTER SETTLEMENTS IN JEDDAH

Within the wider study of slums, a set of typologies are recognised which are used to classify areas according to their formation and characteristics. These typologies include formal and informal, tenements, pirate sub-divisions and squatter settlements (Davis, 2006), to which can also be added the typology of urban village.

Within the city of Jeddah, the most commonly occurring typologies at the urban scale are pirate sub-divisions, urban villages and squatter settlements, which can be briefly described as follows:

- Pirate sub-divisions are defined as plots of peripheral land which are illegally sub-divided and sold privately to individuals to develop. Often these areas occur on the periphery of a city but they can also occur within the urban agglomeration (Figure 1)
- Urban villages describe the condition where an existing village, previously outside the boundary of the city, has become absorbed in rapid urban growth (Figure 2)
- Squatter settlements form rapidly through the illegal occupation of vacant areas of land. Often squatter settlements develop very quickly – almost over night – starting with temporary shelters which become more permanent over time (Figure 3)

If slums are to be addressed across a city, the typical scale of these areas means that it is very difficult to address all of them simultaneously. Collecting detailed socio-economic data on the type of rapidly changing urban areas that typify slums is very difficult. While research carried out to date has identified general spatial characteristics of slums, measures to identify specific slum typologies have not been explored.

Developing these measures would provide a major benefit in both prioritising areas to improve, and generating strategies that respond to the specific problems of formation. If models can be produced quickly and accurately, entire cities could be assessed and slum areas prioritised for improvement (or more detailed study). This reduces the need for socio-economic data to be collected at the start of the process, and allows the often over-stretched resources of rapidly developing cities to be targeted more efficiently.

Figure 1: Pirate sub-division - Al Harrazat

Figure 2: Urban Village – Bani Malik

Figure 3: Squatter settlement - Rabwa

2.1 Current conditions

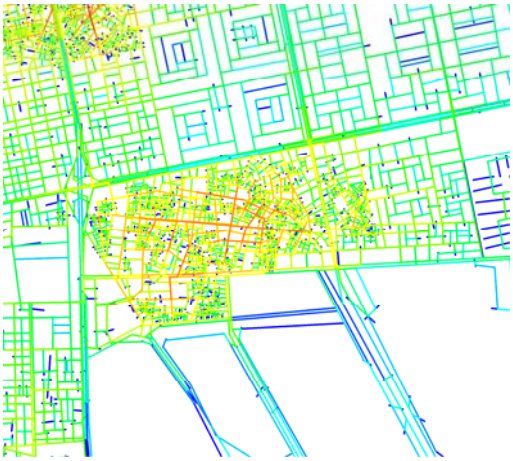
Using the example of two settlements in Jeddah that Space Syntax Limited are familiar with, the spatial characteristics of an urban village (Bani Malik) and a squatter settlement (Rabwa), can be compared.

Bani Malik has existed for around 50 years (Municipality of Jeddah, 2009), and shows a clear internal spatial structure which has evolved around a central spine. The spine is supported by a number of secondary connections to it, and the structure is also evident in the distribution of land uses which concentrate small scale commercial uses along its internal spine. The edge plots consist of outward facing, large scale commercial uses. The internal spine is segregated from the wider city by a major motorway that was constructed around three of its edges from the 1970s onwards.

By contrast, Rabwa has formed in the last 10 years (Municipality of Jeddah, 2009), and while there is a spatial hierarchy, the hierarchy does not create a legible structure; there is a point where highly accessible lines converge, however, many of the most accessible lines do not connect to this point, nor is this structure matched by the distribution of land use (Figures 4 and 5).

Bani Malik and Rabwa share the spatial characteristics of active edges but distinctly different global and local structures, and while the measure of local choice illustrates the structural differences between settlements,

to relate this analysis to typology requires comparison to other settlements, and knowledge of typical slum spatial structures.



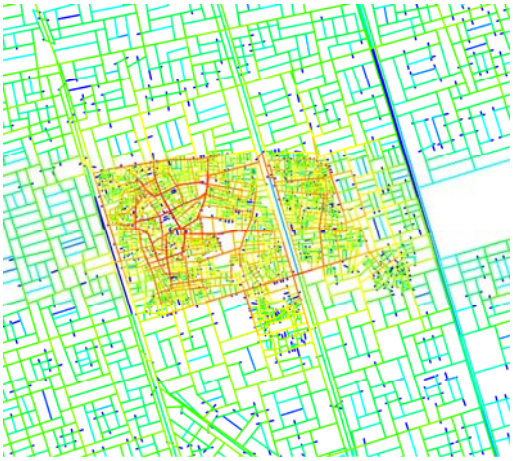


Figure 4: Bani Malik: Choice analysis radius 800m

Figure 5: Rabwa: Choice analysis radius 800m

The inhabitants of both Rabwa and Bani Malik include a high proportion of illegal immigrants, and in Rabwa, everyone occupies the land illegally. It is therefore difficult to discover much about the socio-economic circumstances of these people. Socio-economic data in Delhi collected by census and presented in Dupont's paper "Socio-spatial differentiation and residential segregation in Delhi: a question of scale?" describes that the worst living conditions tend to be found in squatter settlements: 31% of inhabitants are employed, 85% earn less than 2,000 rupees ($44US) per month, 42% are illiterate, 82% of properties are without drinking water, 96% have no separate kitchen, bathroom or toilet and 78% have only a single room to live in (Dupont, 2002). There is a strong case therefore that with limited resources these areas should be addressed as the first priority.

2.2 Formation

In considering the formation of squatter settlements it is possible to start to outline how these different areas might be identified through a spatial measure. Often they develop very quickly; in the case of Rabwa, the settlement developed within weeks after a security guard employed to protect a privately owned vacant sub-division was bribed. Initially, temporary shelters were constructed from light weight materials which were replaced over time with more sound masonry construction. The case of Rabwa is not unique within Jeddah or within squatter settlements world wide.

One of the key processes in forming squatter settlements is negotiation – or more precisely a lack of negotiation – concerning the way two separate properties join. Where legislation such as a party wall act does exist (effectively a set of rules defining how properties join), squatter settlements are unlikely to follow this as they are by definition illegal. In more developed urban slums, where the population has remained stable for a longer period, and communication between neighbours is better, a process of negotiation can take place and the extent of a property boundary agreed between all parties involved. In the case of

squatter settlements, because these areas tend to develop so rapidly, the channels of communication between neighbours are less established. Rather than risk offending an unknown neighbour, it seems that new buildings have been constructed a *safe* distance away. Visiting squatter settlements in Jeddah, this *safe* distance tends to be between half a metre and a metre.

2.3 Morphology

These processes create a very particular urban morphology where there is often a clearly defined edge to the settlement (normally the alignment of the fence or wall that defined the boundary before it was occupied), combined with a very dense urban area characterised by a large number of narrow paths.

The urban villages in Jeddah also tend to have clearly definable edges, but these are formed by the major infrastructure interventions that contributed to their absorption within the wider city - such as motorways or major roads - and this coincides with an increase in block size and outward facing commercial development.

The effect of the half metre spaces between properties in squatter settlements is not that the overall ratio of public space to urban block is particularly high (as the spaces between buildings are often very narrow), but that the node count at a very local scale is high. If the aim of finding a measure to identify a slum typology considers the process of formation, then a measure such as node count, run over a distance comparable to the average plot dimensions – in the 10s of meters rather than 100s – can begin to identify some of the areas that may be squatter settlements.

Testing this measure and comparing the results of Bani Malik and Rabwa does support this: at a radius of 60m, Bani Malik has an average node count of 23.77, with the areas of highest node count distributed in three main clusters away from the settlement edges. The average node count of Rabwa at the same radius is 32.06 with higher node counts distributed more consistently across the settlement although there is a drop around the centre of the settlement (Figures 6 and 7). These figures compare to a city wide average node count of 17.02.

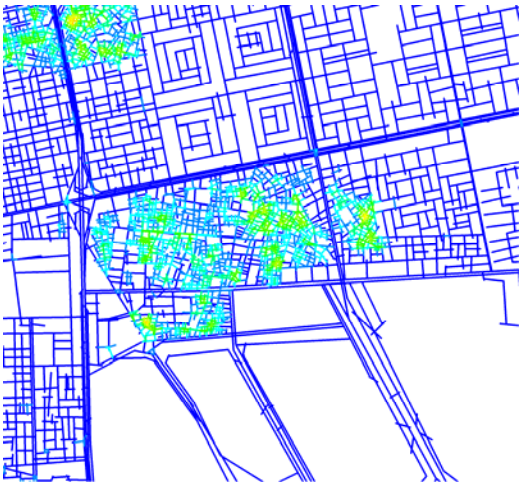


Figure 6: Bani Malik: Node count

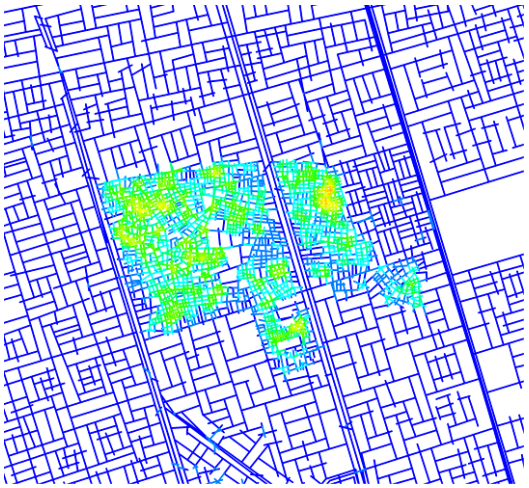


Figure 7: Rabwa: Node count

The range of values is wider within Rabwa where the standard deviation is 15.54, compared to 12.33 in Bani Malik. This would suggest that there is a broader distribution of node count and therefore block size, however as the average node count created by the process of squatting is so high, the distribution of results is more sensitive to lower node count values which are more common in the rest of the city. In Rabwa, it does not mean there are very large blocks, only that they are large in comparison to the rest of the settlement. This appears to be caused by the presence of the larger plots at the centre which are used as a market/trading area, and some private plots used as a plant nursery.

The lower average node count in Bani Malik indicates that block sizes are larger, while the geographic distribution of node count illustrates the impact of the increase in global accessibility created by the motorways. The resulting block consolidation that has occurred around the settlement edges has pushed these dense areas deeper in to the less accessible areas of the settlement.

It must be noted that one of the factors that could influence these findings is that the model of Jeddah was drawn manually as an axial map which was then segmented in Depthmap. This process can create high numbers of nodes in areas where a number of lines converge in public spaces and may lead to a skewing of results, however this should be consistent across settlements. Further study is required on more case study areas to clarify whether the characteristic of more geographically uniform distribution of high average node count at low radius is similar in other squatter settlements.

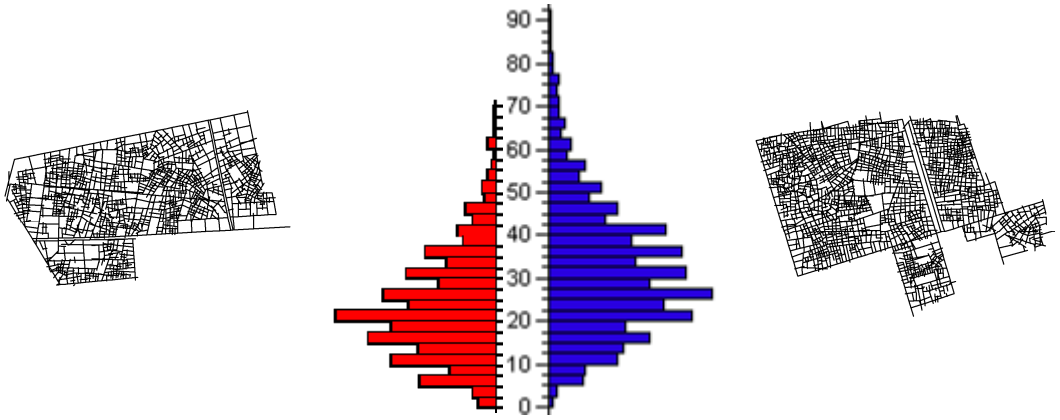


Figure 8: Settlement boundaries and distribution of node count values at radius 60m, Left - Bani Malik, Right - Rabwa

2.4 Summary

By testing two settlements in Jeddah where the formation process of each is known, the mean node count of the squatter settlement at a very local radius (60m), is found to be almost 35% higher than that found in the comparison urban village, and 88% higher than the rest of the city. The next section will start to study Agra's slums to identify whether the general spatial conditions identified by Greene and Karimi et al. are also present. Identifying general similarities between slums in these two cities is the first step in starting to test the effectiveness of the local node count measure in other areas.

3.0 SPATIAL CHARACTERISTICS OF SLUMS

In unplanned settlements, including Jeddah's, a set of spatial characteristics have been identified which appear similar across unplanned settlements; while the edges of the settlements are often "active" (Greene, 2003), their internal spatial structures are almost entirely separate from the wider structure of the city (Karimi et al., 2007). This section starts to examine whether these conditions are also found in Agra's slum areas.

3.1 Spatial modelling in data sparse situations

To be able to test whether the general characteristics of slums identified by Greene and Karimi et al. are present in Agra, an accurate model is required. In turn this requires accurate physical data of the slum areas which presents a consistent problem.

In Jeddah, the work of Space Syntax Limited has been underpinned by the collection of a vast amount of data by the Municipality of Jeddah. Work in the city over the past five years also means that qualitative information has been collected through visits to the areas, and discussions with people who grew up in the unplanned settlements before the slum condition developed.

In Agra, the collection of data has been more difficult. The spatial element of the study was carried out through the manual production of an axial map which was analysed as a segment model using Depthmap software. Construction of the map required accurate data for Agra and in particular the slum areas. A local NGO, the Centre for Urban and Regional Excellence (CURE), was able to provide LMU with maps as part of a three year programme they are undertaking to make improvements in slums.

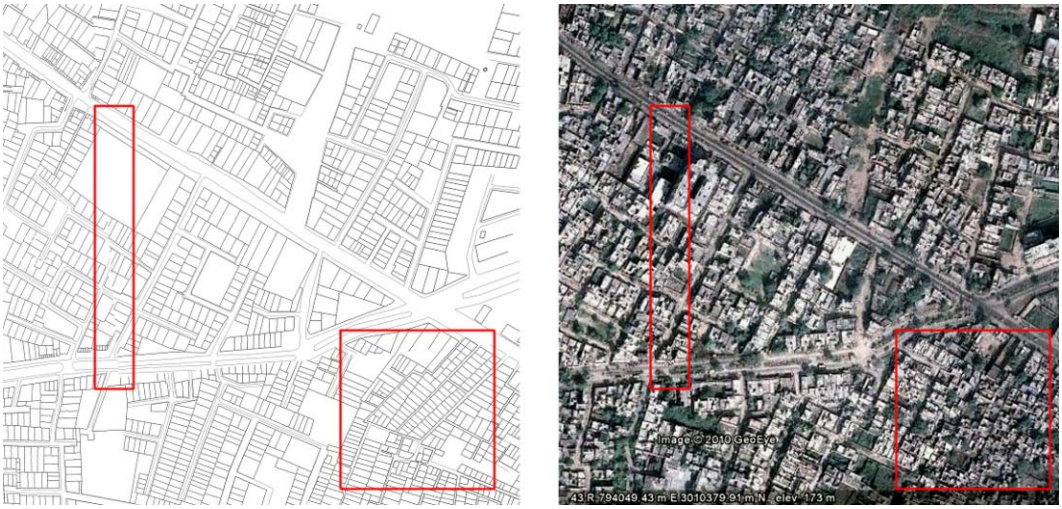


Figure 9: Extract of map of Agra and corresponding area in GoogleEarth - note discrepancies between satellite imagery and manually collected survey data.

Unfortunately, the accuracy of the map varies; in all cases urban block outlines have been clearly defined and in some cases building footprints are defined. Comparison with Google Earth shows some discrepancies between the two sets of information and many areas are different from recorded - although it must be

noted that Google Earth itself does not always use current photographs. Satellite imagery does not get rid of the problem that many slums are formed from complex networks of narrow alleyways, which are very difficult to distinguish from photos. The nature of slums, rapidly growing cities, and the commercial value of up-to-date information, means that these inaccuracies will always exist in traditionally collected survey data (see Figure 9).

The accurate modelling of large slum areas where neither the survey data, nor the resources to collect it exists, presents a major obstacle to the use of Space Syntax in these situations. While the increase in accessibility of GPS technology, and the rise of open source mapping communities such as OpenStreetMap (www.openstreetmap.org), has lead to a major increase in the availability of centreline information for many cities, often the slum areas are still missing.

One solution to the problem of data collection is being piloted by the organisation MapKibera (www.mapkibera.org), in the largest Kenyan slum in Nairobi: Kibera. Through a process of community involvement and interaction, the street network has been mapped by the local community using traces collected from GPS devices. Additional information including data such as land uses, services and facilities are added as places of interest, and while the map does not show details of building footprints, it does show the network of publicly accessible spaces.

Figure 10: Google Earth image of Kibera (top) and map of slum area produced through MapKibera project (bottom).

3.2 Spatial characteristics of Agra's slums

There are over 350 areas which classified as slums in Agra. These areas have been defined on the basis of the UN Habitat definition which identifies any household lacking in one or more of the following characteristics as a slum: access to water or sanitation, security of tenure, durability of housing or sufficient living area (UNCHS, 2003).

Geographically, the slums are distributed evenly across the city, although some patterns emerge: a cluster can be seen towards the centre of the old city adjacent to the Red Fort, and along the Amba Prasad Road, while a series of discrete settlements can be seen distributed at similar intervals along the east-west National Highway 2 (NH2) which defines the peri-urban/rural northern edge of the city (Figure 11).

This pattern of distribution appears consistent with the processes described by Veronique Dupont in the paper "Socio-spatial differentiation and residential segregation in Delhi: a question of scale?" (Dupont, 2002). In this paper, Dupont illustrates how Old Delhi has altered during the last century in terms of social composition and physical degradation: as the better off inhabitants who had traditionally lived close to

economic activity moved towards the less congested areas of city, low income groups were left behind to occupy expensive properties. In combination with this change in city centre inhabitant has been the development of industrial areas along major transport axes, which has sparked both formal and informal growth in close proximity to each other on the urban periphery.

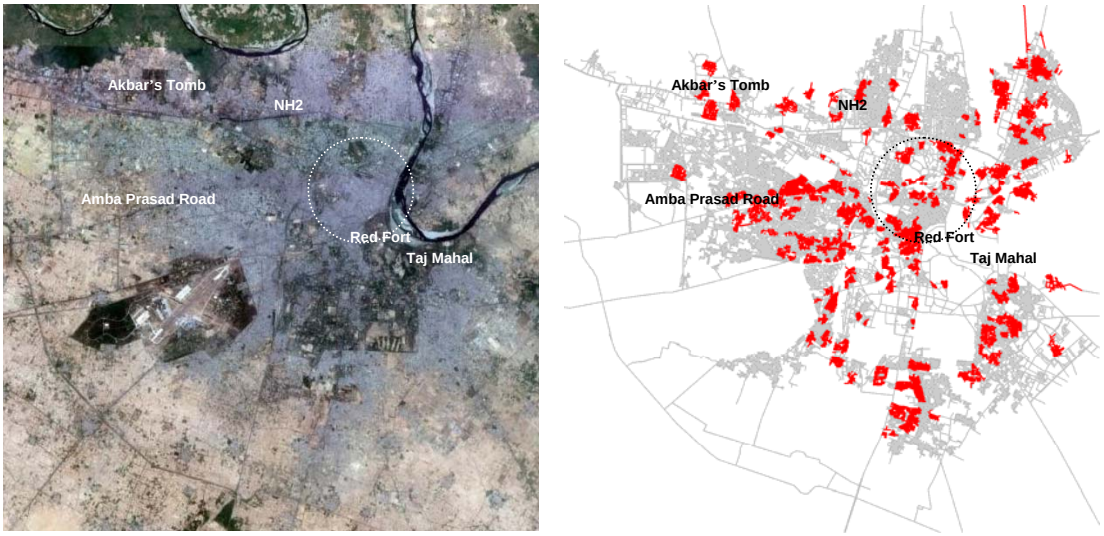


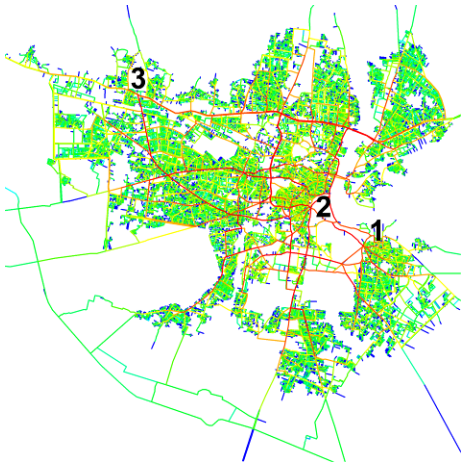
Figure 11: Agra (left) and its 350+ slums shown red (right), historic city centre shown by dotted circle

Spatially, the slums share similar characteristics of location: while they disappear within what could be described as the background network of residential uses (Hillier, 2009), many of them are located as described by Greene with at least one active edge (Greene, 2003) on some of the highest value global choice routes (10,000m) (Figure 12). This potential exposure to a wider scale of movement provides an economic opportunity at the edge of the area, however this edge condition, and the activity it provides tends to function in isolation from the local structure of the slum

These locations bring with them many benefits which include the proximity to the employment opportunities provided by the industrialisation of these areas. In the case of Agra, which has a major income source in the form of tourism, some of the most significant monuments (the Red Fort, Taj Mahal, Akbar's Tomb), lie on the convergences of these routes which offer further potential for economic activity.

The lower income residents benefit from living close to these high choice routes as they focus vehicular movement, including forms of public and shared transportation. Proximity to lower cost transport allows residents to access a wider set of potential employment opportunities across the city, although India's complex Caste system may negate many of these as the lower caste groups are discriminated against in such a way that employment opportunities may be affected (Vithayathil et al.2011).

In contrast to the formalised areas of residential use, the slums display a set of spatial characteristics which distinguishes them: While many of the formalised residential areas appear to have a similar lack of accessibility at the global scale, they have been planned on similarly scaled, often discontinuous, rectilinear grids, which do not create the variation in urban morphology that generates a local scale spatial structure. The slum areas, which are self-built, or adapted around ancient monuments and abandoned structures, develop the variations in route and block structure which helps to define local-scale spatial structures (Figure 13).



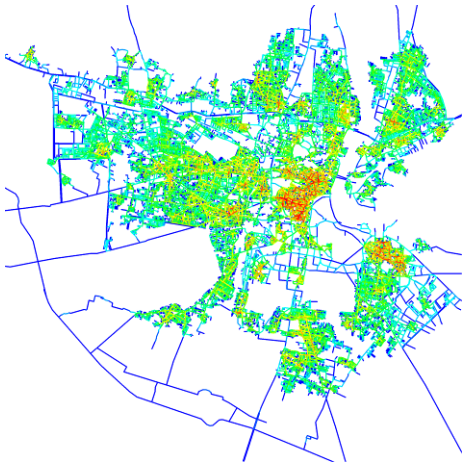


Figure 12: Choice analysis at radius 10,000m. Agra's slums often have an active edge but disappear in to the background network of the city. 1 Taj Mahal, 2 Red Fort, 3 Akbar's Tomb

Figure 13: Choice analysis at radius 400m. While many of the formalised/planned residential areas are still within the background network of the city, the slum areas develop their own structures and centres.

The definition of Agra's slum area boundaries does not appear to have taken spatial structure in to account, and specific boundaries vary widely by area. This means that what may be spatially defined as a single structure could in fact be divided in to two or three slum areas. This discrepancy between spatial and administrative boundaries means that there can be a degree of inaccuracy in using slum boundaries to carry out statistical studies of characteristics.

3.3 Comparison to Jeddah's unplanned settlements

Jeddah's unplanned settlements – which translate in Arabic as random areas – were defined by the Municipality of Jeddah, based primarily on identifying changes in the urban morphology between the planned and unplanned areas.

The boundaries of Jeddah's unplanned settlements are inherently spatial, and it is very rare that a definable local spatial structure is split in to more than one settlement in Jeddah, as happens in Agra.

Jeddah's 50+ unplanned settlements are also located across the city in a wide range of locations from the historic city centre, to the periphery of the urban agglomeration (Figure 14). The change in these areas that has occurred over the last 30 years due to socio-economic and physical condition shares many similarities with the case of Delhi.

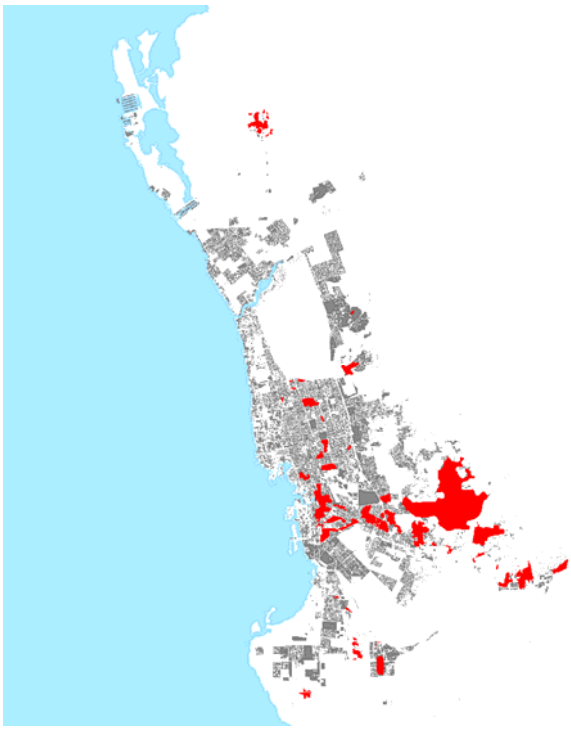


Figure 14: Jeddah's 50+ unplanned settlements (shown red)

The unplanned settlement characteristic described by Karimi et al. (2007), whereby the local scale networks that develop within settlements are independent of the hierarchies that develop at the global scale can also be seen in Agra. One of the differences in this characteristic is the degree to which the slums define themselves as separate spatial entities. In Jeddah the difference is startlingly clear at a choice radius of 800m, in Agra this difference is less clear and occurs at the smaller radius of 400m.

One reason for the difference between the two cities, and the reduced difference between planned and unplanned areas in Agra, could be the variation between typical planned sub-division grids in the two cities: while the unplanned/slum areas have similarly dense spatial networks, in Jeddah the typical shortest edge of a planned urban block is almost uniformly 60m, while in Agra it varies between 25m and 70m but is typically under 50m (Figure 15).

In essence, all residential use in Agra is similarly segregated, although perhaps this should not come as a surprise: many new developments in Delhi seek to segregate themselves through resident screening processes during the sale or rental process, gating communities or employing security guards (Vithayathil et al., 2011). While trends in the housing market must always be viewed carefully as they only reveal patterns about the choices which are available within the market at that time, the following section uses an example from an Agran slum to substantiate the desire for social segregation in residential areas in India.

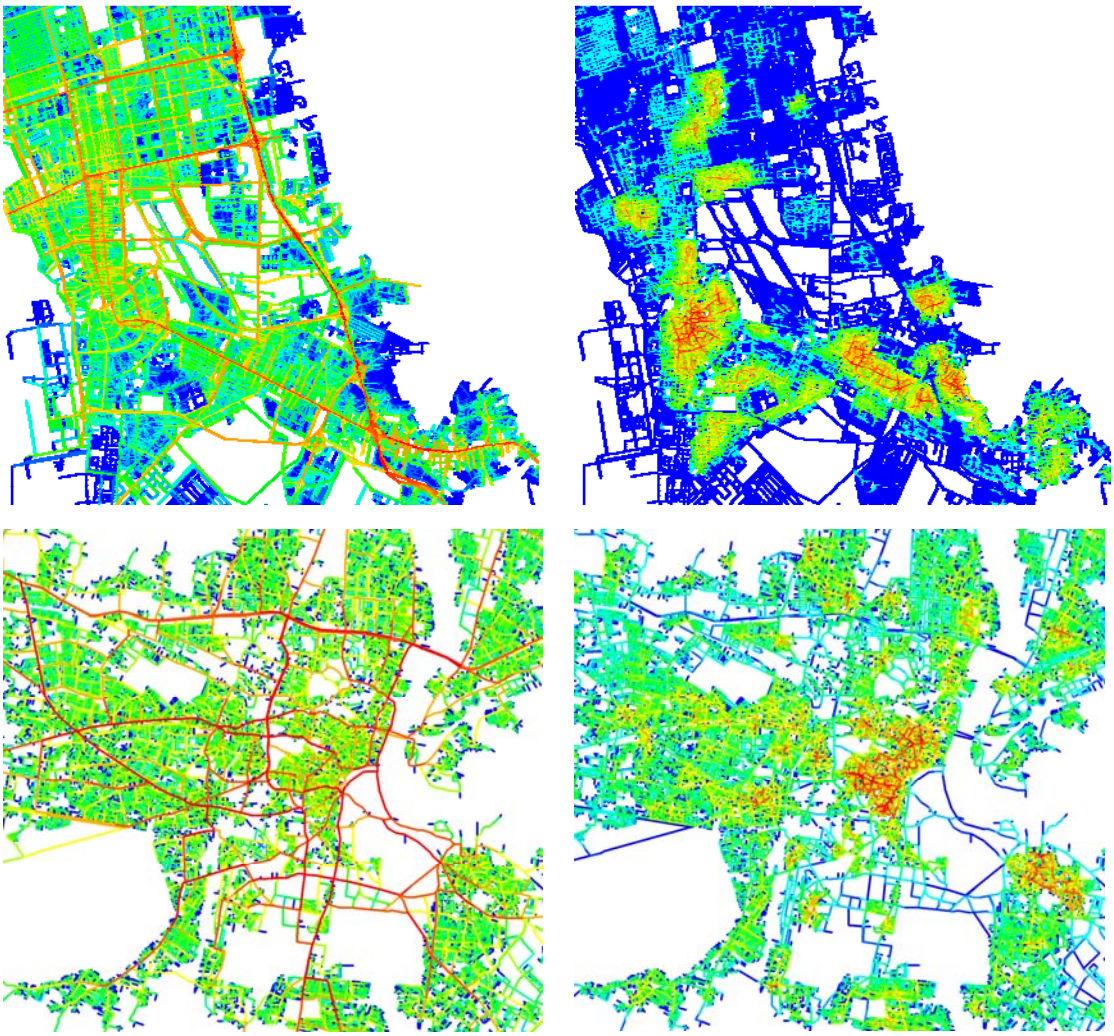


Figure 15: Global-scale choice analysis (left column) and local-scale analysis (right column), of Jeddah (top) and Agra (bottom). In both cities the slums emerge from the wider city at local radii

3.4 Summary

While there are small differences between the scales of analyses at which the characteristics are visible, there are many spatial similarities between slums in Agra and Jeddah, most notably the condition of active settlement edges combined with a distinctly different local and global scale spatial structure. Identification that these conditions are consistent means more detailed testing can be carried out (at a later date) to see whether the identification of squatter settlements in Jeddah also works in Agra. The next section uses case study slums in Agra to start to study the socio-economic conditions that exist within these areas, and to compare them to conditions found in other Indian slums.

4.0 SOCIO-ECONOMIC AND SPATIAL RELATIONSHIPS IN AGRA'S SLUMS

Six areas (chosen by students at ARGSR) form the basis for further study of the relationships between socio-economic and spatial conditions: Sikandra North, Sikandra South, Gokulpura, Wazipura, Old City North and

Old City South, (Figure 16). Within the six study areas many interesting conditions were observed which relate the Indian Caste system to use of the local scale spatial structure of the area.

4.1 City-scale social segregation

The Indian Caste system is complex and ancient, developing from Hindu religious practices that define groups and sub-groups based on occupational categories. There are five main groups which define the "upper and middle classes" – Brahmins (priests), Kshatriyas (warriors) and Vaishyas (traders) - the "backwards classes" – Shudras (workers) – and the "out castes" – Harijans/Untouchables (cleaners, butchers). Caste groups were associated with professions, some of which were seen as being unhygienic or unclean, and for this reason some Caste groups were often located in areas of the city separate from the other groups (Vithayathil, 2011).

This can still be seen by the way slum areas are populated by different groups: In Delhi, socio-economic data at the scale of the planning ward shows relationships between the occupants of slums and their Caste, where the distribution of Outcaste groups is often between three and four times higher in slum areas than planned areas - some slum area populations are formed by more than 65% from the Outcaste group (Dupont, 2002). While Caste plays less of a role in the daily lives of the upper and middle classes, there is evidence that it still plays a major role in the employment, education and living conditions of the lower groups (Vithayathil, 2011).

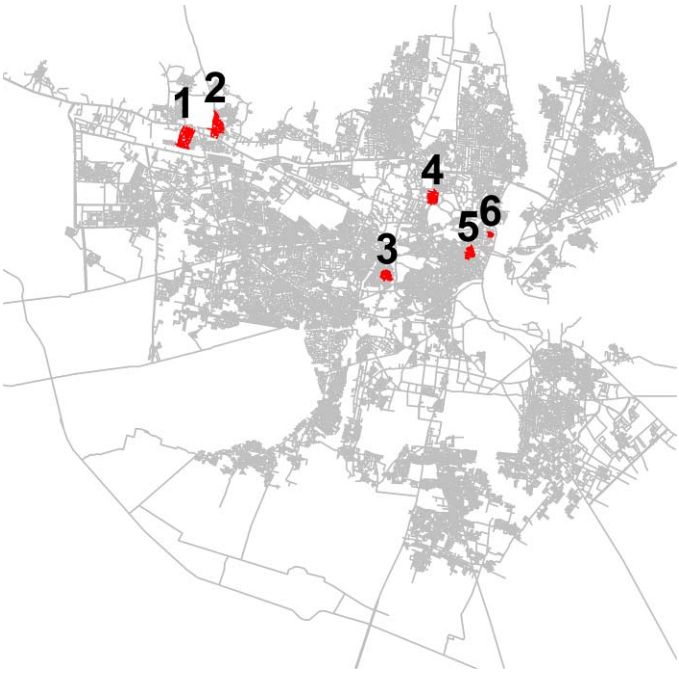


Figure 16: Six study area slums. 1 Sikandra North, 2 Sikandra South, 3 Gokulpura, 4 Wazipura, 5 Old City South, 6 Old City North

To understand whether these patterns are present in Agra presents many problems; accurate and detailed socio-economic data for Agra is even more difficult to collect than physical data – especially across more than 350 areas. Quantitative data collection requires large sample sizes, a carefully designed questionnaire

which can be interpreted consistently and which will provide useful information without causing the subject to feel too uncomfortable to answer, and large amounts of time and personnel to conduct the survey.

4.2 Slum-scale socio-spatial relationships

In the six study areas, socio-economic, physical and functional data was collected qualitatively by LMU students who in some cases spent up to six weeks living in Agra and visiting the slum areas each day. Data was collected by developing relationships with residents, engaging in shared cultural activities, carrying out interviews and observing patterns of use, activity and behaviour across the day.

As should now be clear; the study of Agra's slums presented several problems in relation to data collection. The approach followed here does not create a large enough data set to use for statistical analysis, but it does provide a preliminary understanding of conditions which can be used to outline key issues worthy of further study, and to outline whether similarities to slums in different regions are consistent.

To understand how these relationships occur in Agran slums, the urban forms of these areas needs to be explained in more detail. Across the city, many of the slums and older areas share a characteristic pattern where large urban blocks are broken by a number of narrow Galis (alley ways) running in to them and forming tree like structures which do not penetrate to the other side of the block (Figure 17).

Figure 17: Gokulpura: urban block morphology - a number of narrow Galis (left) penetrate into the block but do not create a connection to the opposite side. Income generating land uses are typically distributed around the more active block edges, while the centre is used predominantly for private residential uses (right). Red – Shops, Orange – Workshops, Yellow – Residential, Black – Monument, Green – Pig Farm, Blue – Public Toilets. Photo by Emily Broom, LMU

The block edges tend to be where the commercial activities such as shops and in some cases light industry or craft-based activities take place, while the tree structures are where residential uses are concentrated. One of the effects of the tree structures is that they focus activity on the block edges – the lack of connections

through the block and weight of origins and destinations created by the Galis increases choice values at a local scale.

By mapping the Caste of the occupants living on each of the Galis, a further pattern emerges which is that each of the fork structures is populated by members of the same Caste. The area of Gokulpura can be split by Caste into three areas. The northern most of these areas is occupied by Brahmins who inhabit a historic part of the city which was built inside and against the internal walls of the city when they were extended in the 1700s. These walls were later removed but the historic alignment of the walls can still be seen in the block structure and boundary between the Brahmin and Shudra Caste groups.

The settlement topography south of this alignment drops away to a Nala (sewerage canal) that cuts through the remaining area of settlement. The two sides of the Nala are occupied by Shudras on the north side, and Untouchables on the south side (Figure 18). Living conditions worsen on the southern side, and surveys of individual houses show that most of the occupants live in buildings originally constructed as temporary shelters, formed from a single living space without access to water or sanitation.

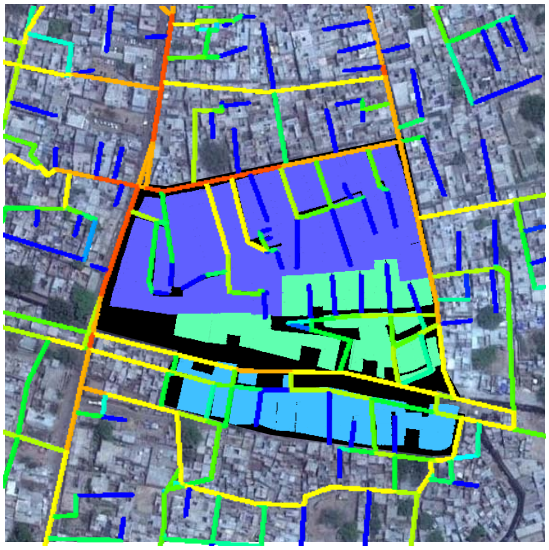


Figure 18: Gokulpura: distribution of Caste type. Dark Blue – Brahmin, Cyan – Shudra, Light Blue – Outcaste

Figure 19: Gokulpura: choice 400m analysis

Analysis of the spatial structure helps to identify how the spatial device of the Gali works in this context. The settlement can be seen as a set of discrete neighbourhoods where the residential areas are spatially segregated from the wider movement patterns of the city. This means that while residents may live in close physical proximity, perhaps even in buildings which share a party wall, the structure of the settlement means they rarely come in to contact with each other unless on the neutral territory of the commercial edges (Figure 19). This pattern is repeated across the other study area settlements.

Within Gokulpura, a further characteristic can be seen: each of the Caste group's Galis focus on a particular edge which strengthens it and gives each group a localised centre. The Brahmins' centre is the strongest at a local radius, followed by the Shudras, and finally the Untouchables – where the strongest shared space is the

edge of the Nala. The variation of activities that take place on each of these centres reflects the socio-economic circumstances of each group with a concentration of shops along the Brahmins' centre, craft shops and workshops along the Shudras' centre, and no economic activity but only public facilities in the Untouchables' centre.

Gokulpura also provides an interesting example of the Indian desire for residential segregation described earlier. When the old wall of the city was removed, a connection in the form of a Gali existed between the Brahmin and Shudra areas. The space at the boundary of this connection was used by the Brahmins as a rubbish dumping ground until a large enough obstacle was created to discourage pedestrian movement between the two areas.

These patterns are repeated throughout the six study areas, with different religions also following the same pattern of distribution in discrete areas. In the areas of Wazipura and Sikandra North, the main spine of each settlement, although spatially continuous, is split in to two territories. These territories were defined physically by brightly painted Hindu occupied buildings at one end and more muted Muslim occupied buildings at the other, however it was also reflected as a psychological barrier in the behaviour of the local children – most of the time, students of ARGSR were followed by groups of Hindu children eager to be involved in whatever was happening, at the point of the boundary however, children would refuse to cross in to what was perceived as another territory. The split in territories can be identified in the model at a very small radius (100m) which reflect the clustering of Caste group Galis around particular areas (see Figure 20 and 21).

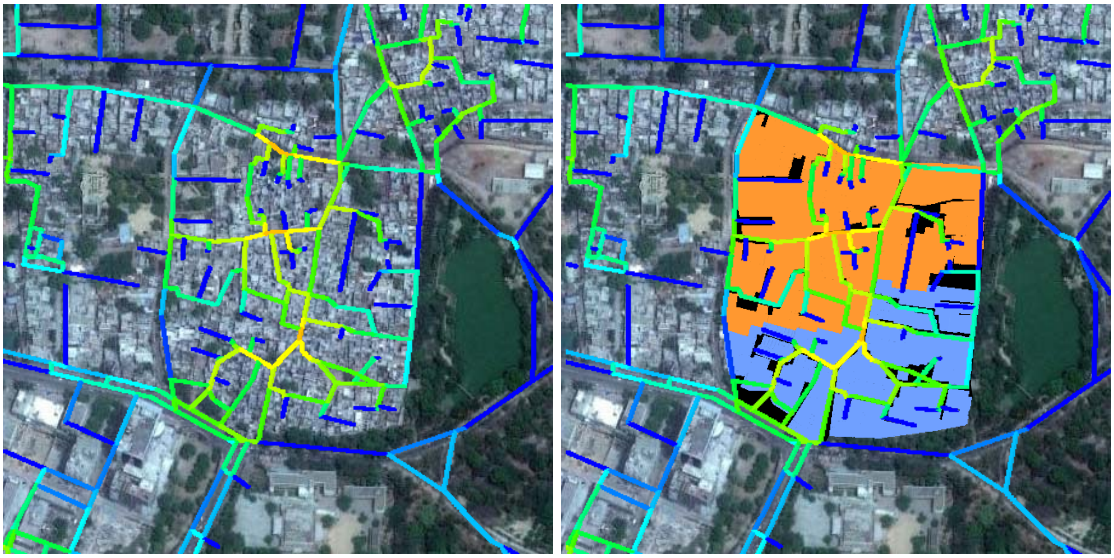


Figure 20: Wazipura: Choice analysis radius 100m and religion – Small centres can be seen to the North and South of the central spine which function as the commercial and cultural centres for each of the two religious groups.

Figure 21: Wazipura: Religious territories, Orange – Hindu, Blue - Muslim

Finally, further relationships can be seen in the use of space by different gender groups. In all six of the slums (except Sikandra South) it was observed that men would leave home to go to work during the day and return in the evening. When the men were present in the settlement they would populate the Gali spaces

outside their properties, using them as an extension of their homes. During this time the women would remain inside, however when the men were at work, the Gali spaces would be empty for a brief period before being re-populated by the women carrying out house work and socialising. During the evenings, when the men returned home the pattern would revert, and women were reluctant to be seen outside of their houses. To overcome the social pressure not to be seen walking alone in the evenings, the local women would move around across building rooftops.

Without the segregation provided by the Gali, or the roof top network, the women may have found the social stigma of being seen out of the house so great that they may not have left it at all. In this context the segregated network is a complex condition: while it does emphasise differences between groups which reinforce long term prejudices, it also provides easily controlled spatial structures which can be adapted by different user groups over the course of a day. Removing this segregation could, over the long-term, encourage movement through different areas and improve familiarity between groups, however in the short-term, it could also prevent some groups (such as women) going about their daily lives as they usually would.

4.3 Summary

The observations of ARGSR students show that the wider scale segregation of residential areas by Caste described by Dupont (2002) also happens at the scale of the settlement. In the case of Agra, this is evidenced through the changing use of space by particular social groups, and these groups are defined not only based on Caste, but also by religion and gender. Spatial analysis of the slum areas at very local scales (100m) is able to pick out localised centres which act as focal points for these social groups, and which would in turn indicate that the structure of the city has evolved to retain these separations.

5.0 CONCLUSIONS

The issue of slums raises a huge problem in terms of accurate data collection, whether that be physical or socio-economic. The development of spatial measures that can be used in data sparse situations to identify settlements most in need of improvement, or to prioritise one slum typology over another, would offer an effective and efficient planning tool for developing cities. This requires further development, both in terms of a method to collect the data accurately and quickly - perhaps through GPS technologies as applied in the work of MapKibera – as does the development of a specific spatial measure, although from the cases studied, very local scale node count does begin to pick out squatter settlements.

Identifying similarities between slums from different cities forms the basis for testing this measure further. By analysing the spatial relationships that exist across scales in unplanned settlements in Agra and Jeddah, it is possible to identify that although differences occur between the two cities in terms of the scale at which the local structures can be seen, the general condition that slums have their own spatial structure working in isolation from the wider city is consistent.

Using spatial analysis to look at the socio-spatial relationships within the six study areas covered by the work of the ARGSR students, it can be argued that the spatial and socio-economic segregation of slum dwellers observed at the scale of the City and the Ward, also happens at the scale of the Slum, and is emphasised through the spatial device of the Gali. Analysis of the spatial model at very local radii makes it possible to see

specifically where these differences occur. It can be argued that the Caste system is older than much of the urban fabric of Agra, and so played a more influential role in shaping the current morphology. This morphology multiplies the social divisions – and there is evidence that in some areas it is being consciously manipulated to reinforce these divisions - which handicap those at the bottom. While the disadvantages that the segregation creates are clear, there is one major advantage to the current form; inhabitants within a very conservative, clearly defined social structure, can live in close physical proximity to each other, allowing the sharing of resource and transfer of goods and services, while only coming into physical contact with each other in agreed spaces.

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BIBLIOGRAPHY

Davis, M, 2006, Planet of slums, Verso

Dupont, V, 2002, Socio-spatial differentiation and residential segregation in Delhi: a question of scale? Elsevier

Greene, M, 2003, Housing and community consolidation in informal settlements: A case of movement economy

Hillier, B, 2009, Spatial sustainability in cities: Organic patterns and sustainable forms

Karimi, K, Amir, Abdulgader, Shafei, K, Raford, N, Abdul, E, Zhang, J, Mavridou, M, 2007, Evidence-based spatial intervention for regeneration of informal settlements: the case of Jeddah central unplanned areas

MapKibera, www.mapkibera.org

Municipality of Jeddah, 2009, Jeddah Strategic Plan

OpenStreetMap. www.openstreetmap.org

UNCHS (Habitat), 2003, *The challenge of slums: Global report on human settlements*, Earthscan Publication Ltd. London.

Vithayathil, T and Singh, G, 2011, Spaces of discrimination: residential segregation in Indian Cities