



Perceptions of the impacts of urban sprawl among urban and peri-urban dwellers of Hyderabad, India: a Latent class clustering analysis

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Abstract

Like many other developing countries, urban sprawl is a growing phenomenon in India, which poses socio-economic and environmental challenges that worryingly affect urban sustainability. In this study, a latent class clustering approach was used to investigate perceptions of urban sprawl among 622 urban and peri-urban dwellers in Hyderabad. The empirical results clustered the respondents into three distinct classes based on their perceptions of urban sprawl impacts: ‘undecided respondents’, ‘negative perceivers’, and ‘opportunity perceivers’. The majority of respondents were undecided with no strong views towards the impacts of urban sprawl, which may increase their vulnerability and hinder effective adaptation to the adverse economic, social and environmental effects of urban sprawl. This also provokes concerns about the effectiveness of government interventions to build public awareness of urban development and its impacts on the city. With regard to the role of demographic and socio-economic characteristics in shaping the perception of the respondents, the results revealed that social caste plays a determining role in forming dwellers’ perception. In particular, members of marginalised social castes were more likely to form positive perceptions of the impacts of urban sprawl as urban expansion generates better and stable income that improve their social status. In addition, individuals with higher levels of education were more likely to form negative or positive perceptions, implying that efforts to raise social capital could be a useful means for mitigating the impacts of urban sprawl. Finally, membership in community development organisations was a key factor in dictating membership of the negative perceivers’ class. Overall, our findings suggest that an appropriate policy framework and specific programmes are needed for enhancing dwellers’ perception towards the impacts of urban sprawl, which can enhance the design, acceptance, and implementation of a more sustainable governance of urbanisation and contribute to achieving urban sustainability in developing countries.

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1 Introduction

Since the second half of the last century, the world has experienced rapid urbanisation processes, which increased the percentage of the global urban population from 30% in 1957 to over 50% in 2018 (United Nations, 2019). Projections suggest that urbanisation will especially accelerate in major regions of the developing world over the coming decades, leading to a substantial demographic transformation process that will concentrate fully two-thirds of the world's population in cities and towns (UN Habitat, 2020). Rapid urbanisation processes in developing countries often result in 'urban sprawl' which has become increasingly pronounced in Asia and Africa, where urbanisation is occurring at a rapid pace (Abu Hatab et al., 2019). Despite that the concept of urban sprawl has been a topic of scientific research for several decades, there has been no consensus about what defines urban sprawl (Wang et al., 2020). However, urban sprawl can generally be defined as a rapid and disorderly expansion of built land-cover, with low population density and with change characterised by the speed of urban area growth outstripping the speed of population growth (Cobbinah et al., 2015; Jaeger et al., 2010).

Previous studies have shown that urban sprawl often leads to diverse negative effects including the inefficient use of land resources, rural outmigration, slums and informal housing in cities, heavy loads of traffic and pollution, disappearance of public spaces, deteriorated inner city neighbourhoods and public health issues (e.g. Grimm et al., 2008; Pandey & Seto, 2015; Rathore et al., 2020). This has prompted researchers to characterise the phenomenon of urban sprawl as being socio-economically and environmentally unsustainable, despite that there is evidence indicating that it has been as a catalysing factor in economic growth and development in developing countries (e.g. Gu et al., 2018; Ha et al., 2019; Jain et al., 2015). In this context, the UN Sustainable Development Goals (SDGs) and their targets explicitly recognise the links between urban sprawl and the social, economic and environmental dimensions of sustainable development (United Nations, 2019). That is, achieving the SDGs in developing countries would greatly depend on how urban environments are planned and shaped, and on the extent to which the benefits accruing from urbanisation are equitably distributed (UN Habitat, 2016).

From the literature perspective, existing studies on urban sprawl in developing countries have predominantly focused on investigating the 'land conversion' aspect of sprawling and measuring its subsequent economic, social, and environmental effects (e.g. Rathore et al., 2020; Singh et al., 2020; Taubenböck & Kraff, 2014). However, a significantly smaller number of studies have investigated public perceptions of urban sprawl and the role of the cognitive, emotional and behavioural aspects that shape and influence public perceptions (Botzat et al., 2016; Saksena, 2011). Perceptions of urban sprawl among urban and peri-urban dwellers could be driven by multiple forces, since urban sprawl occurs in several ways in various settlement zones, such as natural growth in urban population, rural-to-rural migration, urban-to-urban migration, and international immigration (Drescher & Iaquina, 2002). Zhai et al. (2019) show that informal settlers, poor, middle- and high-class urban, and peri-urban dwellers may all coexist in the same community but with heterogeneous perceptions and competing interests. This underscores the importance of adopting comprehensive frameworks to investigate how different demographic and socio-economic

segments of the urban and peri-urban population perceive the effects of urban sprawl and their influence on sustainable development.

As noted by Delgado-Serrano et al. (2015), stakeholders' knowledge and perception about the causes and impacts of interactions between social and ecological systems are important elements for the design and implementation of integral management practices. Thapa and Murayama (2010) point out that understanding the driving forces and effects of urbanisation and land-use changes requires analysing them within their surrounding environments by incorporating perceptions, knowledge and experiences of local communities, who observe and experience these changes from different perspectives. Pauw (2013) illustrates that people's perception determines their behavioural responses to socio-economic and environmental risks and opportunities, and thus shapes adaptation options and outcomes. In the same context, Bidandi and Williams (2020) and Baldwin and King (2018) show that an understanding of how different sociodemographic groups within rapidly urbanising communities perceive the impacts of urbanisation and land-use changes can inform the design of effective governance of urbanisation processes and urban sustainability.

Similar to other developing countries, India has been facing rapid urbanisation processes in recent decades, which increased the country's urban population by around 91 million between 2001 and 2011 (Government of India, 2017). It is projected that by 2050, nearly 50% of the Indian population will reside in urban communities (United Nations, 2014; Government of India, 2012). Thus, sustainable development challenges are increasingly felt more in Indian cities and among urban communities in the southern parts and states of India (e.g. Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, and Telangana), which are urbanising rapidly (Abhishek et al., 2017). In this respect, several studies have shown that many Indian cities are increasingly facing challenges pertaining to poverty, inadequate housing and unemployment, water and sanitation, solid waste management, transport infrastructure and environmental vulnerabilities (Nandi & Gamkhar, 2013; Abhishek et al., 2017; Ebeke et al., 2017). Accordingly, sustainable management of urbanisation has become a growing concern for urban planners to manage various socio-economic and environmental issues triggered by the process of urbanisation (Dinda et al., 2021). Therefore, understanding perception of urban sprawl among urban and peri-urban dwellers can contribute to a more sustainable urban planning that provides opportunities to influence the motives and attitudes of the public and effectively engage them in the design and implementation of urban planning policies.

With this background, this study adds to the literature on public perceptions of urban sprawl and land-use changes in developing countries. Drawing on a survey of 622 urban and peri-urban dwellers in the Hyderabad city of India, we used a latent class clustering approach (LCA) to investigate perceptions of various social, economic and environmental impacts of urban sprawl and examine the determinants of perceptions across different sociodemographic groups of dwellers. Specifically, this study contributes to the existing literature in two important ways. First, unlike the majority of existing studies that tend to focus mainly on farmers and rural residents' attitudes and perceptions of land-use changes and urbanisation, we focus on the perceptions of urban and peri-urban dwellers. Understanding the perceptions of 'urban and peri-urban' dwellers towards urban sprawl is especially important given that future sustainable development challenges in developing countries (e.g. food insecurity, poverty, and inequality) will be concentrated in urban and peri-urban areas (Abu Hatab et al., 2019). Second, we investigate the perceptions of urban sprawl through a sustainable development lens by analysing how urban and peri-urban dwellers perceive its economic, social, and environmental impacts. As noted by Wang et al. (2020),

focusing on the sustainability effects associated with urban sprawl provides a better understanding of their development direction in the future and the causal relationship between urban sprawl and sustainable development. In this respect, Uitto (2019) shows that taking a comprehensive view on sustainable development issues, such as urban sprawl, that integrates the three layers of sustainability is essential for moving towards more sustainable human-natural systems. In addition, while some of our findings are certainly context-dependent, they provide empirically grounded evidence regarding heterogeneities in perceptions of urban sprawl among different sociodemographic groups in developing countries. Thus, our findings could also be a useful starting point for more general research on public perceptions of urban sprawl in rapidly urbanising environments in developing countries, and how cities' sustainability could be achieved through participatory processes of management and decision-making of social–environmental systems.

2 Study area and sampling strategy

With a population of around 8 million inhabitants, Hyderabad is one of the fastest growing metropolises in India, which is further expected to be home to about 19 million residents by 2041 (GoAP, 2013; Census of India, 2011). The city covers an area of nearly 650 km², and it is located on the Deccan Peninsula, acting as the link between north and south regions of India (Das, 2015). In 2014, Hyderabad became the capital city of Telangana, a newly formed state in southern India, and it forms the urban core of the Hyderabad Metropolitan which extends to around 7228 km² (GoAP, 2013). The city was envisioned to be the engine of economic growth for both Andhra Pradesh and Telangana. Since then, Hyderabad has gone through substantial city-centric development projects that have made the city a hub of information technology (IT) and IT-enabled services. Besides these, Hyderabad houses several heavy industries such as Bharat Heavy Electric Ltd (BHEL), pharma industries and central and state research institutes. Because of urban and economic development and the booming IT sectors, the population of Hyderabad has continued to increase in recent years at a rate of 8% annually, with the influx of migrants from other parts of India, contributing the most to population growth. With such high rates of urban growth, Hyderabad has been increasingly facing a wide range of economic, sociodemographic, and environmental challenges, including overpopulation and pressure on infrastructure and natural resources, environmental degradation, increased socio-economic exclusion, spatial inequalities and poverty, unsustainable natural resource and waste management, and pollution. Moreover, the influx of migrants from the neighbouring districts of the state as well as from other states has especially resulted in the expansion of slum settlements, where close to one quarter of Hyderabad's residents live in slums (Census of India, 2011; Das, 2015).

The selection of the study area in the present study was based on the results of Gumma et al. (2017), who assessed urban expansion and other land-use and land-cover changes in Hyderabad from 2005 to 2016. Using the outer ring road of Hyderabad as a boundary of the city (Fig. 1), Hyderabad was divided into imaginary 10×10 km grids, each having similar features, and identified two urban (blue grids) areas and two peri-urban (red grids) areas that experienced the highest rates of urban sprawl between 2005 and 2016 (Fig. 2). Each grid was divided into four equal quadrants resulting in a total of 16 quadrants. Two quadrants were then excluded because the urban areas within these quadrants overlapped

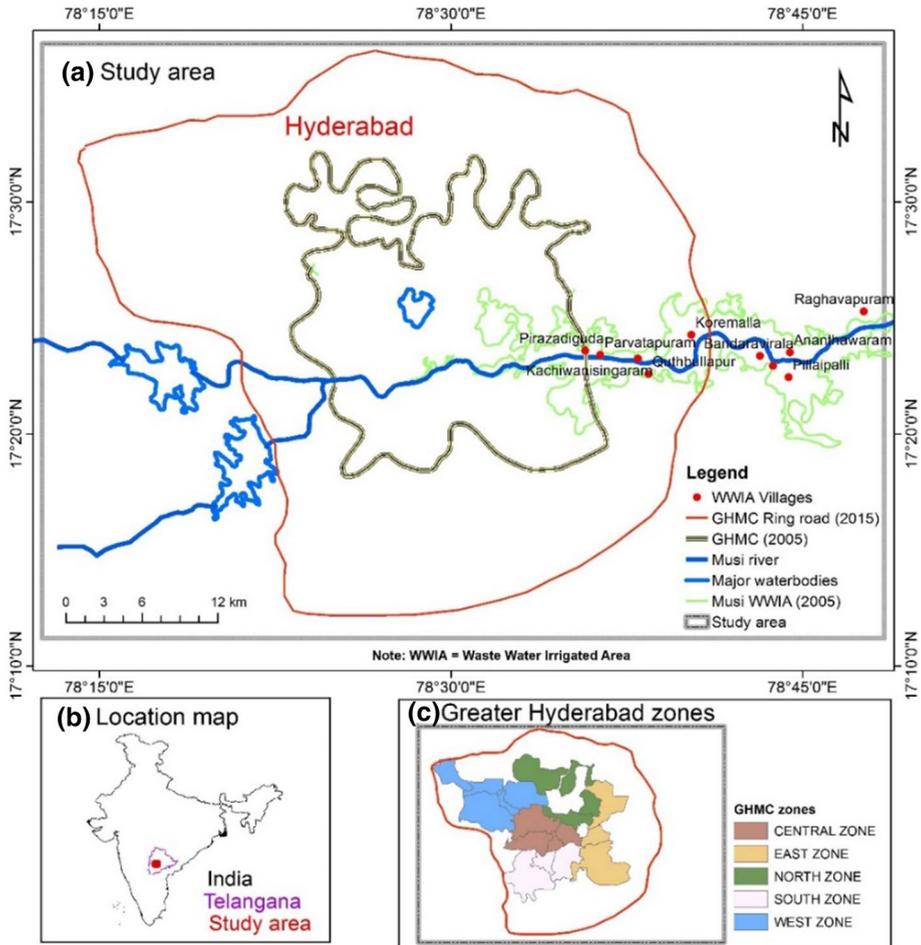


Fig. 1 Study area in Hyderabad (Source of Fig. 1: GIS Unit, ICRISAT, India)

with two other quadrants. Next, one area/mandal¹ from each quadrant was sampled randomly based on population data collected from the District Census Handbook 2011 (Census of India, 2011). These areas were considered to be representative of the urban and peri-urban regions of Hyderabad and a number of 14 mandals was considered an optimal number under the given time frame and budget considerations of the study. The proportion of the geographic area of each mandal in grid cells was estimated using the map in Fig. 2. The proportion of the geographical area of the mandal in the grid was multiplied by the total population of the mandal. Using this method, total population for each grid and its contribution in the total sample was calculated. Finally, based on a probability to proportion size, 662 households were randomly sampled from these 14 mandals, which consist of 291 urban households (47% of the sample) and 331 peri-urban (53%).

¹ Mandal is a sub-administrative division commonly used in India and some South Asian countries.

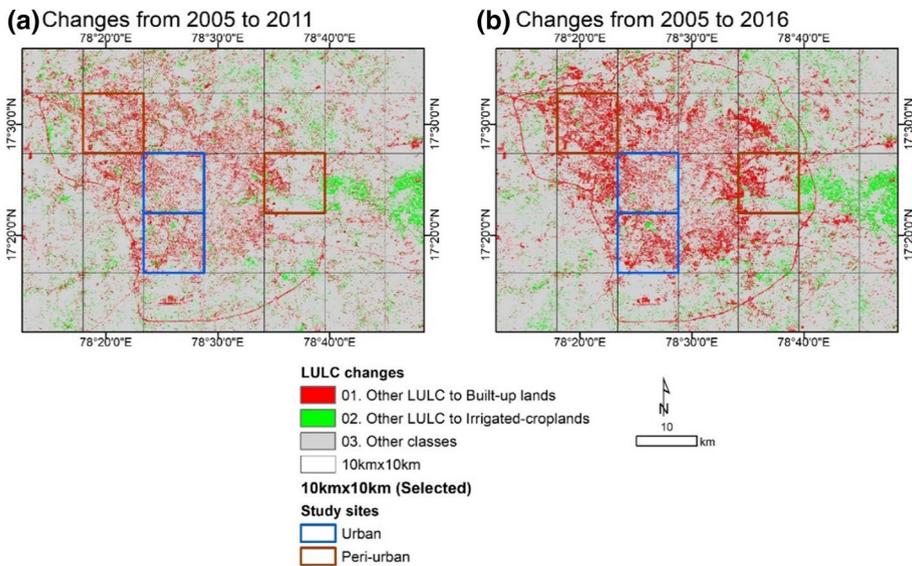


Fig. 2 Study areas identified by land-use and land-cover (LULC) changes for Hyderabad between 2005–2016 based on Gumma et al. (2017)

3 Empirical methodology

3.1 Survey design and data collection

Based on desk research that was carried out to review the relevant literature on urbanisation and public perceptions in developing countries, a tablet-based questionnaire was designed to investigate the perceptions of urban sprawl among urban and peri-urban dwellers in Hyderabad. The final questionnaire included structured and open-ended questions, and consisted of three main sections to obtain information on (A) household sociodemographic and dwelling characteristics, agricultural land and animal inventory, and livelihood options and income of the household, (B) perceptions of urban sprawl, and (C) food and nutrition security of the household. It should be noted that the survey of this study is part of a larger survey that aims to understand the impacts of urban sprawl on land-use changes, livelihoods and wellbeing of households, and food security in India. The empirical analysis in this study is based mainly on section B (*perceptions of urban sprawl*) as well as some questions from section A (*household sociodemographic and dwelling characteristics*). In particular, section B of the survey contains questions related to perceptions and observations of the respondents about changes in the neighbourhood where they live in terms of agriculture, built up area in the neighbourhood, loss of agricultural land and ongoing changes and expansion. It also reflects the opinions of respondents about the rate of urban growth, driving forces that influence expansion in the neighbourhood and the impacts of urban sprawl on the economy, environment and society. The full questionnaire is available in the Supplementary Material of this study.

In accordance with our sampling strategy, data collection took place between October 2018 and February 2019 through face-to-face interviews with households residing

within the blue and red grids highlighted in Fig. 2. Interviews were conducted with the household head or with an individual aged 20 and above. Following the standard ethical procedures for undertaking research on human subjects, written consent from the Deputy Commissioners or Sarpanch of Gram panchayat of the selected locations was taken prior to the data collection. Moreover, informed written consent, together with photograph consent, was taken from each respondent. Greater Hyderabad Municipal Corporation officials supported the team in undertaking the household surveys. In exchange for completing the survey, respondents were rewarded with an incentive in the form of a stainless steel container for storing freshly cooked foods worth around 1.5 US dollars.

3.2 Measuring dwellers' perception of urban sprawl

In recent decades, a rich literature has investigated the impacts of land-use changes and the expansion of built land-cover on developing countries. Elements of this literature suggest that urban sprawl is a complex phenomenon that has multifaceted and interlinked environmental and socio-economic impacts (Ozturk, 2017; Wang et al., 2020), and should consequently be approached holistically by focusing on their interlinkages with sustainable development. Thus, we applied a sustainable development lens to review previous studies on the impacts of urban sprawl in developing countries and identify a list of relevant measures for investigating dwellers' perception of various effects of urban sprawl (Table 1). In terms of the economic effects, some studies have found that urban growth is positively associated with the creation of new business and employment opportunities, as cities are attractive places for investment and growth because they provide access to larger markets, skilled labour, intermediate inputs, and utilities (Collier and Venables, 2017; Fu and Hong, 2010). However, Gollin et al. (2016) point out that the impact of urbanisation on economic development depends on the sector in which the urban labour force is allocated and in which investments are made. It also depends on whether urbanisation is industry-led or resource-led, which results in different productivity growth and economic impacts on business and employment across countries (Gollin et al., 2016).

With regard to the social impacts of urban sprawl, Glaeser (2014) and Hove et al. (2013) show that rapid urbanisation in poor countries has led to poorly managed cities, jeopardised human security through environmental, economic and social challenges and increased the incidents of crimes and gangs within urban areas of these countries. Li et al. (2016) find that urbanisation has increased number of conflicts and social tension in Chinese cities, which highlights the need to improve multi-level governance and inter-regional coordination, adjust the level of redistribution, and integrate rural and urban community governance structures. Previous studies have also shown that urban sprawl is associated with massive rural-to-urban migration flows (e.g. Hossain, 2013; Potts, 2015) and the prevalence and proliferation of slums in developing countries' cities. In addition, Mckenzie (2008) shows that rapid urbanisation and inflow of people from different areas may decrease the number of social networks, worsen social interaction, cohesion and community solidarity. Furthermore, the literature tends to support the hypothesis that urbanisation empowers women economically, improves their social status and enhances their participation in community's decisions (Mabala and Tacoli, 2010; Tacoli, 2017).

With respect to the environmental impacts, the literature generally associates urban sprawl with increased environmental externalities. For instance, Gao and Liu (2012) show that urbanisation processes lead to significant land-use changes and increased deforestation. Ayama et al. (2013) investigated the relationship between urban sprawl and biodiversity in

Table 1 Measurements of respondents' perception of the impacts of urban sprawl

| Dimensions of sustainability | | Relevant literature | | Impact of urban sprawl |
|--|--|---|--|----------------------------------|
| Statements included in the questionnaire | Authors/year | | | |
| Economic | Urban sprawl improved overall standard of living (<i>Living standards</i> *) | Ebeke and Etoundi (2017) | | Negative |
| | Urban sprawl created more business and investment opportunities (<i>Business/investment opportunities</i>) | Ha, Le and Trung-Kien (2019) Collier and Venables (2017) | | Positive Positive/Ambiguous |
| | Urban sprawl increased and diversified employment opportunities (<i>Employment opportunities</i>) | Gollin et al. (2016) Fu and Hong (2010) | | Negative/Ambiguous Positive |
| Social | Urban sprawl increased the incidents of crimes and gangs in the community (<i>Crime</i>) | Sato and Zenou (2015) Glaeser (2014) | | Positive Negative |
| | Urban sprawl increased tensions and stimulated conflicts between residents of the neighbourhood (<i>Conflict</i>) | Hove, Ngweme & Muchemwa (2013) Chen et al. (2018) | | Negative Positive |
| | Urban sprawl caused the proliferation of slums (<i>Slums</i>) | He, Liu, Webster and Wu (2010) | | Positive |
| | Urban sprawl worsened social interaction, cohesion and community solidarity (<i>Social interaction</i>) | Jain et al., (2015) Mckenzie (2008) | | Positive Negative |
| | Urbanisation increased migration (<i>Migration</i>) | Abdullah et al. (2009) Potts (2015) Hossain (2013) | | Positive Positive Positive |
| Environmental | Urban sprawl improved social status and increased women's participation in the community's decisions (<i>Women status</i>) | Mabala and Tacoli (2010) | | Positive |
| | Urban sprawl increased deforestation or loss of biodiversity (<i>Biodiversity</i>) | Tacoli (2017) Gao and Liu (2012) Ayama et al., (2013) | | Positive Negative Negative |
| | Urban sprawl increased pollution of water, soil and air pollution (<i>Pollution</i>) | Gu et al. (2018) Chen et al. (2014) | | Negative Negative |

Table 1 (continued)

| Dimensions of sustainability | Statements included in the questionnaire | Relevant literature | Impact of urban sprawl |
|------------------------------|---|-------------------------------|------------------------|
| | | Authors/year | |
| | Urban sprawl increased solid waste generation and their attendant management challenges (<i>Waste generation</i>) | Chen (2018) | Positive |
| | | Hoorweg and Bhada-Tata (2012) | Positive |

* Labels of statements are in parentheses. These short labels were used in Fig. 3

Nigeria, and found that non-urban sprawl areas generally had more diversity than those within sprawl areas and that urban sprawl caused significant biodiversity loss. In addition, the literature reveals that urban sprawl increases pollutant emissions, changes hydrological processes and water quality significantly, and increases spoil and air pollution (Chen et al., 2014; Gu et al., 2018). Furthermore, previous studies have shown that the generation of municipal solid waste is related to various features of urbanisation, creating increased challenges related to solid waste management (e.g. Chen, 2018; Hoornweg & Bhada-Tata, 2012).

In accordance with the findings of the previous studies highlighted above, our questionnaire initially contained 27 statements to assess perception of various effects of urban sprawl among urban and peri-urban dwellers of Hyderabad. Specifically, the respondents were asked to rate the level of their (dis)agreement with each statement on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Of these 27 statements, we finally selected 12 statements, reflecting the three pillars of sustainability (economic, environmental, and social), for inclusion in the LCA. The selection was based on internal consistency of these statements, which was calculated using the Cronbach's alpha. Table 1 lists each of these statements and the dimension of sustainability that they were intended to assess.

Finally, variations in dwellers' perception of various impacts of urban sprawl were examined according to key demographic and sociodemographic characteristics of the respondents. As shown in Table 2, demographic covariates consisted of age, education, and the social groups to which the respondents belong. With regard to socio-economic characteristics, four variables were included, namely: household size, annual household income, the type of residential area, and membership of a community development organisation or other NGO. In the LCA, we investigated the influence of each of these predictors on the probability for an individual to be a member of any of the latent classes.

3.3 Data analysis

A latent class analysis (LCA) approach was used to *i*) cluster urban and peri-urban dwellers of Hyderabad based on their perceptions of the impacts of urban sprawl, and *ii*) examine the factors that influence their membership of various clusters. LCA is a model-based approach that posits the existence of an 'unobserved' categorical variable that splits a population into mutually exhaustive and exclusive latent classes (Bartholomew et al., 2011). The LCA identifies heterogeneities within a population by analysing behavioural patterns of the individuals (perceptions of urban sprawl in this study), and finds common types, called classes. Each of these classes contains sub-groups of individuals who share similar characteristics, which make them distinct from individuals belonging to other classes. An individual's membership of a particular class can be inferred from a set of measured items. LCA has an advantage over other approaches that lack criteria for cluster choice selection and for identifying the correct number of clusters (Lazarsfeld & Henry, 1968). It also allows for analysing variables of different scale types and mixed measurement levels, makes the choice of the cluster criterion less arbitrary, and provides more formal criteria for identifying the number of clusters.

Following Linzer and Lewis (2011), the LCA can be expressed as follows. Let π_{jrk} represent the 'class-conditional probability' so that an individual in class $r=1, \dots, R$ generates the k_{th} outcome in the J_{th} variable. The sum of all outcomes for each manifest variable within each r is equal to 1. p_r captures the unconditional probability for an individual to

Table 2 Definition of variables used in the LCA

| Variable | Type | Definition |
|---------------------------------|--------|--|
| <i>Demographic variables</i> | | |
| Age | Binary | 1 = ≥ 35 years; 0 = younger than 35 years |
| Residential area | Binary | 1 = the respondent lives in urban area within the boundaries of Hyderabad; 0 = otherwise (peri-urban) |
| Education | Binary | 0 = below secondary education; 1 = secondary or higher |
| Scheduled tribe (ST) | Binary | 1 = the respondent belongs to the ST social group; 0 = otherwise |
| Backward caste (BC) | Binary | 1 = the respondent belongs to the BC social group; 0 = otherwise |
| Forward caste (FC) | Binary | 1 = the respondent belongs to the FC social group; 0 = otherwise |
| Scheduled caste (SC) | Binary | 1 = the respondent belongs to the SC social group; 0 = otherwise |
| <i>Socio-economic variables</i> | | |
| Household size | Binary | 1 = ≥ 5; 0 = less than 5 |
| Income | Poly | 0 = low income (< 180,000 INR); 1 = middle income (180,000–240,000 INR); 2 = high income (> 240,000 INR) |
| Membership | Binary | 1 = the respondent is an active member in a community development association or other NGOs; 0 = otherwise |

Table 3 Fit statistics for the latent classes

| No of classes | AIC | BIC | χ^2 | G^2 |
|---------------|------------------|------------------|-----------------|----------------|
| 2 | 17,787.15 | 18,223.19 | 9272.452 | 7884.05 |
| 3 | 17,031.00 | 17,907.58 | 8320.302 | 6982.16 |
| 4 | 17,281.84 | 17,938.15 | 8669.142 | 7409.51 |
| 5 | 16,876.37 | 17,973.22 | 8067.677 | 7700.66 |

AIC: the Akaike information criterion; BIC: the Bayesian information criterion; χ^2 : Chi-square goodness of fit; and G^2 : Likelihood ratio/deviance statistic

belong to each class before taking into account the responses Y_{ijk} provided on the observed variables, so-called ‘the prior probabilities of class membership’. Assuming conditional independence of the outcome Y given class membership, the probability that an individual i in class r produces a particular set of J outcomes on the manifest variables is therefore the product of the following formula:

$$f(Y_i; \pi_r) = \prod_{j=1}^J \prod_{k=1}^{K_j} (\pi_{jrk}) Y_{ijk}$$

Accordingly, the probability density function across all classes is the weighted sum:

$$P(Y_i, p) = \sum_{r=1}^R \Pr \prod_{j=1}^J \prod_{k=1}^{K_j} (\pi_{jrk}) Y_{ijk}$$

The parameters estimated by the latent class model are Pr and π_{jrk} . Based on the parameters estimates \hat{P}_r and π_{jrk} of Pr and π_{jrk} , the posterior probability that each individual belongs to each class, conditional on the observed values of the manifest variables, can be calculated using Bayes’ formula:

$$\hat{P}(r_i Y_i) = \frac{\hat{P}_r f(Y_i; \hat{\pi}_q)}{\sum_{q=1}^R \hat{P}_q f(Y_i; \hat{\pi}_q)} \quad \text{where } r_i \in \{1, \dots, R\}$$

The estimation of the latent classes and covariates was performed using the freely available poLCA package² within the R statistical package (Linzer & Lewis, 2011). The poLCA uses expectation–maximisation and Newton–Raphson algorithms to estimate the parameters of the latent class models for categorical variables. In this analysis, we ran the expectation–maximisation algorithm with the number of clusters varying from one to five, with 500 random initialisations for each number of clusters.

In light of Forster (2000), the optimal number of classes can be calculated by minimising the Akaike information criteria (AIC) or the Bayesian information criteria (BIC), with the latter being more recommended for fitting the basic latent class with larger sample sizes. Thus, we minimised the BIC to calculate the optimal number of classes of Hyderabad’s urban and peri-urban residents based on their perception of urban sprawl. As

² More information regarding the poLCA package, can be found at: <https://cran.r-project.org/web/packages/poLCA/poLCA.pdf>.

Table 4 Sociodemographic characteristics of respondents

| Characteristics | Description | % of the respondents |
|-------------------------------|--|----------------------|
| Age (years) | < 35 | 66.31 |
| | ≥ 35 | 33.69 |
| Residential area | Urban dwellers (<i>blue grids in Fig. 2</i>) | 46.78 |
| | Peri-urban dwellers (<i>red grids in Fig. 2</i>) | 53.21 |
| Educational level | Below secondary education | 48.49 |
| | Secondary or above | 51.51 |
| Scheduled tribe (ST) | Belongs to ST | 3.17 |
| Backward caste (BC) | Belongs to BC | 54.83 |
| Forward caste (FC) | Belongs to FC | 7.70 |
| Scheduled caste (SC) | Belongs to SC | 34.29 |
| Household size | ≥ 5 | 58.36 |
| | < 5 | 48.07 |
| Household income ¹ | Low income (< 180,000 INR) | 22.66 |
| | Middle income (180,000–240,000 INR) | 44.41 |
| | High income (> 240,000 INR) | 32.93 |
| NGOs' membership | Member | 44.26 |
| | Non-member | 55.74 |

¹At the time of the study 100 INR = 1.45 USD

shown in Table 3, the optimal number of classes was found to be 3, which was also simultaneously found the model parameters that maximised the likelihood. Furthermore, both the likelihood ratio Chi-square (G^2) and Pearson's goodness of fit (χ^2) in Table 3 confirm the appropriateness of the model selection by comparing expected against predicted class membership. That is, both G^2 and χ^2 are minimised at the three-class levels, indicating a goodness of fit at the third latent class.

4 Empirical results

4.1 Sample characteristics

Table 4 presents the sociodemographic characteristics of the respondents. It should be highlighted that during the interviews, both spouses (males and females) were present, and it was not part of the study design to interview each of them separately. Thus, the responses we have should be seen as being representative of the "household" perception of urban sprawl effects. Therefore, the empirical analysis in this study neglected the gender dimension to avoid any misinterpretations of the results. All respondents were aged between 20 and 65 years, standard deviation of 5.98 and a mean of 33.3 years. Around 47% of the respondents reside in the city of Hyderabad (Urban dwellers), whereas the remaining 53% reside in the peri-urban fringes of the city. Ethnographically, slightly over one-half (55%) of the respondents self-reported their social class a backward caste, whereas the other half belonged to the scheduled caste (34.29%), the forward caste (7.7%), and the

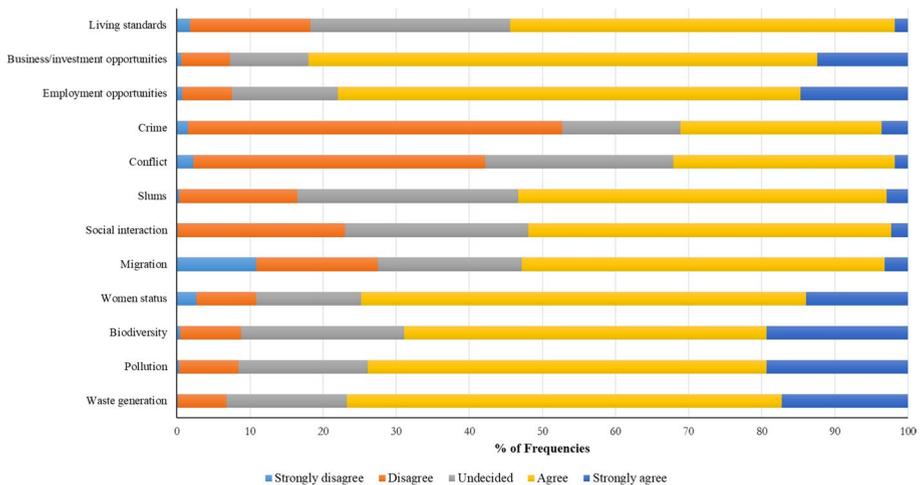


Fig. 3 Frequency distributions of respondents' perception of various effects of urban sprawl Source: Survey results

scheduled tribes (3.17%). It should be noted that social castes in India are considered as a proxy for socio-economic status (Sankaran et al., 2017). Both the scheduled caste (SC) and scheduled tribes (ST) are historically disadvantaged groups. The backward class (BC) is a term that the Government of India uses to classify groups other than SC and ST, which are also economically and socially disadvantaged. The forward caste is one that enjoys high socio-economic status (Lastrapes & Rajaram, 2016). Average household size was 4.85 members, with a standard deviation of 1.96. With regard to the level of education, 51.51% of the respondents completed secondary education or obtained university or post-graduate diplomas, whereas 48.5% had lower levels of education, including 29% with no formal education. The respondents had considerably varied annual household incomes with an average of 218,480 INR and a standard variation of 167,400. In accordance with our categorisation, 44.41% of the respondents had medium household incomes ranging between 180,000–240,000 INR, whereas 32.93% had high incomes of more than 240,000 INR, and 22.66% had low incomes below 180,000 INR. Lastly, 44.41% of the respondents mentioned that they are active members of a community development organisation, whereas 55.74% were not members of any NGO.

4.2 Descriptive analysis of respondents' perceptions of urban sprawl

Figure 3 presents the frequency distributions of respondent scores on a Likert scale of 1 to 5 (where 1 = strongly disagree and 5 = strongly agree) when asked about the extent to which they agree/disagree with the 12 statements presented in Table 1 regarding various effects of urban sprawl. With regard to the economic impacts, nearly one-half of the respondents were in some agreement that urbanisation has improved their overall standard of living, though a further 27% were unsure and the remainder at some level of disagreement. Moreover, the majority of the respondents agreed or strongly agreed that urbanisation created more business and investment opportunities (80%) and accordingly increased and diversified employment options (82%). In contrast, only around 8% of the respondents regarded urbanisation as having negative impacts on business and employment

opportunities. Concerning the environmental impacts, nearly 73% of the surveyed sample agreed or strongly agreed that urbanisation increased deforestation and loss of biodiversity (69%), increased pollution of water, soil, and air (74%) and increased solid waste generation and its attendant management challenges (77%).

With respect to the social effects of urban sprawl, the responses were much scattered and distributed across the response options for the majority of the six corresponding statements. In particular, half of the respondents disagreed or strongly disagreed that urban sprawl increased the incidence of crime and gangs in the community. About 42% of them rejected the argument that urbanisation increased tensions and stimulated conflicts between residents of the neighbourhood. On the contrary, close to only one-third of the respondents regarded urban sprawl as a cause of crime and conflict in their areas. Over one-half of the respondents attributed the proliferation of slums in Hyderabad to urban sprawl, whereas 16% had a contradictory perception and 30% were unsure. Similarly, around one-half of the respondents believed that urbanisation worsened social interaction, community solidarity and exacerbated social and economic division within the community. The other half equally included those who disagreed or were undecided. Close to 50% of the respondents stated that urban sprawl influenced migration from and to the area, whereas around 20% were unsure and nearly 30% disagreed or strongly disagreed with this statement. Lastly, there was a stronger consensus among the respondents (74%) with regard to the role that urbanisation played in creating employment opportunities for women and improving their social status and participation in community decisions.

Although this frequency-distribution-based analysis offers an overall picture of the positions of Hyderabad's dwellers regarding various aspects of urban sprawl, a deeper understanding of the underlying impacts and perceptions of urban sprawl can be gained through segmenting individual responses to these statements. The results of the LCA analysis in the next section address this concern.

4.3 Clustering dwellers' perception of urban sprawl impacts

Table 5 presents the estimated conditional response probabilities for the three classes identified by the BIC criteria. Each column in Table 5 summarises the percentage distribution of a member of the corresponding class responding to a Likert scale item. For instance, there is probability of about 16% that members of Class I would agree that urbanisation improves their overall standard of living, compared to only 2% for members of Class II and around 62% for Class III. The following subsections characterise each of the three classes in more detail.

Class I (Undecided Respondents, 60%): A main characteristic of this class is that a large proportion of members' responses lies in the middle of the Likert scale (that is, undecided). Members tend to positively perceive the impact of urban sprawl on businesses and investment opportunity. However, they tend to moderately agree with the effects of urban sprawl on employment and living standards. Moreover, members of Class I tend to moderately agree or disagree with the likely environmental impacts of urbanisation including biodiversity loss and pollution. Concerning the social impacts of urban sprawl, members of this class have more scattered perceptions. They tend to moderately disagree that urbanisation worsened social diversion, stimulated conflict and increased crime rates in the community. However, they tend to agree that urbanisation improved women's status and participation in the community, increased slums, and fuelled migration.

Table 5 Probabilities of membership in the latent classes

| Perception items | Strongly | | | | Strongly Agree |
|---|---------------|---------------|---------------|----------------|----------------|
| | Disagree | Disagree | Undecided | Agree | |
| CLASS I (Estimated class population share: 60%) | | | | | |
| Improve living standards | 0.0255 | 0.3451 | 0.4131 | 0.1621 | 0.0542 |
| More employment | 0.0662 | 0.1091 | 0.4984 | 0.2281 | 0.0982 |
| Investment/business opportunities | 0.0126 | 0.0028 | 0.5344 | 0.2963 | 0.1539 |
| Biodiversity loss | 0.0976 | 0.2157 | 0.3831 | 0.2084 | 0.0952 |
| Pollution | 0.0851 | 0.2119 | 0.3798 | 0.2321 | 0.0911 |
| Waste | 0.0825 | 0.1584 | 0.3123 | 0.2865 | 0.1603 |
| Woman status | 0.1109 | 0.1058 | 0.3552 | 0.2934 | 0.1347 |
| Social division | 0.1254 | 0.1966 | 0.3813 | 0.2718 | 0.0249 |
| Slums | 0.0185 | 0.1898 | 0.3972 | 0.2664 | 0.1281 |
| Outmigration | 0.0464 | 0.2841 | 0.3101 | 0.1562 | 0.2032 |
| Conflict | 0.1796 | 0.2136 | 0.2781 | 0.1452 | 0.1835 |
| Crime | 0.0928 | 0.2817 | 0.3203 | 0.1823 | 0.1229 |
| CLASS II (Estimated class population share: 21%) | | | | | |
| Improve living standards | 0.1329 | 0.6472 | 0.1599 | 0.0281 | 0.0319 |
| More employment | 0.1984 | 0.3651 | 0.2096 | 0.1757 | 0.0512 |
| Investment/business opportunities | 0.1809 | 0.3582 | 0.2499 | 0.1125 | 0.0985 |
| Biodiversity loss | 0.10852 | 0.1108 | 0.3216 | 0.21968 | 0.2394 |
| Pollution | 0.0841 | 0.112 | 0.2103 | 0.2727 | 0.3209 |
| Waste | 0.0077 | 0.0921 | 0.0956 | 0.6302 | 0.1744 |
| Woman status | 0.1253 | 0.2741 | 0.2549 | 0.2024 | 0.1433 |
| Social division | 0.0618 | 0.1205 | 0.1844 | 0.4265 | 0.2068 |
| Slums | 0.0581 | 0.1778 | 0.2605 | 0.3894 | 0.1142 |
| Outmigration | 0.0712 | 0.0343 | 0.2827 | 0.0822 | 0.5296 |
| Conflict | 0.0816 | 0.0726 | 0.2327 | 0.4019 | 0.2112 |
| Crime | 0.0067 | 0.0841 | 0.3522 | 0.2727 | 0.2843 |
| CLASS III (Estimated class population share: 19%) | | | | | |
| Improve living standards | 0.0154 | 0.0357 | 0.1228 | 0.6293 | 0.1968 |
| More employment | 0.0323 | 0.0919 | 0.0193 | 0.4204 | 0.4361 |
| Investment/business opportunities | 0.0362 | 0.263 | 0.2926 | 0.2131 | 0.1951 |
| Biodiversity loss | 0.0452 | 0.2424 | 0.4152 | 0.1814 | 0.1158 |
| Pollution | 0.146 | 0.2641 | 0.3819 | 0.1204 | 0.0876 |
| Waste | 0.0787 | 0.2949 | 0.2187 | 0.2215 | 0.1862 |
| Woman status | 0.0149 | 0.089 | 0.2083 | 0.4207 | 0.2671 |
| Social division | 0.1368 | 0.2763 | 0.2301 | 0.2153 | 0.1415 |
| Slums | 0.0774 | 0.2425 | 0.3628 | 0.1858 | 0.1315 |
| Outmigration | 0.0636 | 0.1842 | 0.3536 | 0.2465 | 0.1521 |
| Conflict | 0.0171 | 0.4042 | 0.326 | 0.2436 | 0.0091 |
| Crime | 0.2022 | 0.333 | 0.2203 | 0.1621 | 0.0824 |

Probabilities representing over 20% of the class members are highlighted in Bold

Source: Survey results

Class II (Negative Perceivers, 21%): The second group (CLASS II) includes those who are more pessimistic, and to a larger extent see that urban sprawl has brought negative economic, environmental, and social impacts. In particular, a main characteristic of this group is that on average, one quarter of its members tend to be unsure about the economic and social effects of urbanisation, whereas the majority tend to perceive the environmental effects of urbanisation negatively or very negatively. Pollution and issues related to waste generation and management were perceived more negatively compared to the loss of biodiversity. Concerning the economic impacts, members of this group disagree or strongly agree that urbanisation improved their living standards or created employment and business opportunities. In contrast, they agree or strongly agree that urbanisation worsened social division, migration, slums, and conflict.

Class III (Opportunity Perceivers, 19%): CLASS III includes those who tend to regard urban sprawl as a sustainable process in the sense that it has created economic benefits at lower social and environmental costs. In particular, the main feature of this group is the large agreement with the positive economic effects of urban sprawl in terms of creating business, investment, and employment opportunities and improving living standards. Another key feature of this class is the uncertainty of its members' perceptions with regard to the environmental effects of urban sprawl. Concerning the social effects, members of this class tend to agree strongly that urban sprawl improved women's status in the community and stimulated migration, whereas they tend to disagree strongly that urban sprawl increased conflict and crime within the community. Furthermore, there were cumulative chances of 44% and 42%, respectively, for disagreement with the statements regarding urban sprawl's effects on social division and slums.

4.4 Determinants of class membership

Table 6 provides the odds ratios of the explanatory variables which were calculated by taking the exponent of the log-odds. These odds ratios indicate the probability's ratio for belonging to an outcome category (class) relative to the probability of belonging to the base outcome category. Since we have three classes, we ran the model three times, where each latent class was used a baseline outcome.

According to the results in Table 6, age seems to be a major determinant of membership in Class I, the undecided. The probability that an older individual would belong to the undecided group is 1.4 and 2.3 times higher than the probability of belonging to either Class II (negative perceivers) or Class III (opportunity perceivers). The level of an individual's education seems to play an important role in forming perceptions towards the impacts of urban sprawl. Compared to undecided respondents (Class I), individuals who have post-secondary education or above are nearly three times and two times more likely to form negative or positive perceptions, respectively, towards the impacts of urban sprawl. The results indicate that the social caste to which an individual belongs plays a determining role in forming her perception of the impacts of urban sprawl. If an individual belongs to ST or SC groups, she is around 2 times and 1.5 times, respectively, more likely to perceive that urbanisation presents opportunities rather than threats or to be undecided. By contrast, members of the BC and FC were more likely to be negative perceivers or undecided.

Higher annual household incomes were associated with more positive perceptions; whereas a larger household size increased the likelihood of individuals perceiving urban sprawl negatively. With regard to the effect of the type of locality (urban versus peri-urban),

Table 6 Relative odd ratios for the determinants of class membership

| Latent Classes | Explanatory variables | Base Outcome Class | | | | | |
|---------------------------------------|-----------------------------------|--------------------|--------|---------------------|--------|------------------------|--------|
| | | Undecided | | Negative Perceivers | | Opportunity Perceivers | |
| | | Coef | ρ | Coef | ρ | Coef | ρ |
| Class I (Undecided) | Age | | | 0.6245 | * | 0.4829 | *** |
| | Education | | | 2.8329 | ** | 1.7897 | *** |
| | Household size | | | 1.7543 | ** | 0.4815 | ** |
| | Income | | | 0.6811 | *** | 1.6329 | *** |
| | Social group: ST | | | 0.3913 | *** | 1.9417 | *** |
| | Social group: SC | | | 0.2780 | ** | 1.5375 | *** |
| | Social group: BC | | | 1.3088 | ** | 0.6375 | *** |
| | Social group: FC | | | 1.2825 | ** | 0.7079 | *** |
| | NGO membership | | | 1.6927 | | 0.7079 | |
| | Urban Locality | | | 1.8725 | *** | 0.5656 | *** |
| | Class II (Negative Perceivers) | Age | 1.4250 | ** | | | 0.3597 |
| Education | | 0.1788 | *** | | | 1.9568 | * |
| Household size | | 0.2481 | ** | | | 0.3140 | *** |
| Income | | 1.3482 | *** | | | 1.5767 | ** |
| Social group: ST | | 1.6958 | *** | | | 2.2620 | *** |
| Social group: SC | | 1.2761 | *** | | | 1.6530 | ** |
| Social group: BC | | 0.5405 | ** | | | 0.2886 | ** |
| Social group: FC | | 0.4709 | *** | | | 0.4518 | ** |
| NGO membership | | 0.5149 | ** | | | 0.5609 | *** |
| Urban Locality | | 0.4531 | *** | | | 0.6914 | * |
| Class III (Opportunity Perceivers) | | Age | 2.2745 | ** | 1.4774 | * | |
| | Education | 0.5898 | *** | 0.6174 | * | | |
| | Household size | 1.4481 | *** | 1.5065 | *** | | |
| | Income | 0.2329 | *** | 0.2730 | *** | | |
| | Social group: ST | 0.4417 | *** | 0.3814 | *** | | |
| | Social group: SC | 0.3101 | *** | 0.4320 | ** | | |
| | Social group: BC | 1.4079 | *** | 1.4895 | ** | | |
| | Social group: FC | 1.1601 | ** | 1.2623 | | | |
| | NGO membership | 1.4079 | *** | 2.0409 | ** | | |
| | Locality | 1.2956 | ** | 1.9358 | * | | |

*, ** and *** = significant at 1%, 5% and 10%, respectively

the results indicated that if the individual lives in an urban locality she is more likely to be a negative perceiver (two times higher) or undecided (1.2 times higher) than being a positive perceiver of the impacts of urban sprawl. Finally, the results revealed that membership in NGOs and community development organisations is a key factor determining class membership. Specifically, members of these organisations are more likely to be negative perceivers than to be undecided or opportunity perceivers.

5 Discussion

The following subsections discuss the main findings from this study and provide recommendations for urban policy making and future research on urban sprawl in developing countries:

5.1 Perception of urban sprawl impacts

Previous studies have shown that a broad spectrum of perspectives can be commonly observed when exploring the impacts of socio-environmental changes, which makes understanding the cognitive, emotional, and behavioural aspects of the local dwellers crucial for an effective and sustainable management of these impacts (Islam et al., 2014). The results of this study suggest that urbanisation improved the overall standard of living, created an attractive environment for businesses and investment, and generated more employment opportunities. This is in line with previous literature from Fu and Hong (2010) and Collier and Venables (2017) acknowledging that productivity is positively associated with city size, mainly due to the investment environment, scale opportunities, specialisation, and the supply of labour. Concerning the social and demographic impacts, the results were less conclusive, albeit they showed stronger consensus with regard to the role that urban sprawl plays in improving the social status of women and increasing their participation in community decisions. Nevertheless, there was a certain level of agreement that these socio-economic benefits do not come without negative environmental effects (e.g. deforestation and loss of biodiversity; pollution, solid waste management challenges) and societal challenges (e.g. tensions and conflicts between residents of the area, proliferation of slums, worsening community solidarity and social cohesion). These findings are in keeping with previous studies which showed that Indian urban expansion has been associated with economic growth and development but has also posed enormous socio-economic and environmental threats (e.g. Mohan & Dasgupta, 2005; Pandey and Seto, 2015; Haque and Patel, 2018). Overall, our findings clearly point out that in the current context where the population is transitioning to an urban or a peri-urban environment, there is no ‘one-size-fits-all’ solution to the complex and interrelated challenges confronting the urban locations in developing countries like India.

5.2 Identification of sub-groups sharing their perception of urban sprawl impacts

As a major result, this study identified three distinct groups of respondents, which were labelled ‘undecided respondents’, ‘negative perceivers’ and ‘opportunity perceivers’. Specifically, and noteworthy, the majority of the respondents (60%) were unable to form strong views towards the impacts of urban sprawl (Class I, undecided respondents). The second group (Class II, negative perceivers) included 21% of the respondents, who were generally pessimistic about the impacts of urban sprawl. A further 19% of the respondents constituted Class III (opportunity perceivers), who tended to regard urbanisation as an economic stimulator with lower social and environmental costs. As people’s readiness and adaptability to the impacts of urban sprawl would depend on their level of awareness and perception, such a large proportion of undecided respondents in the present study indicates that public understanding of the impacts of urban sprawl in Hyderabad remains inadequate. In turn, this may increase the vulnerability of the dwellers and hinder effective adaptation to the adverse economic, social, and environmental effects of urban sprawl. Several previous

studies have concluded that uncertainty is a common finding when people are asked about their perceptions concerning socio-environmental changes (e.g. Upham et al., 2009). For instance, the results of Sarkar and Padaria (2010) and Kant et al. (2015) pointed out to lack of awareness and confusion among Indian respondents regarding the impacts of other environmental challenges (e.g. climate change). This finding should also provoke concern about the effectiveness of government campaigns and interventions to build public awareness of urban development and its impacts on the city.

5.3 Sociodemographic characterisation of the sub-groups

The results indicated that sociodemographic characteristics of the respondents significantly determine their class membership. In particular, older individuals were found more likely to belong to the undecided group than of belonging to either the negative or opportunity perceivers' groups, respectively. One of the plausible reasons for this indecisiveness by older respondents could be attributed to the facts that they are generally less educated, have shorter planning horizons and that the sociodemographic changes take place at a faster pace (UN Habitat, 2016). In this context, Rajapaksa et al. (2018) based on a sample of respondents from Mumbai in India showing that the younger and the higher educated are more concerned about community and environmental issues and more likely to be involved in pro-environmental activities. In connection with this, the results revealed that compared to undecided respondents, individuals who had post-secondary education or above were more likely to form negative or positive perceptions. This finding coincides with the results of Zhai et al. (2019), which revealed that education, especially higher education, significantly influences individuals' perception towards urbanisation. Their study particularly showed higher levels of education have a significant positive effect on perception, whereas pre-university education level negatively influences an individual's perception of urbanisation. On the contrary, our results pointed out that individuals with higher levels of education are more likely to negatively perceive the impacts of urban sprawl. An explanation of this disagreement between our results and those of Zhai et al. (2019) could be that education, on the one hand, broadens job market opportunities and enhances an individual's ability to find jobs in competitive cities. On the other hand, the effects of urbanisation go beyond the economic aspects (e.g. job opportunities, income, etc.) to include social and environmental effects that can influence overall perception of the highly educated. This finding implies that efforts to raise the social capital of urban and peri-urban communities could be a useful means for addressing the impacts of urban sprawl. Moreover, the results showed that respondents with larger-sized households would perceive urbanisation negatively. In this respect, Tripathi (2018) shows that a larger household size is associated with higher poverty rates and probably increases family living expenditure for urban households in India (e.g. housing, child rearing and schooling), which puts a strain on per capita finances. Concerning household annual income, the results indicated that higher levels of income entailed positive perceptions of the impacts of urban sprawl. As shown by Mohan and Dasgupta (2005), Indian urbanisation has been accompanied by rapid economic growth and

increased business and investment opportunities and it is more likely that wealthier households would gain the most from these economic outcomes.

Distinguishably, individuals who belong to scheduled tribes and scheduled castes were more likely to perceive that urbanisation presents opportunities rather than threats or to be undecided. In contrast, members of the backward and forward castes were more likely to be negative perceivers or undecided. As noted by Bharathi et al. (2019), members of scheduled tribes and scheduled castes migrate to urban areas to escape 'caste hegemonies' in the villages. The increased employment opportunities in the unorganised sectors in the cities attract poor and landless people (mostly from scheduled tribes and scheduled castes) from rural villages to urban areas. Moreover, these caste groups are able to work in forward and backward caste homes as domestic help and child carers among other things. That is, urban expansion generates better and stable income for members of these caste groups and improves their social status, which may explain their positive views towards urban sprawl. The authors therefore share the arguments of Bharathi et.al (2020) that while urbanisation in India is transforming and modulating some aspects of caste inequalities, caste has not structurally disappeared from urban India, a point echoed by Desai and Dubey (2011) and Deshpande and Ramachandran (2019).

Compared to peri-urban dwellers, the results indicated urban residents are more likely to be negative perceivers or undecided. An explanation of this finding is probably that those who originally resided in Hyderabad can compare changes in the city over the time and observe the proliferation and impacts of increasing challenges, such as high population density, rural and peri-urban migration to the city, increasing demand for resources like water and electricity, slums and informal housing, and environmental degradation. With respect to NGO membership, the results revealed that respondents who participate in community development organisations are more likely to form a negative perception towards the impacts of urban sprawl than to be undecided or opportunity perceivers. On the one hand, this may imply that these organisations provide information that helps individuals form their views regarding the multifaceted impacts of urban sprawl. On the other hand, it seems that the focus of these organisations centres on the negative side of urban sprawl (e.g. pollution, waste generation, social inequality). While the pace of urban expansion is expected to accelerate in India in future decades, these organisations should put more focus on building an organised community-centred adaptive mechanism for making urbanisation processes more sustainable. NGOs can create awareness by implementing communication campaigns to educate Hyderabad dwellers about the challenges of urban sprawl and potential adaptation strategies.

5.4 Limitations and recommendation for future research

In light of our findings, the following limitations and recommendations should be considered. First, the review of the literature in this study indicated a lack of studies on perception and behavioural aspects of urban sprawl in developing countries. This presents a major limitation in the literature given that understanding perceptions and changing dwellers' behaviour through relevant interventions is a crucial step towards reducing negative impacts of urban sprawl. Second, although the present study attempted to fill in this gap in the literature, our findings are based on a cross-sectional study and are focused on Hyderabad, which limits, to some extent, the wider generalisation and applicability of the results. Therefore, more research should be carried out to further analyse the perceptions of different sociodemographic groups about urban sprawl and its causes and effects, and how these perceptions might change and might be used to influence urbanisation processes.

6 Conclusion

Our findings contribute new evidence that bolsters prior assertions that urban sprawl worryingly affects urban sustainability and poses significant challenges to city planners in developing countries. In particular, the findings reflect the existence of different perceptions, expectations, and values among urban and peri-urban dwellers. Therefore, a deeper understanding of how different sociodemographic groups perceive the environmental, social, and economic impacts of urban sprawl is essential for bringing about sustainable city planning and governance in rapidly urbanising environments in developing countries. That is, it is imperative to identify and characterise different sociodemographic groups and further investigate their perceptions and visions to formulate alternatives for city development. To accomplish this, an appropriate policy framework and specific programmes are needed for enhancing urban and peri-urban dwellers' perception towards urban sprawl and for promoting a more sustainable management of urbanisation. In addition, for urbanisation to have a transformative potential across all categories of population, holistic and systematic approaches, where the strategies adopted by different stakeholders are integrated, adaptable and flexible, are needed to integrate and protect the interest of all stakeholders. In this regard, involving dwellers and stakeholders is a key element in improving the management and decision-making processes of urban and city planning and in promoting transition towards urban sustainability.

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