Vision
18(4) 277–287
© 2014 MDI
SAGE Publications
Los Angeles, London,
New Delhi, Singapore,
Washington DC
DOI: 10.1177/0972262914553260
http://vision.sagepub.com

Measuring and Mapping Transitory Spaces in India: A Case Study of Hyderabad City

Poulomi Banerjee
Chinmoyee Mallik
Nani Babu

Abstract

The rapid growth of metropolitan suburbs is the most striking feature of spatial transformation in South Asian cities. Reduced carrying capacities of these metropolitan areas are pushing business and people out of their urban core, relocating them in the immediate suburbs and peripheries. Such relocation of industry and commerce or migrant residents are changing the very look and feel of the surrounding villages resulting into emergence of a zone of transition or peri-urban as it is popularly known, wherein urban and rural development processes meet, mix and inter-react (Narain, 2010). However, challenge lies in managing these transitory spaces sustainably as they are institutionally rural but look and feel urban. One of the critical gaps that policy makers often argue of is not having any specialized institutional arrangements and absence of any specific indicators for identification and delineation of peri-urban interface. Following article attempts to address this gap by determining the thresholds that meaningfully distinguish between the urban, peri-urban and rural areas across India. The idea is to go beyond the conventional spatial analysis to a process-based economic modelling, wherein the social dynamism and flux can be clearly brought out to classify 40 sub-districts/taluks of Hyderabad Metropolitan Development Authority's area.

Key Words

Periurbanization, Mapping Rural-urban Interface, Hyderabad

Introduction

'The perceived link between the city and the countryside is evolving rapidly, shifting away from the assumptions of mainstream paradigms to new conceptual landscapes where rural–urban links are being redefined' (Oliveau, 2005, p. 3). 'The transition from predominantly rural to increasingly urban economies is one of the great development challenges of the times' (Saksena et al., 2014, p. 1). These transitory places known as urban fringe, suburban, exurban, urban tract, rurban,, semiurban or peri-urban (Iaquinta and Drescher, 2000; Nottingham and Liverpool Universities, 1998; Rakodi, 1998) are often considered as a diffuse territory identified by combinations of features and phenomena, generated largely by two ways interaction processes between rural and urban centres (Adell, 1999; Nottingham and Liverpool Universities, 1998). It is portrayed as a space in itself, but one that envelopes dynamic interaction processes between the population, and the landscape and their associated land uses and livelihoods (Narain, 2012).

The place-based identification of peri-urban as propounded by traditional theoretical models of economic development in mid-1960s has largely failed to explain the complex processes and features that shape up these volatile transitory spaces. Arguments and debates in the international planning discourse were either urban biased (Rondinelli, 1991; Unwin, 1989) or more rural oriented (Bates, 1981; Douglass, 1998; Firman, 1996; Friedmann and Douglass, 1975, 1978; Karshenas, 1997; Lipton, 1977; Lofchie, 1997; Rondinelli, 1984; Stöhr and Taylor, 1981; Unwin, 1989). They stipulated explicitly or implicitly that the city is the source of growth and market mechanisms played the determining role to disperse the growth impulses to the rural hinterland and thus, balances the regional development in any country. Such place-based approach although has been contested by alternate school of process-oriented thoughts, giving emphasis to urban–rural interrelationships (Unwin, 1989), ambiguity still remains about its physical and conceptual boundaries (Adell, 1999). Such transitory landscapes, where not only flows of people, but of capital, labour, commodities and information leave the central urban context for a restless and place-less periphery (Beauregard, 1995; Garreau, 1991; Soja, 1992) make its delineation and measurement particularly challenging for planners and policy makers.

Statistical definitions of—rural and—urban vary from country to country and can be based on administrative

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

boundaries, size, level of services or population density (Aoyama and Horner, 2010). 'Whether an administrative unit is classified as rural or urban, however, affects how it is governed and the financial resources allotted for governance' (Saksena et al., 2014). Policy administration and management practices in these units are major concerns of the development community as they 'either lie beyond urban administrative boundaries or the resources accompanying this designation, or fall under city administration that lack the financial resources to upgrade their planning and infrastructure' (Saksena et al., 2014, p. 2). While attempts have been made to map the extent and rate of urban expansion at local (Li and Yeh, 1998; Schneider et al., 2005), national and global scales (Seto et al., 2012; Schneider et al., 2009) through remote sensing data very little effort been made to capture the socio-cultural aspects of these volatile transitory spaces.

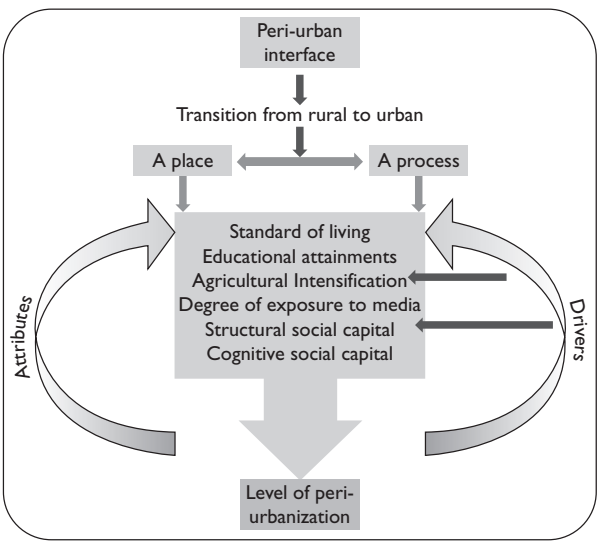
In the view of the earlier mentioned gap we attempt to measure and map peri-urban areas with an assumption that it is a combination of both space and processes. The spatial dynamics is embedded within the processes. It is the space that gives the mental construct of a peri-urban interface. We argue that they are reflection of complex mix of both spatial and 'a-spatial' phenomenon that may be observed at the level of the household, village, sub-district or district. Peri-urban as a 'place' helps to identify features and processes that effectively correspond with ways that stand mid-way between completely rural and purely urban. However, as 'a spatial' phenomenon it corresponds to processes wherein its location is not restricted to the fringe areas but can occur anywhere.

With this understanding we seek to construct an analytical framework for identifying and measuring peri-urban areas based on its various dimensions. We have two fold objectives: (a) to determine the thresholds that meaningfully distinguish between the urban, peri-urban and rural areas across India. The idea is to go beyond the conventional spatial analysis to a process-based economic modelling wherein the social dynamism and flux can be clearly brought out, (b) to classify 40 sub-districts/taluks within Hyderabad Metropolitan Development Authority's area, the planning unit for greater Hyderabad, as being rural, peri-urban, urban and urban core. The classification has been validated through satellite imagery.

Analytical Framework and Methodological Approach

On the basis of the typology given by Iaquinta and Drescher (2000), the study conceptualizes peri-urban as a manifestation of three basic components—economic, social and psychological. Among these, economic factors have always been considered as crucial in determining the urbanity or ruralness. However, Iaquinta and Drescher (2000) pointed out that social and psychological factors too are critical in identifying peri-urban. Following Iaquinta and Drescher, the study has taken six attributes falling under economic, social and psychological categories. In our study we considered peri-urban interface (see Figure 1) as a combination of place and processes and identified through the coexistence of certain specific attributes like—Standard of living/economic well-being, Level of social development, Agricultural intensification, Level of exposure to mass media, Structural social capital and Cognitive social capital. Regional analysis has established the urban bias in the clustering of amenities, facilities and benefits and the rural place denoting the position counter to urban. Understandably, while the urban may correspond with high to medium levels of standard of living, educational attainments and degree of exposure to media, the rural would be marked by low to medium level of attainments in all these three aspects. However, the agricultural variable would behave somewhat differently. The urban, by virtue of its detachment from the primary sector, would be marked by very low levels of agricultural activity. If any agricultural activity coexists with the other three urban attributes, it would be merely for subsistence and far from being intensive, which sooner or later would cease to exist. In the rural interiors also agriculture is also not likely to be very intensive. It is because intensive agriculture would entail large-scale investment in the form of mechanization, inputs and most importantly marketing. The last issue of marketability of agricultural products in India is a well-known area of concern that discourages the farmers located

Figure 1. Analytical Framework of the Study



Source: Authors.

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

in rural interiors to undertake high value crops that entail large investments. So, agricultural intensification in the rural interiors would be of low to moderate nature. Clearly defining the rural and urban attributes, the peri-urban would be that which effectively combines both yet distinguishes itself clearly from the two entities. So, the aspects of standard of living, educational attainments and degree of exposure to media could be any combination of low, medium, high but agriculture would be remarkably intensive. As exposited by Chadha et al. (2004), the agriculture in the peripheral areas of urban areas would be devoted to crops that yield high return and therefore, generally are intensive. So, the peri-urban would be the zone where agriculture would be intensive.

The characteristic pattern of each of these variables determines the peri-urbanization processes. We assume:

- Urban areas having high standard of living, high educational attainments, larger degree of media exposure, better networked with lower degree of interpersonal connections.
- Rural areas having higher fraction of households engage in agriculture, less educational opportunities and media exposure with higher interpersonal relationships and lower structured networking.
- Peri-urban interface being a transitory space the characteristic pattern of these variables lies in midway between purely urban and rural.

A major issue pertains to the problem of aggregating these wide range of different variables to derive a uni-dimensional measure summarizing the level of peri-urbanization and producing a range of critical points differentiating socio-economic levels. This is because each variable, used individually, may not be sufficient to differentiate households sufficiently. By using multivariate statistical modelling, cluster analysis and GIS the study attempted to identify, delineate and map the peri-urban areas and peri-urbanization processes at different levels.

We have used Principal Component Analysis (PCA), a multi-variate statistical technique to reduce these variables into a smaller number of 'dimensions' to construct composite score that meaningfully determine the level of thresholds across urban, rural and peri-urban areas in India. In some cases, the broad indicator is composed of a few other variables where PCA of PCA has been done to obtain the composite of the composite scores. The variables selected to identify each of these dimensions have been outlined in Table 1 elaborating the specific constituent elements and distinctive method deployed in the process of aggregation. The standard of living index is composed of two variables: monthly per capita consumption expenditure and ownership of consumer durables. The variable indicating the ownership of consumer durables is constructed by compositing the number of each of the assets owned from among two sets of assets identified as ordinary and high-end goods. The standard of living index is obtained by doing a PCA of these three variables.

The Social development/Education index is obtained through PCA of highest years of education of adult in the household and highest years of education of adult female

Table 1. List of Broad and Specific Indicators Taken for PCA

Broad Indicators	Specific Indicators	Nature of Indicators
Standard of living	Monthly consumption per capita	Numeric
	Index of ownership of ordinary consumer goods computed through addition of binaries indicating ownership of the following: cycle/bicycle, sewing machine, generator set, mixer/grinder, motor cycle, B/W TV, colour TV, air cooler, clock/watch, electric fan, chair/table, cot, telephone, cell phone, refrigerator, pressure cooker	Categorical
	Index of ownership of high end consumer goods computed through addition of binaries indicating ownership of the following: car, air conditioner, washing machine, computer, credit card	Categorical
Social development/ education	Highest years of education of adult in the household	Numeric
	Highest years of education of adult female in the household	Numeric
Index for agricultural intensification	Index of agricultural capital owned (Number of tube-wells, electric pumps, diesel pumps, bullock carts, tractors, threshers, bio-gas plants owned)	Numeric
	Expense on fertilizer per acre of operational holding	Numeric
	Expense on pesticide per acre of operational holding	Numeric
	Irrigation extent	Numeric
	Index of livestock ownership (number of Milch cow, Milch buffaloes, draft animals, goats, sheep, poultry owned)	Numeric
Exposure to mass media	Average hours per day of TV watched by men, women and kids	Numeric

(Table 1 continued)

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

(Table 1 continued)

Broad Indicators	Specific Indicators	Nature of Indicators
Structural capital index	Memberships	Categorical
	Have you or anyone in the household attended a public meeting called by village panchayat/nagarpalika/ward committee in the last year?	
	Is anyone in the household an official of the village panchayat/nagarpalika/ward committee?	
	Among your acquaintances/relatives are there anyone who belongs to (a) medical profession; (b) teaching profession; (c) government service	
Cognitive capital index	Conflict in village	Categorical
	Approach towards solving common problems in the community	
	Conflict among jatis	
	Theft during last 12 months	
	Breaking into home illegally during last 12 months	
	Attack/threat during last 12 months	
	Harassment of girls	
	Confidence in institutions	

Source: Authors.

in the household. The index of agricultural intensification is composed of five variables which have been once again aggregated using PCA. Within this, the index of agricultural capital owned and index of livestock ownership are two variables that have been computed by compositing the number of each items of agricultural capitals and livestock respectively owned by the household while the other three variables, namely, expense on fertilizer per acre of operational holding, expense on pesticide per acre of operational holding and irrigation extent are simple. The indicator for extent of exposure to mass media is average number of hours per day of TV watched by the men, women and kids. Structural social capital index is calculated by using variables indicating social networking, group membership and association with the panchayat. Cognitive social capital is calculated by taking trust, conflict and crime. The final variable indicating the level of peri-urbanization is obtained by using PCA to aggregate the six dimensions into a single variable.

We then used cluster analysis to classify the sub-districts of Hyderabad Metropolitan Development Area (HMDA) into four categories, urban core, urban, rural and peri-urban. Cluster analysis involves splitting a data set into a number of groups of observations which are distinct in terms of typical group values of the variables (Everitt et al., 2011). The aim is to maximize between group variance and to minimize within group variance. Cluster analysis is a classification technique where any number of variables may be used to classify members of the sample (Saksena et al., 2014, p. 8). We have used K-mean clustering, a centroid-based clustering where clusters are represented by a central vector, which may not necessarily be a member of the data set has been used to classify and map peri-urban, urban and rural areas within HMDA. The list of indicators used for K-mean clustering is given in Table 2.

Measuring thresholds across India has been illustrated through India Human Development Survey 2005–2006 (IHDS), undertaken by NCAER, which is a nationally representative, multi-topic survey comprising 41,554 households in 1,503 villages and 971 urban neighbourhoods across India. In the IHDS, the selection of a sample household was based on unequal probabilities. Measuring

Table 2. List of Indicators Used for K-Mean Clustering

Attributes	Nature of Indicators
Share of households having roof made of asbestos and concrete	Numeric
Share of households using Kerosene and LPG as principal cooking fuel	Numeric
Share of households using treated tap water for drinking	Numeric
Share of households owning TV	Numeric
Share of households owning both land line telephone and mobile	Numeric
Share of households having drain connection	Numeric
Share of area under all vegetables	Numeric
Share of area under total fruits	Numeric
Share of area under floriculture, spices and condiments, aromatic plants and total sugar crops	Numeric
Share of area under tube well irrigation	Numeric

Source: Authors.

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

and mapping peri-urban interface through cluster analysis has been done by using Census 2011 H-Series pertaining data on house listing and household amenities, Andhra Pradesh (mandal level consisting of household amenities only) and Agriculture census of India, Andhra Pradesh, tehsil tables 2005–2006. Mapping is being done from toposheet of 1:25,000 scales with superimposition of village boundaries. We used IBM SPSS (version 19.0.0.2) statistical software to perform the calculations.

Results

Measuring Peri-urbanization Processes Across India

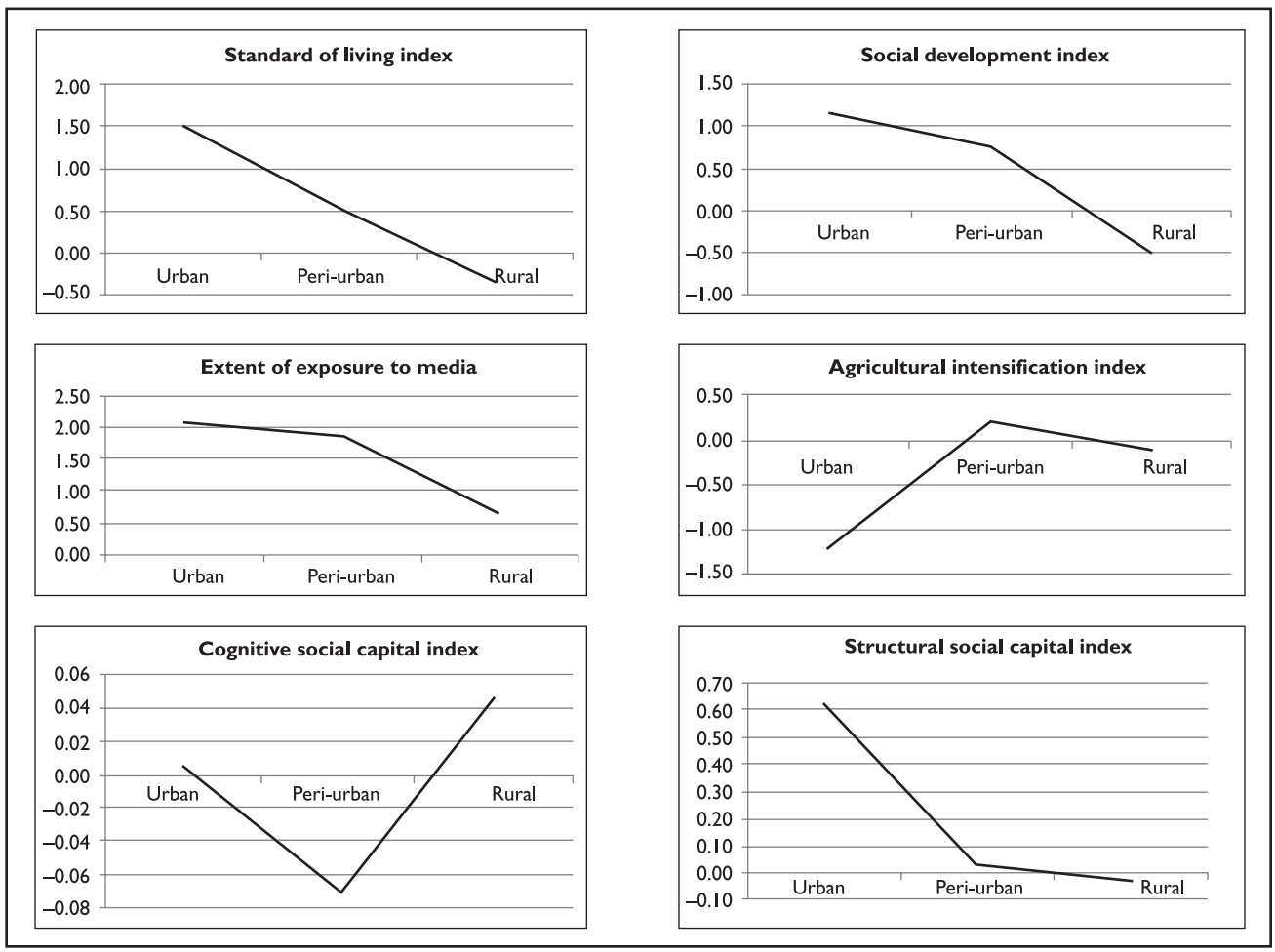
On the basis of 2005–2006 data the pattern of the six key variables that have been used to identify the three zones have displayed in Table 3 and Figure 2. The result shows that the peri-urban marks a sharp break in the distribution of the attributes.

Table 3. Attributes Identifying the Urban, Peri-urban and Rural

Type of Places	Standard of Living	Educational Attainments	Agricultural Intensification	Degree of Exposure to Media	Structural Social Capital	Cognitive Social Capital
Modern/Urban	1.510	1.160	−1.197	2.080	0.621	0.004
Transitional/Peri-urban	0.517	0.756	0.203	1.852	0.027	−0.072
Traditional/Rural	−0.334	−0.487	−0.129	0.624	−0.028	0.048

Source: Computed from IHD Survey, NCAER, 2005–2006.

Figure 2. Attributes Identifying the Urban, Peri-urban and Rural



Source: Authors.

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

In congruity with what the theoretical outline suggests, the indicators of development, namely, standard of living, social development (particularly educational attainments) and extent of exposure to media has assumed very high values in the zone designated as urban and extremely low values for the rural with the break point coinciding with the peri-urban zone. While the indices representing standard of living has indicated an even rate of decline from the urban to the rural, the other two variables have registered sharp break at the peri-urban zone. This actually conforms to the real world situation where in peri-urban areas, due to proximity to urban through better road connectivity and exposure offer better opportunities for education. The proximity factor also encourages association with the urban sources of information and media. Beyond a certain distance the favourable conditions cease to exist and therefore, these variables depict conspicuous decline.

Agricultural intensification, however, represents a very distinctive scenario. The peri-urban is marked by highest level of agricultural intensification followed by the rural and the urban. The two components of social capital have manifested contrasting trends. Structural capital, being composed of social contacts, networks and group memberships, have the propensity to be conditioned by degree of exposure of the individuals and also the educational attainments. Hence, the urban component has registered the highest levels of structural social capital followed by the peri-urban and rural. The cognitive social capital constituting of elements that measure trust, conflict within the community and extent of criminal activities, have revealed lowest levels in the peri-urban, highest in the rural and the urban being located at an intermediate level. The peri-urban, owing to imperfect assimilation of urban and rural forms, is conspicuously subjected to rapid erosion of rural structure of the social relations that used to constitute the safety net accompanied by a lack of integration within the urban system has resulted in the extremely poor social capital of the peri-urban households.

However, at this point it must be remembered that this analysis being based upon household level information, explicitly does not take account of the spatiality aspect and hence, represents the macro process where the households hitherto marked by 'rural attributes' have been undergoing transformation towards urbanity. The section of households which have reached the brink of the transitional phase has embodied the characteristics that represent an admixture of rural and urban features.

From the Table 4 it may be observed that in 2005–2006 about 39 per cent of the households display attributes of peri-urbanization across India. More than one-third of the total households have been subjected to intensified peri-urbanization process. In India, about 60.8 per cent of the households conform to what has been conceptualized as rural, a meagre 0.1 per cent as urban. It is extremely noteworthy that only 0.1 per cent of the total households has displayed urban characteristics irrespective of their location.

Table 4. Households Under Differential Processes of Peri-urbanization

	Frequency	Per cent
Urban	147,730	0.1
Peri-urban	75,070,053	39.1
Rural	116,906,503	60.8
Total	192,124,286	100.0

Source: Computed IHD Survey, NCAER, 2005–2006.

Measuring and Mapping Peri-urban Zones within HMDA

Understandably, peri-urban connotes attributes that assume a level intermediate between the urban and rural. As it is conceptualized a rural area undergoing transition to urban the attributes that are nearing urban would define the peri-urban. By analyzing the rural–urban distribution of the household amenities at the state level for Andhra Pradesh, the 'typical urban attributes' have been identified. In the next stage, these attributes and the selected variables of agriculture has been employed in creating three K-mean clusters to identify the thresholds that define the urban, rural and the peri-urban as shown in Table 5. The cluster that revealed very high shares (above 90 per cent) of the 'typically urban amenities' have been designated as being urban and the cluster representing lowest mean values in case of the 'typical urban amenities' have been assumed to represent rural. It may be noted that the remarkably low shares of the variables relating to agriculture in the urban cluster centre and the respective lower value in the rural cluster strengthens the nomenclature. The intermediate values of the cluster centres of the 'typically urban attributes' in association with those of the agricultural variables that represent most intensive type of agriculture (with respect to that in the urban and rural cluster) may be designated as the peri-urban. It must be pointed out that the peri-urban zone, lying in the proximity of the urban centre, has access to the market and other facilities that encourage the production of perishable goods like fruits and vegetables. Hence, the cluster that represents a moderate share of the 'typically urban attributes' in association with intensified agriculture would embody the peri-urban.

It is evident that peri-urbanization is strongly felt in 12 out of 40 sub-districts/mandals/blocks within HMDA. While representing the same diagrammatically in Figure 3 the peri-urban interface becomes even more vivid. Figure 3 illustrates the fact that peri-urban surely is a zone

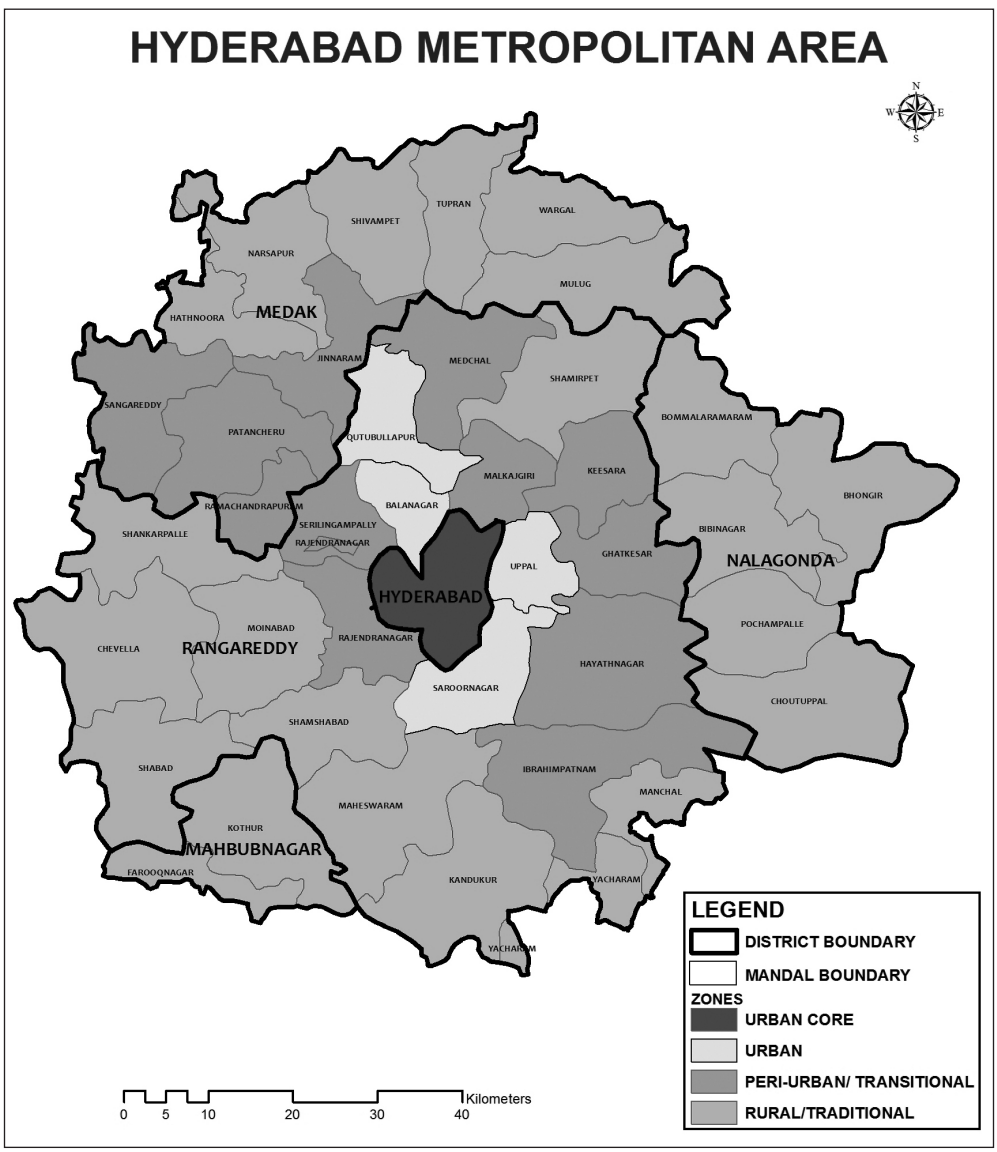
Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

Table 5. Attributes of the Final Cluster Centres

Attributes	Cluster Mean		
	Urban	Peri-urban	Rural
Share of households having roof made of asbestos & concrete	93.54	84.12	59.18
Share of households using Kerosene and LPG as principal cooking fuel	91.12	74.58	33.68
Share of households using treated tap water for drinking	91.43	77.86	34.52
Share of households owning TV	83.80	77.69	61.67
Share of households owning both land line telephone and mobile	11.95	7.88	2.60
Share of households having drain connection	96.76	90.34	69.66
Share of area under all vegetables	5.39	3.68	6.21
Share of area under total fruits	0.78	7.14	4.91
Share of area under floriculture, spices and condiments, aromatic plants and total sugar crops	1.40	3.43	2.00
Share of area under tube well irrigation	27.60	83.63	83.65

Sources: Census of India, 2011 and Agricultural Census 2005–2006.

Figure 3. Classification of HMDA into Urban Core, Urban, Rural and Peri-Urban



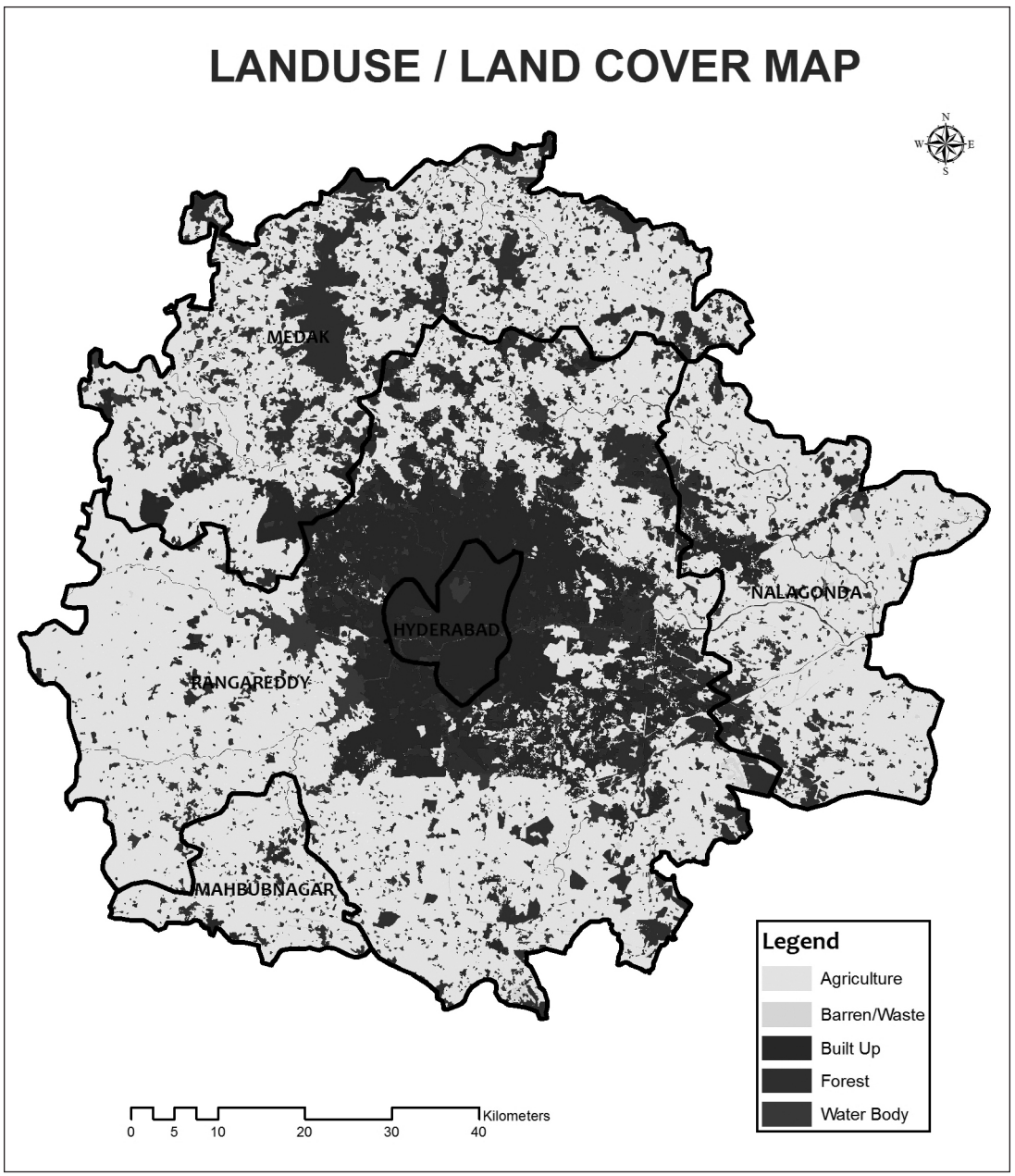
Source: Prepared by the authors.

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

of transition between urban and rural areas. However, peri-urban sub-districts/mandals is predominantly rural areas reinforce the argument that proximity to the towns in itself does not define peri-urban; rather it is the coexistence of both rural and urban characteristics, rural–urban linkages and the flows of goods and services between them.

Our classification model validation has been done through analysis of the satellite images of 2005–2006. The visible and infrared data obtain from IRSLiss-3 satellite imagery 2005–2006 has been used for land use classification. Through visual interpretation methods five land-use classes have been demarcated as evident in Figure 4. The classified map (urban core, urban, rural and peri-urban) then was superimposed on the landuse map in Figure 5. The zoning maps confirming to the image classification validates the results to a large extent.

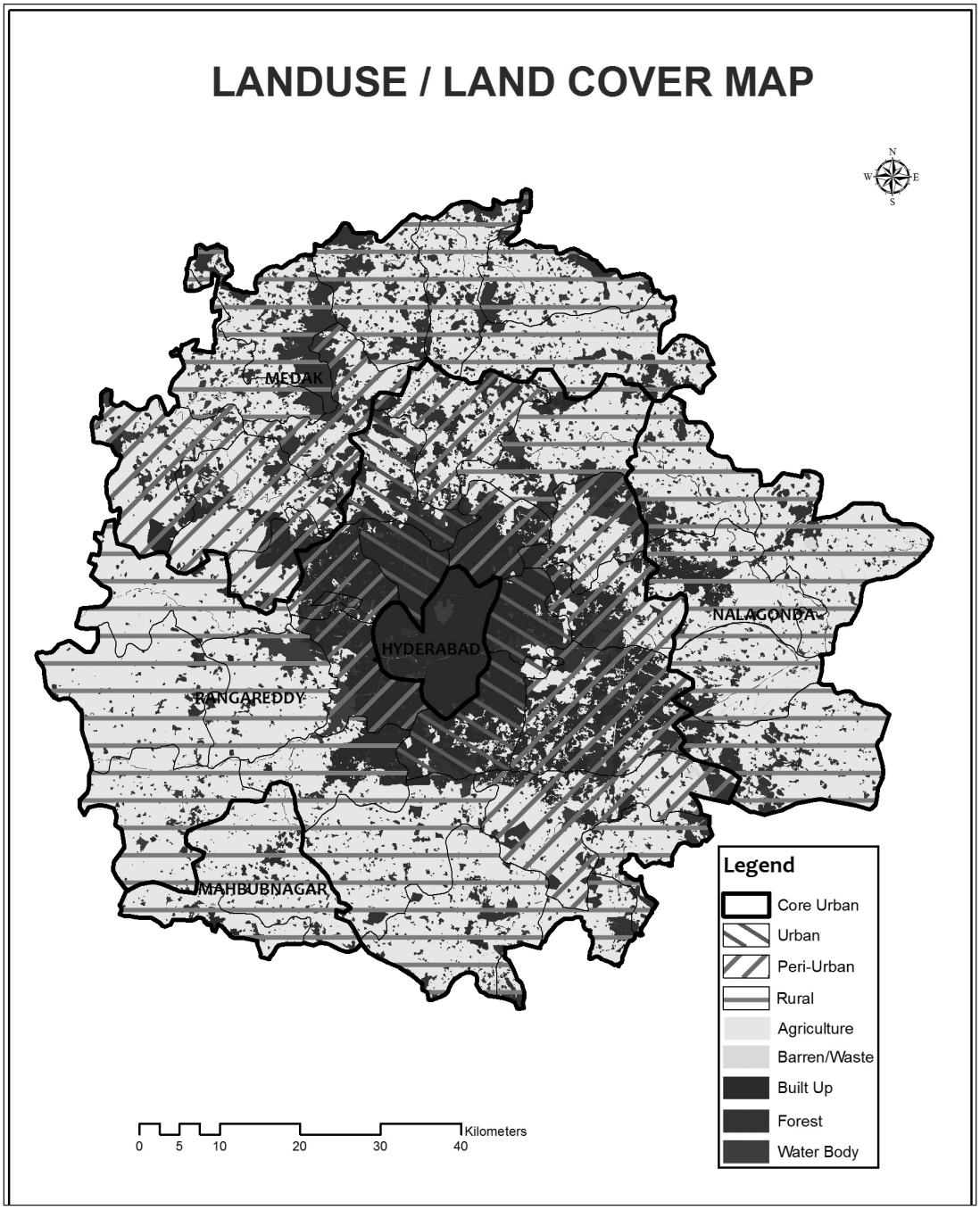
Figure 4. Landuse Land Cover of HMDA



Source: SaciWATERs.

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

Figure 5. Superimposition of Zoning Map on Land-use Land Cover of HMDA



Source: SaciWATERs.

Conclusion and Policy Implications

Our study has carefully analyzed the trajectories of peri-urbanization and concluded that there is certainly a peri-urban space around urban spaces, and is clearly different from the rural. The type of town or a village, their socio-economic characteristics, constitute a factor that explains the more or less distinct presence of a peri-urban space. Thus, zones of low agricultural intensification of urban or rural areas give rise to a zone of intense agriculture essentially catering to the urban markets. That is where we find the most significant peri-urban area in terms of space,

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

and one which is most different on account of its characteristics from the rest of the typically urban or rural environment.

Nevertheless, this space is not homogeneous and present uniformly around all towns or cities. This peri-urban space is itself structured by communication links, which create new inequalities within it. As a matter of fact, the distributional pattern of PUI not necessarily assumes a concentric pattern, rather the peri-urban reality is more fragmented. So it makes way not only for spaces, whose urban characteristics are highly developed, but also for interstitial spaces. It is the distinctive characteristics of any households, rather than their mere location defines them as being urban, peri-urban or rural. Thus, the study shows that peri-urbanization is a combination of both space and processes and it is quite real, visible and measurable. It constitutes today a subject that should be studied at depth with the help of field studies, which will serve to highlight the astonishing diversity of forms it can assume.

Peri-urban is a volatile space where cultural meaning and social organization that encompasses customary, informal relations, essential institutional features and structural constraints are at constant change. They are often a diffused space of high crime rate and low structural and cognitive social capital being in the processes of such changes they are the process of being absorbed whole, marking a jurisdictional change, whether by annexation (actual expansion of the city fringe) or simple reclassification (reflecting de facto urban expansion). More commonly, they are formed from peri-urban villages by a combination of these processes. Whichever is the case, because they are being absorbed 'whole', such places tend to perpetuate and reinforce the existing power structure and bases of inequality often resulting into conflicts and contestations. In absence of any formal institutional back up, fights, conflicts, complains are often unheard or tackle effectively. Creating a specialized formal institutional mechanism to deal with such changing landscapes is, thus, critical for effective planning and policy.

Policy Recommendations

- Defining and measuring peri-urban areas have always been a challenge for the policy makers and practitioners. Understandably, ambiguity in defining and measuring the concept itself can be one of the reasons, but their measurements are largely restricted due to lack of data. Official statistics, like Census of India does not recognize PUI as a separate entity. What ideally is peri-urban is actually embedded within either urban or rural denominations of census. Considering the fact that substantial percentages of Indian households are exposed to these processes of peri-urbanization official reorganization and availability of disaggregated data on PUI is, therefore, crucial. Thus, it is important of having some objective criteria of peri-urbanization can help identify the magnitude of the problem and focus policy makers' attention on these areas and processes.
- Delineating peri-urban areas is a challenge particularly because there are no fixed criteria to identify. Considering the nature of the peri-urban areas it is important to take economic, social and psychological indicators.

Acknowledgements

The study was part of the project titled 'Rural to Urban transitions and the Periurban interface: Identifying, Mapping and Understanding Periurban Areas in India', funded by U. S Department of State grant. The project was led by the East West Center, Hawai (USA) in collaboration with SaciWATERs, Hyderabad (India) and SDPI, Islamabad (Pakistan). We are immensely grateful to Dr Sumeet Saksena from EWC for guiding us in our analysis. We are thankful to Dr Anjal Prakash and Dr Vishal Narain for all their professional support towards writing this article.

References

Adell, Germán (1999). Theories and models of the peri urban interface: A changing conceptual landscape. Strategic Environmental Planning and Management for the Peri-urban Interface Research Project. Discussion Paper (pp. 3–30). University College London: Development Planning Unit.

Bates, Robert H. (1981). *Markets and states in tropical Africa*. Berkeley: University of California Press.

Beauregard, Robert. (1995). Edge cities: Peripheralizing the center. *Urban Geography*, *16*(8).

Firman, Tommy (1996). Urban development in Bandung Metropolitan Region: A transformation to a Desa-Kota region. *Third World Planning Review*, *18*(1), 1–7.

Framework, International Workshop on Rural-Urban Linkages, Curitiba, Brazil.

Friedmann, John, & Mike Douglass (1975). *Agropolitan development: Towards a new strategy for regional planning in Asia*. Los Angeles: University of California.

Garreau, Joel (1991). *Edge city: Life in the new frontier*. New York: Doubleday.

Iaquinta, D.L., & Drescher, A.W. (2000). Defining periurban: Understanding rural-urban linkages and their connection to institutional contexts. Paper presented at the Tenth World Congress of the International Rural Sociology Association, Rio de Janeiro, August 1.

Karshenas, Massoud (1997). Dynamic economies and the critique of urban bias. *The Journal of Peasant Studies*, *24*(4), 1–2.

Kundu, Basanta, Pradhan, K., & Subramanian, A. (2002). Dichotomy or continuum: Analysis of impact of urban centres on their periphery. *Economic and Political Weekly, XXXVII*(50), 5039–5042, December 14.

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016

Lofchie, Michael (1997). The rise and demise of urban-biased development policies in Africa. In Gugler (Ed.), *Cities in the developing world: Issues, theory, and policy*. Oxford: Oxford University Press.

Narain, Vishal (2010). Periurban water security in a context of urbanization and climate change: A review of concepts and relationships. Discussion Paper Series of the Peri Urban Project of SaciWATERs.

———. (2012). Neglected frontiers—peri urban water use and human health in the National Capital Region. In A. Prakash, V.S. Saravanan & J. Chourney (Eds), *Interlacing water and human health—case studies from South Asia*. *Water in South Asia* (Vol. 3, pp. 360–380). New Delhi: SAGE Publications

Nottingham and Liverpool Universities (1998). Literature review on peri-urban natural resource conceptualisation and management approaches, Initial Draft, Peri-Urban Production Systems Research, Natural Resources Systems Programme, DFID, London.

Oliveau, Sébastien (2005). Periurbanization in Tamil Nadu: A quantitative approach. CS H Occasional Paper.

Rakodi, C. (1998). Review of the poverty relevance of the peri-urban interface production system research. Report for the DFID Natural Resources Systems Research Programme, 2nd Draft.

Rondinelli, Dennis (1991). Asian urban development policies in the 1990s: From growth control to urban diffusion. *World Development*, *19*(7), 791–803.

Rondinelli, Dennis A. (1984). *Applied Methods of regional analysis: The spatial dimensions of development policy*. Boulder, Colorado: Westview Press.

Saksena et al. (2014). Monitoring peri-urbanization in the greater Ho Chi Minh City metropolitan area. *Applied Geography*, *53*, 377–388.

Soja, Edward (1992). Inside exopolis: Scenes from Orange County. In M. Sorkin (Eds), *Variations on a theme park: The new American City and the end of public space* (pp. 280–287). New York: The Noonday Press.

Unwin, Tim (1989). Urban-rural interaction in developing countries: A theoretical perspective. In Potter & Unwin (Eds), *The geography of urban-rural interaction in developing countries: Essays for Alan B. Mountjoy* (pp. 12–30). London: Routledge.

Poulomi Banerjee is an economic geographer and is currently placed as a Senior Fellow in SaciWATERs. Having a PhD from Jawaharlal Nehru University, New Delhi, she has worked extensively in the area of policy research, advocacy and capacity building of large scale environmental development projects. Before joining SaciWATERs, she has worked with The Energy and Resources Institute (TERI), New Delhi, in watershed and WASH related arena. In SaciWATERs, she is handeling periurban water security and groundwater management projects, urban-periurban water supply and sanitation and transboundary water governance. Currently she is working as a post-doc fellow under a project titled 'Shifting Grounds: Institutional transformation, enhancing knowledge and capacity to manage groundwater security in periurban Ganges delta systems', funded by Netherlands organization for Scientific Research (NWO).

Chinmoyee Mallik is a geographer by training. She graduated from Presidency College, Kolkata in 2004 and joined Jawaharlal Nehru University, New Delhi. She has recently been awarded a PhD from Jawaharlal Nehru University and has joined Indian Institute of Management Calcutta as a post-doctoral fellow. She is regularly attached to SaciWATERs as a consultant. Her specific areas of interest span employment, peri-urbanization dynamics, agricultural and economic geography.

Nani Babu holds a Master's Degree in Geo-Informatics from Adikavi Nannaya University, Rajahmundry. He has previously worked with APSRAC for the project National Wetland Inventory Assessment. He also worked in SACON as a Junior Research Fellow for the project – 'IGBP-LULC Dynamics and Impact of Human Dimensions in Indian River Basins'. He was involved in Empirical Modelling for the future scenario in the IGBP-Project with NRSC (ISRO) team, Hyderabad. He has been working in this sector for four years. Currently, he is working as a Research Officer, GIS for the Peri-Urban Water Security Project.

Downloaded from vis.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016