



**"Sustainable Settlements in Periurban Areas,"
(Acronym: PERIURBAN)**

WP 7 deliverable 'Dissemination'

**A comparison between
the periurban developments
in the EU & US and India**

Programme: Promoting Competitive and Sustainable Growth

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Executive Summary

This deliverable for the WP Dissemination summarises the PERIURBAN project, which looked into the options for a sustainable development of Indian periurban areas. The comparison between the EU & US and India should clarify the perspectives from both angles. The most important results are as following:

- The juxtaposition of PERIURBAN project findings with European and US literature has revealed that PU development and suburbanization/urban sprawl can be traced by to the same roots. This could be shown from the view point of theoretical concepts to empirical evidence, where the same underlying mechanisms seem to be at work.
- In both cases infrastructure supply for the individual motorised transport appears to be the key element in the process. This is an imperative prerequisite for PU development and suburbanization. However, beyond that there are also indications that transport is also involved in socio-economic trends which may be independent driving forces. The extension of such a transport infrastructure has permitted to opt for more place-independent lifestyles facilitating the individualisation of societies around the world.
- The major qualitative difference between India and Europe/the US is that PU development concerns mainly low-income groups, whereas suburbanization traditionally has been a middle-class phenomenon. However, this may change in the mid and long term as India becomes economically wealthier. This fact emphasizes the need to address equity issues for the design of PU policies for Indian agglomerations.
- Empirical evidence shows that PU development in India is still in a very early stage compared to the degree of suburbanization of Europe and the US. The main reason is that the development has begun with a delay of at least 50, if not up to 100 years. This clearly highlights the enormous latent potential for further PU development in India, but also the potential to prevent the repetition of the same problem. However, it should be noted that India is in a different range of magnitude. This means that the problem should be taken equivalently serious with an urgent need for appropriate action.

- Despite these project results, more evidence and research is required to analyse the problems involved in the periurban issues. This is especially required to develop a clear and applicable theoretic framework for the integration of local knowledge and policies.

1 Introduction

1.1 The Project

The PERIURBAN project was a thematic network, financed by the European Commission, which aimed to gain an understanding for sustainable development in periurban settlements of Indian's major cities.

The main scientific objectives were firstly to identify linkages between environmental and socio-economic processes in the periurban interface (PUI). Secondly, to gain an understanding in the existing institutional mechanisms within the PUI in the Indian region and to identify alternative institutional mechanisms to strengthen environmental management in PUI.

Thirdly, a special focus was on the energy and transport sector and the pressures these exert on natural resources in periurban areas. Especially the transport aspect is one of main importance, which has not been considered to such an explicit extent as in other projects such as the PUI Programme (<http://www.ucl.ac.uk/dpu/pui/index.htm>) (Peri-Urban Interface Programme).

In the final workpackages contains a set of policy options to promote economically and environmentally favourable settlements in the fringe areas around urban settlements in India. One main aim of the project was to deliver the knowledge generated through this project to public, scientists and policy makers using a range of dissemination activities such as the website (<https://www.periurban.org>) or workshops.

1.2 Activities of Workpackage 7

The PERIURBAN project, being a thematic research network rather than a primary research project, included a number of mainly secondary sources and methodologies to solicit input and synthesise information. An initial literature review aimed at collecting and reviewing the existing literature on periurban research; this activity was primarily geared towards published information from India. This exercise revealed that although there is an emerging literature specifically treating rural-urban interaction, published work on India and the energy and transport sectors in this context is still small.

In order to access also unpublished work, an Internet discussion forum was set up under each of the substantive work packages. Although a wide group of individuals and organisations were invited to participate, the discussion forum

yielded little in terms of response and input. The original activity under the PERIURBAN project has been the series of workshops organised by the different partners. During these workshops, lively discussions among core partners and external collaborators around specific project outputs have given rise to refined definitions of the PUI, how to analyse the specific questions arising in the PUI context and also new insights into the complexity of finding a common framework of analysis. These workshops were accompanied with a series of “familiarisation visits” enabling a broader and common understanding of the PUI. Furthermore, these exercises facilitated closer collaboration with ongoing, yet unpublished, research activities on the ground that proved an invaluable addition to the limited published literature.

1.3 Aim of this WP7 Deliverable

The deliverables of the other workpackages looked specifically in an Indian context. This deliverables for WP7-Dissemination includes explicitly the comparison between India and western countries for a clearer assessment of Indian context from a western and specifically EU perspective.

The following steps have been addressed to reach this objective:

- Review literature on suburbanisation/urban sprawl/periurban developments in Europe and the USA and
- compare them to the findings of the PERIURBAN project.
- Draw conclusions form the comparison of the two former.

Although this layout seems to look simple, the material often cannot set up in such a clear-cut way, i.e. that certain reviews could be placed in either sections. This, however, does not constitute a problem since it keeps the assessments on the specific comparative levels.

Thus, the comparison will provide a clearer understanding from an Indian as well as an EU perspective and would lay the foundation for establishing a common ground for further research.

2 Suburbanization, urban sprawl or periurban: concepts and definitions

2.1 The development in the EU and US: General concepts

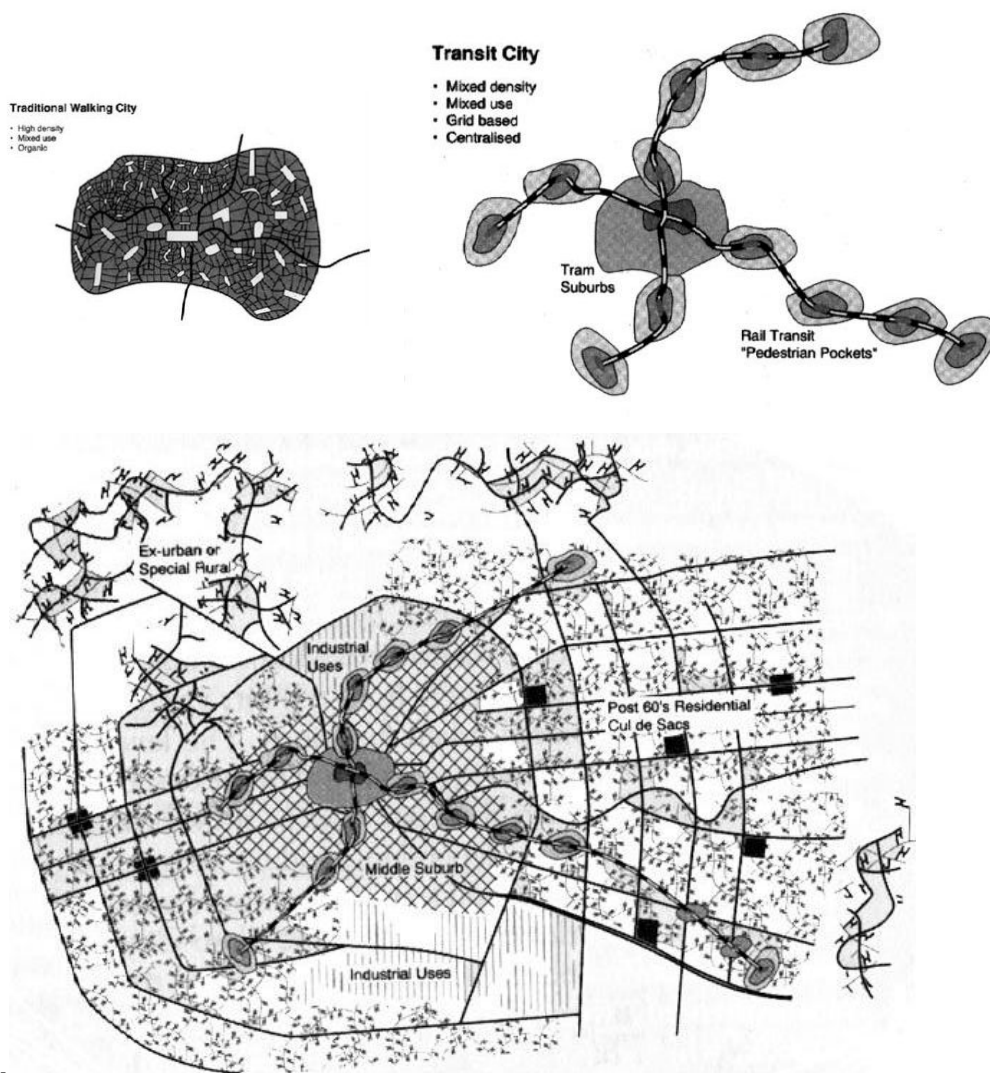
There is a multitude of theoretical concepts on the process of urban development and therefore only a brief overview can be given on selected concepts.

Klaassen, Bourdrez et al. (1981) and van den Berg (1989) distinguish four stages in the development of urban agglomerations where i) the urban region becomes more important through absolute gains of the core city in the process of urbanization. In the subsequent counter-process of suburbanization the hinterland obtains a greater share of development, resulting firstly in a relative, then in an absolute loss for the core city. The process culminates in a de-urbanization in which the city region as a whole loses importance in favour of areas outside the region. Finally, the core city regains population and economic activity through re-urbanization. Without giving detailed empirical evidence, they state that in the 1970s and 1980s most European cities were in phases of 'urbanization' and 'suburbanization' and the process is most advanced with big cities of regions which have experienced early industrialization.

Axhausen (2000) characterises the transport perspective of urban geography which prevailed in the 20th century. Urban visions in the first half of the 20th century isolated traffic as a separate function which lies – in terms of planning and decision making – in hand of transport planning and traffic engineering professions. Consequently, they developed their own 'network logic' which has overpowered traditional urban logic. The main concerns of network logic, efficiency of operations, speed and safety, result in functionally differentiated transport networks which minimize the interaction between flows of traffic. The availability of funding and guidelines (such as the early US AASHO guidelines which later all other Western countries adapted) gave dominance to the profession of transport engineers. Based on the scientific American sprawl literature, he summarizes the factors determining the suburbanization with less place-dependent social networks and living arrangements:

- The oppressiveness of the place-based networks
- Increased participation in higher education
- Greater fluidity of many labour markets
- The car
- Subsidised housing ownership

With the focus on the influence of transport, Newman (2001) combines these concepts by presenting three mobility-related development stages of cities (see Figure 1).



4

Figure 1 Walking, transit and automobile city (Newman 2001)

Since nearly two millions of years of human evolution, walking was fundamental for survival¹. The need to walk became less evident as people gathered in larger settlements due to the introduction of agriculture. However, walking remained the dominant mode and traditional cities never exceeded a size of 5 to 8 kilometres in diameter. This distance corresponds roughly to a *one-hour* walking trip. It should be noted that the ‘one-hour’ trip time is a crucial assumption in this approach.

The industrialisation required work for thousands of additional people, more than the traditional city could possibly hold; the density and form of cities was not appropriate anymore. Infrastructure, such as water and wastes pipes and channel or railways for transporting people and goods, enabled the city development along these corridors. The result was a new urban pattern, the ‘Transit City’. The new Transit City could now spread 20 to 30 km along its corridors while maintaining the *one hour* time horizon for mobility. The original pedestrian-oriented environments were now complemented functionally at the railway network nodes, creating a duplication of the walkable city.

The post 1940’s economy in the industrialised world gave rise to the automobile as a mass form of movement. The car’s popularity in “creating new freedom over space and time” stimulated a new momentum for urban change. In spite of the promised freedom over space and time, the automobile is also constrained by the ‘one-hour’ wide city which means an extension of 40 to 50 km in every direction. This resulted in the suburban developments, filling gradually the area between the transit corridors.

Newman adds an additional stage as the automobile city reaches its limits. He argues that the latent human need to walk and to maintain local social networks will finally result in a renaissance of ‘walkable’ urban structures.

Bronger (2004) describes urban development as the emergence of (i) administratively dependent settlements in the outskirts (‘Vorort’ in German), (ii) administratively independent suburbs (‘Vorstadt’ in German), the formation of twin cities, i.e. conurbation, and the development of self-contained cities outside the urban agglomeration.

In a social science-oriented definition, Bronger (2004) defines ‘suburbanization’ as a process which involves a conceptual, a spatial and a temporal dimension. The conceptual aspect describes suburbanization as part

¹ see http://news.nationalgeographic.com/news/2004/11/1117_041117_running_humans_2.html

of the overall urban development process, including the participation of non-urban population within urban agglomerations in growing material, social and cultural wealth. Theoretically, suburbanization covers all aspect of life. Temporally and spatially there is a distinction between internal and external suburbanization expressing the spatial scope of the process. For the driving forces of suburbanisation, Bronger distinguishes - on a most basic level - incentives for migration into 'push' and 'pull' factors, i.e. negative and positive aspirations about living or business conditions in a certain area. He noted, however, that this distinction is not entirely selective, as both kinds of factors potentially presuppose each other. Some argue therefore that the discussion on which regime is prevailing, makes only sense if detailed empirical survey are available (Bronger 2004).

Brake et al. (2001) conclude on recent suburbanization trends in Germany that suburbanization extends into more remote areas in the form of 'urban sprawl' which corresponds to external suburbanization as defined by Bronger (2004). Therefore it seems justified to qualitatively consider 'suburbanization' and 'urban sprawl' as synonyms, with differences concerning only the exact spatial definition.

The attempt to find an operational definition of suburbanization and urban sprawl which lends itself to empirical analysis reveals the ambiguous character of the qualitative concepts described above: suburbanization can be considered both, as a state and a process. It is just as well reasonable to state that there was urban sprawl, say, in Paris in 2001 as to conclude that urban sprawl occurred in the period 1991–2001 in Paris (Prud'homme and Nicot 2004).

Relating to the state interpretation, two common basic concepts can be observed: (i) The morphological interpretation is based on spatial proximity to the urban core. The major problem associated with this definition is to define a consistent spatial delimitation concept. (ii) The functional definition is most often based on commuting or shopping patterns and is frequently used for the definition of (functional) urban areas, e.g. by statistical offices (Prud'homme and Nicot 2004).

The process definition, i.e. what happens over time with a given urban area, can be interpreted as flattening of density gradients. As a practical indicator, Prud'homme and Nicot propose the 'median distance' which is the radius of a

circle with one half of the population living inside and the other half living outside the circle. Changes of this 'median radius' are a sign of urban sprawl.

Hesse (2001) argues that decreasing spatial frictions result in more transport-intensive settlement structures. Simultaneously these structures lead to individual behavioural patterns which involve high levels of travel as a consequence of a personal 'trade off' between transport and spare time.

2.2 Indian concepts

Although the PERIURBAN project was not a research project, certain assumptions are made for development of the empirical studies.

On a conceptual level, the formation of peri-urban (PU) areas is assumed to be related to the shortcomings of urban centres, such as lack of adequate infrastructure, deteriorated environment, which push the development beyond the traditional city limits, creating a strong influence on these areas (Thirumurthy 2005). However, urbanization beyond the city limit is not only due to urban pressures but also to the easy accessibility through the availability of transportation corridors. This means that urbanization in the area beyond the city, can be identified as a process which transforms rural areas into urban area passing through the PU stage (Figure 2). Therefore, it is likely that today's PU areas will become the urban area of tomorrow, if the transportation network is extended and the inflow and outflow of resources is facilitated.

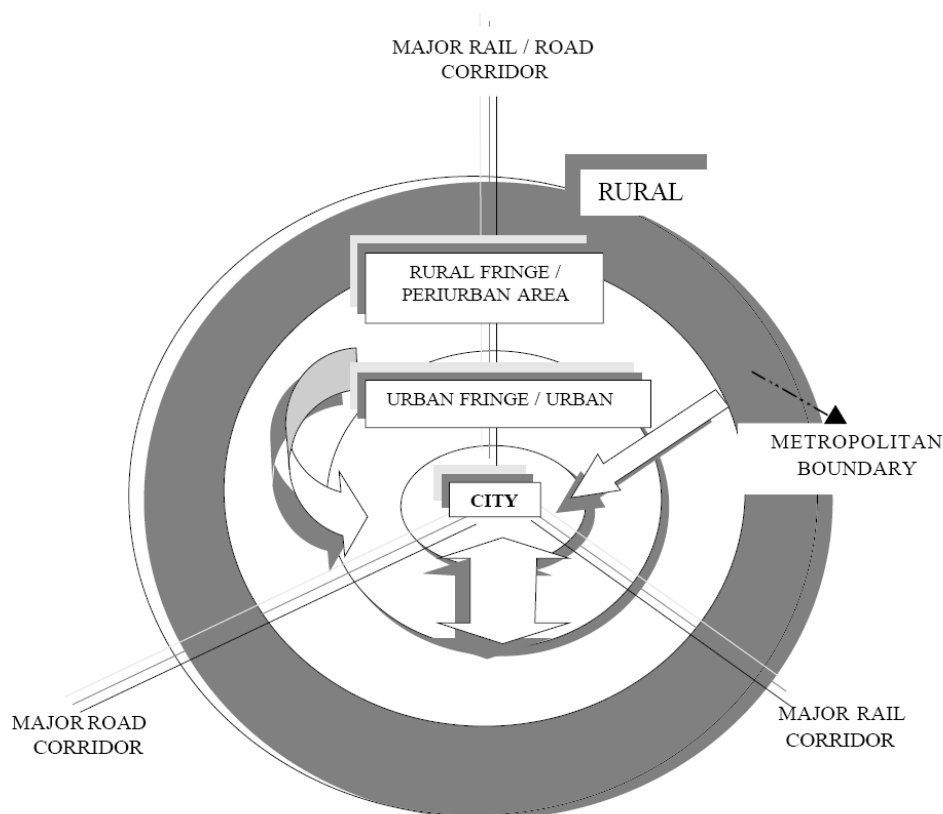


Figure 2 Concept of formation of PU areas (Thirumurthy 2005)

A major emphasis in the PERIURBAN project was placed on definitions of the notion of “peri-urban” (PU). Since clear definitions are still crucial to the analysis the generally agreed results are summarised in Deliverable 5 which identifies three main approaches for the definition of peri-urban interface (PUI):

- The PUI as the periphery of a city
- The PUI as a socio-economic system
- The PUI as the interaction of rural-urban flows

PU has been traditionally defined as ‘the edge of the city’, the ‘urban fringe’ or as the ‘spatial transition zone between urban and rural areas’. A recent example of this type of approach is the concept of ‘footprints’:

A city’s landscape footprint includes the ecologically productive land, water and natural and semi-natural landscapes that the city consumes, permanently changing its traditions uses and cover (Morello, Matteucci et al. 1998).

This definition makes clear that spatial proximity to urban areas is an essential factor in the definition of PU. The approach seems entirely consistent with a “natural science” analysis of PU areas (Timms and Hodgson 2005).

Other approaches to the conceptualisation of the PUI move away from its physical features and focus on its socio-economic characteristics. ‘Peri-urban’ is understood as a social category, regardless of its spatial dimension. In other words, PU communities are those which have a dual urban-rural orientation in social and economic terms.

Established theoretical definitions of urbanism identify three main components of PU development:

1. The demographic component, i.e. increasing population size and density
2. The economic component, i.e. primarily non-agricultural workforce
3. The socio-psychological component

Iaquinta and Drescher (2000) argue that the socio-psychological component is most often omitted from PU definitions; this fact underestimates the prevalence of social change. They distinguish five categories of PU settlements. Only four of them have spatial proximity to urban centres within their definitions, thus, underlining that spatial proximity is not essential.

A third approach attempts to explain the nature of the PUI by looking at the dynamics of rural-urban links and flows at the regional level (see Figure 3). PUI are assumed to be areas where urban-rural linkages, changes and conflicts are most intense. These flows are the expressions of people’s strategies for survival; they include flows of resources between PU, urban and rural areas. The key advantage of this definition is that the notion of flows intrinsically includes transport.

Another advantage is the emphasis on the dynamic nature of the PUI, focussing more on processes than on states. This approach may be particularly appropriate given the rapidly changing nature of social and economic relations within PU communities.

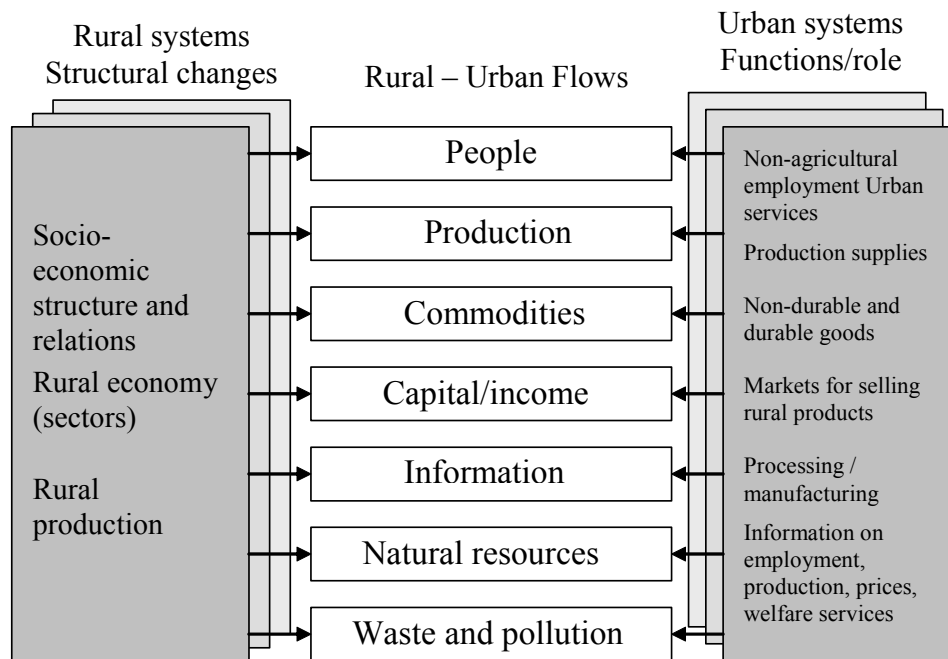


Figure 3 Rural–urban flows

(Thirumurthy 2005) identified the socio-economic driving forces at work as:

- The population growth in the cities due to migration leading to increased land prices in the city
- Increasing congestion and deterioration of living environment in the city
- Higher transportation accessibility
- The availability of health and education facilities outside the city
- The desire to own a house at affordable prices
- The availability of communication facilities outside the city
- Community and friends influence

The pressure on PU areas increases in relation to the difference in potentials. Industries often find PU areas highly suitable in terms of cheaper land, water and unskilled labour. Educational institutions obviously prefer PU areas because of cheaper land and water. A recent trend is the formation of so-called 'Farm houses' – a typical pass time for the urban rich at the cost of conventional agricultural activities. Horticulture activity is extensively practiced producing, vegetables and flowers for the urban market in most of the PU and the adjoining rural settlements.

2.3 The comparison of concepts

Conceptually, there is very little difference between the different definitions of suburbanisation, urban sprawl and PU or PUI. Whereas the two former have an emphasis more on the area of origin, i.e. the urban or city, the notion of PU may assume an identity of its own.

Although the selection of concepts is not comprehensive, it becomes clear that western approaches generally place the focus more on the physical or spatial dimension. Here, the PERIURBAN project could add the multi-dimensionality and actually the complexity of the problem involved. In this way, the socio-economic or functional dimension, as Iaquina and Drescher and IRMA have pointed out, may be regarded as an equivalent dimensions as the physical one. The difference between a 'state' and a 'process' of the PUI can be viewed as complementary, since connecting states at different points in time describe a dynamic process.

In a nutshell, the difference in definition between suburbanisation, urban sprawl or PU is marginal. Depending on the context all terms could be used interchangeable. The spatial dimension is the most obvious one, but other dimensions as socio-economic nature can be equivalent.

3 Measuring suburbanization/periurban: the empirical evidence

3.1 The Evidence from the EU and US

3.1.1 The empirical evidence from the EU & US

While suburbanization and urban sprawl are intuitively apparent and despite the variety of theoretical concepts, ‘hard’ empirical evidence is still relatively scarce. The relevance of such evidence is not just to confirm the existence of the phenomenon *per se* in the long term but to highlight the quantitative magnitude of the development and to find out whether suburbanization is still continuing.

Bronger (2004) points out that the major obstacle to empirical measurements is the problem of an appropriate delimitation concept for urban agglomerations and suburban areas. However, he finds the classification sketched out by Boustedt (1975) most appropriate which structures the urban agglomeration areas based on a demographic and functional transformation process (Table 1). On the basis of this concept he distinguishes several suburbanization types to account for the spatial scopes of different process stages.

Core city	Core area	Metropolitan agglomeration	Metropolitan region	External zone	Hinterland zones
Complementary zone					
Urban zone					
Edge zone					
Hinterland					

Table 1 Partition of urban agglomerations (Boustedt 1975)

In his empirical analysis, Bronger compares four metropolises (New York, Seoul, Mexico City and Mumbai) based on the classification presented in Table 1. The results for New York and Mumbai are given in Figure 4. ‘Historic suburbanization’ is defined as the percentage of people living in core city versus the core area; it describes an early stage of small-scale suburbanization. A high percentage corresponds to a low degree of suburbanization. ‘External

suburbanization' is expressed as the percentage of people living in the metropolitan agglomeration in relation to the metropolitan region; it therefore indicates suburbanization on a wider spatial scale.

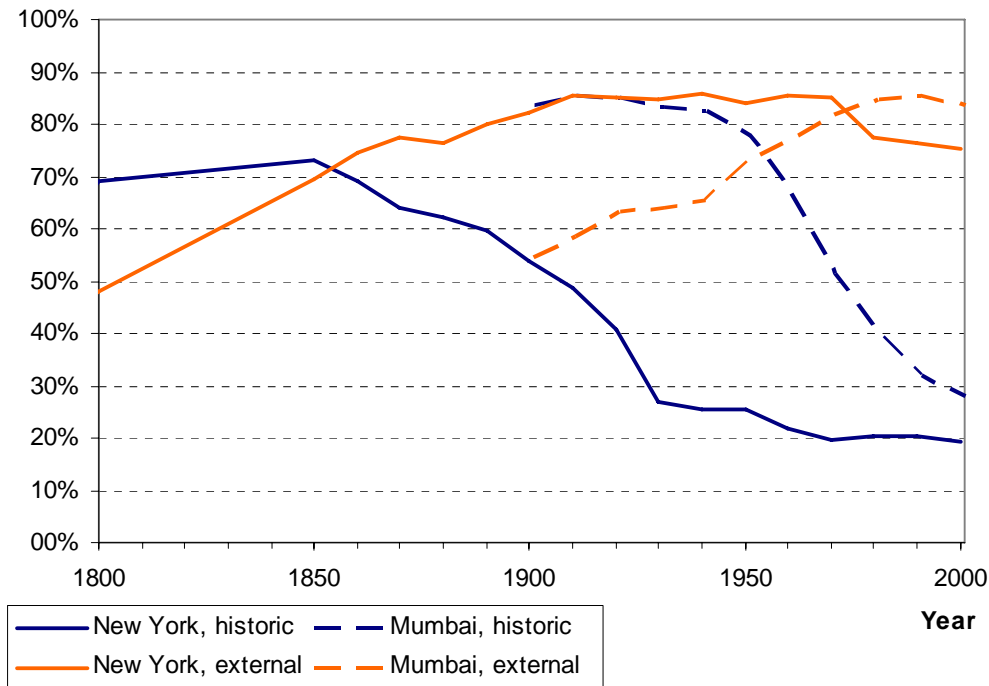


Figure 4: 'Historic' and 'external' suburbanization in New York and Mumbai. The Percentage corresponds to the ratio of people living in core city versus the core area (Bronger 2004)

Suburbanization started on a limited spatial level and then included more and more distant areas. This shows that 'historic' suburbanization took place before 'external' suburbanization both in New York and Mumbai. It is clearly apparent that there exists a time lag between the two cities, with 'historic' suburbanization in Mumbai setting off only in the 1950s, about 100 years after New York. 'External' suburbanization has not taken place to such a substantial degree in Mumbai yet.

Based on absolute population values (Figure 5), current suburbanization in Mumbai is even less distinct. In 2001, Mumbai's core city had the highest population in its history after a temporary decline in the 1980s. On the contrary, absolute population in the core city of New York decreased slowly, but remained steady from 1910 until 1980.

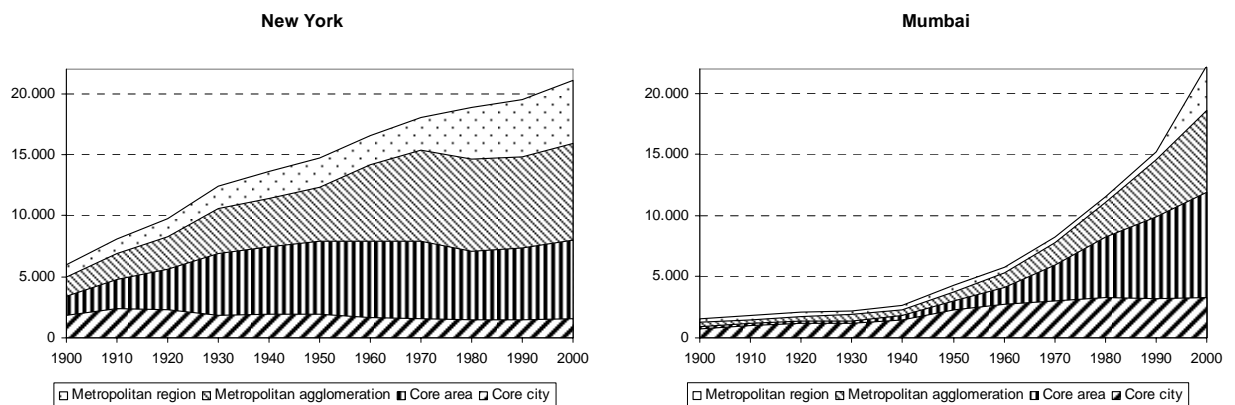


Figure 5 Population development in the metropolitan regions of New York and Mumbai (in thousands)

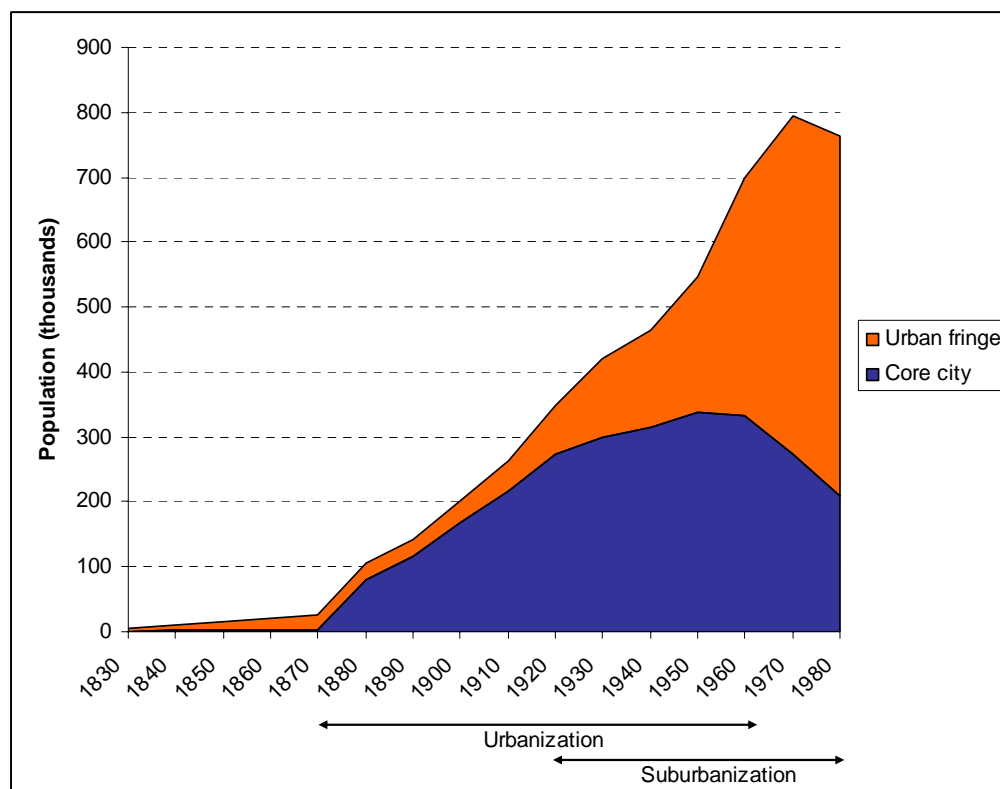


Figure 6 Population development in the Indianapolis agglomeration (Marion County) 1830–1980 (Hulse and Zeigler 1991)

An interesting figure can be derived from data (Hulse and Zeigler 1991) collected in a research project on the Indianapolis agglomeration (Figure 6). The population development clearly suggests a phase of urbanization between 1870 and 1970 when the overall population grew from roughly 20,000 to almost 800,000. Initially, most of the increase is due to the growing

population of the central city. However, starting in the 1920s, an increasing share of this growth concerns the urban fringe; finally from 1950 on, the central city experiences absolute population losses which extend to the whole agglomeration in 1970.

Prud'homme and Nicot (2004) analyze trends of urban sprawl based on a 77-city sample of French cities. Their results are remarkable because they utilize an indicator corresponding to the process definition of suburbanization including the aspect of job suburbanization. The indicator 'median distance' gives the radius of a circle with one half of the population living inside and the other half living outside the circle.

	Population	Jobs
<hr/>		
Median distance (km)		
1982	5.7	3.8
1990	6.6	3.9
1999	7.3	4.8
<hr/>		
Absolute changes (km)		
1982–1990	0.8	0.2
1990–1999	0.8	0.9
<hr/>		
Relative changes (%)		
1982–1990	14.4%	4.5%
1990–1999	12.0%	21.8%

Table 2 Median distances for people and jobs in Rennes (France), 1982, 1990, 1999 (Prud'homme and Nicot 2004)

Generally, they find that suburbanization in French agglomerations continued to progress in the 1982–1999 period, albeit at a fairly moderate rate. The most remarkable exception is Paris which showed higher dynamics. In a case of Rennes, the regional capital of Brittany, they observe that suburbanization speeded up in the 1990s, especially in regard to job suburbanization which exceeded residential suburbanization in this period (Table 2). Throughout their study they find that incomes are higher in the periphery than in the core cities. Their conclusion is that suburbanization still continues in France and it should be determined by the same factors as elsewhere.

3.1.2 The driving forces in Europe and US

Empirical support for the hypothesis of transport, or more specific, travel behaviour being actually one of the main driving forces in the process of urban development, stems from the discussion on ‘travel budgets’, which can be related, for example, to the ‘one-hour’ assumption of Newmann (2001) or to the issue of ‘most basic level’ discussed by Bronger (2004). Travel budgets are defined as time or money spent for daily mobility per person (in relation to households), which consider their daily travel decisions limited to the monetary and time budgets for their spatial activities. Based on travel data of more than 100 US urban regions, Zahavi (1981) found that travel time and travel money budgets are largely constant over time with 1,1 hours and around 5 to 13% of household monetary expenditures, depending on the income group. His conclusion is that households maximise spatial opportunities by increasing travel distances within their monetary and time budgets. This implies that people will make more and longer trips and chose more distant destinations (i) if travel becomes faster or less expensive, (ii) if people get more affluent or (iii) in a combination of these two cases.

Consecutive research has both supported and challenged the existence of constant travel budgets. Mokhtarian and Chen (2004) take a critical view, stating that while stability can be observed at aggregate levels, travel time and money budgets are often found to give widely different results in disaggregate empirical studies. They observe that travel time expenditure is strongly related to socio-economic variables, such as individual and household characteristics, attributes of activities at the destination and characteristics of residential areas.

Schafer (Schafer 1998; 2000) on the other hand, supports Zahavi’s findings of travel time and travel money budgets, albeit acknowledging that neither budget is unique or completely stable. His comprehensive analysis of travel surveys spans from very-low income African villages, over to high-income, high-density European countries up to high-income, low population-density United States (Figure 7).

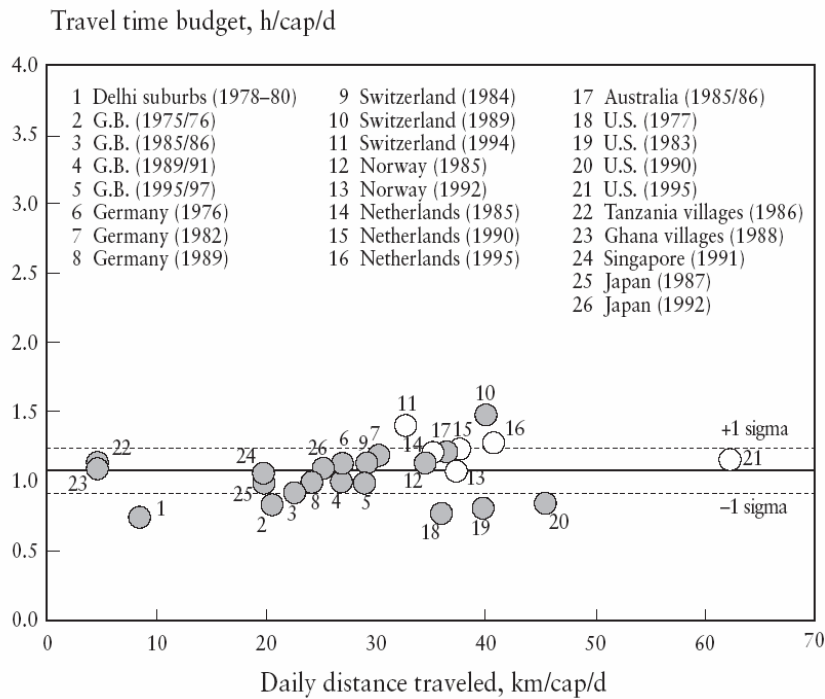


Figure 7 Travel time as a function of daily distance travelled (Kölbl 2000)

The analysis suggests while most of the budgets' variations are attributable to inconsistent survey methods; behavioural change is only of secondary importance. Schafer, thus, concludes that travel budgets offer a simple, elegant framework on the basis of which average travel behaviour characteristics can be approximated on aggregate levels.

Kölbl et al. (2000; Kölbl and Helbing 2003) found that the extent of travel budgets is mode-specific, i.e. each mode of transport has its own travel pattern (see Figure 8). This result explains Schafer's analysis of Figure 7 and the increasing travel distances whereas travel times remain stable.

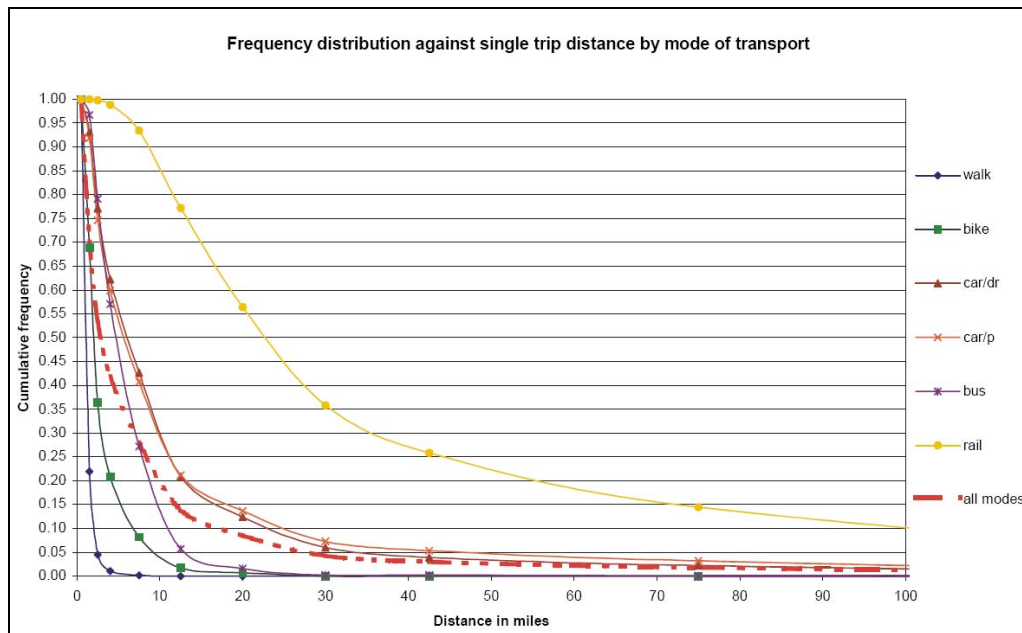


Figure 8 Trip frequency distribution over distance by mode of transport (Kölbl 2000)

The implications of travel budgets on travel behaviour, irrespective of whether they are based on time or money, have their justification, since they are based on observations from two different directions, i.e. microscopically from human travel behaviour and macroscopically from settlement development (Newman 2001). The overall conclusion is that making travel more convenient – be it in terms of speed or (financial) costs – the results will be more travel (trip rates and lengths) and the choice of more distant destinations. This, in turn, generates more dispersed urban forms and other (socio-economic) indicators, as described in the previous section, follow accordingly.

Despite this evidence, Knoflacher (1996) remarks that this fundamental mechanism seems to be widely neglected in the scientific debate and in policy making. He identifies the following explanations:

- “Structural constants” like the travel time budget are not perceivable in isolated cases. They manifest themselves only on a system-wide perspective. Although they constitute “hard” system constraint, they are almost arbitrarily elastic in single cases.
- System impacts can only be observed indirectly. An example is the transition from small retail shops to large shopping centres in the US and Europe.
- Generally, human perception takes the notion of a rigid spatial structure for granted. This fact draws off the attention from the dynamics of spatial structures.

In relation to the socio-economic developments, Maat and Stead (2005) have shown that employment development in urban centres has shifted to clustering around transport infrastructure. This could be found along the motorway A12 in Netherlands, where the proximity to transport infrastructure indeed does have an effect on employment. Although this development is not particularly strong but the employment growth is high within very close proximity to the motorway (1 km from the next motorway junction). Of higher significance is the development of proximities to existing employment areas, which backs up the concept of 'employment clusters'.

3.1.3 The effects for a Periurban Development

Although some of the empirical evidence above suggests to be conclusive, the inferences and opinions are not equivocal.

As defined by Breheny (1996) 'decentrists' do not consider or even deny the influence of settlement structure on mobility behaviour. One of their major hypothesis is that urban mobility does affect mobility but that socio-demographic and socio-economic factors are superposed and are actually more important (Hickman and Banister 2005; Schwanen, Dijst et al. 2005). Settlement structures are assumed not be equally important for all sectors of the population; the heterogeneous urban population therefore makes it impossible to formulate straightforward relations between urban form and travel. Increasing individualism and the differentiation of lifestyles 'decouple' mobility from spatial-physical structures and, therefore, disagree with planning regulation (Hesse 2001). On a methodological level it can be argued that the stated loss of community is not sufficiently supported by historic or sociological evidence (Axhausen 2000). Frequently, an urban structure changes too slowly in order to use land use planning and policy to affect travel behaviour, which can be estimated at a rate of 1–2% per year in the UK (Hickman and Banister 2005).

By contrast, 'centrists' - as defined by Breheny - agree widely on the associated problems, which stem foremost from externalities and excessive levels of motorized transport; and secondly, on the progressing social isolation, both on the level of individuals and certain groups (Knoflacher 1996; Duany, Plater-Zyberk et al. 2000; Burchell, Lowenstein et al. 2002). The functional division of space is identified as the root of the problems, generating a dependency on car or motorised travel and leaving much of the space socially empty and uncoordinated.

In a combined cross-sectional and longitudinal study which caught considerable attention in academics, Newman and Kenworthy (1989) study the interaction between urban form, transport and energy use in 32 cities from North America, Europe, Asia and Australia for the years 1960, 1970 and 1980. The results juxtapose Asian cities with high densities and low fuel consumption and American agglomerations with low densities and high fuel consumption, whereas European and Australian cities constitute intermediate cases (Figure 9). They argue that there seems to be an overall urban density of 30 to 40 people per hectare where a less auto-based kind of urban transport occurs thus reducing the transport energy consumption for cars significantly.

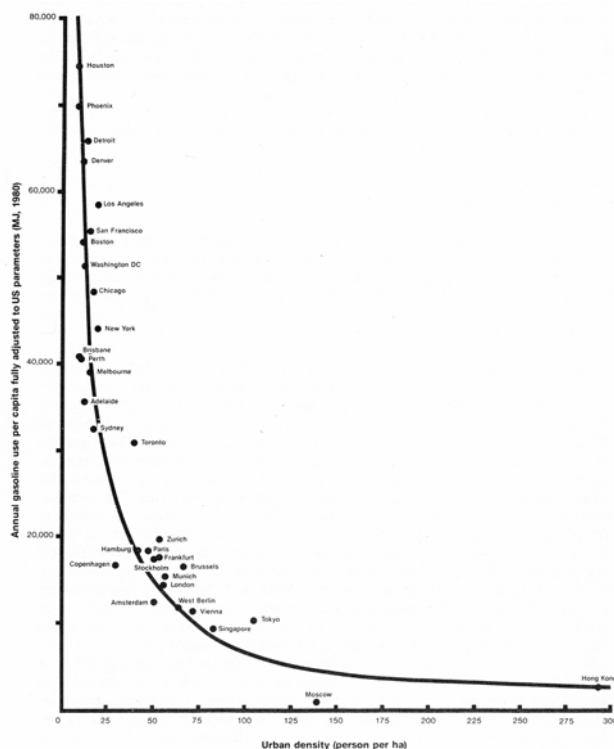


Figure 9 Gasoline use per capita versus urban density (adjusted to US income, vehicle efficiencies and gasoline price) (Kutter 1991)

In Germany, Kutter (1991) finds in his analysis of major urban agglomerations that suburban settlements require more motorized transport for the same level of activity (see Table 3).

Settlement type/size	Motorised transport	Settlement type/size	Motorised transport
Core areas (Berlin)	6,500	Hinterland municipality (110,000 inhabitants)	8,800

Suburban settlements, mixed uses (Berlin, München)	12,310–14,100	Hinterland municipality (less than 45,000 inhabitants)	13,300
Suburban settlements, mainly residential use (Hamburg)	18,280	Hinterland municipality (less than 20,000 inhabitants)	14,500
Suburban settlement, mixed uses		Hinterland municipality (less than 7,500 inhabitants)	14,300
Urban agglomeration	13,500	Hinterland municipality (less than 5,000 inhabitants)	20,500

Table 3 Motorised transport (km travelled per 1000 activities) as a function of settlement types and size (Cervero 1988)

In a detailed household survey, Knoflach et al. (1995) find strong interaction between settlement structure and mobility. They analyze a sample of 126 households in Vienna, including 66 with car and 60 without car. Based on a set of indicators, settlement structure of urban blocks are described in terms of land-use mix (perception of working, shopping and leisure time opportunities by inhabitants), local availability of jobs (jobs per inhabitant) and supply with shopping for daily needs (number of shops within 100m radius). The results are quite explicit in regard to the land-use mix; the modal share of private cars rises from only 8% of blocks with mixed use to 37% of mono-functional ones. Similarly, the share of private car trips is observed to be higher in blocks with limited job availability and in absence local shopping opportunities.

Cervero (1988) looked at mobility at the place of work rather than at people's residence and at suburban commuting patterns. His results point in the same direction, i.e. the mix of uses is the primary site factor which affects the share of private car trips. However, he also observes adverse effects of mixed land-uses, namely a reduction of ride sharing and vehicle occupancy levels. His overall conclusion is that the main benefit of providing complementary uses at the place of work is rather to shorten vehicular trips than to induce people to walk or to cycle.

In a more recent study, Cervero and Wu (1998) observe that density, land-use diversity, and pedestrian-oriented designs generally reduce car trip rates and encourage non-auto travel in statistically significant ways. However, the elasticity between urban structure variables and travel demand measures are

generally close to zero, which indicates that importance of the interaction is fairly moderate.

Crane (2004) focuses on employment sprawl and analyzes its interaction with commute lengths using data from the American housing surveys 1985 and 1997. He finds that job decentralization is in some cases associated with shorter rather than longer commutes. Whereas employment sprawl results in longer commutes in manufacturing and financial services, it seems to reduce trips in the service sector. Crane explains this by the geographical concentration of manufacturing firms and financial institutions in dedicated zones.

In regard to congestion, Ewing et al. (2003) looks at suburbanization and congestion problems as a by-product of more dispersed transport flows. They base their analysis on a four-dimensional index for measuring sprawl, which distinguishes residential density, land-use mix, strength of local activity centres and the accessibility of the street network. The calculation of the sprawl index for 83 of the largest metropolitan areas in the United States shows, that urban sprawl does not influence congestion.

3.2 Indian Evidence

3.2.1 The empirical evidence from the India

India was confronted with an extremely rapid urbanization in the 20th century. The share of urban population, which was only 3% at the beginning of the century, rose to approximately 30%. An spatial view of city growth can be seen in the case of Chennai in Figure 10.

While there has been special concern about the development in the seven 'super metros' (see Table 4), the dimension and severity of problems is similar in all cities.

Super Metros	Population (in million)				
	1961	1971	1981	1991	2001
Calcutta	5.7	7.0	9.2	11.2	13.2
Mumbai	4.2	6.0	8.2	9.9	16.4
Delhi	2.4	3.7	5.7	9.2	12.8
Chennai	2.0	3.2	4.3	3.8	6.4
Bangalore	1.2	1.7	2.9	3.3	5.7

Hyderabad	1.3	1.8	2.5	3.0	5.5
Ahmedabad	1.2	1.7	2.5	3.0	4.5

Table 4 Population of Super Metros in India 1961-2001 (Thirumurthy 2005)

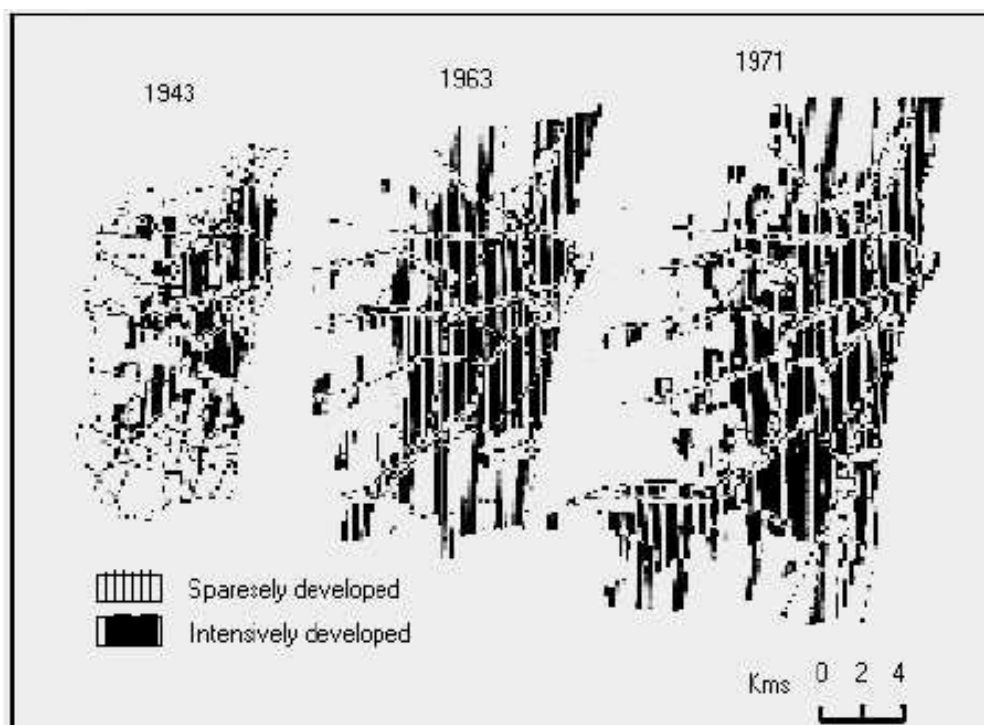


Figure 10: The Development of Chennai (Madras)

With such developments in mind, the challenge within the PERIURBAN project has been to develop an operational definition suitable for Indian context. Currently, official definitions adopted in the Census of India distinguish between urban and rural settlements only.

Based on the static interpretation of the PUI, a series of indicators were defined and classified into three groups (socio-economic, agricultural and infrastructure). Each of the indicators is assigned with a criterion in the form of threshold values which characterize urban settlements. Settlements are then classified as urban, PU or rural if more than 75%, 25–75% or less than 25% of the criteria are fulfilled. The indicators and their respective threshold values are presented in Table 5.

Indicator category	Indicators	Before evaluation	After evaluation	Criterion
Socio-economic indicators	Population			≥ 5000
	Density Persons/Sq.Km		Density (Persons/Sq.Km)	≥ 400
	Literacy		Literacy	$\geq 75\%$
	Workforce-Men		Workforce-Men	$\geq 50\%$
	Workforce-Women			$\geq 25\%$
	Dependents		Dependents	$\leq 60\%$
	Non-Agricultural Workforce		Non-Agricultural Workforce	$\geq 75\%$
	Agricultural Workforce		Agricultural Workforce	$\leq 5\%$
	Manufacture & HHI		Manufacture & HHI	$\geq 2\%$
	Other Services		Other Services	$\geq 95\%$
Agricultural indicators	Cultivators			$\geq 50\%$
	Agricultural Labourers			$\geq 50\%$
	Agricultural land use		Agricultural landuse	$\leq 10\%$
	Crops		Crops	≤ 100 tons
	Horticulture			Y/N
	Cottage & Industries	SSI		Y/N
	Diary Farms			Y/N
Infrastructure indicators	Poultry & Meat			Y/N
	Distance from the City Centre		Distance from the City Centre	≤ 25 km
	Distance from Major Road/Rail Corridor		Distance from Major Road/Rail Corridor	≤ 2 km
	Transport Communication			Y/N
	availability of Bus/Rail facilities			
	Higher Education Institutions			≤ 5 km
	Primary Health center			≤ 3 km
	Shopping Facilities			Y/N
	Presence of MNC			Y/N
	Water Supply			Y/N
Number of indicators	Latrines with Septic tank			Y/N
	Drainage			Y/N
		28	12	

Table 5 Indicators for PU settlements before and after case study evaluation (Thirumurthy 2005)

The initial selection of indicators, which was based on the indicators used in the Census of India to identify urban settlements and on suggestions found in the literature review, was evaluated in a case study analysis covering the Chennai metropolitan area. The result of this exercise was that the number of

indicators could be reduced from 28 to 12 without significant loss of explanatory power (Table 5). At the same time, the practical applicability benefited from to lower data requirements. The developed indicator system therefore is a big step towards an operational definition.

3.2.2 India driving forces

In a case study, ANNA-university analyzed a sample of 9 settlements (municipality level) within the Chennai metropolitan area (Thirumurthy 2005). Whereas the municipal corporation located within the city of Chennai has shown a population growth rate of 11.1% per decade, the 8 municipalities outside the city limits had a growth rate of 1.5 to 5 times of the city rate. All of these municipalities are located either along major transportation corridors or along the boundary of the metropolitan area.

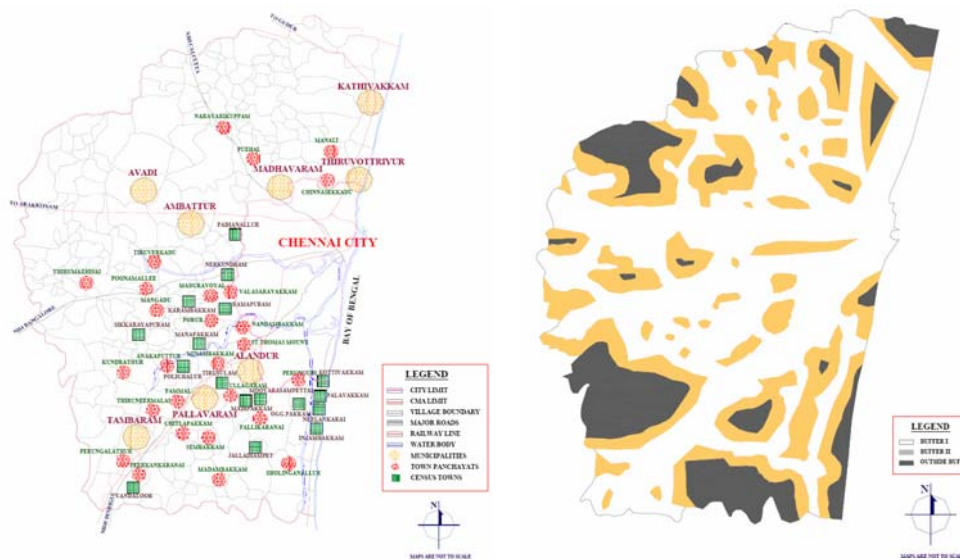


Figure 11 Accessibility and settlement location in the Chennai metropolitan area (Thirumurthy 2005)

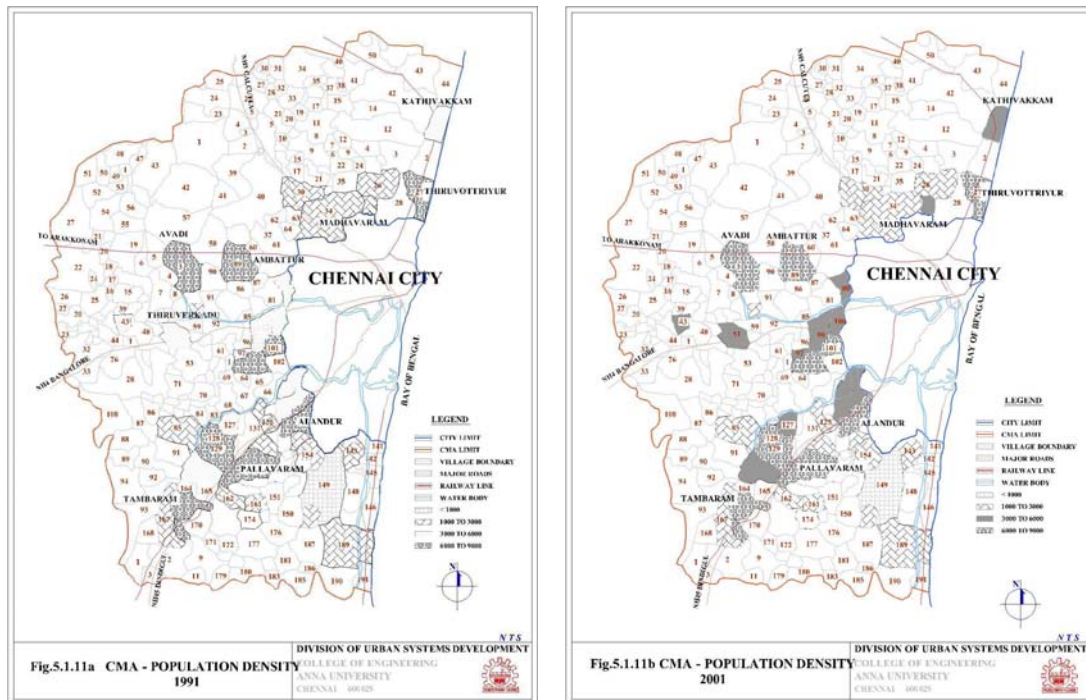


Figure 12 Chennai city population densities 1991, (Thirumurthy 2005)

Figure 12 shows that over a period of time smaller settlements have grown up to the status of municipality only along major transportation corridors. Four corridors can be identified, to the North, the Northwest, the West and the South, respectively. The Northwest corridor is formed by a trunk road, whereas the other corridors consist of a major road and a railway line paralleling each other.

The most distinct development has taken place on the Southern corridor, where the well-developed rail and road facilities provide high levels of accessibility. More than 35% of the 1577 bus services per day - operating within the Chennai metropolitan area - are in the southern corridor. The availability of good drinking water also adds to the attraction. The result is that more than 60% of the education institutions are located on the southern half of CMA. The second most important corridor is the one to the West, whereas the road-only corridor to the Northwest has seen relative moderate development.

The case study clearly supports the finding that transport infrastructure is the primal factor influencing the process of PU development with the respective settlement patterns. Moreover, this shows clearly that the speed of change is most explicit in corridors which combine high level roads and railway infrastructure.

Two other empirical studies on the influence of transport on PU development were carried out by Sudhira et al (2003; Sudhira, Ramachandra et al. 2004). They used geographical information systems (GIS) to study urban sprawl along the Bangalore–Mysore highway and in the Mangalore/Udupi region in Karnataka state which is crossed by National Highway 17. They found that the densities of built-up area were higher closer to the highways. Although the studies do not differentiate development into residential, business or mixed use, their results suggest that development patterns are indeed affected by road infrastructure.

3.2.3 The effects of Indian Periurban Development

Rapidly growing land cost within the city has created an enormous demand for land outside the city with a huge difference in the land value between the centre of the city and the periphery. The differences within the Chennai metropolitan area are shown in Table 6.

Corridor	Land cost (Rs per sq.ft.)					
	Urban		PU		Rural	
	Min	Max	Min	Max	Min	Max
North	207	495	93	234	9	21
	Thiruvotriyur		Manali		Sirugavoor	
West	83	373	87	345	76	127
	Nerkundram		Poonamallee		Thirumazhisai	
South	266	1043	160	693	75	210
	Alandur		Tambaram		Gowrivakkam	

Table 6 Land cost in the Chennai metropolitan area (Thirumurthy 2005)

Because of high rents for land and accommodation in the core city area many people opt for cheaper and better accommodation in the PU areas with a relative moderate increase on expenditure for transport (Institute of Rural Management Anand 2005). The ‘trade off’ between transport and other expenditures results in a more transport-oriented lifestyles.

The low purchasing power of the middle income group, mostly employed in service sector, business sector, trade and commerce and the potential offered by the peripheral areas, especially in low land-cost, have driven this population segment outside the city for residential purposes. This trend was

reinforced by government policies to promote housing activity and financial institutions which reduced the interest rates for loans from 14 to 8.5%.

Maximum and minimum land costs are given for areas adjacent to transport corridors or at the periphery of settlements. Thus, it becomes clear that land costs play also a role in the reinforcement for accessibility and transport infrastructure.

Information on PU transport in India was collected by Thirumurthy (2005) for 16 PU settlements in the southern part of the Chennai metropolitan area. The data collected included income, transport expenditure and modal shares relating to work trips. Two interesting conclusions follow from this data (see). First they confirm the hypothesis that the highest level of walking and cycling occur in the settlements with the lowest transport expenditures and the lowest income. Secondly, the 'richest' settlement, Kilampakkam, has the highest share of rail, although transport expenditures are relatively low with 0% of inhabitants in the highest ranges over 1000 Rs per month.

Settlement Name	Income level (Rs/month)				Transport expenditure (Rs/month)					Modal shares				
	<3000	3000-5000	5000-10000	>10000	0-300	300-600	600-1000	1000-1500	1500-2000	Walk+ Cycle	Two-wheeler	Bus	Train	Car
Kilampakkam	4,0%	8,0%	64,0%	24,0%	4,8%	57,1%	38,1%	0,0%	0,0%	10,0%	16,0%	13,0%	59,0%	1,0%
Mannivakkam	7,1%	17,9%	75,0%	0,0%	7,7%	76,9%	11,5%	3,9%	0,0%	34,6%	19,2%	46,2%	0,0%	0,0%
Mudichur	18,0%	10,3%	38,5%	33,3%	13,9%	50,0%	36,1%	0,0%	0,0%	14,3%	28,6%	34,3%	20,0%	2,9%
Nedunkudrum	31,8%	9,1%	45,5%	13,6%	23,5%	52,9%	23,5%	0,0%	0,0%	15,8%	57,9%	10,5%	15,8%	0,0%
Kulapakkam	14,3%	42,9%	17,9%	25,0%	15,4%	38,5%	42,3%	0,0%	3,9%	8,3%	45,8%	41,7%	4,2%	0,0%
Semmancheri	28,6%	14,3%	28,6%	28,6%	46,2%	0,0%	53,9%	0,0%	0,0%	39,1%	34,8%	21,7%	0,0%	4,4%
Sholinganallur	25,0%	38,9%	13,9%	22,2%	28,2%	21,1%	19,7%	14,1%	16,9%	11,5%	44,2%	44,2%	0,0%	0,0%
Uthandi	66,7%	26,7%	6,7%	0,0%	50,0%	33,3%	10,0%	6,7%	0,0%	64,3%	25,0%	10,7%	0,0%	0,0%
Jallidiampet	27,7%	59,6%	8,5%	4,3%	28,0%	38,0%	12,0%	16,0%	6,0%	20,0%	24,0%	55,0%	0,0%	0,0%
Medavakkam	20,0%	45,7%	20,0%	14,3%	17,1%	38,6%	17,1%	14,3%	12,9%	31,3%	53,1%	12,5%	0,0%	3,1%
Vengavasal	43,6%	35,9%	18,0%	2,6%	34,2%	26,8%	22,0%	9,8%	7,3%	42,9%	16,7%	40,5%	0,0%	0,0%
Perumbakkam	20,0%	13,3%	46,7%	20,0%	26,7%	46,7%	20,0%	6,7%	0,0%	37,0%	40,7%	20,4%	0,0%	1,9%
Thiruvanjeri	41,0%	33,3%	20,5%	5,1%	30,8%	53,9%	15,4%	0,0%	0,0%	14,8%	46,6%	28,4%	4,6%	5,7%
Madampakkam	18,8%	37,5%	33,3%	10,4%	15,2%	20,3%	40,5%	11,4%	12,7%	14,0%	23,3%	51,2%	9,3%	2,3%
Maduraipakkam	44,4%	44,4%	11,1%	0,0%	0,0%	100,0%	0,0%	0,0%	0,0%	10,0%	50,0%	30,0%	10,0%	0,0%
Ottiyambakkam	83,3%	16,7%	0,0%	0,0%	33,3%	50,0%	16,7%	0,0%	0,0%	28,6%	14,3%	50,0%	7,1%	0,0%

Table 7 Income levels, transport expenditures and modal shares for work trips in 16 PU settlements (Timms and Hodgson 2005)

A further case study, carried out in the framework of the PERIURBAN project, reported on 11 settlements within the Chennai Metropolitan Area (CMA), of which five were classed as PU, three as urban and three as rural. The case study investigated the location of employment and mode of transport for working trips (see Table 8).

Name of settlement	Location of employment			Distance to employment			Mode of transport				
	local	outside settlement	no fixed place	< 5 kms	5-10 kms	> 10 kms	Bus	Train	Two wheeler	Bicycle	Walk
URBAN SETTLEMENTS											
Thiruneermalai	78%	22%		90%	10%		11%			30%	59%
Naravarikuppam	100%			100%			10%			20%	70%
Tirusulam	80%		20%	80%	20%			25%		40%	35%
PERI-URBAN SETTLEMENTS											
Chinnasekkadu	80%	20%		100%			10%			30%	60%
Nandambakkam	88%	12%		90%	10%				10%	40%	50%
Thirumazhisai	90%	10%		100%						40%	60%
Nandiambakkam	61%	20%	19%	80%	20%					40%	60%
Vandaloor	57%	22%	21%	60%	20%	20%		30%	10%	30%	30%
RURAL SETTLEMENTS											
Pakkam	75%	20%	5%	100%						30%	70%
Thirumudivakkam	80%	20%		100%						30%	70%
Sothuperambedu	75%	20%	5%	100%						30%	70%

Table 8 Location of employment and mode of transport in 11 settlements of the Chennai metropolitan area (Thirumurthy 2005)

Table 8 shows that, firstly, commuting trips in the Chennai metropolitan area are generally below 5 km. With the exception of Vanderloor, at least 80% of workers in all settlements and in the rural settlements travel less that distance. Secondly, there are significant differences in travel behaviour between urban and PU settlements. Both, distances and modal share patterns, are roughly the same in both settlements types. However, rural settlements are distinct in this respect, featuring exclusively local employment and non-motorized modes for the journey to work.

Based on the ‘sustainable livelihood’ approach, Timms and Hodgson (2005) distinguish 6 sociologically defined types of PU areas in order to show travel needs and aspirations in PU areas. The most distinctive feature in this classification is that between ‘poor’ and ‘rich’ settlements.

For poor PU areas, the following factors increase in relation to travel needs and aspirations:

- The degree of urban influence as expressed e.g. by spatial proximity and the importance of commuting flows to the urban centre.
- A high share of migrants in an area, which implies a lack of traditional place-based livelihood strategies and results in a higher probability to commute to work or education.
- Social heterogeneity which means that inhabitants do not have a history of collective livelihood strategies.

By contrast, rich PU areas are expected to have the highest travel aspirations due to specialized and spatially concentrated jobs and better information on more distant employment opportunities. Moreover, the high service requirements of dwellers in these areas are expected to generate incoming commuting flows of service personnel. Special problems may arise for those generally non-wealthy travellers as the transport system is most likely oriented towards needs of the wealthy.

Some informal, yet informative results on daily travelling behaviour were gained during a ‘familiarisation visit’ included in the PERIURBAN workshop in Bangalore in July 2004. In two PU villages, Manchanahalli and Shanumangala both near to Bangalore, a group of villagers was interviewed. It was found that most of the ‘urban’ needs of the villagers were met by travel to the regional centres of Birdi (12 kms distance) and Kengeri (16 kms distance) instead to the centre of Bangalore. In contrast to the theoretical expectations, the percentage of workers involved in wage labour did not significantly influence the distance travelled for the journey to work. Despite large differences, most such trips were made locally in both villages (Timms and Hodgson 2005).

3.3 Comparison for empirical evidence

From the comparison, it can be concluded that settlement structures in India and Europe/the US are quite distinct. In the US, the majority of population has been living in suburban settlements since 1970 (Morgan, England et al. 1999). In Europe, suburbanization has not progressed to such an extent but is still evident almost everywhere. Large-scale mono-functional land-use is therefore widespread in Europe and the US. By contrast, land-use in India is characterized by a division of urban agglomerations into smaller entities, each offering several activities (Fazal 2001). This has been confirmed by anecdotal evidence in the PERIURBAN project, for example, in the case of the Bangalore agglomeration meet their ‘urban’ needs in the local centre Birdi instead of

Bangalore. Fazal also states that this holds true both for poor and wealthy people. This can be related to the still very high modal split of pedestrians and the prevailing small-scale structure of the urban environment.

The comparative structural development of New York and Mumbai by Bronger (2004) has shown that suburbanization or PU development can be regarded as equivalent. The difference lies in a time lag of 50–100 years of India compared to the US.

Similarly, the underlying principles and driving forces can be regarded to be the same in EU/US and India. This implies that, despite regional differences (social, cultural), the underlying mechanisms are independent of the geographic location. The increase of transport supply is a precondition and one of the main driving forces for PU development. However, transport alone is not sufficient to explain PU development: unfavourable environmental conditions may preclude development in certain areas and social and economic trends call for differentiated analysis.

In this context, the conclusion from Richardson and Bae (2004) based on the comparison of Europe and the US, supports the argument that the underlying principles of urban development are relatively independent from a social and historical context. They contradict claims of seemingly differences between Europe and the US and highlight that there is more convergence than divergence between them.

A distinction can be found in the socio-economic groups which generate PU development or suburbanization. Whereas in the US and Europe, suburbanization is clearly a phenomenon related to the affluent middle-class, PU development in India is due to the migration of the economically underprivileged. However, this is not a natural law. Bronger also observed that in countries, such as South Korea, these urbanization trends quickly can change with the growing economic wealth.

The structuring effect of transport infrastructure seems to be more significant in India than in Europe and the US. Timms and Hodgson (2005) summarize:

This characteristic points towards the importance of roads and lanes, which serve as arteries in Indian cities. The zones near these roads and lanes enjoy comparatively high land values. Misra (1998) observed that the spatial expansion of the Indian cities is more pronounced along the urban arteries, and along roads in particular. These roads change the patterns of city growth from circular (as observed in western cities) to linear (as observed in Indian cities). With expansion, low-value land use is replaced by high-value land-use.

Travel patterns are quite different in India and Europe/US. Data on commuting patterns in the Chennai metropolitan area clearly shows that the majority of trips are fairly short, 80% of trips do not exceed 5km. In Europe and the US, the average trip to work is of around 10–20km.

4 Policy recommendations

4.1 Europe and US

Policy recommendations are usually derived in a two-step approach: firstly, in a normative way, i.e. a vision of an ‘optimal’ or desired urban form is proposed, and secondly, as a process, i.e. measures are proposed which should bring about this vision. If this is exemplified on the “centrists/decentrist” classification, then ‘centrists’ (emphasizing the benefits of mono or poly-centric ‘compact’ cities) opt for planning to influence and control urban development processes whereas ‘decentralists’ (favouring suburban settlement patterns) usually dissuade from intervention (Boarnet 2000; Brake, Dangschat et al. 2001). (For further details of this discussion see Ewing (1997) and Gordon and Richardson (1997)).

The following sections summarize both sides separately and then attempts to integrate the findings.

4.1.1 Pro planning recommendations

The most fundamental recommendation is to integrate transport and land-use policies, also in terms of institutional organisation (Knoflacher 1996; Wegener and Fürst 1999; Duany, Plater-Zyberk et al. 2000; Newman 2001). The aim of such integration is to implement an optimum spatial distribution of activities and a well balanced transport system linking these activities in an efficient and sustainable way. To achieve sustainability, such a combined land-use/transport system should reduce the need for motorised travel by implementing policies aiming at higher-density, mixed-use land uses. The desired result is that people find a greater number and variety of activities in small-scale urban structures. Such structures are expected to bring about a high number of personal encounters thus facilitating the maintenance and establishment of local social networks.

Achieving sustainability is considered an ambitious and comprehensive objective which requires more than isolated and spatially limited actions. Strategic planning approaches should comprehend a planning approach with a functional integration of the wider areas and addressing various aspects of development (Faludi and Valk 1994). Albrechts (2001) points out that strategic planning is as much about process, institutional design and mobilisation as about the development of substantive theories.

The following areas should be integrated in such approaches:

- Investment
- Legislation
- Fiscal policy
- Institutions

Investment in transport should provide funding for non-motorized modes and public space improvement. Investment policies in relation to large-scale transport infrastructure, especially motorways, should favour maintenance over new construction (Ewing, Pendall et al. 2003). In terms of land-use, public investment infrastructure decisions, e.g. on the location of public institutions or social infrastructure such as hospitals, can be used to create development incentives at desired locations.

As a legislative instrument, zoning is often cited as one of the most promising instruments. The implementation of innovative aspects such as conditional zoning is suggested where building permits are bound to certain requirements such as minimum densities or mixes of new developments (Cervero 1988). On the local transport level, design standards could be modified to reduce the current primacy of individual motorized transport.

Fiscal instruments should address the externalities which are created both in the transport and in the land-use system. For transport, road pricing and the commercial operation of the road system is suggested. On the other hand, fiscal instruments may also provide positive incentives for development at desired locations, for example, property tax credits or incentives for companies which show desired behaviour (Cervero 1988)

The main aim of institutions is to enhance regional cooperation because *'local choices made by independent bodies do not always add up to what is best for the entire region'* (Cervero 1989). To avoid spatial externalities the installation of regional governments is frequently proposed, whereas others suggest inter-governmental cooperation (Downs 1994).

In addition to these instruments and measures a series of interesting, sometimes controversial aspects are brought forward.

Wegener and Fürst (1999) point out that the appropriateness of an urban structure and transport system depends on a variety of case-specific factors including the existing spatial structure. An important question of detail is whether to implement densification in the form of a *monocentric* 'compact city' or whether to promote *polycentric* development.

A mono-centric development guarantees the vitality of the inner city and is in line with the image of a traditional European city. However, the scope of compact cities is limited. Further densification may be impossible for historical reasons. Continuing the focus on the city centre can yield counterproductive effects such as rising commute lengths. Polycentric structure is more appropriate for large agglomerations but its implementation is demanding in institutional terms with an intensive regional cooperation and coordination. This dependency on city size makes the issues particularly relevant for Europe where middle-sized cities are prevalent (Martens, Pedler et al. 2002).

A polycentric development is very different perceived in Europe than in the United States (Linneman and Summers 1999). While in the United States sub-centres are expected to compete with the central cities, Europeans often consider them as complementary. It has to be noted, though, that they are usually smaller, more specialised and nearer to the traditional city centres in Europe.

Another important question is whether encouragement ('pull') or discouragement ('push') transport and land-use policies are more effective. In actually applied urban policies, '*pull* policies' are more frequently used whereas in academics, '*push* policies' are generally considered more efficient. Wegener and Fürst (1999) argue that transport policies are only successful if they make car travel less attractive. Similarly, land-use policies preventing undesired development ('push') are more effective than land-use policies aimed at promoting desired developments ('pull').

Yet another aspect is that some authors acknowledge the interaction between transport and urban structure but at the same time emphasize the influence of socio-economic distinctions and developments (Hickman and Banister 2005). Scheinen and Kasper (2005) argue that progressing individualism and differentiation of lifestyle makes mobility increasingly resistant to planning regulations. Their proposed remedy is to explicitly account for different socio-economic groups in transport and land-use policy.

Cervero (1988) highlights the importance to coordinate land-use and transport while projects are at an early stage (described in a study on the suburbanization of workplaces). He states that once projects are realized, the opportunities to influence commuting behaviour are limited.

In a nutshell, a packaging of land-use planning measures is required so that these measure are complement and reinforcing each other on investment and

fiscal policies, legislation and institutions (Marshall and Banister 2000; Marshall and Lamrani 2003).

4.1.2 Comments on Opposing Planning

The main argument against intervention in the land-use/transport system starts with the impossibility to find an 'optimal' urban form at all. In addition, even though it may be possible to develop the vision of an 'optimal' urban form, the proposed measures and policies are generally not effective to attain this ideal. Pennington (2004) generally questions the premise that it is possible to devise and implement an 'optimal' urban form. He refers to the 'economic calculation problem' brought forward by libertarians in the tradition of Hayek, which states that the limited knowledge of demand by central governments and planning authorities results in inefficient distribution of production. The more efficient alternative is to rely on the 'spontaneous order', which arises from the interaction of individual decision makers. Public intervention should be limited to provide an appropriate institutional framework and to assert private property rights.

Axhausen (2000) and Williams (2004) also doubt the possibility to effectively counteract suburbanization. They refer to the ubiquitous availability of the car and telecommunications which favour suburban lifestyles. In this sense, Williams concludes that suburbanization will continue unless there is a fundamental change in attitudes in favour of living in the city.

Another point of critic is the idea of settlement planning to influence mobility behaviour. Breheny (2004) states that the compaction model relies on an over-simplification of the complex travel behaviour, especially in terms of the live-work co-location. Marshall and Lamrani (2003) point out that the spatial match of residence and job location is difficult for multi-worker households. Generally, the over-simplification is attributed to a neglect of the social aspects of mobility and travel behaviour both in theoretical and empirical research (Hesse 2001) and the socio-economic differentiation could be successfully integrated in land-use and transport policies (Hickman and Banister 2005; Scheinen and Kasper 2005).

Axhausen (2000) remarks that proposed anti-sprawl policies advocate comprehensive planning by public authorities on regional levels on a continuous incremental manner despite the difficulties involved; big, planned solutions on the local level should be rejected.

Criticism also concerns the effectiveness of anti-sprawl policies. In a study on the London housing market, Breheny (2004) observed that demand pressures,

which he attributes to restrictive land-use and transport policies, are pushing house prices so high that housing is becoming unaffordable, even for the middle class. The situation has become so difficult that new policies have been introduced to subsidize housing for public service workers (policemen, firemen, nurses). In the US, similar effects have taken place in agglomerations which pursue a densification policy, e.g. Portland, Oregon.

Richardson and Bertaud (2004) conclude for the US, that neither the strategy of densification nor increasing transit supply to promote higher densities will work. They derive their conclusion from an empirical comparison of Atlanta, Georgia (with extreme sprawl) Portland, Oregon (pursuing sprawl-reducing policy) and Barcelona in Spain. Attaining the same modal share for public transport in Atlanta as in Barcelona would require hundred of billions of dollars of investment and a 3,400 mile rail system. They argue that the densities prevailing in US urban agglomerations are well below a threshold value which might be attainable.

A common critical comment on active anti-suburbanization policies relates to the inertia of urban structure. According to Hickman and Banister (2004), changes in urban structures occur at a rate of 1–2% per year in the UK. Therefore, some doubt that significant changes in the settlement structures will be implemented within a time scale which is relevant for practical policy making (Axhausen 2000; Hesse 2001).

4.1.3 Actually implemented policies

In comparison to the policy recommendations above, this section describes policies which have actually been applied in Europe and the US.

Martens, Pedler et al. (2002) identified three basic approaches of transport and land-use planning in European cities, which are also basic classifications. The first one addresses pure transport instruments to influence autonomous land use changes. The second focuses on a direct influence on land-use with ‘pull policies’ which aim to draw private and public investment to sustainable locations. The third approach implements also ‘push measures’ to prevent urban development at unsustainable, i.e. car-oriented, locations. Their ‘pure’ transport policies involve mainly policies favouring public transport, such as the development of light rail systems. The most popular ‘pull’ measure concerning land-use policies is public investment to stimulate development at desired locations. More innovative measures such as reduced infrastructure costs at favoured locations and tax relieves for complying companies are less frequently applied. ‘Push’ policies include development regulations which

require minimum values for densities and diversity or impose parking restrictions; these are rarely applied. They conclude that practical land-use & transport planning and policies are strongly constrained by feasibility considerations, whereas in academics, the focus is on the effectiveness of measures. The main obstacle to more effective land-use and transport planning is the lack of adequate zoning legislation in most European countries and the absence of adequate regional coordination in urban agglomerations.

In the US, land-use planning is far less applied than in Europe. Miller (2004) reports on the frequently cited exception of the Seattle region. On the legal basis of the Washington State Growth Management Act, adopted in 1990, a series of approaches and instruments was implemented to reduce urban sprawl. Measures were taken on various levels, ranging from concrete planning regulations to general institutional issues:

- Identifying critical areas and resource lands to exclude critical areas from urban development. Critical areas comprised either natural resources reservoirs or important natural habitats.
- Establishing urban growth areas to concentrate urban growth in designated areas. In order to avoid land scarcity which could artificially increase cost of land and housing, enough land has to be allocated to meet the development demands for the next twenty years.
- In order to have a sustainable development of urban space, local governments should be constrained to a balanced development of infrastructure and urban development or vice versa. Adequate urban infrastructure has to be provided at the time only when the development projects are permitted.
- Cities and counties have to prepare and approve a comprehensive development plan. All regulations, investment and other development decisions of local government must be consistently integrated into such a comprehensive plan.
- Monitoring the development programme to continuously assess the changes of the measures, their impacts and to evaluate the effectiveness of their plans and progress in their implementation.

Those mandatory, state-wide regulations and requirements were complemented with more local initiatives, which comprised a series of further conventional and innovative measures. But those were set up on the same plans, assuring the local commitment to the support of the overall objectives.

4.2 India

Policy recommendations in the PERIURBAN project were developed in discussions during the workshops. The participants agreed that policy options should be developed for two distinct levels:

- At a “high level” which recognises that transport and land use are closely interconnected, and that solutions should reflect this interconnection.
- At a “transport sector level” which is concerned with the provision of everyday transport facilities, with transport seen as an isolated sector (Timms and Hodgson 2005).

Both these levels need to be considered in parallel. Ideally, solutions on both levels can be found which are mutually consistent. However, it was concluded that in certain circumstances there might be conflicting between the two types of solution.

Nordstrom (2005) identified a series of instruments which should be part of a systematic approach to transform energy systems in PU areas. Due to their generic character these instruments seem to be applicable in the field of transport and land-use as well; they include:

- Policies – political objectives and agendas
- Subsidies – means to achieve social objectives which are not achieved by market forces
- Tariffs – as the visible result of the policy and subsidy
- Regulations - ensuring fair competition where the market fails
- Standards - technical and safety limits for energy system design

In respect to the two ‘levels’ of solutions mentioned above, the use of the following instruments to pursue a series of specific measures and policies was proposed:

For high level solutions, it was generally agreed that there was a need for a relocation of facilities, thus bringing them closer to people and reducing the need for transport. One type of measure involved the establishment of “regional centres”. The suggestion of villagers in Manchanahalli, a settlement in the Bangalore metropolitan area, to open a school for 150 children in their village points in that direction.

Transport-avoiding behaviour is a common strategy in the PU context. It has been noted that most of the villagers use a local centre (as in case of Birdi) to

provide for many 'urban needs' (non-agricultural employment, education and health), avoiding the much longer journey to the next bigger city (as in this case, Bangalore).

The careful integration of transport and land-use policies is also used to avoid adverse effects on social equity. Poverty-oriented PU transport must be integrated in a broader strategy incorporating housing, health, education and other social service policies.

The conception, implementation and monitoring of such integrated land-use and transport policies will require either inter-governmental cooperation or some form of regional planning authority. In the case of cooperation, the allocation of responsibilities should be clearly and formally established; more strategic functions should be retained at higher levels in metropolitan areas. Financial transfers should be organized carefully to be consistent with the allocation of responsibility.

Policy recommendations concerning the 'lower' transport sector level were formulated in a series of needs:

- The need to promote facilities for safe non-motorised transport (walking and cycling) within PU areas. Standards for new road design should incorporate the provision of space for non-motorized modes. The use of bicycles as a mode of transport should be promoted by developing small-scale credit mechanisms for the purchase of bicycles.
- The need for better integration of transport provision across the combined urban/PU region. This concerns both the spatial integration between different types of settlements and the modal integration between different modes of transport. However, care has to be taken that multimodal integration does not harm the poor.
- There was a need for better regulation of existing laws (e.g. safety) and a need for new regulation if current regulation were inadequate. As an example, rights and responsibilities of pedestrians and cyclists should be included in transport legislation.
- The type/size of transport provided at any location should depend upon the demand for travel (which might vary by season). The importance of para-transit provided by the informal sector for the poor has to be recognized; attempts should be made to give it a more formal role in PU transport. A specific suggestion included the use of minivans or minibuses instead of buses where the demand is minor.

4.3 Comparison for policy recommendations

Policy recommendations for India in comparison to Europe & the US are largely in line with each other. On the most abstract level, both share a vision of sustainable settlement structures featuring high (population) densities and a high degree of land-use mixes. The benefits from such an optimal urban form are land and resources savings which can be related directly to the urban structure and transport with a reduction of travel needs.

At the next lower level, concerning instruments it is argued in both cases that attaining this vision of sustainability is a comprehensive task. A comprehensive bundle of instruments is therefore proposed in both cases including public authorities' policies (including public investment), legislation, standards, fiscal policy and institutional reform.

However, the issue of this section is not to re-iterate lists of proposed measures. Instead, we will focus on policy-oriented conclusions that can be drawn from the juxtaposition of the Indian and the European and US situation. From this approach, a series of recommendations for India follow:

- Densification, whether in the form of the 'compact city' or of the poly-centric concentration, is considered a long-term objective in Europe but especially in the US. In the India context, however, spatially concentrated settlements are today (still) commonplace. The conclusion is that India is still in a favourable position. Thus, Europe and the US policies aim at sustainability with 'regeneration' policies by nature, the strategy in India should be to preserve and improve already existing settlement patterns and the natural environment.
- Policies concerned with the PUI should include a special focus on equity issues. In contrast to Europe and the US, low-income groups are the main group involved in PU development in India. These groups are particularly vulnerable to changes in their living environment as they do not have the economic resources to adopt nor do they possess the substantial weight in the political process to enforce their interests.
- Poly-centric development seems to be more appropriate in the Indian context. The choice between mono-centric and poly-centric urban form being mainly dependent on agglomeration size. The sheer size of India's major agglomerations suggests poly-centric development. Moreover - and in contrast to European cities - Indian cities do have a history of multiple self-contained centres where cultural considerations also indicate preference for poly-centric development.
- Some of the arguments, which are brought forward against planning intervention in Europe and the US, do not hold for the Indian context. For the US, these claims are certainly true since suburban densities are too low for a successful

promotion of more sustainable alternatives (Richardson and Bertaud 2004). India, with the still higher urban densities should provide more car-free or car-restricted infrastructure. This would also be in line with equity and sustainable considerations, since the poor people have limited access to motorised transport, which, in any case, extends only the urban structure.

4.4 Research recommendations

Two main research priorities were formulated in the PERIURBAN project:

- A greater level of distinction should be incorporated in further research. The results of the PERIURBAN project revealed that the PUI is very heterogeneous in terms of spatial and socio-economic aspects. A classification of PU areas could base upon work of the PERIURBAN project which distinguished 5 ‘poor’ and 1 ‘rich’ type of PU settlements. Another option is to differentiate according to the importance of the core city a PU settlement ‘belongs to’.
- More empirical work and evidence is needed. Although a considerable amount of general socio-economic data has been gathered especially for the Chennai metropolitan area, more specific questions had to be treated on the basis of theoretical speculations. Empirical evidence is urgently needed on the role of public and private institutions (both local and global) in the development of transport infrastructure, on the access to rail, road and other transport options and on traffic safety in different types of PU areas.

These research needs will address the following objectives:

- Build a comprehensive theory to understand “PU phenomena” within dynamic urbanisation processes.
- Develop indicators on transport for PU areas to assist long- and short-term policy making.

With the last point of the previous section in mind, there is a huge need to research and analysis of the PU development in India. This, however, should not be limited to this subcontinent, since the same development is lurking in many parts of Asia.

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