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Seamless urbanisation and knotted city growth: Delhi Metropolitan Region

Manisha Jain, Hannes Taubenböck, Sridharan Namperumal

(M.Sc. Manisha Jain, Institute of Regional Development Planning, University Stuttgart, manisha.jain@ireus.uni-stuttgart.de)
(Dr Hannes Taubenböck, DLR, Deutsches Fernerkundungsdatenzentrum, 82234 Wessling, Hannes.Taubenboeck@dlr.de)
(Prof Sridharan Namperumal,Department of Regional Planning,School of Planning & Architecture,Delhi,dr.nsridharan@gmail.com)

1 ABSTRACT

Historical evidences show that urbanisation and city development process go through various stages. However, in Asian countries such as India, the population growth surpassed the economic growth contradicting the Western stages of urbanisation and city development. Taking a case study of the Delhi Metropolitan Region (DMR), spreading many neighbouring states and cities, using Klaassen and Berg hypothesis, this paper analyses the impact of influential factors in spatial rescaling of DMR. Using the trend data from the Population Census and Satellite Imageries, it concludes that both the market induced as well as government induced (meaning policy induced) factors lead to the urban growth in different stages reflected in the core and ring (fringe) development within National Capital Region (NCR) of Delhi.

2 INTRODUCTION

Urbanisation in Asia, as compared to the western world has been faster and is often characterized by high rural as well as urban population growth. Not only the rural to urban migration rates are high in Asian countries such as China and India, but also the natural growth rates of urban centers are high. This has resulted in the emergence of mega cities within a short span of time. Compared to western urbanisation, which followed a gradual shift in economic base from agriculture to industry and then to tertiary sector propelled economic development, the economic development in Asian giant's (China and India) is being triggered by service sector growth. This has pushed the urbanisation process to higher levels but without much of job creation in the formal sector. Unable to cope up with the population pressure along with continued implementation of colonial laws forced the cities to expand horizontally than vertically consuming huge productive land (Annez, et al. 2010).

India's urban population in 2008 was 230 million which is projected to 590 million by 2030 that is 40% of total population would be living in cities. The number of million plus cities will increase from 42 in 2008 to 68 in 2030 and Delhi will be one of the five largest cities of the world (Sankhe, et al. 2010). These mega cities face acute shortage of infrastructure and are characterised by dualism with the presence of IT industries alongside low level of literacy and new condominium developments overlooking informal slum developments (Rode, et al. 2008). Agglomeration economies generated by concentration of mega cities and their expansion (Kennedy 2009) due to massive investment by governments at various levels and also due to private sector investments have resulted in horizontal expansion of cities. Resulting in formation of mega cities such as Mumbai surrounded by Thane and Kalyan-Dombivili both million plus cities. Similarly, Delhi is surrounded by Faridabad, Gurgaon and Ghaziabad all million plus cities followed by New Okhla Industrial Development Authority (NOIDA) and Greater NOIDA. In addition Delhi expanded in built up space by developing million plus cities such as Rohini and Dwarka within its boundary.

There is a need to analyse the actual stage, character, and the impact of policies and forces on urban development to help planners evaluate the effectivity of growth management strategies for better allocation of population and resources. The paper had three objectives, to identify urban development stages for NCR of Delhi using Klaassen and Berg hypothesis, to identify the character of urban development and to identify the impact of policies and forces on urban development of DMR. The paper is divided into 6 Sections, after introduction follows the discussion of the urban development hypothesis and its application to NCR of Delhi, Section 4 contains indicator based analysis to identify the character of urban development, and Section 5 analyses the impact of policies and forces on urban development of DMR followed by conclusion.

3 URBAN DEVELOPMENT STAGES HYPOTHESIS AND ITS APPLICATION TO NCR-DELHI

3.1 Hypothesis of urban development stages

Cities in their life cycle go through four stages of development marked by urbanisation, sub-urbanisation, des-urbanisation and re-urbanisation in a cyclical process. During urbanisation stage, industrialisation creates

employment opportunities, which attracts migrants from countryside leading to concentration in the core. As the core becomes congested living conditions deteriorate, with improvement in transportation commuting costs fall and people move out to healthier living conditions in suburbs, starting the process of suburbanisation. Gradual increase in traffic, land price and demand of social infrastructure, raises the living costs in suburbs, as a result people move out to smaller urban areas starting the process of des-urbanisation. These smaller urban areas are in their initial stage of urban life cycle and are at a distance of 50 to 120 Km from dominant agglomeration. Reurbanisation, last stage is achieved by governments effort to bring back life in the core by implementing policies for rehabilitation, urban-renewal, improving traffic situation and up grading social infrastructure. Each stage of urban development is characterised by peculiar demographic, socio-economic and spatial development, and spatial development problems, which are found to be prevalent everywhere in developed and in developing countries unless governments takes measure to steer the growth in a particular direction (Berg, et al. 1982). Hypothesis being a cyclical process aims to predict the future stage of urban development for NCR of Delhi and can serve as a guiding tool for policy makers to formulate, and choose the objectives and the instruments of the urban policy, to deal with the problems associated with each stage of urban development.

3.2 Study area

National Capital Territory (NCT) Delhi is sandwiched between two states, Uttar Pradesh (UP) on right and Haryana on left, here on NCT-Delhi will be referred as Delhi. Delhi consists of Delhi Municipal Council (DMC), New Delhi Municipal Council (NDMC), and Delhi Cantonment Board (DCB). Delhi Urban Agglomeration (UA) consists of Delhi and contiguous urban outgrowth within Delhi. Concerned with the unprecedented population growth of Delhi, central government recognised the regional approach to solve the problem therefore Master Plan Delhi-1962 recommended setting up of Regional Planning Board (RPB) for balanced and harmonised development of the region. The first Regional Plan (RP) 2001 identified an area of 30,242 SqKm for NCR of Delhi comprising of parts of three states, Haryana, UP and Rajasthan and complete Delhi. The area under Delhi, Haryana, Rajasthan and UP sub-regions were 1,483 SqKm, 13,413 SqKm, 4,493 SqKm and 10,853 SqKm (NCRPB 1988).

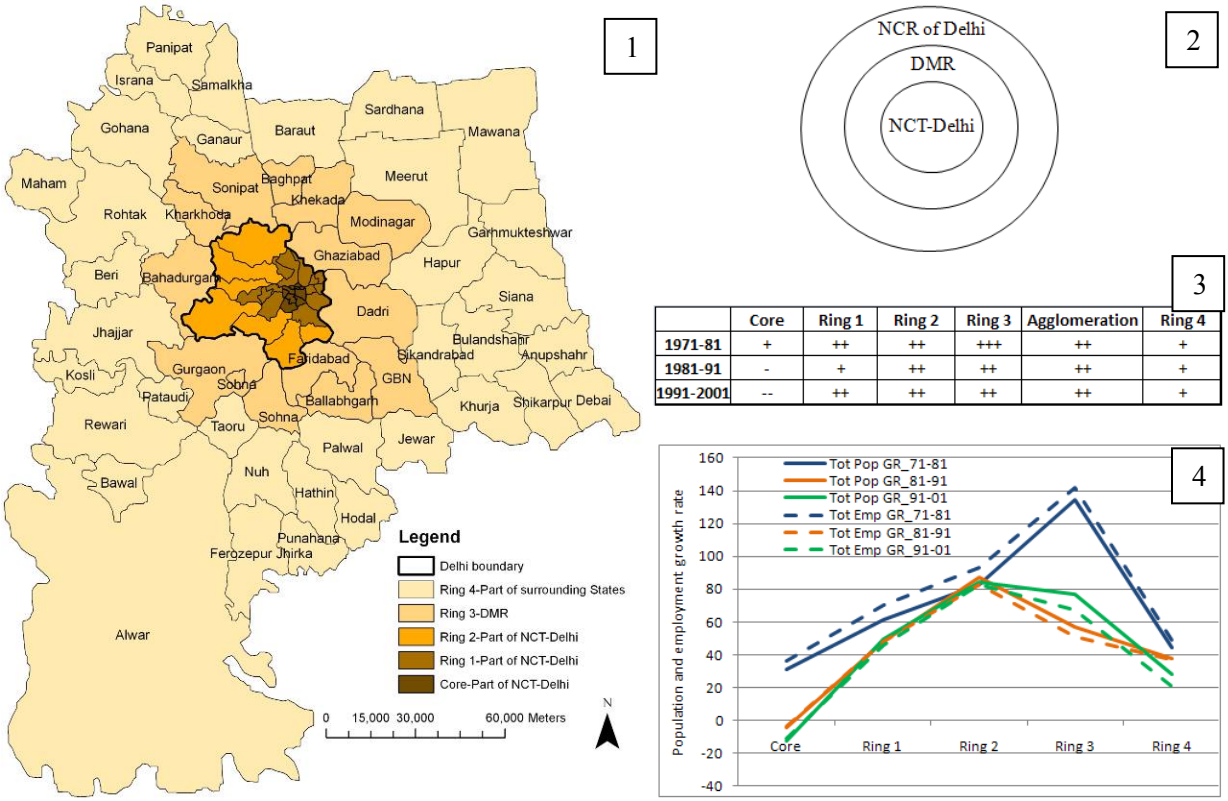
Delhi has undergone rapid population growth from 1.7 million in 1951 to 13 million in 2001 and is projected to increase to 26 million by 2030 (Sankhe, et al. 2010). Delhi has haphazard unplanned growth and faces serious problem of lack of basic services such as water supply, power, transport and solid waste collection, and shortage of housing, which is further aggravated by increasing in-migration to Delhi (UN 1995, Maiti and Agrawal 2005). The economic liberalisation policy of 1991 opened up Indian economy to the international market, which saw incoming of large share of foreign direct investment (FDI) in metropolitan cities. Delhi region (Delhi, part of UP and Haryana) received maximum share of FDI (26%) compared to other regions of the country (MoF 2005-06). Along with this allowance of 100% FDI in real estate and infrastructure by Indian government has made Delhi the hub of foreign real estate players (SDSI 2006) and susceptible to rapid urban growth. The dramatic growth of Delhi, characterised by lack of infrastructure, rapid population and economic growth makes it an excellent case-study.

3.3 Application of urban development stages hypothesis to NCR of Delhi

To identify the urban development stages and character of urban development, Census of India-Primary Census Abstract for Delhi, Haryana, UP and Rajasthan sub-regions for 1971 to 2001 time period and Remote Sensing Images for 1977, 1999 and 2010 time period were used. The Census boundaries from 1971 to 1991 divided Delhi in 2 Tehsils (Delhi and Mehrauli) but Census 2001 divided Delhi into smaller 27 Tehsils. The urban areas from 1971 to 1991 were projected up to 2001 Tehsil boundaries for Delhi and surrounding States of Haryana and UP. The NCR of Delhi was divided into core and rings. Delhi was divided into two incomplete rings (ring1 and ring 2) based on the proximity to the core, intensity of Built up Area development, presence of geographical features and availability of Tehsil boundaries.

Core consisted of Old Delhi Tehsils (Karol Bagh, Pahar Ganj, Sadar Bazar, Daryaganj, Kotwali) and New Delhi Tehsils (Parliament Street, Connaught Place and Chanakya Puri). Ring 1 consisted of East Delhi Tehsils beyond Yamuna (Seelampur, Shahdara, Seemapuri, Gandhi Nagar, Vivek Vihar, Preet Vihar) and other Tehsils such as Patel Nagar, Rajouri Garden, Civil Lines, Model Town and Defence Colony. Ring 2 consisted of rest of South, South-West and North-West Tehsils of Delhi (Saraswati Vihar, Kalkaji, Punjabi

Bagh, Narela, Hauz Khas, Vasant Vihar, and Najafgarh). Tehsils of rings 3 and 4 fall in surrounding states of Haryana and UP. Ring 3 consists of the satellite towns and has been treated as suburbs. Agglomeration consists of core, ring 1, ring 2 and ring 3. Ring 4 consists of remaining Tehsils of Haryana, UP and Rajasthan sub-regions, thus completing the NCR of Delhi. Ring 4 was added to check if the area has entered into the phase of des-urbanisation.



	Core	Ring 1	Ring 2	Ring 3	Agglomeration	Ring 4
1971-81	+	++	++	+++	++	+
1981-91	-	+	++	++	++	+
1991-2001	--	++	++	++	++	+

Figure 1: (Left 1) Map of NCR of Delhi with core and ring division. (Right 2) Model of the study area. (Right 3) Total population and employment growth rates transferred into + and – for 1971 to 2001. Note: +, ++, +++ = Population growth, (+) slow to fast (+++) and -, --, --- = Population decline, (-) slow to fast (---). (Right 4) Total population and employment growth rates from 1971 to 2001. (Source: Census of India and German Remote Sensing Data Center)

Figure 1, left 1 map is NCR of Delhi with core-ring divisions as indicated in the legend. Right-2 explains the location of Delhi with reference to DMR and NCR of Delhi. The results of Right-3 Table indicates that DMR entered suburbanisation phase in 1981-91 and by 2001 was in the intermediate phase between relative and absolute decentralisation as the agglomeration was stagnant and did not lose population and employment. Right-4 Graph shows that rate of employment growth was higher than population growth between 1971 and 1981 and later from 1981 to 2001 rate of population growth outpaced employment growth. The difference between the population and employment growth was not much in Delhi, whereas it was higher in the surrounding States sub-regions. The population and employment growth rates in Delhi were stagnant after economic liberalization of 1991 because of the selected migration of skilled people as the sectors promoted by FDI do not generate high level of demand for unskilled migrants. The above analysis concludes that the region entered suburbanisation in the 1980's and the character of urban development has been rendered by population outpacing employment, an experience opposite of western European cities.

4 INDICATOR BASED ANALYSIS OF URBAN DEVELOPMENT FOR DMR

4.1 Analysis based on demographic and socio-economic indicators

In this Section and Section 4.2 an attempt has been made to support the above identified process of suburbanisation with the help of indicator based analysis. Section 4.1 analyses the process of suburbanisation based on demographic and socio-economic indicators and Section 4.2 analyse the same with the help of spatial indicators.

Census of India defines, Main Workers (MW's) as those who work for the major part of the year in economically productive activity. In this research MW's are termed as Employment. Opposite of the former

are the people not contributing to the economic activity and are termed as Unemployment. Other Workers (OW's) are people engaged in economic activities other than agriculture, cultivation and HouseHold (HH) industries, and are employed in factories, trade and commerce, business, construction, teachers etc. Here OW's are termed as Other Employment (Oth.Emp.).

In Indian context both market based forces, and fiscal-social problem approaches are important in explaining suburbanisation (Sridhar 2007). The ratios of Schedule Caste-Schedule Tribe (SC-ST's), total (Tot.) literates and unemployment (Unemp.) rate in core to that in suburbs are used to test the flight from core blight hypothesis. SC-ST's in India are traditionally socially repressed, so it is possible to believe that their presence would deter location of higher caste. Higher the ratio of SC-ST in the core to that in suburbs higher would be the extent of population suburbanisation, reflecting flight from this community (Sridhar 2010). Table 1 indicates that proportion of ratio of SC-ST in core to that in suburbs has remained high for all time period and unemployment was high during initial decades, these together have contributed to the suburbanisation of the HouseHold (HH).

Year	No of HH	Tot SC-ST	Tot Unemp.	Tot Pop.	Tot Emp.	Tot Literates	Tot Oth.Emp.
1971	2.73	1.41	2.63	2.80	3.04	3.35	3.20
1981	1.53	1.39	1.62	1.56	1.72	1.84	1.86
1991	0.99	1.48	0.90	0.95	1.09	1.09	1.16
2001	0.47	1.71	0.43	0.47	0.58	0.49	0.59

Table 1: Result of core to suburbs ratios in DMR from 1971 to 2001(Source: CoI 1971, 1981, 1991 and 2001)

The extent of employment suburbanisation is important for HH location, whereas population (Pop.) suburbanisation is important for firms. Greater the proportion of suburbanised population, greater is the extent of employment suburbanisation, indicating jobs follow people for the various skills they have to offer. Higher the literacy rate in the core relative to that in suburbs, higher is the extent of centralisation of transport and communication jobs in Indian cities (Sridhar 2010). Table 1 indicates that proportion of ratio of population and employment in the core to that of suburbs is higher indicating that both have suburbanised over time, confirming that jobs follow people for the various skills they have to offer. The higher proportion of ratio of literacy in the core to that of suburbs explains the higher proportion of other employment since former leads to centralisation of skilled jobs.

HH and employment density gradient are not very different from each other for the Urban Agglomerations and metropolitan areas. Decreasing density gradient over time represents suburbanisation, compared to the developed countries Indian cities have high gradient (Sridhar 2007). But the trend is not true for DMR (see Figure 4 Graph 4) where the population density gradient was not steep but flatter (low) during 1977 and 1999 and become steeper (high) by 2010, a case opposite to most of the developed world cities experience.

4.2 Analysis based on spatial indicators

The evolution of urban pattern is closely related to the changing forms of internal transport, since transport makes land accessible for urban development (Mayer 1969). Buses have been the main mode of public transportation in Delhi, followed by increasing automobile ownership and coming up of the Metro in 2002. This change in transport is also reflected in the changing urban pattern of Delhi. Till 1977 (Figure 3 Phase 1) in DMR there was concentrated development, the nodes of suburban development were separated by open spaces and were connected to the center by National Highways (NH's). The reason for the limited growth of suburbs was poor transportation between the suburbs and the City. Later with the improvement in transportation NH's became the axis of urban development with increased densities and strip commercial development (Figure 2 Phase 2). By Phase 3 automobile ownership increased in Delhi, providing flexibility and making inaccessible areas now accessible. Metro and improved transport network between Delhi and its suburbs increased commuting and population of the suburbs by more than million making them mega cities. These have expanded towards each other by merging their BUA along the radial corridors resulting in coalescence of the initially separated suburbs forming a Megalopolis (Figure 2 Phase 3).

Spatial expansion of Delhi can also be related to the phases of Indian economic growth, where phase 1 from independence till mid 1980's is characterised by slow growth of industrialisation. Phase 2 from mid 1980's to mid 1990's is a period of moderate economic growth characterised by public sector driven shift from

industrial to service sector. Phase 3 from mid 1990's to 2010 is period of rapid economic growth characterised by private sector driven service sector (Mazumdar 2010). Figure 2 shows the spatial expansion of Delhi from 1977 to 2010. The increase in percentage of Built-up Area (BUA) to total Delhi areas was slow in initial years and faster later. BUA increased from 10 to 35 to 38 in 1977, 1999 and 2010 (that is in 30, 22 and 11 years). The initial low BUA was due to slow growth of industrialisation and later higher BUA is the result of the adopted economic liberalisation policies leading to the scattered splinter development of the fringe and coalescence of Delhi with surrounding mega cities, making DMR a mega region (see Figure 2 Phase 3). Radius of spatial extent of BUA increased from 15 Km in 1977 to 35 Km in 2010.

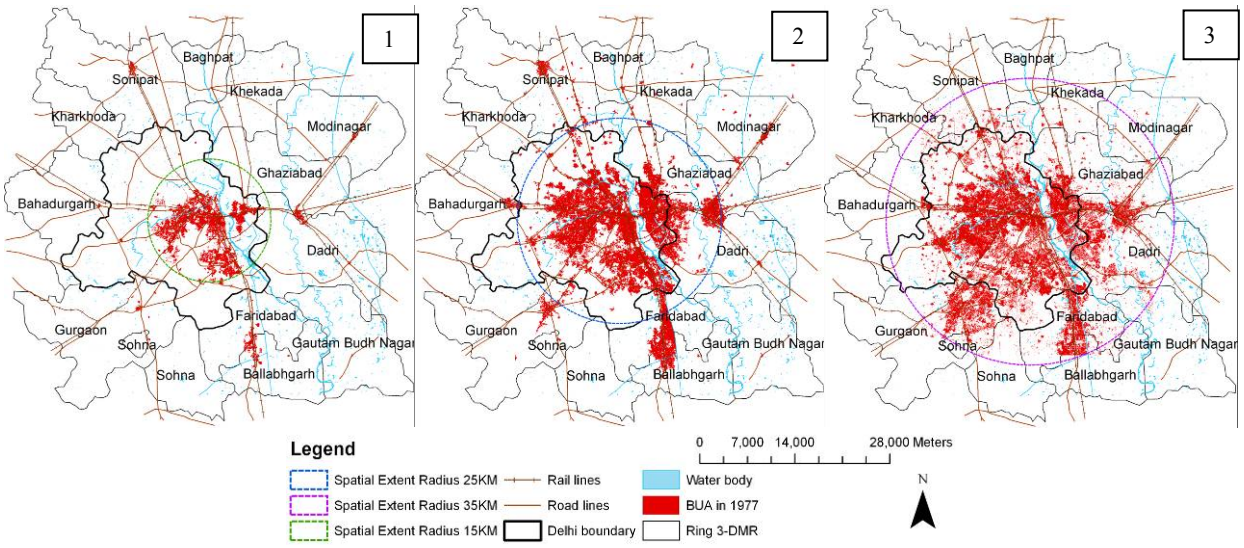


Figure 2: Spatial expansion phases of DMR where 1, 2 and 3 represent time period 1977, 1999 and 2010 (Source: German Remote Sensing Data Center)

City growth is a cyclical process between diffusion and coalescence, which starts with the outward expansion of the core with new developments interspaced with open spaces, as the expansion continues infilling of the gaps takes place leading to coalescence of the diffused urban area into fully built out urban agglomeration (Dietzel, et al. 2005). Coalescence and sprawl was observed for Delhi for a time period 1977 and 1999 by Taubenböck, et al (2008), they explain that taking advantage of the absence of orographic barriers Delhi evolved in a ring shape enabling concentric sprawl. The polycentric structure of satellite cities and urban core in 1970's coalesced by 1999. Figure 2 Phase 3 indicates that by 2010 coalescence resulted in the merging of urban core and satellite cities into one mass. Also observed are splinters of urban growth on the periphery, a sign of concentric ring sprawl which in future would result either in infill or coalescence.

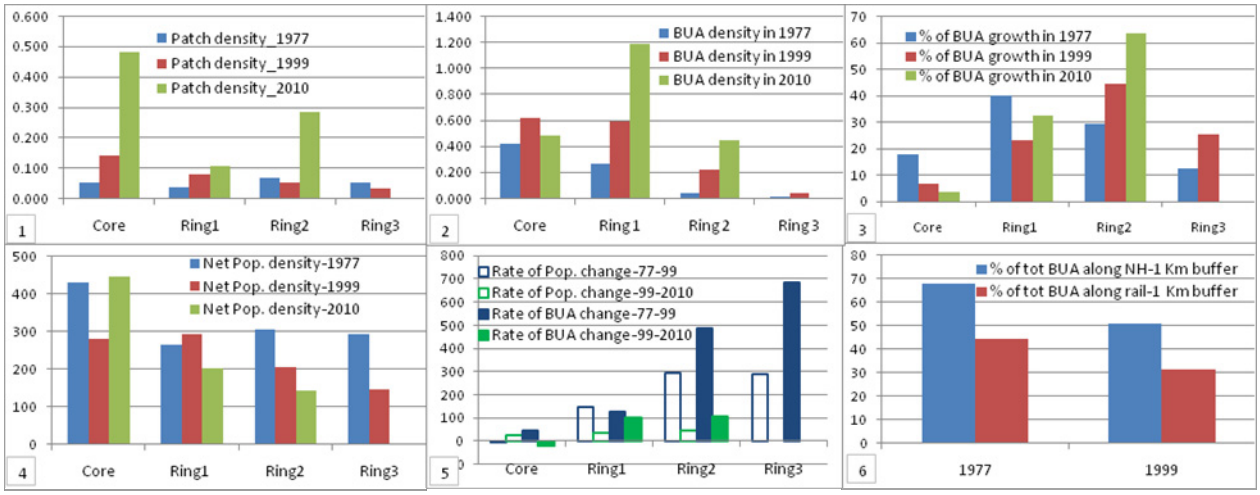


Figure 3: Graph 1 to 6 show the results of the spatial analysis (Source: Census of India and German Remote Sensing Data Center)

Patch density (PD) is the number of urban patches per landscape areas, it is a measure of discrete urban areas in the landscape and is expected to increase during periods of rapid urban nuclei development, but may decrease if urban areas expand and merge into continuous urban fabric (Seto and Fragkias 2005). PD of

Delhi was constantly at a low level for the time period 1977 to 1999 highlighting a laminar coalescence and a laminar urban footprint (Taubenböck, et al. 2008). Figure 3 Graph 1 shows maximum increase in PD in core and in Ring 2 for 2010 time period indicating growth of urban areas in these zones, and low PD of Ring 1 indicates coalescence.

The most fundamental character of urban land use is the ratio between Built-up Area (BUA) and non-BUA. The growth and extent of BUA is addressed by overall BUA growth in percent (Kasanko, et al. 2005). Figure 3 Graph 2 indicates that for the time period 1977 to 1999 BUA densities were higher in the core and decreased outwards with increased distance from the core. Later in 2010 BUA density increased in Ring 1 indicating compact urban development of the zone compared to Ring 2. According to Graph 3 for time period 1977 maximum percentage of BUA growth was in Ring 1 (40%) followed by Ring 2 (30%) and core with 18%, later in 1999 this percentage decreased in Ring 1 and core, and increased in Ring 2 and 3 by 44% and 25%. Later by 2010 the percentage of BUA growth increased in Ring 1 and 2 by 33% and 64% whereas it decreased in core to 13%, indicating peripheral development.

Growth of city is a tidal wave phenomenon in which addition of population expands the city outward like the outward movement of the waves. It is a gradual process in which the density decreases from center to periphery and the zone of maximum growth with time moves outward by filling the previous isolated settlements (Blumenfeld 1954). Figure 3 Graph 4 depicts decrease in net population density from core towards periphery for all time periods. Except that wave of maximum growth in core for 1977 extended to Ring 1 by 1999 and by 2010 core again was the zone of maximum growth. In case of Delhi zone of maximum growth instead of moving outwards has been concentrated in core.

In a metropolitan area, if land is consumed at a faster rate than population growth, it is characterised as sprawling, whereas if population growth is more than land consumption it is characterised as densifying (Fulton, et al. 2001). According to Figure 3 Graph 5 for the time period 1977 to 1999, population growth was higher than BUA change in Ring 1, whereas in core, Ring 2 and 3, BUA change was higher than population growth, indicating that more land was consumed by less people in core, Ring 2 and 3 in comparison to Ring 1. By 2010 population change in core was more than BUA change, whereas in Ring 1 and 2, BUA change was higher than population change, indicating more efficient land consumption in core compared to Ring 1 and 2. There was an overall reduction in rate of change for BUA and population for Delhi, indicating low growth as experienced by initial rapid growth regions.

Strip development occurs along the transport network connecting the main city center to the suburbs. These are linear commercial developments along both sides of the transport network (IFCI and FTS 2010). Figure 2 shows strip development and Figure 3 Graph 6 indicates during 1977 almost 70% and 45% of the total BUA was in 1 Km buffer along the National Highways (NH's) and rail network connecting the center to the suburbs, which reduced to 50% and 30% by 1999. The results of Section 4.1 and 4.2 confirmed the process of suburbanisation for DMR, with results of Sections 4.1 indicating movement of population and employment to the suburbs and results of Section 4.2 indicate both outward and inward expansion of Delhi, outward by coalescence with neighbouring mega cites and inward by development of scattered splinters in the periphery.

5 ANALYSING DRIVERS THAT SHAPE URBAN DEVELOPMENT OF DMR

5.1 Jurisdictional, institutional and administrative complexities in Delhi

Delhi is both a State and capital with largest municipality in the country. The State government controls neither the municipality nor the development authority. The two institutions are directly under the federal government which provide infrastructure and housing, and possess statuary plan making power, hence weakening the engagement between federal government (municipality) and local stakeholders (public). Many agencies are responsible for planning in Delhi compared to only one for coordinating between participating States of the Region (Rode, et al. 2008). Administrative organisations are marked by overlapping jurisdiction, and lack of coordination and communication amongst them. There are 27 revenue districts, 12 election zones and 8 town planning zones without matching boundaries. State government prepares development plans for rural areas whereas DDA prepares Master Plan encompassing rural areas, but there is no coordination between them. Seizing of Delhi Transport Corporation buses by UP State government for covering extra mileage indicates lack of communication between the States (Dutt 1999).

In India urban planning is unable to mange cities as planning not about forecasting and growth management but is a dynamic process of informality, and an ever shifting relationship between authorized and unauthorized (Roy 2009). Almost whole of Delhi is marked by violation of planning and building norms with massive unauthorised constructions, yet only some of these are designated illegal and worthy of demolition while others are protected and formalised. No prescribed set of regulations or law are followed to designate areas as illegal or formal. Pushta (slum colony), Akshardam temple (world's largest "modern" Hindu monument), the Commonwealth Games Village, IT Park, and Delhi Metro Rail depot all fall on the Yamuna flood plain violating the zoning regulation from these only slums were evacuated as they did not fall in Delhi government's aim of World Class City (Ghertner 2008).

Urban growth consistently outstrips the most perspicacious planner's vision in India (Roy 2009). The nature and extent of city growth is unplanned and unanticipated, and the provision of services is not proactive but reactive (Jain 2010). On the opening day of new highway toll plaza connecting New Delhi to its satellite Gurgaon, traffic was backed up simply because planners underestimated the growth in the traffic (Sengupta 2008). The failure of the Delhi BRTS is a result of non coordination of the implementing agency with the planning experts. The experts had recommended an increase in the width of the road before the implementation of BRTS since its initial carrying capacity was not enough. However this was turned down by the implementing agency of BRT, instead of adding the lane to the road, two lanes were taken out of the corridor hence worsening the congestion (Vishnoi 2008). Similar is the failure of Delhi Metro, which is overcrowded and lacks frequency (Rawat 2009).

5.2 Components of urban growth

In India the major component of urban growth is increase due to expansion in area and merging of towns (Kundu 2003). Reclassification of urban boundaries according to the Census definition has resulted in outward expansion of urban Delhi. The spatial extent of urban Delhi was much smaller during the 1961-71 Census, later as the villages in proximity to urban Delhi urbanised they were annexed in the Delhi urban boundary, thus increasing the urban spatial extent of Delhi by 2001 (CoI 1971, CoI 1991). From the total population of Delhi in 2001, 93% lived in urban areas. DDA in MPD-2021 declared whole of Delhi as urban (DDA 2009).

Other components of urban growth for Delhi, from 1961 to 1981 was natural growth but from 1991 to 2001 natural growth declined and in-migration was the main component (Dupont 2005). In 2001 total migration in Delhi UA was 5.55 million, and the contribution of within the State migrants was only 0.31 million whereas the contribution of migrants from other States was 4.96 million (CoI 2001). Delhi attracts migrants due to stronger economic and infrastructure base leading to concentrated urban development with emergence of mega cities (Gurgaon, Faridabad, Ghaziabad, and NOIDA) making DMR a mega region.

5.3 Impact of policy shift from balanced regional growth to city centric growth

First three Five Year Plans (FYP's) promoted balanced regional growth by decentralisation. First Master Plan Delhi (MPD)-1962 recommended decentralisation of population and employment to the surrounding identified new towns for balanced regional development by making the Satellite towns self sufficient in terms of employment and residential places (DDA 1962). But it failed due to lack of infrastructure provision in the Satellite towns. Government realised importance of cities as engine of growth therefore later policies focused on urban areas. 74th Constitutional Amendment Act in 1992 provided Constitutional status to Urban Local Bodies (ULB's) and strengthened them with financial devolution for better urban governance. Jawaharlal Nehru National Renewal Mission (JNNURM) in 2005 was launched to to encourage reforms and fast track planned development of identified cities.

Delhi State government instead of devolution of powers to ULB's leapfrogged them to reach the residents with Bhagidari Scheme (citizen contribution), thus killing the democratisation envisaged by the Constitution (Sridharan 2009). Delhi is a laggard in implementing mandatory reforms of JNNURM such as repealing of Rent Control Act and Rationalizing Stamp Duty, yet has availed funds under this scheme for various sectors such as sewerage, roads, highway and urban renewal (JNNURM 2010). The policy shift from balanced regional growth to city centric growth since independence has increased the regional imbalance leading to migration to urban areas, where most of the rural unskilled migrants are absorbed in informal sector.

5.4 Impact of land policy and regulations

Delhi urban land policy of large scale land acquisition and disposal in 1961 was based on the concept of nationalisation of land for formation of land bank by public authority to undertake urban development by using land as a resource through revolving fund technique. But lack of sufficient amount of acquired land for the implementation of the Master Plan's, slow rate of land acquisition and development, entitlement of profit by DDA on sold land, and biasness towards Higher and Middle Income Group contributed to the increase in land prices since 1961 (Acharya 1987).

Urban Land Ceiling & Regulation Act (ULCRA) of 1976 was to facilitate the availability and affordability of urban land by increasing its supply in the market by imposing a ceiling on the amount of possessed vacant land and possession of land by the State governments for common public good after paying the compensation (JNNURM 2006b). In Delhi freezing of large areas of land for planned development, and its slow development and supply in the market resulted in shortage of developed land with increased land prices (Pugh 1991). Under JNNURM the act was repealed as it failed to meet it objectives and resulted in accumulation of land in few hands and escalation of the land prices.

Land use regulations are development control measures such as zoning and building regulations. The first two Master Plans of Delhi were based on zoning of different land uses, separating residences from jobs leading to long commuting time, dependence on vehicles, increased congestion and pollution but MPD-2021 is a shift from the previous approach towards mix land use (DDA 2009). Building regulations such as limiting the height by Floor Area Ratio (FAR) has resulted in outward expansion, high land values and lack of affordable housing. Planners instead of increasing densities to avoid congestion prefer maintaining low FAR to avoid infrastructure up-gradation cost. FAR for CBD in Hong Kong, Portland Oregon is 15, in Singapore, Jakarta is 10 and in Washington is 6.5 (Bertaud 1996) whereas in Delhi it is 2 (Sridhar 2010)

Low property tax and Rent Control Act (RCA) reduce the revenue base for ULB's and contribute to new developments by blocking developed land from the market. Property tax the main source of revenue for ULB's contributed only 18% to municipal revenue for 2006-07. This lower value was due to the absence of formal count of properties leading to low property registration, assessment of properties 30% lower than market value and lower collection rates (Mathur, et al. 2009). RCA introduced to counter the scarcity of rental housing contributed to housing shortage by discouraging investment in rental housing due to biasness in favour of the tenants. Owners hold back their properties from rental market as tenants have no obligation to maintain property and to pay taxes, and rents are much lower than market values resulting in low rate of return in rental housing, reduced supply of rental housing and emergence of black market (JNNURM 2006a).

5.5 Impact of economic reforms

Economic reforms since 1991 boomed the economic development, real estate and infrastructure projects resulting in rapid land use change and expansion of the city and fuelled demand for office space, technology parks for Business and Knowledge Processing Organisations (BPO's and KPO's) and residential property (Shaw and Satish 2007). This process of globalisation restructured Delhi with central and sub central districts residential areas being transformed into commercial spaces to accommodate branch offices of multinationals, domestic companies and financial institutions. Housing and land prices rose sharply registering an increase of 580% in commercial space and 270% in residential space (Mathur 2005).

Special Economic Zone (SEZ) policy, a response to globalisation in 2000 resulted in peripheral decentralisation of population, jobs and services due to infrastructure provision. SEZ's are the preferred location for the foreign companies which require large spaces and world class infrastructure (Bhandari, et al. 2008). Delhi periphery is characterised by mushrooming of high quality residential and office spaces, specialized parks for software and technology, and golf courses (Mathur 2005). To attract FDI's government policies are biased towards tertiary sector and education increasing service sector and skilled labour in urban areas, therefore rural unskilled migrants due to lack of skill are unable to find job and are absorbed in urban informal sector (Mazumdar and Sarkar 2008). The informal sector accounted for 76% workforce from total employment in 1993-94, which increased to 80% by 1999-2000 (Venkatesan 2007).

Delhi from 1993 to 2002 generated more than national average per capita State domestic product and more than double the national average per capita income. There has been a continuous rise in small scale industries and employment generation from 1951 to 2001 (UNDP 2006). Delhi not only reinforced its manufacturing

base by upgrading the old manufacturing industries but also expanded its information based and white goods industries from 1990 to 1998 (Mathur 2005). The above factors pull the migrants to Delhi. Higher (more than double) average capital value in Delhi compared to surrounding DMR towns (Services 2009) and continuous increase of automobiles from 1991 to 1996 (Maiti and Agrawal 2005), push the residents out of Delhi to the suburbs in search of more spaces and better environment.

5.6 Impact of investment in infrastructure projects

Policy of investment in infrastructure development has also contributed to urban growth of DMR. Prior to Delhi Metro not all designated Satellite towns in the periphery of Delhi picked up due to lack of infrastructure provision and transport connectivity. Launching of Delhi Metro improved the commuting between the Satellite cities and Delhi, the surrounding States to maximise the benefits from close proximity to the capital also invested in improving transportation connectivity with Delhi. As a result Delhi experienced negative population growth during 1991 and 2001, whereas the neighbouring city NOIDA, Ghaziabad, Loni, Gurgaon, Bahadurgarh, and Faridabad have experienced growth rate between 3% to 6% during 1991 and 2001. This outward movement of the people to the suburbs is attributed to the improvement in commuter network, and to the increased economic situation (UNH 2008).

Delhi Metro impacted the land value and land use within 500 meter to 1Km distance of the Metro corridor. The land value increased by 22%, within 500 meter commercial values increased by 18.1% whereas residential values increased by 11.3%. The less dense residential areas have increased in density, slum areas have given way to middle class residential area, commercial shops have come along the corridor and previous commercial multi-storeyed buildings in Connaught Place have become the commercial hub (Swamy 2009). Coming up of Delhi-Mumbai Industrial Corridor (DMIC) between Delhi and Mumbai with several industrial estates, industrial hubs, with top-of-the-line infrastructure would be developed along both side of this corridor in a band of 150 km (DMIC 2007). This corridor will spawn 24 new cities (Jerath 2011) further increasing pace of urbanisation in both Delhi and Mumbai region.

6 CONCLUSION

The above analysis justifies the title seamless urbanisation and knotted city growth for DMR as urban growth is not restricted within the administrative boundaries of Delhi but has spilled over to cities of surrounding states giving it a seamless character and the rapid growth of the million plus cities in close proximity to Delhi have emerged like knots in the spatial framework of DMR. The analysis indicated that NCR of Delhi is in the intermediate phase (between relative and absolute) of suburbanisation and the rate of population growth outpaced employment growth in DMR and NCR of Delhi, which rendered the character of urban development different from the Western experience. The urban development of DMR is a combined effect of administrative and institutional structure, government policies and regulations, and demographic and socio-economic forces. The identification of urban development stage for NCR of Delhi and the character of urban development for DMR, calls for further research for analysing the effectivity of the formulated growth management strategies for better allocation of resources and population.

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