

Land Encroachment Mapping Through GIS on the Northern Flank of Aravalli Mountain Hills – The Delhi Ridge

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Key words: Land Encroachment, Population Growth, Delhi Ridge, Landuse/Landcover, Forest, Sustainable Development.

SUMMARY

The Delhi Ridge encroachment commenced with the habitation of Delhi by 736 A.D. But the need to conserve the ridge was felt even as far back as 14th Century when Firozeshah Tughlaq used the woodland as his exclusive hunting ground. The British realised the importance of the forest as soon as they shifted their Capital from Calcutta to New Delhi in 1912. Within a year of their arrival in the new city, in 1913 they declare the ridge as reserved forest under the Indian Forest Act of 1878. The original area of the Ridge was 15,046 hectares - which has come down to 7,785 hectares. The significance of the Ridge was routinely mentioned in heavy words in the Master Plans of Delhi - MPD-1962, MPD-2001 and MPD-2021. However, ever since 1913, when the Ridge was first declared as a Reserved Forest, the battle for protecting it has continued in fits and starts. The Ridge is functioning as a 'green lung' in Delhi and forms a natural boundary between the Thar Desert and the plains. Its vegetation acts as a moderator of the climate by absorbing the dust and extending the cooling effect into the Delhi cosmopolis. However, all efforts failed to conserve and protect this 'life giver'. Geographers, Environmentalists, Foresters, and Non-Governmental Organisations have since the beginning of the 20th Century been carrying out a tirade against the sacrilege of the Ridge but with little effect. Consequently, large-scale land encroachment activities on the oldest mountain chain of Aravallis – the Delhi Ridge have caused irreparable extensive degradation to the geologically significant landform relics, for the short term economic benefit in total disregard of their long-term adverse implications.

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1. INTRODUCTION

On reviewing the magnitude of land encroachment over the Delhi Ridge, one would find that encroachment commenced with the habitation of Delhi by 736 A.D. The Delhi cosmopolis is historically the “eighth city” on or around this site, on the banks of the Yamuna River. The previous seven cities do not exist anymore, except as remnants of historical ruins, or as part of present day Chandni-Chowk. What happened to the earlier 7 cities? What happened to Indraprastha (1450 B.C.), Surajkund (1024 A.D.), Qila Rai Pithora (1170 A.D.), Siri (1302 A.D.), Tughlakhabad (1320 A.D.), Jahanpanah (1334 A.D.) Shahjahanabad (1648 A.D.)? Reasons for their demise range speculatively from lack of sufficient water, to epidemics, to migrations, to poor governance, to land encroachment, to ...? The British built New Delhi south of Shahjahanabad, and shifted the capital city from Calcutta in 1912. The capital city of India, after independence, has grown in size and density - engulfing all the ancient sites, and overflowing across the Yamuna and the Northern Ridge. According to urban sociologists and historians like Louis Mumford and others, all cities are “living entities”, which go through a life-cycle: birth, growth, consolidation, expansion, decline, and quite often some kind of end, or state of decay, unless they are “turned-around” and “revived” by combined human effort.

Along with the historical monuments and the majestic government buildings, there are patches of forest in Delhi better known as the Delhi Ridge. Unfortunately the Delhi Ridge is also riddled with all sorts of encroachments thus leaving the citizens of Delhi gasping for breath. The increasing land encroachment activities for economic exploitation of the natural forest resources and unauthorised occupation of the Delhi Ridge is resulting into extensive degradation of geologically significant landform relics of the oldest mountain chain - the Aravallis; and this process is, thus, continuously shrinking its green cover functioning as the ‘green lung’ in the midst of the concrete jungle of Delhi. The 32 km - long ridge is an inseparable part of Delhi. It is one of its two natural features, the other being the river Yamuna. It is a part of the Aravallis, the oldest mountain chain which has cradled Delhi like a mother for 1,500 million years. The ridge is our natural heritage. Along with the Yamuna, it has been one of the prime reasons why the location of Delhi was so strategic and favoured by many rulers time and again over the ages. Whether it will be so in the 21st Century, one has to debate about what has been obvious many times past.

The need to conserve the ridge was felt even as far back as 14th Century when Firozeshah Tughlaq used the woodland as his exclusive hunting ground. The British realised the importance of the forest as soon as they shifted their Capital from Kolkota (Calcutta) to New Delhi in 1912. Within a year of their arrival in the new city, they issued a notification on December 6, 1913 declaring an area of 917.47 hectares in eight villages as reserved forest under the Indian Forest Act of 1878.

This is today's Central Ridge flanked by Shankar Road and Dhaula Kuan. On September 16, 1942, the British rulers issued another notification reserving 150.46 hectares in North Delhi as forests. This is now called the Northern Ridge in the Delhi University area. In 1948, the new administrative department of Delhi notified Southern and Central Ridge as reserved forests. The significance of the ridge was routinely mentioned in heavy words in the Master Plans of Delhi – MPD-1962, MPD-2001 and MPD-2021 (plan preparation under process). However, ever since 1913, when the Ridge was first declared as a Reserved Forest, the battle for protecting it has continued in fits and starts.

The Ridge is functioning as a 'green lung' in Delhi and forms a natural boundary between the Thar Desert and the plains. It acts as a barrier obstructing the hot winds and sands of Rajasthan from entering the plains. Its vegetation acts as a moderator of the climate by absorbing the dust and extending the cooling effect into the Delhi cosmopolis. It also acts as air purifier and replenisher of oxygen besides playing the noise buffer. For instance, one hectare of woodland (about 1000 trees) can absorb 3.7 tonnes of carbon monoxide and release 2.5 tonnes of life giving oxygen. However, all efforts failed to conserve and protect this 'life giver'. With its vegetation, the ridge acts as a moderator of the climate and absorbs dust. However, without the ridge and the ridge forest, Delhi would be a barren, exposed cosmopolis unprotected from the nature's vagaries and without its ancient character. The resulting scenario is too bleak to contemplate and to prevent it is entirely in our hands. Hence, the reforestation on a massive scale, a complete stop to land encroachment and monitoring of the population are some of the urgent measures essential to ensure regeneration. But to what extent? This in fact, needs to be analyzed. Geographers, Environmentalists, Foresters, Non-Governmental Organisations have since the beginning of the 20th Century been carrying out a tirade against the sacrilege of the Ridge but with little effect.

The literature available on the subject area, by and large, reveals that the encroaching activities have many impact, in and around the Delhi Ridge forest; for instance, flora and fauna in terms of ecology and environment, landuse pattern, social and environmental health, aesthetic value, population in terms of migration and employment etc. At the national level the published research work of the scholars put more emphasis on the protection of the fragile ecosystem of the Delhi Ridge (Mohan, 2002; Kaur and et. al., 2001; Khan and et. al., 1999; Sokhi, 1993 & 95; Chauhan and Rashid, 1993; Sekon, 1989; and Bhat, 1986). Much of the Delhi Ridge forest covered area having already disappeared; the priority is to save whatever is left behind right now. A scheme of developing the green barrier has been undertaken by the Delhi Development Authority (DDA) for the Bhatti group of mines. The Delhi Ridge's upkeep need to be given to a special unit that may be created in the Forest Department. This wing should comprise of specialists like the Forest Ecologists, the Environmentalists, Foresters and the Horticulturists. Moreover, there are a number of international scholars (Mohan 2002; Blackburn and Milton, 1997; and Mishra, 1994) who are working in this field and their works have already been published, greatly deals on the different environmental issues specially determining the role of forests in sustainable ecodevelopment, however, to what extent the ecodevelopment provide the environmental protection remain an open question.

2. OBJECTIVES AND HYPOTHESES

The main objectives of the study were as follows:

- i to assess the pre- and post-encroachment scenario;
- ii to notifying the areas of the land encroachments;
- iii to examine the encroaching activities impact on the environment; and
- iv to explore the suitable strategies for ecodevelopment.

This study has also attempted to test the following hypotheses:

- i Increasing pressure of population is responsible for large scale encroaching activities and thus causing the shrinkage of the critical ridge.
- ii Encroachments are causing degradation of the fragile ecological system of the ridge in disregard of its impact on the environment.

3. DATABASE AND METHODOLOGY

This study is primarily based on the primary sources of data collected as well as generated from the field keeping in view the specific objectives as well as representativeness of the outline Delhi Ridge. On account of the availability of limited time and resources, the survey of the entire Delhi Ridge was not feasible nor the use of technique. Regarding the implication of environmental degradation due to the deforestation of natural vegetation, landscape's physiological destruction, illegal land encroachment etc., such aspects in data form have also been gathered from the each individual divisions of the ridge. Thus the present study has been supported by the primary sources of data generated through the extensive field survey of the different divisions located within the Delhi cosmopolis. This study has also been partly accomplished with the help of the readily available secondary sources of data gathered from the records of Land and Development Department of Urban Development Ministry, Revenue Department, Forest Department and Delhi Development Authority, etc. of the Delhi State. In most of the land encroaching sites, pre-encroachment environmental scenario in the real sense is difficult to get. The environmental data generated at various sites in and around the core encroachment sites usually becomes the base line data to assess the impact of environmental degradation. GIS softwares like the ARC/INFO, ArcView and GeoMedia have been used for geographical analysis of the spatial and non-spatial data and their presentation.

4. STUDY AREA

The area of the study – the Delhi Ridge – is situated in the northern Aravallis in the north-western part of India. In the geographical sense, the Delhi Ridge is the continuation of oldest mountain chain of the Aravallis. The Delhi Ridge is the culminating spur of the Mewat branch of the Aravallis, constitutes the most significant physiographic features in Delhi cosmopolis. Almost entire Aravalli Hills have been out-cropped since long back (Wadia, 1976). It enters Delhi from the south and extends like a “lean but wiry finger straight to the Yamuna” in a north-easterly direction. Skirting the north-west and west, the ridge appears like the rampart of a huge fort provided by

nature to defend the heart of India. A branch of the ridge separates itself from the main trunk near Bhatti and extends in a north-easterly direction upto Anangpur, where it turns to the north-west till it rejoins the main ridge in a sweeping curve. Apart from this main branch, there are a number of flanking spurs adding to the complexity of the landscape. The tail-end of the last spur of the ridge goes southwards upto Mehrauli and then turns towards Badarpur and Tughlaqabad along the Delhi-Haryana border. These north-south and south-east ranges form a triangular plain with the river Yamuna in the east. The ridge achieves a height of 1,045 feet (318 meters) near Bhatti which is probably the highest point. Relatively, this point is about 360 feet higher than Yamuna Railway Bridge. However, the irregular oval enclosed by the two branches of the ridge described above is in the nature of a plateau. Based on the relief features the Delhi Ridge is broadly divided into the four physiographic divisions namely, the northern, the central, the south-central and the southern.

4.1 Physiographic Divisions

The northern most tip of the rock exposure of the Northern Ridge is at Wazirabad. The rock here is reddish brown to bluish grey in colour and massive in look. Overall bedding surface is seen tending NNE-SSW and dipping east at about 40° to 65° angles. This rock exposure shows to be slightly widening towards south and is widest at its southern-most tip near Boulevard Road. South of it, the rock is exposed at the railway crossing; but further south in the Sadar Bazar area, it is all covered up. The fact reveals that there is a somewhat ‘S’ shaped drag with subsequent development of ENE-WSW trending shear plane. Perhaps this explains the gap between the two exposures but a check is difficult to make since the area is completely built-up now. The concept of the shear plane is postulated here because similar planes are observed in rocks in other parts of the area and the quartzite has high competency.

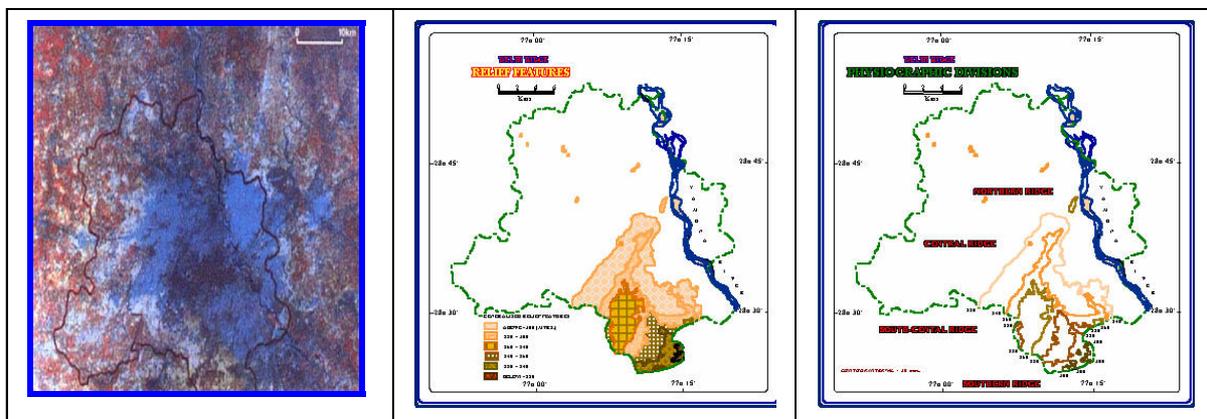


Figure 1

Figure 2

Figure 3

The Central Ridge extends from Karol Bagh and Mandir Marg upto Dhaula Kuan in the South Delhi. South of Sadar Bazar and in the vicinity of Idgarh, the rock is exposed and bedding shows the same trends with a dip of about 50° to 60° towards east. While this trend of bedding continues further south upto the south-western edge of Vasant Vihar through Karol Bagh, Old Rajender Nagar and Dhaula Kuan, a part branches out towards Inderpuri through Dashghara trending in a south-westerly direction leading ultimately to the rock exposures at Inderpuri. From this point of bifurcation, another part branches out towards Anand Prabat trending WNW and ultimately

merging with the rock exposures at Anand Prabat. This mode of branching out is correlated with the mushroom nature of folding that has developed in this part with the two limbs being constrained to the maximum in the vicinity of Inderpuri. At Anand Prabat, the rocks are folded into a synform with its closure to the north and a general plunge towards the south. The axial trace of the trends is NNE-SSW.

The South-Central ridge covering the Mahipalpur-JNU area which around Mehrauli is divided into two parts by Mehrauli and Kishangarh villages. South of Muradabad Pahari and Vasant Vihar, the bedding on the western limb of the regional fold continues in a SSW direction with a slight 'Z'-shaped drag, while the beds on the eastern area run through Mahipalpur, Masudpur and Mehrauli. Through this stretch, the bedding shows development of tight asymmetrical folds. The adjustment to the conditions of strain development in the highly competent quartzite during these folding events, has taken place by shearing. A number of NNE-SSW and N-S trending shear and fault plane traces are observed in the vicinity of Masudpur, Kishangarh and Mehrauli. The restriction of these planes only within the exposures suggests their development subsequent to the folding event. In the stretch between Kishangarh and Lalkot, the bedding trends from NE-NW to NW-S and W-SE with a dip in southerly direction. This variation in trend corresponds to a northerly closing synform.

The Southern Ridge is mainly situated in Mehrauli tahsil. It extends from Badarpur in Delhi and extends upto Haryana border in the south finally meeting Mahipalpur road and Sultangarhi Tomb. South of the Lado Sarai the bedding trend changes to NNW-SSW with easterly dips and this is interpreted as due to the presence of a fault existing between this area and Kishangarh-Mehrauli block. This fault plane trends NE-SW. The eastern limb of synform trends NW-SE but on moving toward Anangpur to the east, it gradually assumes a nearly east-west trend with a dip of about 60° to 70° to the south. Moving east from Anangpur again, the strike of bedding trends NE-SW with easterly dip upto Badarpur and the trend becomes NNE-SSW with easterly dips. This suggests the development of an antiform in this stretch and this structural feature is referred to as the 'Anangpur antiform'. North of this area near Adilabad fort, the strike trends in WNW-ESE with a dip of 30° towards south and this trend also passes into Tughlaqabad area, thus suggesting that the eastern limb of the Anangpur antiform is made to trend in WNW-ESE direction. South of Rangpuri, the bedding trend is N-S to NNE-SSW with a dip varying from 40° to 60° towards east till the vicinity of Yahya Nagar from where the bedding swings in NNW-SSE different beds, and a trace of the zone of shearing on fracturing trending ENE-WSW is observed. Further south in the vicinity of Mandi, the bedding shear plane trace is seen trending NW-SW. The bedding continues as such towards south of Mandi.

4.2 Forest and Biodiversity

With rapid pace of urbanization, Delhi has progressively lost its green forest cover. It has merely 88 km² of forest cover in the total geographical area of 1483 km², representing only 5.93 per cent of the total area. The Delhi Ridge natural forests, which served as the 'green lungs' have dwindled considerably in some pockets mainly due to the human interventions. The degradation of the ridge area has continued until recently due to various encroachments for quarrying, constructing buildings, slum settlements, roads and parks, etc. as is evidenced by Figures 4, 6 and 8. Large chunks of the ridge area are also being used for activities such as garbage dumping, apart from extraction of fuel and fodder and grazing by livestock. Besides,

such urban activities have resulted in the loss of many species of flora and fauna and have disturbed the natural biota of the Delhi Ridge.

Naturalists and ridge lovers have found a wide spectrum of plant species here. There are the native ones like the Babul (*Acacia Arabica*) and Ber (*Jujube*). There are the exotic varieties of Vilayti Kikar (*Acacia*) and Neem (*Margosa Tree*). Amaltash, Palash, Flame of the forest and an orchid species bring vibrant colours to the forest during different seasons. Planting of fast-growing exotics has also changed the biodiversity character of the Delhi Ridge (see Figure 7). In the summer months, when the rest of the Delhi is scorched by heat and exhaust gases, the scrawny leaves of Kikars and Babuls shelter a clean, peaceful world of shade and light. Summer mornings are cool and the stillness of the forest can cool any troubled urban mind (see Figure 5). During the monsoon season, the forest shimmers in green light and countless streams run like scarred lizards on the mushy forest floor. The winter finds the forest a fire with vibrant colours. Shrubs flower in rainbow hues and pink clusters of orchid flowers leave an intoxicating perfume in the air. The forest floor is carpeted with tiny bouquets of violet, blue and yellow. Pale brown branches lean to the ground with migratory birds perched on them. Calls of Koel and Papiha could be heard by any one. However, the geographers and environmentalists feel quite strongly that it is high time to save the ridge... from us.

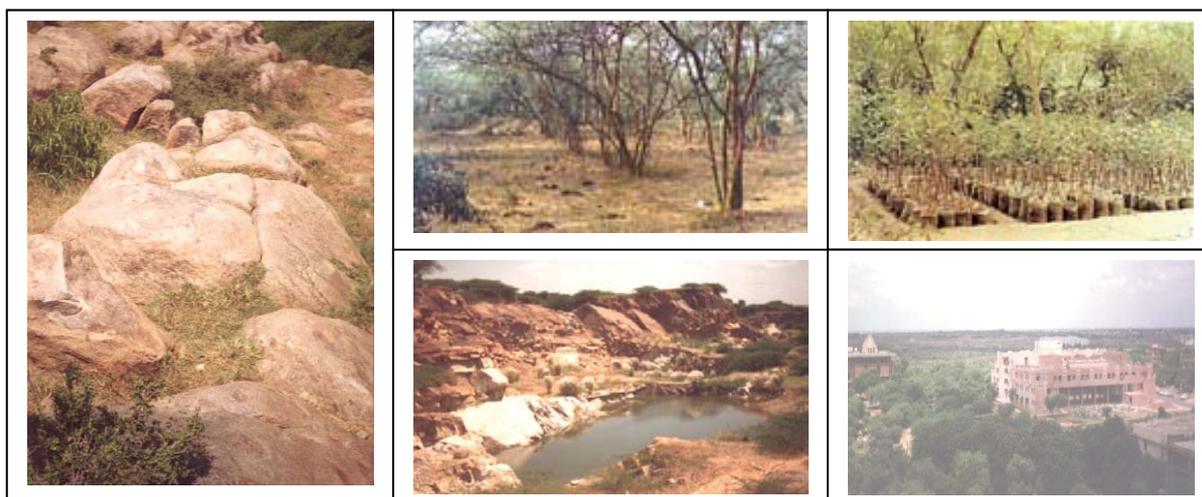


Figure 4

Figure 5 & 6

Figure 7 & 8

A close examination of the ridge revealed that it is a wonderful slice of nature. It is a repository of the Delhi's future and a sobering reminder of what Delhi might have looked a few decades ago until it was run over by wheels and concrete. More than 200 species of birds have been spotted in this tropical thorn forest. Earlier, their number was 300 and more (Dahiya and Krivov, 1999). It is having about 70 species of butterflies and large varieties of animals and insects. Unbelievable as it might seem, some 75 years ago the ridge forest even housed lions, tigers, leopards, antelopes, wolves, jackals, hog deers, etc. which have been vanished over time. However, it is observed that all-over Delhi Ridge there has not been much change in the vegetation cover with the exception of the potential reforested areas where dense vegetation cover has found been increased over the periods (see Figures 7 and 8).

5. PRESSURE OF POPULATION

In Delhi, land environment is under stress due to the pressure of rapid urbanization. Population growth and in-migration of poor people, industrial growth, and poor environmental infrastructure, etc. are the main factors that have deteriorated the quality of Delhi Ridge resources. Delhi's Population, one of the principal drivers of environmental stress has grown by 13.38 million as against 0.41 million persons in 1901 to 13.78 million persons in 2001. The Figure 9 reveal facts regarding the population growth for Delhi, this portrays a rising trend all through during 1901-51. There was not much change in Delhi's population during 1901-11 as it grew by just 1.98 per cent. The decade 1911-21 witnessed an increase by 18.03 per cent, whereas the population increased only marginally from 0.41 million in 1911. This increase may be mainly attributed to the shifting of capital from Calcutta to Delhi in 1912. The growth of population during 1921-31 and 1931-41 was 30.26 per cent and 44.27 per cent respectively.

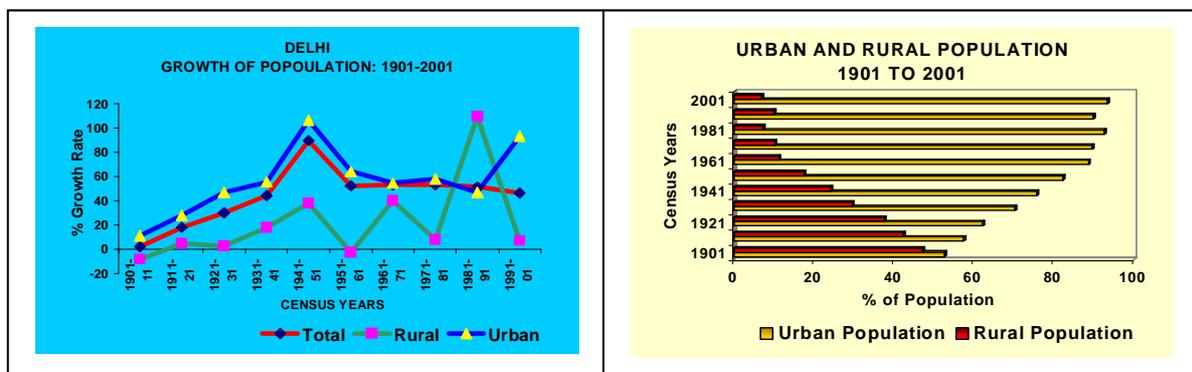


Figure 9

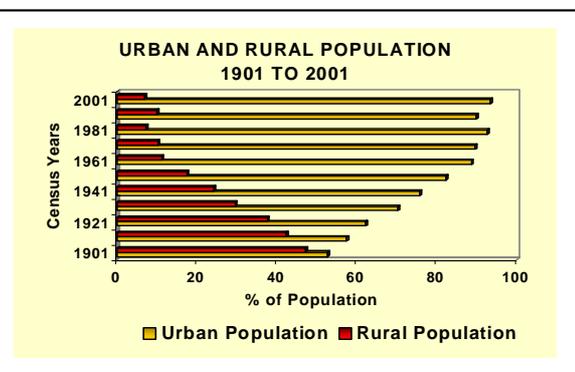


Figure 10

The Highest growth rate of population of 90 per cent was recorded during 1941-51. The partitioning of the country resulted in huge influx of displaced persons in the urban areas as is evidenced by the highest urban growth rate of 106.58 per cent during the same period. During 1951-61, the growth rate fell to 52.44 per cent. During the next period, it again showed ascending trend, although marginally. Such growing tendency in population was due to the multiplication and intensification of services during the post-independence era. During 1971-81 decade, the population recorded a growth rate of 53 per cent. The main factors responsible for unabated growth of population in the Delhi are the expansion of commerce and trade; and the growing industrialisation, particularly, in the field of small-scale industries during the last three decades. During 1981-1991 period, the growth rate of population was 51.45 per cent. Such decline in population growth was resultant due to decline in urban growth rate of 46.87 per cent in 1981-1991 in comparison to the previous decade 1971-81 growth rate of 58.16 per cent. Furthermore, the growth rate of population was declined to 46.31 per cent during 1991-2001. Apart from this, the share of rural population is less than one-tenth of the total population with the continuous shifting of the ratio in favour of urban population. In 1901, Delhi had almost an equal distribution of population in the rural and urban areas as is evidenced by the Figure 10. In 1981, the share of urban population was 92.73 per cent, which

slightly declined to 89.93 per cent in 1991. Whereas it was marginally increased to 93.45 per cent in 2001.

Since Delhi has remained a capital of the country for centuries and a hub of all social and economic activities. It has always been attracting in-migrants. This has resulted in excessive growth of its population, which is not due to natural increase alone, but more because of large-scale in-migration. Because of this, the Delhi is densely populated. It has recorded a growing density of population since 1921. At the time of partition of the country in 1947, Delhi attracted gigantic and unprecedented mass immigration of displaced persons. The highest density of population of 9,294 persons per sq. kms. was recorded during 2001 Census (see Figure 11) which is the highest among all the States and Union Territories of the country, India. Within the Delhi itself, great variations in the density of population can be marked as is evidenced by the Figure 12

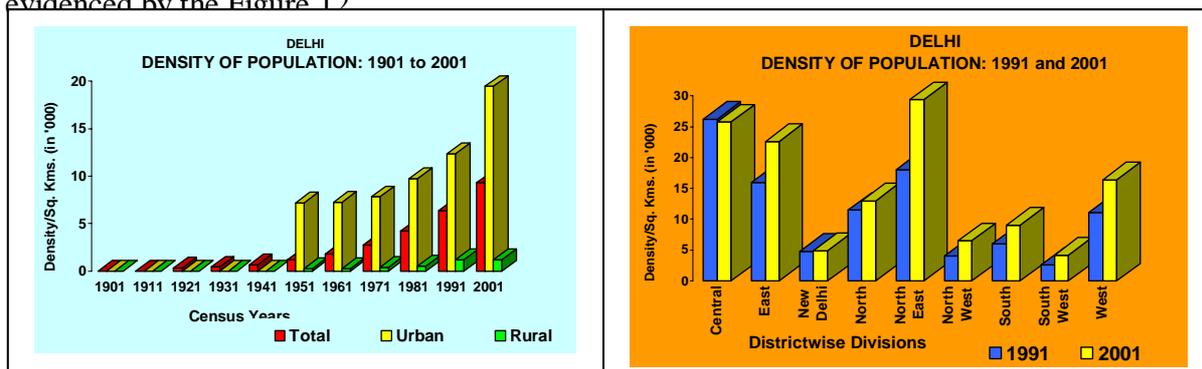


Figure 11

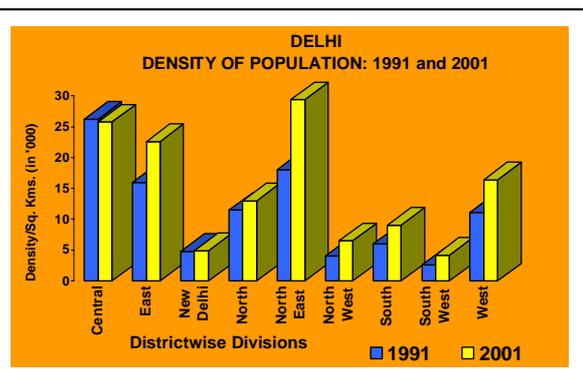


Figure 12

However, the most striking characteristic of the population of Delhi is the predominance of in-migrants. Therefore, forest cover has been changed due to rapid expansion of the urban and industrial activities. These processes have resulted in the expansion of built-up areas on the one hand and large scale quarry and deforestation activities particularly over the Southern Ridge on the other hand. Consequently, the first hypothesis tested with the evidence that the settlement expansion and land encroachment all over the Delhi Ridge is noticed as an important phenomenon resulted due to the high population pressure in the Delhi cosmopolis.

6. DELHI RIDGE ENCROACHMENTS

The Delhi Ridge spread over an area of 7,785 hectares is a continuation of the Aravalli's, which extends into Delhi from Haryana at the Tughlaqabad-Bhatti mines - Dera-Mandi axis moving northwards covering areas of the Asola Wildlife Sanctuary, parts of Delhi Cantonment and Lutyens Zone terminating at Delhi University covering the Kamala Nehru Ridge. There are interesting discrepancies regarding the total area of the ridge. When the Northern Ridge was first declared a reserved forest in 1942, its area was listed as 150.46 hectares - the present notification list states it to be 87 hectares. The balance of 63.46 hectares is unaccounted for. Similar is the case with the Central Ridge, the notified area being 917.47 hectares but the net area available is only 869 hectares. The balance again is unaccounted for. However, sources point out that from the original area of the ridge which was 15,046 hectares - the total area has come down to 7,785 hectares. So,

much of the Delhi Ridge area having already disappeared, the priority is to save whatever is left behind right now.

The Delhi Ridge with 7,785 hectares of land, forming only 6 per cent of the land mass of Delhi, is the life line of about 13.78 million people of the Delhi. It helps in maintaining the oxygen-carbon dioxide balance, purifying air, reducing noise levels, regulating temperature and preserving biodiversity. It is therefore a matter of concern that despite the government notification of 1994 (which declared the ridge as a reserved forest), and the Supreme Court ruling of 1995 in this regard, 70 per cent of the Ridge is still under encroachments. The Delhi Ridge, is composed of four green pockets – the Northern Ridge, the Central Ridge, the South-Central Ridge, and Southern Ridge as is evidenced by the Table 1.

Divisions	Year of Notification	Notified Area (in Hect.)	Actual Area (in Hect.)	Encroached Area (in Hect.)
Northern Ridge	1942	150.46	87.49	63.01
Central Ridge	1913	917.47	869.63	47.84
South-Central Ridge	1948	-	626.98	-
Southern Ridge	1948	-	6200.49	-
<i>Delhi Ridge</i>	<i>1913</i>	<i>15045.74</i>	<i>7784.59</i>	<i>110.85</i>

Table 1: Delhi Ridge Area: 1913-2003

6.1 Northern Ridge

The Northern Ridge spreads over an area of about 87 hectares between Civil Line and Delhi University. When the northern ridge was first declared a reserved forest in 1942, its area was listed as 150.46 hectares during the British Period. The balance of 63.01 hectares is unaccounted for.

6.2 Central Ridge

The Central Ridge covering an area of 869 hectares extends from Karol Bagh and Mandir Marg upto Dhaula Kuan in the south Delhi. The central ridge notified area being 917.47 hectares by the 1913. Whereas the net available area is only 869 hectares. The balance of 47.84 hectares is unaccounted for.

6.3 South-Central Ridge

The South-Central ridge spreads over a very large area of 626 hectares while covering the Mahipalpur-JNU area which around Mehrauli is divided into two parts by Mehrauli and Kishangarh villages. Mining and quarrying activities, especially in the south-central ridge, have also resulted in shrinking of ridge areas, concerning enormous loss to its biodiversity.

6.4 Southern Ridge

The Southern Ridge spread over an area of 6200 hectares is by far the largest part of Delhi Ridge. The Southern Ridge is mainly situated in Mehrauli tahsil. Another ecologically important location, the Asola Wildlife sanctuary, was established in 1991 to enhance the protection and conservation of the ridge flora and fauna diversity.

The Ridge is still dotted with three petrol pumps, eleven religious places, two big hospitals, sixteen schools and five big parks besides the Delhi Electricity Supply Undertaking (DESU) transmission towers, Wireless Monitoring Stations, Indian Space Research Organisation (ISRO), Radio Relay Station, Swimming Pool, Maurice Nagar Police Station, abandoned Water Tanks and Garbage Dumps as is evidenced by the Figures 13, 14 and 15. Even where some encroachments have been removed, the land is still to be retrieved, and where land has been retrieved no greening has been done. For instance, wherever the petrol pumps have been removed from the ridge, underground petrol tanks are still there and land still has to be retrieved from their owners. Also no greening has been done there. Moreover, the places like patches of Ridge in J.N.U., Vasant Kunj, Nicholas Ranges and Jaunpur should be notified and declares as reserved forest. Over the South-Central Ridge about 100 marble shops occupied about 50 hectares of which 30 hectares of land have been converted by the marble traders into nurseries which are non-functional (just to dodge the authorities) and 20 hectares are still lying vacant. Part of the vacant land is strewn with marble pieces. Behind the nurseries several farmhouses are under construction. Even a temple is coming up in utter violation of the law. Besides several parts of the Central Ridge are being used as illegal constructions and garbage dumps. The cattle grazing and chopping of trees are also going on unchecked.

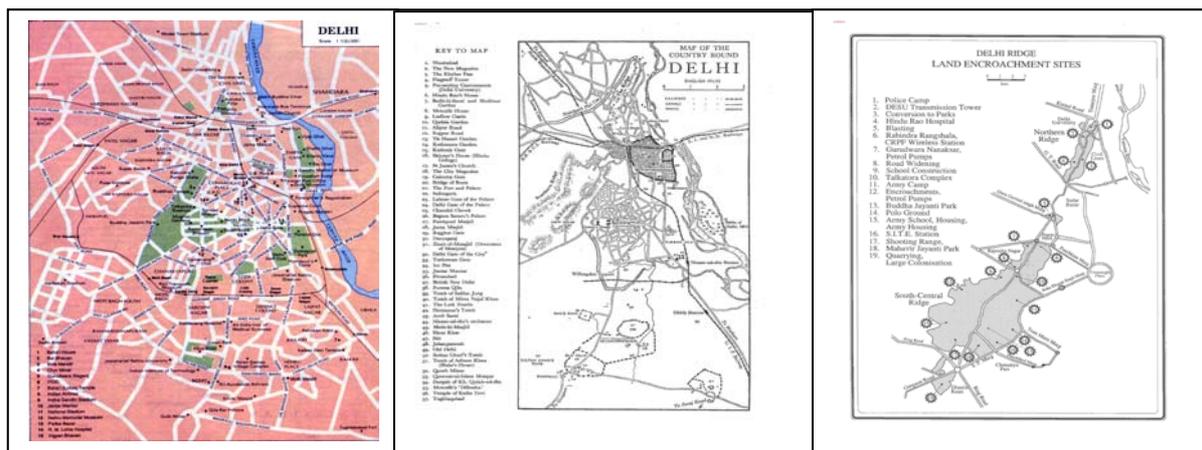


Figure 13

Figure 14

Figure 15

The CRPF and other paramilitary forces should withdraw from the Ridge and schools must be stopped from encroaching thereon. The Central Ridge falling between Shankar Road and Birla Mandir is the worst affected. All the trash from Ganga Ram Hospital is being dumped on the ridge and patients who have come from all over the country have formed a sort of slum on the ridge area, the Hospital has no provision for their stay. Again it could stop the Gurdwara from expanding more. At least five new temples have been there recently. Petrol pumps should also be removed from the 'Green lung'. A number of working quarries at the Mahipalpur, Masudpur, Rajokari, Ghattornia, Jonapur and Tajpur Mines along with the 12 pits of the Bhatti mines have also to be closed for quarrying if the ridge has to be conserved in order to "Leave the earth alone". However, the above mentioned land encroachment analysis puts forward the facts to prove the second stated hypothesis.

7. SUGGESTIONS FOR THE FUTURE

"The State shall endeavour to protect and to safeguard the forests and wildlife of the country" - states Article 48A, of the Indian Constitution and this constitutional provision needs to be translated into action. The high resolution remote sensing imagery should be utilised to map the ridge area so that a fruitful and feasible management plan can be drawn up with the help of geographers, environmentalists and scientists (Sengupta and Venkatachalam, 2001). There are at least six agencies like the Delhi Development Authority (DDA), New Delhi Municipal Corporation (NDMC), Central Public Work Department (CPWD), Municipal Corporation of Delhi (MCD), Forest Department (FD) and Land and Development Department of the Urban Development Ministry (UDM), which are managing the ridge leading to utter confusion. Whereas one agency should be entrusted for proper management of the Delhi Ridge. In this context, the organisations like the World Wildlife Fund (WWF); the Indian National Trust for Art and Cultural Heritage (INTACH); and an environment group "Kalpvriksha" had recently raised the demand for transfer of the Northern Ridge area from DDA's control to that of the Forest Department after strengthening its infrastructure which, as of now, hardly exists. The DDA's primary focus being horticulture and construction. So, it was felt by these bodies that due to the nature of its functioning and susceptibility to political pressures, the DDA was unable to maintain the character of ridge with its rich flora and fauna which acted as a 'green lung' for the Delhi cosmopolis.

The DDA not only contributed towards building and planning of the Capital city of Delhi but also played an important role in development of the forests, particularly the ridge, by planting indigenous trees with a minimum of artificial landscape to achieve the ecological balance. During the first three quarters of 1992-93, they had planted 7.5 lakh trees of which 60 per cent were planted in the ridge. At the "Sanjay Van" in the South-Central Ridge area at Mehrauli, the DDA was much better equipped than the other departments and had the requisite infrastructure under their control to carry out afforestation and conservation of the 869 hectares of the ridge under its charge. However, DDA was not averse to the idea of entrusting the ridge areas to some other governmental agency if the need to do so was felt by the higher authorities in the Ministry of Urban Development. Since there has been a marked reluctance on the part of these departments to hand over their portion of the ridge to another department, the courts of the Delhi, especially its High Court, could consider taking the initiative in untangling the red-tape and give Delhi, its much need breathing space. Greening of the ridge should start even if the encroached land has not been fully

retrieved from the encroachers. Wherever the land reclaimed from the encroachers it should be fenced. The ridge areas should be occasionally patrolled in order to ensure the no new encroachments come up.

There is the need that the area should be notified under the Forest Conservation Act, 1971 and all encroachments and allotments must be immediately stopped. Under the Environment Protection Act 1993, major parts of the Aravalli range in Haryana and Rajasthan were notified as protected forests, but the Delhi Ridge despite being the only green belt in the entire Aravallis was deliberately left out. Delhi Ridge, declared a reserved forest through a Notification issued on May 24, 1994 states that “as the ridge is a part of the Aravalli range, a notification in January, 1992 was issued under section 3 of the Environment Protection Act, 1986 for protection of the Aravallis. If the ridge is included, it will cover it as well”. It is also to be covered by the Rs. 400 crores Aravalli Project funded by the Japanese and the European Economic Community (EEC) to conserve the range. Thus, it is desirable to declare the area as a “National Park” under the Wildlife Protection Act 1972, just as it was done in the case of “Van Vihar” in Bhopal and “Borivilli National Park” in Mumbai (Bombay). Both these areas are now ‘protected areas’ and are flourishing now. However, “let us save ecology from development no doubt but at the same time, let us save development from ecology as well” (Mohan, 2002). The best ecological use of the Delhi Ridge is not after its destruction, but in-situ for establishing the land and people, preserving the forests, ensuring the maintenance of ecological system and the ultimate survival of the local residents.

8. CONCLUSION

The increasing activities of land encroaching has degraded the ecological system resulting into the shrinkage of Delhi Ridge. There is widespread natural vegetation destruction all over the Delhi Ridge. The encroachment should not be allowed in the ecologically fragile Delhi Ridge. What is important is the sustainability of the Delhi ridge over a long-drawn period of time rather than the ephemeral nature of encroaching, the gains of which will be availed by the present generation only. Plantation must be carried out of indigenous species especially in areas where the ridge has been exposed and scorched by the quarrying and deforestation. The Ridge must definitely be declared a Reserve Forest and notified under the Environment Protection Act 1972. Thus, due to the continuous encroaching activities over such a long duration and that too of this magnitude, its impact in the areas in and around encroaching regions, therefore, is obvious. The impact is manifold and prominent amongst them are like the social, economic, ecological and environmental. So, the Delhi Ridge has to be conserved in order to “leave the earth alone”. Consequently, the work carried out will add to our knowledge on the environmental degradation in order to prevent deforestation and protect the forested areas which are functioning as the ‘green lung’ in the concrete jungle of Delhi. Secondly, the gains of knowledge can be applied to sustainable forest belt development and also to detect and identify deforested areas of the Aravalli Mountain Hills – The Delhi Ridge and hence increase forest cover.

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BIOGRAPHICAL NOTES

Dr. Madan Mohan

Academic Degrees: I graduated in Geography subject from the Delhi University (DU) with the B.A. (Hons.) degree in Geography in the academic year 1985-86. I pursued my career for higher education to earn the professional degrees of the Master of Arts (M.A.) in Geography and the Master of Philosophy (M.Phil.) with specialization in the field of 'Urbanisation and Economic Development'. The Jawaharlal Nehru University (JNU) awarded M.A. and M.Phil. degrees to me in the academic year 1987-88 and 1989-90 respectively. The degree of Doctor of Philosophy (Ph.D.) in the field of 'Ecology and Development' has awarded to me in the academic year 1997-98 by the Jawaharlal Nehru University, New Delhi.

Awards and Honors: I had qualified the National Entrance Test (NET) in the Human Geography subject for the award of Junior/Senior Research Fellowships (JRF/SRF) and eligibility for lecturership by the University Grants Commission (UGC), New Delhi.

Academic Positions held: Since the last two academic years i.e. the 24th October, 2000 to date I am working permanently as a Lecturer in Geography in the Department of Geography, Faculty of Natural Sciences, Jamia Millia Islamia (Central University), New Delhi. Earlier, during the periods 25th March, 1996 to 23rd October, 2000 worked with the Jawaharlal Nehru University, New Delhi.

Selected Research Publications: I have authored for a book on the theme of 'Ecology and Development', which has published in India in January 2000. I have also contributed by publication of number of research papers, which have been appeared in several reputed journals both at the national and international levels on the issues of Ecology and Development, Climate Change, Spatial Data for Environment Management, and GIS and Remote Sensing Application for Mapping and Modeling of Social Life Styles.

Membership of Professional Societies/Organisations: I am the life member of the two professional societies – the National Association of Geographer, India (NAGI); and the Association of Population Geographers of India (APGI).

Paper Presented in International Congresses/Conferences: I had participated and assisted in organization of the International Symposium on the theme of 'Population Growth in Developing Countries' held at New Delhi in 1993 in Jawaharlal Nehru University (JNU) in association with the International Geographical Union (IGU), France. In addition to this, I had also participated in the XIXth ISPRS Congress Amsterdam 2000, The Netherlands on the theme of "Geoinformation for All"; the Vth ICORG 2001 International Conference, Hyderabad, India, on the theme of "Spatial Information Technology"; and the XXII FIG 2002 International Congress on the theme of "Geomatics and Property Valuation for Global Sustainable Development", Washington, D.C. United States of America.

Foreign Travels/Countries Visited: I have traveled and visited to foreign countries like the Royal Netherlands (Holland), Amsterdam in 2000 and the United States of America (USA) Washington, D.C. in 2002

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