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Proposal for Ideal Green Spaces at Town and Neighborhood Level - A Case of New Chandigarh

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***Abstract*:- Green Space in urban area performs multidimensional functions and provides enormous benefits to the citizens. Importance is still more due to its limited availability in urban area as a result of urbanization. It not only performs the regulatory but also environmental and social functions and provides various types of benefits as per its location and size at various spatial levels. The hypothesis of this study is that the benefits and functions of Urban Green Space at various spatial levels perform differently. To examine this hypothesis and to evaluate extent of the green space benefits and functions at various spatial level, Chandigarh city is chosen as a case example and its implications in its expansion New Chandigarh . An intensive and in depth study of green spaces in Le Corbusier's master plan with respect to high and low density sectors. Specially analyzing how green space equity varies along spatial and socio-economic gradients, understanding the current status of green space distribution and its variations over different socioeconomic groups of urban residents to enhance the benefits of green space for all residents This paper intent to looks at quantitative aspects of Urban Green Spaces in terms of its benefits to user and giving proposals for green spaces at city and neighborhood level for New Chandigarh.**

***Keywords:* Urban green space , urbanization , Green space equity**

INTRODUCTION

The urban population of Chandigarh has increased by 340.32 % from 1971 to 2011 .The massive increase in the urban population among other factors has resulted in urban growth in Chandigarh and also in the surrounding areas. The surrounding region has witnessed encroachments on fertile agricultural land and vegetation cover due to development and expansion of urban areas in the recent past .The city has a great potential to attract people from all income groups due to high quality lifestyle and high development rate .

Chandigarh has the rare accolade of being one of the few cities in the world with planned landscape. Its Master Plan, a unique work of art, laid the foundation of what is now popularly called a city beautiful. Between the orderly chequered-mesh of the grid-iron road layout encompassing the sectors, lies a structured patterns of linear green belts and city parks.

With increased urban population and re-densified built forms in Chandigarh an extension of the city New Chandigarh has been proposed by Greater Mohali Area Development Authority to cater to the projected growth of Chandigarh. The conversion of green spaces into the built-up areas has become one of the major reasons for habitat destruction worldwide.

Through accelerating urbanization, mass demographic growth and expanding global consumption patterns, more and more open spaces in cities continue to be converted into industrial, commercial or residential areas. Green space has become an increasingly scarce resource, for which many competing forces battle for the right to control and manipulate it. The loss of Open spaces in cities will put tremendous strain on resources and threaten human health. Evidence indicates that the frequency of physical activity is negatively affected by a lack of greenery.

Thus public Green Space per Capita, as a landuse indicator can be valuable for examining the citizens' daily wellbeing and quality of life. There is an urgent need to look after the issues related to the urban green spaces at grass root level or at local level.

Hence the main objective of this study was to analyze the urbanization impact quantitatively over the city green spaces over two major spatial levels i.e. City level(Macro level), and Neighborhood level(Micro Level) in terms of per capita green availability and also by mapping its benefits and functions.

STUDY AREA

New Chandigarh is a new planned smart city near Mullanpur in the Mohali district (SAS Nagar) in Punjab, India. It is designed as an extension of already crowded city of Chandigarh. It is developed by Greater Mohali Area Development Authority. New Chandigarh LPA lies in the state of Punjab and was planned within the purview of the overall vision of the Greater Mohali Region Plan 2008-2058.

The total area notified as Local Planning Area (LPA) for New Chandigarh is 6,109 hectares with key land uses as Residential, Mixed Use, Education and Health. Other supporting land uses include, City Centre, Commercial and Green & Recreational areas. There are no manufacturing industries proposed as per the notified master plan and proposed revised land use plan.

The New Chandigarh LPA has been planned to cater to an ultimate population of approximately 10 lakh by the year 2058. The

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gross residential population density applicable to the entire LPA is 170 ppa (people per acre).
The entire LPA is divided into three broad density zones :
• Low (upto 30 ppa) • Low Density Zone(upto 150 ppa) • High Density Zone(200 ppa).

Fig.3-1 National & State level location of New Chandigarh LPA
Source: AECOM

Fig.1 New Chandigarh location

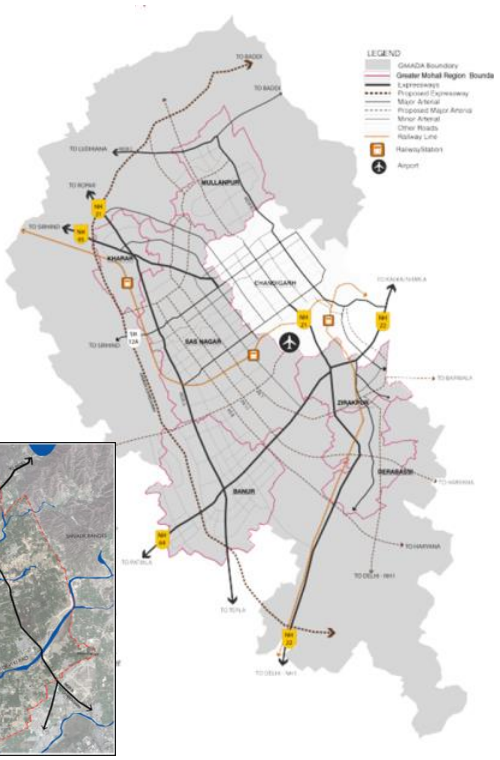


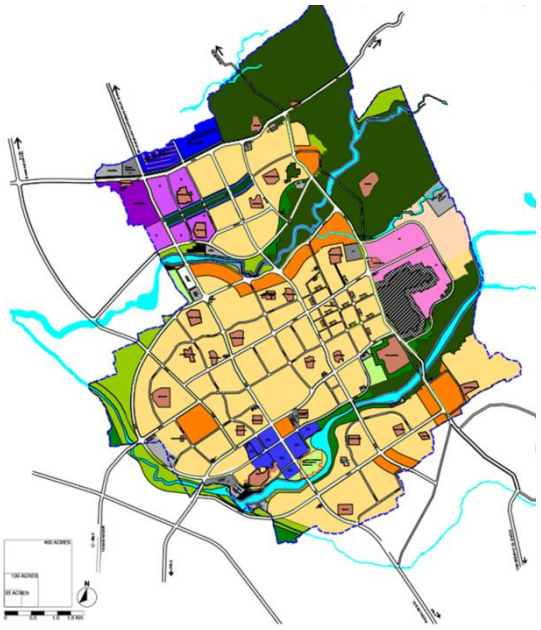
Fig.2 New Chandigarh regional connectivity

Fig.3 New Chandigarh physical features and boundary on satellite imagery Source : Detailing of Master Plan New Chandigarh

Land Use	Area in Ha	Percentage
Residential	2288.54	37.46%
Mixed Use	280.98	4.60%
Commercial- City Centre	84.16	1.38%
Commercial- Retail	19.94	0.33%
Commercial- Wholesale/ Warehouse	81.22	1.33%
Commercial- Marriage Palace	9.87	0.16%
Institutional- Education City	116.38	1.91%
Institutional- Medi City	140.86	2.31%
Institutional- Research and Development	61.04	1.00%
Institutional- Others (Cremation grounds,Goshala, Animal shelters, Veterinary hospital)	11.82	0.19%
Recreational	157.54	2.58%
Parks	149.79	2.45%
De Notified PLPA- Agriculture	1,185.89	19.41%
Forest and Open Space	197.58	3.23%
Village Settlement Area (Abadi)	207.25	3.39%
Roads	576.89	9.44%
Defence Zone	79.92	1.31%
Transportation	40.51	0.66%
Utilities	91.20	1.49%
Other (River, Riverine buffer, Defence buffer)	327.84	5.37%
Total	6,109.18	100.00%

Table 1 New Chandigarh Landuse

Source : Detailing of Master Plan New Chandigarh



Map.1 New Chandigarh Master Plan

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RESEARCH METHODOLOGY

Hypothesis:

The hypothesis of this study is that the benefits and functions of Urban Green Space at various spatial levels perform differently.

Scope and limitations:

Only structured (Parks ,neighborhood ,housing area parks , planned green avenues) are considered .Forest areas Catchment area, steep
hill vegetation Green on banks of nallah , road side plantation is not considered. Census data of 2011 is considered for population.

Method adopted for Quantitative Analysis:

Calculation of Per capita green space is adopted for quantitative analysis.

As per WHO norms minimum per capita green requirement is **9 m2 per/person** and as per UDPFI guidelines it is about **10-12 m2 per/person.**

Per capita Green = Total area under green / Total population

LITERATURE REVIEW

The parks, green spaces, open areas and playgrounds within an urban area influence the quality of the urban environment for residents, contributing to the overall health of the city environment. Green spaces symbolize peace, minimal stress and a cleaner environment for many people, which are considered as important factors in making a city livable, pleasant and attractive for its citizens and guests. The major functions performed by Urban green space are as follows:

S.NO.	TYPE	FUNCTIONS
1	**Regulation functions**	Regulates the chemical composition of atmosphere and purifying the local air
		Controlling the runoff and flooding
		Regulating the hydrological cycles
		Supporting biological diversity in the city
		Preventing the soil erosion and sediments
		Regulating the local and global climate
2	**Carrier functions**	Conserving the energy in the city through controlling the micro climatic variations
		Helping the recreation and tourism
		Integrating the urban man to the nature
3	**Information functions**	Aesthetic information
		Spiritual and religious information
		Cultural and artistic inspiration
		Scientific and educational information sources

Table 2 Functions of green spaces
Source : Chandigarh Urban Green Guidelines2014

Major benefits obtained through urban green spaces are categorized under two perspectives i.e. tangible and intangible they are as follows:-

Tangible Benefits

Ecological Benefits :

1. Green spaces have been to absorb pollutants, moderate the impact of human activities for eg. Absorbing pollutants and releasing oxygen.
2. They contribute to the healthy urban environment by providing clean air, water and soil.
3. They improve the urban climate and maintain the balance of the city's natural urban environment.
4. UGS provide safe play space for children & contribute to their physical, social and mental development.

Benefits at Planning level:

1. A network of high quality green spaces linking residential areas with business, retail and leisure developments can help to improve the accessibility and attractiveness of local facilities and employment centres.
2. It encourages people travel safely by foot or by bicycle for recreation.
3. Well-designed UGS provide a barrier to noise and can function as a visual screen.

Economic Benefits:)

1. Research all around the world shows that the property owners value the urban forest by the premium they pay to live in the neighborhood UGS and urban parks. For e.g. Just one km increase in the distance to the nearest forested area leads to an average 5.9 % decrease in market value of the dwelling.
2. Study on effects of neighborhood parks on the transaction price of high rise private residential units in Hong Kong indicated that neighborhood parks could lift price by 16.88%, including 14.93% for availability and 1.95% for view. Comparing with

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other landscape elements, Neighborhood parks induced the heaviest investment intention in the home buying behavior.

INTANGIBLE BENEFITS

Social Benefits:

1. Green spaces provide a refreshing contrast to the harsh shape, colour, and texture of buildings and stimulate the senses with their simple color, sound, smell and motions.
2. Well managed and maintained green spaces contribute to social justice by creating opportunities for people of all age groups to interact.
3. Encourages volunteerism, Promotes stewardship,
4. Promotes individuals with disabilities.
5. It supports seniors ,helps in development of youths and enhances education
6. They enhance cultural life by providing venues for local festivals, civic celebrations and theatrical performances.
7. Reduces crime, Strengthens community by reflecting the different communities they serve and meeting their varying needs.

Health Benefits:

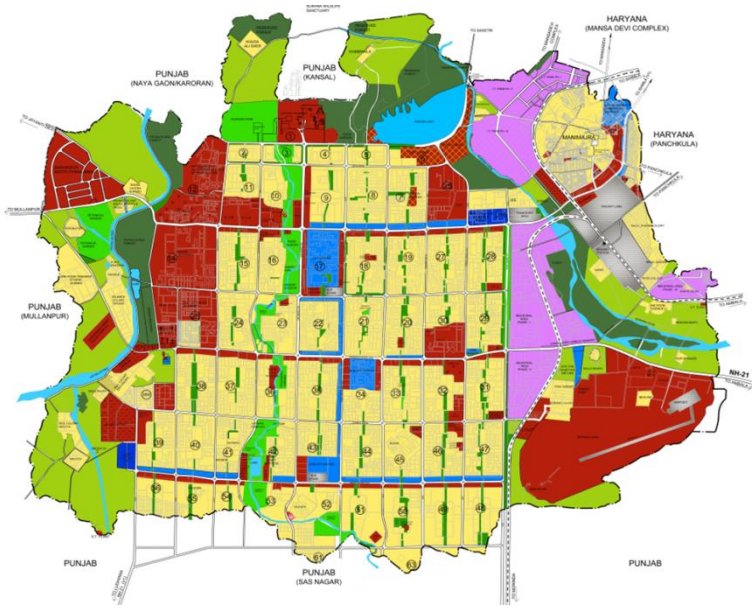
Decrease obesity, Boosts immune system, Relieves stress, Life expectancy, Reduces depression.

Improves Quality of life.

1. Recreational activities are a medium in which participants can change their self-image and gain personal satisfaction. Quality of life benefits from recreational activities include:
2. Enhanced self –esteem through improved feelings of self–worth, reliance and gain personal satisfaction.
3. Personal growth
4. Enhanced expression of and reflection on personal spiritual ideals and feelings of satisfaction from one's personal, neighborhood and community life.

Case study

Chandigarh was the first planned city in India post-independence in 1947 and known for its impeccable urban green spaces . Chandigarh is a union territory in the northern part of India that serves as the capital of the states of Punjab and Haryana. As a union territory, the city is ruled directly by the Union Government of India and is not part of either state.Chandigarh is located near the foothills of the Shivalik Range of the Himalayas in northwest India. It borders the states of Haryana and Punjab. The exact geographic coordinates of Chandigarh are 30.74°N 76.79°E.



Map 2 Existing Chandigarh Master Plan
Source: Chandigarh Master Plan 2031

Fig.4 Location of Chandigarh

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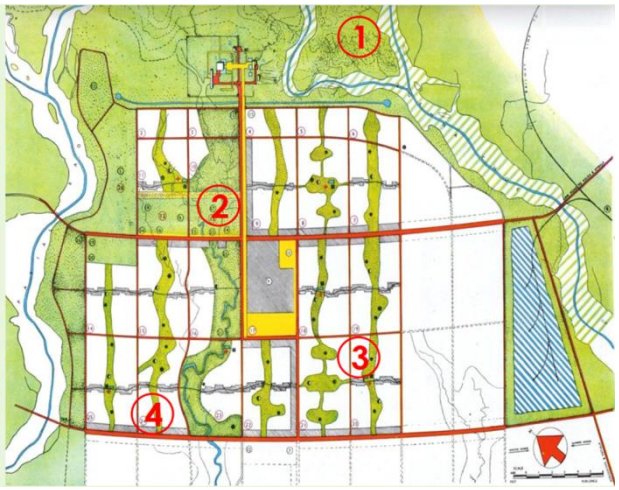
		SECTOR					
S.NO		Phase-I (Sector 1-30) Sector 26 E ,Ind.Area I , Sukhna Lake, Golf Range/Club	Phase-II (Sector 31-47) Sector 38 West ,Ind.Area II,	Phase-III(Sector 48-56) and part of Sector 61 and 63	Periphery	Total	Percentage
1	Total Area (In Acres)	9398.83	5158.76	1870.54	11741.87	28170	100
2	Residential	4012.7	3460.26	1371.31	1827.89	10672.16	37.88
3	Commercial	444.49	433.52	140.51	321.21	1339.73	4.76
4	Transport	747.95	514.23	161.66	622.26	2046.10	7.26
5	Industrial	516.74	272.08	-	537.68	1326.50	4.71
6	Publi/Semi Public	1812.92	372.18	92.41	691.28	2968.79	10.54
7	**Recreational**	**1850.33**	**72.19**	**81.28**	**424.67**	**2428.47**	**8.62**
8	Agriculture	-	-	-	-	-	-
9	Public Utilities	13.7	34.3	23.37	230.96	302.33	1.07
10	Railway Land	-	-	-	316.29	316.29	1.12
11	Defence	-	-	-	1573.00	1573.00	4.52
12	Forest	-	-	-	2113.97	2113.97	7.50
13	Reserved	-	-	-	-		
14	Vacant Land	-	-	-	3082.67	3082.67	10.94

Table 3 Chandigarh landuse
Source: Chandigarh Master Plan 2031

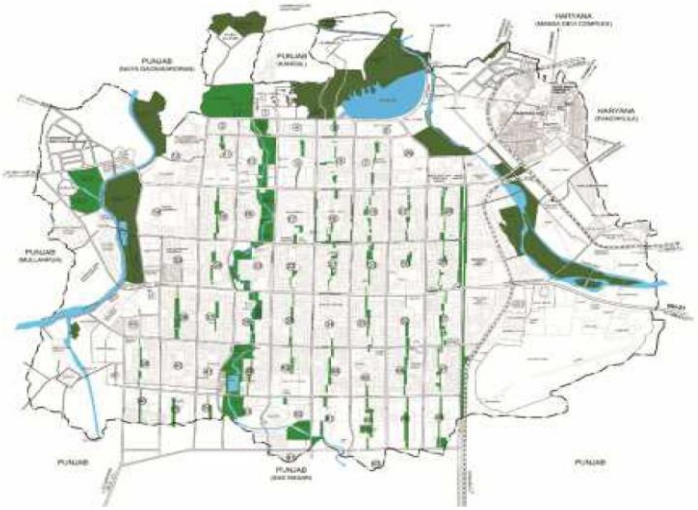
Chandigarh Green Space Typology

As per Chandigarh's master plan green spaces are subdivided into four major divisions:

1. **City level Public Green Space with artificial waterbody** - that attract people from outside the city and may have national importance.
2. **Free Flowing Green Spaces** connecting the entire site - Green belts, forests surrounding the city
3. **Semi Private Green Areas for Neighborhood pockets** - attract people from residential units across the city, have a number of facilities and features and hold neighborhood events.
4. **Private Green Areas for Residential units** - used by the local community, with limited facilities.



Map 3 Chandigarh green space typology
Source: Foundation Le Corbusier



Map 4 Chandigarh green space at city level
Source: Chandigarh Master Plan 2031

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S.NO	Category	No. of parks	Area in ha	URDFPI norms	Remarks
1	**Sub-City Park (SCP) (250,000sqm and above)**	1	161.8	100 Ha 1 for 1,000,000 population	**High**
2	**District Park (DP) (50,000-250,000 sqm)**	7	182.11	25 Ha 1 for 500,000 population	**Intermediate**
3	**Community Park (CP) (10,000-50,000 sqm)**	18	102.44	5 Ha 1 for 100,000 population	**Intermediate**
4	**Neighborhood Park (NP) (5000-10,000sqm)**	74	259.9	1Ha 1 for 15,000 population	**Intermediate**
5	**Housing Area Park (HAP) Less then 5000Sqm**	1733	198.6	0.5Ha 1 for 5000 population	**Intermediate**

Table 4 Comparative Analysis Hierarchy of green space in Chandigarh with URDFPI norms.

Macro Level Analysis

- Green Area Available Within The Sectoral Grid = 2342 Acres.
- Green Area Available In Manimajra = 71 Acres.
- Botanical Garden = 180 Acres.
- Total Planned Green Area = 2593 Acres.
- Forest Area In U.T. Chandigarh=3436Ha.
- Total Green Area Including Forest = 3828 Ha. (9455 Acres).
- Green/Open Spaces (Percentage) = **33.5%** Of The Total Area

1. Average Green Available In 2011 (Sqm/Person)=**17.4Sqm/Person (including all types of open spaces)**
2. Average Green Available In 2011 (Sqm/Person)=**9.31**Sqm/Person **(including only parks and garden**

S.NO		URDFPI	Chandigarh	Remarks
1	**Area**		114 sqkm	
2	**Population**		10,54,686	
3	**Green space**		9827000sqm	
4	**Green space %**	10-15%	8.62	**Less**
5	**Green space per capita**	10-12 sqm	9.31 sqm	**Less**

Table 5 Comparative analysis of green space in Chandigarh with URDFPI norms.

Micro level

High Density Sector

Sector – 20 is a high density sector .Major portion of the sector is residential having a mix of government and private housing of G+2 structure having school, college ,institutional buildings in its vicinity.

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Area	1.47 km2
Population in sector	25901
No. of Parks	48
Total green area	52,478 sqm
Per capita green sqm/person	2 sqm/person

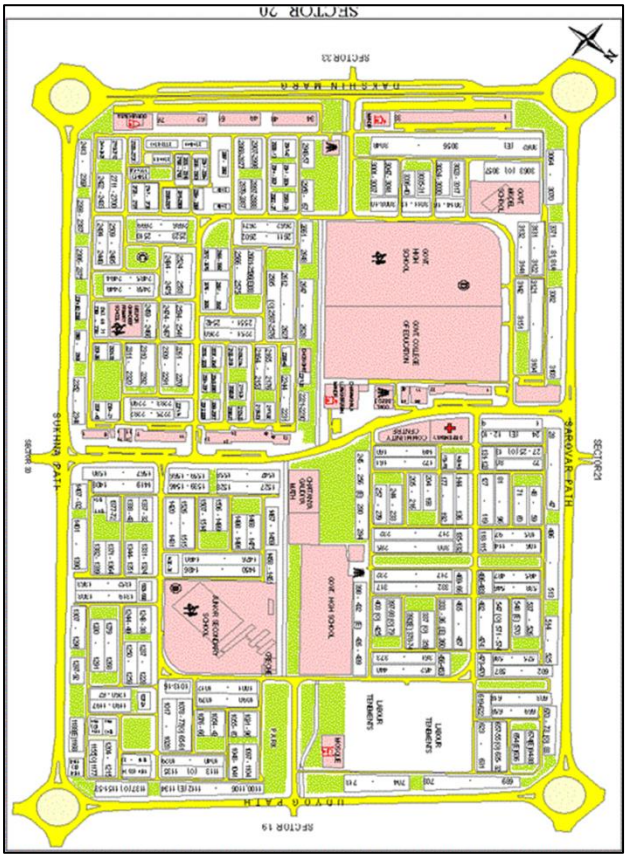

Fig.4 Chandigarh Sector 20 Plan
Source: UT Administration

Fig.5 Chandigarh Sector 20 Parks
Source: Author

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Sector 4 is a low density posh area of Chandigarh. The sector is inhabited by the VIPs of the town having 4-8 kananl private housing and it has no nuisance of a market place though there is one in the neighboring Sector 9. Sector 4 is a walking distance from the Rock Garden and the Sukhna Lake which is the two icons of the city and above all it over looks the hills which are by themselves very scenic.

Area	1.54km2
Population in sector	12,234
No. of Parks	12
Total green area	41538 sqm
Per capita green sqm/person	3.3sqm /per person

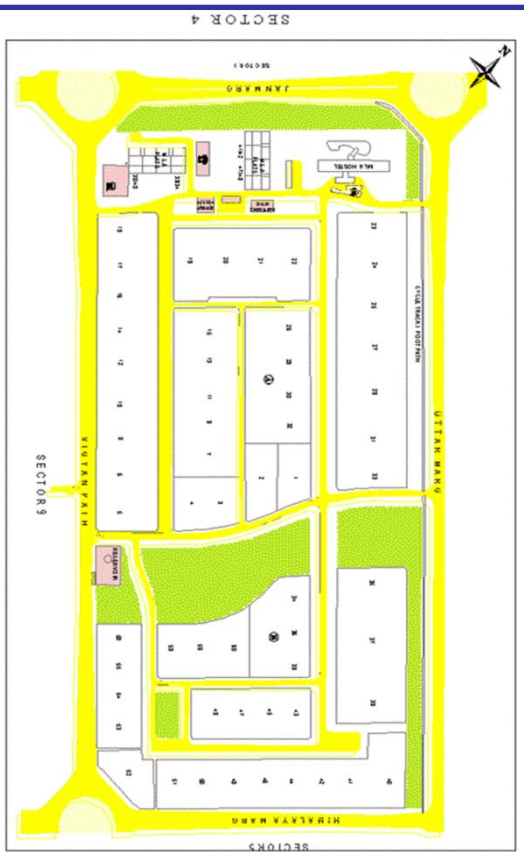

Fig.6 Chandigarh Sector 4 Plan
Source: UT Administration

Fig.7 Chandigarh Sector 4 Parks
Source: Author

S.NO		High density	Low density	URDFPI norms	Remarks
		Sector -20	Sector-4		
1	**Area**	1.47 sqkm	1.54 sqkm		
2	**Population**	25,901	12234		
3	**Green space**	52,478 sqm	41538 sqm		
4	**Green space per capita**	2 sqm/person	3.3 sqm/per person	10-12 sqm/person	**Less**

Table 6 Comparative Analysis of green spaces in sectors with URDFPI norms.

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Inferences

From analysis it was found that a planned city like Chandigarh at city level has sufficient provision of urban green ,though recreation spaces at city level is less than the norms laid by URDPFI .

At sector level there is gap in green space equity among high density and low density wards.
At sector level has per person green space 2sqm per person in a high density sector and 3.3 in a low density sector which is less as per URDFPI norms.

As standards set by URDPFI are quite to achieve by cities due to increase rate of urbanization ,so urban green space standards , typology and hierarchy followed in Chandigarh as envisaged by Le Corbusier are taken into consideration for proposing ideal green spaces for cities.

Existing Site

As per Greater Mohali Development Authority Sector -22 is a proposed housing site in New Chandigarh. The site has an area of 106.2 Ha and is surrounded by proposed 60 m wide roads for connectivity. Sector-22 has village Palheri of 11 hectare in its central core and 2.5 hectare land reserved for group housing by Suntech city .The remaining site is proposed for government housing .

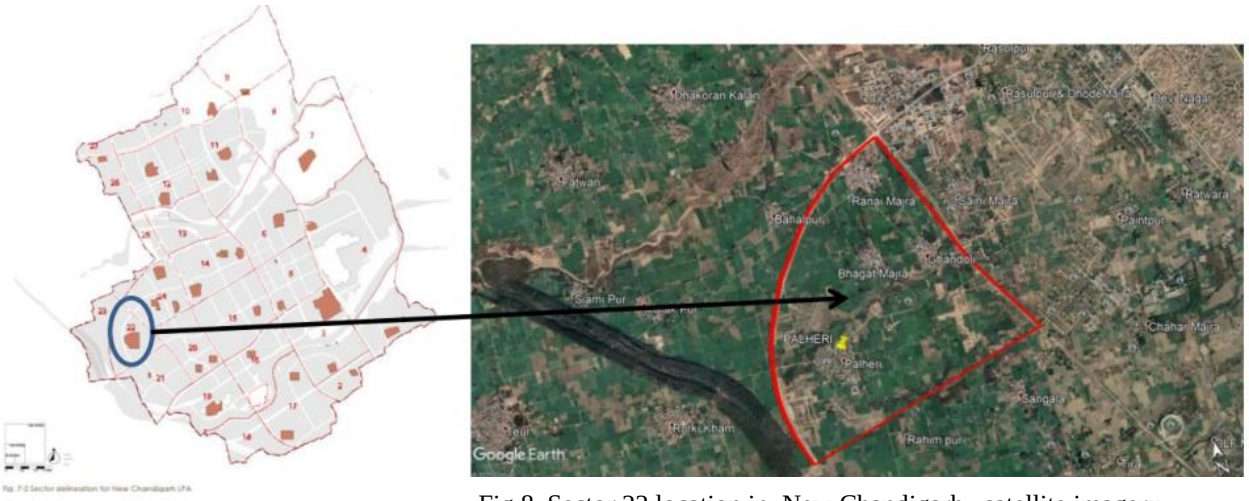

Fig.8 Sector 22 location in New Chandigarh ,satellite imagery
Source: Google

Table 7 Proposed landuse by GMADA for sectors in New Chandigarh

S.NO		Percentage area
1	**Residential**	50
2	**Commercial**	5
3	**Public-Semi Public**	34
4	**Green**	5

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Proposal And Recommendation

At city level green spaces proposed by GMADA are as follows:

- Recreational = 157.54 Ha (2.58 %)
- Parks = 2.45 Ha (149.79 %)
- Forests and Open Spaces = 197.56 Ha (3.23 %)
- De Notified –PLPA –Agriculture =1185.89 Ha (19.41 %)

- Total Planned Green Area = 159.99 Ha
- Total Green Area Including Forest = 1383.3 Ha
- Green/Open Spaces (Percentage) = **30.67%** of The Total Area

1. Average Green Available (Sqm/Person)=**13.83Sqm/Person (including all types of open spaces)**
2. Average Green Available (Sqm/Person)=**15.9** Sqm/Person **(including only parks and garden**

	URDFPI	New Chandigarh	Old Chandigarh	Remarks
Area		60 sqkm	114 sqkm	
Population		Proposed 10,00,000	10,54,686	
Green space		1599000 sqm	9827000 sqm	
Green space per capita	10-12 sqm	15.9 Sqm	9.31 Sqm/person	New Chandigarh has been proposed a relatively high amount of green space

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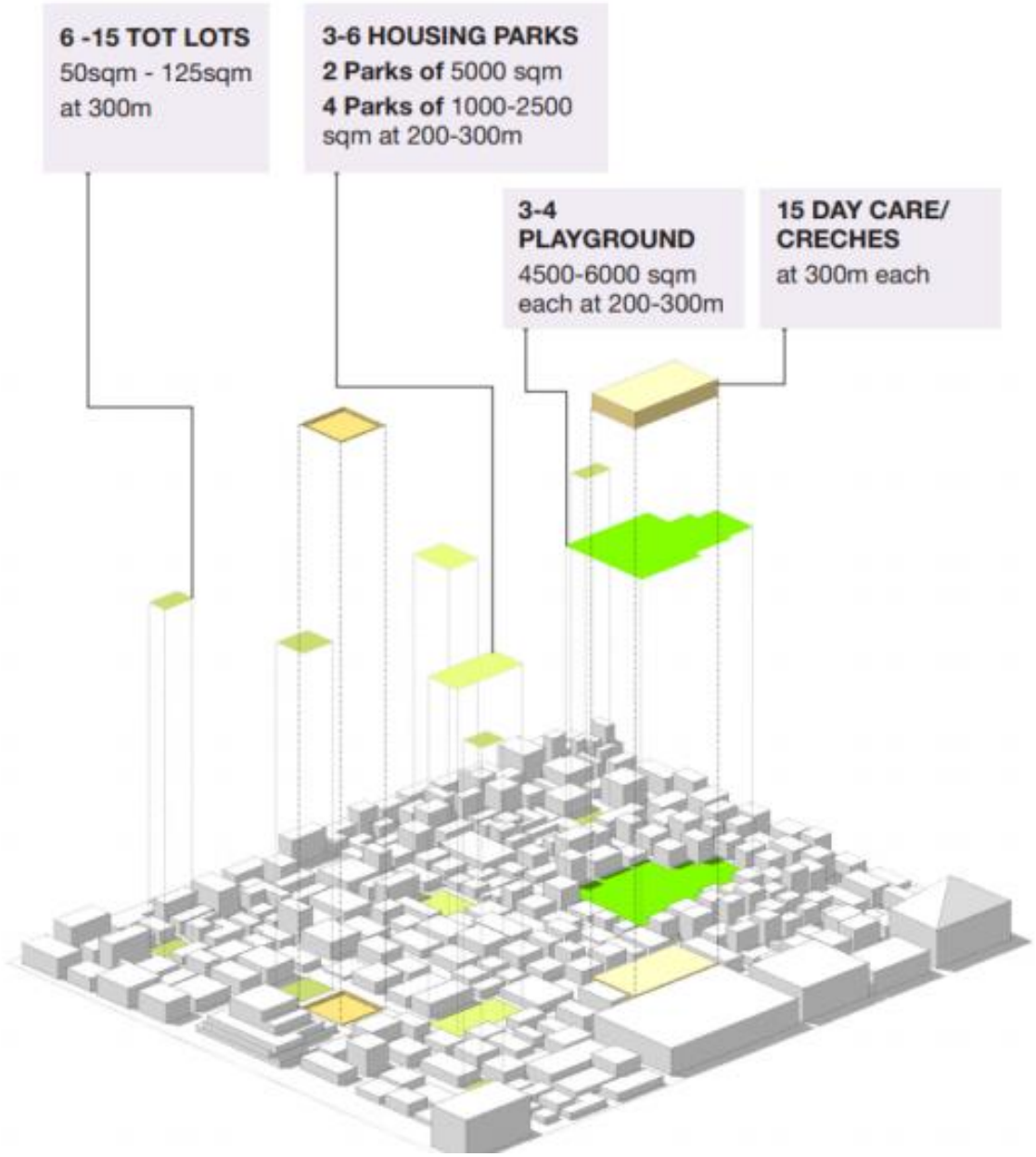

Total Area of the Neighborhood is 60 Ha Approx. and total population is 15,000 people.

*The recommendations mentioned here are based on the existing space standards suggested by URDPFI. The existing norms have been modified keeping in view the reduced speed of movement and comfortable outdoor time relevant for Indian climate

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Hierarchy	Distance	Density	Area	**Remarks**
Totlot	No Existing data **Recommended: Placed at walking distance of max.10 minutes or 300m**	6 No's for a neighborhood **Recommended: 6 -15 No's**	125 sqmt each covering a total area of 750sqm **Recommended: 50 - 125sqm. Covering a total area of 750sqm**	The existing norms specify the area of a tot-lot as 125sqm. We suggest that spaces as small as 50sqm can also be converted to tot-lots. This will incresae their spread and reached across the neighborhood
Housing Area Park	No Existing data **Recommended: Place at 200-300 m**	3No's **Recommended: 3 -6 No's**	5000 Each. covering a total area of 15000 Sqm **Recommended: 2500 - 5000sqm. covering a total area of 15000sqm**	The number of Housing area parks is suggested to be increases for better reach
Neighborhood Park/ Playground	No Existing data **Recommended: Place at 200-300 m**	1No's **Recommended: 3-4 No's**	10000 Sqm **Recommended: 4500 - 6000sqm. covering a total area of 18000sqm**	The existing norms suggest 1 No. Neighborhood Park of 10000sqm. We suggest the area coverage should increase from 10000 to 18000sqm. Also the area should be broken into 3-4 Nos. of parks for better distribution.
Average Per Capita Open Space		0 -12sqm per person Including recreational space, Organized green & Other common open spaces (such as vacant lands/ open spaces including flood plains, forest cover etc. in plain areas. Min. 3sqm/ person In the built up area (excluding recreational space, vacant land, flood plain, forest) **Recommended: 3-4 sqm per person**		The range provided in URDPFI is a gross figure of open space and therefore a high value for a neighborhood .The NBC standard of 3.0sqm is a baseline standard. A range of 3-4 sqm is suggested in an attempt to better the existing norm

Table 28 Ideal green space recommendation

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Ideal Green Space for a high density Sector22 , for New Chandigaarh

S.NO		Area in Ha
1	Sector 22	106.2
2	Existing Plotted housing Suncity	2.5
3	Existing village Palheri with future expansion	12.4
4	Area available for planning	91.3

Total Population 200 PPA / 500 PPH
91.3 Ha x 500 = 45650

S.NO		**Area in Ha**	**Percentage**
1	Residential	45.6	50
2	Commercial	4.56	5
3	Roads/Transport	21	23
5	Public/Semi Public	11	10
6	**Recreational**	**11**	**12**
	Total Area (In Ha)	93.16	100

S.NO	Plot Type	No of Plots	Total Plots	No of Residents
1	HIG	243	729	3645
2	MIG	845	2535	12675
3	LIG	1863	5589	27945
4	Group Housing	NA	NA	1385
5	Total			45650

S.NO	**Plot Type**	**Unit Area (SQM)**	**Area in sqm**
1	HIG	375	91300
2	MIG	162	136900
3	LIG	98	182600
4	Group Housing	NA	91976
5	Total		502776

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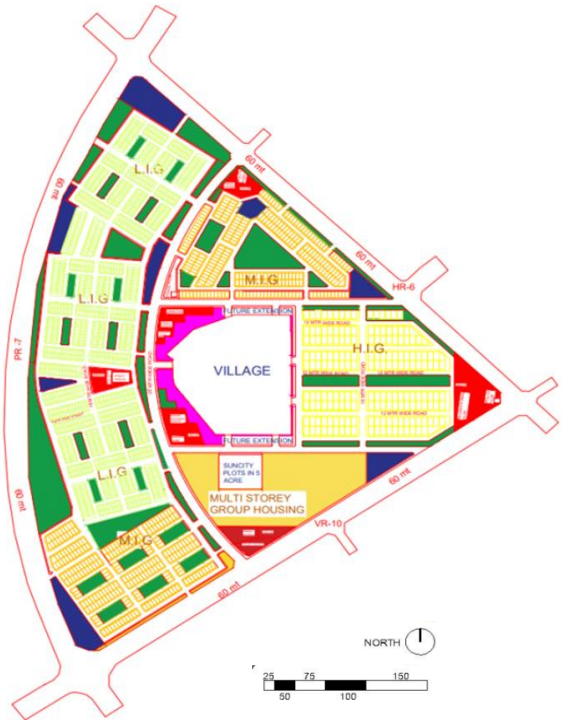
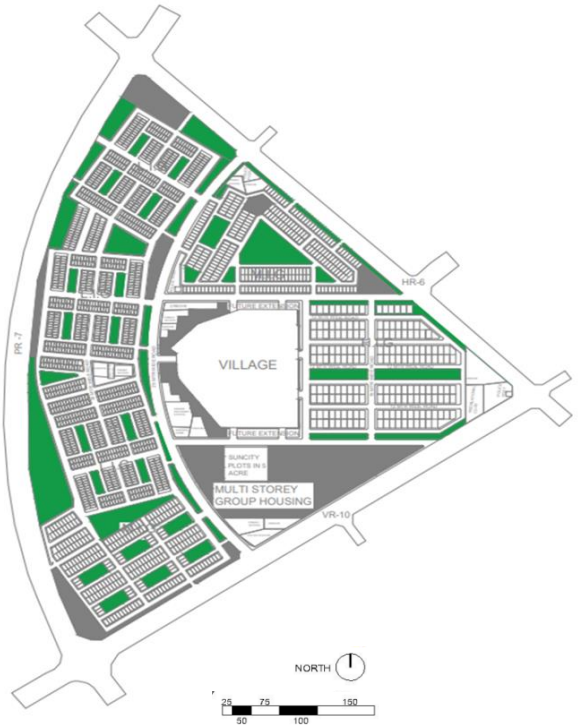
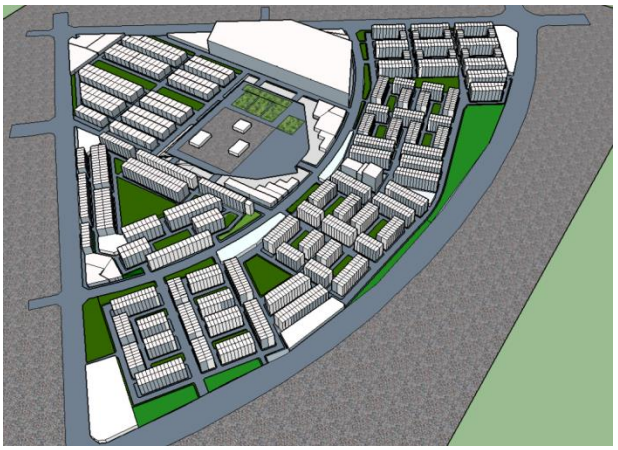
S.NO	Plot Type	Area in Ha	No of floors	Area in Percentage
1	HIG	9.13	G+2	20
2	MIG	13.69	G+2	30
3	LIG	18.26	G+2	40
4	Group Housing	9.1	G+3	10
5	Total			100





Distribution of green space

Total Population 200 PPA / 500 PPH
91.3 Ha x 500 = 45650
Green Space Per Person **2.4 SQM**



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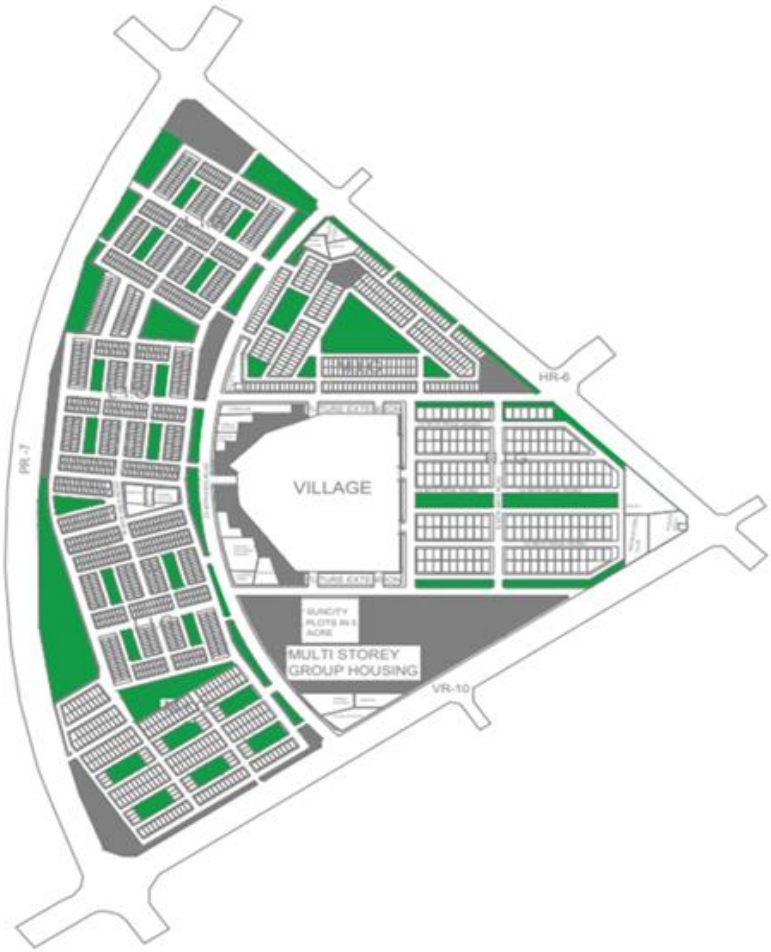
S.No	Category	No. of Parks	Area In Sqm
1	Community Park (CP) (10,000-50,000 sqm)	2	31505
2	Neighborhood Park (NP) (5000-10,000sqm)	5	27500
3	Housing Area Park (HAP) Less then 5000Sqm	42	50995



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CONCLUSION & RECOMMENDATIONS

S. No	Potential Challenge	Policy Proposal
1	Degradation of urban green spaces due to overuse	Providing local urban green space close to people's homes to distribute the demand pressure Restricting planning to functions that match the size and capacity of the urban green space Ensuring adequate and frequent maintenance and cleaning
2	Community dissatisfaction with urban green space features/ services	Early community engagement Involving local residents in design and construction Clarifying at an early stage that urban green space interventions need time to deliver their full benefits.
3	Uncertain or reduced budgets for maintenance of urban green spaces	Ensuring a low-maintenance design Looking at innovative models of funding (such as community ownership models like land trusts, foundations or cooperatives) Ensuring local political support early on working with community groups, nongovernmental and other organizations to support maintenance
4	Community engagement	Organizing competition for best gardens at residential levels Organising dedicated festivals- like Rose Festival to promote open spaces

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