

GIS As A Tool For Sustainable Development Of Model Green City In India

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1 INTRODUCTION:

A sustainable development of a city is one which is self reliant and healthy which is not overcrowded to jeopardise living space. The broad regulatory and incentive structure needed to support the achievement of development goal, within a framework which promotes local and global sustainability, is relatively easy to conceive under two broad heading:

- I. Ecological sustainability
- II. Economic viability

The poverty suffered by the minority of urban dwellers in rich nation and the majority of the poorer nation can be drastically reduced without a large expansion in resource use the social and ecological cost of providing safe and sufficient water supplies, provision for sanitation, garbage removal, energy use and health care and ensuring safe, secure shelter are stated the quality of life of wealthy and unusual healthy environment. At the same time there is need to minimise the call on local and global environment capital demand a competence and capacity to act by city itself. Out of the most important policy issues in implementing sustainable development is building the institutional framework within each city, district and region at local level. The capacity of local govt to plan and manage the area under their jurisdiction, to promote more sustainable pattern of resource use and urban forms to invest is needed infrastructure and service to enhance the locality attraction for more productive investment which guided by the needs and priority of the citizen for both development and sustainability. And, overall, local govt cannot take on the role without a strong financial base, the support of national govt and an appropriate legislation, regulatory and incentive structure. But to make effective policies, plans and implementation procedures must be designed and implemented. This in turn requires accurate spatial information. Remote Sensing and Land Information System (LIS) Geographical Information Systems (GIS) are effective instruments for data capture, processing and communication within urban planning and management processes.

2 NEED OF STUDY:

Cities in all parts of the world face mounting challenges such as population shifts, inadequate or aging infrastructure, sprawl, the spread of informal settlements, traffic congestion, water shortages and air pollution,. Metropolitan cities grow beyond imaginable proportions, particularly in the developing world. Urban issues therefore warrant – and receive – increasing attention. Thus, the ever increasing, urbanization process accelerates as a name of Primate City escalating the socio-economic demands, which altering the biophysical environment of the city.

According to the 1995 UN Census these are six largest cities on the planet are Tokyo, Mexico, Sao Paulo, New York, Bombay & Delhi. The National Capital of India, Delhi, is a city where indisputable economic progress related to urbanisation is accompanied by



tremendous environmental concerns, congestion, poverty, and housing shortages. Delhi's population increases and reach to 13.5 million. To make city viable to future growth it was suggested for a planned decentralization to outer areas named as National Capital Region. Gurgaon is one of 22 "satellite" town in this region, today turned over a new leaf, joining important position on the industrialmap of India and now Gurgaon is challenged by a very fast growth rate and it is one of the most prestigious industrial townships in India and is home to major icons in information technology. Its close proximity 25 km to Delhi will make it an ideal showcase for the whole of India.

Agenda 21, adopted by the United Nations Conference on Environment and Development on 14 June 1992 in Rio de Janeiro, is the international community's response to the United Nations General Assembly's call for halting and reversing the effects of environmental degradation. It is a comprehensive programme of action to be implemented by Governments, development agencies, organizations of the United Nations System, and independent groups in every area where human activity affects the environment. As one of the signatories of the resolutions regarding Agenda 21, India is committed to the implementation of Agenda 21.

Accordingly, India is considering applying the Green City concept to Gurgaon City as "Model for Sustainable Urban Management" by incorporating environmentally sustainable solutions with respect to:

- I. Water Supply And Waste Water Treatment;
- II. Energy Supply, Energy Savings And Renewable Energy Development;
- III. Waste Management, Soil Pollution And Air Pollution;
- IV. Cleaner Industrial Technologies And Environmental Management;
- V. Agriculture And Food Industries;
- VI. Building Construction And Urban Ecology Management;
- VII. Urban Traffic And Transportation.

Main objective is to achieve lasting harmony between man and nature and to protect the interests of future generations. An integrated medium to long-term planning and implementation strategy, close public-private participation, public awareness and responsibility constitute. A basic approach is to a holistic solution to urban environmental concerns.

3 AIM OF STUDY:

This paper aims to integrate above aspects of Model Green City by using GIS. The essential links are coordinate data of buildings and personal identification codes. A geographic information system (GIS) is allowing resource agencies, scientists, and watershed groups to compile and analyze information at multiple temporal and spatial scales. It helps to make identification and description the limiting factors, synthesize data for use in developing and implementing plan, identify data needs, analyze and prioritize data to support plan, for inventory, update and evaluate programs and activities related to **SMART Cities**

4 EVOLUTION:

Gurgaon, with a standard urban area at about 50 square km. and a resident population of about 230,000 (1997 figures), the floating population is 10,000 per day. Average annual population growth is 18-20%. The district headquarter is situated in Gurgaon city. Now Gurgaon has become one of the most important corporate and industrial hubs of state Haryana in India. Gurgaon also known as 'Guru Gram' or 'Guru Gaon' (village of the spiritual teacher) was named after Dronacharya, a character in the Epic Mahabharata. It is said that Guru Dronacharya of the Pandavas and the Kauravas gave spiritual instructions to them at this place. The office and manufacturing plant of India's largest car maker Maruti Udyog Limited is situated here as are a large number other industries. Another area in which Gurgaon is excelling is the IT industry and software development. Real estate is booming here with new buildings coming up at an astronomical pace. Now this city is chosen for a showcase for sustainable urban development as a model for other Indian.

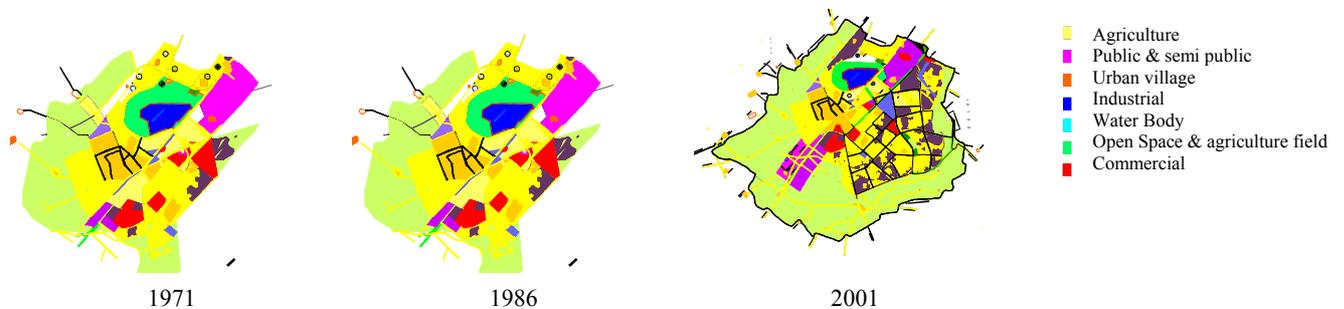
Gurgaon city is located at 28°53' N latitude and 75° 35' E longitude and is situated at a distance of 25 kms south-west of Delhi, the national Capital and 285 km from state headquarters of Chandigarh. It lies at 229 meters above mean sea level and forms a part of the National Capital Region. Gurgaon district is an area of confluence of aravalli hills, Indo-Gangetic plains and Indian desert, Gurgaon urban area can be broadly classified under two district sections namely the HUDA(Haryana Urban development Authority) area and the old town (municipal area limit). The area under HUDA can be further subdivided into (i) private coloniser area, (ii) Huda sector (iii) Institutional area and (iv) the urban villages. The current estimated population of Gurgaon including the urban area, the existing town, and the 17 village surrounded by urban development is 400,000 (HUDA 2001). The projected total population of the urban area for the year 2011 is around 1.6 million.



The Gurgaon city has been the head quarters of Gurgaon district, the southern most district of Haryana since 1816, and has exhibited steady growth after the partition. Spread over an area of 15.33 sq km the Gurgaon town had a population of 1,73,542 and the Gurgaon urban area had a population of 2, 29,243 spreading over an area of 30.2 sq km according to 2001 census. The population density shows that Gurgaon city and urban area are densely populated as compared to the Gurgaon district. The most important factor for this is its close proximity to Delhi. Rewari railway line on the south-western outskirts of Delhi. National Highway No. 8 passes through its main core of city. This Gurgaon originated as a village called Guru gram. Since that time it has been under control of various rukes who come to rule from Delhi like Maurya, Tomar, Chauhan and Mughals. The Gurgaon district passed into British

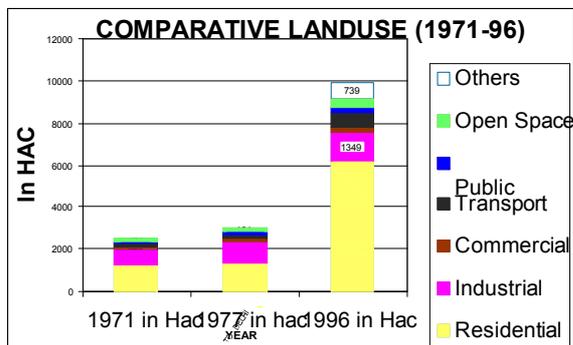
hands in 1803 and revealed in 1851. In 1966 Haryana took birth and it was designated as district and has been Tehsil and district headquarter. The first development pro was in 1971, 77 and further 82 and NCR in 1989 assigned as important hub for development. In 1981 haryana model has been evolved as Public-private partnership and it was boost up as Electronic City. But it was boost up where Maruti udyog has been set up in 1984 and in 1997 been develop Corporate park. It becomes recognise as class I town in 1991. The city has developed into 4 phases:

- I. 1968-71:
- II. 1975-78:
- III. 1985-95
- IV. 1995-present



5 EXISTING ENVIRONMENTAL STATUS:

The urbanisable area is divided into 57 sectors under various land uses. The extent of land use is given below: Haryana urban development Authority has so far acquired and developed most modern lines with a network of wide sector roads. In residential sector minimum 45% of area under a particular sector is kept for parks, open spaces, roads and community building including community centres, dispensaries, schools, cresses, police post, post office, electric sub station, etc. As per the norms adopted by HUDA. Even higher order facilities provided for every estimated population of one lac persons include provision of colleges, hospitals, police stations, telephone exchange, fire stations. To meet the Commercial needs of the town, a City-Centre in Sector No.



29 covering 480 acres of land has been acquired and planned to provide for facilities like World trade Centre, Finance District, Commercial Office towers, departmental stores, Cinema house, hotels, fire station, leisure valley, amusement park, etc. Three other District Centres in sector 23A, 56 and 47, to serve a clusters of adjoining sector have also been planned besides the local convenient shopping centres in each residential sector. Three sectors viz. Sector 18(part), Sector 32 and 44 have exclusively been planned for institutional land use which include Corporate Offices, Training, research and development Institutions like

Pepsi, Coca Cola British Telecom, Flour Daniel, GE Capital, CI Dunpont, Global business park etc. It has excellent location for future growth, too.

More than 80 % population are literate. The economic characteristics of an area play a determining role in the overall development of the region. In Gurgaon, the maximum share of population is in tertiary sector (72.6%) followed by secondary (25.7%) and primary sector (1.7%). The functional classification of Gurgaon can be designed as service town.

The urban services provided under the master infrastructural plan by HUDA encompasses the urbanizable area of Gurgaon (covering a part of the town area also). These include the following services:

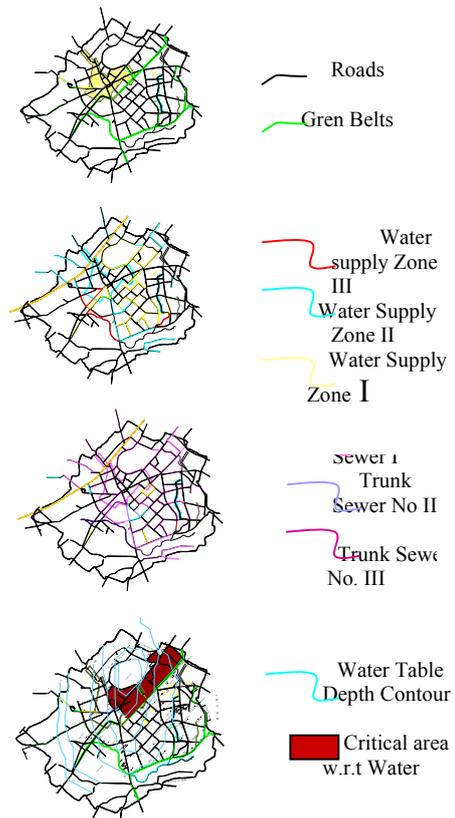
- I. Drinking water Supply: total capacity is 12.5 lacs gallons which have been installed to serve across national Highway include sectors of 29, 30, 41, 27, 28, 25, 18, 19, 20, 24, 26, 26a, 42, 43, 53, 54 & 55, 56. (fig 3)
- II. Sewerage System: As per topography of Gurgaon, the sewerage system has been divided into four zones. The slope of the urban area is toward the western side and the Najafgarh drain is available at a distance of 6 Kms from Gurgaon. The sewerage of the entire area will be collected near sector 4, near Delhi-Rewari railway Line and be treated by the Sewerage Treatment Plant. Total capacity is 68 MLD, constructed under the Yamuna Action plan is functional. (Fig 3)
- III. Storm water Drainage: It is situated at the tail of the Aravalli hills has a natural gradient from the northeast direction to southwest direction. Previously the storm water from the Aravalli hills and from the catchment area of Gurgaon flowed through the natural creeks and surface drains existing in the area with ultimate disposal to the Najafgarh drain. Due to urbanisation, the storm drains for drainage has been channelised into seven zones.
- IV. Street Lighting: Gurgaon has total network of master roads i.e. V2 roads (60 meter R.O.W) and V3 roads (30 meter R.O.W) of 151.05 kms, of which the existing PWD (B&R) roads is 41.80 kms. The street lighting network is about 151.05 kms i.e. V2 roads is 40.48 Kms and V3 roads is 110.57 Kms of which the existing PWD, B&R roads forms part of master roads is 41.80 Kms.

- V. Horticulture and Arbosculture: Master Horticulture provides planting of trees along the roadsides, green belt and in open space besides development of green belt along National highway-8 and along roads 60 meter and 30 meter wide. Development of liesure valley on 29 sector is also used for this plan. Under this head road side plantation, provision of M.S. tree guards, plantation of shrubs, development of green Belts and thick plantation in green belts are also proposed.
- VI. Community Building- External & internal: Gurgaon town has 35583 residential building and 8127 shops/ institutional building as per the Municipal survey of 1999. There are 341 industries, 42 big marketts, 11 small markets 10 hotels & 134 big and small restaurant in Gurgaon Town and 42 hospital including nursing homes/dispenseries and 71 schools/ colleges in UA. Total status of infrastructure of this are are as follows

6 CRITICAL ISSUES:

The urban- environmental issues in Gurgaon if not addressed and managed today, the stress on infrastructural provision will be reflected by the year 2010 AD when the construction of houses and colonies will be at their completion stage. The plethora of plans and policies, for sustainable urban development process in Gurgaon has assumed prime importance. Though, the few issues that still require urgent attention includes:

- I. Solid waste disposal sites and cremation grounds
- II. Need to shift from the traditional approach of planning to to more participatory and realistic planning. For that there is need full information to people.
- III. Villages within the Urban Area tend to become repository of the poor and also acquire slum like character . The growth of informal sectors, unathorised colonies and urban villages along with the high rise private developers building have given rise to peculiar situation in Gurgaon. Hence all the areas need to be carefully planned and integrated within gambit of planning.
- IV. A large proportion of the Gurgaon's population is still using water and as a result the ground water is becoming brackish due to over exploitation. The dramatic ground water lowering in Gurgaon poses a serious threat in future, with the depth of water lowering upto 40 meters in the central area and 30 meters in the adjoining areas.
- V. Gurgaon poses an attractive land market for the investors/developers wherein a large proportion of the flats which are being built by the developers are kept vacant and speculation on the land considered.
- VI. Having one main single connectivity from south Delhi to Gurgaon (Mehrauli-Gurgaon) the 21- Km Delhi Gurgaon stretch handles over 1.9 lakh passenger car units daily against its capacity of 40 PCUs. There is need to introduce intra city transportation system and strengthen inter city transport system is of critical importance in Gurgaon.
- VII. The inclusion of low energy building and newer techniques to conserve energy must be incorporated in the plan from initial stage itself.



The resource potentials and carrying capacity of the region to be assessed and incorporated in the plan, whereby giving the details of the existing situation and future projections. To carry out carrying capacity in order to assess the extent to which development activity could proceed without endangering the environment. Basically carrying capacity refers how much land can carry in term of human and animal population by supplying the basic needs like water, land, food and fodder. The carrying capacity has two aspects:

- Supply side of environment; life supporting system
- Demand site.

To carry out this analysis here to work out through use of GIS tool to assess the gap between demand and supply as sector wise. Each parameters of Green city concept are taken for assessing the carrying capacity of area in terms of:

- I. **water supply and waste water treatment** can be done by using recycle of water use and water harvesting method:

A Recycling of Waste Water:

Total sewage generation: 10.2 Mld

50% can be recycle= 5.2 Mld

out of that it would waste water i.e 80% 1 mld

if again it will recycle 2.5 mld.

Total Fresh water demand 5.19 mld

From recycle of water 2.15

Remainn gap= 3.14 Mld

B Rain water Harvesting:

- a) Total run off Residential Housing=0.2 mld
- b) Total run off Public & semi public area=0.01 mld
- c) Total run off paved area 0.0035 mld
- d) Total run off greenn are 0.5 mld
- e) Total run off =0.7135mld
- f) Remaining gap=3.14 - 0.7135=2.416 mld

So, there is need for reduce of use by using ultra modern toilet facility and new plumbing design .

II. energy supply, energy savings and renewable energy development:

III. waste management, soil pollution and air pollution;

- a) Total population:5000000
- b) 1% floating population: 50000
- c) For floating population solid waste generation:250gm /day=12500kg/day or1.25 tonnes
- d) For residential 0.3 to 0.6kg=250 tonnes
- e) For commercial =100 tonnes
- f) For street sweeping=50 tonnes
- g) For institutional =50 tonnes
- h) For industrial=50 tonnes total solid waste=450 tonnes
- i) Existing area for land fill site 4.2 hac
- j) So, need for segregation of biodegradable waste and collect from door to door.

IV. **cleaner industrial technologies and environmental management:** The most important objective of the waste management policy is to reduce waste amounts, and prevention has top priority by recognized waste hierarchy system:

- Cleaner technology - initiatives to prevent waste generation and maximum recycling and reuse.
- Incineration – waste is incinerated when it cannot be recycled and when residues from incineration do not cause environmental problems. Energy is recovered for generation of electricity and heat.
- Landfill disposal.

For these three hierarchal set up these following issues are taken into consideration

- Waste management system – optimal operation of collection, transportation, treatment, and final disposal.
- Waste administration, organization, and economic instruments.
- Reuse – recycling, energy recovery, etc.
- Environmental communication.
- Sustainable landfills.
- Capacity building – legislative and administrative capacity as to planning, monitoring, and control.
- Training and education.

IV. agriculture and food industries:Food industry and beverages help to sustain villages and regional area to self sustain

V. building construction and urban ecology management: Energy efficient buildings are inograted over this are to take way of sustainble developmennt:

Basic energy sources in an eco-friendly building complex

Sky	Sun	Air	Water	Earth
-day lighting - heat sink	-heating - electricity generation - day lighting - greenhouse effect - solar chimneys	-ventilation - heat sink	-roof gardens - earth berms for insulation	-roof ponds - fountains for humidification - rainwater harvesting

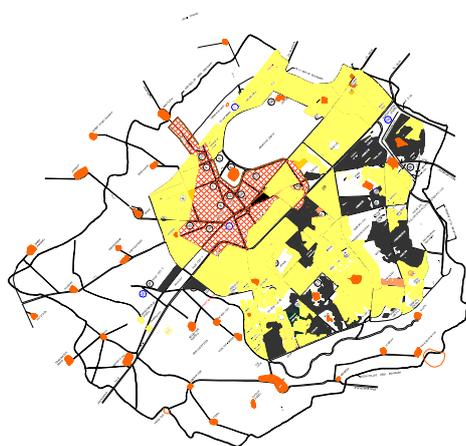
The first stage of green building design is to incorporate solar passive design interventions and try to reduce the loads on conventional systems. Energy conservation is possible by judicious design of lighting and HVAC (heating, ventilation and air conditioning) systems, controls and operation strategies.

VI. urban traffic and transportation. Intra sector transportation is needed and as well as restriction of car movement of internal road and pedestrianisation can be done and cycle path is beneficiaries.

Hence the comprehensive profile of this area by identifying the major issues provides imperatives for devising planning inputs in formulation of concrete plan for this region. The accessibility of physical and social infrastructure of this area is mismatch in developmental process. Some area is having more and some are having less. As well as total quantum of facility are also inadequate.

FACILITY	SECTOR						SUPER SECTOR				DISTRICT MODEL				CITY	AREA PER UNIT
	STANDARD 31		32		40		STANDARD 32		40		Existing		Proposed			
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed		
EDUCATION FACILITY																
Pre primary school	4														0.08 HAC	
Primary School	3	3	2			3	1								0.20 HAC	
Senior Secondary School		1		3		1	2								1.60 HAC	
Integrated School								1		1					3.50 HAC	
College								1		1					4HAC	
University														1	10 HAC	
Technical Education Centre															4HAC	
HEALTH CARE FACILITY																
Intermediate Hospital								1							2.70HAC	
General Hospital								1					1		4HAC	
Poly Clinic								1	1						0.30 HAC	
Nursery Home	2	1				1			1						0.30 HAC	
Dispensary		1				1									0.20 HAC	
SOCIO CULTURAL FACILITY																
Community Park	4														0.06 HAC	
Library	1														0.2 HAC	
Recreational Club								1							1.0 HAC	
Music, Dance, Drama														1	1 HAC	
Socio Cultural Centre													1		0.15 HAC	
Distribution services																
Petrol Pump																
Milk Booth	4															
LPG Godown		1						1								
Police Station		1						1							1.5 HAC	
Police Post	31	1													0.16 HAC	
Jail														1	1 HAC	
Fire Station													1			
COMMERCIAL CENTRE																
Formal Shop	55							365							0.03HAC	
General retail	35							295							0.05 HAC	
Fruits & Vegetable	6							40							0.08 HAC	
Service & Repair	13							30								
RECREATIONAL FACILITY																
Local Park & Play Ground																
Community Park																
District Level Park																

Due to unavailability of infrastructure some of sectors are lacking to pace of development. Some are developed i.e. which are under private coloniser and as well as land value is also high, some are lacking behind to grab the opportunity due to several constraints. To



Status Of Development

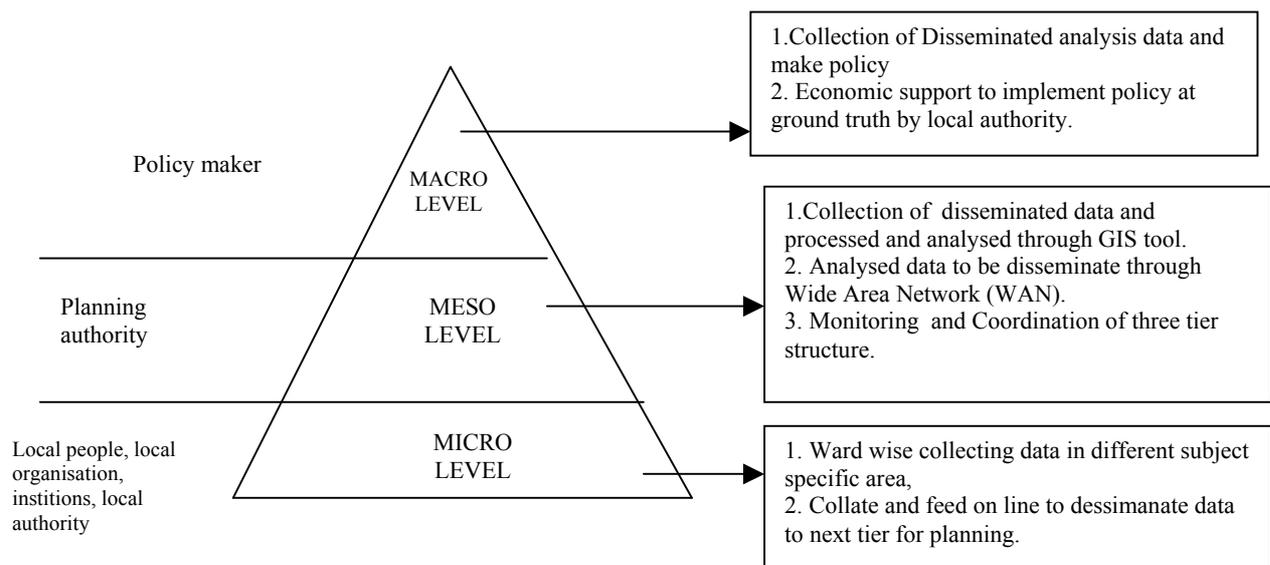
- Most developed
- Developed
- Less Developed
- Slum & Urban Village
- Others

overcome the situation there is need Participatory technique to maintain the information by local people and plan accordingly. Because Environmental Information is a source, which together with Physical, economical, technical and human resource is essential for national development. Sustainable development, which has evolved as the goal for human welfare in recent times, is rooted in the

availability of right information to the right person at the right place and at th right time. The need for information arises at all levels, neighbourhood/ community level to Local ward office level or municipal authority level to higher policy makrer. This dessimaniation information is uploaded on-line in particular programme and after collecting this information policy has to be prepared and implementation can be drwan for future Ecological Sustainable and Economic Viable city.

7 SUGESION:

In order to make Gurgaon into a green city, the action plans have been formulated database development through collecting data by local people, local organisation, institions, local authority (government and non government) can feed data according to sujet head of Green City (Parameter) on internet line. After collecting data, data can be processed second level planning authority and can be analysed through GIS tool and has been provided with internet facility. At Focal point policy has been made and disseminate again in



internet and plan has to work out at local level planning. This process is basically to collect, collate processed, analysed dissemination of information by electronic mediaby using GIS Tool in planning measures. To work out the programme every sector can be used as area for implentation. This