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Compact Development as Land Use Planning Tool for Urban Disaster Management

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1 ABSTRACT

Cities are dynamic and complex in nature and have interdependent systems that are vulnerable to urban hazards and natural hazard risks (Godschalk, 2003). At one hand cities are hubs of intense resources, technological development and they offer solution to various global issues like technology for low carbon development; use of renewable resources; energy efficiency developments; green buildings and mitigation strategies at large for sustainable human development. On the other hand, cities are sources of environmental degradations and green house gas emissions. The urban areas of cities of developing countries are characterised by low density urban sprawl, fragile infrastructure, low resilience and poor coping capability of people. Thus people and development are vulnerable to disasters and climate change which wipe off years of development causing death and injury.

The need for urban disaster management emphasises on identifying and reducing risks and vulnerabilities, along with tapping potential opportunities for low-carbon urban development. Sustainability and resilience are interdependent and can be promoted through a combination of strategies such as integrated urban planning, high density compact planning, mixed land uses; identifying synergies between disaster risk reduction and adaptation; improving urban service quality and promoting green buildings and sustainable transport [1]. There is a need of paradigm shift in traditional urban planning concepts to high density compact planning, which proves to be successful emerging model for development.

In high density Compact City model, the smaller, high density cities reduce the spatial extension of cities; create places where people can live closer to work, rely less on environmentally damaging methods of transportation, and reduce the collective carbon footprint. As compared to previous planning models, the compact city model does not limit the population of a certain area; it is by default a high-density development. Nor does it persist in defining and segregating zones of activities. The limited availability of land calls for a mixed-use approach with a mixed of commercial, residential, institutional and recreational facilities.

This paper tries to explore the role of compact city development in urban disaster management and its implications in future. The paper also tries to identify the relationship of sustainable development strategies, and disaster resilience for safe future cities. Here it aims to identify the problems associated with this concept in the present context of the cities.

2 INTRODUCTION

Cities are life lines of society and are centres of technological development (UNISDR, UNHABITAT, 2011) which have the capacity to deal any kind of problem whether environmental, social or economical due to advancement of science and technology, with the concentration of human resource and political activities. It is due to these advantages it invites urbanisation which when uncontrolled poses inumerable challenges in cities and even more due to incapability of the city administrators to cope up with the pace of urbanisation. Cities have become highly vulnerable to live with poor housing, almost no infrastructure in poverty ridden areas; are sources of green house gas emissions and are impacted by more severe and frequent attack of disasters and climate change. Although with this advent devastation world administrators have realised the importance of disaster management and many national and international efforts have been taken in the context.

It is not only the mitigation strategies that are important, but the integrated approach of landuse planning that would be most effective and implementable. In this light presumably strengthening building byelaws and

[1] TERI Team (Ghate A. et al. 2010). "Climate Resilient and Sustainable Urban Development."

codes is one of the key measures of urban disaster mitigation being focused. But recent earthquake and tsunami in Japan (which has well-enforced building codes are crucial tools for mitigating disaster risk though saved many lives by reducing the death toll) gave an important lesson that we cannot "build away" all disaster risk through building codes and other structural solutions alone inspite of its best enforcement practice(Sun, 2011). Even when life can be preserved, the cost of property and other economic damages can be staggering. It is thus "the location" that is key factor in determining a community's natural hazard vulnerability. Thus the "smart growth" integrated with the disaster mitigation and climate change strategies, can result in stronger livable and highly resistant communities, with a breathable environmental has been foced in next two sections of the paper. It is important to identify the challenges while adopting smart growth especially with respect to disaster management has been discussed in the last section. This discussion gives light to the way forward in this direction.

3 CITIES ARE DYNAMIC MODELS

"The 19th century was a century of empires, the 20th century of nation states, the 21st century will be a century of cities."

Wellington E. Webb, Former mayor of Denver, Colorado

3.1 Cities as Efficient Models

Cities are intense resource centres with technological advancements and high development. They are economy generators as about 600 urban centers generate about 60 percent of global gross domestic product (GDP). By 2025, 136 new cities are expected to enter the top 600, all of them from the developing world .[2] GDP is an important indicator of development and it becomes even more when we talk about sustainable development. Strong economy of an area is an absolute contributer in making any development initiatives sucessful and in achieving sustainable disaster resistant cities.

Cities generally have complex interconnected urban functions such as sanitation, utilities, land usage, housing, and transportation, building, energy etc. which provide opportunities for improvements in the urban environment through institutional factors that include urban planning, governance, land management, legislation and financing, thus contribute in economic, social development of the region. It is because increased density and better management that reduce the cost of service delivery, promote innovation, and enable prosperity through economic development. They are centres of major political and social changes in a country [3].And play active role in global dialogues and have unique ability to respond to a global issue, such as climate change/disaster management.

They offer dynamism to deal with Environmental factors and phenomenon such as climate change, risks and hazards, quality of air, land and water etc. in terms of scale, stronger linkages, and a greater sense of urgency among residents and their local leaders (World Bank, UN 2010). Co-benefits of urban disaster management and mitigation are largest in cities(World Bank, 2010). It is these benefits of development that urban centres attract population, and are subjected to high vulnerabilities which is discussed in the next section.

3.2 Vulnerability of Cities

As cities are concentrations of resources, technology, population, they are vulnerable to greater extent. Cities of developing countries are characterised by low density urban sprawl, fragile infrastructure, low resilience and poor coping capability of people which is a resulut of uncontrolled urbanisation. By 2030 nearly 60 percent of the global population is projected to be urban with the developing world housing nearly 80 % of this population (TERI, 2010). The 20 largest cities consume 80 % of the world's energy and urban areas generate 80 % of greenhouse gas emissions worldwide(Ewing, et al. 2007.) [4].

Corelationship of urbanisation and increasing hazards: Urbanisation is thus contributing significantly to climate change and poor disaster management along with urban poverty. Urban poverty increase

[2] Dobbs R., et. Al, 2010, "Urban world: Mapping the economic power of cities"
[3] F. C. (2010). "Rapid Urbanization and Mega Cities: The Need for Spatial Information Management." ISBN 978-87-90907-78-5, the International Federation of Surveyors (FIG), Copenhagen, Denmark
[4] Reid Ewing, K. B., Steve Winkelman, Jerr y Walters, Don Chen. "Growing Cooler: The Evidence on Urban Development and Climate change." Urban Land Institute

vulnerability and fragility of socioeconomic systems resulting in extensive setbacks to development. The total poverty in India, has doubled from 15 % in the early 1960s to nearly 30 % in 2004 [5] . Majority of the urban poors are usually built on hazardous sites in high-risk locations, or located in low-lying areas prone to direct and indirect risks due to environmental degradation such as regular floods, landslides occurrences, together with lack access to basic urban services and un-regulated and unsafe construction .[6] These people cannot afford insurance, savings or asset accumulation, and their socio economic vulnerability is immense (TERI 2010). As the goverments in urban centres are unable to keep pace with urbanisation coupled with low political will power, the cities have become even worse physicaly, socially and environmentally. Administrations in large cities are often confronted with a multitude of key problems, like poor governance, high unplanned urban densities, traffic congestion, energy inadequacy, unplanned development and lack of basic services. This leads to illegal construction within the city and in its periphery, informal real estate markets, proliferation of slums, poor natural hazards management in overpopulated areas climate change and, environmental degradation.

Corelationship of climate change and disasters: About 75 per cent of the world's major natural catastrophes between 1970 and 1997 occurred in the Asia and the Pacific region, mostly in poverty-ridden developing countries (UNESCAP and ADB 2000).There has been a general upward trend in the number of natural disasters due to hydrometeorological as seen from Figure 1. Increase in no and frequency of disasters during past 4 decades is mainly due to climate change which is an impact of global warming due to increase in CO_2 emissions in the atmospheres. To mitigate as a long term strategy we need to use low carbon development strategies. This is greatly possible with the advent of technology and smart growth principles. (CRED-OFDA 2002)

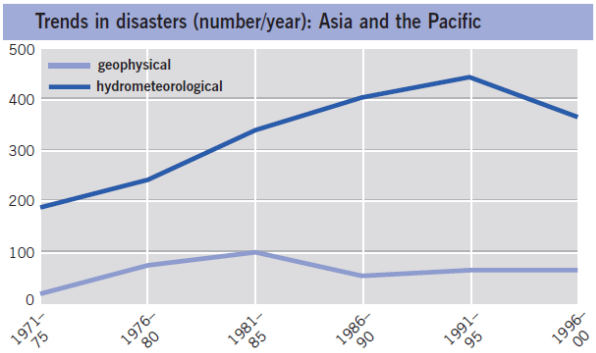

Figure 1: Increasing trends of hydrometerological Disasters in Asia and Pacific [7]

Corelationship of vulnerability and land degradation: These vulnerabilities are increased manyfold as cities often expand or grow in ways that may degrade natural buffer systems. People construct impermeable land surfaces that prevent percolation of water into the soil (Moser, 2008).The poor spatial arrangement of population and assets create risks to urban systems, to populations and to the nature and probability of hazard occurance. Constraints on the availability of land as a resource in urban areas often results in proliferation of slums and informal settlements. The combination of factors- such as faulty land use and planning, low density urban sprawl, rapid urbanisation, migration from rural areas, lack of integrated land use and transport planning that enables mass transit and efficient clustering of settlements and industries; result in unsustainable development. Sustainable development cannot be an expansive development in present context; it needs to be comprehensive (compact with smart growth principles) considering the changing environment (which triggers the disaster) and changing societal needs in terms of development. It is thus important to the impact of present development on degrading environment, which is becoming a major concern in terms or disasters and climate change.

[5] Prabhakar, S.V.R.K., A. Srinivasan, and R. Shaw. 2009. Climate change and local level disaster risk reduction planning: need, opportunities and challenges. Mitigation and Adaptation Strategies for Global Change, 14:7-33

[6] Moser, C. and D. Satterthwaite (2008). "Towards pro-poor adaptation to climate change in the urban centres of low- and middle-income countries." SOCIAL DIMENSIONS OF CLIMATE CHANGE: 231

[7] (S. Of and T. H. E. Environment, "Global overview," Direct, pp. 1972-2002, 2002.)

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4 DEVELOPMENT AND URBAN DISASTER MANAGEMENT

There is an indirect relationship between urban growth pattern and disaster occurrence (Dickson et al. 2010). Disaster is a function of risk and results from the complex interplay between developmental policies, existing vulnerability, population and areas exposed; hazard events, as well as climate change (World Bank, 2010). It has been observed that Africa and Asia, which have the highest rates of urban growth globally, are also experiencing the fastest rate of increase in the incidence of natural and human-made disasters over the last three decades (UN-Habitat, 2007).

4.1 Impact of disasters on development:

Natural hazards and emergency management are major issues in most cities. They have caused major losses of human lives and livelihoods, destruction of economic and social infrastructure, as well as environmental damages. In addition to the projected estimation of 100,000 lives lost each year due to natural hazards, the global cost of natural disasters is anticipated to top $300 billion annually by the year 2050. (UNISDR, WSSD, 2002). Not only this, disasters exacerbate poverty, damage infrastructure and critical facilities, disrupt business, disable lifelines vital for economic activity and service delivery. They halt or slow progress towards the achievement of the Millennium Development Goals (MDGs) [8] (Scott 2009). They delay development programs by reducing available assets and utilizing the financial resources allotted for development being used for rehabilitation and post disaster recovery. Disasters have negative impacts on environment as they affect natural resources. Changes in climate risk in particular imply that urban areas may face hazards in the future which are outside their past experience.

While no country in the world is entirely safe, lack of capacity to limit the impact of hazards remains a major burden for developing countries. An estimated 97 % of natural disaster related deaths each year occur in developing countries. Vulnerability to disasters is closely linked with population density and economic resources. The highest number of deaths occurred in South Asia (the sub-region with the highest population density and the lowest per capita income) (UNPD 2001, World Bank 2001). Given these trends, without major changes in the management of disaster risks and of urbanization processes risk to city residents will increase in the future as populations grow (World Bank 2010).

4.2 Urban Disaster Management:

Disasters can result from the way development occurs, and conversely can change the way development takes place (World Bank, 2010). The three components of disaster risk - hazards, exposure, and vulnerability are increasing in urban areas. (World Bank 2010). The disaster management needs to (1) assess disaster risks-by risk assessments and vulnerability mapping, (2)mitigate through urban planning – by mainstreaming Disaster Risk Reduction (DRR) into planning through risk sensitive landuse planning and (3) build resilience and coping capacity to combat disasters. Land use and urban development practices need to take into account susceptibility to natural hazards. The investments in new city infrastructure offer a tremendous opportunity to build sustainable (smart and efficient) and resilient cities using less energy and water especially in developing and least developed countries. Smart choices in housing, energy and public transport could reap massive local and global benefits. the right choices will save water, energy and carbon, and improve health and quality of life(Prabhakar et al., 2009) Developing resilience by capacity building, adopting strong legislative, administrative measures, decreasing carbon emissions by stratifying planning measures, going for compact development, reducing travel time; tapping dense local knowledge and adapting local strategies are some measures which are needed to be taken up in an integrated manner with the planning principles (UNDP, 2002).

5 COMPACT DEVELOPMENT AS URBAN DISASTER MANAGEMENT TOOL

Compact Development can be used as a tool for development and urban disaster management; because it specifically directs land use (directs the location and concentration of socioeconomic activities (TERI 2010) and transportation systems. Planning can reduce population vulnerability by facilitating improved access to resources, services and amenities. The urban planning approach needs to bridge the gap between urban

[8] Millennium Development Goals (MDGs) are eight goals to be achieved by 2015 that responds to the world's main development challenges. These are drawn from the targets and actions contained in the Millennium Declarations in the UN Millennium Summit in September 2000

disaster mitigation, sustainable human development and climate change. As stated earlier the new development should not increase the vulnerability to disasters, there is a need for smart principles of development.

5.1 Concept of Compact Development towards Urban Risk Reduction

The term "compact development" implies higher average "blended" densities and features a mix of land uses, development of strong population and employment centers, interconnection of streets, and the design of structures and spaces at a human scale (Ewing et al. 2007). Compact development planning help people live within walkable distances to work, shops, home, education recreation, parks and transit points. The street network can be designed to interconnect, rather than end in culs-de-sac. Finally, by building more homes, offices, stores and other destinations "up" rather than "out," communities can shorten distances between destinations. This makes neighbourhood more economically viable, allows more frequent and convenient transit service, and helps shorten vehicular trips. Compact development is a part of Smart growth.

The 10 Smart Growth Principles that have been identified by researchers and practioners are- mix land use development , take advantage of compact building design, create a range of housing opportunities and choices , create walkable neighbourhoods, foster distinctive, attractive communities with a strong sense of place, preserve open space, farmland, natural beauty, and critical environmental areas, strengthen and direct development towards existing communities, provide a variety of transportation choices, make development decisions predictable, fair, and cost effective, encourage community and stakeholder collaboration in development decisions.(emerine, et al. 2006). Based on these principles the smart growth development, helps to achieve sustainablility. It is first important to understand the benefits of "Smart Growth" (high density compact development) over Urban sprawl. When we analysez these with respect to their impact on disaster management, the influence is remarkable and has been further discussed.

5.2 Smart Growth versus Urban Sprawl

Smart growth policies are one which result in more compact, accessible development within existing urban areas. A comparitive table showing urban sprawl and compact development.

	Smart Growth	Sprawl
Density	Higher Density, Clustered Activities,	Low Density ,Dispersed Activities
Growth Pattern	Infill (brownfield) Development	Scattered , prepheiry (Greenfield) Development
Urban Form	Cluster development, High Density High rise Development	Sporadic Development, Leapfrog pattern, Commercial strip, Low Density plotted Development, Single Use Development
Land use mix	Mised landuse	Homogeneous(single use, segregated) Landuses
Scale	Human Scale, smaller buildings, blocks and roads, designed for pedestrians	Large scale, Large Blocks, Hierarchial roads, increased road areas, less details
Services(shops, Schools, parks)	Local,well distributed, smaller, easily accessible (withing walking distances)	Regional Consolidated, Stripped Development, Larger zones, requires automobile access
Transport	Multimodal transport and land- use patterns that support public transit, walking, and cycling	Automobile-oriented transport and land-use patterns, poorly suited to walking, cycling, and use of less public transit systems
Connectivity	Highly connected roads, sidewalks and paths.	Hierarchical road network with numerous dead-end streets, and unconnected paths and sidewalks
Street Design	Streets designed to accommodate a variety of activities.	Streets designed to maximize motor vehicle traffic volume and speed
Policy Formulation and Planning Process	Planned and coordinated between jurisdictions and stakeholders	Unplanned, with little coordination between jurisdictions and stakeholders
Public Places	Emphasis on the public realm (streets, sidewalks and public parks	Emphasis on the private realm (yards, shopping malls, gated communities, private clubs), sporadic public places, mostly unmaintained

Table 1: Comparison Showing Smart Growth Development and Urban Sprawl.(Ewing, 1996; Galster et al, 2001, Litman 2011)

When these are compared with respect to their impacts to disaster management (which needs comprehensive integrated planning approch), it is seen that the smart growth provides development of high density clustered activities, with strong resilient urban infrastructure (which will increase the coping capability when disasters strike), characterised by infill development, mixed landuses, local services accessible near the residential areas within pedestrian movement, multi nodal transportation which encourages walking, cycling and public transit which also prevents environmental dgradation, pollution. The connectivity of roads is simple and strongly linkes compared to hierarchical road network with numerous dead end streets; the former makes it possible to desig the evacuation routes during emergency management.

5.3 Reduction in green house gas emissions can affect intensity, magnitude and frequency of Disasters.

Disasters are impacted by climate change and urban growth pattern. Low density urban sprawl results in increase in the number and length of trips and rapid motorisation. This has resulted in dramatic rise in Green House Gas (GHG) emissions. The rate of motorisation inextricably links to urbanisation. Figure 2 shows that while urban population has increased by 50 % during 1990–2004, the number of Registered Motor Vehicles (RMVs) has risen by nearly 400 % in India.(Saxena 2008).

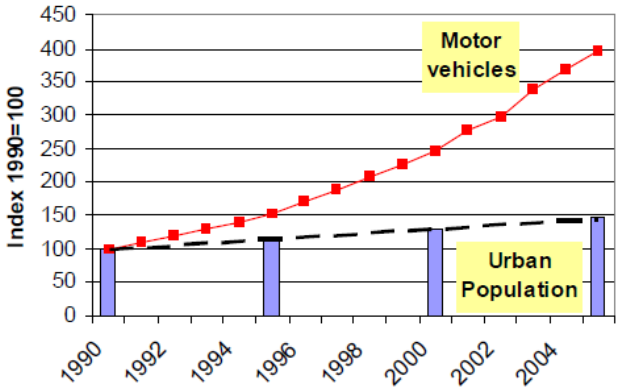

Fig. 2: Motorisation and urbanisation trends in India[9]

The transport sector is responsible for almost 25 % of global CO_2 emissions (IISD, 2004). Transport emissions are growing at approximately 2.1 % per year worldwide, and 3.5 % per year in developing countries (IEA, 2002).These impact climate change which inturn affects the frequency, magnitude and intensity of disasters especially hydro- meterological disasters like flooding, extreme temperature, high and intense rainfall etc.(Saxena, S. 2008). Growing Cooler, a study published in 2008 by the Urban Land Institute and EPA, examined the research on compact development, vehicle miles traveled, and carbon dioxide emissions to determine that more efficient development patterns could help reduce our impact on the climate. The study concluded that compact development can reduce vehicle miles traveled by 20 to 40 percent compared to conventional development patterns. Further, based on the amount of development by compact infill, the study estimated that compact development could reduce CO_2 emissions by 7 to 10 percent in 2050. As reduction in CO_2 emissions is a strategic need for urban disaster management, it can be achieved through policy measures and/or by comprehensive integrated development using smart growth principles, providing mixed landuses to reduce vehicle dependency.

5.4 Chanelling growth away from vulnerable locations

Disaster mitigation calls for channelling growth away from hazardous locations. Land scarcity enforces urban sprawl in vulnerable locations like; in floodplains, along the coast line, along the earthquake fault lines etc. As these lands are easily affordable, mostly urban poor locate themselves in such locations. Smart growth plays a role in mitigating disasters firstly compact development reduces the spatial extent, not reaching the hazardous locations, secondly by integrating vulnerability and risk maps with smart growth principles it channelizes the urban growth into safe zones within the city. Therefore it helps in creating greater resilience. A sucessful example of chanelling growth away from hazardous area, is Metro, the the Portland metropolitan area, which encourages towns to use seismic hazard maps when designating “urban reserve areas”—areas that will “eventually be brought inside the urban growth boundary” using smart

[9] http://epa.gov/dced/climatechange.htm

growth principles.(Sun, 2011). Thus integrating urban disaster management tools like risk mapping and microzonation produce technical information for the identification of hazardous areas, and serve in developing zoning regulations and establishing population density levels and also enable the managers to design mitigation action plans and support the smart growth concept. These can be very effective since they integrate socioeconomic factors and technical factors (housing, infrastructure, lifelines, and critical facilities).

5.5 "Urban resilience"- can be increased by using smart growth principles

Disaster mitigation can be achieved by making wise decisions for locationg new infrastructure and/alternatively by increasing the resilience of the existing infrastructure to incorporate the increasing demands. Compact development makes more efficient use of land and resources by reducing the environmental footprint of new contruction and preserving the open spaces(UNESCAP, UNISDR, 2010). By strengthening the existing urban infrastructure, will serve the dual purpose of catering the new development requirements , reduction in infrastructure costs and energy usage and second creating greater resilience. Smart growth acts as a boost up for other structural mitigation strategies in urban disaster management. It can benefit by inviting greater public investments, creates a stronger tax base; more employment opportunities; closer proximity to jobs and services; increased efficiency associated with using already developed land, reusing/repurposing existing buildings, and using existing infrastructure; and reduced development pressure on the edge. Several economic incentives and tax policy options may be used to direct business development toward existing communities (UNESCAP, UNISDR, 2010). Once redevelopment and infill development occurs, it intensifies calls for structural protections for urban hazard mitigation. This boosts up the economy of the region and increases its resilience and reduces socio economic vulnerability of people. This suggests that the largest potential gains in disaster mitigation can be achieved.

5.6 Reduction of impervious surface- mitigation strategy for water related disasters

Compact Development policies tend to reduce per capita impervious surface area (land covered by buildings or paved for roads and parking facilities). Benefits like better stormwater management and reduction in heat island effects can be achieved by increasing pervious surface. It leaves more land for other productive uses, like farming, it reduces the capital and operating costs of providing public infrastructure and services (such as roads, utility lines, garbage collection, emergency services and school transport). It improves overall accessibility , reduces transportation costs, including the per capita costs to consumers to own and operate vehicles, road and parking facility costs, traffic accidents, and pollution emissions. Therefore it reduces 'every day risks' in urban areas, which otherwise acts as catalysist in greater intensity risks of natural and man made hazards.

	Dispersed	Compact	Difference
Roadways	$17.6	$11.2	$6.4 (-36%)
Transit	$6.8	6.2	0.6 (-9%)
Water and Wastewater	$5.5	$2.5	$3.0 (-54)
Fire Stations	$0.5	$0.3	$0.2 (-46%)
Recreation Centers	$1.1	$0.9	$0.2 (-19%)
Schools	$3.0	$2.2	$0.8 (-27%)
Totals	$34.5	$23.3	$11.2 (-33%)

Public services infrastructure costs tend to be higher for more dispersed development.

Fig. 3: Public Services Capital Costs, Billions (IBI 2008): The City of Calgary Plan program compared the capital costs in providing infrastructure and public services [10]

The City of Calgary Plan-it program compared the costs of providing infrastructure and public services to more compact and dispersed development patterns as seen in Figure 3. The study found that the more compact land use saves about a third in capital and operating costs for roads, transit services, water and wastewater, emergency response, recreation services and schools.This not only indicates the economic savings but also the savings that would be achieved in terms of land usage(Litman 2004).

[10] Image source: T. Litman, "Understanding smart growth savings," vol. 9, p. 2007, 2004

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5.7 Efficient Emergency Response Management:

Compact Development improves emergency services response times as fire departments, emergency responders, and police stations are closer to the areas they serve and have more route options, easy accessibility and immediate response inability to respond to emergency calls (EPA, 2010). As the spatial extent of the city is less, the roads are shorter and wider and infrastructure are better designed, it is possible to plan the shorter evacuation routes during emergency management and the collape time of the structures (buildings) is also delayed which gives little more time to save lives. Strong infrastructure serves as a lifeline during emergency. Nevertheless there are some channenges while implemention and acceptance of this concept by people and administrators. These have been discussed in the next part.

5.8 Reduction in urban heat island effect

Microclimate of a place is greatly affected by the pattern of urban development, density of buildings(both horizontal and vertical), suface heat emissions from buildings and open spaces and carbon emissions due to human activities. One of the worst effects of urbanization is the urban heat island (UHI) effect, which develops when urban cooling rates are slower than rural ones. The compact development (high-density buildings) reduce the heat release back to space by blocking the view; dense development in urban areas, reduces wind speeds and inhibits cooling by convection as seen in Figure 4.

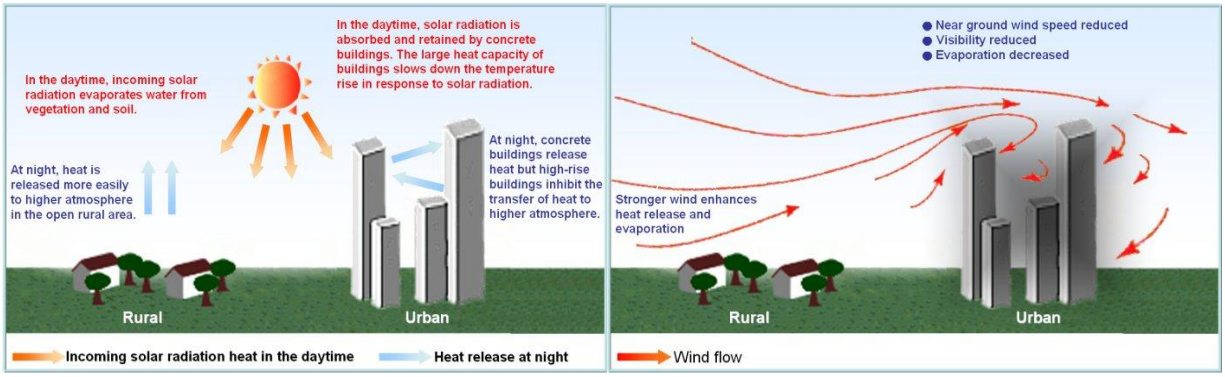

Figure 4. Urbanization effects on the heat energy balance and effects on the low level wind flow in the urban area.[11]

6 CHALLENGES

Compact Development is not popular with the managers and planners. Benefits of compact development cannot be achieved without effective participation of all the stateholders, in public, private and government domains. Urban Disaster Risk Reduction (DRR) when integrated with smart growth principles towards achieving sustainability would lead to effective urban disaster management. It would lead to communities which are more livable, cost effective and environmentally adaptive to low impact of climate change. But as rightly said "Smart Growth in dumb places"—those that are particularly disaster prone—is the antithesis of true sustainability. (Sun , 2011). This would make the communities more vulnerable. Therefore the challenges in adopting smart growth for effective DRR lie as below.

6.1 Sustainability and urban disaster risks

As many of the existing old cities are located in vulnerable locations, such as in low-lying coastal areas, along major earthquake faults, and along major rivers, and much of the land available for redevelopment and infill are often lands along waterfronts or land is particularly hazard- prone (Sun 2011). Increasing the density presents several serious challenges for managing growth in disaster risk areas as this will certainly exacerbate vulnerability of population and other elements at risk (infrastructure, lifelines, transportation, and housing, urban services). Compact development therefore must be integrated with structural and non structural measures of disaster risk mitigation. It needs to be adaptive to a given location. It should address the local issues and guide development with respect to specific urban risks through the types of projects to be adopted. Outsmart choice of density development might increase unsustainability. Secondly the smart growth needs to be supported by governance and legislation. New York, for example, recently passed the State Smart Growth Public Infrastructure Policy Act to halt public funding of sprawl by requiring state

[11] (http://www.hko.gov.hk/climate_change/urbanization_e.htm)

agencies to submit a "smart growth impact statement"for public projects and to "advance projects" that meet the state's Smart Growth criteria. . Another example is Portland, the city's Bureau of Planning and Sustainability has adopted "Neighborhood Design Policies" that encourage "new development" in areas that are losing housing and "increases in residential density" through "residential infill development."

6.2 Retreating from Hazardous areas

Retreating from the disasters areas is the most effective method of mitigating- in highly vulnerable locations or where population is extremely at risk due to greater socio economic vulnerability.Redevelopment efforts (Ieven though integrated with Disaster Risk Reduction strategies), in urban areas particularly those along coasts or inland waterways may not prove to be effective and retreating from these hazardous areas is perhaps the most cost- effective, long-term disaster mitigation strategy and is suggested by disaster scholars and practitioners. Unfortunately, retreat from hazardous areas is difficult to implement due to property rights, the costs associated with buy-outs, the likely disruption of existing community ties that relocation entails, and local political opposition to relocation efforts. (Sun 2011).

6.3 Density is a serious problem in case of failure or disaster response

Increasing density concentrates not only population but also resources—including the resources needed for effective disaster response. This concentration of response resources can be advantageous if those resources emerge from the disaster unscathed. If, however, they are destroyed in the disaster event, the resulting equipment shortages and communication failures can seriously hamper response and relief activities. Thus compact development strategies are relatively important with respect to planning of resource locations.

6.4 Current Growth patterns

The development does not take into consideration the local landuse planning, disaster management plans and the importance and involvement of Disaster Management authority into planning process which are greatly deciding factors in smart growth principle. As land-use planning is more of a state and local prerogative and approaches to land-use planning vary from state to state, national and state legislatures may be in the best position to encourage integration of hazard mitigation into land-use decisions(of smart development). When a state or locality adopts sustainability (smart growth) policies or legislation, it should include disaster mitigation as an important component and goal of sustainability and vice-versa. India, for example, should consider amending its Disaster Management Act (2005) to include attention to Smart Growth criteria in consideration to disaster risk Planning as well as UDPFI [12] guidelines in India (provides guideliens for urban Planning in India at National Level) should address the principles of Smart Growth and Disaster Management.

6.5 Evaluation of risks of redeveloping urban areas to the cost of alternative growth:

The risks of redeveloping urban areas must be weighed against the costs and risks of alternative growth patterns. For instance, planning for new urban cores in less risky locations is more weighted, rather than low density sprawling or shifting the existing urban cores toward hazardous areas through strategies like waterfront redevelopment. Sometimes the creation of urban centers of growth may be inevitable, as existing urban centers are unlikely to be able to accommodate all future growth.

6.6 Urban Form should support development in Disasterous areas

The cities which choose to redevelop particularly vulnerable areas despite the disaster risks, those redevelopment efforts should employ an urban form that either helps mitigate current risks or will facilitate strategic retreat in the future.(Sun, 2011) For example, some experts have suggested that strategic retreat can be more easily accomplished if a waterfront community is built around a series of roads (and utilities) that run perpendicular to the coast, rather than being built around a coastal road that runs parallel to the waterfront's edge. Such an urban design allows communities to make some concessions to the water over time (by ceding the property and stretches of road closest to the water) without losing all coastal access and

[12] UDPFI (Urban Development Plan Implementation and Formulation), formulated in 1996 under the Maharashtra Regional and Town Planning Act 1966, by Ministry of Urban Development for guiding urban development in India.

road and utility infrastructure. Urban redevelopment, then, can at least be an opportunity to ease the way to more permanent mitigation measures that may be necessary down the road.

6.7 Inaccurate assessment and Information may lead to vulnerable planning

Compact development can be vulnerable in disaster prone sites. Inaccurate risk assessment and information may lead to channelling growth to hazardous locations in unsustainable manner. People underestimate the everyday risks/disaster risks and incorrect risk perceptions might lead to wrong decisions associated with redeveloping or increasing the density of existing urban areas. As researchers have frequently argued, individuals faced with imperfect information about risk (and limited time, resources, and mental energy to devote to seeking out and processing further information) may form their own assessment of risk by relying on the perceived collective judgment of others.(Sun 2011).

6.8 Existing Bylaws and legislation does not support the Smart Principles

Existing byelaws and building code do not support smart growth principles. In most of the countries especially taking example of India, the building byelaws define the density of residential areas, promote setbacks in plotted development, the Floor Area Ratio (FAR) restriction is allowed maximum upto 2.5 which is only allowed in concentrated zones, promotes zoning of landuses which is against mixed landuse development, and it increases dispersed development which is against sustainability in the present context. The National Commission on Urbanisation of India (NCU, 1988) [13] recognized the need for adequate supply of land, efficiency and equity in allocation of land and promotion of flexibility in land use, thus suggested low rise development as the most efficient growth pattern.

7 CONCLUSION

Sustainability will reduce everyday risks along with mitigating the disasters and building stonger resilience to climate change.The ‘Hyogo Framework for Action 2005-2015 [14] says in its priority actions that "An integrated, multi-hazard approach to disaster risk reduction should be factored into policies, planning and programming related to sustainable development,.." . Thus the protocol for disaster management calls for integrated sustainable (smart) development to be energy efficient, resilient to climate change and disasters with strong coping capability. This can be achieved successfully with the smart growth principles emphasing high density compact development. Smart growth consists of various development features that create more efficient land use patterns. Numerous studies indicate that smart growth can reduce public infrastructure and service costs, providing savings on roads, water, sewage, garbage collection, utilities, school transportation, delivery services, and parking facilities. This serves in strong economy. The major challenges associated with the concept are that there are no laws to support this planning, secondly more research needs to be done in this area to understand the various positive and negative implications(for example traffic congessition still remains the problem even though the per capita vehicle mileage gets reduced) of the smart growth. With respect to disaster smart growth need to be located in safe areas otherwise it may increase vulnerability manyfolds. More capacity building of people and administrators is needed for application of this concept. The governments need to take action on their part by changing the legislations to support and promote smart growth because if they don’t do now, it will be too late tomorrow!

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[13] See National Comission on Urban, Report (1988) vol. II, pp 226

[14] The World Conference on Disaster Reduction was held from 18 to 22 January 2005 in Kobe, Hyogo, Japan, and adopted the present Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (here after referred to as the “Framework for Action”)

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