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Digital Earth – A sustainable Earth

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Abstract. All life, particularly human, cannot be sustainable, unless complimented with shelter, poverty reduction, provision of basic infrastructure and services, equal opportunities and social justice. Yet, in the context of cities, it is believed that they can accommodate more and more people, endlessly, regardless to their carrying capacity and increasing ecological footprint. The 'inclusion', for bringing more and more people in the purview of development is often limited to social and economic inclusion rather than spatial and ecological inclusion. Economic investment decisions are also not always supported with spatial planning decisions. Most planning for a sustainable Earth, be at a level of rural settlement, city, region, national or Global, fail on the capacity and capability fronts. In India, for example, out of some 8,000 towns and cities, Master Plans exist for only about 1,800. A chapter on sustainability or environment is neither statutorily compulsory nor a norm for these Master Plans. Geospatial technologies including Remote Sensing, GIS, Indian National Spatial Data Infrastructure (NSDI), Indian National Urban Information Systems (NUIS), Indian Environmental Information System (ENVIS), and Indian National GIS (NGIS), etc. have potential to map, analyse, visualize and take sustainable developmental decisions based on participatory social, economic and social inclusion. Sustainable Earth, at all scales, is a logical and natural outcome of a digitally mapped, conceived and planned Earth. Digital Earth, in fact, itself offers a platform to dovetail the ecological, social and economic considerations in transforming it into a sustainable Earth.

1. Introduction

While this paper is being written, India is coming to terms with its worst ever disaster in the Himalayan region of Uttarakhand. While more than 100,000 people have been evacuated to safety after the disaster, some 10,000 are feared dead. Some 3,700 villages remain blacked out for more than a fortnight, an equal number remains cut-off due to damaged or blocked roads. In a sequential bundle of events, during a period of two days (June 16-17, 2013), 220mm of torrential rains broke 88 years record in the upper reaches of the state of Uttarakhand. This was preceded by cloudbursts wreaking havoc with rivers swelling beyond capacity. Mounds of earth crashed into homes, hotels, buildings, temples and toppled trees. Over 100,000 pilgrims and nature tourists got trapped for days. The torrential rains, continuing for the third day, caused raging Alaknanda and Bhagirathi rivers to engulf and washout anything that came into their way. While climate change is being considered as the principal cause of the rains of this magnitude, there are eye-witness accounts of the glacier melting and giving way to a very large quantity of waters retained in the

glacier lakes and a mild Earthquake simultaneous to the pouring down hell (various media sources; Times of India, 2013) [1].

As the environmentalists and the various Government machinery debate whether the disaster was man-made by way of interference with the nature or natural by way of nature's response to severe interference by man, one's attention is drawn to the balancing act that was perceived and suggested by Ian McHarg (1969) [2] in his classic and still relevant master piece, `Design with Nature'. Using his famous `overlay technique' for spatial measurement, mapping, monitoring and modelling, his map overlays could highlight intrinsic natural features, that commonly included flood zones, wetlands, woody vegetation stands, slopes, drainages, areas under civilization and other man-made features. Further, assigning weights to each asset helped in arriving at a meaningful conclusion reading the specific use (or otherwise) of a parcel of land. In its simplistic form, these were the principles of attaining sustainability. These very principles became the basis of modern day GIS and other geo-spatial information systems.

This paper examines, mainly form an Indian urban context, where the lessons learnt in these basic principles given by McHarg are forgotten and how, by adopting the route of an overlay, weights, GIS and geo-spatial information systems, the Earth, so conceived and visualized digitally, can be sustainable.

2. The Indian National Commission on Urbanisation

Establishment of a National Commission on Urbanisation in 1985 and its recommendations (MUD, 1988) [3], were perhaps, the first ever National level concentrated attempt of looking at the settlement pattern of urban centres of the country in a spatial manner. It specifically covered the aspects of emergence of nodal points; special regional characteristics of urban growth; spatial eco-tones of urbanization; spatial distribution of wheat and rice productivity and industrial employment; and spatial planning of settlements. Besides other analysis, it studied the spatial distribution of cities and urban agglomerations in 1971 and 1981. Accordingly, the Commission came out with a set of recommendations that included a spatial perspective to the pattern of urban settlements at the National scale. It went on to recommend location of urban settlements by population size and function in their regional/ sub-regional context. It highlighted the necessity of delineating properly the planning regions at national level and sub-regions at state level. Identification of about 50 Spatial Priority Urbanisation Regions (SPURs) was a very important recommendation of the Commission from a geo-spatial perspective.

The Commission reminded that a major dimension of the problem of meaningful growth of National cities, viz., Calcutta, Bombay, Delhi and Madras, is the spatial dimension. Unfortunately, that was the end of the story. No elaborate efforts were made to implement the recommendation of the Commission. Although numerous attempts have been made by the scholars and alike to analyse the spatial distribution of urban settlements in the country, this has not translated into an `official' vision for spatial settlement pattern planning for urban areas in the country.

This has been the state of affairs as far as spatial approach to urban India at all levels of planning, i.e. the National, regional (State), city/ town, zonal or area level.

3. A General lack of geo-spatial vision

3.1 SEZs

Currently, India has more than 1,000 units in operations in over a dozen functional SEZs, each an average size of 200 acres (0.81 km^2). Apart from this, 8 Export Processing Zones (EPZs) have been converted into

SEZs. All these SEZs are in various parts of the country in the private/ joint sectors or by the State Government. But this process of planning and development is under question, as the states in which the SEZs have been approved are facing intense protests, from the farming community, accusing the government of forcibly snatching fertile land from them, at heavily discounted prices as against the prevailing prices in the commercial real estate industry. Attempts to set up SEZ in some areas have led to protests by villagers in the area. Locating and developing SEZs is closely related to the process of urbanisation. However, in this case also, the approval and establishment of the SEZs is on a case to case basis by the respective State or the Central Government. There has been hardly any attempt to plan for a proper distribution of the same at the National or State scale. A cursory look at the locations of SEZs (approved as well as in various stages of approval) suggests large areas of gap in their spatial location. Clearly, there are concentrations of the SEZs and voids, across the States (ICR India, 2009) [4]. An opportunity to coordinate their locations with that of large and metropolitan cities was not utilized.

3.2 Master Plan for Delhi

Delhi, being the Capital of India and one of the earliest examples of preparation of Master Plans in India, is generally a role-model for other cities in the country. Although there are a few examples in `geo-spatial' approach to Master Planning in the country, these are largely confined to `mapping'. The Master Plan for Delhi – 2021 states, "Mapping of the NCT of Delhi would be done using remote sensing and GIS tools and will also be updated from time to time to have valuable data as regards ground situation …" (MUD, 2007) [5]. Although mapping is the first essential step in the direction of a spatially-digital earth, we need to graduate from merely `mapping' to a comprehensive geo-spatial analysis and solutions.

3.3 A Missing Sub-Regional Plan of the NCR Regional Plan

National capital Region (NCR) of Delhi is one of the largest metropolitan regions of the country, spreading across four states. The NCR Plan – 2021 (MUD, 2005) [6] envisages preparation of sub-regional plans, at the level of each state, to ensure a proper distribution of settlements, apart from other details. Delhi, however, has chosen not to prepare such a sub-regional plan, showing a disregard to a geo-spatial approach. At the NCR regional level too, a point based settlement pattern has been proposed where the largest urban settlement (i.e., Delhi) has not been differentiated from the smallest. Introduction of the concept of Central NCR (CNCR) was a right step in the direction of a geo-spatial approach. Unfortunately, this opportunity has also not been exploited in the absence of any plan for the CNCR (including Delhi), which could have also worked as a sub-regional plan. Similarly, no effort has been made to ensure a shift form a `point base approach' to large `Continuously Built-up Areas' approach (Mahavir, 1996) [7] while dealing with settlement patterns as well as while dealing with large built masses spreading beyond administrative boundaries.

4. National Urban Information Systems

The Union Ministry of Urban Development launched a centrally sponsored National Urban Information System (NUIS) Scheme, in March 2006. The Scheme (Urban India, 2009) [8] comprises two major components, i.e, the Urban Spatial Information System (USIS) that includes development of GIS based multi-hierarchical database, with application tools, to support Master/ Zonal plan preparation; Urban Local Bodies (ULBs) administration and utilities management, and the National Urban Databank and Indicators (NUDB&I), that includes designing and establishing a comprehensive data bank and integration of these parameters to support planning and derive indicators for National Urban Observatory (NUO) for monitoring the health of urban settlements.

The specific objectives of the NUIS Scheme include: to develop attribute as well as spatial database for various levels of urban planning and decision support to meet requirements of urban planning and management by use of modern data sources such as satellite and aerial platforms to generate a comprehensive 3-tier GIS database in the scale of 1:10,000 for utilities planning and to build capacity among town planning professionals in the use of modern automated methods.

Among various other targeted achievements, it is expected that the implementation of the Scheme will result in planning and management of urban settlements based on updated and scientific database supported as decision support system, employing modern planning methods using GIS technology. 168 towns and cities of the various sizes were selected under the Scheme.

Simultaneous to the NUIS, the Government of India initiated JnNURM - Jawaharlal Nehru National Urban Renewal Mission (http://jnnurmmis.nic.in/missioncities.htm accessed on December 22, 2009) [9], with objectives to include planned development of identified cities including peri-urban areas, outgrowths and urban corridors leading to dispersed urbanization. 65 towns and cities were selected under the Mission.

Though both the NUIS and the JnNURM aim at planned development of towns and cities of all sizes, the schemes remain largely in isolation to each other, from conception to detailing. Even the selection of town and cities for the two schemes has been without any reference to each other. The scale and size of the two schemes vary grossly. The coverage, both in terms of population covered and the spatial distribution of towns and cities is with apparent disregards to each other. Moreover, the gross oversight in synchronizing the two schemes has rendered the beneficiaries, i.e., the large urban population of these towns and cities, at a disadvantaged position.

5. Digital Earth – A sustainable Earth

Urban population is growing at the rate of 180,000 people per day globally, which is why our cities are growing vertically too. Yet, in the context of cities, it is believed that they can accommodate more and more people, endlessly, regardless to their carrying capacity and increasing ecological footprint. The ‘inclusion’, for bringing more and more people in the purview of development is often limited to social and economic inclusion rather than spatial and ecological inclusion. Economic investment decisions are also not always supported with spatial planning decisions. Most planning for a sustainable Earth, be at a level of rural settlement, city, region, national or Global, fail on the capacity and capability fronts. In India, for example, out of some 8,000 towns and cities, Master Plans exist for only about 1,800. A chapter on sustainability or environment is neither statutorily compulsory nor a norm for these Master Plans. Apart from lack of qualified town planners, lack of authentic and updated spatial and attribute data is often the other reason for unplanned cities and towns.

The past decade has seen the proliferation of high resolution Earth observation satellites. The sub-metre resolution imagery from these satellites is capable of supporting mapping projects from 1:50,000 to 1:5,000 scales, making this a cost-effective and quick option for cadastral and land information systems. This approach is particularly suitable in rural areas, mountains and desert like areas with wide-open spaces. Frequent revisit of the satellites allows for frequent monitoring and updating of the land systems. India, with her own satellites of the sub-metre resolution capability can provide excellent data of high frequency. Yet, it is more often overlooked due to socio-economic and political compulsions. On the other hand, many times, the images for satellites are expected to resolve critical and fine spatial issues. The fact remains that everyone has to measure in one way or the other; because what you can’t measure, you can’t manage (Dold, 2013) [10]. Moreover, crowdsourcing can fill in the gap for areas where the images cannot

be obtained frequently. It is people centric and has strength in local knowledge, higher currency, wider range of geospatial data, greater attribution and good vernacular. However, crowdsourced data is not normally managed in a systematic manner with moderation, and therefore, tends to have inconsistent coverage with variable and unknown quality and authenticity. Despite these drawbacks, crowdsourced geospatial data is being used in an increasing number of professional and social applications where accurate, authoritative and assured geospatial data is not required. It is delivering significant benefits to developing countries where up-dating is sparse (McLaren, Robin, 2013) [11]. Yet, the need for in-field checks, surveys, and more importantly, agreement on where exactly the boundaries lie will remain", in urban areas (Rekha, 2013) [12].

It is this need of agreement on where exactly the boundaries lie will remain, that can be precisely resolved using the principles and techniques given by McHarg. As father of map overlays and thus, GIS, he had already provided a platform for mapping, analysing, manipulating, visualizing and presenting geographic data and thus arrive at spatial locational decisions which are convincing to people and decision makers alike and yet founded on strong scientific and technological principles that ensure the sustainability of these decisions. The weighted overlay techniques given by McHarg, when manipulated using data obtained from satellite images, crowdsourcing and limited field checks, in today's GIS platform, influences every individual to think spatially and with nature. That the "… form must not follow function, but must also respect the natural environment in which it is placed (McHarg, 1969) [2]" can be better understood and conveyed with today's GIS platforms. In true sense of understanding, he already conveyed, in 1969, that a (spatially) digital Earth is a prelude to a sustainable Earth.

Also, planning for urban settlements has to graduate from a cosmetic `GIS Mapping' approach to a comprehensive geo-spatial analysis and solution approach. There is no dearth of technology and humanware, there is only a need for a strong geo-spatial vision at all levels of urban planning and development. A (spatially) digital Earth helps developing this vision.

In the Indian context, geospatial technologies including high resolution satellite images, GIS, Indian National Spatial Data Infrastructure (NSDI), Indian National Urban Information Systems (NUIS), Indian Environmental Information System (ENVIS), and Indian National GIS (NGIS), etc. have potential to map, analyse, visualize and take sustainable developmental decisions based on participatory social, economic and social inclusion. Sustainable Earth, at all scales, is a logical and natural outcome of a digitally mapped, conceived and planned Earth. Digital Earth, in fact, itself offers a platform to dovetail the ecological, social and economic considerations in transforming it into a sustainable Earth.

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