

Environmental Sustainability Initiatives in Master Planning: A Case of Large-scale Township Projects in India

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ABSTRACT:- The way our future urban areas are planned, designed, managed and used have been already under transition based on two important factors: rapid urbanization and growing awareness towards sustainability. The recent challenges of planners of new cities, townships and residential projects are driven by a combination of the demand for new housing combined with the need to plan and build without compromising and irreparably harming the natural environment. This study, with the help of ten township case studies from India examines the environmental sustainability strategies or best practices taken up by township projects in their master planning stages. The paper identifies four key principles and various strategies under which environmental sustainability can be categorized for a useful assessment of large scale township projects.

Keywords’:- Environmental sustainability, township development projects, master planning, green townships, eco-cities

I. INTRODUCTION

Rapid population and economic growth pose profound implications for the future of human society in India and therefore, the pathway taken by urban development over the next few decades will play a crucial role in the trajectory of natural resource depletion as well as climate change. Large-scale townships in India have been planned and proposed in a big number across the country and because of their land intensive nature as well as size of population and infrastructure demands. These projects will be playing an increasingly important role in driving a shift in India’s changing urban pattern and environment. It has become imperative for planning professionals to consider the conceptual ideas for combining urbanization and sustainability in the actual planning and designing process, especially in green field townships that utilize land and other natural resources in great quantum.

Large-scale township project planning in India vary in terms of addressing and defining new paradigms of urban environment and the issues related with environmental externalities. The implementation of environmental sustainability initiatives in township planning is also influenced by various paradigms of physical environment and sustainable urban development. There are many implementation tools that have been possibly guiding the inclusion of environmental considerations in the planning process of large scale land development projects including residential and mixed use townships across the world. These include well established impact assessment techniques (EIA, SEA etc) and commercially successful performance indicator systems in addition to Life Cycle Assessments (LCA) and urban metabolism concept. Many planning agencies have also been using project assessment software tools to guide the planning process. There has also been an increased application of performance assessment systems developed by Indian Green Building Council-IGBC Green township rating system [1] and Green Rating for Integrated Habitat Assessment -GRIHA- Large Developments [2]. Therefore, where many of the planned, proposed and under construction township developments in India are claiming themselves to be green developments or sustainable neighborhoods, few important research questions can be framed: are these developments really striving to live within their ecological limits, reduce their ecological footprints and acknowledge their connection and impact on other areas and communities? Are these developments designed with nature and do they have positive relationship with their surrounding and are they self-sufficient and energy efficient? Do these townships facilitate and encourage more sustainable and healthy lifestyles?

To address these research questions and to understand the fundamental principles of environmental sustainability applicable to planning of large township project, the research adopts a case study approach for an empirical inquiry into the environmental sustainability initiatives and practices taken up by studied townships under a basic framework of key principles and strategies.

II. CONCEPTS & MODELS FOR SUSTAINABLE TOWNSHIP PLANNING

Environmental sustainability in recent times in urban development projects is being practiced under various scientific approaches of urban metabolism and a consistent argument in this case is that the urban metabolism of the cities is continuously increasing [3]. This points to the need to better characterize the amount of materials stored as stock within the urban system - buildings, roads, and infrastructure- and the flows into cities and out of them more broadly, since studies have been conducted on only a limited number of cities worldwide [4]. A variety of urban metaphors have emerged as per the varied approaches to planning for sustainability. These terminologies convey city-based or project based goals. Spatial metaphors have been used to powerful effect in the market, in public policy, and in academic polemics [5]. For example, at city level metaphors like ‘better cities ’and ‘livable city’ etc. represent the vision and future guidelines for working of cities. From environmental sustainability point of view, metaphors that have been commonly used for cities include: Ecological city [6], sustainable city [5], livable city, compact city, healthy cities and green townships etc. [5]. In the relation to economic development, traditionally, the transition towards sustainability has been discussed at three stages, poverty related, production related and then finally consumption related and this view originates from the growth paradigm that unbound economic growth is the key to raise living standards [7].

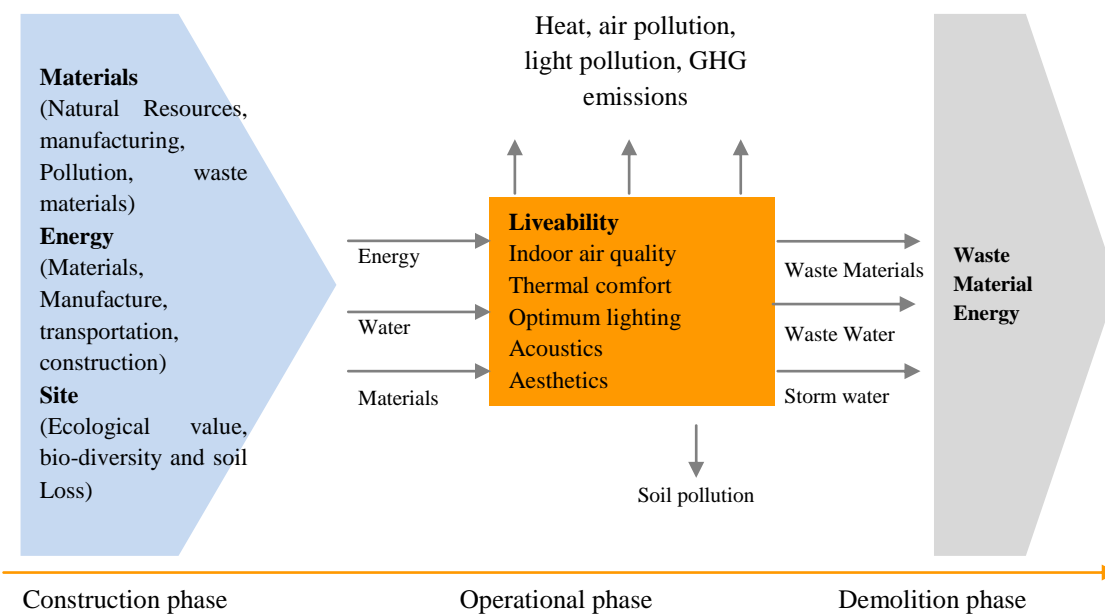


Figure 1: Urban metabolism concept in building life cycle [8]

The issue of increasing urban metabolism (Fig 1), that is the increasing amount of materials and energy being consumed by the urban areas, is being addressed through a variety of initiatives, the prominent one of which are the eco-city developments that have been called as practice led initiatives and are becoming more mainstream in policy and regulatory processes across the world [9]. These eco-cities have been focusing on renewable energy, water and waste management and also provision of public and green modes of transportation [10]. The World Bank defines eco-cities as “cities that create economic opportunities for their citizens in an inclusive, sustainable, and resource-efficient way, while also protecting and nurturing the local ecology and global public goods, such as the environment, for future generations” [10]. The aim of these eco cities is to utilize the innovative and appropriate technologies for the higher goal of community economic development. These developments have been trying to achieve this by adopting ecological principles and bio-regionalism in physical planning. This ecology central approach to planning is seen in the approach towards urban design in the form of these practices [11] which include: Integrated water resources management: closing the water cycle,

Energy management, reducing the greenhouse gases, Waste minimization and integrated waste management, integrated transport policies and an integration in the framework of urban management.

The emergence of eco-cities across the globe shows trends towards showcasing these developments either as a pilot project or an exemplary start-up of environmental sustainability efforts by the local government or development agencies. This is clearly evident in the numerous eco-city examples in China. Eco-cities are also acting like test beds for technological innovations and trials in urban projects to tackle the pressing issues of climate change[9]. The emerging eco-cities like Tianjin Eco city, Dongtan eco city, Chanxidian eco city, Nanjin eco hi tech island etc all have their conceptual origin of ecological planning principles and clean technology solutions. Most of these eco cities have adopted the LCA towards addressing the environmental sustainability issues at township level [12]. There are various other physical planning models that have also been used for planning for sustainability, for example, the New Urbanism concept for urban planning and design emerged in the 1970s and 80s in USA as a response to the problems related to urban sprawl. This concept of neighborhood design is based walk-able neighborhoods, mixed land use, high density and compact developments[13]. It promotes higher dependency on public transport systems like trains, light rail and less on the private vehicles and proposes mixed-use development as the key response to promote walk to work culture and includes twenty key principles across three scale of regional, neighborhood and building level designs[14].

Similarly, Transit oriented development[15]concept has been adopted world over and has laid emphasis on the physical planning, mixed and intensive land use and use of multiple transportation modes. It is also being termed as the ‘walkable urbanism’ due to its focus on walkable neighborhood planning [16]. A combination of walking, cycling etc hailed as green transportations, along with effective public transit systems essentially reduces the dependence on private vehicles and therefore reducing the fossil fuel usage, pollution and carbon emissions associated with it. This in combination of the Smart City [17]concept is a very recent terminology used in city planning and neighborhood level planning. This model of development is in experimental stages and there is no clear definition and understanding of implementation of the concept of technology integration into main stream urban planning and urban infrastructure provision.

India has taken up task of upgrading the existing city infrastructure to develop 100 smart cities as a part of a top led national initiative by the Ministry of Urban Development [18]. Few projects in India have already been trying to adopt state of the art technology in planning. For example GIFT city, Palava City and Wave City developments include technology integration in waste and water management, utility corridors and security systems etc. The approach here has been to take IT companies as development partners, for example, IBM smart city concept in Wave City. Here urban performance is considered as a function of the complex interplay between systems composed of infrastructures, capital, assets, behaviors, and cultures; spanning the economic, social, technological, and environmental. In another terminology, the urban developments that are able to achieve significant reduction in energy demands or developments that produce more energy than they consume are generally termed as zero carbon developments [19] as the reduced energy dependency is directly related to reduction in the amount of CO2 emissions[20]. The reduction in energy demands for built-environment is achieved through passive design and layout interventions and innovative technologies of energy efficient lighting, heating and cooling systems and the energy consumption reduction has to be then supported by energy production with renewable sources.

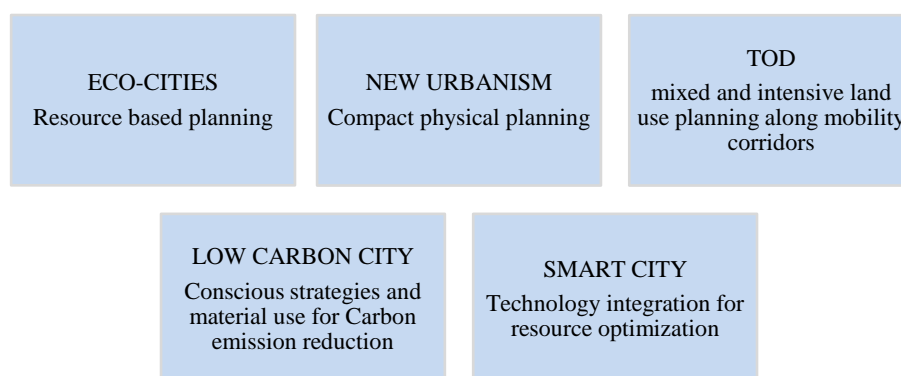


Figure 2: Few emerging models of sustainable township planning

In summary, the emerging models (Fig 2) to address environmental sustainability issues in township planning have similar goals though varied pathways to achieve their individual targets. There is a need for an underlying basic set of principles to assess the initiatives/strategies/practices that a township must follow in their master planning to achieve the broad and long term goals of environmental sustainability.

III. CASE STUDIES

The adoption of environmental best practices is seen as a phenomenon that will happen in the lifetime of this process of development of project, but the initiation of best practices shall be visible in master planning stage. Therefore, the projects identified for study have been in different stages of development of conceptual planning, master planning, construction, or operational stages. The case study approach helps in reviewing the practical manifestations and their own interpretations towards development. A reiterative process of selection has been taken up for township case studies and after the initial screening of the townships chosen as case studies, a field study has been undertaken for a select few township sites to understand the present status, context and implementation of some of the important initiatives proposed in the master plan.

3.1 Defining Large Scale Townships

This research defines large scale townships as projects covering a total contiguous land area of 100 acres or more for development and involve land use transformation and new construction on either brown or green field. The implementation of these projects may take many years and may involve one or multiple developers, promoters or construction companies. The proposed plan should have an integrated land use and constitute at least residential, commercial and institutional components on the project site. This research takes into consideration the fact that these townships are not covered in the macro level city planning and neither can be completely covered under micro level building design. Therefore, the understanding of planning and design of these township projects is at a meso-level. Meso-level considerations overlap with urban design scale, neighborhood level scale and sector scale in terms of planning (Fig 3).



Figure 3: Physical context of master planning area in township projects

4.1 Township Case Study Profiles

Upcoming large-scale township projects that fulfill the criteria of having a total project area of more than 100 acres and having mixed use developments, and after a brief review of the promotional material and proposals 10 township projects were selected based on their assertion for environmental sustainability (Fig 4).



Figure 4: Township Case-studies

(Image Sources: Lavasa Hill City: www.lavasa.com, Magarpatta City, www.magarpattacity.com, Marg Swarnabhoomi, www.margswarnabhoomi.com, GIFT City, www.giftgujarat.in, Esencia Green Township, www.esencia.in, Amanora Park, Pune, www.amanora.com, Mahindra World City, Chennai, www.mahindraworldcity.com, Wave City, Ghaziabad, www.wavecity.in, Nanded City, Pune: www.nandedcitypune.com, Palava City, Mumbai: www.palava.in)

These cases show inclination towards environmental sustainability strategies though the extent to which such practices are adopted shall be clear only in long term, the planned project profile of the studied townships in given in Table 1.

Table 1: Township case studies: project details

S no.	Project Name and Location	Total Project Area	Project Period	Development type	Key sustainability features
1	Lavasa Hill City, Near Pune	25,000 acres	2008-2021	Green field, Low density, Mixed use residential township development, 300,000 residents and 2,000,000 tourists	Natural resource conservation and Eco-friendly housing
2	Magarpatta City, Pune	400 acres	2006-2012	Green field, Mixed use, medium density township development, 90,000 Population	Eco-friendly township development
3	Marg Swarnabhoomi, Near Chennai	1000 acres SEZ, 172 acres township	2009-2016	Green field, Medium density residential township, Special Economic Zone, 150,000	Pilot project for platinum rating by IGBC GTRS
4	GIFT City, Ahmedabad	550 acres	2008-2017	Green field, High density high rise, Financial district Flagship development (only 23% residential land use), 300,000 residents and 2,000,000 tourists	Technology based smart city concept
5	Esencia Green township, Gurgaon	112 acres	2012-2015	Green field, Residential township	Pilot project for GRIHA green township rating
6	Amanora Park, Pune	400 acres	2008-2020	Green field, Residential township	Award winning eco-township
7	Mahindra World City, Chennai	1550 acres total, 325 acres residential	2002-onwards	Green field, Mixed use township with a major component of Industrial, apparel and IT SEZ, 30,000 residents, 35,000 direct	First IGBC gold rated township integrated with IGBC gold rated SEZ

				jobs in SEZ	
8	Wave City, Ghaziabad, NCR	4500 acres (1671 acres in phase 1)	2010-onwards	Green field, Integrated Mixed use Residential township	Smart growth principles and IGBC rating targeted
9	Nanded City, Pune	700 acres	2010-onwards	Green field, Mixed use-Residential township	Eco-friendly township development
10	Palava City, Mumbai	2780 acres	2011-onwards	Green field, Integrated Residential township, Approx. 500,000 people and 350,000 jobs	Promoted as Smart City

3.2 Environmental Sustainability Assessment Criteria

This research distills certain key principles of environmental sustainability as presented in the literature, existing international performance rating systems and select case studies. The forms of environmental responses in the field of natural area management have been categorized as per two type of action involved, a technical fix and value changes [22]. This traditional environmental response categorization has been expanded into four categories that are useful to describe environmental sustainability responses in large scale townships as observed in case studies. In case of township development projects, the key approaches in environmental sustainability have been broadly categorized into the four types: Morphological, Eco-conservational, Technological and Behavioral (Table 2). In each of these principles major response categories have been identified under which various strategies/initiatives or best practices were listed for assessment, which are termed as indicators. Each of these indicators is in the form of a qualitative or quantitative initiative that is used to assess the performance of the township.

Table 2: Fundamental principles of environmental sustainability and response strategies

Key principle	Description
Morphological (Design shift)	This category includes environmental sustainability initiatives related to physical planning, zoning, layout of buildings on the site, form and density of development. As the literature review suggests new urbanism, compact and high density developments and transport oriented development concepts are accepted as the more environmentally sustainable as developments that have higher sprawl. Case studies have demonstrated a clear design shift in terms of compact planning, mixed land use and placing of activities as per transport corridors (TOD) to reduce overall energy consumption and resulting efficiency in place making. Response Strategy 1: Planning, design and Land use(12 indicators)
Eco-conservational (Natural Resource Protection)	Issues related to environmental resources and their utilization and recycling and reuse. These resources include the natural landscape, ecology and bio-diversity, water and waste. The traditional focus of natural resource protection remains a lead priority keeping water waste management as the main focus, planning for higher green area per capita and conservation of local bio-diversity and compensatory plantation etc. Response Strategy 2: Landscape, ecology and bio-diversity(12 indicators) Response Strategy 3: Water conservation, efficiency and reuse(8 indicators) Response Strategy 4: Waste and material management(10 indicators)
Technological (Technical Fix)	Increasing reliance on renewable energy sources, focusing on green and non-motorized transportation, public transportation systems and aiming for carbon emission reduction are placed in this category where new technologies play an important role in achieving targets of environmental sustainability of township projects. Newer technologies and their amalgamation in energy efficiency and transportation sector have been adopted by most of case studies. These include solar and wind energy sources, and hybrid vehicles etc. on site. Response Strategy 5: Energy efficiency and renewable (13 indicators) Response Strategy 6: Effective Green and Public Transportation(7 indicators) Response Strategy 7: Carbon emission reduction and Environmental(6 indicators)
Behavioral (Value Change)	Making the decision makers sensitive towards environmental sustainability decision making, end-users or residents more responsible towards the use of available resources etc. are important in sustaining the momentum towards environmental sustainability of a township project. A focus on low consumption lifestyle is seen in some selective cases, though this being a post occupation aspect, planning level strategies are not prominent and need more focus. Response Strategy 8: Environmentally responsible social behavior(7 indicators)

4.2 Evaluation Scoring

In each response category various initiatives/strategies and best practices adopted by the township developments in their master planning stages have been identified for evaluation. In total, there are 75 such indicators used. These initiatives are a mix of planning strategies, policy and design. These initiatives in many studied townships have been elaborated in the form of performance indicators and many may even have a quantitative target. For this purpose, the implementation status scoring has been carried out by a process of ranking and qualitatively assessing each of the initiative in each of individual case. The total set of ES initiatives as derived in the previous section and categorized under principles and strategies (indicators/practices/ proposed planning strategies etc.) have been used for this implementation evaluation. Each of the 75 indicators has been given evaluation ranking depending upon the extent to which the township has demonstrated strong or weak inclination towards proposing, planning or implementing the initiative. This evaluation ranking is based on the researcher's estimates based on the available information on the case. Depending upon the demonstrated initiative and its rigor in the master planning of the townships, a multiple level scoring system was developed. This ranking helped in developing a composite score for each of the selected initiative for each of the township. For each of the sub-strategy/initiative the score given has been converted into a percentage score for all case studies put together:

Criteria and given score

- No visible planning strategy proposed or implemented to support the initiative or regulatory compliance only: 1
- Initiative proposed with optimal planning strategy/standard to support it: 2
- Initiative proposed with qualitative or quantitative target and supportive planning strategy: 3
- Initiative proposed with exemplary quantitative targets or demonstration of strategy/design: 4
- Not applicable to the particular project or information not available: NA
- Sum of all individual scores: Initial score (A)
- Total feasible score (B): Number of initiatives (excluding NA) multiplied by the maximum individual score possible (i.e. 4)
- Final Score (C): Percentage $C = (A/B) \times 100$

In each of the township development, there is a different focus on the strategies and it useful to understand which response strategy get higher preference overall in all the studied township case studies. It has been observed that Indian township case studies have a common understanding and implementation focus for the basic initiatives for urban services (Fig 4).

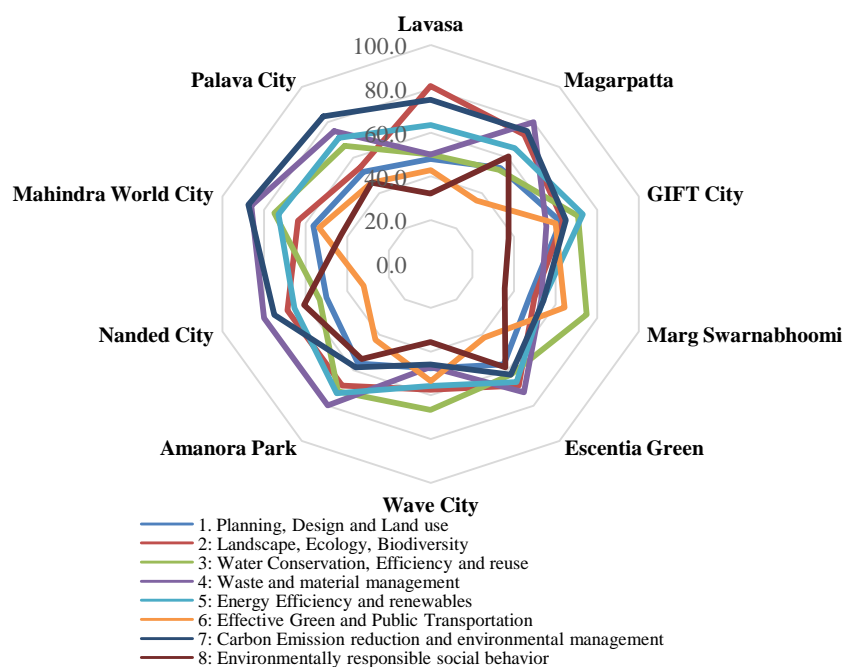


Figure 4: Performance of case studies in each category

4.2 Inferences

Many initiatives are selective and dependent upon the project details and context. The studied township projects have pointed at a number of issues in planning and implementation of an environmentally responsible development. The chosen case studies have demonstrated a number of environmental sustainability initiatives taken up at the planning level, however, these initiatives differ greatly with regard to their scale and ability for replication. The foremost challenge faced by these townships is evidently the financing. The reviewed case studies have approached the issue of finance in different ways. Many such large scale townships require both public and private sector involvement. Internationally, large scale collaborations bring together private firms and states, Indian case studies though are mostly completely private initiatives, sourcing funds through real estate funds and venture capitals. These developments anticipate revenues from real estate sales, long-term leases, and office rentals.

The complexity and scale of development involved in these townships have been the key factor behind cooperation and coordination among various players involved. Most of the studied townships for example have international planning consultants involved and at deal with partnerships and collaborations between real estate developers, architects, construction contractors, technology houses, sector experts, infrastructure service providers and funding institution in addition to green building rating firms etc. It is important to note that whether all government, all private or collaborative private public partnerships develop these projects, the scale of complexity and challenges remain distinct for each. The townships that aim for environmental sustainability face a different kind of acceptability issue to promote themselves in the market and it might be a difficult task to bring together the vision of the planners and experts to the resident in these townships in future. It is observed that these townships are gearing up for private high cost maintenance solutions and rely less on state interventions. Wave City and Palava City, collaborating with IBM to integrate smart technologies into their planning process is a step ahead in implementation of Smart City concepts for enhancing sustainability as well as livability in these projects.

V. CONCLUSIONS

Approaches to sustainability differ from project to project and are contextual. Local and regional economic fabric, local climate and environmental resources, social structure etc can be underlying forces determining what is environmentally sustainable for a particular project. Therefore, a particular set of indicators may not be entirely applicable or relevant for all projects; though key principles can be identified, which encompass the environmental dimensions to make a project more environmentally sustainable in comparison to conventional development. The research identifies and categorizes environmental sustainability initiatives in the form of adopted practices by way of an empirical inquiry in the form of township case studies. The initiatives taken up by townships can be clearly categorized into four key principles relating to morphological changes in design, conservation of natural and ecological resources, technology driven changes, changes sought in behavior.

The policies regarding township projects are made at a state level, which have different development focus in each region. Every state has its own definition for these types of integrated developments. The environmental clearances for these projects may depend upon the size and nature of development. In most cases, the clearances are done at state level but in case the project lies in an environmentally sensitive zone, the clearance is needed from central ministry. In addition, not all the projects may require a full-fledged EIA before being clearance. These regulatory and policy issues have kept the development process of large scale townships in an ambiguous position from the point of view of clarity of execution and implementation. Therefore, there are many challenges to developing replicable business models for environmentally sustainable urbanization. At a policy level, the implementation techniques being used for environmental protection have not been evidence based and higher influences seem to originate in political influences, rather than pragmatic scientific solutions to climate change and resource depletion. But, what is really missing is an overall vision about the growth and development of integrated townships in the country as a whole. There needs to be a guiding policy, which would provide directions to the state on the extent and the nature of such development that would be feasible.

VI. FURTHER RESEARCH

This research is a part of a broader research goal that emphasises on the indicators in the form of planning strategies, initiatives as well as best practices adopted by township developments in India and to propose for a useful generalized decision making framework for similar developments to follow in future.

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