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Research Article

Achieving Ecological Sustainability in Cities through Indigenous Landscape Planning

Jothilakshmy Nagammal

Professor & Head, Saveetha College of Architecture & Design, Saveetha Institute of Medical & Technical Sciences, Chennai, India
jothilakshmy68@gmail.com

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Abstract: For any thriving sustainable planning, we need a contextual site specific holistic approach with the economical, social, ecological, spatial and environmental along with detail investigation of the climatic, geographical, cultural and landscape studies. The detail environmental factors and planning parameters to be considered by the architects and planners for any development related to the three major environments like the coastal, hilly and desert are explained in detail. The importances of landscape planning and design in the three different ecologically bio diversified areas are further highlighted to achieve sustainability. Other planning parameters like energy efficiency, selection of appropriate materials, water conservation etc. for achieving sustainable building design in an urban area has been discussed. The different methods and various models are discussed to pave the way for achieving sustainable development such as the multidisciplinary and transdisciplinary approaches. A New Planning Model has been suggested by integrating the techniques and methods of various ecological landscape planning approaches.

Keywords: Ecological Landscape, Appropriate Architecture, Landscape Planning Models, Ecological Sustainability, Indigenous Landscape Planning

1. Introduction

City planning is a component of the overall regional planning of a district or a region (2012). Regional planning takes into consideration of the natural geography along with the landscape and negotiates the resources needed for and the infrastructure linkages of city plan. After establishing such resource and infrastructure linkages, city planning goes into details of urban landscape, urban infrastructure, zonal planning and urban design. Design policies should avoid unnecessary prescription or detail and should concentrate on guiding the overall scale, density, massing, height, landscape, layout and access of new development in relation to neighboring buildings and the local area more generally (2013). Local planning authorities should not attempt to impose architectural styles or particular tastes and they should not suppress innovation, originality or initiative through unsubstantiated requirements to confirm to certain development forms or styles. It is, however, appropriate to search for to encourage or reinforce local distinctiveness particularly where this is supported by clear plan policies or supplementary planning documents on sustainable design. On the other hand in a sustainable planning approach, we need a contextual site specific holistic approach with the economical, social, ecological, spatial and environmental along with detail investigation of the climatic, geographical and cultural and landscape studies (1998). In this era of sustainability this paper is looking into the shortcomings of current master plan and regulations approach and will suggest a holistic way of city planning with ecological sustainability and indigenous planning approach.

2. Role of Ecology and Landscape towards Sustainable Architecture and Planning

In this 21st century of ever increasing population, urbanization and pollution, the need of the hour is to create self sustainable architecture and planning. In the current scenario of rapid depletion of natural resources, designing with nature and exploration of alternative energy sources leads to sustainable architecture. The main objective of Sustainable architecture and Planning is to achieve

- Better quality of health & life
- Reduction in annual maintenance costs
- Low energy consumption
- Conserve scarcely available conventional energy sources
- Higher comfort and reduced costs by using alternative building technologies.
- Promoting a way of living with the natural landscape.

First let us look into different natural terrains and its biodiversity and ecosystem prevailing in it. The past and the present ongoing natural processes in the different terrains like Costal, Forest or Desert environment has to be studied, documented and analyzed carefully to arrive at vital parameters to be incorporated in the check list for sustainable planning (2010). The ecology of the area determines the planning principles for the area. Land use plans

and Master plans should be sensitive to the Natural resources and prevailing ecology. The ecological factors shall be studied, documented and correlated with the related features and further transformed into design elements which shall contribute towards achieving sustainable planning.

A. Coastal Environment

B. Ecological Factors Related Features

The ecological features related to the specific coastal environmental factors and the related planning parameters ate tabulated in Table 1 Below.

Table 1- Environmental factors and Planning parameters in a Coastal Environment

Environmental Factors	Planning Parameters
High tide line	Zonal classifications, Land use plans
Cyclone	Building design, outdoor spaces
Water table	Septic tanks, wells, bore wells
Soil condition	Foundation design, soft landscape
Sea erosion	Construction activities and infrastructure development
Humidity	Building form and design
Climate	Building design
Breeze direction	Orientation of Bldg, Fenestrations etc.
Coastal Fauna & Flora	Scenic values and bio diversity
Coastal corrosion	Material selection
Dust and glare	Design of outdoor and indoor spaces
Aquifers	Water recharging areas

C. Landscape Design

The important Landscape Design features in a coastal environment are featured below.

- Buffer plantation reduces the direct impact of salt breeze on buildings and vegetation. (Plantations like Casuarinas, Silver oak, Coconut trees, Palm trees etc.)
- Lawn areas, reduces radiation onto built environment thereby reducing heat gain. They also arrest dust and controls glare so shall be adopted and planted in the open spaces.
- Sand dunes can be stabilized by ground covers with wild grass with fibrous roots which shall prevent soil erosion.
- Tress like Silver oak, Tabebua, Casuarinas etc. shall be planted as buffer plantations and wind belts which help to reduce dust coming inland.
- Non corrosive street furniture shall be designed in parks and other street side facility spaces which are also easy maintenance against dust and vandalism too.
- Wells shall be preferred to bore wells to prevent salt water intrusion.
- Sewage treatment plants are planned to prevent leaching. Canna plants indica beds absorb organic wastes and also Reed beds shall be used as filtering media for sewage water disposal.
- Covered decks and balconies shall be planned and designed as part of the building design to reduce indoor heat gain.
- Compost pits shall be provided for disposal of solid waste and is also produces good organic manure.
- Provision of Courtyards in the building design shall facilitate cross ventilation and provide good indoor views.

Hill Side Environment

Ecological Factors Related Features

The ecological features related to the specific hill side environmental factors and the related planning parameters ate tabulated in Table 2 Below.

Table 2- Environmental factors and Planning parameters in a Hilly Environment

Environmental Factors	Planning Parameters
Slopes	Erosion, zoning
Valleys	Storm water runoff, erosion, rich vegetation
Ridges	Potential view points

Plateaus	Zoning, play fields, etc
Soil	Erosion, foundation design, septic tank design
Rocky outcrops	Zoning
Aspects	Building orientation and window positions.
Climate	Building design, Thermal comfort
Precipitation	Roof forms
Fauna & Flora	Scenic values, bio diversity & infra structure

Landscape Design

The important Landscape Design features in a hilly environment are highlighted below.

- Afforestation in steep slopes helps to control soil erosion & control flash floods.
- Designing along contours minimize cut and fill
- Check dams and weirs to control erosion
- Percolation ponds for water conservation and wild life. Curtails forest fire.
- No construction activities on Valleys and 10m width across valleys.
- Use of locally available building materials
- Open space linkages for wild life and percolation
- Infra structure developments in tune with contours and natural resources
- Low lying areas a\can be designed as water bodies
- Organic manures and pesticides, bio degradable in nature to preserve Fauna & Flora.
- Rotation of crops is encouraged to maintain soil nutrition.

. Arid Environment

D. Ecological Factors Related Features

The ecological features related to the specific desert environmental factors and the related planning parameters ate tabulated in Table 3 Below.

Table 3- Environmental factors and Planning parameters in a desert Environment

Environmental Factors	Planning Parameters
Dust storms	Development patterns bldg. design
Solar radiation	Building design, const. materials, orientation and Size of openings
Diurnal variations	Building materials and technologies
Local materials	Building technology
Fauna & Flora	Scenic beauty and bio diversity

E. Landscape Design

The important Landscape Design features in a desert environment are discussed below.

- Introverted planning
- Clustered development
- Hardy soft landscape to reduce solar radiation. Transpiration effects cooling. (Acasia auriculiformis, Albezzia lebbeck, Erythrina indica, Casuarina Equisetifolia, Cassia siamea)
- Hardy shrubs and trees to arrest dust
- Screen walls to define outdoor spaces and to arrest dust
- Courtyard planning and water bodies create local micro climatic effects
- Water conservation techniques.(Drip irrigation, sprinklers, percolation ponds)

It is very clear from the above discussions that whatever be the natural land form, the environmental factors related to the ecological background of the place has to be studies in detail with respect to existing landform, soil, climate, water table, local materials, and fauna & flora. The planning parameters for the sustainable design

approach to be adopted in each area also are mentioned in detail in all the above three tables. The landscape design approach to each landform varies and the important planning approach to be adopted in the form planning principles can be adopted as the regulations in the respective environment to achieve sustainability. Some of the key planning parameters discussed are elaborated below in detail for better understanding and techniques of implementation in building planning and design to achieve sustainability.

3. Sustainable Planning and Scientific Solutions

Sustainable planning is based on scientific solutions arrived from a careful study of ecological factors. They vary from site to site. Vasthu is based on traditional theories (when science was not fully developed) which adopts a universal planning guide for any site, be it a desert, composite of hot &humid climate, coastal, arid or forest environment. Ecological planning is sustainable planning and should prevail over vasthu, for better quality of life.

- Scientific planning based on ecological factors should be adopted
- Alternative building materials should be explored and implemented to steel and concrete as concrete roofs are store houses of heat.
- Alternative energy sources should be explored to reduce the strain on rapidly depleting conventional energy. Use of non conventional energy sources should be encouraged like geo energy, solar energy, tidal energy etc.
- The alarming pollution levels should be minimized by switching over to advanced technologies.
- Water conservation technology should be explored. Rain water harvesting and waste water treatment plants should be made mandatory.
- Innovative structural systems and cost effective building techniques are to be encouraged

Bio degradable products to be innovatively used to achieve sustainability.

4. Towards Sustainable Symbiosis of Nature and Architecture

A can of coca – cola made of aluminium, if recycled saves electricity adequate to run a television set for three hours instead of just throwing it away. We need to calculate the magnitude of energy consumed by the unending chain of metal clad, steel reinforced, artifacts used in the buildings.Architecture as symbiosis of natural and the artificial, architect as the doctor of vital forces bears the responsibility to maintain the equilibrium between the built and the natural environment. For every built object implies an alteration to the landscape. Every wooden log means a forest cut, every stone boulder means a hill grounded and every brick block means an earth excavated. Knowing full well the finiteness of resources and recurring implications of its consumption, every development requires being sustainable. Sustainability is understood as self reliance and ability to absorb environmental and such other impacts of development action in the present times, without degrading or depriving the developmental opportunities for the time to come. In other words, it is recognition of the fact that environment and development are not mutually exclusive but are interdependent and as such can become mutually reinforcing. Resource management and resource generation, therefore, become the fundamental concerns of sustainable developments.Resources in architectural applications include man, machine as well as material. Every architectural decision, from its site location to surface finishes, calls for the in depth understanding of its environmental implications and complete comprehension of the long term consequences. Issues pertaining design, technology, energy, land, water and vegetation become critical for sustainable architecture, both for their optimal utilization as well as resource generation. Each of these elements can be seen as productive culture.

F. Efficient Design

It implies an optimal utilization of space, leaving no waste, thus, optimizing the resources. Building design by the way it is positioned on the land, orientation to sun and wind, massing of the built and the un built, organization of various activities, size and scale of spaces etc. can favorably control not only the living comforts but also the resource consumption and the energy intake.

For example, sharing of the walls between adjoining buildings not simply reduces consumption of construction material but also cuts down the surface exposure, making the building less susceptible to external forces of climate. Splitting the total built up area in several floors also helps in reducing the impact on landscape. Varying levels and volumes in a space bring down the energy consumption by nearly 10%. Addition of a floor above cuts it down to the order of 20% while sharing further the two side walls reduces it to nearly half. Correspondingly the built surfaces and fenestrations oriented in harmony with movement of sun and wind ensures comfort conditions within the building through forbidden shadows and synchronized flow of breeze. Buildings oriented regardless of climatic considerations can create unfavorable effects to the inhabitants. Turbulences created between two tall buildings or

sun penetrating through large westward windows in summer afternoons, exemplify the fact. Better the naturally created comfort conditions lesser would be the need for the mechanical devices and implicit energy consumption.

G. Appropriate Technology

Efficient design complied with appropriate technology ensures savings in cost of material as well as energy consumption. Use of locally available material saves on fuel consumption through reduced transportation requirements. Environmental imbalances are sustained in its procurement as they are locally available. Labor intensive rather than machine oriented construction process is understood by, and accessible to, even the unskilled workers, providing large employment opportunities. Site intensive production of building components make the operation decentralized avoiding the need for heavy mechanization for transport. Standardization of building components with their mass production on site combines the advantages of industrialization as well as decentralized local manufacture by allowing for manual handling along with quick assembly. Ensuring both control over quality and speed of construction. Cast in situ construction with a support system combined with an onsite prefabrication of infill is a productive combination, gaining constructively from both, without involving costly transportation, complex machinery, or large investment.

Apart from appropriate building systems and construction techniques even the very selection of materials leaves much to be desired. Energy implication of building materials from its procurement to production is important to realize. Energy consumed while preparing soil blocks is 50% less than consumed by burnt bricks. Cement's energy cost is nearly 5 times that of burnt clay bricks while mild steel is 15 times. PVC is 60 times and Aluminium is nearly 80 times. Similarly, brickwork in cement mortar consumes twice the energy than a stone wall set in lime; reinforced concrete slab consumes over four times the energy consumed by stabilized mud blocks and so on. Asbestos possess yet another kind of environmental problem. Its suspended particles in the air while its manufacture or during its use in service ducts, can prove carcinogenic. All these issues point at the careful selection of materials and techniques benefiting the contextual circumstances and climatic forces.

H. Renewable energy

Energy consumption is not simply confined to procurement of material or production of components but even extends further to include subsequent maintenance of building and comfort conditions within. Climate conscious designs achieve near comfort conditions by absorbing or amplifying external physical environment through passive means without any energy intensive implements. Thus, by reducing the energy intake required for balancing internal comfort conditions and its subsequent maintenance. The emphasis in such approaches is on resource conservation.

The other approach to energy conscious design is active interaction with nature where resource generation is the basic intent. Sun or winds seen as a productive resource to the built masses get oriented to maximize their exposure to such natural elements. May it be windmill or solar panels, oriented towards wind and sun respectively stores and transforms the incident breeze or solar radiation into forms of energy. Electricity or heat, thus, produced becomes productive resource at no environmental cost. As a matter of fact, it becomes a resource generated! Energy renewed!

A. Water Harvesting and Recycling

Water is another precious resource often in short supply and yet irresponsibly wastes. Cherrapunji the wettest spot in the world, it faces drinking water problem, and the problem is certainly not so much with adequacy of resource but instead with its management.

In early times, rain water used to get harvested by means of digging series of collective tank accumulating storm water from plains and streets of village, or by storing rainwater from the roofs and courts into basement storage tanks of every house. Water channels of Mandu or Sikri and tank system of Pondicherry or Jodhpur are reminders of such ingenious practices of creatively integrating rain water with architecture. Sad enough, such traditional wisdom appears to have literally drained off with passing time.

As per a quick estimate, if rainwater falling on an average size house is stored, in a city as dry as Ahmadabad, with a meagre annual rainfall of 800mm, it can provide water adequate for two months demand on an average size family. Not only does water stored mean water gained but also it is also useful in creating favourable microclimate through evaporative cooling. Water seeped underground helps moisten the subsoil and charge aquifers.

Water recycling after treating naturally the wastewater through aquatic weeds, plant material or fish etc. proves equally resourceful. The water thus treated is safe enough for gardening or flushing the toilets.

Obvious as these may sound; ignored as such they are in real terms. In the wake of so called modernity and progress we have consciously repelled against the older traditions including the traditional wisdom. Rather than close knit, compact city structure we continue to build in bulk isolated and disjointed buildings, which are oblivious

to their surroundings. Not only the overall distances are increased but also wasted are the extra lengths of infrastructure, transportation and communication network; straining furthers the social network – an important aspect of our sustenance.

It is staggering to note that motor car turnabouts on express ways take up the land equivalent of the living towns of near past. For instance, 40 acres of land is wasted in typical cloverleaf intersections of interstate highways in USA simply allowing maintaining high car speed turning. Ironically it amounts to the same square metres of land occupied by the medieval towns, which continue to be lived in, even today, by over two thousand families along with their shrines and shops. No wonder the habitation that amounts to only six percent of the ground cover has consumed the resources of even the remaining ninety-four. It is never untimely to learn from time. It's high time to save our human race to save our souls our own sustenance.

B. Landscape-Ecological Planning Approach

Landscape-ecological planning is a specialization within landscape planning, which focuses on spatial planning, the organization of uses and relationships of land uses to achieve precise goals like achieving sustainable development. The landscape ecological planning approach is characterized by focusing on the linkage of ecological patterns and processes to the local geographical land & climate; it also includes the actions and values of humans, and social and economic dimensions. Landscape-ecological planning adopts the landscape as the principle spatial unit of research and sustainable planning recommendations. Promoting sustainability has become an overarching regulation of land-use planning. We will focus on sustainable landscape planning, as understood through theory, classified according to a proposed typology which is applied to several existing landscape-planning frameworks/models/contexts.

For a thriving sustainable urban planning, it is helpful to organize the number of approaches, frameworks and methods currently available for sustainable landscape planning under a typology. This is not deliberate as a complete analysis or review of the subject, but fairly as a framework useful for understanding the similarities and differences between selected existing landscape planning methods in practice. The typology includes five sub categories:

(i) theoretical direction; substantive or practical

(ii) resource or intention orientations

(iii) interdisciplinary / transdisciplinary

(iv) planned orientation and

(v) spatial concepts

The two fundamental types in the theoretical direction in landscape planning are substantive and procedural. Substantive theories are descriptive and prescriptive and originate from basic research in the natural and social sciences and humanities and support a better understanding of the landscape as an interface of natural and cultural processes and articulate the ideology, purpose and principles of sustainable landscape planning. The purpose of information derived from substantive theories are structured, presented and executed by planners. An example of substantive theories is Island biogeography theory, which is applied in landscape-ecological planning. When the planning is focused on biodiversity, conservation or restoration and sustainable landscape these theories are very relevant. Substantive theories that have influenced landscape planning examples include prospect and refuge, central place and trans-active and participative theory. Procedural theories put forward recommendations for putting substantive theory into practice. Urban Planners focus on methodological issues, such as suitability analysis, optimal land-use allocation, and applied landscape-ecological planning approaches. Planners draw on substantive theories for information and guidelines but use procedural theories as a framework to organize information in a form that readily permits the more direct application of information in addressing landscape-planning problems. An urban planner should be aware of the substantive theories that guide and inform the operational methods that are applied for execution of planning.

C. Resource Or Goal Orientation

Planning can be classified according to the different goals, methods and approaches. The abiotic–biotic–cultural (ABC) model is helpful to describe the specific objectives addressed in planning and the level of integration between different goals. In this model,

- Abiotic goals include water resources, soil and air quality.
- Biotic goals focus on biodiversity in general, including individual species and habitat protection and ecological restoration.

- Cultural goals are human-based and also include: transportation, land use, recreation, historic preservation and economic goals.

An array of planning types graphically organized within a triangle that represents the ABC model is shown in Figure 1. A number of planning sectors or themes are located in the diagram according to their emphasis and level of integration within the ABC resources. The figure shows that advancement is occurring towards a more integrated planning perspective as shown by the central circle.

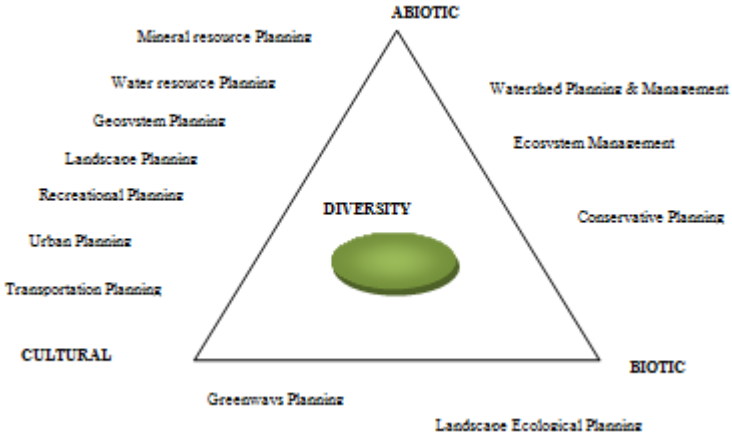

Figure 1- Representation of **A**biotic–Biotic–Cultural (ABC) model

5. Interdisciplinary and Transdisciplinary

The inclination towards interdisciplinary and transdisciplinary approach is central to sustainable planning and it provides another useful tool to understand and classify planning methods. As discussed in ABC method, planning is possibly evolving towards an integrated or balanced approach where in multiple abiotic, biotic and cultural goals are simultaneously pursued. Historically, this integration has involved knowledge and participation from various disciplines, initially under a multidisciplinary approach in which disciplines operated with minimal interaction and collaboration. Under the interdisciplinary approach, researchers and professionals from multiple disciplines collaborated, shared information and achieved a higher level of synthesis and integration towards a holistic approach. In the transdisciplinary model, planning is incorporated with more research, enabling the multidimensional views of sustainability to be understood more thoroughly with a lot of concerned disciplines, and all stakeholders including the public are involved in the process of planning and decision making. The level of transdisciplinary has become a major benchmark in rigorous sustainability planning.

6. Strategic Orientation

Methods in planning can also be classified according to their planned direction: protective, defensive, offensive or opportunistic. These strategies, in core, define the planning context related to the macro-drivers of change in a known landscape and the tactical nature of the planners' response to the development. Major strategic approach also helps to place the planning activities within the setting, which is particularly important when planning methods are transferred or adopted for use in various locations, contexts or for different applications. When the existing landscape supports sustainable processes and patterns, a protective strategy may be employed according to the selected environment.

Essentially, this strategy defines an eventual or best possible landscape pattern that is proactively protected from change while the landscape around it may be allowed to change. When the existing landscape is already fragmented, and core areas already limited in area and isolated, a defensive strategy is often taken. This strategy seeks to limit / control the negative processes of division or urbanization.

As a last option, the self-protective strategy is often necessary, but it can also be seen as a intransigent strategy which attempts to catch up with or put on the brakes, against the inevitable process of landscape change, in defensive way of an ever-decreasing nature. An offensive strategy is based on a goal or a possible landscape configuration that is articulated, understood and accepted as the vision. The offensive strategy differs from protective and defensive strategies in that it employs restoration, or reconstruction, to re-build landscape elements in previously disturbed or fragmented landscapes. This strategy is often practiced in locations where intensive land use has produced a cultural landscape with limited opportunities for nature protection.

The offensive strategy essentially involves putting nature back into the landscape, according to the identified vision or plan. It is seldom practiced because it is expensive and often politically sensitive. A landscape often contains unique elements or configurations that represent special opportunities for sustainable landscape planning. These unique elements may or may not be optimally located, but represent the potential to provide particular desired functions. This strategy is dependent on the presence of certain unique landscape elements, such as abandoned rail corridors, open spaces, streets, underutilized areas etc.

The opportunistic strategy involves recognition of particular opportunities to add with other functions to these spaces and to affect future landscape configuration to support ecological or cultural processes. An urban planner should be aware of the drivers of changes in a given landscape with respect to the goals of a particular plan. This awareness is the basis for informing the planner's choice of methods and of engaging with the appropriate participants in the planning process.

7. Spatial Concepts

The essence of planning is to have spatial concepts which guide, inspire and communicate strategy. Spatial concepts are often articulated as images, which are highly visual images understandable by the public, but which also can maintain and inspire the planning process. Even though it is very subjective and derived from intuitive thinking spatial concepts are well accepted in planning.

It is an important interface of pragmatic and sensitive knowledge through which normal knowledge is complemented with inspired insights. These concepts are essential tools for positive and can structure and inspire the planning process, with respect to public participation which is a key success factor in transdisciplinary planning. This shall be taken as a sort of strategic device package with which planners can articulate various strategies that respond to the existing landscape context and configuration and the forces and changing dynamics of landscape with the intention of planning a more sustainable spatial pattern.

This methodical approach of strategic model for spatial planning, which addresses multiple landscape ecological goals maintains large patches of indigenous local vegetation, accommodates local needs as well as their preferences. It also contains a variation of grain size, supports general and native species supports genetic variation; and creates a boundary zone. Another important spatial concept in sustainable planning is the creation of framework concept, which is based principally on existing abiotic geo-hydrological landscape patterns. Out of the many methods for sustainable landscape planning three methods are discussed briefly which are procedural methods, intended to implement the planning process.

A. Ecological Planning Model

The Planning method which addresses multiple abiotic, biotic social and cultural goals, with a focus on land use allocation is called the Steiner's Ecological Planning Model. The model has an eleven step procedure for studying the biophysical and socio-cultural systems of a place especially the landscape to expose the specific land uses which is best to be practiced. Goal establishment, implementation, administration and public participation through systematic education and citizen involvement throughout the process is also included in this model. This can be considered transdisciplinary as it involves various professionals, experts and citizens in a highly interactive and participatory planning process. The structure is adaptable to multiple strategic contexts and it employs spatial concepts in the form of various design explorations at a advanced scale. The Ecological Planning Model has been applied effectively across a range of cultural social and environmental contexts.

a) Framework Method for Landscape Planning

The Model which is presented as a series of six questions, fundamental for landscape planning is called Steinitz' Framework Method for Landscape Planning.

(i) Representation: How we shall describe the native state of the landscape in the form of types, content, boundaries, space and time?

(ii) Process: How the landscapes work with the environment? What are the different functional and structural relationships among its elements to the surrounding nature?

(iii) Evaluation: How does we judge whether the current state of the landscape is functioning well with the environment? The parameters for the assessment are attractiveness, territory diversity, cost of maintenance, nutrient flow and value, public health, creating a local image, bio-diversity, supporting various eco systems etc.

(iv) Change/Intervention: What are the interventions/steps to be taken for conserving/preserving, improving or changing the existing landscape?

(v) Impact: Using the various models we have to assess what predictable differences might the changes cause to the environment?

(vi) Decision: How is the decision to change/improve /conserve/preserve the landscape to be made effectively? How is a relative assessment to be made among the choices of courses of action?

This Framework model provides a vigorous and flexible process for analyzing, assessing the existing landscape and for engaging experts, professionals and stakeholders in a well-versed, iterative and participatory planning process. The framework is suitable to address multiple ABCD (Abiotic, Biotic, Cultural and Diversified) goals, and is adaptable to all strategic planning contexts. It shall be considered transdisciplinary as it integrates public and as well as various expert participation.

b) Framework Method for Sustainable Landscape Ecological Planning

The Framework Method for Sustainable Landscape Ecological Planning clearly addresses multiple abiotic–biotic–cultural diversified goals and resources. The outline is presented in a linear process but in reality it is nonlinear, cyclical and iterative and may be entered at any point in the process of planning. It was conceived to be transdisciplinary, as it includes scientific knowledge and also the stakeholders and citizens. The method clearly acknowledges the planned context, and relies on spatial concepts to resolve patterns of spatial compatibility and divergence. This framework method is based largely on theory and concepts of ecological landscape, and applied through spatial assessments and spatial concepts. As with Steinitz' method, this framework guides the planning process through a series of options with potential scenarios, inspire and challenge the decision-making process to link planning actions with potential outcomes. The created scenarios describe the current situation, some alternative future and the necessary steps or actions needed to link the present with the future goals. These planning scenarios are not intended to be complete plans, but are very apt for encouraging informed conversation of alternatives. The various scenarios are evaluated, with public, expert and stakeholder input before finalizing the plan. The discussion leads to a landscape plan that is adaptive in terms of implementation, monitoring, maintaining, value added and education.

c) Barriers, challenges and strategies to implement sustainable landscape planning

Regardless of the method selected or adapted for planning, significant barriers and challenges exist to the implementation of sustainable landscape plans. Major challenges among these are the uncertainty and adaptability. Uncertainty is inbuilt in multipurpose and interdisciplinary approach planning. Uncertainty exists in several principal forms relative to planning and they are geographical/spatial, temporal, process, transferability, and participatory. Experiences from previous planning projects and scientific approaches are helpful to assist the planners in reducing uncertainty which includes the collection of data, the use of data analogues, developing multiple hypotheses, and monitoring. Planners operate in the real world where there is crucial to act. The environment doesn't stop or wait while planners work to collect data to reduce uncertainty. Planning works on a target that is moving.

The adaptive approach reconceived uncertainty as an opportunity to understand by doing. For at least for the last two decades, adaptive management has been practiced in resource management, but it has not yet been widely integrated into urban planning. Adaptive management reconceived management actions as experiments that have testable hypotheses whereas traditional management hesitated to apply new policy decisions until proof of efficacy was obtained through long- and short-term empirical studies, adaptive management is a proactive method under which projects and policy decisions are used as experimental possibilities to learn by doing. Collected data made available upon the outcome of each policy decision or model implemented are used to plan alternative and future choices, attempting to reduce the amount of uncertainty and improving ecological knowledge and understanding over time period.

Monitoring the implemented planning projects and outcomes is the primary tool used to gauge the efficacy of decisions made, and is itself the subject to a wide range of ambiguity. In the adaptive approach, uncertainty lies in determining appropriate systems to choose from or populations of study, spatial-temporal scales and geographic extent of the plan. To achieve a true adaptive planning method will require a process that is completely following transdisciplinary approach. Adaptive planning requires that the planner accept a certain level of uncertainty and risk, maintain a commitment to monitoring, and perhaps most importantly, be willing to fail and learn a lesson from it to improve further planning proposals. Thresholds and guidelines represent important alternatives to adaptive planning and can support sustainable planning.

8. Conclusions

The generic guidelines for land-use planning and management that serve an important function in framing the key areas to follow the sustainable planning decisions are examining the impacts of local planning decisions in a regional context, planning for long-term change and unexpected circumstances. Planning policies also should able to preserve the native rare landscape elements and associated species. We shall avoid land uses that deplete the

natural resources over a wider area and shall make sure to retain large contiguous or connected areas that contain critical habitats for a keeping a balanced sustainable eco system. Urban Planners shall minimize the introduction and spread of non-native species in the planning proposals and avoid or compensate for effects of development on ecological processes in the region. We shall implement land-use and land-management practices that are compatible with the natural potential of the delineated plan area.

The global focus on sustainability is influencing planning theory to congregate in several aspects. There is a separate focus on spatial planning at a wider landscape scale in recognition of the extensive acceptance of significant theories from landscape design and ecology. Under the sustainability model as the goal, sectoral/zonal planning is being replaced with multipurpose planning that clearly acknowledges the vision for an integrated range of abiotic, biotic and cultural resources. The complication and scale of large scale, multipurpose planning insists for a transdisciplinary approach to address the complexity and the challenges, with the people's participation of the affected region for a meaningful adoption. If there is a boundary in sustainable planning, it lies in the development of an adaptive approach to planning in which plans are made with the best knowledge available, but with open acceptance of the uncertainty but strictly followed by a strong monitoring and re-evaluation system of plans in order to close the loop, and to learn by doing the process.

The framework is suitable to address the new multiple ABCD Planning model as Abiotic, Biotic, Cultural and Diversified goals, and is adaptable to all strategic planning contexts. It shall be considered transdisciplinary as it integrates public and as well as various expert stakeholders participation shall be adopted to achieve sustainable cities through ecological landscape planning

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