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1- Sustainable Development in Architectural and urban design

Evaluating Sustainability of Landscape Network Through Different Types of City Forms

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Open space and landscape are places that provide not only environmental improvement in a city but also functional and social needs for residents. Landscape network in a city draws its shape in association with buildings, and then it shares its urban forms

Sustainable urban form is currently one of the most debated topics in urban design. Accordingly, many comparisons of city forms and structures were based on reasonable accurate understanding of the micro structure behind such forms. Frey, H. (1999) reviewed argument for and against specific urban forms and investigated their sustainability and concluded that the polycentric structures is the more sustainable form that promises a better place and more responsive to the environment.

But, as being the negative figure that defines city form, sustainability of the landscape network relative to the city became questionable in the Frey, H.'s conclusion. The research tries to investigate the landscape sustainability -as major relative component of the city- through the polycentric structure on one hand and through other city forms on the other hand.

The study will compare landscape characteristics relatively to different forms of city, with sustainability principles concerning about landscape. It will examine the validity of the Frey, H.'s theory of sustainable city forms, pro or against sustainable landscape network.

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1-Landscape Network Definitions: Forms and Functions

1.1 Conceptual Definitions of Landscape Network and its Role in the City

To identify the related landscape network within a city; it was important to highlight the definition of landscape and its function through earlier times till recently. Hubbard and Kimball (1917) refer to landscape architecture as a primarily a fine art whose:

> "most important function is to create and preserve beauty in the surroundings of human habitations and in the broader natural scenery of the country; but it is also concerned with promoting the comfort, convenience and health of urban population, which have scantly access to rural scenery,".

This definition reflects the contact with nature landscape was essential for human morality, health and happiness. It is in the surroundings of human habitations and in the broader natural scenery of the country. Garret Eckbo (1950) defines landscape architecture as covering

> "That portion of the landscape which is developed or shaped by man, beyond buildings, roads, or utilities and up to wild nature, designed primarily as space for human living (not including agriculture, forestry). It is the establishment of relations between buildings, surfacing, and other outdoor construction, earth, rock forms, bodies of water, plants and open space, and the general form and character of the landscape; but with primary emphasis on the human content, the relationship between people and landscape, between human beings and three dimensional outdoor space quantitatively and qualitatively."

This definition is essentially concerned with site planning and relations between people and the design in the context. Thus it is more limited in scope than that of Hubbard and Kimball. Box and Harrison (1995) define natural green space in urban areas as "land, water and geological features which have been naturally colonized by plants and animals and which are accessible on foot to large numbers of residents". According to Barton, Davis & Guise, 1995 network is needed for several reasons:

1- Distribution of green spaces loses much of the value of each element.
2- Wildlife needs 'corridors' to allow species diffusion and habitat reinforcement. A sustainable landscape is one where people perceive town and country to be entwined and interdependent, not the one imposed on the other. Therefore, the open space network links through the town and out into the countryside.
3- People like attractive green 'round walks' on the urban fringes.
4- The linear forms of streams and rivers, hills and woods, form a natural framework for urban development.

Through those definitions of landscape; network in a city can be defined as network of open spaces located in the city and its borders.

1.2 Interlocking Functions of Green Network

The functions of green spaces as stated in the local agenda 21 are:

1.2.1 Access to Open Space

People should have the realistic option of walking or cycling to a range of open spaces, and then be able to walk between spaces on the green network. Standards of access will necessarily vary according to the nature, size, and density of the town (Local Agenda 21).

1.2.2 Wildlife Refuges and Corridors

Within the development brief there should be a specific wildlife strategy that identifies distinctive habitats. The wildlife 'refuges' should be as large s possible and compact rather than linear. The larger the area, the greater the likelihood of species diversity. 'Corridors' of green spaces between refuges provide stepping-stones of wildlife diffusion. The corridors should link between town and country to encourage the penetration of less urban-adapted species into the town (Local Agenda 21).

1.2.3 Energy and Pollution

Green network can also function to manage urban heat loss, grow fuel, and absorb air-borne pollutants. Shelter belts or woodland areas, for example along the crest of hills, serve the triple function of reducing wind speed, providing for recreation and for wildlife. Green spaces acts as the lungs of urban areas. In addition to changes in species composition, urbanization affects plant-environment interactions and vegetation functions in urban ecosystems. The urban forest

influences the microclimate and the atmospheric concentration of pollutants and the local carbon storage fluxes (Jo and McPherson, 1995 of Alberti, 2000).

1.2.4 Aesthetic Aspects

Another role of urban vegetation is providing critical aesthetic values and community well-being (Alberti, 2000) (Fig. 1)

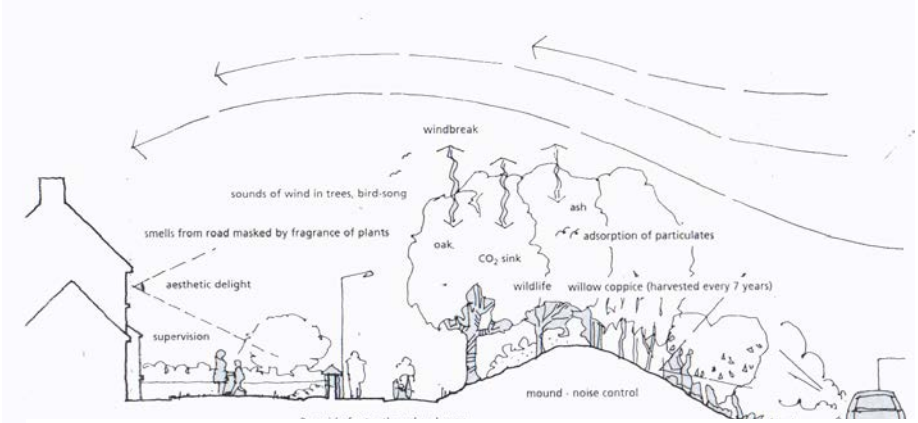

Fig 1: The interrelated functions of green spaces (Local Agenda 21)

1.3 Description of Different Forms of Landscape Networks Relevant to City Form.

From the above section, it can be concluded that landscape network is as being the negative figure that defines city forms. The city models described below represent macro-scale forms. They are concerned with the overall compactness or dispersal of urban fabric and with the concentration or decentralization of services, facilities, workplaces and green areas within the overall city form. The models are presented roughly in order of H. Frey classification of settlements form. These models are all assumed to accommodate a similar total population of quarter a million people.

The following section shows the different city forms and highlights its relevant landscape network in order to identify different landscape network forms.

1.3.1 The Core City

The core city model is perhaps the extreme concept of a compact city in which all the city's functions are packed into one continuous body with very high density and an intensive peak of activities at the center. This kind of city is clearly reminiscent of the medieval city though of much larger scale.

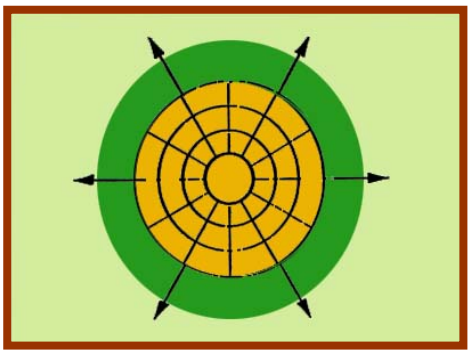

***Fig 2*:** The Core City (Frey, 1999).

Relevant landscape network:

Green spaces in the core city would generally be small and take the form of local pockets, supported perhaps by the intensive greening of some streets and squar (Frey, 1999).

1.3.2 The Star City

Another of Lynch's model is that of 'star' (Lynch, 1985) or the 'urban star'. It has a single dominant center of high density and mixed uses. Transportation routes radiate out of the center containing public transport system and the main vehicular traffic routes. Secondary centers and other uses of high to medium density are located along the public transport routes with the more intensive uses around the sub-centers, (Fig. 3).

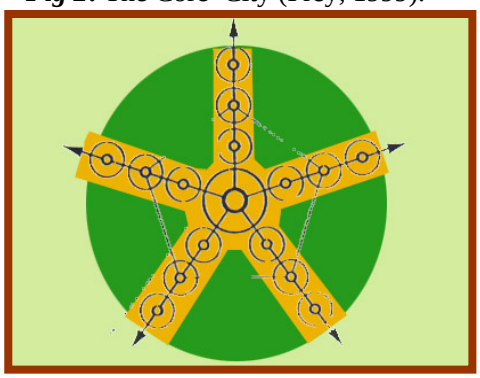

***Fig 3*:** The star City (Frey, 1999).

Relevant landscape network:

Tongues of open land, in which even low-density development would be disallowed, take up the space between the 'fingers' of the linear development, which is incorporated into the city

area. At moderate densities (less than the core), the 'fingers' might extend considerably, even to other metropolitan centers. (Frey, 1999).

1.3.3 The Satellite City

In the satellite city model (Fig. 4), a central city is surrounded, at some distance, by a set of satellite communities of limited size. Growth of the central city is channeled not into continuous development 'fingers' but into separate communities. Compact cities are generally thought to become less efficient and to provide poorer environmental and living conditions; when maximum size has been reached.

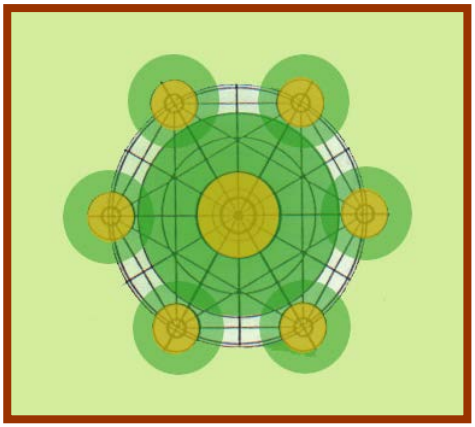

***Fig 4*: The Satellite City (Frey, 1999).**

Relevant landscape network.

Satellites are separated from the central city by rural land and are themselves surrounded by green belts

1.3.4 The Galaxy of Settlement

Lynch's galaxy of settlement represents an urban or metropolitan form in which the old center and sub-centers of today's city are, as the result of continued decentralization, dispersed into small units, each with a relatively dense central core and linked by a network of communication and transport lines (Fig. 5). This concept would then resemble the traditional neighborhood developments (TNDs) of small size of about 80 ha inhabiting between 3000-6000 people. The distance from edge to center 10 minutes walk about 600m.

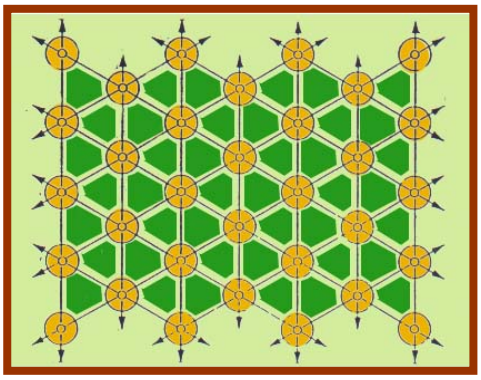

***Fig 5*: The Galaxy of Settlements (Frey, 1999).**

Relevant landscape network

The units would be separated by areas of open land.

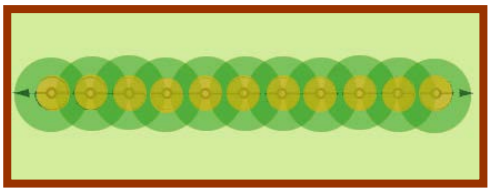

***Fig 6*: The linear city (Frey, 1999).**

1.3.5 The Linear City

The linear city (Fig. 6) grows along a continuous transport line, ideally public transport, or a parallel series of lines. Intensive uses of production, residence, commerce and services are located along and on either side of the lines and, specially, from dense nodes at transport stops. Less intensive uses are located in parallel bands of space outside the compact strips of development.

Relevant landscape network

Rural land is immediately beyond the less dense bands and in close proximity to all development, which is relatively shallow. (Frey, 1999).

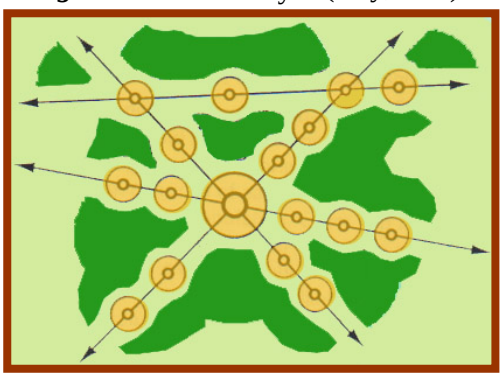

***Fig 7*: The polycentric Net (Frey, 1999).**

1.3.6 The Polycentric Net or the Regional City

Lynch's polycentric net resembles a dispersed form of the metropolis with a specialized and complex circulation system taking on the form of a triangular grid pattern that can grow in any direction. Central city activities would be decentralized over the net and concentrated in the nodes at junctions of the circulation system with different densities and degree of specialization; there would be larger and smaller centers, the first more specialized (Frey, 1999).

Relevant landscape network. Green belts and wedges would form another kind of grid (Fig.7). It is obvious that this city or metropolitan model is a composite form of other city models.

2. Indicators of Sustainable Landscape Network

Urbanization affects the structure and function of natural systems both directly, through converting the land surface, and indirectly, by modifying energy flows and the availability of nutrients and water. (Godron and Forman, 1982 of Alberti, 2000).

This part will summarize the factors that insure the sustainability of landscape network in order to identify the relative indicators to which the evaluation of landscape network is referred.

2.1 Patch Size

Fragmentation of natural patches is one of the best known impacts of human activities on the diversity, structure, and distribution of vegetation (brothers and Spingarn, 1992 of Alberti, 2000). It is known that urbanization affects patch structure by altering the size, shape, interconnectivity, and composition of natural patches. (Forman and Godron, 1981 of Alberti, 2000). Levenson (1981 of Alberti, 2000) applied principles if island biogeography to woody vegetation in some metropolitan areas and found that native species richness declined as patch size fell below 4.0 hectares.

2.2 Edge Effect

Urban-induced fragmentation is also known to generate edge effects by increasing the length of edge of patches exposed to disturbance agents. It was also documented that edges have dramatic effects on the structure and dynamic of forests. Microclimate changes associated with fragmentation (for example, light, moisture, temperature, and wind) affect the increased edge of the forest patch. (Harris, 1984; Chen et al., 1992 of Alberti, 2000). Edge effects are exacerbated in smaller patches, which have a large proportion of edge patch.

2.3 Degree of Habitat Heterogeneity

Urbanization is also blamed for homogenizing the landscape. The degree of habitat heterogeneity is considered a key factor in maintaining species than more homogeneous patches. This is due to greater variation in microclimates, soil type, and topography, and thus greater variation in habitats. For example**,** golf courses are not conducive to supporting native species. Loss of heterogeneity may be more relevant for some species that others but certainly has significant effects on species richness (Newmark, 1987 of Alberti, 2000).

2.4 Landscape Connectivity or Open Space Network

Another important factor for ecosystems threatened by urbanization is landscape **connectivity**, which may mitigate the impact of urbanization. Corridors that connect remnant patches are predicted to facilitate the movement of plants and animals, increasing their chances for survival. They also help maintain the integrity[*] of other ecological processes. For example, the integrity of riparian corridors is critical to prevent soil erosion and protect water quality (Naiman and Decamps, 1990 of Alberti, 2000).

2.5 Access to Open Space

Open space provides room for human recreation; therefore it should be located within walking and cycling distances. Local Agenda 21 stated the possible standards for recreational access as shown in the following table:

Facility	**Maximum Normal Distance/ Time**
Allotments/ shared external space	200m (barrow distance)
Playground and local green space	400/ 5 minutes walk
Park or green on the open	600/ 7.5 minutes
Playing fields	1000m/ 12.5 minutes
Natural green space (20 hectares+)	2 km/25 min walk, 8 min by bike
Open country or green lung (200 h. min)	5 km/ 20 minutes bike ride

Table 1: Possible standards for recreational access (Local Agenda 21).

[*] The debate on ecological monitoring and assessment points to the concept of ecosystem integrity. The term ecosystem integrity suggests that the attributes of ecosystem structure and functions should be metrics for measuring ecological conditions and impacts. Ecological integrity is defined as the ability to support and maintain a balanced, integrated, adaptive community of organisms having species composition, diversity, and functional organization comparable to that of natural habitat of the region.

2.6 Green Belts

Positive planning for the green spaces in and around towns may sit ill with traditional protection of the urban fringe with a green belt. A more subtle approach than just a green belt is called for, recognizing the varied and often competing demands on open land, establishing zones reflecting different priorities, and moving from 'belt' to 'wedges'. The exception when there is a need for countryside protection as the green belt is likely to be vital to discourage the expansion of commuter settlements and encourage urban regeneration (Local Agenda 21).

2.7 Degree of Urbanization

The number of species decreases with the level of urbanization. The historical center of the city had the lowest number of species and the least species diversity. Seasonal changes affected species abundance. Most species inhabit the city because of the presence of patches of their natural habitat (Alberti, 2000).

2.8 Self-Sufficiency

Urbanization modifies the composition of urban avian communities through change in climate, abundant food and water supply, increased nest sites, and smaller predictors. Habitat fragmentation creates edges and reduces vegetative cover with implications for food supply, nest placement, and predation (Blair and Walsberg, 1996 Alberti, 2000).

3. Evaluation the Sustainability of Different Landscape Networks through Mentioned Indicators.

It is now necessary to return to a more comprehensive set of evaluation criteria and to compare the city models with regard to all the sustainability of green areas indicators. The study will examine the validity of the Frey, H.'s theory of sustainable city forms, pro or against sustainable landscape network. Accordingly, characteristic of landscape networks will be evaluated according to the generally agreed sustainability indicators mentioned in section (2). Results will be then compared with the H.,Frey comparison of different city forms based on specific characteristics of urban form and structure on the city's overall performance.

It is important to note that; the comparison is carried out as a matter of principle rather than detail. Furthermore, this evaluation is not based on accurate measurements for which the available empirical data are insufficient but is based on reasonable assumptions regarding the influence of specific characteristics of urban form, structure and landscape network on the city's overall performance.

What is known at this stage is that the core city, though offering shorter distances within the built up areas due to its compact form, has not quite such a good relationship to the open country and may therefore not provide the same environmental quality as other models. Another is that the galaxy of settlements may provide open land that, because of the high degree of fragmentation of the urban fabric, is rather fragmented itself and perhaps not quite so suitable for forestry and agriculture and other large-scale uses (Frey, 1995).

Other similarities and differences emerge from evaluation of the various city models, which is presented in tabular form (Table 2).

A summary of the evaluation is again presented in matrix form. A simple scoring method is used, with simple values varying from good (+) to indifferent or neither good nor bad (+/-)and finally bad (-)For each criterion the evaluation is summarized in a single such value, which is then aggregated to a total (Table 3). This comparison helps to provide a visual picture of the potential performance values of the six city models.

The compared city models are supposed to realize the following conditions

- The overall relationship between built-up and open land is around 60% to 40% respectively.
- The average growth population density (the number of persons per hectare (pph) of city area excluding open country side to be 60 pph.
- Each model to accommodate a population of 250,000.

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Overall, and under the assumption that all models accommodate a similar population and that all criteria are given equal weight, the core city scores worst, the galaxy of settlements and polycentric net second worst, the star city somewhere in the middle, and the linear city and the satellite city score best.
However, if patch size, urban encroachment upon open land, access to the countryside, environmental conditions and the creation of green network are given higher priorities. The core city clearly scores negatively in most aspects other than the containment, the galaxy of settlements and the polycentric net are somewhere in the middle, the star city and the linear city score well and the satellite city again scores best.

4. Conclusion

The investigation of sustainable urban forms has come up with the evidence that the classification of the forms respond positively to the general sustainability criteria differs from the classification of the forms respond to the sustainability of green spaces. The following table demonstrates the difference between the two classifications (H. Frey & the above table):

Classification		Core City	Star City	Satellite City	Galaxy of Settlements	Linear City	Polycentric Net
H. Frey general	Equal weight	-1	+2	+6	+1	+1	+6
	weighted	-4	+1	+2	0	0	+3
Specified classification	Equal weight	0	+4	+7	+2	+5	+4
	weighted	-1	+4	+7	+3	+4	+2

Grade	H. Frey (general)	Specified (green areas)
First	Polycentric Net Satellite City	Satellite City
Second	Star City	Linear City
Third	Linear City Galaxy of Settlements	Star City Polycentric Net
Forth	Core City	Galaxy of Settlements
Fifth		Core City

This knowledge provides a useful basis for exploring new patterns and interactions that occur in urban ecosystems. However, current evidence is inadequate to draw conclusions about the ecological performance of various urban forms. Further empirical research is needed before it is possible to assess the ecological sustainability of alternative forms. For example, the following questions need to be addressed:
- How do ecological conditions vary as a function of alternative urban patterns?
- At what scales are various ecological processes controlled in urban ecosystem?

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