ANALYSIS OF SUSTAINABLE URBANISM THEORIES

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Annotation. *This article reviews the main approaches to the theory of sustainable urban planning and their practical examples in a scientific and analytical way. Considering cities as complex adaptive systems, the principles of landscape ecology are applied. In Ian McHarg's concept of Design with Nature, landscape layers are adapted using a layered GIS method. Richard Forman developed landscape ecology and promoted a mosaic system based on the patch–corridor–matrix mode. Jane Jacobs considers cities as "organic complexity" and favors decentralized development, harmonious with the natural flow of the population. Jan Gehl advocates the strengthening of pedestrian and public spaces, putting the human factor in the forefront of urban design. Peter Calthorpe emphasizes the integration of transport and landscape in cities through the Transit Oriented Development model. Timothy Beatley, who also put forward the concept of biophilic urbanism, believes that the enrichment of the city with nature (i.e. parks, trees, greenery) is necessary for human health and social well-being. The article analyzes the experiences of Germany (Freiburg–Vauban), Denmark (Copenhagen), Singapore ("City in Nature"), the Netherlands (Rotterdam), the United States (Portland, New York), and Sweden (Hammarby Sjöstad) and explores landscape approaches to sustainability.*

Keywords: *Sustainable urban planning, landscape ecology, complex system, GIS, biophilic design.*

Introduction. The processes of urbanization of the 21st century require cities to be considered as complex economic-social-ecological systems. Modern research emphasizes that the city is a complex adaptive system. In this approach, the city consists of ecological, economic and social layers, the interrelation of which leads to the emergence of new system properties. Therefore, the concepts of sustainable urban planning are combined with the principles of natural landscapes. Ian McHarg (1969) in his work Design with Nature proposes a methodology for combining engineering design with landscape layers[1]. His main idea is to analyze the ecological potential of each area (soil type, hydrology, vegetation) and develop plans accordingly. McHarg says: “Man is a conscious being and must manage the biosphere. To do this, he must design in harmony with nature”. To this end, McHarg recommends combining several landscape layers into one layer (graphic overlay) using a geographic information system (GIS).

The main part. Sustainable urban planning is an approach aimed at the ecologically, socially and economically balanced development of cities. In recent years, cities have been interpreted as Complex Adaptive Systems: where social, economic, technological and

environmental factors are dynamically and non-linearly interconnected, leading to unpredictable outcomes. For example, according to Abujder et al. (2025), “cities should be conceived as Complex Adaptive Systems (MAS), whose non-linear socio-economic-environmental interactions produce unpredictable outcomes”. From a sustainability perspective, approaches that take this complexity into account are needed: that is, urban planning should be formulated through a layered systematic (landscape, infrastructure, community) analysis. In this regard, complex systems theory and landscape ecology become the main theoretical criteria for modeling sustainable urban planning.

Below is an analysis of the methodology of scholars who have played a key role in sustainable urban planning.

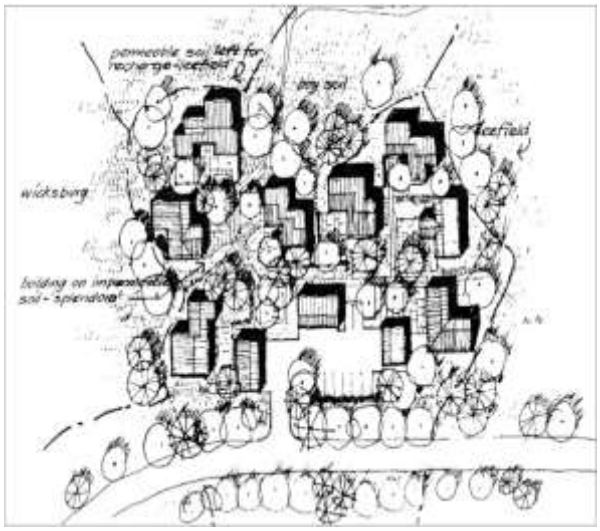

Figure 1. Design with Nature: Ian McHarg’s ecological wisdom as actionable and practical knowledge

Ian McHarg (1969): McHarg introduced the methodology of creating soil, water, waste and landscape layers in his book Design with Nature. His thesis is that each place-based plan should take into account (ecourban sustainability). McHarg says: “Man is the only conscious being, he is the manager of the biosphere. In practice, McHarg proposes the creation of layers (need-overlays) based on GIS (geographical information system), which will determine which zones are suitable for residential, industrial or green areas.

Richard Forman (1995, 2002): Forman is a founder of landscape ecology and has advanced the concept of the mosaic landscape. His patch-corridor-matrix model is applied to national planning and urban planning. According to Forman, each landscape patch (vectorized image) is classified as a patch, corridor, or matrix; their proportions and connections determine the overall landscape pattern. Forman also identifies four essential elements for a good landscape structure: large forest patches, wide corridors, patch connections (for species movement), and small “nature pulses” in urban areas. This principle emphasizes the biodiversity and ecoconnectivity of green infrastructure in urban planning.

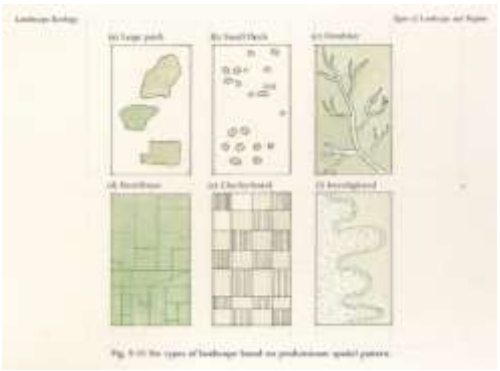

Figure 2. Forman Watercolor Diagrams.

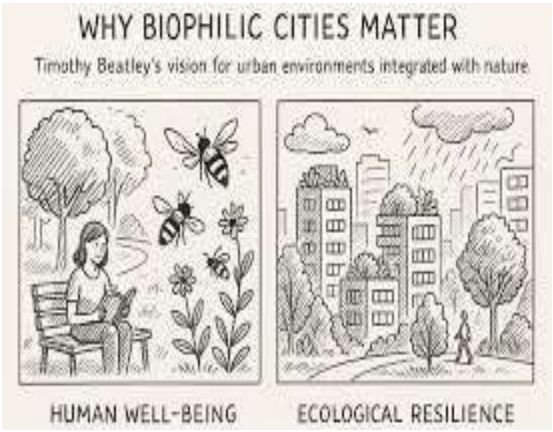

Figure 3. Timothy Beatley and Biophilic Cities

Timothy Beatley (2000–2021): Beatley pioneered the concept of biophilic cities, emphasizing the increased access of nature to cities. She notes the biological affinity of humans for nature (“biophilia”) and argues that “natural elements in the city provide measurable benefits”: productivity, mental health, stress reduction, and creativity. Her work emphasizes the integration of agrarian landscapes, lakes, and forests into the city.

Jane Jacobs (1961): Jacobs sees the city as a complex, decentralized system. She argues that city streets should be lively, multi-purpose, and pedestrian-oriented. According to Jacobs, “cities are organic complexes” that are optimized by people and local processes. Jacobs resented the rigid corporate approach of traditional planning and advocated for natural growth in decentralized, discrete blocks.

Jan Gehl (1987, 2010): Gehl prioritizes the human factor in urban design. He advocates for walking, cycling and walking spaces in cities. He believes that “if cities are to be orderly, safe, sustainable and healthy, planning and architecture must be designed to promote walking”.

Figure 4. Jane Jacobs - Jane's Walk Vienna

Peter Calthorpe (1993–2009): Calthorpe pioneered the concept of Transit Oriented Development (TOD). He defines TOD as “regional planning, urban regeneration, suburban regeneration and pedestrian neighbourhoods rolled into one project”. The idea is to create neighbourhoods where people can easily reach places such as work, services and entertainment by foot or public transport. According to Calthorpe, “building a pedestrian-friendly environment near transit is the key to moving communities away from car-centric environments”. He believes that “dense clusters near transit hubs.

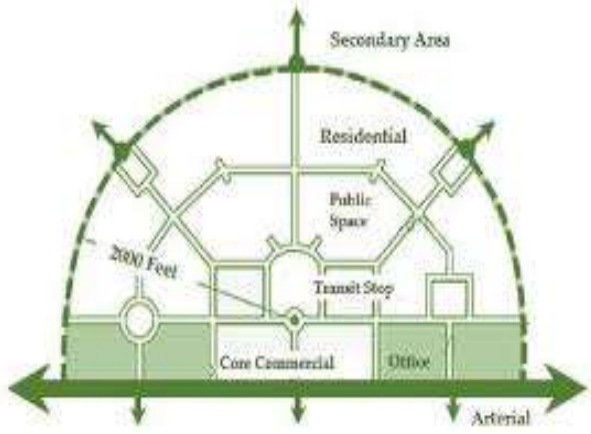

Figure 5. Concept of transit-oriented development (TOD).

The methodology for sustainable urban planning encompasses a wide range of tools and techniques. The following are key:

GIS (Geographic Information System): GIS is an essential tool for planning urban plans based on interactive maps. GIS is used to analyze the various layers of the Earth’s surface (land, water, vegetation, climate, transport, population density, etc.). For example, New York City uses GIS extensively in its land use and environmental planning, while Singapore has used digital mapping as a powerful tool for sustainable development. GIS can be used to model landscape analysis, heat island effects, water retention, and green space growth at the city scale.

Landscape analysis and landscape adaptation model: A landscape analysis is conducted for each area based on soil, biodiversity, climate, and anthropogenic impacts. Here, the patch-corridor-matrix model is used to identify vegetation patches and corridors. Also, based on Forman’s “Four Necessary Patterns” principle, large green patches and green corridors (cloud gardens, urban forests) passing through them are designed, which support the movement of diverse animal and plant species. Landscape analysis evaluates urban landscapes in the context of the ecosystem.

Biophilic design: According to Beatley’s approach, it is necessary to incorporate elements of nature and biological forms in the design of buildings and spaces. For this purpose, the creation of flight reserves (bird corridors), roof gardens, green walls, and landscaped open spaces is recommended. Biophilic design is an attempt to make urban environments “humane” by taking into account the natural appearance and feelings that humans enjoy.

Residential development and microprojects: Designing cities with community participation

Housing and micro-projects: Cities should be designed with public participation. In Germany, for example, the Vauban district of Freiburg built freely planned housing with public participation (electricity-efficient properties in accordance with Passivhaus requirements). Such street and public space planning methods are also principles used in the methodology.

Indicators and monitoring: At each project stage, certain indicators are needed to check the effectiveness. For example, the share of green spaces, the percentage of bicycles in the transport structure, the possibility of inland swimming, the air quality index, the number of public parks, etc. are taken as indicators. Their measurement and monitoring help to assess the level of sustainability.

Conclusion. The article analyzes the complex systems and landscape approaches of sustainable urbanism. The ideas of integrating people and the city with the natural environment - from McHarg's layered planning to Calthorpe's TOD - provide advanced methods for sustainable urbanization. While McHarg and Forman emphasize the development of plans based on landscape ecology, Jacobs and Gehl propose the creation of people-centered, vibrant neighborhoods. Beately considers it necessary to introduce additional green spaces into the city through the biophilic concept. As can be seen from examples from

different countries, these principles are also being confirmed in practice. Projects such as Freiburg, Copenhagen, Singapore and Hammarby have achieved sustainability by expanding green infrastructure. PRESIDENT: The above studies show that urban planning concepts developed based on ecological landscape principles allow for the integration of both economic and social development of the city. Furthermore, a complex systems approach can increase the resilience of the city and contribute to the sustainable use of resources. From a scientific perspective, sustainable urban planning should combine natural landscape analysis, GIS, environmental indicators, and public participation. This article, based on the research and practical examples provided, calls for a more integrated and participatory approach in the future.

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