Anthropocene Cultural Landscapes for Sustainability

Cultural landscapes emerge from the artificialization of nature and the opening of the land, resulting in a landscape that conforms to the culture and the availability of technologies, thus creating a whole system with either higher or lower levels of life quality and sustainability. Three central elements operate interactively in the construction of cultural landscapes: the territory, the social actors who act in the territory, and the articulators (e.g., technology and regulations). The construction of cultural landscapes gives rise to a gradient of territorial typologies, including wildland, rural and urban, which have different requirements and consumption of resources and energy.

1. Introduction

In the Anthropocene, humans have become the dominant force behind the transformation of territories and the construction of cultural landscapes[1][2]. Territorial problems and the increasing degradation of social-ecological systems demonstrate, however, that we may lack the capacity to properly direct this force in order to construct landscapes that last over time[3][4]. A landscape, as part of a worldview, is produced intellectually and materially by a certain social group[5]; a cultural landscape can be considered as a complex geographic reality, existing in historical time, that functions as a system of energy, material, and information flow interwoven in real, perceived, and symbolic ways[6]. It has been increasingly acknowledged that whole-system approaches are required to inform national and international agendas dealing with climate change, social-ecological degradation, and poverty in the Anthropocene[7]. Such whole-system approaches should overcome epistemological barriers between the natural sciences, social sciences, and the humanities, and deal with techno-economic and political realms in which decisions concerning territories are implemented[8].

In the last 50 years, a paradigm shift has occurred in science with the emergence of the paradigm of complexity[9], and so-called complexity science, in which the study object evolved from separate components to a focus on the whole[10][11][12]. This shift has meant that many researchers no longer focus on linear and deterministic processes but rather on self-organized networks of interactive actors that give rise to complex systems[13][14][15]. This approach tried to overcome the limitations of mainstream scientific knowledge, which posits the objectivity of scientific truths, acknowledging the need for a comprehensive and contextual approach dealing with uncertainties[8][10][16][17]. This paradigm shift also allowed addressing issues such as human social learning based on intentional and adaptive collective cognition in the construction of sustainable cultural landscapes[3][8][18][19]. During the last decades, researchers from different fields have nurtured the theory, principles, and methodologies of complexity science and its applications. Morin[9], for example, proposed a general theory of complexity for contemporary science; Capra[20] proposed understanding life as networks of relationships at different levels; Padua [21] defined environmental history as an open, non-reductionist investigation of the interrelationships between social and natural systems over long periods of time. The concept of the cultural landscape is a whole-system study object, fundamental to comprehensively understand current transformations and evolutionary dynamics of territories[22][23].

2. Artificialization and the Construction of Cultural Landscapes

Artificialization is the transformation of nature by human interventions, causing a different and dynamic state of the ecosystem and its natural components (e.g., soil, water, trees, or a forest, meadow, mountain range, coastal border). The result of artificialization is cultural landscapes, which are different from the most likely state that the ecosystem would have achieved without human intervention. Throughout human history, the prevailing trend has been the intensification of the artificialization of nature. The development of agriculture and the subsequent emergence and construction of the first cultural landscapes took place around 11,000 years ago, when humans started tilling the land and farming cereal grains and other cultivars, marking the beginning of the expansion of the anthropogenic border[24].

The artificialization of nature is facilitated by the action of operators (i.e., the necessary stimulus in a system to change from one state to another in a certain period) with a certain amount of work and a certain probability of success[25]. The process of artificialization is geared toward the conquest of niches and the optimization of the anthropogenic channeling of goods and services, extracting and incorporating elements into the ecosystem, often simplifying it structurally and functionally[1]. Three elements interact in the process of constructing a cultural landscape: the territory with its natural and anthropogenic components, the social actors who act in the territory, and the articulators (e.g., technology and regulations) of the interaction between the two previous elements. The characteristics of these three elements differ between societies, according to their own cultures and local ecosystems, giving rise to a diversity of cultural landscapes in the world. A cultural landscape, in its space-time territorial expression, can be represented symbolically as:

$$P = f(S, \Sigma, \phi, \sigma a)$$

where:

- S is space-time;
- Σ is territorial units with social actors inhabiting and acting there;
- ϕ is flows within each territorial unit and between the territorial units;
- σa is the system's total response (output).

Each society establishes a relation of mutual adaptation with local nature[26][27] within the complementary processes of humanization (artificialization) of nature and naturalization of the human[28]. Naturalization is the reverse process of artificialization in the construction of cultural landscapes.

3. Metabolism of Cultural Landscapes

The cultural landscape organizes itself in a process of artificialization, resulting in a complex system that is far-from-equilibrium. The theory of dissipative structures[20][29][30], explores the dynamics of such systems, in which order and disorder complement each other[29]. Dissipative structures correspond to situations in which the dissipation of energy in the system can provide clues for a local order at the expense of the growing chaos in its environment. At the same time, total entropy keeps increasing according to the second law of thermodynamics[20][29]; in this way, the order "floats in disorder". For example, living organisms take ordered structures (food) from their environment, use them as resources for their metabolic processes, and dissipate lower-order structures (waste) into the environment. Living organisms are constantly kept in a state that is far-from-equilibrium but stable, maintaining their general structure despite the incessant flow and change of components. Prigogine's concept of dissipative structure includes the idea of points of instability and bifurcation, in which the behavior of the system is unpredictable and depends in part on its history. These instabilities can lead to the spontaneous emergence of new forms of order, that is, self-organization[20]. Prigogine's theory of dissipative structures provides a theoretical basis to explain the socio-cultural dynamics and mutations that seemed inexplicable in terms of energy flow or the effect of adding instability to human ecosystems[31]. Moreover, a condition that is far-from-equilibrium will be associated with a more significant potential for innovation, and thus a greater potential for adaptation[32].

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