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# Hyperfeedback: meliorization regulation mechanism towards sustainable development based on landsenses ecology

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## ABSTRACT

The theoretical research and practice of sustainable development based on landsenses ecology are carried out through the overall framework mechanism of meliorization and process regulation. This kind of mechanism is denoted as hyperfeedback mechanism of meliorization towards sustainable development, or hyperfeedback for short. Based on the basic idea of landsenses ecology and meliorization approach, this paper expounds the hyperfeedback and related aspects, puts forward the concept and characteristics of hyperfeedback system, and illustrates a platform framework for the meliorization simulation and management of hyperfeedback system.

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Landsenses ecology; sustainable development; social-economic-natural complex system; meliorization; regulation; management; hyperfeedback mechanism; hyperfeedback system

After a long time of joint efforts and concerted action, the international community has achieved rich theoretical results and practical experiences in the field of sustainable development. These theoretical results and practical experiences provide a good basis for the realization of international sustainable development goals. The urgent demand of international sustainable development and the new situation of rapid development of science and technology need us to try some new ways or establish some new frameworks to study the theory and practice of sustainable development.

## 1. Landsenses ecology and social-economic-natural complex ecosystem

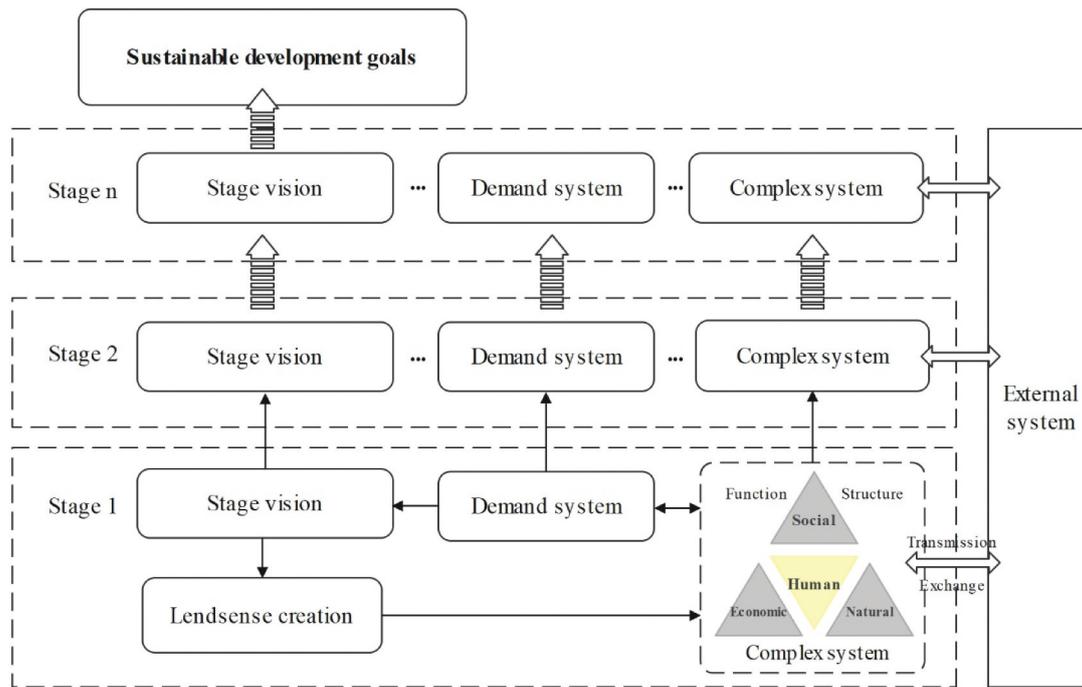
Landsenses ecology was defined as a scientific discipline that studies land-use planning, construction, and management toward sustainable development, based on ecological principles and the analysis framework of natural elements, physical senses, psychological perceptions, socio-economic perspectives, process-risk, and associated aspects (Zhao et al. 2016).

For a system under study, landscape ecology should first clarify the vision or in other words the development goal of this system, and then carry out landsense creation to the system (carrier) according to the vision. The process and result of landsense creation should make people produce corresponding resonance via their senses and cognitions and form corresponding common behavior, and then realize or tend to the vision (Zhao et al. 2020).

Shijun Ma and Rusong Wang put forward the concept of social-economic-natural complex ecosystem in the 1980s (Ma & Wang, 1984; Ma 1981). They believe that many major social problems are directly or indirectly related to the social-economic development and the natural environment on which humans depend. Social system, economic system, and natural system are three different systems, but their survival and development are restricted by each other's structure and function. Therefore, they must be considered as a complex system, i.e., social-economic-natural complex ecosystem. The two scholars further elaborate the basic principles and application approaches of social-economic-natural complex system by using the rural area, urban area, and region as practical examples.

In order to facilitate the follow-up analysis and expression, we denote the social-economic-natural complex ecosystem as complex system for short.

Within a complex system, the three subsystems of society, economy, and nature are interdependent and restrict each other and form this complex system through the coupling of human factors. Population and the occurrence, development, and change of its related problems directly affect the relationship between the subsystems as well as the transmission and exchange of material, energy, value, and information, thus affecting further the structure and function of the complex system and the realization of sustainable development. Therefore, we need to study the sustainable development of complex system through people's 'demand system'.



**Figure 1.** The demand system and sustainable development.

At the same time, there is a wide range of material, energy, value, and information transfer and exchange processes between a complex system and its external system, which depends on the complex system itself, the external system, and the relationship between the complex system and the external system.

For the sustainable development of complex system, landscape ecology is adopted to study how to carry out the landscape creation to the complex system under the vision or goal of sustainable development so that people in the complex system can have corresponding resonance and form corresponding common behavior to the vision, and then push and ensure the complex system to move forward along the vision of sustainable development.

## 2. The demand system and sustainable development

‘Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ ([WCED] World Commission on Environment and Development 1987).

From the perspective of landscape ecology, sustainable development can be further understood as a development mode that provides sustainable welfare for the present and future generations while maintaining, improving, and increasing the capacity of ecosystem services (Zhao et al. 2020).

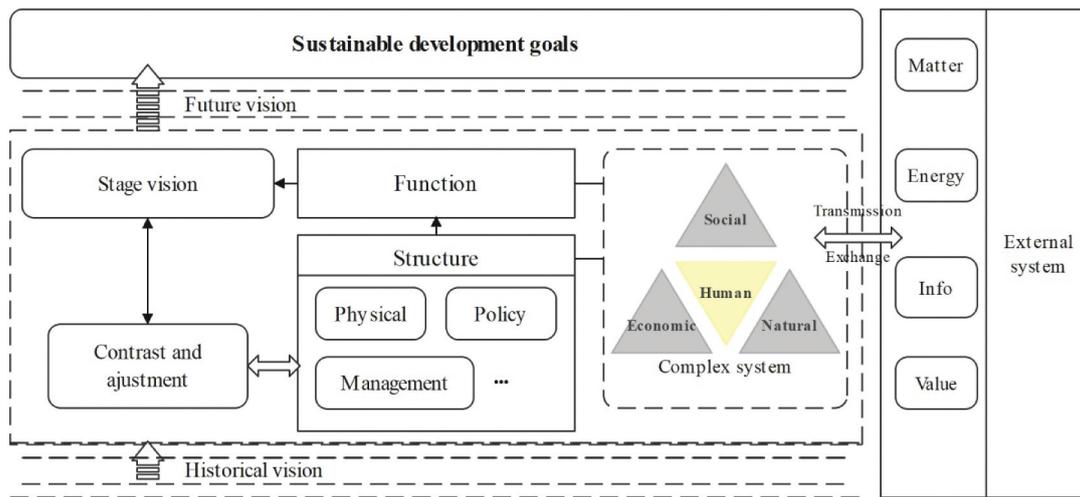
This description of sustainable development directly highlights the relationship among ecosystem services, needs, and welfare, which directly enables

people to experience and understand the process of vision-landscape-landscape creation-resonance-vision. At the same time, it also enables the theoretical research of sustainable development and the practical application of its fruits to be carried out more directly. It should be emphasized that the ecosystem services mentioned here refer to the physical or material quantity of ecosystem services, not the value or monetary quantity of ecosystem services. The assessment of the value or monetary quantity of ecosystem services often blurs or even deviates from the purpose and original intention of ecosystem services assessment.

The composition and weight of people’s ‘demand system’ are changing with the development of the times. In a sense, sustainable development is an endless continuous process with ‘ultimate goal’ but no end. Sustainable development goal presents a dual attribute, that is, the consistency of the overall direction of sustainable development process and the stage characteristics of specific goals.

The stage goal of sustainable development, or in other words, the stage vision of sustainable development should be formulated by comprehensive analysis and weighing of the development status of social economy, science, and technology, people’s demand system and other factors at this stage (see Figure 1).

The process of sustainable development is to promote the overall direction and goal of sustainable development in the process of realizing a series of stage vision. The process of sustainable development is essentially a process of meliorization. The direction, long term, and process of sustainable development determines its own characteristics of meliorization.



**Figure 2.** The overall meliorization framework of sustainable development of complex system and the hyperfeedback mechanism.

The core of the meliorization model is to pay attention to the operation process of the complex system, and make timely and necessary management and regulation of the complex system according to the operation status of the complex system so that the complex system can run in the direction of sustainable development.

### 3. The overall framework of meliorization of sustainable development of complex system and the hyperfeedback mechanism

Sustainable development of complex system is the core of landsenses ecology. Landsenses ecology is an effective way to study the sustainable development of complex system.

The sustainable development of complex system is an endless continuous process with 'ultimate goal' but no end. In this process, there are many elements and complicated structural relationships in the complex system, and many uncertainties and unknowns in the internal and external relationships of the system as well, so it is necessary to use the overall framework of meliorization to study the sustainable development of the complex system.

The core content of meliorization framework is that in order to ensure the overall direction of the sustainable development of the complex system and the realization of the goals or visions of each stage in the process of sustainable development, it is often necessary to adjust the structure of the complex system so as to improve the overall function of the complex system to achieve the goals or visions of each stage. Such adjustment of the structure of the complex system refers to the necessary and timely adjustment of it done according to the comparison and feedback of the results and possible results of the operation of the complex system with the established stage goal (vision) of the

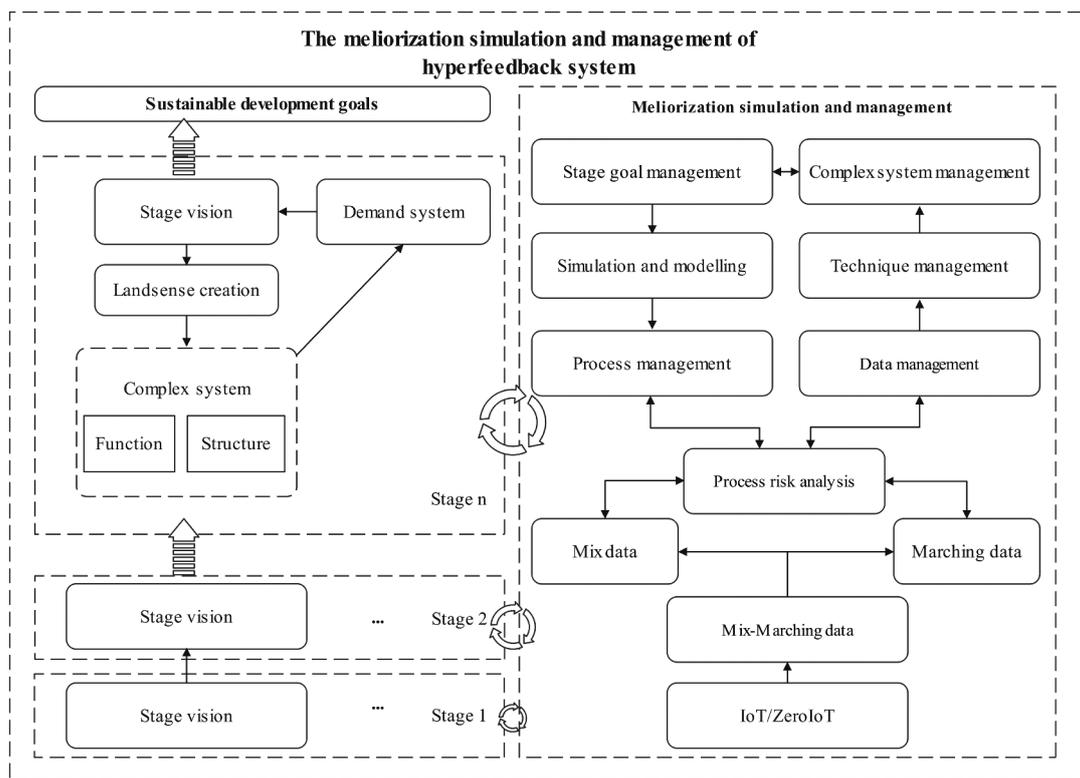
complex system in the process of promoting sustainable development. This kind of adjustment to the structure of the complex system can be carried out simultaneously from one or all aspects of the physical structure, policy structure, management structure, etc., according to the actual needs so as to improve the overall function of the complex system towards the goal or vision (see Figure 2).

Through this feedback regulation mechanism, the operation results of complex system will better tend to or be meliorized towards the established development goals or vision of complex system. We denote this feedback regulation mechanism through the process of meliorization and the overall regulation mechanism as the hyperfeedback regulation mechanism for sustainable development, or hyperfeedback for short. Accordingly, the complex system with this kind of hyperfeedback is denoted as the sustainable development-oriented hyperfeedback system, or hyperfeedback system for short.

Hyperfeedback system has two characteristics. First, hyperfeedback can adjust and change the structure of the complex system, and then 'meliorize' the overall function of the complex system, even if the results of the operation of the complex system better tend to the development goal or vision of the complex system at the given stage. Second, the subsystems or elements of the complex system will respond to the hyperfeedback in time, that is, these subsystems or elements will respond to the hyperfeedback adaptively based on the general rules or ways of organizational growth, such as the complex interrelationship between them.

### 4. The meliorization simulation and management of hyperfeedback system

The realization of the goal of hyperfeedback often needs to go through the process of multiple feedback



**Figure 3.** The meliorization simulation and management platform of hyperfeedback system.

regulation, which is determined by the complexity of the hyperfeedback system.

In order to formulate the overall implementation plan of the sustainable development of hyperfeedback system and effectively manage the process of the sustainable development of the hyperfeedback system and the corresponding goals and visions of each stage of the process, it is necessary to build a 'meliorization simulation and management platform of hyperfeedback system' by comprehensively using various relevant science and technology. Through this platform, we can simulate the hyperfeedback system and manage the whole process of improvement timely and effectively. Figure 3 shows a framework of 'meliorization simulation and management platform of hyperfeedback system'.

The 'meliorization simulation and management platform of hyperfeedback system' includes the dynamic processes of the sustainable development of complex system as well as the trending simulation and management, both of which are continuously moving toward the 'ultimate goal'. The platform effectively controls and oversees various data sources in the sustainable development process of the complex system of mix-marching data. It uses stage goal management, simulation and modelling, process management mechanism and relevant science and technique to ensure the structure and function of the complex system to be capable of meeting the demand system.

It should be pointed out that due to the diversity and complexity of the components of the hyperfeedback system and their relationships, and the process and long-term nature of sustainable development, the 'qualities' of various supporting data or information needed to comprehensively and systematically analyze, study, and regulate the hyperfeedback system is basically inconsistent, and some are uncertain or even missing. That is to say, the supporting data or information are mix-marching data. The characteristics of mix-marching data determine that the management of hyperfeedback system requires corresponding process risk analysis, and also determine that the system simulation in the normal sense cannot be directly transplanted to the meliorization simulation and management of hyperfeedback system.

### Disclosure statement

No potential conflict of interest was reported by the author(s).

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