

# The Study of Sustainable Development of Real Estate Based on System Dynamics

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**Abstract:** This paper explores the concept of sustainable development and its ecology implications in real estate industry. The successful of the sustainable developing is to strike a balance among economic development, environment protection and social promotion. Based on system dynamics, the inter-relations of factors within the sustainable development of real estate environmental issue were analyzed. This paper describes the use of this framework to provide suggestions and identify innovation approaches of the environment.

**Key words:** Sustainable development; Real estate industry; Ecology; System dynamics

## 1 Introduction

The real estate industry is a fundamental factor of the national economic development, compared with other industries. Since its leading and basic characteristics, the real estate industry development has the effect of "barometer" or "cold and heat meter" to the national economics. Therefore, the sustainability of real estate development, has a directly effect on the entire national economy and sustainable development of society.<sup>[1]</sup>

Following the Brundtland Commission report in 1987, which defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"<sup>[2]</sup>

There are three different directions in sustainable development of real estate: the direction of economics, sociology and ecology. With its different development stages, different direction emphasis is put on :at the early stage ,the need for economic growth is more important ,but not the environmental issue at the first place ;at the period of rapid development<sup>[3]</sup> ,the balance of social development ,social distribution, interests equilibrium is as the key concern ;when human civilization awareness reaches a certain stage ,the ecology direction of sustainable development becomes more apparent. Here again, however, social concerns have been secondary to environmental issues. The important indicator and basic principles are trying to have a harmonious development between environmental protection and economic development.

The sustainable development of real estate industry currently focuses on the following points:

[1] Considering the ecology direction of sustainable development in real estate, the papers have the analysis of current developments and give policy recommendations after qualitative explaining.<sup>[4]</sup>

(2) Taking the economic direction of sustainable development into account, these papers have both the qualitative and quantitative analyses on the real estate sustainable development from the perspective of supply and demand of the market.<sup>[5-7]</sup>

(3) Establishing the real estate evaluation index system of sustainable development, and having analysis with AHP.<sup>[8]</sup>

(4) The study of Evaluation Index System of green building, including BREEAM of UK, LEED of US et al. bringing and reconstructing these systems with China's actual conditions.<sup>[9-10]</sup>

Sustainable development should be coordinated with the environment capacity on the basis of natural resources. Since real estate is the unity of land and housing, it not only has the basic attributes of natural resources, but also the material base and condition to social economics. The sustainable development shall take great importance on the dependent relationship between human and nature after influencing the ecology, warning people not developing the social and economy at the expense of damaging natural ecosystems. When mentioning the sustainable development in real estate, we mean its wide complex complication concerning such factors as the nature, economy, population and society etc.

System dynamics is a comprehensive method to achieve goal, which study how to coordinate and manage the interconnected subsystems and factors<sup>[11]</sup>.The requirements for the data are relatively low, and different parameters of the system input can examine the different status and trends.

The purpose of this paper is to focus on the ecology direction of sustainable development in real estate industry, After analyzing the inter-relations of factors within the sustainable development of real

estate, a system dynamics model of sustainable development is set up with the use of system theory to make the sustainable development quantified, which includes the economic subsystem, the environment subsystem, social subsystem and the influencing subsystem. The specific objectives involves achieving objectives in the realms :the structure ,speed and size of The real estate industry maintain coordination with other industries ;the scale, speed should adapt to the capacity of ecological environment ,provided that the virtuous cycle use and sustainable utilization of land resources.

## 2 System Dynamics Model

The object in this paper is to research China's real estate industry, while system dynamics model involves many factors, which needs historic data and inter-relationship and takes much energy .In this stage, we only take commercial housing in urban real estate secondary market as the target.

The dynamic model consists of five parts: socio-economic subsystem, land resources subsystem, policy subsystem, environment subsystem, resource subsystem (see Figure 1) .

Subsystem analysis is to get the different factors and subsystems interaction and feedback mechanisms, through this local details` research, to reveal the nature and the sustainability of the whole system.

### 3.1 Socio-economic subsystem

Social subsystem means such factors as policy implementation, industry systems and technological progress in the system have a great impact on the sustainable development process; The sustainable development in real estate industry will in turn act on the social development, which has the relationship of mutual influence and mutual restriction.

Economic subsystem is the driving force for the sustainable development in real estate industry, which enables the system to conduct normally and orderly. Since it can effectively promote the input and use of land resources which meets the needs of the social system, a healthy ,sustainable and stable development would not achieve until taking the social, economy and ecology into consideration.

### 3.2 Environment and resource subsystem

Residential development must be carried out under constraints, limited human resources and environmental capacity. So the ecosystem must be included in the whole system, especially in the current situation that society and economy develop rapidly, the resource consumption is great and environmental damage is high.

### 3.3 Land resources subsystem

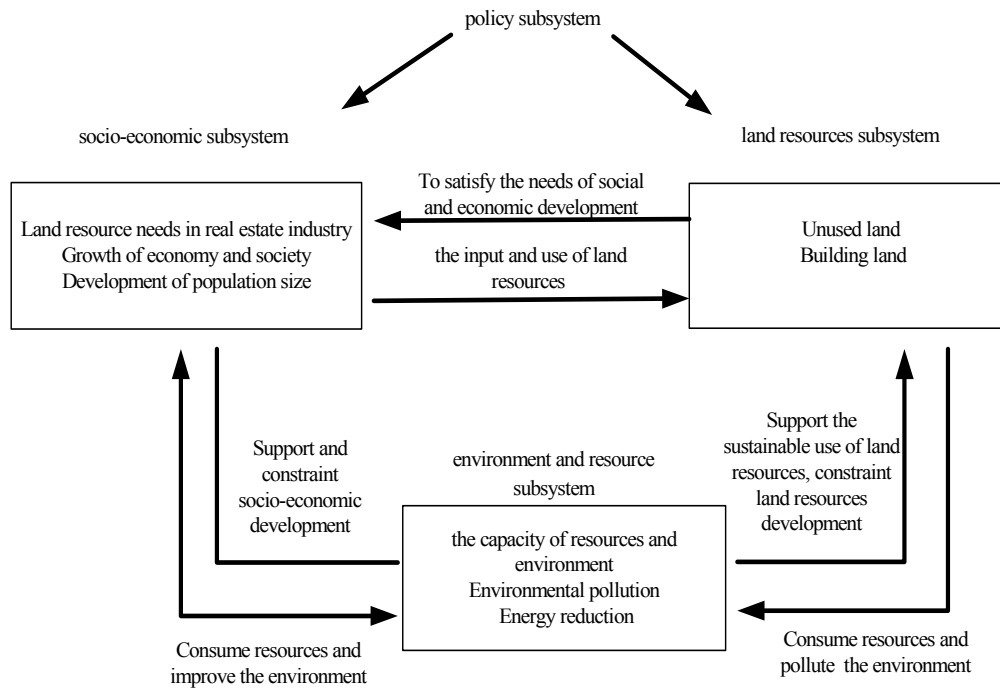


Figure 1 System Dynamics model system

As the basic element for social and economic development, land is a finite resource, irrational use of resources will lead to pollution and depletion, and ultimately lead to have serious consequences for social and economic development. In consequence land resources and socio-economic interaction mechanism is essential.

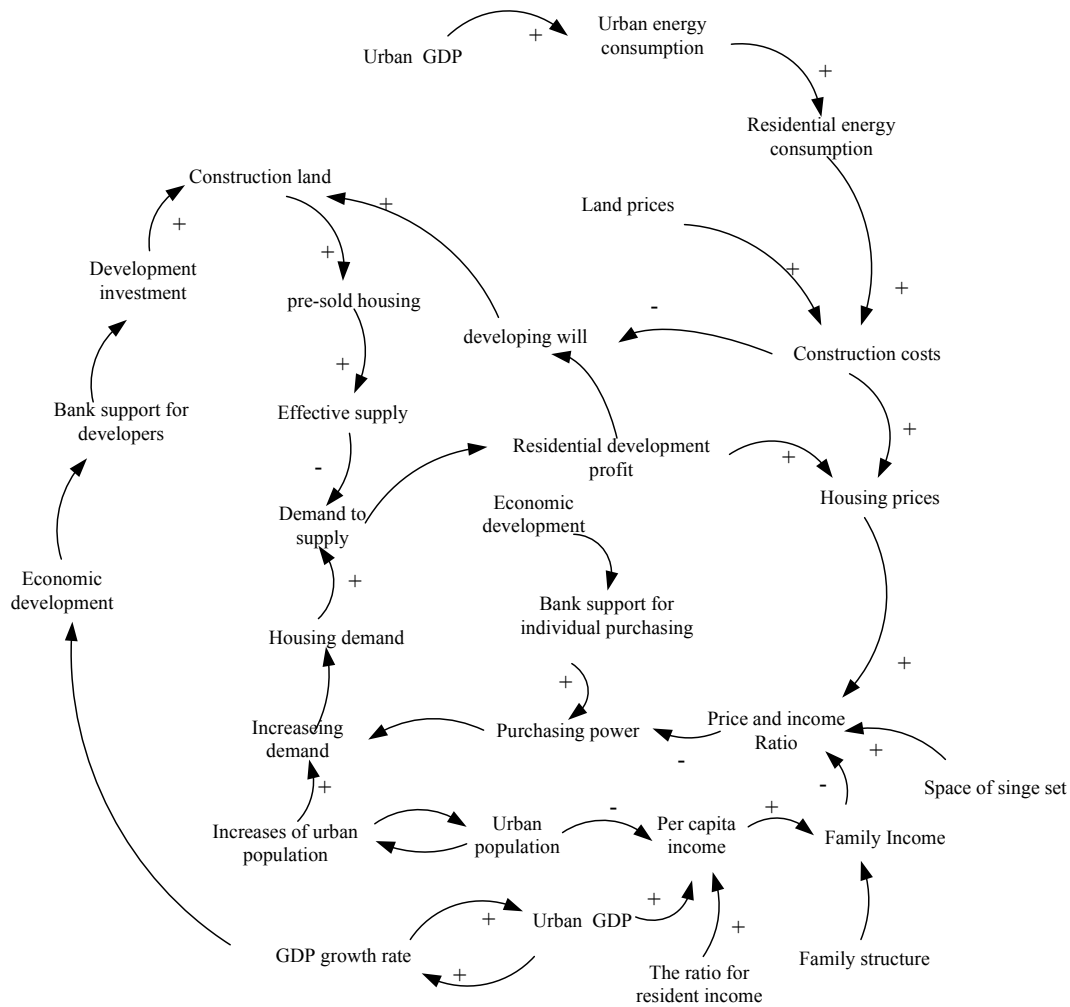
**3.4 Establishment of cause-and-effect relation**

Economic growth stimulates social needs: economic growth increases housing demand, then drives the development through demand circuit.

Economic growth stimulates environment needs: economic growth increases residential energy consumption and damages the environment.

Ecology system affects the socio-economic system: housing price has the corresponding increase as residential energy consumption increases, and suppresses housing demand through demand circuit.

A total of 20 main variables selected to build the system dynamics model of residential real estate. The cause-and-effect relation is shown in figure 2.



**Figure 2 System Dynamics cause-and-effect relation**

**4 Conclusions**

How to perfect the urban functions, improve the living environment, protect the natural ecology under the conditions of ecological resources is the common problem before government departments and real estate related industries.

## (1) Make the land use intensive and sustainable to have it efficiency

Combined the long-term interests with short-terms to find the best binding, but not the highest price the better. Taking all the factors into account, we should regard land management as a major event which related to the interest of future generation. Then do a good job of land supporting facilities and services. The implementation of three-dimensional operations considering underground space is to increase the value of the land

## (2) Guide and regulate the real estate to inhibit the excessive growth of house prices

Government should make it own position clearly and establish housing security system for the low-income residents to reduce pressure from the upwards housing price. At the same time the high-end housing market regulation should be strengthened to avoid developers illegal misuse of land; in order to guide and regulate housing demand and have the market sustainable development the following methods can be implemented: strict implementation of policies in housing development, and sales, Improvement of the tax policy in housing transfer, moderately differentiated credit policy adjustment.

## (3) Boot the developers to actively participate in urban renewal to reduce the development costs purposefully.

Since the origin of sustainable development is protecting the ecology, eco-green houses should have to save resources, reduce consumption, lessen pollution, improve indoor environmental quality which is the direction of housing construction. Therefore this paper focuses on the ecological direction of the sustainable development in real estate industry, in which comes down to five system applied dynamics model, organizes the cause-and-effect relations and research, analyzes the large systems that includes all the factors affecting sustainable development.

The future work is to determine the quantitative relationship between these elements, to have the empirical analysis and policy testing to draw forecasting trending decision-makers concerned.

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