Game Analysis of Rural Collective Construction Land Circulation in Rapidly Industrialized Area of China——A Case of Nanhai District of Foshan City

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Abstract This paper introduces the basic principles and application of game theory, sets up the game model of rural construction land circulation, and analyzes the utility function results under the approval of local government of China, taking Nanhai District of Foshan City as an example. Research result shows that under the current macro-economy and system conditions, the optimal way of rural construction land circulation and expansion in rapidly industrialized area is to realize independent circulation in accordance with laws and regulations without changing the land ownership. The effective approach of regulating and controlling independent circulation is to optimize game structure and the utility functions by implementing demand management of construction land, strengthening land space control, reinforcing the construction of rural land market system, and improving profit distribution mechanism. Finally, we put forward some policy proposals on how to regulate the rural construction land circulation and expansion.

Key words Industrialization; Construction land; Circulation; Game; Nanhai District of China

Changes of economic system and land system have provided system background for the expansion of urban and rural land. Rural land joint stock system has offered institutional arrangement for the coordination of interests between rural collectivity and peasants. However, these are just the necessary conditions for the expansion of construction land, but not sufficient conditions. Factors influencing the urban and rural construction land, especially the expansion and circulation of rural collective construction land, are very complicated. The concentrated expression is multilateral game. The process and final result of the game depends largely on both the game structure and the mastery degree of information of the two parties concerned. At present, there has an initial accumulation of relevant researches on the introduction of game theory in China, such as the game analysis of the causes and countermeasures of gray land market (Wang Yutang) [1], and the game analysis of collective construction land use right circulation (Kang Xionghua) [2]. However, special research on rapidly industrialized area is still rare.

Nanhai District of Foshan City is a typical rapidly industrialized area of China with complex pattern of industrialization, and relatively complete industrial system. Meanwhile, after the non-agriculture of rural land in Nanhai District, the right of use is hired and sold, but is not operated by the village collective. The relationship between the expansion and circulation of rural construction land is close, which is an ideal area for the research on expansion and circulation of rural construction land under the background of industrialization. On the basis of the analysis of land system change, this paper analyzes the interests game behavior by construction land circulation of all parties, especially the local government (government of Nanhai District), and the rural collectivity (village collective economic organizations). Then, we study the action process, inherent mechanism and regulation strategy of rural construction land expansion in rapidly industrialized region.

1 Basic principles and application of game theory

Game theory is to make decision and to maximize the effectiveness by decision subject under a given information structure. Game theory is a kind of information analysis and a research method of benefit equilibrium. It has a very extensive and successful use in economics [3]. Game theory can be divided from two aspects. The first is to divide game theory into complete information game and incomplete information game, according to the participants’ master degree of other participants and the relevant information of the whole activity. The second is to divide game theory into static game and dynamic game, according to the sequence characteristics of the behavior of participants. The two division methods are combined together, and the game can be divided into four types, which are complete information static game, incomplete information static game, complete information dynamic game, and incomplete information dynamic game [4].

With the development of marketization and informatization, circulation of rural construction land in rapidly industrialized area has changed from information opacity to information transparency. Meanwhile, due to the existence of a variety of factors and variables, rural construction land circulation has gradually developed from incomplete static game to complete information
static game. There are four layers and five aspects of game in the expansion and circulation of rural construction land. The first is the game between the state and local government; the second is the game between local government and rural collective economic organization; the third is the game between different local governments; the fourth is the game between different rural collective economic organizations; and the fifth is the game between rural collective economic organization and peasant[5-6].

2 Construction of game model of rural construction land circulation

We specifically analyze the behavior subject, action space and utility function of rural collective construction land circulation in rapidly industrialized area, on the basis of making clear the prerequisite hypothesis and game structure. Then, game theory model of the expansion and circulation of rural collective construction land are constructed (Fig. 1). And this theory model can be used to carry out empirical analysis of the typical and rapidly industrialized areas in Nanhai District of China.

Fig. 1  Game model of rural collective construction land circulation in rapidly industrialized area

2.1 Prerequisite hypothesis  Under the condition of a market economy, all parties of construction land circulation are rational. They rigorously pursue the maximum benefits. Meanwhile, in the rapidly industrialized area with highly marketization and informatization, peasants’ awareness of the rights and information is increasing. Therefore, we use the complete information dynamic game to analyze.

2.2 Model elements

2.2.1 Behavior subject. Behavior subject of rural collective construction land circulation in rapidly industrialized area mainly involves four layers and five aspects, such as the state (central government), local government, rural collective economic organization, peasant, construction land importer (developer and so on). Taking into account the needs of research simplification, we mainly discuss the game relation between local government and rural collective economic organization, and simply analyze the national and peasants layers.

2.2.2 Action space. Under the background of management system disequilibrium of rural construction land circulation and expansion, behavior choice of national layer includes no institutional innovation, institutional innovation, and the transition type of the two (partial innovation). And the pilot area of land system reform is a kind of partial innovation.

Under the background of national macro-institutional arrangements and institutional environment (mainly the no institutional innovation or the partial innovation), the behavior choice of local government is classified into two types, that is not endorsement of the collective construction land circulation or endorsement. If the local government does not endorse the collective construction land circulation, the behavior of rural collective economic organization can be divided into three types (Fig. 1), including the no circulation (no expansion I1), the grey circulation (I2) and the state requisition (I3). However, if the local government endorses the collective construction land circulation, the behavior can also be divided into three types, which are the no circulation (no expansion I1), the independent circulation (I2) and the state requisition (I3).

2.2.3 Utility function. Utility function of the game of rural construction land circulation is affected by its own action as well as the action choice of the other party. The establishment of utility function is built on the basis of qualitative analysis and determination. Concrete valuation mainly adopts the form of expert advice scoring, and consults to the relevant research results[1-7]. Finally, appropriate adjustments and amendments are conducted according to the actual situation of rapidly industrialized area. The result can basically reflect the research questions.

(1) Utility function of the local government (a). It mainly involves the following four aspects: the first is the partition of potential benefits of rural collective construction land circulation (f); the second is the allocation efficiency of regional land resources (z); the third is the regional economic and the financial and social benefits brought by construction land circulation (s); the fourth is the policy risk (f). Their function equation is

\[ a = f + z + s - f. \]

In the 1990s, Nanhai District in Foshan City became the pilot area of rural land reform. Therefore, government ratified that circulation of rural collective construction land could be carried out under the premise of unchanged ownership and adherence of the relevant planning. But in fact, there were risks of breaking the relevant planning due to relevant planning circulation of rural land. Valuation of t is 20 (the full score is 100) according to the expert interviews. Unlike the land expropriation by government, the major income from rural construction land circulation and expansion has remained in the internal rural collective, after paying the various land-related taxes and fees (the new construction land use fee is 56 yuan/m², and the cultivated land reclamation fee is 20 yuan/m²). According to the calculation of dynamic gains, valuation of f is 80. According to expert interview valuation and theoretical analysis, valuation of land allocation efficiency is 50, which is brought by the expansion and circulation of rural collective construction land. And the valuation of regional economic and social benefits is 50.

(2) Utility function of rural collective economic organization (b). It is determined by the following factors: first is the potential benefits brought by the construction land circulation (q);
the second is the post-earnings and the premium benefits of employment and service after construction land circulation (y); the third is the taxation and opportunity costs (p), that is the taxation and opportunity costs of land use conversion; and there is a significant regional differences of opportunity cost; the fourth is the risk cost (x). Their function equation is \( b = q + y - p - x \). According to expert interview valuation and field investigation, valuations of q, y, p and x are 80, 50, 20, 80 and 20. Valuation of p mainly reflects the regional differences. For example, after the conversion of agricultural land with low productivity and quality, its opportunity cost is relatively low. But the opportunity cost and the construction cost of high-benefit agricultural land are very high after land use conversion.

3 Result analysis of the game of rural construction land circulation

Nanhai District is a pilot of national land system reform. China has given Nanhai District the pilot power to change the rural collective construction land in accordance with the laws and planning. At the same time, local government has urgent demand for construction land due to the pursuit of economic development. In this historical background and institutional environment, Nanhai government ratifies the reasonable circulation of rural collective construction land. Therefore, we can use the game model mentioned above to analyze the results of various utility functions under the permit of local government (Fig.2).

![Game structure and result of rural collective construction land circulation in Nanhai District](image)

**Fig. 2** Game structure and result of rural collective construction land circulation in Nanhai District

### 3.1 Game result

If the collective construction land selects no circulation, the utility of local government is \( a = 0 \), and the utility of rural collectivity is \( b = 0 \). Utility combination under this game path is \( (0, 0) \).

However, if the collective construction land is expropriated, the potential benefit of local government is 80; efficiency of land resources allocation is improved greatly, which is 50. The regional economic, financial and employment benefit reaches 50. Meanwhile, the risk of illegal use of land is 20. Hence, the utility of local government is \( a = 160 \); but the potential economic benefits of rural collective organization is only 20, the premium benefit is 20, opportunity benefit is 80, and risk cost is 0. Thus, the utility of rural collectivity after requisition is \( b = -40 \). Utility combination under this game path is \( (160, -40) \).

If the collective construction land adopts independent circulation, the result of utility function is \( a = 100 \), \( b = 120 - 60 \). Utility combination under this game path is \( (100, 120 - 60) \).

### 3.2 Analysis of game result

Under the current macroeconomic development and system background, the optimum mode for rural construction land expansion and circulation is the independent circulation in accordance with the laws and regulations without changing the land ownership, according to the analysis of game model. Under this game path, though the direct economic benefit of Nanhai government is low at the early stage of circulation, the indirect economic benefits brought by land circulation are relatively significant such as economic development, employment increase and enhanced efficiency of land resource allocation. Rural collective economic organizations have to bear certain tax costs and cost risks, but the early and late differential income gains, which are obtained from the expansion of construction land and the circulation of use right, are relatively substantial.

In addition to the game relation between local government and rural collective economic organizations, the benefits game between rural collectivity and peasants also exists. This game relation is coordinated by the joint-stock cooperative system design with the core of land. Rural collective economic organizations operate a temporary recovery of land right from peasants, in order to carry out a unified land development and management of land. Meanwhile, the organizations must guarantee peasants a certain degree of economic benefits. Thus and divide becomes the peasants’ core indicator to evaluate the collective economic organizations. However, due to the game structure relation between rural collective economic organizations and peasants in Nanhai, peasants are in a disadvantageous and passive position. They have only shared 50% of the benefits from the expansion and circulation of rural collective economic organizations\(^8\). Future direction of reform should strengthen the game of three parties or even more, in order to realize the peasants’ real participation\(^9\).

### 3.3 Research conclusion

Under the concession of national policy and the acquiescence of their own, ratification of the rural collective construction land circulation by rapidly industrialized area is the key factor leading to the rapid expansion and circulation of rural collective construction land.

Under the system environment of the approval of local government, rural collective construction land has realized independence circulation without changing the collective ownership of land. It has achieved economic interests of both the rural collectivity and peasants, takes into account the interests of local governments, and promoted the economy and rapid development of regional industrialization. Moreover, realization of the independence circulation mode of rural collective construction land has greatly promoted the industrialization of rural collective construction land. However, under the arrangement of land joint-stock cooperative system with the spatial partition units of administrative village and villagers group, this land circulation mode has caused the rapid, disorder and distributed expansion of rural collective construction land. Thus, the phenomenon of inefficient allocation and extensive use of land resources is inevitable, which has threatened the sustainable development of rapidly industrialized area.
4 Policy suggestion on regulating the circulation and expansion of rural construction land

4.1 Changing the development mode of urbanization and industrialization; implementing the demand management of construction land

Continued brisk and "high" demand for rural construction land is the power source of the rapid circulation and expansion of rural construction land. Therefore, the important way to control the rural construction expansion is to strengthen the demand management of construction land, as well as to optimize the demand structure. Traditional industrialization mode over-emphasized the development of industrial scale. It is a development mode dominated by traditional industries with private economy as the main body, and "large dispersion, small gathering" of small and medium-sized enterprises as the organizational form. This "bottom-up" and extensive mode of development sponsored by the grassroots and civilian has caused the continued brisk and "high" demand for rural construction land. Rapid expansion rate of construction land also has led to the scattered and broken layout of construction land, and a variety of social problems.

Therefore, we should make great efforts to change the patterns of industrialization and urbanization, and to alter the economic development and industrial distribution model. Firstly, according to the actual situation of regional development, we should timely raise the threshold of industrialization, increase the marginal cost of the land expansion of non-agricultural industries, and support the development of land-intensive and environment-friendly industries. Secondly, we should advocate the urbanization of center town, focus on the development of center town, promote the urban agglomeration of population, industry, capital, information, and other elements, strengthen the construction of industrial agglomeration area relying on cities and towns, and encourage enterprises to move into cities and industrial parks.

4.2 Improving the structure of game; strengthening the control of land space and the construction of market system

In the new historical stage, aiming at the disordered situation of expansion and circulation orders of rural construction land, rapidly industrialized area should continue to adhere to land use control. It should also strengthen the control of land use space by combining with the main-function area planning, urban planning and environmental protection planning. That is to strictly divide the construction prohibited area, the construction limited area, and construction allowed area. Areas related to the overall well-being of the region, such as basic farmland protection areas, scenic spots, forest parks, ecologically sensitive areas, are all classified into the construction prohibited area. And high-efficiency agriculture land, including farmland, woodland and water aquaculture, is classified into the construction limited area. State and local government should use laws to strictly prohibit the construction occupation and non-agricultural circulation of farmland in construction prohibited area. And the state and local government should strictly limit the construction occupation and non-agricultural circulation of farmland in construction limited area.

Because of the different social responsibilities of city and countryside at present, the rural land market is seriously lagged, which leads to the spread of the invisible land market. Therefore, we should firstly perfect the rural social security and employment security system, in order to rationally reduce the "burden" of rural land [10]. Secondly, on the basis of the clear land ownership, we should establish the market of rural collective construction land, improve the collective construction land circulation mechanisms and supporting regulations, and realize the compensated use system of "same land, same price, same right" between collective land and state-owned land. Based on these, we can gradually ban the invisible land markets, cancel the dual track of land supply and the hierarchy of land use, establish a unified, open, standardized, and orderly market system of land, and avoid land speculation and land transfer out of control by system.

4.3 Improving the relationship between the benefits distribution mechanisms and the utility function; regulating the behavior choice of all parties in the game

We should correctly distinguish the rent, tax and fee, and rationally allocate the benefits of collective land circulation. Income from normal circulation of collective land is rent, mainly measured by the input in land and the natural condition of land. Internal distribution method of this income should be made. Related fees should be charged fairly, and the related tax is collected mainly by the state and local governments. It can be determined flexibly in accordance with the number of investment parties and the improvement degree of basic necessary conditions. A transaction tax must be paid during land transactions; at the same time, value-added tax must be collected by the state in order to nationalize a part of the land value added, that is sharing increments with the people in common [7].

In the utility function of local government, the state should line out the "red line" for land by strengthening legislation and law enforcement, formulate appropriate administrative measures and space management approach, enhance the policy risk of the dereliction of duty and the violation of the law by local government, reduce the potential benefits of local government in rural construction land circulation.

There are three optimized paths of utility function for rural collective organizations. ① We should improve the opportunity cost of rural construction land expansion and circulation by enhancing the land transfer and its tax cost, perfecting agricultural production condition, and developing high-efficiency agriculture. ② We should optimize the paths from the layer of policy. On the one hand, Government should try to "block", that is to enhance the policy risk and law risk costs of the illegal circulation by signing the responsibility system. On the other hand, government should also try to "mediate". Rapidly industrialized area, especially the economically developed areas, should provide adequate compensation to agricultural areas and ecological protection areas by financial payment transfer, ecological compensation, transfer of development rights, public services equalization and welfare equalization. ③ We should strengthen
the financial monitoring of collective economic organizations.

References

快速工业化地区农村集体建设用地流转的博弈分析
——以广东省佛山市南海区为例
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摘要 概述了博弈论的基本原理及博弈的分类，提出了研究的假设假设和博弈模型的要素。农村建设用地流转博弈模型的要素包括：①行为体，涉及国家、地方政府、农户集体经济组织和农户，行为体一般在4个层级5个方面；②行为场，农村建设用地流转博弈各方的行为选择取决于其他方的行为选择；③效用函数，分别构建了地方政策和农村集体经济组织的效用函数。在土地制度下，以广东省佛山市南海区为例，得到了农村建设用地流转博弈模型的结果。集体建设用地流转行为选择的效用组合为（0, 0），自然行为选择的效用组合为（160，-40）；自然行为选择的效用组合为（100，100），100）。研究表明，在现有土地制度条件下，快速工业化地区农村建设用地扩张与流转的最佳路径是，在不改变土地所有制的前提下依法统一土地流转，实现城乡土地一体化的有效途径，通过实行建设用地流转交易，加强农村土地市场制度建设及扩大利益分配机制，优化土地结构与流转各方的效用。最后，提出了地方建设用地流转与扩张的政策建议。一是转变工业化与城镇化发展模式，实行建设用地需求管理；二是强化建设用地空间管制和市场制度建设，改进流转博弈结构；三是完善利益分配机制和效用函数关系，规范流转各方的行为选择。

关键词：工业化；建设用地；流转；博弈；南海区

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关于长江口渔业资源管理的探讨
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摘要 介绍了中国长江口的鱼类系组成和主要经济鱼类。鱼类系组成中，鳗鲡目种类最多，鳗鲡目鱼资源最多。长江口鱼类数量少于北支，但经济鱼类资源量大。长江口鱼类共有6大类，其经济鱼类种类分为鲢、刀鲚、石斑鱼和银鱼等主要经济鱼类。按其地域性分析，长江口鱼类资源多为本地鱼类，具有较高的经济价值。研究了影响长江口渔业资源的3个因素，即水域生态条件的改变，温度和盐度对鱼类资源的影响。渔业资源研究结果表明，优化管理，加强渔业资源保护，加强对长江口渔业资源的管理。关键词：长江口；渔业资源；管理