land

MDPI

Article

A Study on Accounting for Suburban Agricultural Land Rent in a Chinese Context Based on Agricultural Ecological Value and Landscape Value

Keqiang Wang [1,2], Jianglin Lu [3,*], Hongmei Liu [4], Xin Fan [5], Lina Zhang [6] and Silu Zhang [2,7]

1 School of Public Economics and Administration, Shanghai University of Finance and Economics, Shanghai 200433, China
2 Technology Innovation Center for Land Spatial Eco-Restoration in the Metropolitan Area, Ministry of Natural Resources, Shanghai 200003, China
3 School of Customs and Public Administration, Shanghai Customs College, Shanghai 201204, China
4 School of Finance and Business, Shanghai Normal University, Shanghai 200233, China
5 Center for Turkmenistan Studies, China University of Geosciences, Wuhan 430074, China
6 School of Marxism, Beijing Jiaotong University, Beijing 100044, China
7 Shanghai Construction Land and Land Consolidation Affairs Center, Shanghai 200003, China
* Correspondence: 2005210@shcc.edu.cn

Abstract: Agricultural land protection is vital for the realization of national food security and an ecological civilization. From the perspective of agricultural ecological value and landscape value, perfecting the theory of agricultural land rent is beneficial to the construction of an ecological civilization. Based on Marx's land rent theory of agricultural production, the analytical framework of the agricultural decision support systems (DSS) was constructed; then, the agricultural land rent in suburbs was theoretically accounted for via a numerical example, and its realization rules were simulated according to the conditions of China (i.e., the specific solutions in force). Some interesting conclusions were found: (1) Agricultural production in suburbs involves both natural reproduction and social reproduction. (2) Agricultural land rent should include production land rent, ecological land rent, and landscape land rent. (3) The promotion of an ecological civilization and the development of the economy and society will lead to an increase in the comprehensive coefficient of agricultural land rent. (4) With the development of the economy, ecological land rent and landscape land rent should be gradually charged from zero payment to full payment. Based on these conclusions, five corresponding policy implications are proposed to improve the land profit of agricultural land owners to promote agricultural production, food security, and an ecological civilization.

Keywords: suburban agricultural production; agricultural land rent; agricultural ecological value; agricultural landscape value; sustainable land uses; decision support systems

Citation: Wang, K.; Lu, J.; Liu, H.; Fan, X.; Zhang, L.; Zhang, S. A Study on Accounting for Suburban Agricultural Land Rent in a Chinese Context Based on Agricultural Ecological Value and Landscape Value. *Land* **2023**, *12*, 2138. https://doi.org/10.3390/land12122138

Academic Editors: Claudia Di Bene, Marco Vassallo and Concetta Cardillo

Received: 27 September 2023
Revised: 26 November 2023
Accepted: 28 November 2023
Published: 6 December 2023

1. Introduction

In order to meet the challenges resulting from the rapid increase in the world's population and food demand across the world, sustainable agricultural development is essential, in particular to increase food production [1]. Agricultural decision support systems (DSS) play an vital role in continuing to remain viable and increase productivity [2]. With advances in computing techniques, the use of artificial intelligence, etc., DSS have been widely used in agricultural decision making [3], especially by many agricultural enterprises [1]. One study concluded that DSSs should be aimed towards aggregating data to enhance the decision-making power available to farmers [4]. This paper argues that increasing agricultural land owners' engagement in agricultural production is crucial in order to promote sustainable agriculture development and that established DSS analytical frameworks take less account of the issue of agricultural land owners' incentives to engage in agricultural production. The protection of agricultural land is a basic guarantee to realize national food

security [5]. Food security is both intrinsically and instrumentally important to human flourishing [6]. Even in developed countries such as the United States (US) food security is an issue; a lack of food security is one of the most pressing issues facing the US today [7].

In addition to the value of agricultural products (including services) (*APs*), agricultural production also has the value of ecological products (including services) (*EPs*) and landscape products (including services) (*LPs*). Agricultural production has the function of ecological environment promotion (e.g., purifying the air, alleviating the heat island effect), which is critical to the operation of the Earth's life support system [8]. There were 948 agricultural sightseeing parks in Beijing in 2019, with a total operating income of CNY 2.32 billion (USD 1 = CNY 6.9, source: World Bank WDI Database), 19.201 million tourists, and CNY 1.44 billion of income from rural tourism (data source: Beijing Statistical Yearbook 2020, compiled by Beijing Municipal Bureau Statistics and Survey Office of the National Bureau of Statistics in Beijing. http://nj.tjj.beijing.gov.cn/nj/main/2020-tjnj/zk/indexch.htm, accessed on 11 September 2022). The government encourages products with high landscape values to be produced at high rates and for their production to be prioritized, especially in the lead up to special events such as the cauliflower festival, peach blossom festival, and rice festival. The government also requires landscape links, such as the construction of country parks and rural parks, to form the systematized and scaled-up effect of agricultural landscapes so that the suburbs can become the backyards of cities. Therefore, it is time for the suburbs of large cities like Beijing, Shanghai, New York, etc., to fully recognize the value of *EPs* and *LPs* in agricultural production.

This study aims to study agricultural land protection from the perspective of increasing agricultural land owners' land rent profit based on Marx's land rent theory of agricultural production. Perfecting the theory of agricultural land rent (R_A) is beneficial to the protection of agricultural land. Marx greatly promoted and developed the land rent theory, including R_A theory. Limited by the productivity conditions in that particular era and the non-scarcity of agricultural ecological value and landscape value, Marx's land rent theory of agricultural production is based on the function of product production. It is basically a theory of agricultural production land rent (R_P). In the new stage of the socialist market economy, the existence, source, accounting rules, and realization rules of China's R_A in suburbs are different from the capitalist R_A described by Marx. Regardless of the separation of land ownership, contracting rights, and management rights under the Chinese socialist economic system or the separation of land ownership and land management rights under the capitalist economic system discussed by Marx, their essence is both the separation of land ownership and land management rights. Perfecting the theory of R_A also has a certain positive significance for the construction of an ecological civilization. Agricultural land also has a strong ecological service function, and agricultural land protection is an important part of ecological civilization construction. With the development of the economy and society and the construction of an ecological civilization, landscape and ecology are increasingly scarce. However, because of the externalities of agricultural ecology value and landscape value and the relative disadvantage of agriculture, land rent profits for agricultural land owners cannot be achieved in full based on the existing land rent theory, especially in economically developed areas and in the post-industrial era. Thus, this paper carries out a study using suburbs as an example.

Increasing agricultural land owners' land rent profits is an important factor in supporting multifunctional agriculture, and the DSS are an important analytical tool to facilitate the achievement of the sustainable agriculture development goals. Unlike the existing farmer-oriented DSS framework, this paper aims to construct a new analytical framework based on the theory of land rent to provide a reference for policy reforms to improve agricultural land owners' land rent profits. This paper constructs an agricultural DSS analytical framework and then studies the accounting rules and realization rules of the static and dynamic R_A in suburbs. The innovative aspects of this paper are as follows: First, based on Marx's land rent theory of agricultural production, this paper constructs the R_A theory, which integrates R_P, agricultural ecological land rent (R_E), and agricultural landscape land

rent (R_L), consummating and developing Marx's land rent theory of agricultural production and also enriching the analytical perspectives of agricultural DSS. Second, a numerical example method is adopted to study the accounting rules and realization rules of the static and dynamic R_A in suburbs. Third, five pieces of policy enlightenment for stimulating agricultural land owners to protect agricultural land and actively engage in agricultural production based on R_A theory are proposed.

The rest of this paper is structured as follows: Section 2 covers the materials and methods used for the study; Section 3 outlines the study's results; Section 4 presents a discussion of the results; and, finally, relevant conclusions and implications are summarized in Section 5.

2. Materials and Methods

2.1. An Agricultural DSS Analytical Framework

2.1.1. The Many Uses of Land and Agricultural Land Protection

In rural China, collective land property rights are standard [9]; thus, there are almost no private property rights for cultivated land in China today [10]. According to the Land Administration Law of the People's Republic of China (2019 Amendment), land use is divided into three categories: agricultural land, construction land, and unused land. Without agricultural land regulation by government departments, agricultural land owners can choose to use agricultural land unchanged (expressed by A) or change it into construction land (expressed by B), as shown in Figure 1. S_A and S_B are the supply curves of agricultural land and construction land, respectively. The horizontal axis is the supply quantity of construction land or agricultural land, and the vertical axis is the corresponding price. At equal acreage ($Q_{A0} = Q_{B0}$), the price of agricultural land P_{A0} is far less than that of construction land P_{B0}. The value of construction land is $V_{B0} = Q_{B0} \cdot P_{B0}$, while the value of agricultural land is $V_{A0} = Q_{A0} \cdot P_{A0}$, and the former is far greater than the latter; that is, the area of rectangle (CDJI) is far greater than 0. If P_{A0} is increased to P_{A1} and its supplement is improved from Q_{A0} to Q_{A1}, the added value of agricultural land will be ΔV_A, which is numerically equal to $(Q_{A1} \cdot P_{A1} - Q_{A0} \cdot P_{A0})$. If the supplement of the construction land is improved from Q_{B0} to Q_{B1}, the added value of the construction land will be ΔV_B, which is numerically equal to $(Q_{B1} \cdot P_{B1} - Q_{B0} \cdot P_{B0})$. Then, ΔV_B is far greater than ΔV_A, which is numerically equal to the difference between the areas of the polygon (GHNLIJ) and rectangle (CDGF), which is far greater than 0. Therefore, in the case of two possibilities of agricultural use and construction land for new land, the latter occupies an absolute advantage, which leads to the loss of profits for agricultural land owners.

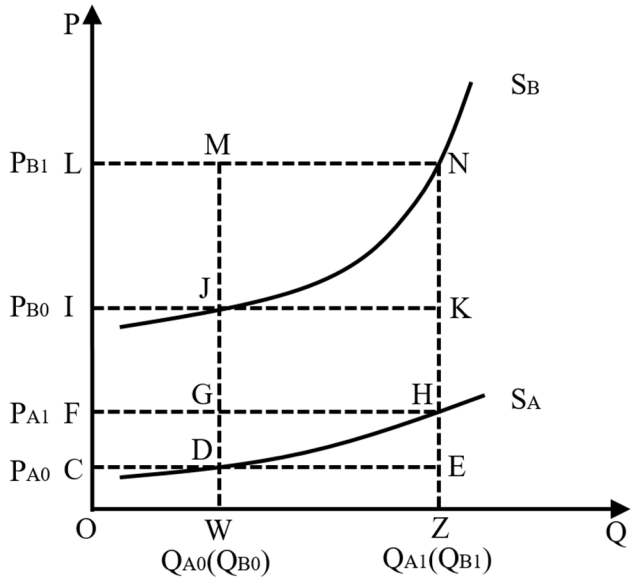

Figure 1. The profit loss of agricultural land owners under the regulation of agricultural land use.

2.1.2. The Multifunctionality of Suburban Agricultural Production

The products produced by suburban agricultural production include *APs*, *EPs*, and *LPs*. First, agricultural production has the function of *AP* production. It has long been recognized that farm program payments tied to production are capitalized into land values [11–13]. Agricultural production is the basic and primary function of agriculture. In the process of agricultural production, *APs* such as animals, plants, and microorganisms are obtained to ensure the effective supply of *APs* and national food security. The theoretical framework is shown in Figure 2.

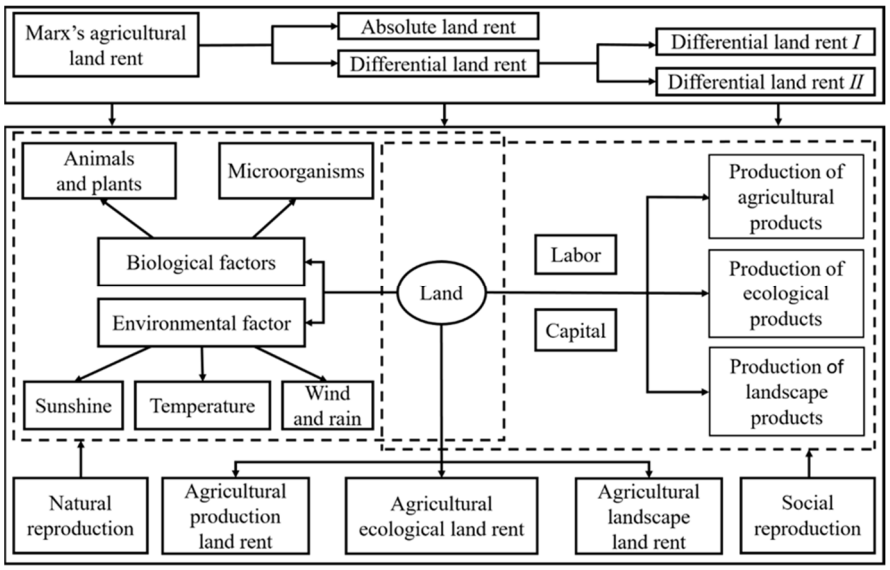

Figure 2. Theoretical framework of agricultural production and R_A.

Second, agricultural production has the function of *EP* production. Environmental value is the meaning, utility, and benefit of a specific environment to human survival and development [14]. Crop photosynthesis helps reduce the urban heat island effect, and crops also have soil improvement, water conservation, microbial decomposition, biodiversity conservation, and many other ecological functions.

Third, agricultural production has the function of *LP* production. Crops in agricultural production can form different landscapes with seasons (the income of farmhouse tourism, folk custom tourism, and other related industries driven by farmland landscapes even exceeds the value of crops. See When the Water of Cultural Creativity is Introduced Into Farmland–Sidelights of Beijing Farmland Sightseeing Season in 2012, Farmers' Daily, 11 August 2012). Agricultural experiences and rural tourism may also become a new economic form, which will bring landscape effects. The government encourages giving priority to the production of high value *LPs* and requires landscape links to form the systematized and scaled-up effect of agricultural landscapes so that the suburbs can become the backyards of cities.

2.1.3. Agricultural Production's Natural and Social Reproduction

Suburban agricultural production comprises the combination of natural reproduction and social reproduction, as shown in Figure 2. Agricultural natural reproduction is mainly affected by biological factors and environmental factors. Natural productivity is mainly manifested via the combination of biological and environmental productivity. Agricultural reproduction is based on the natural reproduction of plants and animals [15]. Agricultural production depends on specific natural conditions, such as sunshine, temperature, wind, and rain. Agricultural natural reproduction is the natural process of crop replacement under specific natural conditions. Agricultural social reproduction includes the reproduction of social productive forces and the reproduction of social production relations. The

reproduction of social productive forces occurs in the process of labor and is related to labor tools and objects. Agriculture also inputs labor and capital into the agricultural ecosystem, combines ecology with the economy through the role of agricultural technology in the process of agricultural production, and promotes the circulation transformation of natural material and energy.

2.1.4. Multiple Land Rent for Suburban Agricultural Production

R_A is composed of R_P, R_E, and R_L; that is, $R_A = R_P + R_E + R_L$. The production of *APs*, *EPs*, and *LPs* requires labor and capital investment. It is reasonable to share the excess profits created by labor production and generate R_P, R_E, and R_L, which derive from the sharing of excess profits by agricultural land owners in the production process of *APs*, *EPs*, and *LPs*, respectively. All three are forms of the economic realization of land ownership, including absolute and differential land rent (*I* and *II*).

Labor is the source of value creation, and the whole agricultural production process follows the theory of labor value. Natural resources in a natural state possess no value without the condensation of human labor. Production factors only act as the forming factor of use value, not as the forming factor of exchange value [16]. This is true of all natural factors of production without human assistance, such as land, wind, water, iron in the veins, trees in the primeval forest, etc. [16]. Agricultural production is accompanied by labor processes, including natural reproduction and social reproduction. The labor process is the purposeful activity of manufacturing use value. It is the possession of natural things for the sake of human needs, the general condition of material transformation between man and nature, and the eternal natural condition of human life [16]. The commodity production process must be the unity of the labor process and value forming process [16]. If the value of labor paid by capital is compensated by the new equivalent, it is a simple process of value formation, and if the process of value formation continues beyond this point, it becomes a process of value multiplication [16]. The production process of *APs*, *EPs*, and *LPs* is the process of labor, capital input, and value formation in agricultural production. According to Marx's theory of labor value, the value and surplus value are created in this process. Because of scarcity, *EPs* and *LPs* need to invest more labor and capital to reproduce to realize their value multiplication. Based on the premise of the market production price formation mechanism, differential land rent means that it does not affect the product price itself [17]. Differential land rent is divided into differential land rent *I* and differential land rent *II*. The former refers to the equal amount of labor and capital invested in different equal amounts of land, formed due to different fertility and location and conditioned by the fertility and location. The latter, generated by productivity difference, refers to the labor and capital continuously added to the same land and has different labor productivities under the condition of continuous additional investment in the same land. Marx attributed absolute land rent to the organic composition of capital in the agricultural sector lagging behind the social average and admitted that once the organic composition of agriculture is equal to the social average, absolute land rent will disappear [18]. Whether it is R_P, R_E, or R_L, the organic composition of agricultural production capital is smaller than that of industrial capital.

2.1.5. Accounting Rules and Realization Rules of Suburban R_A

First, we analyze the accounting rules of suburban R_A. According to Marx's land rent theory of agricultural production, R_A consists of absolute land rent, differential land rent *I*, and differential land rent *II*. The essence of absolute land rent is that when the surplus value rate is equal or the labor exploitation degree is equal, an equal amount of capital in different production sectors will generate an unequal surplus value according to their different average compositions [19]. Differential land rent is always generated from the difference between the individual production prices that govern a monopolized natural force and individual capital and the general production prices of the general capital invested in the production sector [19]. When the human ecological footprint exceeds the ecological

carrying capacity, it will make the ecological resources appear to be obviously scarce, leading to the difference in input and output in the process of human production. Thus, the difference between individual production prices and social production prices (excess profit) is formed and converted into rent. The excess profit from the ecological service of high-quality ecological resources is the differential land rent *I* [20], while the excess profit deriving from the use of more efficient equipment, technology, organization, and means of production are similar to differential land rent *II*. The worst ecological resources need to pay ecological absolute land rent. The differential land rent *I* of R_E comes from the consumption of high-quality ecological resources, while the differential land rent *II* of R_E comes from improved production efficiency. Differential rent is essentially a monopoly profit; as long as the land is not different, differential land rent will exist.

Land rent is closely related to location. In suburbs, R_A may be higher than industrial land rent, while in superior locations, industrial land rent may be higher than R_A. Extending from the urban area to the outside, the city is divided into three parts: the urban area, peri-urban area, and suburban area. The industrial park is in the peri-urban area, the pure agricultural area is in the suburban area, and the industrial and agricultural interlaced areas can be found between the two. Assume that in the pure agricultural area, there are three adjoining pieces of land in area D, namely, D_1, D_2, and D_3, with the same conditions except for fertility, as shown in Figure 3. D_1 is the worst. D_2 is more fertile than D_1. D_3 is as fertile as D_2.

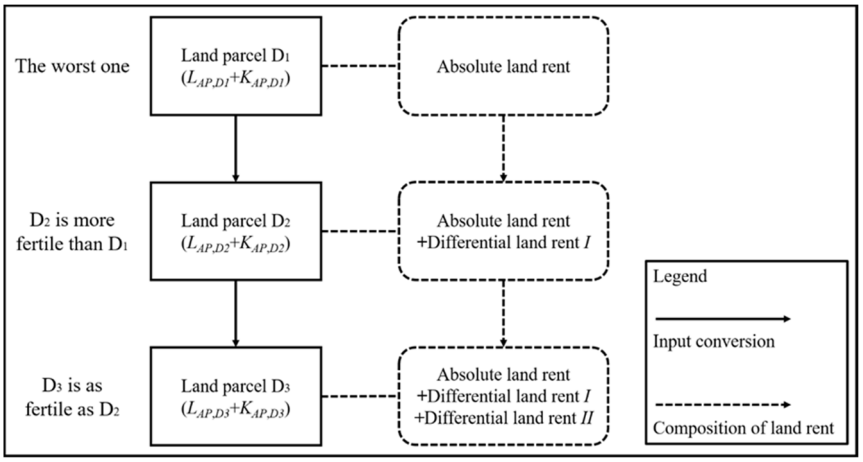

Figure 3. Schematic diagram of accounting rules of suburban R_A (take R_P as an example).

In quantitative terms, land rent is the 'surplus profit' appropriated by landowners [21]. Ground rent is a fee that the user of the land has to pay to the landowner to obtain permission to use the land [22]. The general formula of land rent *R* is as follows:

$$R = V - L - (1 + r) \cdot K \quad (1)$$

In Equation (1), *R* is the land rent. *V* is the value from agricultural land use, and its monetary form is profit. *L* is the labor input. *K* is the capital input. *r* is the interest rate. *V*, *L*, *r*, and *K* are key elements in accounting for agricultural land rent. We carry out specific accounting for R_P, R_E, and R_L. Take R_P as an example to illustrate land rent's composition and accounting method. For R_P, assume that the labor input, capital input, and agricultural product yield for *AP* production are $L_{AP,D1}$, $K_{AP,D1}$, $Q_{AP,D1}$ in D_1. The value from agricultural land use in D_1 is $V_{AP,D1}$. Assume that the labor input, capital input, and agricultural product yield for *AP* production are $L_{AP,D2}$, $K_{AP,D2}$, $Q_{AP,D2}$ in D_2. The value from agricultural land use in D_2 is $V_{AP,D2}$. Assume that the labor input, capital input, and agricultural product yield for *AP* production are $L_{AP,D3}$, $K_{AP,D3}$, $Q_{AP,D3}$ in D_3. The value from agricultural land use in D_3 is $V_{AP,D3}$. If the market price of *AP* is $P_{AP,Dm}$ (m = 1, 2, 3), the prices determined by the *AP* market are the same for *AP*, and agricultural land

owners cannot control the price of products. We assume that the prices are equal; that is, $P_{AP,D1} = P_{AP,D2} = P_{AP,D3} = P_{AP}$. Then, the value from agricultural land use in D_1, D_2, and D_3 is $V_{AP,D1} = P_{AP} \cdot Q_{AP,D1}$, $V_{AP,D2} = P_{AP} \cdot Q_{AP,D2}$, and $V_{AP,D3} = P_{AP} \cdot Q_{AP,D3}$. Differential land rent *I* ($R_{P,I}$) is generated under the condition that $L_{AP,D2} = L_{AP,D1}$, $K_{AP,D2} = K_{AP,D1}$. Since D_2 has better fertility, it will gain higher output with equal labor and capital; thus, $Q_{AP,D2} > Q_{AP,D1}$, so $V_{AP,D2} > V_{AP,D1}$. Due to land ownership monopolies, higher profits are converted into $R_{P,I}$. Differential land rent *II* ($R_{P,II}$) is generated under the condition that $L_{AP,D3} > L_{AP,D2}$, $K_{AP,D3} > K_{AP,D2}$. Because of better fertility, further investment (labor or capital) can acquire higher output; that is, $Q_{AP,D3} > Q_{AP,D2}$, so $V_{AP,D3} > V_{AP,D2}$. The value added is $R_{P,II}$. Then, we can obtain the absolute land rent ($R_{P,A}$), $R_{P,I}$ and $R_{P,II}$ of R_P.

$$R_{P,A} = P_{AP} \cdot Q_{AP,D1} - L_{AP,D1} - (1 + r) \cdot K_{AP,D1} \quad (2)$$

In Equation (2), $R_{P,A}$ represents the absolute land rent of R_P. P_{AP} is the market price of *AP*. $Q_{AP,D1}$ is the agricultural product yield for *AP* production in D_1. $L_{AP,D1}$ is the labor input for *AP* production in D_1. r is the interest rate. $K_{AP,D1}$ is the capital input for *AP* production in D_1.

$$R_{P,I} = P_{AP} \cdot Q_{AP,D2} - L_{AP,D2} - (1 + r) \cdot K_{AP,D2} - R_{P,A} = P_{AP} \cdot (Q_{AP,D2} - Q_{AP,D1}) - (L_{AP,D2} - L_{AP,D1}) - (1 + r) \cdot (K_{AP,D2} - K_{AP,D1}) \quad (3)$$

In Equation (3), $R_{P,I}$ represents the differential land rent *I* of R_P. P_{AP} is the market price of *AP*. $Q_{AP,D2}$ is the agricultural product yield for *AP* production in D_2. $L_{AP,D2}$ is the labor input for *AP* production in D_2. r is the interest rate. $K_{AP,D2}$ is the capital input for *AP* production in D_2.

$$\begin{aligned} R_{P,II} = P_{AP} \cdot Q_{AP,D3} - L_{AP,D3} - (1 + r) \cdot K_{AP,D3} - R_{P,A} - R_{P,I} = P_{AP} \cdot (Q_{AP,D3} - Q_{AP,D2}) \\ - (L_{AP,D3} - L_{AP,D2}) - (1 + r) \cdot (K_{AP,D3} - K_{AP,D2}) \end{aligned} \quad (4)$$

In Equation (4), $R_{P,II}$ represents the differential land rent *II* of R_P. P_{AP} is the market price of *AP*. $Q_{AP,D3}$ is the agricultural product yield for *AP* production in D_3. $L_{AP,D3}$ is the labor input for *AP* production in D_3. r is the interest rate. $K_{AP,D3}$ is the capital input for *AP* production in D_3.

We can obtain the total land rent (R_P) of D_m (m = 1, 2, 3) from *AP*:

$$R_{P,Dm} = R_{P,A,Dm} + R_{P,I,Dm} + R_{P,II,Dm} \quad (5)$$

In Equation (5), $R_{P,Dm}$, $R_{P,A,Dm}$, $R_{P,I,Dm}$, and $R_{P,II,Dm}$ represent the R_P, $R_{P,A}$, $R_{P,I}$, and $R_{P,II}$ of D_m, respectively. The accounting rules of R_E and R_L are similar, as shown below:

$$R_{E,Dm} = R_{E,A,Dm} + R_{E,I,Dm} + R_{E,II,Dm} \quad (6)$$

$$R_{L,Dm} = R_{L,A,Dm} + R_{L,I,Dm} + R_{L,II,Dm} \quad (7)$$

In Equation (6), $R_{E,Dm}$, $R_{E,A,Dm}$, $R_{E,I,Dm}$, and $R_{E,II,Dm}$ represent the R_E, $R_{E,A}$, $R_{E,I}$, and $R_{E,II}$ of D_m, respectively. In Equation (7), $R_{L,Dm}$, $R_{L,A,Dm}$, $R_{L,I,Dm}$, and $R_{L,II,Dm}$ represent the R_L, $R_{L,A}$, $R_{L,I}$, and $R_{L,II}$ of D_m, respectively. Notably, absolute land rent is generally paid in full. However, due to the externality of the agricultural production of *EPs* and *LPs*, the buyers are mainly government departments. Due to the influence of government departments' purchase intention and purchasing ability, R_E and R_L can only be partially realized. When the full amount is realized, we call it the expected value, which is the result that satisfies the expectation of agricultural land owners. When it is partially implemented, we call it the realizing value. In particular, when the value is maximized, it is also the expected value $R_{A\text{-}expe}$.

Second, we analyze the realization rules of suburban R_A. All forms of land rent are based on the existence of land ownership. In a capitalist society, landlords occupy and share the excess surplus value of land by means of land ownership. In a socialist society, land rent is distributed between ownership and contract rights. Collective land

property rights are standard in rural China [9]; suburban land is mostly collective land with collective ownership, and the right to use the land belongs to farmers and other agricultural producers and operators. The former is both the laborer and land contractor, and the rent received is paid for self-employment. For the latter, the land rent is the land transfer fee for the land contractor. These two kinds of land management methods in the suburbs of socialist countries do not violate Marx's theory of labor value and have a profound theoretical and practical basis.

2.1.6. Theory of R_A Maximization

First, we analyze the basic assumptions and rent maximization. Marx points out that no matter what the unique form of land rent, all the types have one thing in common: the possession of land rent is the economic form through which land ownership is realized, and the land rent is based on land ownership; that is, the ownership of certain plots by certain individuals [19]. Land rent is determined such that firms produce at constant returns to scale point [23]. Profit maximization is the basic principle of land allocation by agricultural land owners:

$$U = Max(U_{UL}, U_{AL}, U_{CL}) \tag{8}$$

In Equation (8), U represents total land utility, and U_{UL}, U_{AL}, and U_{CL} represent the utility of unused land (UL), agricultural land (AL), and construction land (CL), respectively. Assuming that labor and capital can flow freely, the agricultural land owner uses its land for rent, and the maximum profit from owning the land becomes the maximum rent; that is,

$$U = MaxR = Max(R_{UL}, R_{AL}, R_{CL}) \tag{9}$$

In Equation (9), R_{UL}, R_{AL}, and R_{CL} refer to the land rent of unused land, agricultural land, and construction land, respectively. Due to the regulation of agricultural land use, the maximum rent of agricultural land is the behavior function of making the maximum rent of agricultural land; that is,

$$U = MaxR_{AL} = MaxR_A \tag{10}$$

Assuming that agricultural land owners only own land and hire labor and lease capital, agricultural land owners can theoretically obtain land rent.

Second, we analyze the R_A model and its realization rules. Based on the above analysis, the expected theoretical value of R_A ($R_{A\text{-}expe}$) consists of R_P, R_E, and R_L; then,

$$R_{A\text{-}expe} = R_P + R_E + R_L \tag{11}$$

The stronger the production capacity and social demand are, the greater the R_E and R_L. Agricultural ecological value and landscape value have externalities, so the realization of R_E and R_L is not comprehensive. Assume that its realizable coefficients are $\alpha \in [0, 1]$ and $\beta \in [0, 1]$, respectively. Then, the value realized in real life of R_A is $R_{A\text{-}real}$; then,

$$R_{A\text{-}real} = R_{P\text{-}real} + R_{E\text{-}real} + R_{L\text{-}real} = R_P + \alpha \cdot R_E + \beta \cdot R_L \tag{12}$$

In Equation (12), α and β are the realization coefficients of R_E and R_L, respectively. α and β are proportional to the degree of ecological and landscape scarcity. With the advancement of the construction of ecological civilization, the scarcer the ecology and the landscape, the stronger and greater the social willingness to buy, and the larger α and β are. Ecological services usually have public and external attributes; in reality, governments often act as buyers of ecological services [24]. Under the pressure of meeting the social demand, the government will pay R_E and R_L in part or in full. At present, the government's ecological compensation and tourism compensation for agriculture are typical R_E and R_L payment methods. Generally, there are two key factors influencing the realization coefficients of R_E and R_L: purchasing ability and purchasing intention. The greater the development level of society and economy, the greater the social demand for ecology

and landscape and the stronger the purchasing ability and purchasing intention to pay for R_E and R_L. Assume that α and β are positively related to the level of socioeconomic development. Then,

$$\alpha = f(Abil, Inte, Othe) \tag{13}$$

$$\beta = g(Abil, Inte, Othe) \tag{14}$$

In Equations (13) and (14), *Abil* and *Inte* are the purchasing ability and purchasing intention to pay for R_E and R_L, respectively. They are proportional to the urbanization rate and the level of economic development. *Othe* represents the influential factors other than *Abil* and *Inte*. The most important influential factors are *Abil* and *Inte*. Therefore, for the convenience of studying the problem, we only analyze these two most important factors. Because of the externalities of *EPs* and *LPs*, the purchases of these two products are mainly from government departments. The city's government buys them according to the social demand. This kind of government purchase is mainly manifested as ecological compensation. In reality, there are other levels of government, and by simply analyzing, we assume that the buyer of agricultural ecological function compensation is the governments of the urban and suburban areas. It should be emphasized that although the production of *APs*, *EPs*, and *LPs* all require labor and capital input, the production of *APs* is basic and a prerequisite. In the composition of R_A, R_P is the most basic element, and R_E and R_L depend on R_P. The ratio λ of total R_A to R_P (used to measure the degree of deviation of R_A from R_P) is the comprehensive coefficient of R_A:

$$\lambda = R_{A\text{-}real} / R_P \tag{15}$$

Obviously $\lambda \geq 1$, λ directly affects the protection of agricultural land by agricultural land owners. The larger λ is, the more comprehensive the content of R_A. The larger R_E and R_L are, the larger λ is. The lower realization degree of R_A is, then, the greater the damage to the interests of the agricultural land owners, the easier it is for the agricultural land owners to transfer the agricultural use of the land to other uses. When the purchase intention of society toward R_E and R_L is stronger, the government's purchase ability is stronger, and the protection willingness of agricultural land owners to use land for agricultural purposes will also be stronger.

Third, the realized R_A maximization model can be represented as follows:

$$MaxR_A = MaxR_{A\text{-}real} = Max(R_P + \alpha \cdot R_E + \beta \cdot R_L) \tag{16}$$

It can be seen from Equation (16) that when R_P remains the same, the stronger the purchase intention and ability of R_E and R_L, the larger the realized value of R_A, and the greater the willingness of agricultural land owners to use land for agricultural purposes. $R_{P,t}$, $R_{E,t}$, and $R_{L,t}$ change yearly, as does the realization degree α_t and β_t of $R_{E,t}$ and $R_{L,t}$; therefore,

$$R_{A\text{-}real,t} = R_{P,t} + \alpha_t \cdot R_{E,t} + \beta_t \cdot R_{L,t} \tag{17}$$

In Equation (17), $R_{A\text{-}real,t}$ represents the value realized in real life of R_A. $R_{E,t}$ and $R_{L,t}$ are the R_E and R_L at time t. Then, Equation (17) can be expressed as follows:

$$MaxR_{A,t} = MaxR_{A\text{-}real,t} = Max(R_{P,t} + \alpha_t \cdot R_{E,t} + \beta_t \cdot R_{L,t}) \tag{18}$$

The more fully $R_{E,t}$ and $R_{L,t}$ are included in the R_A, the higher the enthusiasm of agricultural land owners to protect the agricultural use of agricultural land and the higher the enthusiasm to engage in agricultural production. It can be predicted that with the development of the economy and society and the promotion of ecological civilization, people's recognition of $R_{E,t}$ and $R_{L,t}$ will be gradually enhanced, and their willingness and ability to pay will be enhanced accordingly. Agricultural land owners' enthusiasm for protecting agricultural land and agricultural production will also be enhanced.

2.2. Methods and Data

This paper constructed a agricultural DSS analytical framework in Section 2.1 to provide a reference for policy reforms to improve agricultural land owners' land rent profit. The previous section also studied the accounting rules and realization rules of the static and dynamic R_A in suburbs. In the above part of the construction of the R_A theory, based on Marx's land rent theory of agricultural production combined with the characteristics of land rent generation in suburbs and integrated with the ecological value and landscape value of agricultural production, an R_A accounting system integrating R_P, R_E, and R_L has been formed.

Rents arise from externalities and the use of natural resources, and their benefits are somewhat externalized [25,26]. The ecosystem continuously provides ecosystem products and services to human beings [27], the same applies to agricultural production. The enhancement of the ecological value of agricultural land is inhibited by the overuse of fertilizers and other polluting factors [28]. However, in the numerical simulation, because R_E and R_L have not attracted enough attention, society is in the stage of deepening its understanding of R_E and R_L, and there are no systematic and extensive data to support more detailed research. Thus, the numerical example method commonly used in political economy at that time, which Marx adopted in *Capital* [29], is used to carry out the theoretical accounting of R_A in suburbs, and its realization rules are simulated. This paper abstracts and sets the data according to the in-depth field investigations and interviews conducted by a research group in the suburbs of Shanghai, China.

In the numerical simulation, the classical numerical example method in the study of land rent theory is used, and the suburb static and dynamic R_A are simulated and analyzed. The research object of this paper is the suburban R_A, which aims to explore the source, accounting rules, and realization rules of suburban R_A and is representative and universal but not limited to the specific aforementioned suburbs. In the static numerical simulation process of R_P, R_E, and R_L in suburbs, the input of labor and capital, the input proportion between labor and capital, the interest rate, the surplus value rate, the level of agricultural output, and the prices of *APs*, *EPs*, *LPs* are set based on the actual situation understood through theoretical analysis and investigation.

In the dynamic numerical simulation process of R_A in the suburbs, the social payments of R_E and R_L are different in different stages of economic development. For example, in the developed eastern provinces of China, the price of ecological compensation is higher, while in the central and western regions, the price of ecological compensation is lower. Moreover, the purchasing ability and purchasing intention of urban and suburban governments to pay R_E and R_L are affected by many factors. This paper makes a judgment based on the actual situation, which was gauged via an investigation. We set the dynamic change in R_P as an isochronous series, and since the realization of R_E and R_L is closely related to the economic development stage, we set the willingness and ability trend of urban and suburban governments to pay R_E and R_L according to the economic development stages.

3. Results

3.1. Numerical Simulation of Suburban Static R_A

First, suburban static R_P. Based on a field investigation in the suburbs of Shanghai, China, the surplus value rate and the interest rate in the process of numerical simulation are assumed accordingly, which does not affect the regularity of R_P changes. Assume that the surplus value rate and interest rate are 30% and 5%, respectively; *APs* are sold on the market at prices higher than labor and capital costs. Assume that the labor and capital inputs on the land of the worst units in suburbs (D_1) are 100 and 200 units, respectively. Assume that the output of *APs* is 412.50 units and that the unit price is CNY 0.80 per unit; then, $R_{P,A}$ is CNY 20. Assume that the labor and capital inputs on superior land (D_2) are also 100 and 200 units, respectively, because it is better in fertility; the unit output under the same input condition is larger than that of the inferior land, assuming 650 units, and $R_{P,I}$ is CNY 190. Make additional inputs to the superior land (D_3) per unit area, with labor and capital inputs increasing to 150 and 300 units, respectively. Due to additional investment,

at this point, the output is larger than when no additional investment is made; assuming 1000 units, the rent for agricultural production is CNY 335, in which $R_{P,A}$, $R_{P,I}$, and $R_{P,II}$ are CNY 20, CNY 190, and CNY 125, respectively. See Table 1.

Table 1. Numerical simulation of suburban static R_A.

	R_P			R_E			R_L		
	$R_{P,A}$	$R_{P,I}$	$R_{P,II}$	$R_{E,A}$	$R_{E,I}$	$R_{E,II}$	$R_{L,A}$	$R_{L,I}$	$R_{L,II}$
Labor input (*L*)	100	100	150	120	120	180	60	60	90
Capital input (*K*)	200	200	300	240	240	360	120	120	180
Output (unit) (*Q*)	412.50	650	1000	577.50	910	1400	330	520	800
Price (CNY/unit) (*P*)	0.80	0.80	0.80	0.90	0.90	0.90	0.60	0.60	0.60
Sale volume (CNY)	330	520	800	519.75	819	1260	198	312	480
Surplus value rate *w* (%)	30	30	30	30	30	30	30	30	30
Interest rate *r* (%)	5	5	5	5	5	5	5	5	5
Factor cost accounting coefficient (%)	100	100	100	100	100	100	100	100	100
Individual production price (CNY)	330	330	495	396	396	594	198	198	297
Labor and capital cost (CNY)	310	310	465	372	372	558	186	186	279
Absolute land rent (CNY)	20	20	20	147.75	147.75	147.75	12	12	12
Differential land rent *I* (CNY)	0	190	190	0	299.25	299.25	0	114	114
Differential land rent *II* (CNY)	0	0	125	0	0	255	0	0	75
Total land rent (CNY)	20	210	335	147.75	447	702	12	126	201

Notes: $R_{P,A}$ represents the absolute land rent of R_P; $R_{P,I}$ represents the differential land rent *I* of R_P; $R_{P,II}$ represents the differential land rent *II* of R_P. $R_{E,A}$ represents the absolute land rent of R_E; $R_{E,I}$ represents the differential land rent *I* of R_E; $R_{E,II}$ represents the differential land rent *II* of R_E. $R_{L,A}$ represents the absolute land rent of R_L; $R_{L,I}$ represents the differential land rent *I* of R_L; and $R_{L,II}$ represents the differential land rent *II* of R_L.

Second, suburban static R_E. We assume that the government attaches importance to *EPs*, especially in the context of the "ecological priority" governance concept under the background of ecological civilization construction. The input of *EP* production is more than that of agricultural product production, assuming that the input of *EP* production is 1.20 times that of agricultural product production. The output of *EP* is assumed to be a unitary function of the output of *APs*. Because the production of *EPs* depends on the production of *APs* to a certain extent, the output will be higher. Assume that the output of *EPs* is 1.4 times that of *APs*; then, the surplus value rate is 30% and the interest rate is still 5%. Under the background of ecological civilization construction, ecological scarcity leads to greater social demand for *EPs* than *APs*, assuming that the price of the *EP* is CNY 0.90 per unit. There are two ways to realize R_E: one is to circle the land and sell tickets, and the other is government subsidies. When the scarcity of ecology is stronger and the degree of social attention to ecological value is higher, the society's willingness to buy *EPs* will be stronger, and the value of ecological function will be realized in part or even completely. The same is true of R_L. Assume that the labor and capital inputs on the land of the worst units in suburbs (D_1) are 120 and 240 units, respectively. Assume that the output of *EPs* is 577.50 units, with a price of CNY 0.90 per unit. Then, $R_{E,A}$ is CNY 147.75. In area D, we assume that the labor and capital inputs on superior land (D_2) are also 120 and 240 units, respectively. Because it is better in fertility, the unit output under the same input condition is larger than that of the inferior land, assuming 910 units; then, $R_{E,I}$ is CNY 299.25. In area D, make additional inputs to the superior land (D_3) per unit area, with labor and capital inputs increasing to 180 and 360 units, respectively. Due to additional investment, at this point, the output is larger than when no additional investment is made, assuming 1400 units; then, the rent for agricultural production is CNY 702, in which $R_{E,A}$, $R_{E,I}$, and $R_{E,II}$ are CNY 147.75, CNY 299.25, and CNY 255, respectively. See Table 1. In fact, if the R_E of agriculture is higher, its ecological value may even exceed the value of *AP*. Whether R_E can be realized depends on the scarcity of ecological function. In the early stage of

agricultural and industrial societies, agricultural production was the main factor, and the ecological supply of the whole society exceeded the demand, so it was not necessary to deliberately purchase the ecological services of agriculture.

Third, suburban static R_L. We assume that the government pays less attention to *LPs* than to *EPs*, so agricultural land owners invest less in *LPs* than in *APs*, assuming that the input of *LP* production is 0.6 times that of agricultural product production. The output of *EPs* is assumed to be a unitary function of the output of *APs*. Due to the relatively low input, its output is lower than the output of *APs*. The production of *EPs* depends on the production of *APs* to a certain extent. Assume that the output of *EPs* is 0.8 times that of *APs*, the surplus value rate is 30%, and the interest rate is still 5%. Under the background of ecological civilization construction, landscape scarcity leads to greater social demand for *LPs* than *APs*; however, the value realization of *LPs* is more difficult than that of *APs* and *EPs*, so the price of the *LP* is assumed to be 0.6 CNY/unit. Assume that the labor and capital inputs on the land of the worst units (D_1) in the suburbs are 60 and 120 units, respectively. The output of *LPs* is 330 units, with a price of CNY 0.6 per unit; then, $R_{L,A}$ is CNY 12. In area D, assume that the labor and capital inputs on superior land (D_2) are also 60 and 120 units, respectively. Because it is better in fertility, the unit output under the same input condition is larger than that of the inferior land, assuming 510 units; then, $R_{L,I}$ is CNY 114. In area D, make additional inputs to the superior land (D_3) per unit area, with labor and capital inputs increasing to 90 and 180 units, respectively. Due to additional investment, at this point, the output is larger than when no additional investment is made, assuming 800 units; then, the rent for agricultural production is CNY 201, in which $R_{L,A}$, $R_{L,I}$, and $R_{L,II}$ are CNY 12, CNY 114, and CNY 75, respectively. See Table 1. Agricultural R_L is higher, especially in the suburbs in economically developed areas. Their R_L may even exceed the value of crops, such is the case with the Shanghai Fengxian Rapeseed Festival, resulting in higher R_L.

Finally, suburban static R_A. According to Table 1, it can be further calculated that the sum of $R_{P,A}$, $P_{E,A}$, $R_{L,A}$ is 8.99 times that of $R_{P,A}$; the sum of $R_{P,A} + R_{P,I}$, $R_{E,A} + R_{E,I}$, $R_{L,A} + R_{L,I}$ is 3.73 times that of $R_{P,A} + R_{P,I}$; and the sum of R_P, R_E, R_L is 3.70 times that of R_P. See Table 2. Paying only the R_P will underestimate the total R_A.

Table 2. Ratio of R_A to R_P.

	$R_P + R_E + R_L$			R_A/R_P		
	$R_{P,A} + R_{E,A} + R_{L,A}$	$R_{P,I} + R_{E,I} + R_{L,I}$	$R_{P,II} + R_{E,II} + R_{L,II}$	$[R_{P,A} + R_{E,A} + R_{L,A}]/R_{P,A}$	$[R_{P,I} + R_{E,I} + R_{L,I}]/R_{P,I}$	$[R_{P,II} + R_{E,II} + R_{L,II}]/R_{P,II}$
Labor input (*L*)	280	280	420	2.80	2.80	2.80
Capital input (*K*)	560	560	840	2.80	2.80	2.80
Output (unit) (*Q*)	1320	2080	3200	3.20	3.20	3.20
Price (CNY/unit) (*P*)	-	-	-	-	-	-
Sale volume (CNY)	1047.75	1651	2540	3.18	3.18	3.18
Surplus value rate w (%)	-	-	-	-	-	-
Interest rate r (%)	-	-	-	-	-	-
Factor cost accounting coefficient (%)	-	-	-	-	-	-
Individual production price (CNY)	-	-	-	-	-	-
Labor and capital cost (CNY)	868	868	1302	2.80	2.80	2.80
Absolute land rent (CNY)	179.75	179.75	179.75	8.99	8.99	8.99
Differential land rent *I* (CNY)	0	603.25	603.25	-	3.18	3.18
Differential land rent *II* (CNY)	0	0	455	-	-	3.64
Total land rent (CNY)	179.75	783	1238	8.99	3.73	3.70

Notes: $R_{P,A}$ represents the absolute land rent of R_P; $R_{P,I}$ represents the differential land rent *I* of R_P; $R_{P,II}$ represents the differential land rent *II* of R_P. $R_{E,A}$ represents the absolute land rent of R_E; $R_{E,I}$ represents the differential land rent *I* of R_E; $R_{E,II}$ represents the differential land rent *II* of R_E. $R_{L,A}$ represents the absolute land rent of R_L; $R_{L,I}$ represents the differential land rent *I* of R_L; $R_{L,II}$ represents the differential land rent *II* of R_L. "-" means it does not exist.

3.2. Numerical Simulation of Suburban Dynamic R_A

First, we analyze the suburban dynamic $R_{P\text{-}real,t}$. To simplify, $R_{P,A,t}$, $R_{P,I,t}$ and $R_{P,II,t}$ are not subdivided, and the total $R_{P,t}$ is taken as an example to study its variation law. Due to the scarcity of land resources, with the development of the economy and society, there is an overall increase in $R_{P\text{-}real}$. It is assumed that the production coefficient in the production process of AP increases by arithmetic progression, and the common difference is 0.02. According to the above assumptions, the $R_{P\text{-}real}$ of period t is $R_{P\text{-}real,t}$ and can be represented as:

$$R_{P\text{-}real,t} = k_t \cdot R_{P,1} \tag{19}$$

In Equation (19), k_t is the production coefficient of period t, and $R_{P,1}$ is the R_P at time $t = 1$.

$$k_t = 1 + 0.02 \cdot (t - 1) \tag{20}$$

Then, the dynamic model of $R_{P\text{-}real,t}$ is as follows:

$$R_{P\text{-}real,t} = [1 + 0.02 \cdot (t - 1)]\, R_{P,1} \tag{21}$$

According to Equation (21), $R_{P\text{-}real,t}$ rises with time. The slow growth of $R_{P\text{-}real,t}$ can be explained from the two aspects of agricultural output and market price: Because of the macro-regulation of the AP market, the price of AP is basically stable. Slow progress in terms of agricultural technology results in slow growth in agricultural productivity. Due to space limitations, only the first 40 periods of the simulation results are reported, one year for one period. The production coefficient gradually increases from 1 to 1.78, and $R_{P\text{-}real,t}$ gradually increases from CNY 335 in the first year to CNY 596.30 in the fortieth year.

Second, we analyze the suburban dynamic $R_{E\text{-}real,t}$. During the numerical simulation of dynamic $R_{E\text{-}real,t}$, assume that $R_{E\text{-}real,t}$ is a function of the base period $R_{E,1}$. Then, we can obtain the following:

$$R_{E\text{-}real,t} = \alpha_t \cdot R_{E,1} = R_{E,1} \cdot f(Abil_t, Inte_t, Othe_t) = R_{E,1} \cdot (\theta_{urb,t} \cdot \varphi_{urb,t} + \theta_{sub,t} \cdot \varphi_{sub,t}) \tag{22}$$

In Equation (22), $R_{E\text{-}real,t}$ represents the $R_{E\text{-}real}$ at time t. α_t is the realization coefficients of R_E at time t. $Abil_t$ and $Inte_t$ are the purchasing ability and purchasing intention to pay for R_E at time t. They are proportional to the urbanization rate and the level of economic development and are the most important influential factors. $Othe_t$ represents the influential factors other than $Abil_t$ and $Inte_t$ at time t. For the convenience of studying the problem, we only analyze these two most important factors. $\theta_{urb,t}$ and $\theta_{sub,t}$ represent the purchasing ability coefficient of governments of urban and suburban areas for R_E at time t, respectively. $\varphi_{urb,t}$ and $\varphi_{sub,t}$ represent the purchasing intention coefficient of the government of the urban and suburban areas for R_E at time t, respectively. The government of suburban areas buys the agricultural ecological value and pays $R_{E\text{-}real,t}$ according to the social demand. The main form of this purchase is the ecological compensation of the government. In reality, there are other levels of government, but to simplify the analysis presented herein, assume that the buyer of agricultural ecological function compensation is the government of the urban and suburban areas. It is assumed that the governments of urban and suburban areas take the proportion of the non-agricultural population in the whole region under their jurisdiction as the main reference variable and that the purchase of ecological value is mainly determined by the demand of non-agricultural population, assuming that it is a linear function of non-agricultural population and that the purchasing intention coefficient at the urban and suburban areas increases with the number of periods by 0.02 and 0.01, respectively. The purchasing ability coefficient of the two levels of government to purchase ecological value is different and non-linear, assuming that the purchasing ability coefficient increases in stages as the proportion of non-agricultural population increases and as the society and economy develop. For the numerical simulation of suburban dynamic R_A, it is assumed that the purchasing ability coefficient of urban and suburban areas can be divided into three stages. The Stages of Economic Growth written by Rostow (1960) consist

of five stages: the traditional society, the preconditions for take-off, the take-off, the drive to maturity, and the age of high mass consumption [30]. In 1971, Rostow added the sixth stage in Politics and the Stages of Growth [31]. The six stages of economic development are the traditional society stage, the preparation stage, the take-off stage, the mature stage, the mass consumption stage, and the surpassing mass consumption stage. Although Rostow fails to achieve a grand synthesis, he must be given high marks for his effort [32]. In an actual economic society, this purchasing ability to pay for R_E or R_L will be affected by the stage of economic development. The division of economic stages is not the focus of this study, and no matter how the economic development stages are divided, the purchasing ability to pay for R_E or R_L is rising as a whole. Therefore, this paper makes this assumption, which is in line with the actual economic law, will not have a substantial impact on the results, and will not affect our analysis of the realization rules of R_A. It is assumed that the three pairs of coefficients are 0.50, 0.30; 0.80, 0.50; and 1.00, 1.00, respectively. The corresponding years are 15 years, 15 years, and 10 years. The subsequent simulations are based on this assumption. Thus, we can obtain the following:

$$\varphi_{urb,t} = f(pop_{urb,non,t}/pop_{urb,tot,t}) = 0.01 + 0.02 \cdot (t - 1) \quad (23)$$

$$\varphi_{sub,t} = f(pop_{sub,non,t}/pop_{sub,tot,t}) = 0.01 + 0.01 \cdot (t - 1) \quad (24)$$

In Equations (23) and (24), $pop_{urb,non,t}$ and $pop_{urb,tot,t}$ represent the non-agricultural population and the total population in the urban areas at time t, respectively. $pop_{sub,non,t}$ and $pop_{sub,tot,t}$ represent the non-agricultural population and the total population in the suburban areas at time t, respectively. Then, the dynamic model of $R_{E\text{-}real,t}$ is as follows:

$$R_{E\text{-}real,t} = 0.01 \cdot R_{E,1} \cdot [(\theta_{urb} + \theta_{sub}) + (t - 1)\,(2 \cdot \theta_{urb} + \theta_{sub})] \quad (25)$$

According to the aforementioned assumptions and the previous static numerical simulations, the cashed $R_{E,A}$, $R_{E,I}$, and $R_{E,II}$ are CNY 147.75, CNY 299.25, CNY 255, respectively, so $R_{E,1}$ is CNY 702. The promotion of an ecological civilization has increased people's attention to the environment and the demand for ecological services, as has the purchase intention of the two levels of government for $R_{E\text{-}real}$. From the early lower purchasing ability and intention to the later higher purchasing ability and intention to pay for R_E, this changes the situation at the beginning when the realization value of $R_{E\text{-}real}$ is 5.62, which is far lower than that of $R_{P\text{-}real,t}$, and this enables $R_{E\text{-}real,t}$ to surpass $R_{P\text{-}real,t}$ at the later stage. In the third stage, the two levels of government buy ecological values completely, and $R_{E\text{-}expe,t}$ has been fully realized. As the city's two levels of government pay more willingly, the value amount of $R_{E\text{-}real,t}$ gradually increases from CNY 5.62 in the first year to CNY 835.38 in the fortieth year.

Third, we analyze the suburban dynamic $R_{L\text{-}real,t}$. During the numerical simulation of dynamic $R_{L\text{-}real,t}$, assume that $R_{L\text{-}real,t}$ is a function of the base period $R_{L,1}$. The city's government buys the agricultural landscape value and pays the $R_{L\text{-}expe}$ according to the social demand. The main form of this purchase is the landscape compensation of the government. Buyers of compensation for agricultural landscape function are divided into local governments and city governments, assuming that the buyers of agricultural ecological function compensation are urban and suburban governments. It is assumed that the urban and suburban governments take the proportion of the non-agricultural population in the whole region under their jurisdiction as the main reference variable and that the purchase of landscape value is mainly determined by the demand of the non-agricultural population, assuming that it is a linear function of the non-agricultural population, and the purchasing intention coefficients at the urban and suburban levels increase with the number of periods by 0.02 and 0.01, respectively. The purchasing abilities of the two levels of government to purchase landscape value are different and non-linear, assuming that the purchase intention coefficient increases in stages as the proportion of the non-agricultural population increases. The purchasing ability coefficients of the

governments of the urban and suburban areas are divided into three stages, which are 0.40, 0.20; 0.60, 0.40; and 1.00, 1.00, respectively.

According to the aforementioned assumptions,

$$R_{L\text{-}real,t} = \beta_t \cdot R_{L,1} = R_{L,1} \cdot g(Abil_t, Inte_t, Othe_t) = R_{L,1} \cdot (\delta_{urb,t} \cdot \eta_{urb,t} + \delta_{sub,t} \cdot \eta_{sub,t}) \quad (26)$$

$$\eta_{urb,t} = g(pop_{urb,non,t} / pop_{urb,tot,t}) = 0.01 + 0.02 \cdot (t - 1) \quad (27)$$

$$\eta_{sub,t} = g(pop_{sub,non,t} / pop_{sub,tot,t}) = 0.01 + 0.01 \cdot (t - 1) \quad (28)$$

In Equation (26), $R_{L\text{-}real,t}$ represents the $R_{L\text{-}real}$ at time t. β_t is the realization coefficient of R_L at time t. $Abil_t$ and $Inte_t$ are the purchasing ability and purchasing intention to pay for R_L at time t. They are proportional to the urbanization rate and the level of economic development and are the most important influential factors. $Othe_t$ represents the influential factors other than $Abil_t$ and $Inte_t$ at time t. For the convenience of studying the problem, we only analyze these two most important factors. $\delta_{urb,t}$ and $\delta_{sub,t}$ represent the purchasing ability coefficient of governments of urban and suburban areas for R_L at time t, respectively. $\eta_{urb,t}$ and $\eta_{sub,t}$ represent the purchasing intention coefficient of the government of the urban and suburban areas for R_L at time t, respectively.

In Equations (27) and (28), $pop_{urb,non,t}$ and $pop_{urb,tot,t}$ represent the non-agricultural population and the total population in the urban areas at time t, respectively. $pop_{sub,non,t}$ and $pop_{sub,tot,t}$ represent the non-agricultural population and the total population in the suburban areas at time t, respectively. Then, the dynamic model of $R_{L\text{-}real,t}$ is as follows:

$$R_{L\text{-}real,t} = 0.01 \cdot R_{L,1} \cdot [(\delta_{urb} + \delta_{sub}) + (t - 1) \cdot (2 \cdot \delta_{urb} + \delta_{sub})] \quad (29)$$

Based on the above assumptions and the previous static numerical simulations, the cashed $R_{L,A}$, $R_{L,I}$, and $R_{L,II}$ are CNY 12, CNY 114, and CNY 75, respectively, so $R_{L,1}$ = CNY 201. Due to the improvement in the urbanization level, the demand for leisure and sightseeing is increasing, and the purchase intention of the two levels of government for $R_{L\text{-}real,t}$ is getting stronger. At the beginning, the realized value of $R_{L\text{-}real,t}$ is 1.21, which is far lower than that of $R_{P\text{-}real,t}$, but in the later stage, the gap between $R_{L\text{-}real,t}$ and $R_{P\text{-}real,t}$ decreases. For example, Shanghai plans to establish 25 country parks to meet the urban population leisure and sightseeing needs. When the third stage is reached, the two levels of government pay all the landscape value, and the agricultural land value reaches the maximum realization. As the purchase intention of the city's two levels of government increases, the value amount of $R_{L\text{-}real,t}$ gradually increases from CNY 1.21 in the first year to CNY 239.19 in the fortieth year.

Finally, suburban dynamic $R_{A\text{-}real,t}$. $R_{A\text{-}real,t}$ is the sum of $R_{P\text{-}real,t}$, $R_{E\text{-}real,t}$, and $R_{L\text{-}real,t}$. The realization rules of $R_{A\text{-}real,t}$ are shown in Figure 4, and the gap evolution between different $R_{A\text{-}real,t}$ is shown in Figure 5. The suburban dynamic total $R_{A\text{-}real,t}$ has the following realization rules: the total $R_{A\text{-}real,t}$ is a multiple of $R_{P\text{-}real,t}$. This shows that people's recognition of agricultural ecological value and landscape value is improving. As can be observed from Figure 5, the relative amounts of each total $R_{A\text{-}real,t}$ are as follows: the $R_{P\text{-}real,t}$ is far greater than $R_{E\text{-}real,t}$ in the first year; however, over time, the gap gradually narrows, and at the later stage, it even appears that $R_{P\text{-}real,t}$ is smaller than $R_{E\text{-}real,t}$. At the beginning, $R_{P\text{-}real,t}$ is far greater than $R_{L\text{-}real,t}$; as the number of periods increases, the gap between the two gradually increases. With the full payment of $R_{E\text{-}real,t}$, $R_{P\text{-}real,t}$ is still higher than $R_{E\text{-}real,t}$. At the beginning, the gap between $R_{P\text{-}real,t}$ and $R_{L\text{-}real,t}$ is small, and it gradually widens as the number of periods increases.

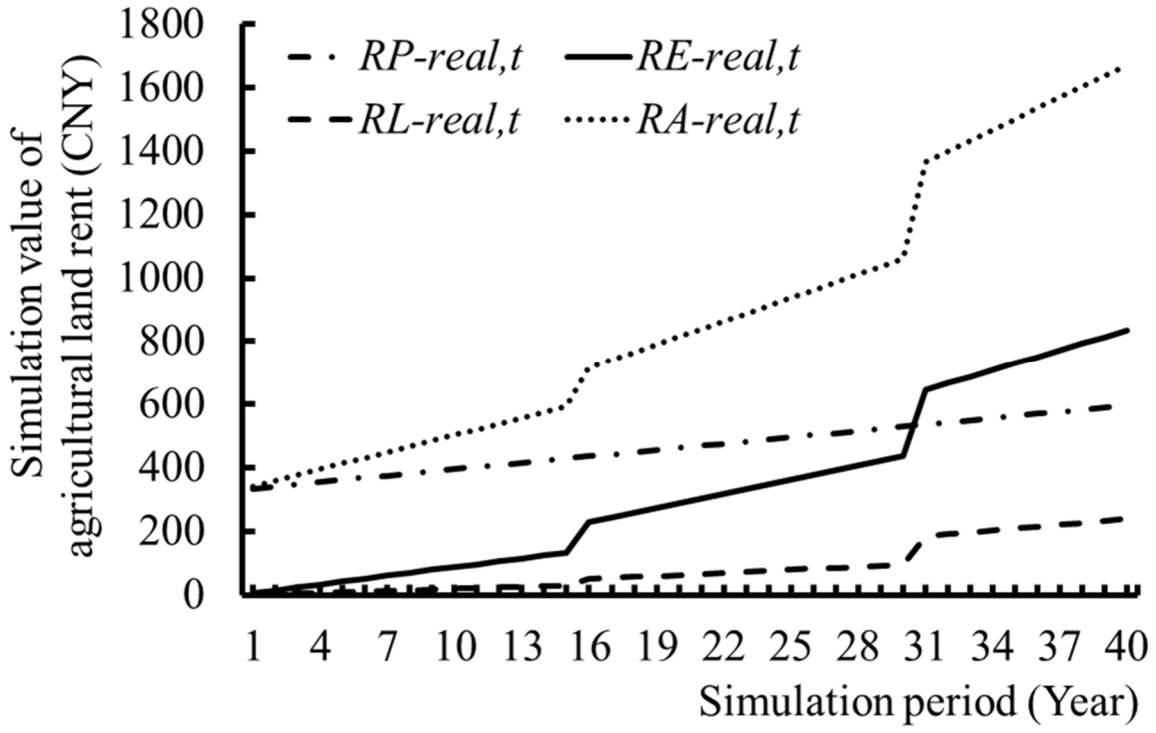

Figure 4. Realization rules of each $R_{A\text{-}real,t}$.

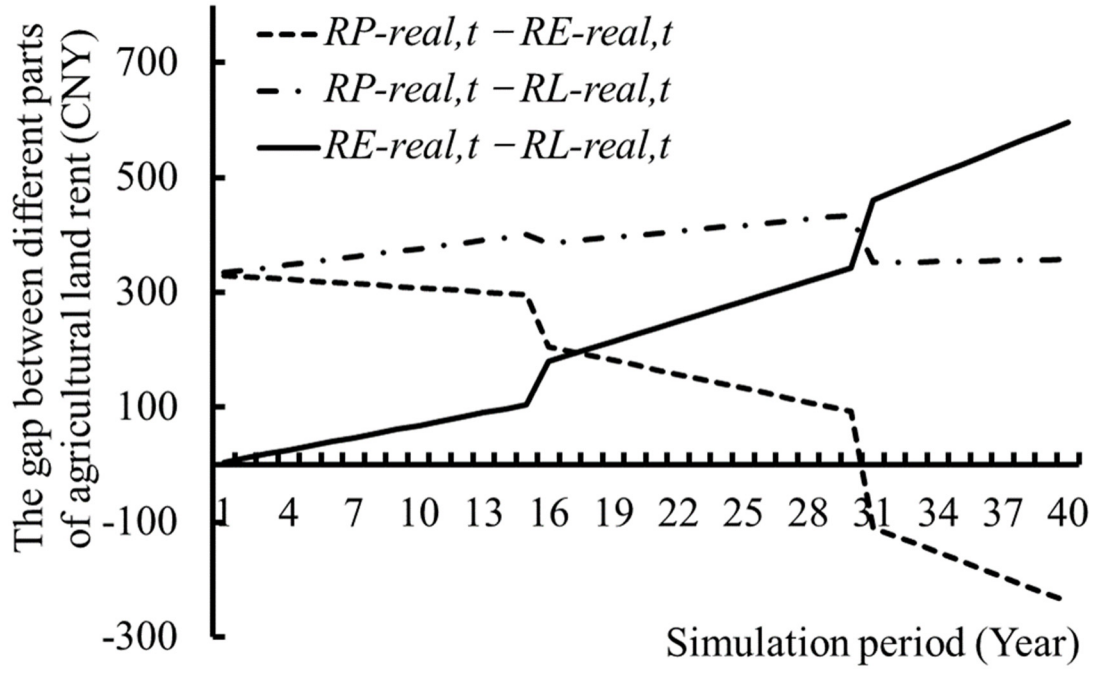

Figure 5. Evolution of the gap among each $R_{A\text{-}real,t}$.

According to the analysis of the theoretical part of this paper, the ratio λ between the total $R_{A\text{-}real,t}$ and the $R_{P\text{-}real,t}$ is increasing, and the lower the realization degree of $R_{A\text{-}real,t}$ is, the lower the profit of agricultural land owners; thus, the lower the enthusiasm of agricultural land owners to engage in agricultural production. With the increase in $R_{E\text{-}real,t}$ and $R_{L\text{-}real,t}$ purchasing intention, the realization degree of agricultural ecological value and landscape value is gradually enhanced. Although the ratio λ between total $R_{A\text{-}real,t}$ and $R_{P\text{-}real,t}$ is increasing, the gap between $R_{E\text{-}real,t}$ and $R_{P\text{-}real,t}$ initially shows a decreasing

trend before counter surpassing with $R_{E\text{-}real,t}$ and gradually exceeding $R_{P\text{-}real,t}$. With the development of an ecological civilization and economy, people's recognition of $R_{E\text{-}real,t}$ and $R_{L\text{-}real,t}$ will be enhanced, and their purchasing intention and ability will increase as well. $R_{E\text{-}real,t}$ and $R_{L\text{-}real,t}$ improve from early zero to full payment to meet the needs of ecological civilization construction, which is helpful for increasing agricultural land owners' land rent profits and enhancing agricultural land owners' enthusiasm for protecting agricultural land use.

In reality, the urban governments at all levels in economically developed areas have carried out multiangle subsidies for agriculture, and the ecological compensation and tourism compensation for agriculture provided by the governments of urban and suburban areas are typical R_E and R_L payment methods. Furthermore, the authors of this paper hold the belief that enriching the connotation of R_A gradually realizes the transformation from R_P to total R_A, including R_P, R_E, and R_L, which play a positive role in protecting agricultural land use.

As hypothesized earlier, R_E and R_L in agriculture are becoming more and more important with the economic development of the suburbs, and neglecting to account for them is not conducive to the sustainable development of agriculture. The level of economic development will increase R_E and R_L, but the accounting of this part of land rent will, to some extent, increase government expenditure. The government needs to balance economic growth and sustainable agricultural development. It is worth noting that with the development of the economy, the proportion of agriculture in the national economy is decreasing. Economic development helps to promote agriculture, and the sustainable development of agriculture will further promote economic development, forming a positive interaction between the two.

4. Discussion

Research on land rent is an important field of economics, and scholars worldwide have continuously verified and perfected the theory of land rent. Capital by Karl Marx is widely recognized around the world [33]. For French physiocrats and Adam Smith, land rent is the price paid for the value contributed by nature itself [34]. Marx points out in *Capital* that land rent is the form in which land ownership can realize multiplication value in the economy [19] and explains the origin of capitalist land rent, which involves differential land rent, absolute land rent, labor land rent, product land rent, and monetary land rent [19]. Bourgeois scholars, represented by scholars such as David Ricardo, only admit differential land rent and deny absolute rent [35]. Marx's important contribution lies in developing differential land rent theory to a new level [36]. The use of natural resources and the emergence of externalities generate rents [25]; however, a large number of people benefit from many ecological and landscape services provided by natural resources without paying compensation [26]. Ecological land rent is essentially the excess profit generated by the scarce ecological resources, which can come from both differential land rent *I* and differential land rent *II*. Differential land rent, in Marx's theory, depends on the specificities of prevailing socioeconomic relations [34,37]. In addition, extensive studies have focused on illegal cultivated land use in China [38,39], while few studies have paid attention to the value realization of agricultural ecological value and landscape value based on land rent theory, especially in suburbs.

Some scholars have also discussed agricultural land protection. Rapid urbanization and resource depletion contribute to the loss of agricultural land [40]. Since the mid-1970s, agricultural land preservation has attracted attention [41]. In the past 40 years, China has attached great importance to the protection of cultivated land [42]. The new round of land titling increases the degree of privatization of land property rights, even though land ownership is still collective by law [9,10,43]. Although the ownership of the cultivated land belongs to the village collectives, the use rights, benefit rights, and disposal rights of the land are almost private [9]. Due to land use regulations, it is difficult for agricultural land owners (referring to agricultural land owners in a broad sense, including village

collectives and agricultural producers and operators; suburban land is mostly collective land with collective ownership, and the right to use the land belongs to farmers and other agricultural producers and operators) to obtain the full value-added benefits from land use transformation. Land value-added distribution is unreasonable at the institutional level [44]. There are also some case studies that have evaluated the effect of cultivated land protection policies [45].

In summary, many publications in the literature have extensively discussed land rent theory and the protection of agricultural land; however, few studies have analyzed the accounting rules and realization rules of R_A based on land rent theory, especially from the perspective of agricultural ecological value and landscape value. The existing R_A theory, characterized by R_P, is not conducive to agricultural land protection, nor is it conducive to the sustainable development of agriculture and the construction of an ecological civilization. The neglect of agricultural ecological value and landscape value accelerates the loss of cultivated land. According to the 2017 China Statistical Bulletin of Land, Mineral and Marine Resources, the national cultivated land area was reduced by 320,400 hectares by the end of 2017. The unlimited expansion of built-up areas will inevitably lead to the depletion of agriculture and natural resources, threatening national food security [46]. Limited by the productivity conditions at that time and the non-scarcity of the ecology and landscapes, Marx's land rent theory of agricultural production is based on the function of agricultural production and does not pay too much attention to agricultural ecological value and landscape value. In the era of backward agricultural productivity, food, clothing, and survival are prioritized over environmental protection [47]. With society entering the middle and late stages of industrialization, agriculture not only produces *APs* but also produces *EPs* recognized by society, as well as *LPs* recognized by leisure society. In urban areas, agriculture is called "urban agriculture", and the function of agriculture has transitioned from only *AP* production recognized by society to the *AP* production function, along with the *EP* production function and *LP* production function. The governments and societies of some economically developed cities in China have regarded ecological and landscape functions as more important than agricultural production functions, and there was a situation in which the government dedicated a large amount of funds to agricultural production, including ecological compensation. For example, for agricultural operators who carry out deep plowing in autumn and winter, 13.33 CNY/hectare (data source: http://service.shanghai.gov.cn/XingZhengWenDangKuJyh/XZGFDetails.aspx?docid=REPORT_NDOC_006782. accessed on 11 September 2022) will be subsidized in the Qingpu District, Shanghai, China. The subsidy for rice cropping will be 21.33 CNY/hectare (Data source: https://www.shqp.gov.cn/agri/nwzwgk/ml/fg/20201105/801236.html. accessed on 11 September 2022) in the Qingpu District, Shanghai, China. How can the land profits of agricultural land owners be improved to promote agricultural production, food security, and an ecological civilization? The protection of agricultural land in suburbs is difficult to explain from the perspective of Marx's traditional land rent theory of agricultural production. For this reason, the numerical example method commonly used in political economy at that time, which Marx adopted in *Capital* [29], is used to carry out the theoretical accounting of R_A in suburbs, and its realization rules are simulated.

The accuracy of the theoretical methods and data of R_A calculation can be used to guide agricultural production and land transfer. It is necessary and valuable to strengthen research in this regard. There are many factors that affect agricultural land owners' enthusiasm for agricultural production, such as happiness and income. From the perspective of land rent profit, compared with the non-increase in land rent profit, the increase in profit will at least not reduce agricultural land owners' enthusiasm in agricultural production. Ecological civilization, as everyone knows, is a social form with the basic purposes of facilitating harmonious coexistence, a virtuous cycle, comprehensive development, and sustained prosperity between man and nature, man and man, and man and society. One of the important points of ecological civilization is environmental improvement. From the perspective of environmental value, improvements in R_A, improvements in agricultural

land owners' enthusiasm to protect cultivated land, and improvements in the ecological environment belong to a part of the ecological civilization. This promotion effect is relatively limited, but it cannot be ignored.

This paper aimed to expand on Marx's land rent theory of agricultural production and reveal the accounting rules and realization rules of R_A in the new stage of a socialist market economy. The agricultural DSS analytical framework of this paper provides a tool for analyzing the accounting rules and realization rules of the static and dynamic R_A in suburbs and provides a decision-making basis and reference for policy makers to promote sustainable agricultural development, and this is the key innovative aspect of this paper. It is worth noting that there are many influencing factors of R_A, and the functional form is also diverse. Due to the unavailability of data, without affecting the general trend, the calculation is not very accurate, though it will be improved with more in-depth research. We will pay more attention to the stage of economic development and payment coefficient in a follow-up study. When follow-up data are available, we will also conduct further in-depth research.

5. Conclusions and Implications

5.1. Conclusions

Based on Marx's land rent theory of agricultural production, in this paper, the analytical framework of DSS was constructed; then, the agricultural land rent in the suburbs was theoretically accounted for via using a numerical example, and its realization rules were simulated. The main conclusions that can be drawn based on this study are as follows:

First, agricultural production in suburbs is not only natural reproduction but also social reproduction. Agricultural production in suburbs produces *APs* as well as *EPs* and *LPs*. Therefore, R_A should include R_P, R_E, and R_L.

Second, with the promotion of an ecological civilization and the development of the economy and society, people's recognition of R_E and R_L, as well as their purchase intention and ability, will all be improved, which will lead to an increase in the comprehensive coefficient of R_A.

Third, $R_{E\text{-}real,t}$ and $R_{L\text{-}real,t}$ are paid from the early zero to the full amount, which meets the needs of ecological civilization construction, helping to increase agricultural land owners' land rent profits and strengthening their enthusiasm for protecting agricultural land use.

Fourth, the numerical simulation results show that the gap between $R_{P\text{-}real,t}$ and $R_{E\text{-}real,t}$ shows a tendency to decrease first before the latter exceeds the former, while the gap between $R_{P\text{-}real,t}$, $R_{E\text{-}real,t}$, and $R_{L\text{-}real,t}$ widens.

5.2. Implications

Based on the above main conclusions, for the sake of national food security and ecological civilization construction, we put forward the following policy recommendations.

First, agricultural production is strategically important for guaranteeing national food security, and in the new stage of the socialist market economy, the government should fully recognize the multifunctionality of agricultural production. (1) The most important function of agricultural production lies in the production of *APs*, which is the basic guarantee of national food security. (2) In addition to recognizing the *AP* production function of agricultural production, the government should also increase its recognition of the *EP* production and *LP* production functions of agricultural production.

Second, agricultural production has positive significance for ecological environmental protection and ecological civilization construction. In the new stage of economic and social development, the government should fully recognize the ecological value and landscape value of agricultural production. The government should also recognize that the ecological and landscape values of agriculture have obvious positive externalities and public benefits for the whole society and align the contribution of agricultural production

with the improvements in the social ecological environment and the landscape recreation of residents.

Third, on the basis of fully affirming the multifunctionality of agricultural production, the government should fully recognize the R_E and R_L of agriculture and then establish an R_A accounting system that integrates R_P, R_E, and R_L and increases the payment of R_E and R_L to improve the realization degree of R_E and R_L.

Fourth, from the perspective of agricultural economics, it is important to emphasize the positive externalities of agricultural production and strengthen the government's macro-control of agricultural production. Because of the obvious positive externalities and public welfare of agricultural ecological value and landscape value, it is difficult to realize R_E and R_L through market-oriented ways, so the government should play a leading role in the payment of R_E and R_L. The stakeholders of agricultural production include three main bodies: village collectives, agricultural producers and operators, and consumers. Challenges may exist in practice, mainly with regard to externalities in the compensation of R_E and R_L. The beneficiaries of the *EPs* and *LPs* of agricultural production are mainly tourists in non-agricultural industries. The ecological and landscape values are not exclusive and can be shared by all residents within the region. Consumers (mainly tourists) only need to pay very little, or even consume *EPs* and *LPs* free of charge. It is difficult for village collectives and agricultural producers and operators (such as tourism companies) to realize their investment in the process of building agricultural landscapes, and it is difficult for farmers to increase their land rent profits, and this will bring challenges to the protection of agricultural land. Therefore, strengthening the government's macro-control of agricultural production is important. The government can set up a compensation mechanism for R_E and R_L by transferring part of the tax revenue from non-agricultural industries to motivate agricultural land owners to protect their cultivated land. (1) Subsidize agricultural production by increasing government financial investment, where the subsidy is not limited to the production function of agriculture but should also subsidize the ecological function and landscape function of agriculture to increase agricultural land owners' motivations to protect agricultural land. The government could also support agricultural production and encourage agricultural landscape and ecological investment through tax returns and agricultural infrastructure investments. (2) For individuals or units that actively protect agricultural land, give the necessary support and backing to protectors in terms of human, material, financial, and technical resources and mobilize local governments to protect agricultural land. (3) The ecological and landscape values of agriculture have obvious positive externalities, and local governments that are in a position to do so should pay part of the ecological and landscape compensation in the early stage and make full payments in the later stage. The local governments described here include the grassroots governments where the agricultural land is located and governments above this level at all levels.

Finally, according to the source and realization rules of agricultural land transfer, China should properly raise the subsidy standard for agriculture under the World Trade Organization (WTO) rules. In December 2001, China joined the WTO. However, according to the Organization for Economic Cooperation and Development (OECD) and Food and Agricultural Organization (FAO) of the United Nations [48], the extent of China's support for its agricultural sector is minimal and below the OECD average. Agricultural subsidies are strongly driven by macro-economic factors, including the share of agriculture in the gross domestic product and per capita gross domestic product [49]. Therefore, as economic development progresses, China should properly raise the subsidy standard for agriculture under the WTO rules, protect the legitimate interests of agricultural producers, and promote the sustainable development of agriculture. On the one hand, the government should improve the ability to pay for land transfer, increase the payment for agricultural land transfer, and guarantee the legitimate rights and interests of agricultural land owners to the maximum extent. On the other hand, the government should increase the restrictions on the non-agricultural flow of agricultural land to curb the negative effects of the non-

agriculturalization of agricultural land based on national food security and ecological civilization construction.

In addition, it should be emphasized that from the perspective of building a common global green future, issues related to the continuous degradation of the natural environment are very important. This study provides a reference for developed countries or economically developed regions in developing countries. In these regions, agricultural production has positive externalities, and compensation for R_E and R_L is of positive significance for food security and ecological sustainability.

Author Contributions: Conceptualization, K.W. and J.L.; methodology, K.W., J.L., H.L., X.F. and L.Z.; investigation, K.W., J.L., H.L. and S.Z.; writing—original draft preparation, K.W. and J.L.; writing—review and editing, K.W., J.L., H.L., X.F. and L.Z.; funding acquisition, K.W., J.L. and H.L. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the National Office for Philosophy and Social Science of China, grant number 22AGL027; the Shanghai Planning Office of Philosophy and Social Science, grant number 2023ZGL003, 2020BJB010; the Technology Innovation Center for Land Spatial Eco-restoration in the Metropolitan Area, MNR, Shanghai, 200003, grant number CXZX202201; the Shanghai Municipal Planning and Natural Resources Bureau, grant number Ghzy2023001 and Ghzy2023005; and the Research Start-Up Grant Program of Shanghai Customs College (chaired by Jianglin Lu).

Data Availability Statement: All data are presented in the research paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Armstrong, L. (Ed.) *Improving Data Management and Decision Support Systems in Agriculture*, 1st ed.; Burleigh Dodds Science Publishing: Cambridge, UK, 2020. [CrossRef]
2. Manos, B.; Matsatsinis, N.; Paparrizos, K.; Papathanasiou, J. (Eds.) *Decision Support Systems in Agriculture, Food and the Environment: Trends, Applications and Advances*; IGI Global: Hershey, PA, USA, 2010. [CrossRef]
3. Hanzlík, P.; Kožíšek, F.; Pavlíček, J. Design of intelligent decision support systems in agriculture. *Int. J. Math. Comput. Simulat.* **2015**, *9*, 113–118.
4. Eastwood, C.R.; Chapman, D.F.; Paine, M.S. Networks of practice for co-construction of agricultural decision support systems: Case studies of precision dairy farms in Australia. *Agric. Syst.* **2012**, *108*, 10–18. [CrossRef]
5. Qian, F.; Wang, W.; Wang, Q.; Lal, R. Implementing land evaluation and site assessment (LESA system) in farmland protection: A case-study in northeastern China. *Land Degrad. Dev.* **2021**, *32*, 2437–2452. [CrossRef]
6. Barrett, C.B. Overcoming global food security challenges through science and solidarity. *Am. J. Agric. Econ.* **2020**, *103*, 422–447. [CrossRef]
7. Millimet, D.L.; McDonough, I.K.; Fomby, T.B. Financial capability and food security in extremely vulnerable households. *Am. J. Agric. Econ.* **2018**, *100*, 1224–1249. [CrossRef]
8. Costanza, R.; d'Arge, R.; de Groot, R.; Farber, S.; Grasso, M.; Hannon, B.; Limburg, K.; Naeem, S.; O'Neill, R.V.; Paruelo, J.; et al. The value of the world's ecosystem services and natural capital. *Nature* **1997**, *387*, 253–260. [CrossRef]
9. Qiu, T.; Ma, X.; Luo, B. Are private property rights better? Evidence from the marketization of land rentals in rural China. *Econ. Chang. Restruct.* **2022**, *55*, 875–902. [CrossRef]
10. Luo, B.; Fu, B. The farmland property rights deformity: The history, reality and reform. *China Agric. Econ. Rev.* **2009**, *1*, 435–458. [CrossRef]
11. Floyd, J.E. The effects of farm price supports on the returns to land and labor in agriculture. *J. Polit. Econ.* **1965**, *73*, 148–158. [CrossRef]
12. Herdt, R.W.; Cochrane, W.W. Farm land prices and farm technological advance. *Am. J. Agric. Econ.* **1966**, *48*, 243–263. [CrossRef]
13. Shoemaker, R. Agriculture land values and rents under the conservation reserve program. *Land Econ.* **1989**, *65*, 131–137. [CrossRef]
14. Li, S. *Environmental Philosophy: A Study of Environmental Problems from the Perspective of Philosophy*; Communication University of China Press: Beijing, China, 2010. (In Chinese)
15. Li, G. The natural productive forces and study on the agricultural history—What way to cognize the natural productivity. *Agric. Hist. China* **2014**, *33*, 3–15. (In Chinese)
16. Marx, K. *Capital: Volume I*; People's Publishing House: Beijing, China, 2004. (In Chinese)
17. Meng, J.; Gong, J. Financial capital and "class monopoly rent"—Harvey's institutional analysis of capitalist urbanization. *Soc. Sci. China* **2014**, *8*, 91–108. (In Chinese)
18. Engels, F. *Karl Marx, Friedrich Engels: Collected Works*; People's Publishing House: Beijing, China, 1973; Volume 26, No. 2. (In Chinese)

19. Marx, K. *Capital: Volume III*; People's Publishing House: Beijing, China, 2004. (In Chinese)
20. Tsvetnov, E.V.; Shcheglov, A.I.; Tsvetnova, O.B. Eco-economic approach to evaluation of agricultural lands polluted by chemicals and radionuclides. *Eurasian Soil Sci.* **2009**, *42*, 334–341. [CrossRef]
21. Basu, D. Marx's Analysis of Ground-Rent: Theory, Examples and Applications. UMASS Amherst Economics Working Papers. 241. Available online: https://scholarworks.umass.edu/econ_workingpaper/241/ (accessed on 11 September 2022).
22. Corell, R.; Herzog, E. Subprime crisis and Marx's theory on ground rent. *Word Rev. Polit. Econ.* **2014**, *5*, 149–171.
23. Oded, H.; Ori, Z. Production in Urban Environments. *CESifo Econ. Stud.* **2023**, *69*, 61–68. [CrossRef]
24. Engel, S.; Pagiola, S.; Wunder, S. Designing payments for environmental services in theory and practice: An overview of the issues. *Ecol. Econ.* **2008**, *65*, 663–674. [CrossRef]
25. Muller, A. How to make the clean development mechanism sustainable—The potential of rent extraction. *Energ. Policy* **2007**, *35*, 3203–3212. [CrossRef]
26. Sjaastad, E.; Angelsen, A.; Vedeld, P.; Bojö, J. What is environmental income? *Ecol. Econ.* **2005**, *55*, 37–46. [CrossRef]
27. Xu, K.; Yang, Z. Research on the value of land ecological service in Yunnan province based on the perspective of spatial pattern. *Sustainability* **2022**, *14*, 10805. [CrossRef]
28. Guo, S.; Hu, Z.; Ma, H.; Xu, D.; He, R. Spatial and temporal variations in the ecological efficiency and ecosystem service value of agricultural land in China. *Agriculture* **2022**, *12*, 803. [CrossRef]
29. Chen, Y.; Rong, Z. Completing Marx's work by following Marx's logic: Revisiting transformation theory. *Econ. Res. J.* **2018**, *53*, 183–198. (In Chinese)
30. Rostow, W.W. *The Stages of Economic Growth: A Non-Communist Manifesto*, 3rd ed.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 1960.
31. Rostow, W.W. *Politics and the Stages of Growth*; Cambridge University Press: Cambridge, UK; New York, NY, USA, 1971.
32. Dirlam, J.B. A review of: "The stages of economic growth" a non-communist manifesto by W. W. Rostow Cambridge University Press, New York, 1960. *Eng. Econ.* **1961**, *6*, 28–34. [CrossRef]
33. Lu, P. The true meaning of capital and its misinterpretation: Also on the relationship between capital and western economics. *Stud. Marx.* **2015**, *7*, 102–112+159. (In Chinese)
34. Ward, C.; Aalbers, M.B. Virtual special issue editorial essay: 'The shitty rent business': What's the point of land rent theory? *Urban Stud.* **2016**, *53*, 1760–1783. [CrossRef]
35. Hong, Y. *A Concise Course of Capital*; Fudan University Press: Shanghai, China, 2014. (In Chinese)
36. Harvey, D. *The Limits to Capital*; Verso: London, UK, 1999; pp. 349–353.
37. Haila, A. The theory of land rent at the crossroads. *Environ. Plann. D* **1990**, *8*, 275–296. [CrossRef]
38. Lian, H.; Li, H.; Ko, K. Market-led transactions and illegal land use: Evidence from China. *Land Use Policy* **2019**, *84*, 12–20. [CrossRef]
39. Chen, Z.; Wang, Q.; Chen, Y.; Huang, X. Is illegal farmland conversion ineffective in China? Study on the impact of illegal farmland conversion on economic growth. *Habitat Int.* **2015**, *49*, 294–302. [CrossRef]
40. Abubakar, I.R. Predictors of inequalities in land ownership among Nigerian households: Implications for sustainable development. *Land Use Policy* **2021**, *101*, 105194. [CrossRef]
41. Mulkey, D.; Clouser, R.L. Market and market-institutional perspectives on the agricultural land preservation issue. *Growth Chang.* **1987**, *18*, 72–81. [CrossRef]
42. Zhou, Y.; Li, X.; Liu, Y. Cultivated land protection and rational use in China. *Land Use Policy* **2021**, *106*, 105454. [CrossRef]
43. Luo, B. 40-year reform of farmland institution in China: Target, effort and the future. *China Agric. Econ. Rev.* **2018**, *10*, 16–35. [CrossRef]
44. Li, H. A study on differential rent distribution, public service supply and population urbanization. *Stud. Marx.* **2015**, *1*, 70–80. (In Chinese)
45. Lu, X.; Zhang, Y.; Zou, Y. Evaluation the effect of cultivated land protection policies based on the cloud model: A case study of Xingning, China. *Ecol. Indic.* **2021**, *131*, 108247. [CrossRef]
46. Sun, Q. On the distribution of interests in the process of homestead expropriation by local government—Based on the perspective of Marx's land rent theory. *Stud. Marx.* **2013**, *11*, 69–77. (In Chinese)
47. Huang, M.; Ye, Q. The Marxist green development concept and green development in contemporary China: Comment on incompatibility theory between environment and development. *Econ. Rev. J.* **2017**, *52*, 17–30. (In Chinese)
48. OECD/Food and Agriculture Organization of the United Nations. *OECD-FAO Agricultural Outlook 2013*; OECD Publishing: Paris, France, 2013. [CrossRef]
49. Lopez, R.A.; He, X.; De Falcis, E. What drives China's new agricultural subsidies? *Word Dev.* **2017**, *93*, 279–292. [CrossRef]