Equilibrium Resolution Mechanism for Multidimensional Conflicts in Farmland Expropriation Based on a Multistage Van Damme’s Model

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Abstract: Multidimensional conflicts in farmland expropriation originate from the game of multidimensional interests between the local government and farmers. The strategy choices and equilibrium results of the two sides have evolved with changes to the situation and policy adjustments. Focusing on different types of farmland expropriation conflicts, this paper constructs a multistage Van Damme’s model of multidimensional conflicts in farmland expropriation, analyzes the stable equilibrium point of the behavior evolution of the local government and farmers under litigation settlement and nonlitigation settlement, and conducts simulation analysis on the behavior evolution and conflict resolution of both sides at different stages through MATLAB numerical simulation. The results show that (1) the interests’ game between the local government and farmers has changed periodically due to the evolution of the farmland expropriation system; (2) under litigation settlement, there is only the “government rent-seeking” conflict: in order to resolve the conflict, the cost of litigation for farmers can be reduced, while other policy interventions, such as controlling the rent-seeking ceiling of the local government and increasing the rent-seeking costs of the local government, can be implemented; (3) under nonlitigation settlement, there are three types of conflicts: to resolve the “government rent-seeking” conflict, we should control the rent-seeking ceiling of the local government and increase the rent-seeking costs of the local government or its positive social externality benefits under reasonable expropriation; to resolve the “nail household dilemma” conflict, we should increase the rent-seeking costs of farmers or their positive social externality benefits under reasonable compensation; to resolve the “extreme controversy” conflict, on the one hand, we should control the rent-seeking ceiling of farmers, and on the other hand, while controlling the rent-seeking ceiling of the local government, we should increase the farmers’ positive social externality benefits under reasonable compensation or negative social externality losses of both sides under rent seeking.

Keywords: farmland expropriation; multidimensional conflicts; evolutionary game; multistage van Damme’s model; MATLAB numerical simulation

1. Introduction

Farmland expropriation is an important task to promote urban renewal and development, and reducing the risk of conflicts in farmland expropriation is a necessary prerequisite to ensure smooth implementation of farmland expropriation. In the 1990s, China’s urbanization construction ushered in a period of rapid development. Under the powerful stimulus of land dividends, a large amount of farmland has since been converted into urban construction land. According to China’s “Summary of the National Land Use Master Plan,” by 2030, urban expansion will occupy more than 54.5 million mu of previously cultivated land, and the number of farmers losing land will reach 78 million. However, during this large-scale loss of farmland and urban construction, there have been many
social conflicts, disputes, and even mass incidents. Among the many reasons for farmers’ petitions in China, land issues account for more than 65%, of which 73.2% are related to land expropriation [1]. There are approximately four million disputes caused by land expropriation in China every year [2]. In rural areas, conflicts in land expropriation, illegal construction, law enforcement, and farmland transfer are the most typical. Among them, land expropriation conflicts are the type with the largest proportion and the highest severity, with characteristics of high frequency, high intensity of resistance, and wide range of influence. Meanwhile, the development trend shows a gradual increase from the eastern coastal areas to the underdeveloped areas in the central and western regions. In fact, from China’s first land expropriation regulation in 1953, Measures on Land Expropriation for National Construction, to the implementation of the new Land Management Law in 2020, the state made many adjustments and changes to the scope of land expropriation, expropriation procedures, compensation standards, resettlement methods, etc., and was committed to reducing the risk of conflicts in farmland expropriation. Especially in recent years, as the state’s emphasis and penalties continue to increase, the issue of conflicts in farmland expropriation has gradually eased, but local conflicts still exist. Moreover, occasional vicious conflicts may not only lead to a crisis of trust among farmers as well as between farmers and the collective, and shake the legitimacy of grassroots organizations in rural society, but also cause a large number of property losses and even serious consequences of casualties. Therefore, the land issue centered on farmland expropriation has become the main issue of current rural conflicts in China.

Derived from sociology, the term “conflict” means that two or more social units are incompatible or mutually exclusive in their respective goals, which leads to psychological or behavioral contradictions [3]. Some scholars define conflict as “a one-time, repeated or multiyear disagreement between actors due to a conflict of interest with limited resources” [4]. As conflicts and disputes due to land expropriation have intensified, they have begun to draw the attention of researchers. Bishnu described land conflicts as the farmers’ struggles to change unequal social land relations [5]. Reuveny et al. proposed the concept of land use conflicts, which is a contradictory state in the process of land resource utilization [6]. Accordingly, this paper treats land expropriation conflict as an interactive process wherein various stakeholders exhibit confrontational psychology or behavior to fight for land benefits. In China, individual interest, collective interest, and public interest are the three common drivers causing land expropriation and demolition. Among them, farmland expropriation conflicts caused by individual interest are the most common [7]. Based on their intensity, conflicts can be divided into autonomous demolition, joint demolition, illegal demolition, and violent demolition. The reason may be due to the local government’s management system, problems such as excessive reliance on the unscientific development model of land finance, excessive pursuit of the GDP (gross domestic product) assessment mechanism, and the “pan-administrative” tendency of grassroots organizations. It may also be caused by the lack of some key legal provisions in the upper-level law of farmland expropriation or vague interpretation, such as the difference in the understanding of compensation for expropriated land and for expropriated house, or the lack of corresponding regulations on the specific operating procedures and methods [8]. It may also be caused by differences in compensation standards in various regions or inconsistencies in compensation standards for collective land acquisition and state-owned land acquisition [9]. It is precisely because of the complexity and diversity of conflict causes that the resolution of conflicts in farmland expropriation has become the focus and difficulty of the reform of the farmland expropriation system.

Throughout the evolution of China’s social transformation and the alternation of old and new systems, the legal cognition contradiction between the principle of property protection and economic development has increased the risk of conflicts in farmland expropriation [10]. For farmers, the imperfection of the social security system often makes them worry that demolition will lead to poverty and disrupt their original way of life, so they are hesitant to have their land expropriated. Confronting a reality in which both
poverty and sudden wealth are simultaneously caused by demolition, farmers fearing huge economic losses express concern about the local governments’ abuse of the “public interest” in implementing farmland expropriation [11]. In addition, due to the imperfect market supervision system, a housing evaluation agency is usually designated by the local government, and the evaluation price lacks fairness and neutrality, which often makes farmers question the evaluation results [12]. The above phenomena, on the one hand, reflect the difference of behavior logic between farmers and the local government. On the other hand, they indicate that the farmland expropriation conflict is not only an economic problem, but also a complex social problem that includes behavioral preferences, strategic interactions, and belief interactions. In this process, the strategic interaction and belief interaction between different game subjects change with the adjustment of national policies and evolve into a new game equilibrium result, which leads to the multidimensional conflict characteristics of the farmland expropriation conflict. It is generally believed that the land expropriation system not only empowers local governments to requisition land but also provides farmers with legal protection of their rights and interests [13]. However, in practice, due to the limitations of China’s current farmland expropriation system, the effect of policy implementation often deviates from the original intention of policy design. For example, different types of houses should correspond to different compensation standards, but the vastly different self-built houses in rural areas often lead to problems, such as fuzzy compensation standards and discretion. However, many legal provisions are only principles and frameworks, and they lack effective judgments on the behavior evolution of farmland expropriation conflicts and game results. These make it difficult for the local government and farmers to reach the goal of interest reconciliation and, on the contrary, aggravate the occurrence of conflicts and cause the two sides to fall into the “Boxed Pig” game in which the reconciliation–conflict cycle continues [14].

In the process of farmland expropriation, farmers pay unprecedented attention to fairness. They not only pay attention to whether they are fully compensated, but they also compare their compensation with that of others. However, the inequality of resources and status determines the unfairness of the competition between farmers and the local government. In this case, it can be considered that the conflict of farmland expropriation is a fierce confrontation between public and private rights around different interests [15]. The result of multiple interest appeals is bound to be a multiple interest game. When farmers receive more compensation, it means that local governments need to spend more. The interests relationship between the two is a zero-sum game. In addition to litigation settlement, nonlitigation settlement, affected by the behavioral logic of “a big problem needs a big solution, a small one needs a small solution,” has also become the main way for farmers to deal with disputes. From the perspective of conflict evolution, the farmland expropriation conflict is a dynamic evolution process from conflict accumulation to conflict intensification and then to conflict resolution. Among these, interest is the main inducing factor, and the strategic choice and interaction mode of both sides are the key variables to determine conflict intensity and evolution. Because of this, we must prevent a single type of conflict, but also prevent transformation of different conflicts to avoid causing more serious problems. That is why, in addition to litigation settlement, nonlitigation settlement has also become one of the main ways for farmers to deal with disputes over farmland expropriation. Accordingly, this article explores the formation mechanism of multidimensional conflicts in farmland expropriation, clarifies the evolutionary rules of conflicts in farmland expropriation, and proposes solutions to conflicts in farmland expropriation according to different types of conflicts, which have important practical and research value.

2. Literature Review

Since its reform and opening up, the evolution of the farmland expropriation system in China has mainly gone through three stages [16]. The first stage was centered on economic construction, which mainly started from the State Council’s promulgation of
the Regulations on Land Expropriation for National Construction in 1982. For the first time, the government proposed that land expropriation is compulsory and clarified the scope of compensation. By implementing the Land Management Law in 1987, land was allowed to enter the market as a production factor. Then, the Law of the People’s Republic of China on Rural Land Contracting passed in 2002, clarifying the scope of rural land. In short, farmland expropriation mainly follows the overall development of the concept of “centering on economic construction,” and the principle of compensation follows the original purpose of the expropriated land. The second stage mainly focused on the balance of interests of social subjects, which began with a Constitution amendment in 2004. For the first time, regulations on expropriation and compensation were made, but the regulations were rather vague and did not cover the subjects of how to compensate or what to compensate. When the 2007 Property Law was proposed as a manifestation of respect for and protection of the citizens’ property rights, the design of the land expropriation system began to emphasize fairness. The third stage focuses on social harmony, which started with the implementation of the Administrative Enforcement Law of the People’s Republic of China in 2012. It introduced a framework design of the administrative enforcement mode mainly applying to the people’s court for enforcement and supplemented by administrative enforcement, which helps to promote procedural justice and protect civil rights. By 2014, the “Several Opinions on Comprehensively Deepening Rural Reform and Accelerating the Advancement of Agricultural Modernization” proposed to speed up establishment of a system of value-added income distribution for rural collective operating construction land. In 2020, the new Land Management Law put forward the basic principle of expropriation compensation to ensure that the original living standards of the expropriated persons are not lowered and long-term livelihood is guaranteed. The evolution of the farmland expropriation conflict is closely related to the development of the farmland expropriation system, thus showing the transformation of power between the local government and farmers.

The current research on the multidimensional conflicts in farmland expropriation mainly includes two aspects: behavior research on multidimensional conflicts and game research on multidimensional conflicts. The behavior research on multidimensional conflicts in farmland expropriation can be divided into rights protection conflicts, profit-making conflicts, and institutional conflicts. Rights protection conflicts refer to violations of farmers’ rights due to illegal land expropriation by the local government, leading to farmers’ resistance and demand of rights protection [17]. Since China implemented the Tax-Sharing Reform in 1994, the local governments’ dependence on land finance has further increased [18]. Therefore, to obtain more fiscal revenue from the land, a local government may implement illegal land expropriation [19], mainly by reducing compensation standards and forcing land expropriation [20]. In the face of improper behavior of local governments, farmers’ dissatisfaction has been aroused, and the risk of conflicts in farmland expropriation has increased [21]. However, the decision-making process of farmland expropriation, lacking the effective participation of farmers, often puts farmers at a disadvantage in the negotiation of interest distribution, leading to conflicts between farmers to obtain and protect land rights, exercise land rights, or exclude other people’s intervention in the land [22,23]. A survey showed that the current areas with more serious rights protection conflicts in farmland expropriation in China are mainly located in the southwest and southern provinces, especially in Guangdong and Yunnan [24]. Among them, the high incidence of land conflicts in Yunnan is related to the acceleration of the industrialization process, the disregard for legal procedures for land expropriation by local officials, and the defects of the land compensation system [25]. Guangdong is the forerunner of China’s reform and opening up, and its strong awareness of rights makes it easier for farmers to adopt various methods to protect their legal rights [26].

Profit-making conflicts refer to the fact that there is a large amount of ambiguous interest space in the process of land expropriation, and the subjects of interest competition engage in fierce interest games to maximize their interests, including petitions and mass incidents [27]. With the rapid development of urbanization, the economic externalities
brought about by urban renewal projects have increased the level of housing prices [28]. In the face of the huge added value generated by urban renewal projects, it inevitably intensifies the competition for the distribution of benefits among stakeholders [29]. Studies have shown that when farmers consider the public interest, they tend to give in, but when adopting the personal interest, they tend to confront. When a local government expropriates land for personal gain, conflicts occur. In this process, the blind pursuit of personal interests leads to the occurrence of profit-making conflicts in land expropriation [30]. Local governments often expect to obtain more financial resources through farmland expropriation and reduce the economic cost of urbanization. However, due to the huge gap between the amount of compensation given to farmers and the land transfer income received by local governments, farmers feel that their interests are damaged and choose to take risks to protect their rights [31]. Some scholars attribute the local governments’ mercenary and radical decision-making on land-related issues to the lack of political ethics in the contemporary demolition policy [32]. On the other hand, to maximize their interests, farmers may resist land expropriation, which may lead to conflicts between the local government and farmers [33]. Based on loss aversion, endowment effect, and psychological accounting, farmers are often reluctant to accept development projects which may further aggravate the risk of farmland expropriation conflicts [34]. Some scholars have found that most farmers currently welcome the expropriation of farmland, but the crux of the problem is that farmers want more compensation, and the farmers’ choice of a collective petition and fierce confrontation can improve their bargaining position and help to obtain high compensation. This approach will encourage more farmers to take similar actions. As a result, compensation standards will continue to increase, but demolition conflicts will continue to increase as well [35]. If farmers get more compensation, local governments will incur more costs. However, local governments hope to obtain more economic benefits while gaining political achievements through land expropriation. Therefore, the interest between the two is a “zero-sum game” [36].

Institutional conflicts refer to the conflicts caused by the unreasonable land expropriation system, which is manifested in three aspects: (1) the compensation standard for land expropriation is too low; (2) land expropriation lacks negotiation; (3) the scope of land expropriation is too wide. At present, China mainly adopts an administrative-led agricultural land expropriation system, and local governments have the “first mover advantage” and the “second mover advantage” in the negotiations, resulting in the passive and shallow participation of farmers, and they are in a disadvantageous position in the negotiations [37,38]. In the game process, local governments play a dual role in farmland expropriation. They are not only the competitors in interests, but also the rule-makers, which means that the game between a local government and farmers is unfair [39]. When disputes over farmland expropriation occur, due to the direct interest relationship between the local government and farmers, the settlement mechanism of land expropriation disputes loses its function and causes land expropriation disputes to escalate into land expropriation conflicts due to bias [40]. Some scholars believe that due to loopholes in the current administrative land expropriation system, which leaves room for illegal land expropriation, local governments can avoid penalties [41]. When farmers cannot find effective measures to protect their interests, they are more willing to choose group behaviors such as petitioning to protect their rights and even resort to violent behaviors to fight. Farmers’ dissatisfaction with the land expropriation policy to a certain extent indicates that there are defects in the farmland expropriation system. The use of administrative farmland expropriation compensation methods often ignores farmers’ differential compensation needs. In the farmland expropriation compensation game without withdrawal rights, insufficient land compensation and uncertainty in future employment opportunities have led to conflicts in farmland expropriation [42–44].

In the game research on the multidimensional conflicts in farmland expropriation, it is generally believed that the essence of farmland expropriation is the continuous game process of interest redistribution, in which each participant maximizes the distribution
of land transfer benefits based on the current land expropriation system [45]. In this process, there are complex relationships between the local government, developers, village collective organizations, and farmers, and the imbalance of interest distribution is the main source of conflicts in land expropriation [46]. The root of the huge social contradictions in China caused by land expropriation lies in the imbalance of interest distribution, and the root of the imbalance of interest distribution lies in the imperfect interest distribution system and mechanism [47]. Liu and Chen pointed out that property rights in the public domain are scarce resources. When all relevant stakeholders want to obtain these resources, conflicts of interest arise. They believe that the restriction of national laws on farmland rights, excessive intervention of local governments and grassroots organizations, and the lack of farmers’ capabilities are the causes of conflicts in farmland rights [48]. Shi established a static game model with complete information and concluded that the main motivation for local government’s illegal land acquisition and farmers’ choice to resist behavior is the competition for land interests [49]. Fan and Bai analyzed the game of interests between the local government and farmers in the process of farmland conversion and explained the reasons for the damage to farmers’ rights and the internal mechanism of legal rights protection [50].

In summary, based on the behavioral game, the issue of conflicts in farmland expropriation in China may be the behavior of farmers’ rights protection triggered by unilateral rent-seeking by the local government, the boycott behaviors of farmers to obtain higher compensation, or the fierce competition between the two sides of the game based on the maximization of their respective interests. Therefore, this paper divides the farmland expropriation conflicts into three types: “government rent-seeking”, “nail household dilemma,” and “extreme controversy.” Since most of the existing studies are based on a single conflict perspective, focusing on the static game analysis between the local government and farmers, there is a lack of research on the correlation and dynamic evolution of conflicts. However, income expectations of the farmers losing land and local governments in different external environments are different, and the corresponding game strategies are constantly adjusted. Which equilibrium state is reached depends mainly on the initial conditions and the path of evolution [31]. In the field of economic research, Bolding’s “Evolutionary Economics” and Nelson and Winter’s “Evolutionary Theory of Economic Change” are the signs of the birth of modern evolutionary economics, and “Evolutionarily Stable Strategy” published by Maynard Smith laid the theoretical foundation for evolutionary games. Different from the “complete rationality” assumption of traditional games, evolutionary games are based on bounded rationality and focus on the dynamic equilibrium of long-term games [52]. Given this, based on the evolutionary game method of Friedman [53], this paper establishes a multidimensional conflicts game analysis framework for farmland expropriation combined with conflict behavior and system development.

3. Game Analysis Framework

The essence of farmland expropriation is a process of interest redistribution [54], so farmland expropriation conflicts often originate from the interest competition game between the local government and farmers. According to China’s Land Management Law, Land Management Law Implementation Regulations, and other relevant laws and regulations, farmland expropriation is usually carried out under the following procedures. Firstly, the local government announces planned land expropriation, clarifying the scope of land expropriation, compensation methods, compensation standards, resettlement channels, etc. Secondly, the local government launches an on-site investigation. Thirdly, the local government draws up a compensation and resettlement plan for land expropriation. If farmers have objections to the plan, they can raise them to the local government within the prescribed time limit, and the local government should hold a hearing. Fourthly, the local government organizes and implements farmland expropriation. Fifthly, the farmers go through the relevant procedures within the prescribed time limit and complete land delivery. When there is a dispute over the compensation standard, the farmers can file an
administrative lawsuit or apply for administrative reconsideration. If the farmers refuse to relocate within the prescribed time limit and do not apply for administrative litigation or administrative reconsideration, the local government can apply to the court for enforcement. Given this, this paper draws on the van Damme’s game theory, considers the dynamic game of the local government and farmers’ successive decision-making and a static game of simultaneous decision-making in the process of farmland expropriation, and constructs a game analysis framework of multidimensional conflicts in farmland expropriation.

3.1. Van Damme’s Game Theory

As shown in Figure 1, game player 2 makes decisions first, and has two strategies: R and D. If R is selected, both sides get 2X units of benefits, and then the game ends. If D is selected, the game enters the second stage, and the two sides make decisions simultaneously, and both sides have two strategies: S and W. When both sides choose S or W at the same time, the benefits of both sides are 0. When player 1 chooses W and player 2 chooses S, player 1 obtains X units of benefits and player 2 obtains 3X units of benefits. When player 1 chooses S and player 2 chooses W, player 1 obtains 3X units of benefits and player 2 obtains X units of benefits. The above game contains two types of interest conflicts: (1) when the two sides have complementary strategies, that is, one side shows strength and the other side shows weakness, distribution result (3X, X) or (X, 3X) may appear; (2) when the two sides have a competitive strategy, that is, when both sides show strength or weakness, distribution result (0, 0) may appear.

![Figure 1. Two-stage van Damme’s game matrix with two players.](image)

3.2. Multistage Van Damme’s Model

According to the van Damme’s game theory and the general process of farmland expropriation, this paper takes the local government and farmers as the game subjects based on the dynamic and static games between the two sides and constructs a multistage van Damme’s game matrix with multidimensional conflicts in farmland expropriation as shown in Figure 2.
3.2. Multistage Van Damme’s Model

According to the van Damme’s game matrix with two players, the local government and farmers constantly adjust their strategic choices based on their cognitive judgments.

3.2.1. Model Assumptions
- Assumption 1: both the local government and farmers are bounded rational economic agents aiming at maximizing economic benefits.
- Assumption 2: The local government has the first mover advantage in the game process, and it first proposes a distribution plan.
- Assumption 3: When the two sides of the game cannot reach an agreement on the distribution plan, the farmers have the advantage of a latecomer when facing disputes, and they can choose litigation settlement or non-litigation settlement.
- Assumption 4: With the changes in the national farmland expropriation policy, the local government and farmers constantly adjust their strategic choices based on their cognitive judgments.

3.2.2. Model Construction

As shown in Figure 2, the local government first proposes distribution scheme 1. If the farmers accept this scheme, the local government’s income is $F_1$, and the farmers’ income is $F_2$, satisfying $F_1, F_2 > 0$, and then the game ends. If the farmers refuse, the local government starts negotiations, and the farmers propose the second distribution scheme. If the local government accepts the results, the local government’s income is $\lambda_1 M_1$, and the farmers’ income is $\lambda_2 M_2$, where $\lambda_1, \lambda_2$ are the time loss coefficient of the local government and the farmers, respectively, representing the negotiation cost and time cost caused by bargaining and satisfying $0 < \lambda_1, \lambda_2 < 1$. If the local government refuses, farmers have two strategic choices: litigation and non-litigation. Among them, the probability of farmers choosing litigation is $\rho$ ($0 \leq \rho \leq 1$), and the probability of choosing nonlitigation is $1 - \rho$. When farmers choose litigation settlement, the income distribution of both sides will be based on the distribution result of the court, that is, the local government’s income is $\lambda_1^2 (V_1 - C_1)$, and the farmers’ income is $\lambda_2^2 (V_2 - C_2)$, satisfying $V_1, V_2 > 0$, where $C_1$ and $C_2$ represent the negotiation cost of the local government and the farmers, respectively, and satisfy $C_1, C_2 > 0$. If farmers choose nonlitigation settlement, it will be decided by the local government and farmers simultaneously. At this time, the local government has two strategic choices of “compromise” and “compulsion,” and the farmers have two strategic choices of “acceptance” and “confrontation.” For the local government, the probability of choosing compromise is $\delta$ ($0 \leq \delta \leq 1$) and the probability of choosing compulsion is $1 - \delta$. 

Figure 2. Two-stage van Damme’s game matrix with two players.
For farmers, the probability of choosing acceptance is \( \theta \) \((0 \leq \theta \leq 1)\) and the probability of choosing confrontation is \(1 - \theta\).

According to the strategic choices of both sides in the game, there are four possible strategy combinations: when the local government chooses compromise and farmers choose acceptance, the local government’s income is \( \lambda^2_1(V_1 + I_1) \) and the farmers’ income is \( \lambda^2_2(V_2 + I_2) \), satisfying \( I_1, I_2 > 0 \), where \( I_1 \) and \( I_2 \) represent the positive externality benefits obtained by the local government and farmers, respectively. When the local government chooses compromise and farmers choose confrontation, the local government’s income is \( \lambda^2_1(V_1 - \Delta S_1) \) and the farmers’ income is \( \lambda^2_2(V_2 + \Delta S_1 - C_4) \), satisfying \( \Delta S_1 > 0 \) and \( C_4 > 0 \), where \( \Delta S_1 \) represents the excess income obtained by the farmers and \( C_4 \) represents the struggle cost of the farmers. When the local government chooses compulsion and farmers choose confrontation, the local government’s income is \( \lambda^2_1(V_1 + \Delta S_2 - C_3) \) and the farmers’ income is \( \lambda^2_2(V_2 - \Delta S_2) \), satisfying \( \Delta S_2 > 0 \) and \( C_3 > 0 \), where \( \Delta S_2 \) represents the excess income obtained by the local government and \( C_3 \) represents the struggle cost of the local government. When the local government chooses compulsion and farmers choose confrontation, the local government’s income is \( \lambda^2_1(V_1 - C_3 - I_3) \) and the farmers’ income is \( \lambda^2_2(V_2 - C_4 - I_4) \), satisfying \( I_3, I_4 > 0 \), where \( I_3 \) and \( I_4 \) represent the negative external losses borne by the local government and farmers, respectively.

### 3.3. Van Damme’s Evolutionary Game Analysis

According to the above model assumptions, when the two sides of the game cannot reach an agreement on the distribution plan, farmers have two path options for litigation settlement or nonlitigation settlement, and the starting point is to ensure the maximization of economic benefits. In the game, the strategic choice of both sides evolves with the change to each other’s relative income, and gradually forms a relatively stable game equilibrium result. Therefore, this article first analyzes the evolution of the game subject’s behavior under litigation settlement and nonlitigation settlement.

#### 3.3.1. Evolutionary Game Analysis Under Litigation Settlement

Under litigation settlement, the game satisfies the following constraints:

\[
\lambda^2_2(V_2 + \Delta S_1 - C_4) < \lambda^2_1(V_2 - C_2) \quad \text{and} \quad \lambda^2_2(V_2 - C_4 - I_4) < \lambda^2_2(V_2 - C_2),
\]

that is, no matter what strategy the local government chooses, the benefits of farmers when choosing confrontation are less than when choosing litigation. Therefore, when the two sides cannot reach an agreement on the distribution scheme, the farmers abandon the “confrontation” strategy and only retain the two strategic choices of “acceptance” and “litigation.” Accordingly, the game model is transformed, as shown in Table 1.

**Table 1.** Game payment matrix under litigation settlement.

| Local Government          | Farmers                                      |
|---------------------------|----------------------------------------------|
|                           | Litigation \((\rho)\)                      | Acceptance \((1 - \rho)\)                       |
| Compromise \((\delta)\)   | \(\lambda^2_1(V_1 - C_1), \lambda^2_2(V_2 - C_2)\) | \(\lambda^1_1(V_1 + I_1), \lambda^2_2(V_2 + I_2)\) |
| Compulsion \((1 - \delta)\) | \(\lambda^2_1(V_1 - C_1), \lambda^2_2(V_2 - C_2)\) | \(\lambda^2_1(V_1 + \Delta S_2 - C_3), \lambda^2_2(V_2 - \Delta S_2)\) |

For the local government, the expected benefits when choosing “compromise” and “compulsion” are \(E_{(\delta)1}\) and \(E_{(1-\delta)1}\), respectively, and the average benefit is \(E_{(G)1}\), calculated as follows:

\[
E_{(\delta)1} = \rho \lambda^2_1(V_1 - C_1) + (1 - \rho) \lambda^2_1(V_1 + I_1)
\]

\[
E_{(1-\delta)1} = \rho \lambda^2_1(V_1 - C_1) + (1 - \rho) \lambda^2_1(V_1 + \Delta S_2 - C_3)
\]

\[
E_{(G)1} = \delta E_{(\delta)1} + (1 - \delta) E_{(1-\delta)1}
\]

When \(E_{(\delta)1} > E_{(G)1}\), the expected benefits of the local government when choosing the “compromise” strategy are greater than the average benefits. As time goes by, for
the local government, the probability $\delta$ of choosing the “compromise” strategy increases. When $E_{(1-\delta)|1} > E_{(G)|1}$, the expected benefits of the local government when choosing the “compulsion” strategy are greater than the average benefits, and the probability of choosing the “compromise” strategy decreases over time. Therefore, the replication dynamics equation for the local government can be achieved as follows:

$$F_1(\delta) = \delta \left( E_{(\delta)|1} - E_{(G)|1} \right) = \delta (1 - \delta) (\rho (\Delta S_2 - I_1 - C_3) + I_1 - \Delta S_2 + C_3)$$

(4)

For farmers, the expected benefits of choosing “acceptance” and “litigation” are $E_{(1-\rho)}$ and $E_{(\rho)}$, respectively, and the average benefit is $E_{(H)|1}$, calculated as follows:

$$E_{(1-\rho)} = \delta \lambda_2^2 (V_2 + I_2) + (1 - \delta) \lambda_2^2 (V_2 - \Delta S_2)$$

(5)

$$E_{(\rho)} = \lambda_2^2 (V_2 - C_2)$$

(6)

$$E_{(H)|1} = (1 - \rho) E_{(1-\rho)} + \rho E_{(\rho)}$$

(7)

Similarly, the replication dynamic equation expressed as $F(\rho)$ for the farmers’ choice of “litigation” strategy is:

$$F(\rho) = \rho (E_{(\rho)} - E_{(H)|1}) = \rho (1 - \rho) \left( E_{(\rho)} - E_{(1-\rho)} \right) = \rho (1 - \rho) \lambda_2^2 \left[ -\delta (I_2 + \Delta S_2) + \Delta S_2 - C_2 \right]$$

(8)

3.3.2. Evolutionary Game Analysis Under Nonlitigation Settlement

Under nonlitigation settlement, the game satisfies the following constraints:

$$\lambda_2^2 (V_2 - C_2) < \lambda_2^2 (V_2 - \Delta S_2) < \lambda_2^2 (V_2 + I_2)$$

and

$$\lambda_2^2 (V_2 - C_2) < \lambda_2^2 (V_2 - C_4 - I_1) < \lambda_2^2 (V_2 + \Delta S_1 - C_4),$$

that is, no matter what strategy the local government chooses, the benefits of farmers when choosing the “acceptance” or “confrontation” strategy are greater than when choosing the “litigation” strategy. Therefore, when the two sides cannot reach an agreement on the distribution scheme, the farmers abandon the “litigation” strategy and only retain the two strategic choices of “acceptance” and “confrontation”. Accordingly, the game model is transformed, as shown in Table 2.

Table 2. Game payment matrix under nonlitigation settlement.

| Local Government | Farmers     |
|------------------|-------------|
| Compromise (δ)   | $\lambda_1^2 (V_1 + I_1), \lambda_2^2 (V_2 + I_2)$ | $\lambda_1^2 (V_1 - \Delta S_1), \lambda_2^2 (V_2 + \Delta S_1 - C_4)$ |
| Compulsion (1-δ) | $\lambda_1^2 (V_1 + \Delta S_2 - C_3), \lambda_2^2 (V_2 - \Delta S_2)$ | $\lambda_1^2 (V_1 - C_3 - I_2), \lambda_2^2 (V_2 - C_4 - I_1)$ |

For the local government, the expected benefits when choosing “compromise” and “compulsion” are $E_{(\delta)|2}$ and $E_{(1-\delta)|2}$, respectively, and the average benefit is $E_{(G)|2}$, calculated as follows:

$$E_{(\delta)|2} = \theta \lambda_1^2 (V_1 + I_1) + (1 - \theta) \lambda_2^2 (V_1 - \Delta S_1)$$

(9)

$$E_{(1-\delta)|2} = \theta \lambda_2^2 (V_1 + \Delta S_2 - C_3) + (1 - \theta) \lambda_1^2 (V_1 - C_3 - I_2)$$

(10)

$$E_{(G)|2} = \delta E_{(\delta)|2} + (1 - \delta) E_{(1-\delta)|2}$$

(11)

The replication dynamic equation $F_2(\delta)$ for the local government’s choice of the “compromise” strategy is as follows:

$$F_2(\delta) = \delta \left( E_{(\delta)|2} - E_{(G)|2} \right) = \delta (1 - \delta) \left[ \theta (I_2 + \Delta S_1 - \Delta S_2 - I_3) - \Delta S_1 + C_3 + I_3 \right]$$

(12)
For farmers, the expected benefits when choosing “acceptance” and “confrontation” are $E_{(0)}$ and $E_{(1-\theta)}$, respectively, and the average benefit is $E_{(1)}$, calculated as follows:

$$E_{(0)} = \delta \lambda_2^2(V_2 + I_2) + (1 - \delta) \lambda_2^2(V_2 - \Delta S_2)$$ (13)

$$E_{(1-\theta)} = \delta \lambda_2^2(V_2 + \Delta S_1 - C_4) + (1 - \delta) \lambda_2^2(V_2 - C_4 - I_4)$$ (14)

$$E_{(1)} = \theta E_{(0)} + (1 - \theta) E_{(1-\theta)}$$ (15)

The replication dynamic equation $F(\theta)$ for the farmers’ choice of the “acceptance” strategy is as follows:

$$F(\theta) = \theta \left(E_{(0)} - E_{(1)}\right) = \theta (1 - \theta) \left[E_{(0)} - E_{(1-\theta)}\right] = \theta (1 - \theta) \lambda_2^2 [\delta(I_2 + \Delta S_2 - \Delta S_1 - I_4) - \Delta S_2 + C_4 + I_4]$$ (16)

### 3.4. Equilibrium Point and Stability Analysis

According to the Friedman’s method [53], this article first analyzed the stability of the local equilibrium point through the Jacobian matrix, and then analyzed the stability of the local equilibrium point of the dynamic replication system to find the evolutionary stability strategy (ESS) under litigation settlement and nonlitigation settlement, respectively.

- **Path 1:** under litigation settlement.

The replication dynamic system under litigation settlement is composed of Equations (4) and (8). To obtain the abovementioned equilibrium points, we first set equations with $J_1$, the following formulae:

$$F_1(\delta) = F(\rho) = 0;$$

five possible local equilibrium points of the replication dynamic system can be obtained, which are $D_{11}(0, 0)$, $D_{12}(0, 1)$, $D_{13}(1, 0)$, $D_{14}(1, 1)$, and $D_{15}(\delta^*_1, \rho^*)$. Among them, $\delta^*_1 = \frac{\Delta S_1 - \Delta S_2}{\Delta S_1 + \Delta S_2}$, $\rho^* = 1$.

The partial derivatives of $F_1(\delta)$ and $F(\rho)$ with respect to $\delta$ and $\rho$ are calculated using the following formulae:

$$\frac{\partial F_1(\delta)}{\partial \delta} = (1 - 2\delta) \lambda_1^2 [\delta(\Delta S_2 - I_1 - C_3) + I_1 - \Delta S_2 + C_3]$$ (17)

$$\frac{\partial F_1(\delta)}{\partial \rho} = \delta (1 - \delta) \lambda_1^2 (\Delta S_2 - I_1 - C_3)$$ (18)

$$\frac{\partial F(\rho)}{\partial \delta} = -\rho (1 - \rho) \lambda_2^2 (I_2 + \Delta S_2)$$ (19)

$$\frac{\partial F(\rho)}{\partial \rho} = (1 - 2\rho) \lambda_2^2 [\delta(I_2 + \Delta S_2) + \Delta S_2 - C_2]$$ (20)

The Jacobian matrix $J_1$ and trace $tr(J_1)$ of the system are calculated using the following formulae:

$$J_1 = \left(\begin{array}{cc}
\frac{\partial F_1(\delta)}{\partial \delta} & \frac{\partial F_1(\delta)}{\partial \rho} \\
\frac{\partial F(\rho)}{\partial \delta} & \frac{\partial F(\rho)}{\partial \rho}
\end{array}\right)$$ (21)

$$tr(J_1) = \frac{\partial F_1(\delta)}{\partial \delta} + \frac{\partial F(\rho)}{\partial \rho}$$ (22)

Four Jacobian matrices can be obtained by substituting the above local equilibrium points with $J_1$; they are as follows:

$$J_{11}(0, 0) = \left(\begin{array}{cc}
\lambda_1^2 (I_1 - \Delta S_2 + C_3) & 0 \\
0 & \lambda_2^2 (\Delta S_2 - C_2)
\end{array}\right)$$ (23)

$$J_{12}(0, 1) = \left(\begin{array}{cc}
0 & 0 \\
0 & -\lambda_2^2 (\Delta S_2 - C_2)
\end{array}\right)$$ (24)
\[ J_{13}(1, 0) = \begin{pmatrix} \lambda_1^3(\Delta S_2 - I_1 - C_3) & 0 \\ 0 & -\lambda_2^2(I_2 + C_2) \end{pmatrix} \]  
\[ J_{14}(1, 1) = \begin{pmatrix} 0 & 0 \\ 0 & \lambda_2^2(I_2 + C_2) \end{pmatrix} \]

The abovementioned equilibrium point is the result of continuous adjustment and improvement on the random combination of the local government and farmers’ strategy selection. Only if \( \text{Det}(J) > 0 \) and \( \text{Tr}(J) < 0 \), the equilibrium point is an evolutionary stable strategy (ESS). In this way, the determinants and traces of the above equilibrium points are obtained, as shown in Table 3.

| Equilibrium Points | Det \((J_1)\) | Tr \((J_1)\) |
|--------------------|---------------|---------------|
| \( D_{11}(0, 0) \) | \( \lambda_1^2 \lambda_2^2 (I_1 - \Delta S_2 + C_3)(\Delta S_2 - C_2) \) | \( \lambda_1^2 (I_1 - \Delta S_2 + C_3) + \lambda_2^2 (\Delta S_2 - C_2) \) |
| \( D_{12}(0, 1) \) | \( 0 \) | \( -\lambda_2^2 (\Delta S_2 - C_2) \) |
| \( D_{13}(1, 0) \) | \( -\lambda_1^2 \lambda_2^2 (\Delta S_2 - I_1 - C_3)(I_2 + C_2) \) | \( \lambda_1^2 (\Delta S_2 - I_1 - C_3) - \lambda_2^2 (I_2 + C_2) \) |
| \( D_{14}(1, 1) \) | \( 0 \) | \( \lambda_2^2 (I_2 + C_2) \) |
| \( D_{15}(\delta_1^*, \theta^*) \) | \( 0 \) | \( 0 \) |

Under litigation settlement, when \( I_1 - \Delta S_2 + C_3 < 0 \) and \( \Delta S_2 - C_2 < 0 \), the ESS of the system is \((0, 0)\), in which the evolutionary stable equilibrium strategy of both parties in the game is (compulsion, acceptance). When \( \Delta S_2 - I_1 - C_3 < 0 \), the ESS of the system is \((1, 0)\), in which the evolutionary stable equilibrium strategy of both sides in the game is (compromise, acceptance).

- **Path 2:** under nonlitigation settlement.

The game replication dynamic system under nonlitigation settlement is composed of Equations (12) and (16). We first set equations \( F_2(\delta) = F(\theta) = 0 \); the five possible local equilibrium points of the replication dynamic system can be obtained, which are \( D_{21}(0, 0) \), \( D_{22}(0, 1) \), \( D_{23}(1, 0) \), \( D_{24}(1, 1) \), and \( D_{25}(\delta_2^*, \theta^*) \). Among them, \( \delta_2^* = \frac{\Delta S_2 - C_1 - I_1}{I_2 + \Delta S_2 - \Delta S_1 - I_4} \), \( \theta^* = \frac{\Delta S_2 - C_1 - I_1}{I_2 + \Delta S_2 - \Delta S_1 - I_4} \).

The partial derivatives of \( F_2(\delta) \) and \( F(\theta) \) with respect to \( \delta \) and \( \theta \) are calculated using the following formulae:

\[
\frac{\partial F_2(\delta)}{\partial \delta} = (1 - 2\delta)\lambda_1 \big[ (I_1 + \Delta S_1 - \Delta S_2 - I_3) - \Delta S_1 + C_3 + I_3 \big]
\]  
\[
\frac{\partial F_2(\delta)}{\partial \theta} = \delta (1 - \delta)\lambda_1^2 (I_1 + \Delta S_1 - \Delta S_2 - I_3)
\]  
\[
\frac{\partial F(\theta)}{\partial \delta} = \theta (1 - \theta)\lambda_2^2 (I_2 + \Delta S_2 - \Delta S_1 - I_4)
\]  
\[
\frac{\partial F(\theta)}{\partial \theta} = (1 - 2\theta)\lambda_2^3 \big[ (I_2 + \Delta S_2 - \Delta S_1 - I_4) - \Delta S_2 + C_4 + I_4 \big]
\]

The Jacobian matrix \( J_2 \) and trace \( \text{tr}(J_2) \) of the system are calculated using the following formulae:

\[
J_2 = \begin{pmatrix}
\frac{\partial F_2(\delta)}{\partial \delta} & \frac{\partial F_2(\delta)}{\partial \theta} \\
\frac{\partial F(\theta)}{\partial \delta} & \frac{\partial F(\theta)}{\partial \theta}
\end{pmatrix}
\]

\[
\text{tr}(J_2) = \frac{\partial F_2(\delta)}{\partial \delta} + \frac{\partial F(\theta)}{\partial \theta}
\]
Four Jacobian matrices can be obtained by substituting the above local equilibrium points with $J_2$, they are as follows:

\[
J_{21}(0, 0) = \begin{pmatrix}
\lambda_1^2 (C_3 + I_3 - \Delta S_1) & 0 \\
0 & \lambda_2^2 (C_4 + I_4 - \Delta S_2)
\end{pmatrix}
\]

(33)

\[
J_{22}(0, 1) = \begin{pmatrix}
\lambda_1^2 (I_1 + C_3 - \Delta S_2) & 0 \\
0 & -\lambda_2^2 (C_4 + I_4 - \Delta S_2)
\end{pmatrix}
\]

(34)

\[
J_{23}(1, 0) = \begin{pmatrix}
-\lambda_1^2 (C_3 + I_3 - \Delta S_1) & 0 \\
0 & \lambda_2^2 (I_2 + C_4 - \Delta S_1)
\end{pmatrix}
\]

(35)

\[
J_{24}(1, 0) = \begin{pmatrix}
-\lambda_1^2 (I_1 + C_3 - \Delta S_2) & 0 \\
0 & -\lambda_2^2 (I_2 + C_4 - \Delta S_1)
\end{pmatrix}
\]

(36)

Similarly, the determinants and traces of the above equilibrium points are obtained, as shown in Table 4.

| Equilibrium Points | Det ($J_2$) | Tr ($J_2$) |
|-------------------|-------------|------------|
| $D_{21}(0, 0)$    | $\lambda_1^2 \lambda_2^2 (C_3 + I_3 - \Delta S_1)(C_4 + I_4 - \Delta S_2)$ | $\lambda_1^2 (C_3 + I_3 - \Delta S_1) + \lambda_2^2 (C_4 + I_4 - \Delta S_2)$ |
| $D_{22}(0, 1)$    | $-\lambda_1^2 \lambda_2^2 (I_1 + C_3 - \Delta S_2)(C_4 + I_4 - \Delta S_2)$ | $\lambda_1^2 (I_1 + C_3 - \Delta S_2) - \lambda_2^2 (C_4 + I_4 - \Delta S_2)$ |
| $D_{23}(1, 0)$    | $-\lambda_1^2 \lambda_2^2 (C_3 + I_3 - \Delta S_1)(I_2 + C_4 - \Delta S_1)$ | $-\lambda_1^2 (C_3 + I_3 - \Delta S_1) + \lambda_2^2 (I_2 + C_4 - \Delta S_1)$ |
| $D_{24}(1, 1)$    | $\lambda_1^2 \lambda_2^2 (I_1 + C_3 - \Delta S_2)(I_2 + C_4 - \Delta S_1)$ | $-\lambda_1^2 (I_1 + C_3 - \Delta S_2) - \lambda_2^2 (I_2 + C_4 - \Delta S_1)$ |
| $D_{25}(\delta^*_2, \theta^*)$ | 0 | 0 |

Under nonlitigation settlement, when $C_3 + I_3 - \Delta S_1 < 0$ and $C_4 + I_4 - \Delta S_2 < 0$, the ESS of the system is $(0, 0)$, in which the evolutionary stable equilibrium strategy of both sides in the game is (compulsion, confrontation). When $I_1 + C_3 - \Delta S_2 < 0$ and $C_4 + I_4 - \Delta S_2 > 0$, the ESS of the system is $(0, 1)$, in which the evolutionary stable equilibrium strategy of both sides in the game is (compulsion, acceptance). When $C_3 + I_3 - \Delta S_1 > 0$ and $I_2 + C_4 - \Delta S_1 < 0$, the ESS of the system is $(1, 0)$, in which the evolutionary stable equilibrium strategy of both sides in the game is (compromise, confrontation). When $I_1 + C_3 - \Delta S_2 > 0$ and $I_2 + C_4 - \Delta S_1 > 0$, the ESS of the system is $(1, 1)$, in which the evolutionary stable equilibrium strategy of both sides in the game is (compromise, acceptance).

4. MATLAB Numerical Simulation

Under the different payment structures of the game between the local government and farmers, the evolutionary stability strategy of the game shows significant differences. The formation of the evolutionary stability strategy is closely related to the periodic adjustment and change of the state’s macro policy on farmland expropriation. Therefore, to establish a balanced resolution mechanism for farmland expropriation conflicts, the evolutionary equilibrium results of the game should be combined with the development and evolution of the macro policy on farmland expropriation. This article uses the MATLAB software to numerically simulate the evolution of conflicts in farmland expropriation under litigation settlement and nonlitigation settlement and proposes a balanced solution to the three types of farmland expropriation conflicts, namely the “government rent-seeking” conflicts, the “nail household dilemma” conflicts, and the “extreme controversy” conflicts. The simulation results are shown in Figures 3–12, where the horizontal axis represents the
evolution time, the simulation period is set as 10, and the vertical axis represents the probability of a game players’ strategy selection, which evolves in the range of 0 to 1. The initial probability is assumed to be $\rho = \delta = \theta = 0.5$, which means that the local government and farmers choose between different strategies with an initial probability of 0.5. Under litigation settlement, the relative magnitude of different parameters is mainly changed by changing the values of $\Delta S_2$ and $C_2$. Under non-litigation settlement, the relative size of different parameters is mainly changed by changing the values of $\Delta S_1$, $\Delta S_2$, $I_2$, and $I_4$, and the value of the default parameter is strictly limited within the constraint range.

Figure 3. Simulation results under litigation settlement ($C_2 = 4$).

Figure 4. Simulation results under litigation settlement ($C_2 = 1$).
Consult, farmers = ∆ − λ > 0, ∆ ct. Therefore, to resolve the ∆2 Ise, ve − = − = 1 − 2 C nly obtain C < , > 36x782 2021 Mathematics 2021, 9, 1208 ernment under reasonable expropriation ha expropriation conflict is resolved. In addition, increasing the rent Figure 6. 

librium result of (compromise, acceptance), and the “government rent Figure 5. 

equilibrium result of (compromise, acceptance), and the “government rent 

Figure 5. Simulation results under litigation settlement (C2 = 1, ∆S2 = 2.5).

Figure 6. Simulation results at the first stage (∆S2 = 3.5).

Figure 7. Simulation results at the second stage (∆S2 = 1.5).
with other assumptions remaining unaltered resulted in the following changes (Figure 9).

Figure 9. Simulation results at the third stage ($\Delta S_2 = 1.5, \Delta S_1 = 2.5$).

The above results indicate that when the behavior of the local government gradually tends to compromise. At this time (compromise, acceptance) is the evolutionary stable equilibrium point of the game, that is, the "nail household dilemma" also gradually tend to confrontation. At this time, (compulsion, confrontation) is the evolutionary stable equilibrium point of the game, that is, the "nail household dilemma". In this case, the "nail household dilemma" always results in nonlitigation settlement, we can increase farmers' positive social externalities. Given this, two hypotheses are proposed: the government seeks compensation, and "get rich overnight," which are often involved in government rent-seeking conflict under nonlitigation settlement.

In recent years, due to the continuous improvement of farmers' income and the continuous increase in expropriation prices, local government has often encountered the "nail household dilemma". Under the background of "nail household dilemma," the local government often exceed the compensation, forcing the local government to reduce the compensation. As the cost of rent-seeking rises, the local government gradually tend to confrontation. At this time, (compulsion, confrontation) is the evolutionary stable equilibrium point of the game, that is, the "nail household dilemma". If the local government does not want to face the "nail household dilemma," they have to give in to farmers to prevent the "nail household dilemma." Therefore, the local government gradually tend to compromise. At this time (compromise, acceptance) is the evolutionary stable equilibrium point of the game, that is, the "nail household dilemma." In this case, the "nail household dilemma" always results in nonlitigation settlement, we can increase farmers' positive social externalities. Given this, two hypotheses are proposed: the government seeks compensation, and "get rich overnight," which are often involved in government rent-seeking conflict under nonlitigation settlement.

Figure 10. Simulation results at the fourth stage ($\Delta S_3 = 3.5, I_4 = 1, \Delta S_2 = 2.5$).
Figure 11. Simulation results at the fourth stage ($\Delta S_2 = 2.5$, $I_4 = 1$, $\Delta S_1 = 1.5$).

Figure 12. Simulation results at the fourth stage ($I_2 = 3$, $I_4 = 3$, $\Delta S_2 = 1.5$).

4.1. Numerical Simulation Analysis Under Litigation Settlement

When the litigation conditions for farmland expropriation are significantly improved, it is relatively easy for farmers to protect their rights through the law, so farmers are more inclined to resolve disputes through litigation. According to Equations (4) and (8), the initial conditions are set as $\lambda_1 = 0.9$, $\lambda_2 = 0.95$, $I_1 = 2$, $I_2 = 2$, $C_3 = 1$, $C_2 = 4$, and $\Delta S_2 = 3.5$; the simulation results are shown in Figure 3.

It can be seen in Figure 3 that when $\lambda_1^2(V_1 + \Delta S_2 - C_3) > \lambda_1^2(V_1 + I_1)$ and $\lambda_2^2(V_2 - C_2) < \lambda_2^2(V_2 - \Delta S_2)$, the local government tends to be compulsory and farmers tend to accept. Therefore, (compulsion, acceptance) is the evolutionary stable equilibrium point of the game. At this time, the “government rent-seeking” conflict occurs. The results show that although the threshold for farmers’ litigation has been lowered, when farmers’ litigation costs are high, farmers still choose to accept when facing disputes or suffer a loss of profits. The occurrence of the above situation not only weakens the social credibility of the law, but also makes it difficult to protect the legitimate rights and interests of farmers through legal channels. Given this, the simulation of reduced litigation costs of farmers to set $C_2 = 1$ with other assumptions remaining unaltered results in the following changes (Figure 4).

It can be seen in Figure 4 that when the cost of litigation for farmers is reduced to make $\lambda_2^2(V_2 - C_2) > \lambda_2^2(V_2 - \Delta S_2)$, farmers no longer compromise when facing disputes or suffer a loss of profits, but choose litigation to defend their rights. As farmers’ strategic
choices change, the local government’s compulsion strategy is also shaken. Therefore, the reduction of farmers’ litigation costs is conducive to having farmers seek legal ways to resolve farmland expropriation conflicts and influences the local government’s strategic choices. Given this, the simulation of further control of the rent-seeking ceiling of the local government to set $\Delta S_2 = 2.5$ with other assumptions remaining unaltered results in the following changes (Figure 5).

It can be seen in Figure 5 that when the litigation costs of farmers are reduced and the rent-seeking ceiling of the local government is controlled, $\lambda_2^2(V_1 + \Delta S_2 - C_3) < \lambda_2^2(V_1 + I_1), \lambda_2^2(V_1 + I_2)$, the local government gradually tends to compromise and the farmers gradually tend to accept. At this time, the two sides of the game achieve the evolutionary equilibrium result of (compromise, acceptance), and the “government rent-seeking” farmland expropriation conflict is resolved. In addition, increasing the rent-seeking costs of the local government or the positive social externality benefits under reasonable expropriation have the same effect as reducing the litigation costs of farmers. In summary, under litigation settlement, there is only the “government rent-seeking” conflict. In this case, reducing the litigation costs of farmers has a restrictive effect on the rent-seeking behavior of the local government, but it cannot eliminate the rent-seeking behavior. Only reduction of the litigation costs of farmers and cooperation with other policy interventions, such as controlling the rent-seeking ceiling of the local government, increasing the rent-seeking costs of local government or positive social externality benefits under reasonable expropriation, is conducive to the effective resolution of the “government rent-seeking” conflict. Corresponding to the actual situation, on the one hand, we can continuously improve the farmland expropriation system to create convenient conditions for farmers to participate in litigation. On the other hand, we can reduce the litigation cost by improving the litigation efficiency, shortening the litigation time, or increasing the legal aid to the vulnerable groups. In addition, we can also strengthen the supervision of the local government’s behavioral norms to limit its rent-seeking behavior.

4.2. Numerical Simulation Analysis Under Nonlitigation Settlement

When lawsuit conditions for farmland expropriation deteriorate, farmers’ legal rights protection is costly and difficult, so farmers are more inclined to resolve disputes through nonlitigation. At this time, there is great uncertainty in the game between the local government and farmers. Based on the time series of the evolution of farmland expropriation conflicts, the conflicts in farmland expropriation are divided into four evolutionary stages, namely “strong government, weak farmers;” “weak government, weak farmers;” “weak government, strong farmers;” and “strong government, strong farmers.”

- The first stage: “strong government, weak farmers.”

In the early stage of China’s implementation of farmland expropriation, the local government was more inclined to expropriate land at a low price due to the constraints of financial power, giving farmers relatively low compensation. Therefore, at that stage, there were relatively more conflicts of farmers’ rights protection caused by illegal land expropriation and forced land expropriation, and farmland expropriation had strong government rent-seeking characteristics. According to Equations (12) and (16), the initial conditions were set as $\lambda_1 = 0.9, \lambda_2 = 0.95, I_1 = 2, I_2 = 1, I_3 = 2, I_4 = 3, C_3 = 1, C_4 = 1, \Delta S_1 = 1.5$, and $\Delta S_2 = 3.5$. The simulation results are shown in Figure 6.

It can be seen in Figure 6 that when $\lambda_2^2(V_2 + I_2) > \lambda_2^2(V_2 + \Delta S_1 - C_4), \lambda_2^2(V_2 - \Delta S_2) > \lambda_2^2(V_2 - C_4 - I_4)$, and $\lambda_2^2(V_1 + I_1) < \lambda_2^2(V_1 + I_1)$, the farmers gradually tend to accept and the local government gradually becomes compulsory, so (compulsion, acceptance) is the evolutionary stable equilibrium point of the game, that is, the “government rent-seeking” conflict occurs. At that stage, the design of the farmland expropriation system was biased towards local governments, which created conditions for local governments to seek rent. According to the statutory principle of compensation for the original purpose of the expropriated land, the rent-seeking income obtained by the local government from land expropriation was much higher than the income of farmers, who often could only obtain
relatively little land income. Moreover, local governments were given the legal power of compulsory land expropriation and demolition, so the struggle costs of farmers were much higher than the rent-seeking costs of the local government. As a result, farmers could only be forced to accept when facing disputes or suffering a loss of profits.

• The second stage: “weak government, weak farmers.”

With a gradual increase in farmland expropriation conflicts in various regions, the state simultaneously deepened the reform of the farmland expropriation system. In particular, the promulgation of Property Law in 2007 became an important legal basis for the reform of the farmland expropriation system, and it began to reflect fairness. At present, China has put forward the prohibition of forced expropriation and demolition, according to which the consent of farmers must be obtained and sufficient compensation must be provided. Penalties for illegal land expropriation have been continuously increasing; this has led to a significant increase in rent-seeking costs for local governments and a significant reduction in rent-seeking benefits. As a result, farmers’ compensation has continued to increase, and incidents of infringement of rights have drastically reduced. Given this, the simulation of reduced rent-seeking income of the local government to set \( \Delta S_2 = 1.5 \) with other assumptions remaining unaltered results in the following changes (Figure 7).

It can be seen in Figure 8 that when the rent-seeking income of the local government is reduced to make \( \lambda \frac{1}{2} (V_1 + I_1) > \lambda \frac{1}{2} (V_1 + \Delta S_2 - C_3) \), the local government gradually tends to compromise and the farmers gradually tend to accept. At this time, (compromise, acceptance) is the evolutionary stable equilibrium point of the game, that is, the “government rent-seeking” conflict is resolved. In addition, increasing the rent-seeking costs of the local government or increasing the positive social externality benefits of the local government under reasonable expropriation have the same effect. Therefore, to resolve the “government rent-seeking” conflict under nonlitigation settlement, we can control the rent-seeking ceiling of the local government, increase the rent-seeking costs of the local government, or increase the positive social externality benefits of the local government under reasonable expropriation. Corresponding to the actual situation, we can increase the penalties for the local government’s violations, forcing the local government to reduce rent-seeking.

• The third stage: “weak government, strong farmers.”

In recent years, due to the continuous improvement of farmers’ compensation standards and the rapid increase of real estate prices, more and more farmers are developing a profit-seeking mentality such as “hope for land expropriation” and “get rich overnight,” hoping to obtain greater benefits through farmland expropriation. Moreover, the more the local government cannot and dare not impose and demolish, the more likely the nail households will ask for high prices. Therefore, the simulation of reduced rent-seeking by the local government and increased rent-seeking income of farmers to set \( \Delta S_1 = 2.5 \) with other assumptions remaining unaltered resulted in the following changes (Figure 8).

It can be seen in Figure 9 that when the farmers’ rent-seeking income is increased to make \( \lambda \frac{1}{2} (V_2 + \Delta S_1 - C_4) > \lambda \frac{1}{2} (V_2 + I_2) \), the farmers gradually tend to confront, and the local government gradually tends to compromise. At this time, (compromise, confrontation) is the evolutionary stable equilibrium point of the game, that is, the “nail household dilemma” conflict occurs. The above results indicate that when the behavior of the local government is restricted by the system, the increase in rent-seeking costs make it gradually reduce rent-seeking and give farmers more compensation. As the cost of rent-seeking is greatly reduced, farmers are more inclined to choose confrontation and become nail households to force the local government to transfer more land interests. Therefore, the simulation of increased rent-seeking income of farmers and increased positive social externality income of farmers under reasonable compensation to set \( \Delta S_1 = 3.5 \) and \( I_2 = 3 \) with other assumptions remaining unaltered resulted in the following changes (Figure 9).

It can be seen in Figure 9 that when the farmers’ rent-seeking income is increased, their positive social externality benefits under reasonable compensation are increased to make \( \lambda \frac{1}{2} (V_2 + \Delta S_1 - C_4) < \lambda \frac{1}{2} (V_2 + I_2) \), the farmers gradually tend to accept and the local
government gradually tends to compromise. At this time, (compromise, acceptance) is the evolutionary stable equilibrium point of the game, that is, the “nail household dilemma” farmland expropriation conflict is resolved. In addition, increasing farmers’ rent-seeking costs has the same effect. Therefore, to resolve the “nail household dilemma” conflict under nonlitigation settlement, we can increase farmers’ positive social externality benefits under reasonable compensation or increase farmers’ rent-seeking costs. Corresponding to the actual situation, at the early stage of farmland expropriation, the local government should pay attention to farmers’ interests, resolve farmers’ concerns timely, and avoid the occurrence of “nail household dilemma” problems caused by their improper behavior.

- The fourth stage: “strong government, strong farmers.”

Faced with the rapid increase in housing prices in China in recent years, new farmland expropriation policies have also been introduced. The current “large demolition and construction” land expropriation and demolition model is gradually being replaced by the “old city reconstruction” model. Under the background of the continuous decline in land income and the continuous increase in expropriation prices, local governments often prefer not to demolish, and no longer give more compensation to farmers. For farmers, the continuous rise of housing prices gives them higher psychological expectations of rent-seeking. Moreover, the previous successful cases of nail households’ rent-seeking relatively lower their expectations of a negative social externality loss caused by rent-seeking, and they are unwilling to give up their interests, which eventually leads to a deadlock of farmland expropriation. Given this, the simulation of not decreased farmers’ rent-seeking income, their relatively low expectation of negative social externality loss caused by rent-seeking, and increased local government’s rent-seeking income to set \( \Delta S_1 = 2.5 \), \( I_1 = 1 \), and \( \Delta S_2 = 2.5 \) with other assumptions remaining unaltered resulted in the following changes (Figure 10).

It can be seen in Figure 10 that based on the assumptions above, when \( \lambda^2_1(V_2 - \Delta S_2) < \lambda^2_1(V_2 - C_4 - I_4) \), the local government gradually tends to be compulsory, and the farmers also gradually tend to confrontation. At this time, (compulsion, confrontation) is the evolutionary stable equilibrium point of the game, that is, the “extreme controversy” conflict occurs. The above results show that when the two sides of the game do not give in to each other’s interests or seek rent simultaneously, the final result can only be that both sides lose, and the original development plan of the local government may be forced to change, and the living environment of farmers becomes worse. Given this, two hypotheses are proposed from the perspective of both sides in the game: (1) simulation of reduced rent-seeking income of farmers to set \( \Delta S_1 = 3.5 \), \( I_1 = 1 \), and \( \Delta S_2 = 2.5 \) with other assumptions remaining unaltered resulted in the following changes (Figure 11); (2) simulation of controlled rent-seeking ceiling of the local government, increased positive social externality benefits of farmers under reasonable compensation and negative social externality losses under rent-seeking to set \( I_2 = 3 \), \( I_4 = 3 \), and \( \Delta S_2 = 1.5 \) results in the following changes (Figure 12).

It can be seen in Figure 11 that when the rent-seeking income of farmers is reduced to make \( \lambda^2_1(V_1 - \Delta S_1) > \lambda^2_1(V_1 - C_3 - I_3) \) and \( \lambda^2_1(V_2 + I_2) > \lambda^2_1(V_2 + \Delta S_1 - C_4) \), the local government gradually tends to compromise and the farmers gradually tend to accept. At this time, (compromise, acceptance) is the evolutionary stable equilibrium point of the game, that is, the “extreme controversy” conflict is resolved. It can be seen in Figure 12 that when the rent-seeking income of the local government is reduced, farmers’ positive social externality benefits under reasonable compensation and negative social externality losses under rent-seeking are increased, the farmers gradually tend to accept, and the local government gradually tends to compromise. At this time, the two sides of the game also achieve the evolutionary equilibrium result of (compromise, acceptance), and the “extreme controversy” conflict is also resolved. Therefore, to resolve the “extreme controversy” conflicts under nonlitigation settlement, on the one hand, we can control the rent-seeking ceiling of farmers. On the other hand, while controlling the rent-seeking ceiling of the local government, we can increase the farmers’ positive social externality gains under reasonable expropriation or negative social externality losses under both sides’ rent-
seeking. Corresponding to the actual situation, on the one hand, we can actively play the role of public opinion and media intervention to correctly guide the settlement of "extreme controversy" issues. On the other hand, we should improve the mechanism of interest expression and interest coordination, strengthen the communication and consultation between the two sides, and constantly narrow the differences to continuously reduce the rent-seeking behavior of both sides.

5. Discussion and Conclusions

5.1. Discussion

Compared with the existing research, the research results of this article have both similarities and differences with the abovementioned literature. The similarities are shown in, first of all, the fact that the numerical simulation results of the multidimensional conflicts in farmland expropriation in this article are consistent with the changes in the farmland expropriation system since China’s reform and opening up. From 1982 to the present times, China’s farmland expropriation system has experienced an evolution from “centering on economic construction” to “centering on the main interests” and then to “centering on social harmony.” In different periods, there were obvious differences in the strength of the local government and farmers. According to the results of numerical simulations, the evolution of farmland expropriation conflicts proceeded through four stages: “strong government, weak farmers,” “weak government, weak farmers,” “weak government, strong farmers,” and “strong government, strong farmers.” This is consistent with the conflict characteristics of land expropriation in different periods. Secondly, the “government rent-seeking” conflict, the “nail household dilemma” conflict, and the “extreme controversy” conflict proposed in this article are in line with the reality of conflicts in China’s farmland expropriation. According to relevant studies, the current conflicts in farmland expropriation in China are mainly motivated by rights protection and gaining benefits. The three types of conflict correspond to three possible situations: the “government rent-seeking” conflict corresponds to situations where local governments illegally expropriate land and farmers defend their rights through resistance; the “nail household dilemma” conflict corresponds to the situation where farmers seek profits; the “extreme controversy” conflict corresponds to the situation where local governments and farmers seek profits simultaneously. Finally, according to most of the existing literature, farmland expropriation is a game of interest between different related entities, and the imbalance of interest distribution caused by the imperfection of the system is the main cause of conflict. The research in this article confirms it and further analyzes the correlation between system perfection and conflict evolution.

The difference is that most of the existing studies are based on a single perspective, focusing on analyzing a certain type of conflict problem, and there are relatively more studies on conflicts of farmers’ rights protection caused by illegal land expropriation by local governments. However, the reasons for conflicts in farmland expropriation are complex and diverse, which may be caused by local governments, farmers, or both sides of the game. Moreover, in different situations, conflicts may develop dynamically and lead to new conflicts. Therefore, we believe that different types of farmland expropriation conflicts cannot be separated from each other, and the research method should include not only the static analysis method, but also fully reflect the dynamic evolution process between different conflicts in the same field of view. Different from the existing studies, the contributions of this article are as follows: (1) the research object of this article is multidimensional conflicts in farmland expropriation, and different types of conflicts are based on the same model framework; (2) this article adopting the evolutionary game method uses the MATLAB software to simulate and analyze the dynamic evolution process of different types of conflicts in farmland expropriation during the evolution process of China’s farmland expropriation policy; (3) this article explores the two main ways for farmers to deal with disputes: litigation settlement and nonlitigation settlement, and respectively proposes countermeasures for conflict resolution under different paths.
However, this article also has several limitations. First of all, the feasibility of a solution largely depends on the corresponding policy support. When the environment changes, policies also need to be adjusted accordingly, otherwise policies may fail and solutions may not be as expected. Secondly, the inconsistency of national development goals in different periods may cause system conflicts. For example, the incoordination between the economic system and the social system will adversely affect the implementation effect of the plan. Finally, people’s subjective belief differences such as emotions, preferences, and other irrational factors results in a solution that can only minimize but not completely avoid the occurrence of problems. Therefore, in the future, this paper will further expand the research framework and introduce the multidimensional preference set in behavioral economics, which means the future research, from the perspective of psychology, combined with loss aversion, interactive fairness, reference dependence, and other behavioral preferences of the game subject [55,56], will be able to analyze the psychological utility value of the game subject in farmland expropriation. Meanwhile, we can improve the solution measures by strengthening the foresight and flexibility of policies and the coordination of different institutional goals, as well as by taking into account the differences in individual behaviors.

5.2. Conclusions

Multidimensional conflicts in farmland expropriation originate from the game of multidimensional interests between the local government and farmers. The strategic choices and equilibrium results of the two sides have evolved due to changes in the situation and policy adjustments. To present the complexity and diversity of farmland expropriation conflicts in the same dimension, this article constructed a multistage van Damme’s model of multidimensional conflicts in farmland expropriation and analyzed different types of farmland expropriation conflicts under litigation settlement and nonlitigation settlement. According to the strategic choice and evolution stable equilibrium of the local government and farmers under different conditions, this article discussed the formation mechanism and evolution law of three types of farmland expropriation conflicts, which are the “government rent-seeking” conflict, the “nail household dilemma” conflict, and the “extreme controversy” conflict, and used MATLAB numerical simulation to simulate and analyze behavior evolution and conflict resolution of the two sides at different stages to propose a balanced solution for different types of farmland expropriation conflicts. The conclusions are as follows:

1. When litigation conditions for farmland expropriation are significantly improved, it becomes relatively easy for farmers to protect their rights through the law, farmers are more inclined to resolve disputes through litigation. When litigation conditions for farmland expropriation deteriorate, farmers’ legal rights protection is costly and difficult, farmers are more inclined to resolve disputes through nonlitigation. According to the analysis of evolutionary equilibrium, under litigation settlement, there are only two possible evolutionary results in the game of farmland expropriation conflicts, which are (compulsion, acceptance) and (compromise, acceptance), and litigation cost is the key factor to determine the outcome of the game. However, under nonlitigation settlement, there is greater uncertainty in the game between the local government and farmers. With the evolution of the farmland expropriation system, the game underwent changes. There are four possible evolutionary results: (compulsion, acceptance), (compromise, acceptance), (compromise, confrontation), and (compulsion, confrontation).

2. Under litigation settlement, there is only the “government rent-seeking” conflict. The reduction of the litigation threshold provides convenience for farmers to participate in litigation, but if the litigation costs of farmers are high, farmers still choose to accept when they face disputes or suffer a loss of interests rather than seek legal protection. The occurrence of the above result not only weakens the social credibility of laws, but also makes it difficult to protect the legitimate rights and interests of farmers through legal channels. Through numerical simulation, when farmers’ litigation costs
are reduced, farmers’ strategic choices gradually shift from acceptance to litigation resolution. As farmers’ strategic choices changed, the local government’s compulsion strategy wavered. Further, when the cost of litigation for farmers is reduced and the rent-seeking ceiling of the local government is controlled, the strategic choices of the local government tend to compromise, farmers’ strategic choices tend to accept, and the “government rent-seeking” conflict is resolved. In addition, increasing the rent-seeking costs of the local government or the positive social externality benefits under reasonable expropriation has the same effect. Therefore, reducing the litigation costs of farmers is conducive to have farmers seek legal ways to resolve the farmland expropriation conflicts and has a restrictive effect on the rent-seeking behavior of local governments. Only by reducing the litigation costs of farmers and cooperating with other policy interventions, such as controlling the rent-seeking ceiling of the local government, increasing the rent-seeking costs of the local government or positive social externality benefits under reasonable expropriation can the “government rent-seeking” conflict be resolved. In reality, to resolve the “government rent-seeking” conflict under litigation settlement while creating convenient conditions for farmers to participate in litigation, we should also directly or indirectly reduce the litigation costs of farmers’ legal rights protection so as to ensure the maximum effect of legal rights protection. In addition, we should strengthen the supervision of the local government’s behavior norms and make necessary restrictions on its rent-seeking behavior.

3. Under nonlitigation settlement, there are three types of conflicts. At the stage of “strong government, weak farmers,” the system design of farmland expropriation biased to the local government creates conditions for the local government rent-seeking, so the “government rent-seeking” conflict may occur. To resolve the “government rent-seeking” conflict, we can control the rent-seeking ceiling of the local government, such as by increasing the penalties for the local government’s violations and forcing them to reduce rent-seeking. We can also increase the rent-seeking costs of the local government or its positive social externality benefits under reasonable expropriation. At the stage of “weak government, strong farmers,” when the local government’s behavior is restricted by the system, farmers’ rent-seeking costs are greatly reduced, making them more inclined to choose confrontation and become nail households, so the “nail household dilemma” conflict may occur. To resolve the “nail household dilemma” conflict, we can increase the rent-seeking costs of farmers or their positive social externality benefits under reasonable compensation. Moreover, local governments should pay attention to farmers’ interests, resolve farmers’ concerns timely, and avoid the “nail household dilemma” problems caused by their improper behavior. At the stage of “strong government, strong farmers,” facing the continuous decline in land income and the continuous increase in the expropriation price, the inconsistency between local governments and farmers has brought farmland expropriation into a deadlock, so the “extreme controversy” conflicts may occur. To resolve the “extreme controversy” conflict, we can control the rent-seeking ceiling of farmers. Alternatively, while controlling the rent-seeking ceiling of local governments, we can increase the farmers’ positive social externality benefits under reasonable compensation or both sides’ negative social externality losses under rent-seeking. Corresponding to the actual situation, we can actively play the role of public opinion and media intervention to correctly guide the settlement of “extreme controversy” issues. Meanwhile, we should improve the mechanism of interest expression and interest coordination, strengthen the communication and consultation between the two sides, and constantly narrow the differences to continuously reduce the rent-seeking behavior of the two sides.
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