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Game of Marine Natural Resources Management: A strategy for Determining Rights Registration

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Abstract: The unified right confirmation and registration of natural resources in sea areas (URCRNRSA) has been considered a key approach to the effective management and sustainable utilization of marine resources. In China, the system of URCRNRSA is insufficient due to the lack of central auditing supervision and public participation. In this study, the mechanism of stakeholder interaction is clarified based on the game relationship among the tripartite of the central government, local governments, and the public. The evolutionary process of tripartite decision-making is simulated with an evolutionary game model. On this basis, the strategic choices of the tripartite were analyzed in the four evolutionary scenarios of high-quality URCRNRSA. It was demonstrated that the tripartite could jointly affect the URCRNRSA through cooperation-constraint, principal-agent, and incentive-compatibility relationships. The most effective, realistic, and feasible URCRNRSA strategy was the trinity system with local government high-quality rights confirming, the central government auditing as a hard constraint and the public participating as a soft constraint. The main influencing factors for the tripartite to make different strategy selections were clarified through parameter sensitivity analysis, including cost, benefit, reward, and punishment. Accordingly, the policy recommendations were put forward to ensure the stable and efficient implementation of the URCRNRSA in China.

Keywords: natural resources in sea areas of China; right confirmation and registration; resource audit; public participation; evolutionary game; evolutionary simulation

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1. Introduction

Effective management and protection of natural resources is the premise and foundation of sustainable development and utilization of natural resources in sea areas [1–3]. The natural resource right confirmation and registration system have been recognized as an effective strategy for natural resource management, which has been effectively implemented in the management of terrestrial resources in many countries [4–6]. In recent years, this system has been adopted by some coastal countries in the management of marine natural resources [7]. Aiming at the conflicts caused by the disordered development and utilization of natural resources due to uncertain property rights [8], the unified right confirmation and registration of natural resources in sea areas (URCRNRSA) has been designed as a legal system to clarify the ownership of natural marine resource property rights at multiple scales of ecosystem and governance [9,10]. Therefore, effectively coordinating the governance of socioeconomic development and ecological and environmental protection has become a crucial issue that requires urgent addressing in developing countries [11,12]. Many countries are actively trying to establish relevant infrastructure to collect national marine spatial data for supporting the right confirmation and registration [13], which is hoped to achieve sustainable utilization of natural marine resources through allocating property rights [14]. However, the redistribution or cancellation of national marine resource rights is not as simple as that of terrestrial resources, and the existing marine jurisdiction

and laws are relatively new and untested [15]. It is necessary to further explore how to construct and strengthen the URCRNRSA [10].

In recent years, the Chinese government proposed the reform idea of the unified right confirmation on natural resources and ecological spaces such as waters, forests, mountains and hills, grasslands, wastelands, and mudflats [16]. The pilot work of unified right confirmation and registration of various natural resources was performed continuously. A pilot project of the URCRNRSA has been implemented to construct the cadastral survey database of sea areas and nonresident islands and to inspect the survey data results in China. The natural resources of the sea areas are different from other natural resources. The ownership of the sea areas is exercised by The State Council of China on behalf of the State, and the subject driving ownership is the Ministry of Natural Resources of China which is a department of The State Council of China. On this basis, the natural resources in sea areas are delegated to local governments, departments, units, and individuals through multi-level principal-agent relationships by the Ministry of Natural Resources of China [17]. In reality, it is difficult for a multi-level principal-agent relationship to reflect virtual state ownership due to the characteristics of the ambiguity or uncertainty of marine resources as well as the difficulty of delimitation and liquidity of the ocean. Therefore, it has become an urgent key issue how to solve the problem of the unclarified and unimplemented rights and interests of owners in the process of the URCRNRSA in China.

In recent years, a series of studies have been conducted on the right confirmation, including marine tenure rights [10,18], property rights of fishery resources [19,20], marine space property [21], water resource rights [22], agricultural land rights [23], and forestland rights [24]. It has been demonstrated that clear property rights are conducive to realizing sustainable management objectives. Moreover, supervision has been recognized as the guarantee of realizing high-quality right confirmation and registration [16]. In China, the practice of unified right confirmation and registration of natural resources is faced with many problems, including interest conflicts among stakeholders of some resources [25], incomplete registration information [26], inadequate specification of standards and norms, disputes over ownership, and inconsistent basic data [27]. Specifically, as to URCRNRSA in China, the ownership list of sea resources badly needs to be introduced for the central and local governments hierarchically to hold, respectively, and the existing design of natural resource registration should be adjusted to apply to the resources in sea areas [28]. The reason was that some local governments ignored the importance of basic data support for the right confirmation [9]. Most existing studies have proposed specific solutions to the current situation and problems at the practical level. Still, they rarely explored the problem of inadequate implementation of the rights and interests of owners due to the lack of supervision in the process of determining the URCRNRSA at the institutional level.

According to Property rights theory, the clarification of property rights is to "internalize" the externalities of public goods to promote people's management and protection of natural resources [29]. Stakeholder participation is an important factor in influencing the implementation of marine natural resources ownership [15,30]. The construction of a supervision system that covers the entire process from "entrance" to "exit" is an effective way to internalize the externalities of public goods. However, supervising the property rights of natural resources has been solely charged by functional departments of government. Their dual identities, just like being a competitor and referee at the same time, make it difficult for the government to reasonably and effectively supervise the process of the URCRNRSA [31]. The contradiction between owners and managers could be solved with the mechanism of tension and restriction among different parties to achieve the best balance between profit pursuit and public welfare [32]. Therefore, it is necessary to establish an external supervision system from the bottom up to strengthen social supervision, especially to give full play to the role of public participation in supervision so that the local government could carry out a high-quality right confirmation with the help of the public.

In terms of internal supervision, the audit of resources and the environment plays an important role in revealing the institutional barriers, obstructions, and loopholes in the

aspect of resources and environmental management [33]. Chinese government emphasized the audit of leading officials' work related to natural resource assets [34]. For further constructing the natural resource asset audit system, the central audit department should conduct tracking audits and cooperative audits [35], which can help local governments clarify the status of local natural resource assets and track the changes in the ownership of natural resources [36]. A system of URCRNRSA has just been established to provide basic information and data for governments. The systems of natural resource asset assessing, accounting, and auditing were still at the level of theoretical exploration. It is urgent to construct and improve the property rights supervision of natural resources from both the theoretical and practical levels in China's sea areas. Therefore, the system of URCRNRSA could be further improved by conducting audits of natural resources in sea areas.

In terms of external supervision, it is difficult for the public to play a supervisory role due to the inadequate public supervision system. The information disclosure was not complete, resulting in the inability of the public to access the information about natural resource property rights in a timely. Furthermore, the lack of publicity and a reward system run by the government led to a weak awareness of the public's supervision of administrative behaviors related to natural resource property rights. Additionally, since no feedback channel was established, the public could not give feedback to the government when encountering problems related to the property rights of natural resources [31].

In reality, governments and the public are bounded and rational at all levels, and it takes a long time for their strategic choices to evolve to ultimate stability. Evolutionary game theory is mainly used to study the long-term game of participants in a state of imperfect rationality [37]. Scholars have conducted evolutionary game studies on natural resource registration and confirmation, public supervision, and resource asset auditing, for example, forestry rights and agricultural land rights [38,39], which revealed the starting point of and dynamic changes in a multi-agent property rights game. The impact of resource asset audits on the strategies of different entities was analyzed by constructing an evolutionary game model of multi-agent environmental governance in China [40]. In addition, the impact of public participation in supervision on the strategic choices of other entities was analyzed in view of the important role of public participation in supervision [37]. Most existing studies were confined to the single perspective of resource right confirmation, resource auditing, or public participation and supervision, and they rarely linked the three. Additionally, there was no research on the URCRNRSA of China.

Above all, the theoretical and practical exploration of natural resource right confirmation and registration provides theoretical support and inspiration for the research related to marine resources. To speed up the establishment of the URCRNRSA system in China, in this study, the following two innovative attempts were made: (1) The analytical framework for the URCRNRSA was constructed, which included three levels of the central government, local governments, and the public, on the basis of the resources asset audit system and the public participation system for the purpose of comprehensively interpreting the interactions among these three entities. (2) In order to achieve the high-quality URCRNRSA, the evolutionary strategy path of the high-quality right confirmation and registration is theoretically explored by analyzing the costs and benefits of each entity's strategic choice in different situations and identifying the main factors influencing the tripartite strategic choice.

2. Theoretical Analysis and Model Assumptions

2.1. The Interaction Mechanism between the Central Government and Local Governments Based on the Cooperation-Constraint Relationship

Theoretically, there may exist a cooperation-constraint relationship in the URCRNRSA between the central government and local governments, which corresponds to the central government's entrusted agency and supervision behaviors of local governments, respectively (Figure 1). The central government, a party whose own interests are consistent with the general welfare of society [41], constructs the system of URCRNRSA from a long-term

perspective. The local governments, as the main executor of the economic development of local resources, take the initiative to promote every project and decision that is conducive to the development of the economy, society, and environment. Specifically, the central government may be constrained by the hidden actions and hidden information of the agents because the central government's authority is delegated to local governments, departments, and units through layers of principal-agent relationships [42]. For example, some departments and units, due to their "short-sighted" consideration of short-term interests or private interests, complete the right confirmation with low standards in the process of right confirmation or pass the responsibility to each other when multi-department cooperation is involved. Some departments and units may even be unable to point out and sign for the right because they are not familiar with the specific natural resources management and current situation [26]. Due to severe information asymmetry, the principal-agent relationship between the central government and the local government may generate incentive variation and agency variation, which will lead to an adverse selection and moral hazard [43]. Therefore, the central government, as the main party exercising the ownership of natural resources in sea areas, has the obligation and responsibility of formulating and implementing various policies to supervise and constrain local governments to avoid low-quality right confirmation with measures of internal inspection and resources asset audits, etc. in a top-down way to make sure local governments perform high-quality right confirmation.

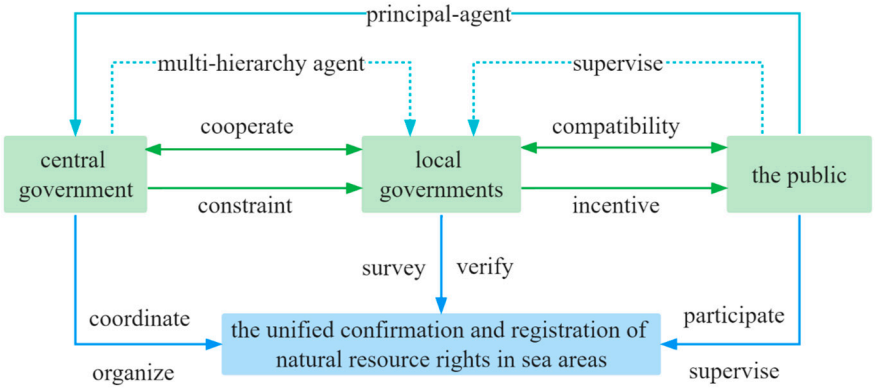


Figure 1. Stakeholder relationship and its interaction mechanism on the UCRNRSA.

2.2. The Interaction Mechanism between the Central Government and the Public Based on the Principal-Agent Relationship

The Law of the People's Republic of China on the Administration of the Use of Sea Areas clearly stipulates that sea areas belong to the state and that the exercise of power in sea areas is divided into direct exercise and agency exercise, which is determined based on the resources list of hierarchical agency of the central government and local governments in holding ownership [28]. The public is the owner of the rights and interests of natural resources. If the central government entrusts local governments to hold ownership, the agent of ownership is registered as the local people's government [26]. The central government will have an impact on URCRNRSA by encouraging the public to participate in the system (Figure 1). In order to improve participating public awareness, the central government can better publicize the property rights system of natural resources by publicly releasing the list and standards of natural resources in sea areas. Then, the central government encourages the public to participate in the supervision of the status of resource right confirmation and guides the public to participate in the marketization of natural resource assets in sea areas. Thereby, the property rights system for natural resources in sea areas will be strengthened. Furthermore, public participation can reduce the cost for the central government to obtain information about the rights registration of local government. The public can be able to obtain information on the current situation of natural resources in local sea areas in real-time. When the public finds that local governments have conducted low-quality practices in the process of URCRNRSA, for example, incomplete right confirmation results,

inadequate registration steps, or others, they can put pressure on local governments by way of complaints and petitions as well as report the problems to the central government through public information platforms. The local governments, in order to gain public trust and circumvent the punishment imposed by the central government, prefer to adopt a high standard and strict requirement to conduct a high-quality right confirmation, thereby ensuring the quality of the URCRNRSA.

2.3. The Interaction Mechanism between Local Governments and the Public Based on an Incentive-Compatibility Relationship

According to the principle of incentive-compatibility, the interest goal of local governments is consistent with the goal of maximizing social welfare in the long run, which indicates that local governments, as the defenders of public social interests, must improve the incentive mechanism in the process of the URCRNRSA (Figure 1). In this process, local governments should make the public aware that the interest goal of the URCRNRSA is closely related to the public's own long-term interests and also aware that the public's interests are consistent with the overall welfare of society. In this way, the sense of identity of the public and its enthusiasm are continuously improved to participate in the URCRNRSA. However, at present, due to information asymmetry, low property rights awareness, and high participation costs, the public has insufficient enthusiasm for constructing the URCRNRSA. Compared with other stakeholders, the public is a "vulnerable group". To ensure the interests of the public, the local government should establish an information interaction mechanism between the local government and the public [41]. However, under the assumption that the local government is an economic entity rather than a moral agent, as a self-interested subject, the local government may tend toward excessive expansion of control power, which makes it difficult to effectively contain the opportunism in the process of maximizing the local government's interests. Therefore, for an incentive to be compatible, it is necessary to establish an effective supervision mechanism to expose and correct the behavior that deviates from the public interest [42].

2.4. Evolutionary Game Model Assumptions

Based on the theoretical analysis above, in this study, an analytical framework of the relationship among the central government, local governments, and the public is established for exploring the path of high-quality URCRNRSA. Among them, the central government is the leader, local governments carry out the step-by-step implementation, and the public participates extensively. The central government, local governments, and the public are denoted as X, Y, and Z, based on the premise that they are all bounded rational individuals and have a certain learning ability and behavioral choice right. In addition to the existing pilot scheme procedure of the URCRNRSA, the strategy set of the central government is {auditing, no auditing}, which refers to the key role of the resource asset audit system in constructing the property rights system. Auditing refers to the audit work carried out by the central government to guarantee the quality of resource right confirmation effectively and to clarify the current status of resource property rights. The strategy set of local governments, which are the main party responsible for confirming resource rights, is {high-quality right confirming, low-quality right confirming}. High-quality right confirmation needs the following information: ① information provided with the registration information integration platform; ② natural resources registration information; ③ natural resources record or archive information; ④ information generated by administrative approval; ⑤ information on laws and regulations, government orders, planning, and court decisions; and ⑥ information received by government departments through open registration [44]. The public is the beneficiary of resource right confirmation, and its strategy set is {participating, nonparticipating}. Public participation refers to the direct or indirect participation of stakeholders in the processing of resource right confirmation and public resource affairs [45]. The number of the three types of game groups is considered to be relatively stable and standardized to 1. At time t, the probability that the

central government group chooses to audit is $x(t)$, the probability that the local government group chooses to adopt high-quality right confirmation is $y(t)$, and the probability that the public group chooses to adopt participation is $z(t)$.

Based on the scheme of URCRNRSA and the actual situation of the natural resource audit system, the following model assumptions were made:

Hypothesis 1: The central government is a "neutral sector" with the goal of maximizing social welfare and is not captured by any interest group. For the central government, the fixed income from the right confirmation is p_1, and the cost of the right confirmation is c_1. The cost increment of the audit strategy selected by the central government, for example, from hiring external experts for collaboration and standardizing the audit process, is denoted as Δc_1. The public's choice of participation strategy can reduce the right confirmation cost of m incurred by the central government. If the central government chooses the audit strategy, the probability of finding low-quality right confirmation by local governments is η_1, and if it chooses the no audit strategy, the probability of finding low-quality right confirmation by local governments is η_2 ($\eta_1 > \eta_2$), and a fine of h is imposed on local governments.

Hypothesis 2: When the central government chooses the audit strategy, there is a θ probability that the local government authority can be forced to improve the work standards, standardize the right confirmation process, and consequently, the long-term benefits are i brought to the central government from auditing. For local governments, choosing the high-quality right confirmation strategy will bring long-term benefits of r to the central government. When the central government chooses the no audit strategy and local governments choose the low-quality right confirmation strategy, there is a μ probability that the central government will lose its long-term credibility of j.

Hypothesis 3: The standard and requirement of right registration are relatively fixed in a certain period of time, and the cost is certain under the existing technical conditions. The acquisition method and price of the right-to-use sea areas are relatively fixed according to different levels of sea areas. Therefore, we assume that the benefits and costs of the right confirmation are relatively fixed. For local governments, the fixed benefits from right confirmation is p_2, and the fixed cost incurred by the right confirmation is c_2. When local governments choose the high-quality right confirmation strategy, there will be a β probability to bring long-term benefits of d through improving the efficiency of resource market allocation and promoting the fair distribution of resources. At the same time, this strategy choice will also generate an additional right confirmation cost of Δc_2, mainly used for the additional manpower and material resources in order to strengthen the standard and normative basis and unify the basic data. At this time, local governments will have ξ probability of providing incentives to the public for choosing the participation strategy, and the incentive implementation reward to the public will be b. The public's choice of participation strategy may reduce the cost of l of right confirmation incurred by local governments.

Hypothesis 4: When local governments choose the low-quality right confirmation strategy, the probability of rent-seeking behaviors will be δ, and its benefits will be q. At this time, there is a φ probability of damaging the rights and interests of all the resources owned by the whole people, which causes a long-term loss of e in the efficiency of the market-based allocation of resources. When the central government audits, there will be an α_1 probability for the public to find that local governments have carried out low-quality right confirmation if the public chooses the participation strategy. When the central government does not audit, there will be an α_2 probability for the public to find that local governments have carried out low-quality right confirmation if the public chooses the participation strategy, where $\alpha_1 > \alpha_2$. At this time, local governments will give negative externality compensation of n to the public.

Hypothesis 5: For the public, the fixed benefit from the right confirmation is p_3. When local governments perform low-quality URCRNRSA, i.e., a mere formality that causes the rights and interests of all people not to be implemented, the public can adopt the nonparticipation strategy, that is, tolerating the non-implementation of marine resource rights and interests or hoping that the government will take the initiative to improve such implementation. The public can also adopt the participation strategy; that is, the public can protect their legitimate rights and interests through cooperation, reporting, petitioning, etc., and at this time, it will generate participating cost of c_3.

Hypothesis 6: When the public chooses the participation strategy, there is a ξ probability of receiving an incentive of b from local governments. The long-term benefits are v to the public on the condition that local governments carry out high-quality URCRNRSA. When local governments perform low-quality URCRNRSA, the public loss is a_1 on the condition that the central government audits, while on the condition that the central government does not audit, the public loss is a_2, where $a_2 > a_1$.

All the variable definitions are shown in Table 1.

Table 1. Variable definitions.

Definition	Symbol	Definition	Symbol
Central government	X	The long-term benefits from high-quality confirming rights of local governments	d
Local government	Y	The probability of long-term benefits from high-quality confirming rights of local governments	β
The public	Z	The reduced cost of confirming rights by local governments due to the public's participation strategy	l
The fixed income from confirming the rights of the central government	p_1	The probability of local governments providing incentives to the public for choosing the participation strategy	ξ
The fixed cost of confirming the rights of the central government	c_2	The reward of local governments to the public for choosing the participation strategy	b
The reduced cost of confirming rights by the central government due to the public's participation strategy	m	The probability of rent-seeking behaviors of local governments in confirming rights	δ
The increased cost auditing of the central government	Δc_1	The benefits of rent-seeking behaviors of local governments in confirming rights	q
The long-term benefits of the central government from high-quality confirming rights	r	The long-term loss of local governments with low-quality confirming rights	e
The probability of finding local governments low-quality confirming rights by the central government with the audit strategy	η_1	The probability of long-term loss of local governments with low-quality confirming rights	φ
The probability of finding local governments low-quality confirming rights by the central government without an audit strategy	η_2	The probability of the public finding low-quality confirming rights with choosing the participation strategy	α_1
A fine for local governments' low quality confirming rights by the central government	h	The probability of the public finding low-quality confirming rights without choosing the participation strategy	α_2
The long-term benefits of the central government from the audit strategy	i	The negative externality compensation for the public from local governments	n
The probability of long-term benefits for the central government from the audit strategy	θ	The fixed income from confirming the rights of the public	p_3
The benefit loss of the central government without audit strategy under the condition of low-quality confirming rights	j	The cost of the public for choosing the participation strategy of confirming rights	c_1
The probability of benefit loss of the central government without audit strategy under the condition of low-quality confirming rights	μ	The long-term benefits for the public from high-quality confirming rights	v
The fixed income of local governments from confirming rights	p_2	The benefit loss of the public from low-quality confirming rights with central government audit strategy	a_1
The fixed cost of local governments from confirming rights	c_2	The benefit loss of the public from low-quality confirming rights without a central government audit strategy	a_2
The extra cost of local governments from high-quality confirming rights	Δc_2		

Based on the descriptions and research hypotheses on the central government, local governments, and the public with regard to the URCRNRSA above, the payment matrix of their respective strategic behavior is shown in Table 2.

Table 2. Payoff matrix of tripartite evolutionary game.

Strategy	The Central Government	The Local Government	The Pubilc
(auditing, high-quality confirming rights, participating)	$p_1 - c_1 - \Delta c_1 + \theta i + m + r$	$p_2 - c_2 - \Delta c_2 + \beta d + l - \xi b$	$p_3 - c_3 + \xi b + v$
(auditing, high-quality confirming rights, nonparticipating)	$p_1 - c_1 - \Delta c_1 + \theta i + r$	$p_2 - c_2 - \Delta c_2 + \beta d - \xi b$	$p_3 + v$
(auditing, low-quality confirming rights, participating)	$p_1 - c_1 - \Delta c_1 + \theta i + m + \eta_1 h$	$p_2 - c_2 + \delta q - \varphi e - \eta_1 h - \alpha_1 n$	$p_3 - c_3 + \alpha_1 n - a_1$
(auditing, low-quality confirming rights, nonparticipating)	$p_1 - c_1 - \Delta c_1 + \theta i + \eta_1 h$	$p_2 - c_2 + \delta q - \varphi e - \eta_1 h$	$p_3 - a_1$
(no auditing, high-quality confirming rights, participating)	$p_1 - c_1 - \mu j + r$	$p_2 - c_2 - \Delta c_2 + \beta d + l - \xi b$	$p_3 - c_3 + \xi b + v$
(no auditing, high-quality confirming rights, nonparticipating)	$p_1 - c_1 - \mu j + r$	$p_2 - c_2 - \Delta c_2 + \beta d - \xi b$	$p_3 + v$
(no auditing, low-quality confirming rights, participating)	$p_1 - c_1 - \mu j + \eta_2 h$	$p_2 - c_2 + \delta q - \varphi e - \eta_2 h - \alpha_1 n$	$p_3 - c_3 + \alpha_2 n - a_2$
(no auditing, low-quality confirming rights, nonparticipating)	$p_1 - c_1 - \mu j + \eta_2 h$	$p_2 - c_2 + \delta q - \varphi e - \eta_2 h$	$p_3 - a_2$

3. Model Construction and Stability Point Analysis

3.1. Construction of Strategy Selection Models for the Tripartite

In the process of the URCRNRSA, it is necessary to comprehensively consider the main factors that affect the payment function of each party and analyze how the changes of different factors affect the choice of the game parties in order to achieve the optimal strategy combination that is most conducive to the overall system.

In the initial stage, it is assumed that the probability for the central government to audit is x ($0 \le x \le 1$) and that the probability of choosing not to audit is 1-x. The probability is y ($0 \le y \le 1$) for local governments choosing to carry out high-quality rights confirmation, and the probability is 1-y to perform low-quality right confirmation. The probability of public participation is z ($0 \le z \le 1$), and the probability of nonparticipation is 1-z.

1. Analysis of the evolutionary stability strategy of the central government.

The expected utilities of the central government auditing and the central government not auditing are as follows:

$$E_x = yr + zm + (1 - y)\eta_1 h + (p_1 - c_1 - \Delta c_1 + \theta i) \tag{1}$$

$$E_{1-x} = yr + (1 - y)\eta_2 h + (p_1 - c_1 - \mu j) \tag{2}$$

The average payment of the central government when making strategic choices is as follows:

$$E_1 = yr + xzm + x(1 - y)\eta_1 h + x(\theta i - \Delta c_1) + (1 - x)(1 - y)\eta_2 h - (1 - x)\mu j + (p_1 - c_1) \tag{3}$$

Then, the replicator dynamics equation for the strategy selection of the central government is as follows:

$$\frac{dx}{dt} = x(1 - x)[(1 - y)(\eta_1 h - \eta_2 h) + zm + (\theta i + \mu j - \Delta c_1)] \tag{4}$$

$$0 \le z = \frac{\eta_1 h - \eta_2 h}{m} y + \frac{\Delta c_1 + \eta_2 h - \theta i - \mu j - \eta_1 h}{m} \le 1 \tag{5}$$

$$0 \le z \ne \frac{\eta_1 h - \eta_2 h}{m} y + \frac{\Delta c_1 + \eta_2 h - \theta i - \mu j - \eta_1 h}{m} \le 1 \tag{6}$$

When Formula (5) is true, the value of Formula (4) is always 0. Regardless of the value of x, the strategy selection process of the central government is in a stable state.

When Formula (6) is true, the value of Formula (4) is 0. When x = 0 or x = 1, the strategy selection process of the central government is in a stable state.

The partial derivative of the replicator dynamics equation is as follows:

$$\frac{d\dot{x}}{dt} = (1 - 2x)[(1 - y)(\eta_1 h - \eta_2 h) + zm + (\theta i + \mu j - \Delta c_1)] \tag{7}$$

At this time, the discussion of the stable equilibrium is carried out under different conditions as follows.

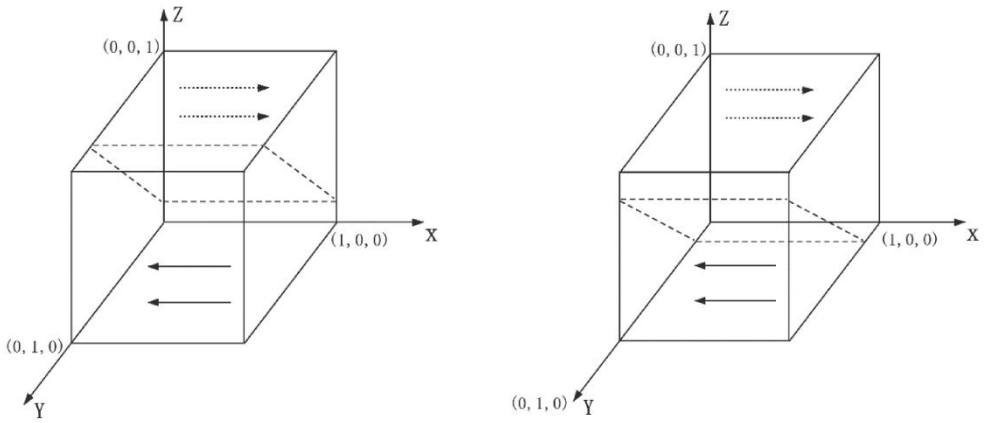
$$0 \le \frac{\eta_1 h - \eta_2 h}{m} y + \frac{\Delta c_1 + \eta_2 h - \theta i - \mu j - \eta_1 h}{m} < z \le 1 \tag{8}$$

$$0 \le z < \frac{\eta_1 h - \eta_2 h}{m} y + \frac{\Delta c_1 + \eta_2 h - \theta i - \mu j - \eta_1 h}{m} \le 1 \tag{9}$$

When Formula (8) is true, Formula (7) is greater than 0 at $x = 0$, and Formula (7) is less than 0 at $x = 1$, $x = 1$ is the evolutionary stable point. That is, the central government chooses the auditing strategy.

When Formula (9) is true, Formula (7) is less than 0 at $x = 0$, and Formula (7) is greater than 0 at $x = 1$, $x = 0$ is the evolutionary stable point. That is, the central government does choose the no auditing strategy.

The evolutionary stable strategy (ESS) of the central government can be obtained by solving the replicator dynamics equation of the central government (Figure 2).



(**a**). $0 < \frac{\Delta c_1 + \eta_2 h - \theta i - \mu j - \eta_1 h}{m} < 1$ (**b**). $-1 < \frac{\Delta c_1 + \eta_2 h - \theta i - \mu j - \eta_1 h}{m} < 0$

Figure 2. Evolution phase diagram of central government strategy selection under different conditions.

2. Analysis of the evolutionary stability strategy of local governments.

The expected utilities of high-quality right confirmation and low-quality right confirmation by local governments are as follows:

$$E_y = zl + (p_2 + \beta d - c_2 - \Delta c_2 - \xi b) \tag{10}$$

$$E_{1-y} = -x\eta_1 h - (1-x)\eta_2 h - z\alpha_2 n + xz(\alpha_2 n - \alpha_1 n) + (p_2 + \delta q - c_2 - \varphi e) \tag{11}$$

The average payment of local governments when making strategic choices is as follows:

$$\begin{aligned} E_2 = {} & yzl + y(\beta d - \Delta c_2 - \xi b) - x(1-y)\eta_1 h - (1-x)(1-y)\eta_2 h - (1-y)z\alpha_2 n \\ & + x(1-y)z(\alpha_2 n - \alpha_1 n) + (1-y)(\delta q - \varphi e) + (p_2 - c_2) \end{aligned} \tag{12}$$

Then, the replicator dynamics equation for the strategy selection of local governments is as follows:

$$\frac{dy}{dt} = y(1-y)[x(\eta_1 h - \eta_2 h) + z(l + \alpha_2 n) + xz(\alpha_1 n - \alpha_2 n) + (\beta d + \varphi e + \eta_2 h - \Delta c_2 - \xi b - \delta q)] \tag{13}$$

$$0 \le z = \frac{x(\eta_2 h - \eta_1 h) - (\beta d + \varphi e + \eta_2 h - \Delta c_2 - \xi b - \delta q)}{x(\alpha_1 n - \alpha_2 n) + \alpha_2 n + l} \le 1 \tag{14}$$

$$0 \le z \ne \frac{x(\eta_2 h - \eta_1 h) - (\beta d + \varphi e + \eta_2 h - \Delta c_2 - \xi b - \delta q)}{x(\alpha_1 n - \alpha_2 n) + \alpha_2 n + l} \le 1 \tag{15}$$

When Formula (14) is true, the value of Formula (13) is always 0. Regardless of the value of y, the strategy selection process of local governments is in a stable state.

When Formula (15) is true, the value of Formula (13) is 0. When $y = 0$ or $y = 1$, the strategy selection process of local governments is in a stable state.

The partial derivative of the replicator dynamics equation is as follows:

$$\frac{d\dot{y}}{dt} = (1-2y)[x(\eta_1 h - \eta_2 h) + z(l + \alpha_2 n) + xz(\alpha_1 n - \alpha_2 n) + (\beta d + \varphi e + \eta_2 h - \Delta c_2 - \xi b - \delta q)] \quad (16)$$

At this time, the discussion of the stable equilibrium is carried out under different conditions as follows.

$$0 \leq \frac{x(\eta_2 h - \eta_1 h) - (\beta d + \varphi e + \eta_2 h - \Delta c_2 - \xi b - \delta q)}{x(\alpha_1 n - \alpha_2 n) + \alpha_2 n + l} < z \leq 1 \quad (17)$$

$$0 \leq z < \frac{x(\eta_2 h - \eta_1 h) - (\beta d + \varphi e + \eta_2 h - \Delta c_2 - \xi b - \delta q)}{x(\alpha_1 n - \alpha_2 n) + \alpha_2 n + l} \leq 1 \quad (18)$$

When Formula (17) is true, Formula (16) is greater than 0 at $y = 0$, and Formula (16) is less than 0 at $y = 1$, $y = 1$ is the evolutionary stable point. That is, the local governments choose the strategy of high-quality right confirmation.

When Formula (18) is true, Formula (16) is less than 0 at $y = 0$, and Formula (16) is greater than 0 at $y = 1$, $y = 0$ is the evolutionary stable point. That is, the local governments choose the strategy of low-quality right confirmation.

The ESS of local governments can be obtained by solving the local government replicator dynamics equation (Figure 3).

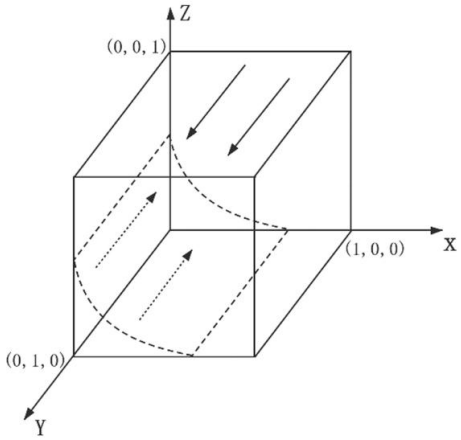


Figure 3. Evolution phase diagram of local government strategy selection.

3. Analysis of the evolutionary stability strategy of the public

The expected utilities of public participation and public nonparticipation are as follows:

$$E_z = y(\xi b + v) + x(1-y)\alpha_1 n + (1-x)(1-y)\alpha_2 n - x(1-y)a_1 - (1-x)(1-y)a_2 + (p_3 - c_3) \quad (19)$$

$$E_{1-z} = yv - x(1-y)a_1 - (1-x)(1-y)a_2 + p_3 \quad (20)$$

The average payment of the public when choosing the strategy of participation or nonparticipation is as follows:

$$\begin{aligned} E_3 = {} & yz\xi b + yv + x(1-y)z\alpha_1 n + (1-x)(1-y)z\alpha_2 n - x(1-y)za_1 \\ & -(1-x)(1-y)za_2 - x(1-y)(1-z)a_1 \\ & -(1-x)(1-y)(1-z)a_2 + p_3 \end{aligned} \quad (21)$$

The replicator dynamics equation for the strategy selection of the public is as follows:

$$\frac{dz}{dt} = z(1-z)[y(\xi b - \alpha_2 n) + x(\alpha_1 n - \alpha_2 n) + xy(\alpha_1 n - \alpha_2 n) + (\alpha_2 n - c_3)] \quad (22)$$

$$0 \le y = \frac{x(\alpha_2 n - \alpha_1 n) + c_3 - \alpha_2 n}{x(\alpha_2 n - \alpha_1 n) + \xi b - \alpha_2 n} \le 1 \quad (23)$$

$$0 \le y \ne \frac{x(\alpha_2 n - \alpha_1 n) + c_3 - \alpha_2 n}{x(\alpha_2 n - \alpha_1 n) + \xi b - \alpha_2 n} \le 1 \quad (24)$$

When Formula (23) is true, the value of Formula (22) is always 0. Regardless of the value of z, the strategy selection process of the public is in a stable state.

When Formula (24) is true, the value of Formula (22) is 0. When $z = 0$ or $z = 1$, the strategy selection process of the public is in a stable state.

The partial derivative of the replicator dynamics equation is as follows:

$$\frac{d\dot{z}}{dt} = (1-2z)[y(\xi b - \alpha_2 n) + x(\alpha_1 n - \alpha_2 n) + xy(\alpha_1 n - \alpha_2 n) + (\alpha_2 n - c_3)] \quad (25)$$

At this time, the discussion of the stable equilibrium is carried out under different conditions as follows.

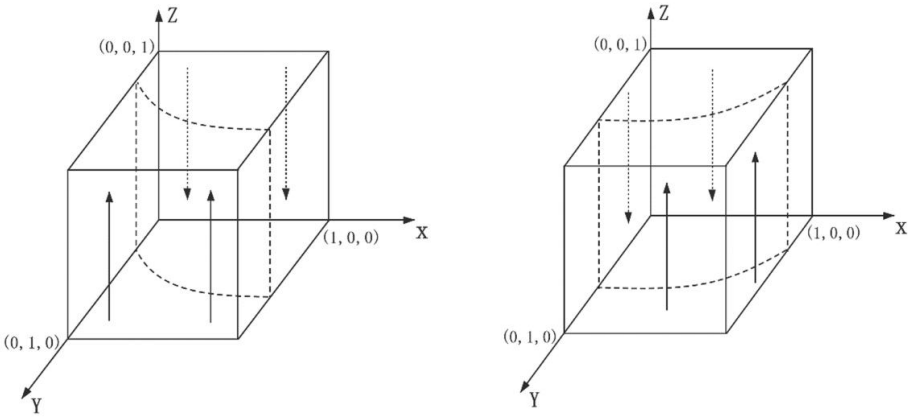
$$0 \le \frac{x(\alpha_2 n - \alpha_1 n) + c_3 - \alpha_2 n}{x(\alpha_2 n - \alpha_1 n) + \xi b - \alpha_2 n} < y \le 1 \quad (26)$$

$$0 \le y < \frac{x(\alpha_2 n - \alpha_1 n) + c_3 - \alpha_2 n}{x(\alpha_2 n - \alpha_1 n) + \xi b - \alpha_2 n} \le 1 \quad (27)$$

When Formula (26) is true, Formula (25) is greater than 0 at $z = 0$, and Formula (25) is less than 0 at $z = 1$, $z = 1$ is the evolutionary stable point. That is, the public chooses the participation strategy.

When Formula (27) is true, Formula (25) is less than 0 at $z = 0$, and Formula (25) is greater than 0 at $z = 1$, $z = 0$ is the evolutionary stable point. That is, the public chooses the nonparticipation strategy.

The ESS of the public can be obtained by solving the public replicator dynamics equation (Figure 4).



(**a**). $\xi b - \alpha_2 n > 0, \xi b - c_3 > 0$ (**b**). $\xi b - \alpha_2 n < 0, \xi b - c_3 < 0$

Figure 4. Evolution phase diagram of the public strategy selection under different conditions.

3.2. Stability Point Analysis

According to the Malthusian equation, the three−dimensional dynamic system (J) can be obtained by calculating the replicator dynamics equation of the central government, local governments, and the public.

The analysis results of the three−dimensional dynamic system (*J*) show that there are eight pure strategy equilibrium points and one mixed strategy equilibrium point adopted by the tripartite in the system (*J*), theoretically [46]. In an asymmetric game, the evolutionary game equilibrium E is an evolutionary stable equilibrium and must be a strict Nash equilibrium. Moreover, a strict Nash equilibrium is a pure strategy equilibrium [47]. That is, the mixed strategy equilibrium in an asymmetric game must not be an evolutionary stable equilibrium [48]. Therefore, this paper discusses only the eight stable points of pure strategy equilibrium of the tripartite evolutionary game.

Then this paper tries to further solve the stable equilibrium point of the system (*J*) evolution. When all the eigenvalues λ of the Jacobian matrix have a negative real part, the equilibrium point is an asymptotically stable point according to the Lyapunov stability theory [49]. If not all eigenvalues λ are <0, it is necessary to further determine whether the equilibrium point is a saddle point.

To simplify the calculation process, make $\eta_1 h - \eta_2 h = A$, $\theta i - \mu j - \Delta c_1 = B$, $\alpha_2 n + 1 = C$, $\alpha_1 n - \alpha_2 n = D$, $\beta d + \varphi e + \eta_2 h - \xi b - \delta q - \Delta c_2 = E$, $\xi b - \alpha_2 n = F$, $\alpha_2 n - c_3 = G$.

The system (*J*) Jacobian matrix is as follows:

$$\begin{bmatrix} (1-2x)[(1-y)A + zm + B] & -x(1-x)A & x(1-x)m \\ y(1-y)(A+zD) & (1-2y)(xA + zC + xzD + E) & y(1-y)(c+xD) \\ z(1-z)(D-yD) & z(1-z)(F-xD) & (1-2z)(yF + xD - xyD + G) \end{bmatrix} \quad (28)$$

Based on the matrix above, the eight pure strategy stability points of the system (*J*) and their eigenvalues can be obtained (Table 3).

Table 3. System J equilibrium points and its eigenvalues.

Equilibrium Point	Eigenvalues			Condition of Asymptotically Stable Points
	λ_1	λ_2	λ_3	
E_1(0,0,0)	A + B	E	G	A + B < 0, E < 0, G < 0
E_2(0,0,1)	A + B + m	C + E	− G	A + B + m < 0, C + E < 0, − G < 0
E_3(0,1,0)	B	− E	F + G	B < 0, − E < 0, F + G < 0
E_4(1,0,0)	− B	A + E	D + G	− B < 0, A + E < 0,D + G < 0
E_5(1,0,1)	− A − B − m	A + C + D + E	− D − G	− A − B − m < 0, A + C + D + E < 0, − D − G < 0
E_6(0,1,1)	B + m	− C − E	− F − G	B + m < 0, − C − E < 0, − F − G < 0
E_7(1,1,0)	− B	− A − E	F + G	− B < 0, − A − E < 0, F + G < 0
E_8(1,1,1)	− B − m	− A − C − D − E	− F − G	− B − m < 0, − A − C − D − E < 0, − F − G < 0

Table 3 indicates that the central government will choose the strategy of audit if the sum of the long-term benefits of central government auditing and the long-term loss of not auditing is greater than the audit cost. Otherwise, the central government will not choose the strategy of an audit. For local governments, according to the cooperation-constraint relationship, under the condition of relatively fixed benefits and costs of right confirmation, the quality of right confirmation is dependent on the intensity of penalties imposed on local governments for low-quality right confirmation by the central government. If the penalties are severe, local governments will choose to carry out a high-quality right confirmation strategy. While the penalties are lenient, they will choose the low-quality right confirmation strategy. As to the public, they will consider the incentive intensity of local governments and their participation cost. Moreover, they will also consider the externality compensation obtained when they find low-quality right confirmation. If both the incentive intensity and the externality compensation are too low and the participation cost is high, the public will choose the strategy of nonparticipation; otherwise, they will select the strategy of participation.

4. Scenario Simulation and Parameter Analysis

The stability points and conditions are obtained for the evolutionary game of the central government, local governments, and the public according to the solution of the equilibrium point of the evolutionary game model and the analysis of the asymptotic stability condition of the equilibrium point above. On this basis, the principle is clarified for simulating tripartite strategy selection; that is, the model variables and parameter assignments must satisfy economic assumptions and empirical judgments, i.e., the principle of changing the value of specific assignments without changing the simulation results [50].

In order to explore the most effective strategy profile to achieve high-quality right confirmation, scenario simulating is conducted on the evolution path of stable points. Then the evolutionary stability path map is drawn by analyzing the evolution conditions of tripartite and the value range of the parameters. The sensitivity of parameters is analyzed to explore the factors influencing the selection of the evolutionary stability path. Under the initial condition, assume probabilities of auditing by the central government $x = 0.5$, high-quality right confirmation by local governments $y = 0.5$, and participation by the public $z = 0.5$.

4.1. Scenario 1: The Central Government does Not Audit, Local Governments Carry out High-Quality Right Confirmation, and the Public does Not Participate

The stable point of scenario 1 is E3 (0, 1, 0), which needs to satisfy three inequality conditions to evolve into an ESS. In this study, MATLAB 2016a software is used to numerically simulate the process of the tripartite strategy adjusting and evolving. The specific evolutionary paths of parameter assignment are shown in Figures 5 and 6. In Figure 5, the abscissa represents the passage of time, the ordinate represents the probability of each part strategy selection, and the curve represents the evolutionary process of each part behavior. Figure 5 indicates that over time, local governments take the lead to reach the equilibrium point of evolution and choose high-quality right confirmation. Then, the central government reaches the equilibrium point at a faster speed and chooses to audit, while the public needs a longer evolutionary process to reach the equilibrium point and chooses not to participate. The tripartite strategy will evolve to equilibrium when $t = 2$. Figure 6 shows that the evolution process of probability for the tripartite to choose a strategy moves from the initial point (0.5, 0.5, 0.5) to stable point E3 (0, 1, 0).

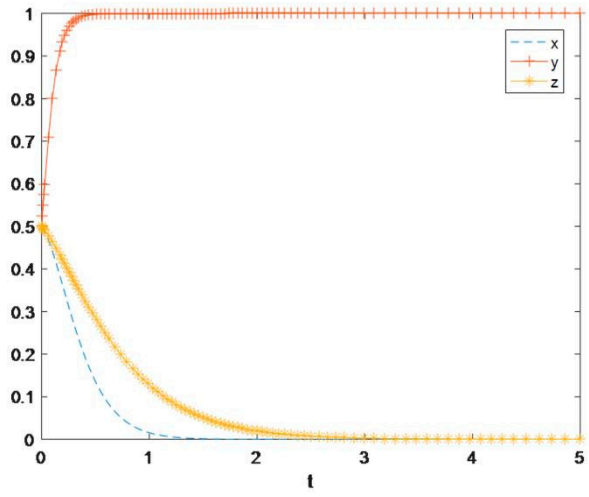


Figure 5. Two-dimensional diagram of evolutionary path at stable point (0, 1, 0).

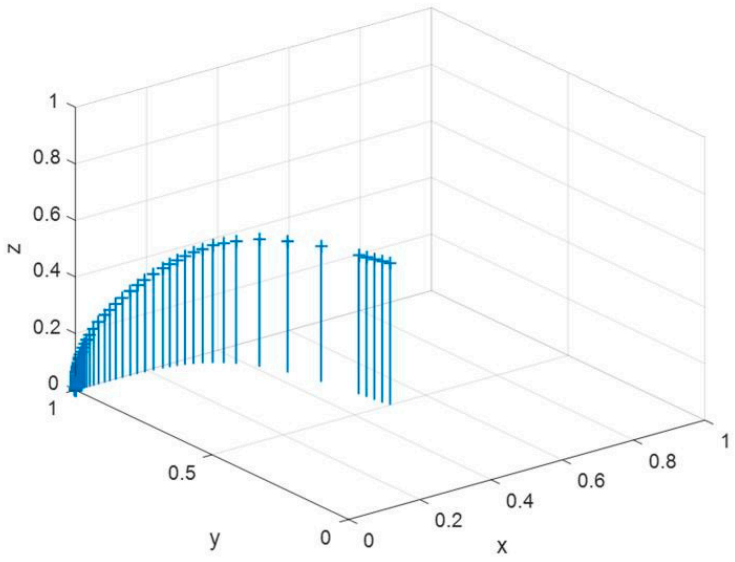


Figure 6. Three-dimensional diagram of evolutionary path at stable point (0, 1, 0).

4.2. Scenario 2: The Central Government does Not Audit, Local Governments Carry out High-Quality right Confirmation, and the Public Participate

The stable point of scenario 2 is E6 (0, 1, 1), which needs to meet the following conditions to evolve into an ESS. The specific evolutionary paths are shown in Figures 7 and 8. Figure 7 indicates that over time, local governments will adjust to the high-quality right confirmation strategy at a very fast speed, and the central government will then select the no audit strategy at a relatively fast speed, while the public will need a longer time to evolve to reach equilibrium and choose nonparticipation. As shown in Figure 7, the tripartite strategy will evolve to equilibrium when $t = 4$. Figure 8 shows that the evolution of the tripartite strategy selection probability moves from the initial point (0.5, 0.5, 0.5) to stable point E6 (0, 1, 1).

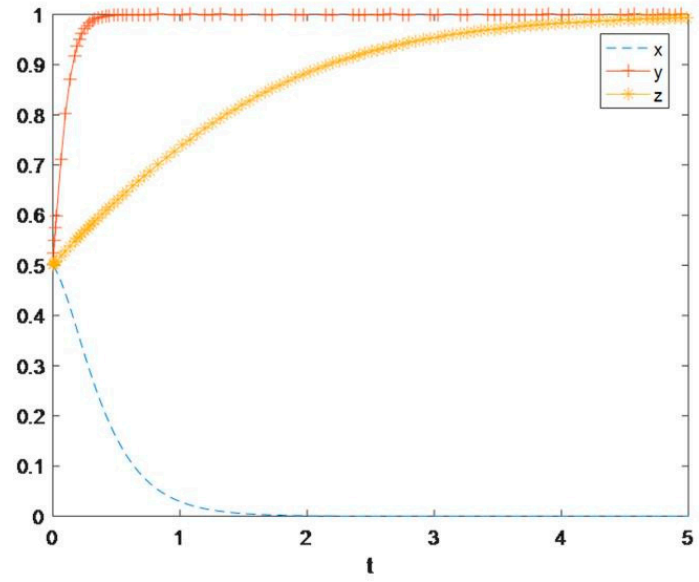


Figure 7. Two-dimensional diagram of evolutionary path at stable point (0, 1, 1).

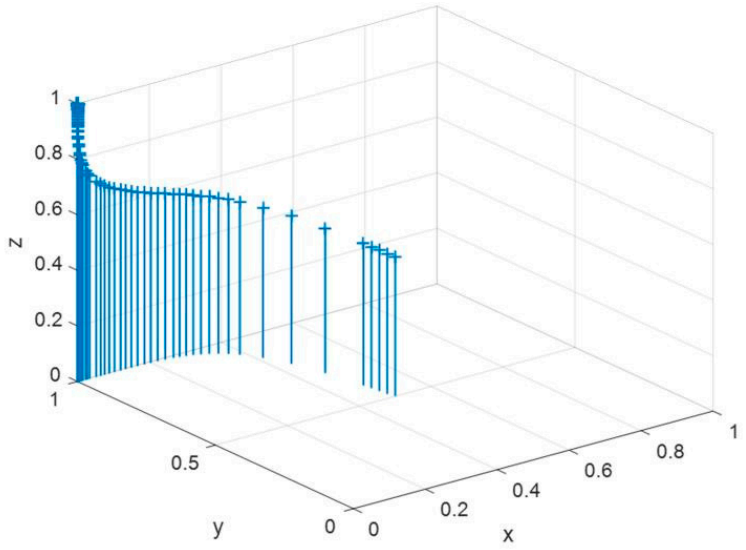


Figure 8. Three-dimensional diagram of evolutionary path at stable point (0, 1, 1).

4.3. Scenario 3: The Central Government Audits, Local Governments Carry out High-Quality Right Confirmation, and the Public does Not Participate

The stable point of scenario 3 is E7 (1, 1, 0), which needs to meet the following conditions to evolve into an ESS. The specific evolutionary paths are shown in Figures 9 and 10. Figure 9 indicates that over time, local governments will adjust to the high-quality right confirmation strategy at a very fast speed. The central government will then select the audit strategy at a faster speed, while the public will need a longer time to choose the nonparticipation strategy to reach equilibrium. As shown in Figure 9, the tripartite strategy will evolve to equilibrium when $t = 4$. Figure 10 shows that the evolution of the tripartite strategy selection probability moves from the initial point (0.5, 0.5, 0.5) to stable point E7 (1, 1, 0).

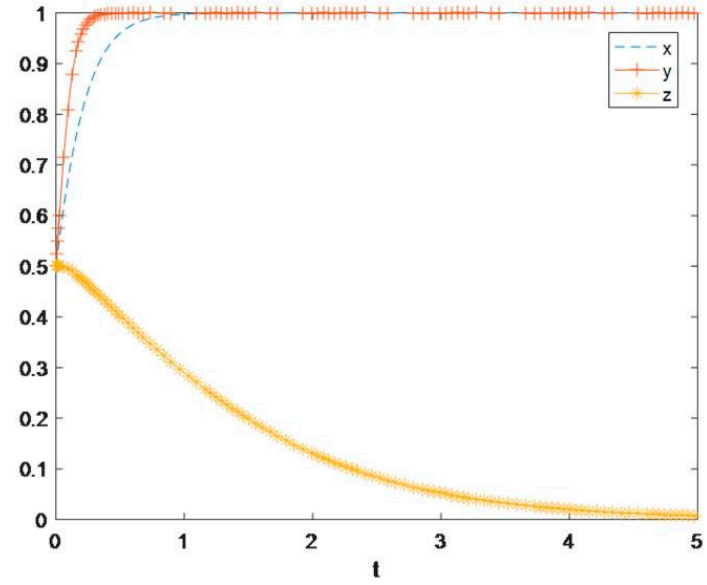


Figure 9. Two-dimensional diagram of evolutionary path at stable point (1, 1, 0).

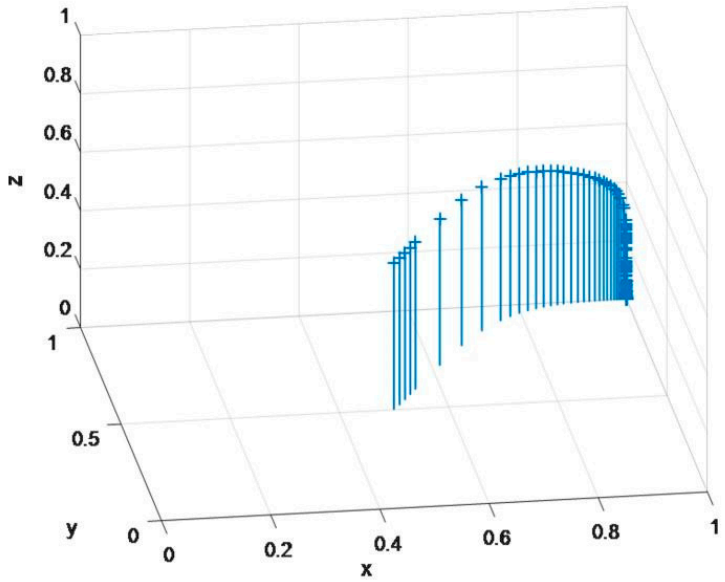


Figure 10. Three-dimensional diagram of evolutionary path at stable point (1, 1, 0).

4.4. Scenario 4: The Central Government Audits, Local Governments Carry out High-Quality Right Confirmation, and the Public Participate

The stable point of scenario 4 is E8 (1, 1, 1), which needs to meet the following conditions to evolve into an ESS. The specific evolutionary paths are shown in Figures 11 and 12. Figure 11 indicates that over time, local governments will adjust to a high-quality right confirmation strategy at a very fast speed. The central government will then select the audit strategy at a relatively fast speed, while the public will need a long time to evolve to reach equilibrium and participate. As shown in Figure 11, the tripartite strategy will evolve to equilibrium when $t = 4$. Figure 12 shows that the evolution of the tripartite strategy selection probability moves from the initial point (0.5, 0.5, 0.5) to stable point E8 (1, 1, 1).

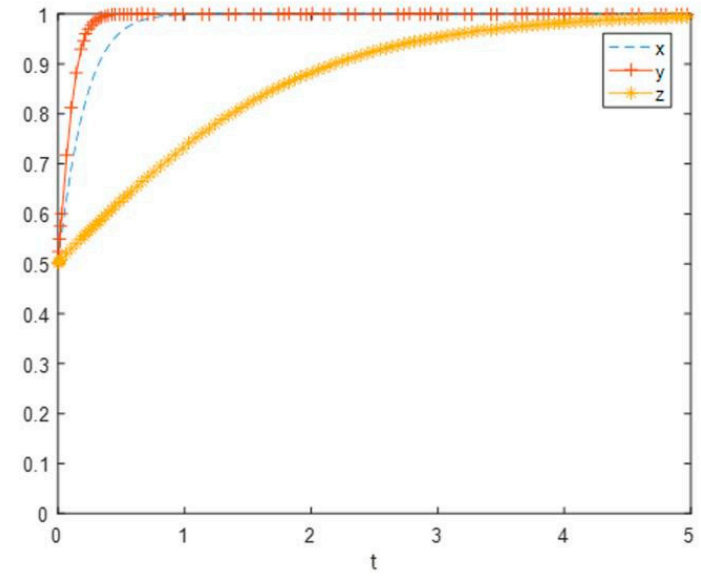


Figure 11. Two-dimensional diagram of evolutionary path at stable point (1, 1, 1).

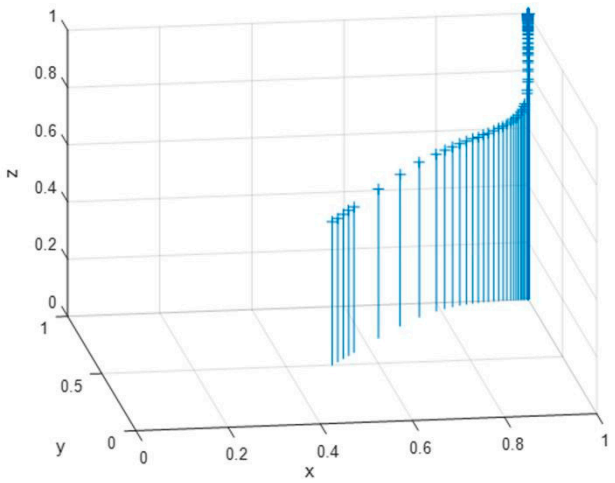
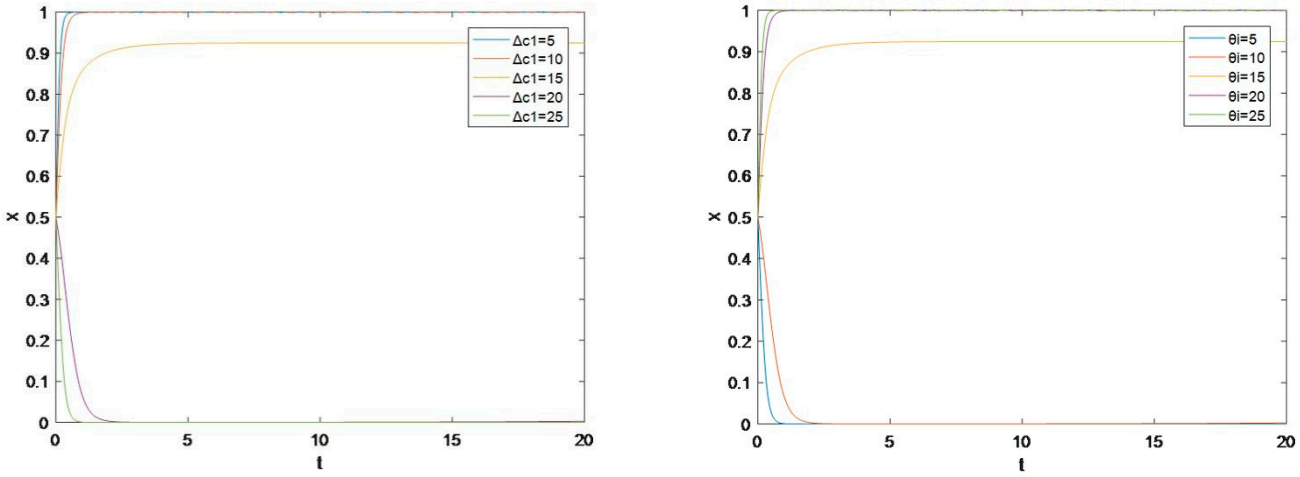


Figure 12. Three-dimensional diagram of evolutionary path at stable point (1, 1, 1).

Above all, the analysis results from all the scenarios revealed that the strategy set of the central government auditing, local government high-quality right confirming, and public participation is the most effective governance system for high-quality URCRNRSA. In different specific practices, the tripartite made different strategy selections, which indicated various effects of policy. In scenario 1, the strict self-restraint mechanism is difficult to realize for local governments. The "soft" constraint with only public participation is not applicable under scenario 2. Moreover, the "hard" constraint with only the central government is not conducive to long-term managing local governments under scenario 3. While in scenario 4, the central government can make good use of audit supervision to constrain the motives and low-quality right confirmation behaviors of local governments, the incentive system of local governments can stimulate public participation in right confirmation, and public participation can reduce the cost of right confirmation incurred by the central and local governments. That is, in this scenario, it would be more realistic for local governments to choose high-quality right confirmation under the dual institutional constraints of the central government and the public.

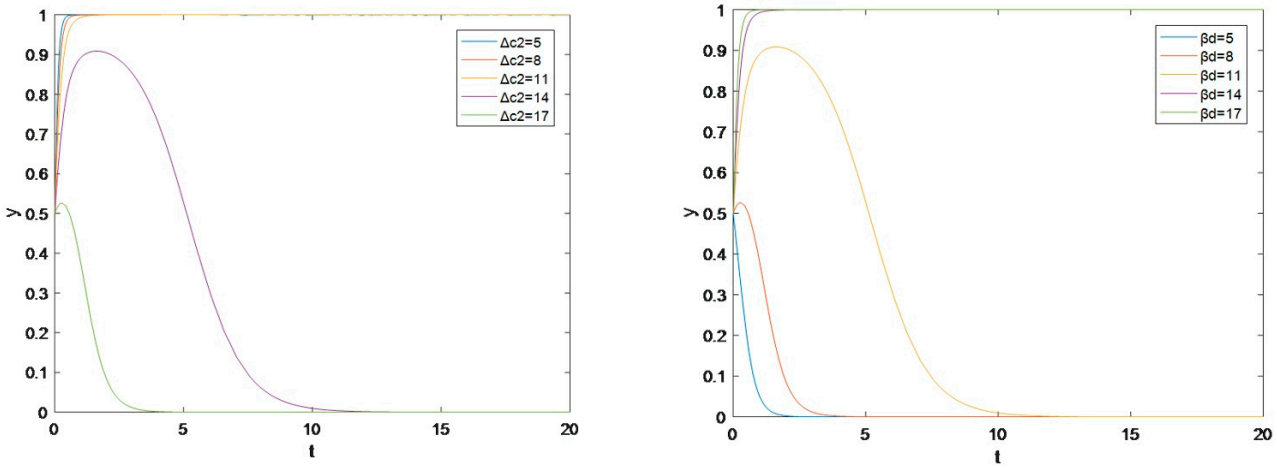
4.5. Parameter Analysis

Nowadays, the practice of local government right confirmation is at the exploratory stage, and there is still a certain gap with the theoretical high-quality right confirmation because there are no clear central government audit procedures and public participation measures in the current pilot program for URCRNRSA in China. Therefore, the influencing factors of high-quality URCRNRSA are explored by conducting the parameter analysis in this study. The initial conditions of stable point E1 (0, 0, 0) are used as the reference, and then the parameters are set to $\eta_1 h = 10$, $\eta_2 h = 5$, $\theta i = 10$, $\mu j = 5$, $\Delta c_1 = 20$, $m = 2$, $\alpha_2 n = 3$, $l = 2$, $\alpha_1 n = 2$, $\beta d = 10$, $\varphi e = 10$, $\delta q = 10$, $\Delta c_2 = 15$, $\xi b = 2$, $c_3 = 3$. The relevant parameters of the benefits and costs of different entities are set separately to further analyze the impact of each parameter change on the model [51]. The general benefits and costs of the tripartite are relatively fixed for a certain period of time. In contrast, the important influencing factors are long-term benefits, additional audit costs, penalty intensity, the additional costs of rights confirmation, incentive levels, compensation levels, etc. Therefore, this study, focusing on the impact of the different parameter changes above on the strategy selection of various entities, tries to explore the influencing factors of the evolutionary stable path of the strategy selection. The stimulating evolutionary stable path of the strategy selection is conducted on the condition of changing the parameters (Figures 13–16).



(**a**) The impact of additional audit costs on central government strategies (**b**) The impact of long-term benefits on central government strategies

Figure 13. The impact of additional audit costs and long-term benefits on central government strategies.



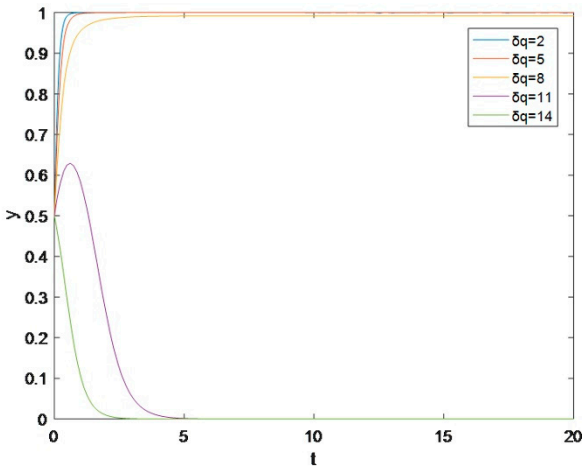
(**a**) The impact of additional confirmation costs on local government's strategies.

(**b**) The impact of long-term benefits on local government's strategies.

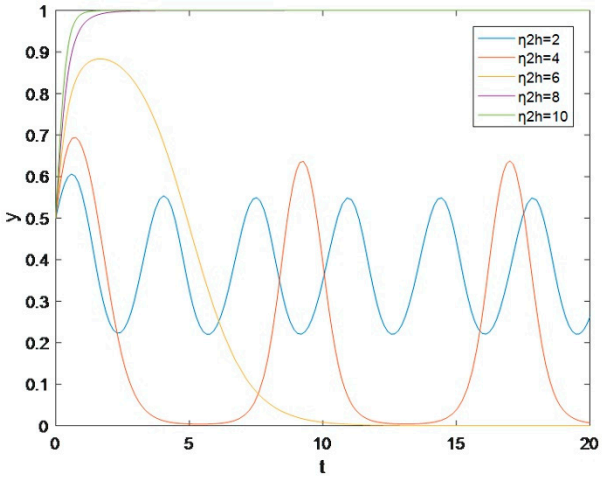
Figure 14. The impact of additional confirmation costs and long-term benefits on local government's strategies.

Figure 13 shows that both reducing additional audit cost Δc_1 and increasing long-term benefits θi can promote the evolution of the central government in the direction of choosing the audit strategy. When auditing, the central government should consider not only the issues of short-term costs, such as the additional manpower and material resources involved in the URCRNRSA but also the issues of long-term economic and social benefits.

Figures 14 and 15 show that when making strategic selections, local governments will pay attention to the issues of the additional cost of right confirmation Δc_2 and accountability penalty $\eta_2 h$. Both reducing the additional cost of right confirmation and increasing the accountability penalty can promote the evolution of local government's strategic selection to the high-quality right confirmation strategy. In contrast, an appropriate increase in the intensity of accountability and penalty will have a greater impact on the probability of strategic selection. Furthermore, local governments will pay attention to the issues of long-term benefits βd and the benefits of rent-seeking behaviors δq. Both reducing the benefits of rent-seeking behaviors and increasing the long-term benefits will promote the evolution of local government's strategic selection to the high-quality right confirmation strategy.

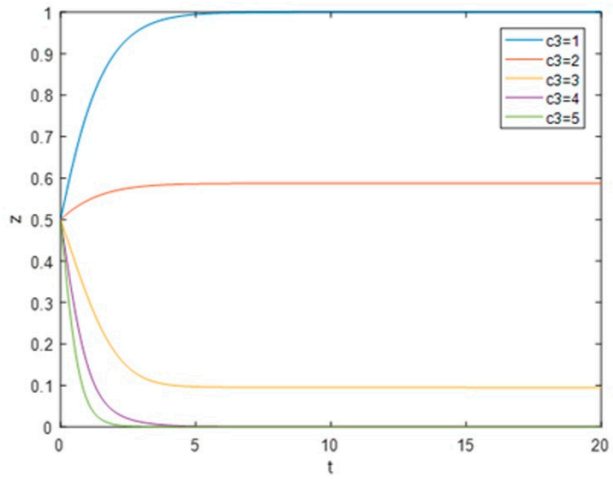


(**a**) The impact of the benefit from rent-seeking behaviors on local government's strategies.

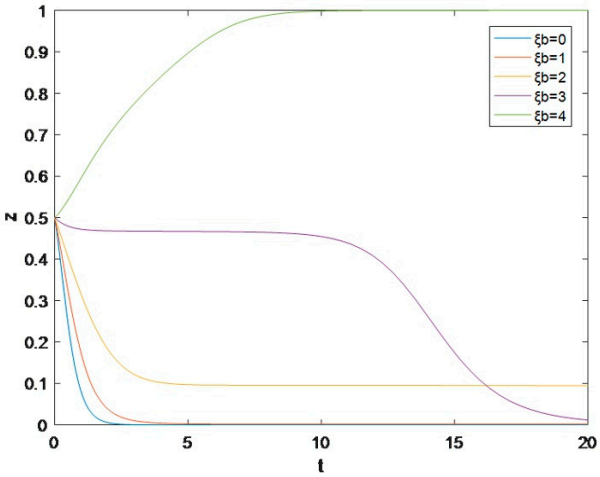


(**b**) The impact of accountability or punishment on local government's strategies.

Figure 15. The impact of both the benefit from rent-seeking behaviors and accountability or punishment on local government's strategies.



(**a**) The impact of participation cost on the public strategies



(**b**) The impact of incentive benefits on the public strategies

Figure 16. The impact of participation cost and incentive benefits on the public strategies.

Figure 16 shows that both the relatively high incentive benefits and relatively low participation costs can promote the evolution of the public to choose the participation strategy. When choosing the strategy, the public will consider the level of net benefit from the strategy itself. The public should realize that they will not only be benefited from the URCRNRSA itself but also obtain the incentive benefits from local governments. The government at all levels can reduce the information asymmetry between the public and the government to reduce the cost of public participation by strengthening system construction so as to promote public participation more effectively.

5. Conclusions and Policy Recommendations

5.1. Conclusions

In the present study, auditing by the central government and participation by the public were innovatively incorporated into the analytical framework for the URCRNRSA. The learning behavior and strategy adjustment mechanism of the tripartite in the long-term game process was analyzed by the established "central government-local governments-the public" tripartite evolutionary game model of the URCRNRSA. Scenario simulations were

conducted under conditions of different costs and benefits with different parameters. The main conclusions of the study were as follows:

The tripartite of the central government, local governments, and the public jointly affect the URCRNRSA through cooperation-constraint, principal-agent, and incentive-compatibility relationships. The strategic choices of the tripartite are strongly influenced by their costs and benefits, respectively. The local government's behavior in implementing the URCRNRSA could be impacted by the central government and the public. The most effective and realistic strategy for URCRNRSA should be local government high-quality right confirming with the central government auditing as a hard constraint and public participation as a soft constraint. The key factors that influence the strategy choice of the tripartite are cost, benefit, reward, and punishment. The strategy choice of the central government could be driven to evolve in the direction of choosing the audit strategy if reducing additional audit costs and increasing long-term benefits. The strategy choice of local governments could be promoted to evolve in the direction of choosing the high-quality right confirmation through reducing the additional cost of right confirmation, reducing the benefits of rent-seeking behaviors, appropriately increasing accountability penalties, and increasing long-term benefits. At the same time, the strategy choice of the public could be motivated to evolve in the direction of choosing the participation strategy by higher incentive benefits and lower participation costs.

5.2. Policy Recommendations

Based on the research conclusions above, the following policy recommendations are proposed to achieve the most effective strategy selection:

(1) Improve the central government's resource audit mechanism. The central government should establish a comprehensive system of ex-ante supervision, in-process supervision, and post-accountability auditing and reduce the supervision costs of marine natural resources [52]. Introducing a resource audit system in the process of the URCRNRSA can give full play to the role of auditing, further clarify the value and amount of natural resources in sea areas [53], and lay the foundation for the audit of natural resource assets of outgoing leading cadres.

(2) Stimulate local governments' motivation for high-quality right confirmation and registration. The central government should clarify the standards and procedures of the URCRNRSA and strengthen the supervision and auditing of local governments. Particularly, the central government should strengthen whole process management, such as improving the performance evaluation ratio, refining the evaluation indicators, appropriately increasing the intensity of penalties and accountability, establishing a sound mechanism for taking responsibility so as to reduce the probability of rent-seeking behaviors by local governments [54].

(3) Strengthen public participation and supervision. It is necessary to improve the incentives of public participation in resource asset confirmation and guide the public to correctly realize the important role of rational right confirmation and the development of resource assets in safeguarding the rights and interests of owners. Corresponding public service platforms should be established to disclose information on the URCRNRSA.

The institutional system of URCRNRSA is in the stage of pilot construction, and there is no mature specific case. Limited by the actual data, this study performed a preliminary theoretical exploration of system construction. Therefore, the parameters in this paper could only be set by combining the theoretical analysis of the evolutionary game model and practical experience. In the future, with the continuous development of the URCRNRSA, official statistics could be obtained and with which further empirical analysis could be conducted. In addition, due to the complexity of the distribution of natural sea areas, the right confirmation of a certain sea area maybe involve two or more local governments. This situation has not been considered in this paper, so the game situation should be further analyzed in the future. It is hoped that the results of this study could provide a theoretical basis for future quantitative research, thereby providing a more useful decision-making

reference for improving and implementing the system of URCRNRSA in China as well as countries and regions with similar situations.

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References

1. White, A.T.; Christie, P.; D'Agnes, H.; Lowry, K.; Milne, N. Designing ICM projects for sustainability: Lessons from the Philippines and Indonesia. *Ocean Coast Manag.* **2005**, *48*, 271–296. [CrossRef]
2. Diggon, S.; Bones, J.; Short, C.J.; Smith, J.L.; Dickinson, M.; Wozniak, K.; Pawluk, K.A. The Marine Plan Partnership for the North Pacific Coast—MaPP: A collaborative and co-led marine planning process in British Columbia. *Mar. Policy* **2022**, *142*, 104065. [CrossRef]
3. Wang, S.H.; He, Y.Q.; Song, M.L. Global Value Chains, Technological Progress, and Environmental Pollution: Inequality Towards Developing Countries. *J. Environ. Manag.* **2021**, *277*, 110999. [CrossRef] [PubMed]
4. Qi, Y.; Li, W. A Nested Property Right System of the Commons: Perspective of Resource System-Units. *Environ. Sci. Policy* **2021**, *115*, 1–7. [CrossRef]
5. Ostrom, E.; Hess, C. Private and common property rights. *Prop. Law Econ.* **2007**, *5*, 53. [CrossRef]
6. Wang, S.H.; Li, W.Y.; Xing, L. A Review on Marine Economics and Management: How to Exploit the Ocean Well. *Water* **2022**, *14*, 2626. [CrossRef]
7. Astor, Y.; Sulasdi, W.N.; Hendriatiningsih, S.; Wisayantono, D. The evaluation of marine cadastre defnitions among Australia, Canada and United States of America based on Indonesia's perspective as an archipelagic state. In *Cadastre: Geo-Information Innovations in Land Administration*; Springer: Cham, Switzerland, 2017. [CrossRef]
8. Satria, A.; Muthohharoh, N.H.; Suncoko, R.A.; Muflikhati, I. Seaweed Farming, Property Rights, and Inclusive Development in Coastal Areas. *Ocean Coast Manag.* **2017**, *150*, 12–23. [CrossRef]
9. Liu, C. Local practice and institutional innovation in the reform of natural resources property rights system. *Reform* **2018**, *297*, 77–87.
10. Muawanah, U.; de Alessi, M.; Pomeroy, R.; Kurniasari, N.; Shafitri, N.; Yulianty, C. Going into Hak: Pathways for Revitalizing Marine Tenure Rights in Indonesia. *Ocean Coast Manag.* **2021**, *215*, 105944. [CrossRef]
11. Wang, S.H.; Wang, X.Q.; Chen, S.S. Global Value Chains and Carbon Emission Reduction in Developing Countries: Does Industrial Upgrading Matter? *Environ. Impact Assess. Rev.* **2022**, *97*, 106895. [CrossRef]
12. Fu, X.M.; Wang, L.X.; Lin, C.Y.; Wu, W.Y.; Ku, H.L.; Jiang, S.S.; Liu, Y. Evaluation of the innovation ability of China's marine fisheries from the perspective of static and dynamic. *Mar. Policy* **2022**, *139*, 105032. [CrossRef]
13. Flego, V.; Roić, M. Land tenure registration on the marine areas in Croatia. *Ocean Coast Manag.* **2018**, *166*, 72–81. [CrossRef]
14. Englander, G. Property rights and the protection of global marine resources. *Nat. Sustain.* **2019**, *2*, 981–987. [CrossRef]
15. Kerr, S.; Colton, J.; Johnson, K.; Wright, G. Rights and ownership in sea country: Implications of marine renewable energy for indigenous and local communities. *Mar. Policy* **2015**, *52*, 108–115. [CrossRef]
16. Han, Y.F.; Tong, T. On the nested structure of the system for unified confirmation and registration of natural resources rights. *Resour. Sci.* **2019**, *41*, 2216–2226. [CrossRef]
17. Lu, X.X.; Li, H. Reform of property right system of natural resources assets: Theoretical basis, basic characteristics and institutional effect. *Reform* **2021**, *2*, 14–28.
18. Pomeroy, R.; Courtney, C.A. The Philippines Context for Marine Tenure and Small-Scale Fisheries. *Mar. Policy* **2018**, *95*, 283–293. [CrossRef]
19. Morzaria-Luna, H.N.; Turk-Boyer, P.; Polanco-Mizquez, E.I.; Downton-Hoffmann, C.; Cruz-Piñón, G.; Carrillo-Lammens, T.; Munguia-Vega, A. Coastal and Marine Spatial Planning in the Northern Gulf of California, Mexico: Consolidating stewardship, property rights, and enforcement for ecosystem-based fisheries management. *Ocean Coast Manag.* **2020**, *197*, 105316. [CrossRef]
20. Afflerbach, J.C.; Lester, S.E.; Dougherty, D.T.; Poon, S.E. A global survey of "TURF-reserves", Territorial Use Rights for Fisheries coupled with marine reserves. *Glob. Ecol. Conserv.* **2014**, *2*, 97–106. [CrossRef]

21. White, C.; Costello, C. Matching spatial property rights fisheries with scales of fish dispersal. *Ecol. Appl.* **2011**, *21*, 350–362. [CrossRef]
22. Shen, D.J.; Ali, G.N.; Chen, C. Water rights system in the Yellow River basin: Problems, challenges, and suggestions. *Resour. Sci.* **2020**, *42*, 46–56. [CrossRef]
23. Gao, Q.; Xu, X.G. Farmland right confirmation under the background of agricultural supply-side structural reform. *Theor. Explor.* **2017**, *225*, 11–17. [CrossRef]
24. Zhu, W.Q.; Zhang, L.Q. The impact of confirming collective forest land property rights to households on the forest land circulation behavior of farmers. *Resour. Sci.* **2018**, *40*, 1407–1417.
25. Deng, M.; Wang, H.M. A polycentric-cooperative mode and contracting mechanism design in water transfer: A case of Hami. *Resour. Sci.* **2012**, *34*, 114–119.
26. Liang, Y.G.; Zhou, S.W. Practical thinking on the right registration of natural resources. *China Land* **2020**, *5*, 31–33.
27. He, H.; Tan, Y. Issues related to unified registration of natural resources. *China Land* **2020**, *6*, 31–33.
28. Liu, W.F.; Liu, D.H.; Guan, S.; Jiang, W. The key points and restrictive factors of confirmation and registration of sea area right. *Mar. Sci. Bull.* **2021**, *40*, 11–18. [CrossRef]
29. Banana, A.Y.; Gombya-Ssembajjwe, W. Successful forest management: The important of security of tenure and rule enforcement in Ugandan fores. *People For.* **2000**, *30*, 87–98.
30. Bennett, N.J.; Kaplan-Hallam, M.; Augustine, G.; Ban, N.; Belhabib, D.; Brueckner-Irwin, I.; Bailey, M. Coastal and Indigenous community access to marine resources and the ocean: A policy imperative for Canada. *Mar. Policy* **2018**, *87*, 186–193. [CrossRef]
31. Qu, M.H.; Zhang, T. Analysis on the supervision system of natural resources property rights in China. *J. Henan Univ. Sci. Technol.* **2020**, *38*, 82–88. [CrossRef]
32. Xi, Z.G. The nature and realization mechanism of national ownership of natural resources—From the perspective of natural resources registration. *J. Party Sch. Cent. Comm. C.P.C.* **2020**, *24*, 122–128.
33. Guo, P.F. The Development Stages, Theoretical Perspective and Practice Prospect of China's Resource and Environmental Audit. *Chongqing Soc. Sci.* **2021**, *3*, 6–19. [CrossRef]
34. Hu, Y.J.; Gu, S.Z. Research trends and analysis of natural resource assets. *Resour. Sci.* **2018**, *40*, 1095–1105. [CrossRef]
35. Tang, Y.J.; Zhao, M.X.; Wang, X.L. Theoretical framework and practice path of natural resources audit in China: Reflections based on five new ideas of development. *J. Nanjing Audit. Univ.* **2018**, *15*, 16–24.
36. Fu, X.M.; Wang, N.; Jiang, S.S.; Tang, H.Y.; Xue, Z.K.; Li, J.M.; Wang, C.Y. Value evaluation of marine bioresources in Shandong offshore area in China. *Ocean Coast Manag.* **2018**, *163*, 296–303. [CrossRef]
37. Qu, G.; Yang, L.; Qu, W.; Li, Q. Game Model to analyze strategy options between government regulation and public supervision under in the third party international environmental audit. *Chin. J. Manag. Sci.* **2021**, *29*, 225–236. [CrossRef]
38. Chen, A.N.; Zhu, Z. The origin of resources property rights and moral: An interpretation of evolutionary game theory. *J. Nat. Resour.* **2013**, *28*, 1438–1450. [CrossRef]
39. Liu, C. The decentralization of collective forestland tenure reform in China since the reform and opening-up from the perspective of evolutionary game theory. *Chin. Rural. Econ.* **2020**, *425*, 21–38.
40. Liu, R.B.; Wang, H.B. Analysis of audit of outgoing leading officials' natural resources accountability. *Audit. Res.* **2017**, *198*, 32–38.
41. Sun, X.B.; Chang, Q.B. Research of the behavior of low-carbon economy objects based on incentive compatibility theory and game theory. *Chin. J. Manag. Sci.* **2014**, *22*, 794–800.
42. Xu, F.H.; Wang, J.J. Inefficiency of local government's performance: Two principal-agent inefficiency and its policy signification. *Soc. Sci.* **2007**, *10*, 25–33. [CrossRef]
43. Li, J.J.; Zhong, J. An analysis of local government economic behavior in China from the perspective of public choice. *China Ind. Econ.* **2004**, *4*, 27–34. [CrossRef]
44. Chen, L.P.; Wu, C.G.; Liu, L.; Liu, W. Foreign natural resources registration system and the enlightenment. *Land Resour. Inf.* **2016**, *185*, 3–10. [CrossRef]
45. Guo, J.; Xu, Y.Z. The logics, paths, and effects of public participation in environmental management. *Resour. Sci.* **2020**, *42*, 1372–1383. [CrossRef]
46. Qu, X.C.; Hou, G.S. Governance of platform information security based on tripartite evolutionary game. *J. Mod. Inf.* **2020**, *40*, 114–125. [CrossRef]
47. Selten, R.A. Note on evolutionarily stable strategies in asymmetric animal conflicts. *J. Theor. Biol.* **1980**, *84*, 93–101. [CrossRef]
48. Wei, Y.H.; Chen, X.L.; Zhou, X.F. Data sharing, corporate strategy and government regulatory incentives based on evolutionary game. *Financ. Econ.* **2020**, *4*, 107–120.
49. Zhu, L.L.; Rong, J.M. Three-party evolutionary game and simulation analysis of drug quality supervision under the government reward and punishment mechanism. *Chin. J. Manag. Sci.* **2020**, *9*, 1–12.
50. Chu, Z.P.; Bian, C.; Liu, C.X.; Zhu, J. Evolutionary game analysis on haze governance in Beijing-Tianjin-Hebei: Based on a simulation tool for proposed environmental regulation policies. *China Popul. Resour. Environ.* **2018**, *28*, 63–75.
51. Zhang, Z.Y.; Qi, T.H. Research on national audit risk from the perspective of tripartite evolutionary game. *Jilin Univ. J. Soc. Sci. Ed.* **2020**, *60*, 128–139,238. [CrossRef]
52. Wang, S.H.; Chen, S.S.; Zhang, H.Y.; Song, M.L. The Model of Early Warning for China's Marine Ecology-Economy Symbiosis Security. *Mar. Policy* **2021**, *128*, 104476. [CrossRef]

53. Fu, X.M.; Wu, W.Y.; Lin, C.Y.; Ku, H.L.; Wang, L.X.; Lin, X.H.; Liu, Y. Green innovation ability and spatial spillover effect of marine fishery in China. *Ocean Coast Manag.* **2022**, *228*, 106310. [CrossRef]
54. Wang, S.H.; Wang, Y.C.; Song, M.L. Construction and analogue simulation of TERE model for measuring marine bearing capacity in Qingdao. *J. Clean. Prod.* **2017**, *167*, 1303–1313. [CrossRef]