

Article

What Makes a Sustained Rural Tourism Development?—A Strategy Optimization Proposal Based on Stakeholder Simulation of an Evolutionary Game

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Abstract

This study constructs a tripartite evolutionary game model within China's rural tourism context, analyzing strategic interactions among government, tourism enterprises, and local residents to optimize sustainability. By performing an initial examination of the evolutionary game involving three parties, we identify key stakeholder variables and propose enhancement strategies. Findings suggest incentivizing governmental engagement, rewarding enterprises for scenic maintenance, and prioritizing resident knowledge improvement. These insights offer practical cooperation models for structured development while providing an innovative methodological framework for future research. The approach demonstrates potential to inform policy decisions and validate conclusions using AI models, thereby contributing to sustainable rural tourism development.

Keywords: rural tourism; rural areas; sustainable development; stakeholders; evolutionary game



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1. Introduction

The global economy and host societies derive substantial benefits from the tourism industry, which creates numerous employment opportunities, improves local infrastructure, and consequently promotes regional prosperity [1]. The unique features of rural traditional culture serve as a primary attraction for public participation in rural tourism. Simultaneously, increasingly well-developed rural tourism projects not only accelerate economic growth in rural areas but also facilitate the dissemination and preservation of traditional culture, ultimately forming a distinctive charm and sustainable development potential.

According to relevant data, in 2019, China's rural leisure tourism will reach 3.2 billion trips, with tourism consumption exceeding RMB 850 billion. The 2024 China Rural Tourism Development White Paper by industrial research company Fastdata said that the rural tourism sector emerged as a front-runner for the domestic tourism market, attracting about 800 million visits in the first quarter [2]. Since the concept of regional tourism was introduced and promoted, rural tourism has experienced an “explosive” development trend, and its position in the tourism industry has become increasingly prominent. Rural tourism is a form of travel in which tourists choose to experience, explore, and engage with local culture, natural scenery, and rural life, serving as an effective means to boost economic prosperity and community development in rural areas [3,4].

The imbalance of rights and responsibilities, combined with a one-dimensional focus, significantly impacts environmental protection, public participation, and the preservation

of cultural traditions. Establishing a sustainable, balanced development framework is fundamental to mitigating these challenges, as it serves as the foundation for alleviating them. This form of tourism could significantly influence environmental protection, promoting community participation and preserving cultural traditions [5]. By exploring sustainable development paths in rural tourism, the ultimate goal is to achieve a three-way win in terms of economic, social, and environmental advantages. Macro-level methods for advancing sustainable development in rural areas include enhancing community participation, adopting proactive government policies and regulations, and implementing reasonable planning and management to avoid overdevelopment [6–8]. However, it should be highlighted that the commonality among these methods is that the implementers are stakeholders. Stakeholders are commonly described as any entity or person capable of influencing or being influenced by the accomplishment of an organization's goals [9]. Tourism involves multiple stakeholders [10,11], including residents, tourists, tourism developers/operators and governments [12]. In China, the government, tourism companies, and residents are three pivotal stakeholders in rural tourism [6–8].

Previous research has proposed various methods for dealing with multi-criteria decision problems with different decision weights [13]. However, decision-making in the rural tourism development process is not a one-time event but a dynamic, long-term process of stakeholder interaction [14]. Overall, the distribution of benefits and decision-making models is complex and inclusive, operating across multiple levels. Current research is insufficient in simulating stakeholder interactions from a game-theoretic perspective and proposing optimization strategies, particularly in the in-depth analysis of incentive mechanisms within participation frameworks.

Under this context, this study aims to construct a tripartite game model to analyze the strategic choices of government departments, tourism enterprises, and rural residents in the Chinese context, thereby identifying optimal strategies for sustainable development. The structure of this paper is as follows: Section 2 reviews the core concepts and theoretical frameworks relevant to the relationship between rural tourism and game theory. Section 3 presents the research methodology and constructs the three-party evolutionary game model. Section 4 presents a simulation analysis examining the complex, interactive relationships among multiple stakeholders in rural tourism across various scenarios. Section 5 summarizes the theoretical and practical implications of effective cooperation among different stakeholders. Section 6 concludes this study by synthesizing key findings from the simulation analysis, highlighting its limitations and suggesting directions for future research.

2. Literature Review

This section systematically reviews the core concepts and theoretical frameworks relevant to this study. By evaluating existing literature and research, it explores the characteristics and complex relationships among stakeholders in China's rural tourism. Furthermore, it provides a theoretical basis for the parameter settings of this study by comparing relevant game models.

2.1. Rural Tourism Development and Game Theory

The development of rural tourism is increasingly a critical focus in rural revitalization strategies for both developing and developed countries, particularly because of its significant implications for enhancing local culture, environment, and the economy. Over the past several decades, the tendency towards rural tourism development has consistently gained traction, beginning with heritage preservation and promotion in European countries in the early 20th century, followed by eco-tourism initiatives in many developing

countries [15,16]. At present, developing countries such as India and Vietnam, as well as developed countries such as the United Kingdom and Germany, are actively promoting rural tourism development initiatives. These endeavors aim to boost local economies while also safeguarding indigenous cultural heritage.

Rural tourism is broadly defined as a form of tourism that takes place in rural settings and incorporates activities representative of rural life, including farming, nature-based exploration, cultural practices, and community engagement. In his seminar paper, Lane (1994) outlined an overarching discussion of the five conditions for defining Rural Tourism: located in rural areas, rural in scale, and functionally dependent on the countryside's natural character [17] and place pattern [18]. Nevertheless, these conditions are arguable. For instance, researches underscore that rural tourism need not be geographically located in the countryside [8,14,17]. From their perspective, it can also be developed in urban areas that incorporate rural functions. Such differing interpretations of “rurality” imply that the scope of rural tourism studies has expanded to encompass the urban spectrum, while remaining associated with traditional and rustic characteristics.

The United Nations World Tourism Organization [19] describes rural tourism as comprising activities and experiences related to nature, agriculture, rural lifestyles, fishing, and sightseeing. These occur in non-urban regions characterized by low population density, landscapes where agriculture and forestry predominate, and traditional social structures. Functioning as a distinct tourism category, rural tourism not only provides recreational opportunities but also stimulates local entrepreneurship, boosts household and regional incomes, and supports sustainable development. By leveraging natural, cultural, and historical assets, rural tourism helps preserve cultural heritage and promote environmental stewardship, thereby contributing holistically to sustainability goals [20].

Under such contexts, management models employed in rural tourism were considered to ensure not only economic benefits but also the preservation and enhancement of social and cultural aspects. Various research relating to game theory and rural tourism has been organized as follows (Table 1):

Table 1. Game model relating to rural tourism and stakeholders.

Study Focus/Authors (Year)	Methods and Models Employed	Aim and Contents of Methods and Models
A two-agent model/ Mosetti (2006) [21]	A two-agent model: the first actor is the private sector, the second the public services.	The problem is under the so-called “tragedy of commons”: action has to be undertaken by the public sector (local, regional, or national authorities) to reallocate the non-optimal equilibrium arising from such externalities.
Tourism supply chains/ Keskin and Ucal (2020) [22]	A baseline model including three types of agents: one theme park, multiple accommodation providers, and multiple tour operators.	The research investigates the strategic dynamics embedded in a market with two different tourism supply chains, and then extends the model to an infinite-horizon repeated game. The result shows that agents in a tourism supply chain achieve higher profits in any given period of a repeated game than in the static version of the game.

Table 1. Cont.

Study Focus/Authors (Year)	Methods and Models Employed	Aim and Contents of Methods and Models
Game Theory & Land Ethics/Kopf & Hsu (2021) [23]	Game Theory, Historical Case Study	The study was conceptual, demonstrating two potential equilibria. The research resulted in a game-theoretic model that has the explanatory power to aid stakeholders and policymakers in achieving transformative social, economic, and environmental change.
Eco-gamification in Tourism/Yu et al. (2024) [24]	“Gamification-User-Destination” Model; Survey Data (n = 308)	• Investigate the relationship between users’ destination images, destination psychological ownership, and online pro-environmental behaviors. • Examine whether destination environmental responsibility and gamified media richness jointly moderate the proposed relationships. The study proposes a ‘gamification-user-destination’ model to explore the psychological mechanisms underlying the connections formed between users and destinations through eco-gamification.
Sustainable Tourism Supply Chain/Torkabadi et al. (2025) [25]	Dynamic Nash equilibrium and cooperative strategies; ANN-based demand modeling	• Analyze the behavior of tour and local operators. • Pursue increasing profitability and enhancing sustainability levels. • Analyze the productivity of human resources as a key factor in profitability and sustainability efforts. In this model, each player (Tour Operator, Local Operator, and Government) aims to maximize their profit by optimizing different variables such as pricing, sustainability efforts, and human resources management.

2.2. Stakeholder Collaboration in Sustainable Tourism

Stakeholders are commonly described as any entity or person capable of influencing or being influenced by the accomplishment of an organization’s goals [9]. Tourism involves multiple stakeholders [10,11], including residents, tourists, tourism developers/operators and governments [12]. In the global perspective of tourism development, there has been a growing emphasis on prioritizing sustainable development [26]. The collaboration and participation of multiple stakeholders in the tourism industry have emerged as a shared focus in both academic research and practical fields [27,28]. Such collaboration manifests in areas such as planning, destination decision-making, and management [29]. Effective collaboration can establish robust networks among diverse stakeholders [30], enabling multiple parties to access the critical resources needed to achieve their objectives [31] and ultimately contributing to the sustainable development of tourism destinations [32,33].

In academia, any individual or group affected by organizational decisions and actions is regarded as a “stakeholder.” The decision-making process in rural tourism development inherently involves multiple stakeholders, each with distinct evaluative criteria [34], and

requires decisions to be made under numerous criteria that represent diverse objectives [35]. Given that the significance of each criterion may differ, the academic community has proposed various methods to address multi-criteria decision-making problems with varying decision weights, including the analytic hierarchy process, the entropy weight method, and the fuzzy set approach, among others. Given that decision-making in rural tourism development is not a one-time event but a long-term, dynamic process involving stakeholder interactions [36], various approaches have been proposed to address the challenges, including game theory and other perspectives.

However, the complexity of promoting sustainable tourism development through stakeholder collaboration is heightened by the varied and diverse nature of stakeholders involved in the industry [37]. Obstacles to inter-organizational collaboration are multifaceted [29,33], encompassing conflicts of interest and divergent perspectives among stakeholders, complex interdependencies between parties, and heterogeneous communication styles [37]. Stakeholders usually possess divergent perspectives and varying interests [38], which may potentially lead to conflicts [12,32]. In addition, not all stakeholders can be easily recognized, and those hidden ones may be ignored by managers in actual tourism development [12]. Both conflicts and neglect can lead to ineffective collaboration among stakeholders in tourism, resulting in the failure of the local tourism's sustainable development strategy [39]. The current discourse lacks a discussion on fostering sustainable tourism destination development through effective stakeholder collaboration, particularly regarding the complexities of meaningful participation [37]. Waligo, Clarke [37] proposed a framework to address this issue, based on a case study conducted in the UK. The framework comprises three strategic levels: attracting stakeholders, integrating them into the processes, and effectively managing their participation. Indeed, understanding the complex relationship among stakeholders is a critical prerequisite for fostering collaboration among heterogeneous actors and achieving sustainable destination development [36]. A large number of studies have focused on stakeholders in tourism [40]. However, current research emphasizes the identification of tourism stakeholders, their saliences and the roles of different stakeholders [29]. For example, Roxas and Rivera [41] explained how tourism stakeholders can leverage their roles and cooperative advantages to manage destinations through regulation, protection, and livelihoods from a governance perspective. It is still unclear how tourism stakeholders interact with one another and how these interactions contribute to sustainability [41]. There is a lack of empirical research to explain the complex relationship between different stakeholders [42].

While policy analysis from a multi-stakeholder perspective has gained consensus and wide application in global socio-economic research, its adoption in rural tourism development remains limited, with its potential to identify optimal sustainable development pathways yet to be fully realised. This gap is particularly evident in the scarcity of empirical studies that use evolutionary game theory frameworks to simulate underlying mechanisms. Current research indicates that bottom-up development models and demand-driven mechanisms are increasingly attracting governmental attention. Notably, however, resource competition stemming from residents' diverse needs persists within stakeholder groups, rendering benefit distribution and decision-making processes a multi-level, highly interconnected complex system. Understanding stakeholder types and their complex relationships is of significant value: it facilitates the development of more effective tourism destination management methods or models [36] and promotes active participation by multiple stakeholders, thereby garnering broader support for regional tourism development [33]. Existing research has yet to establish a comprehensive analytical framework, and the examination of incentive strategies within participation mechanisms remains underdeveloped.

Based on this, our study develops an analytical model across action situations to systematically elucidate the complex interactions among key stakeholders. The findings will help identify barriers and challenges in multi-agent collaboration, thereby providing a theoretical basis for enhancing participation efficiency and cooperative outcomes in rural tourism development.

2.3. Understanding Stakeholders of Rural Tourism in China

China considers rural tourism an important means to achieve rural revitalization [19] and has released a series of national-level documents to encourage and support its development [43], including the strategy for beautiful countryside construction and rural revitalization. Guided by national policies, rural tourism in China has achieved rapid development [19], yet it has also triggered a series of conflicts [43]. In the course of rural tourism development, Wang and Yotsumoto [44] identified eight key areas of conflict, including land procurement, allocation of ticket revenue, vending rights, management authority over tourism activities, demolition and construction of housing units, restrictions on entry into certain areas and village elections. These conflicts fundamentally reflect misalignments in goals and interests among different stakeholders in rural tourism [12,32,44].

The government is a key factor in rural tourism development [26,45]. As a multi-level and multi-departmental entity [46,47], China's government structure comprises central and local tiers [10,47]. The primary responsibility for the management and development of tourism rests with local authorities [48], which are specifically responsible for local tourism development planning [6], fiscal policy formulation [6,47,49], infrastructure support [6], and facilitation of multi-stakeholder collaboration through coordinated services [6]. The main goal of the government is to fulfil its social responsibility and gain political advantage by achieving local economic development [50].

Enterprise is another important part of rural tourism development. The enterprise is primarily responsible for investing in rural tourism destinations, which are used for tourism development in the early stage and operation in the later stage [49]. The objective of enterprises in rural tourism is for economic benefit [51]. Residents are the main body of rural tourism [5].

Residents are not only part of rural tourism products but are also the group most directly affected by tourism impacts, compared to other stakeholders [40]. Tourism has many obvious positive and negative effects on residents [5]. Based on social exchange theory, numerous investigations have explored the correlation between residents' perceptions of tourism's impact and their attitudes and supportive actions towards the development of tourist destinations [52]. When the benefits do not outweigh the costs, residents tend to be less inclined to endorse tourism development [53,54]. Perceptions of tourism development and the level of participation influence the community's endorsement of tourism development [55]. Studies consistently establish a positive causal relationship between community participation and sustainable tourism development [56]. The more residents actively participate in tourism development, the more conducive it is to sustainable tourism development [57,58].

Currently, most of the research on stakeholders adopts the methods of interviews and questionnaire surveys [12]. However, the complex relationships among stakeholders in rural tourism destinations are dynamic [40], as they can change at any time due to shifts in tourism development and the actions of other entities [37]. Ma, Dai [59] investigated the interplay among governments, inhabitants, and developers as key players in the process of rural tourism land expropriation. The study revealed that stakeholder relationships were not merely collaborative or confrontational; instead, they were intertwined, with their interests evolving in response to land expropriation. Therefore, this study aims to use the

game method to simulate a complex interactive relationship model among multiple rural tourism stakeholders under different conditions.

2.4. Clarifying the Relationships Among the Three Stakeholders

Based on stakeholder analysis, key stakeholders involved in rural tourism development can be categorized into three primary groups: government entities, tourism enterprises, and rural residents. Among them, government entities include the Ministry of Finance, the Tourism Bureau, the Market Regulation Bureau, the Environmental Protection Bureau, the Natural Resources Bureau, the Village Committee, the Village Collective, and other grassroots governance-related departments [60]. Tourism enterprises include small, medium, and large profitable tourism companies, non-profit tourism companies, and other social capital groups. Rural residents include those who support tourism with strong initiative, those opposed to tourism, and those maintaining a neutral stance [61].

The government body involves multiple levels and fields. Higher-level authorities are responsible for formulating overarching policy directives, while subordinate departments undertake the refinement and implementation of these directives. During implementation, subordinate departments are required to provide regular progress reports to higher authorities to facilitate real-time optimization of operational directions. Additionally, inter-departmental coordination and mutual supervision are maintained to prevent fraudulent practices and rent-seeking behaviors. Therefore, a game relationship also exists between the superior and subordinate departments within the government body. During implementation, active multi-stakeholder participation necessitates the formulation of incentive and disincentive strategies toward tourism enterprises to enhance engagement. These strategies include commitments during investment promotion phases regarding land use and tax incentives, coupled with regulatory controls on service pricing by relevant departments [62]. Concurrently, proactive outreach initiatives targeting residents are deployed to strengthen their inclination and willingness to participate in tourism development.

Driven by profit motives, tourism enterprises frequently face challenges such as “large corporations acquiring small and medium-sized enterprises” and the ongoing maintenance of scenic areas [2,63]. To secure operational rights for projects, distinctive enterprises often reduce service prices while simultaneously enhancing service quality. Under government coordination, the pace and quality of development initiatives continue to improve. Furthermore, the provision of rural infrastructure enhancement services addresses long-term operational needs, alleviates government regulatory pressures, and generates additional economic benefits and improved living conditions for residents [64]. This synergistic approach consequently accelerates tourism development and rural economic growth.

Rural residents have different attitudes towards tourism development, and there is a “game” among the three parties over their interests in acquiring. The resident body needs to transform from passive to active in the entire process of work promotion, enhance its participation and voice, and give feedback on the changes in life after tourism development and subsequent needs to the government departments and tourism companies through various channels, continuously improve the development of rural tourism, and solve problems such as resident employment, slow rural economic development, and low cultural level with the influx of tourists brought about by tourism development [61,65].

Not only do the three main parties have internal game relationships, but they also have relationships with each other. This study aims to conduct an initial examination of an evolutionary game involving three parties, followed by suggesting potential enhancement approaches derived from the game analysis. Furthermore, to optimize the benefits for all stakeholders involved in the development of rural tourism, primary participants include the government, rural inhabitants, and tourism enterprises. Table 2 shows that the researcher

developed five main models based on prior models and the specific Chinese context, aiming to provide a theoretical basis for subsequent parameter setting in the three-party game and for optimizing rural tourism development. In many studies, such phenomena have been divided based on the concept of stakeholders' interests, but there is relatively little simulation analysis based on their beneficial concepts. There are studies to simulate the process of two beneficial inter-subject games [66]. This study aims to address this Research gap and phenomenon. The three key subjects of the system are simulated to provide a more accurate strategic analysis, and the optimal method analysis of Nash equilibrium-driven methods is conducted.

Table 2. Rural tourism development model.

Model Type	Model Content
 Government-led	This model is characterized by government-led decision-making in allocating rural tourism resources, playing a coordinating role in planning, infrastructure development, promotion, and setting development directions. The government-led approach is also manifested in specific forms, such as “government + farmers” and “government + enterprises + farmers,” in which the government leads while involving village collectives, enterprises, and farmers. This model is commonly adopted in the initial stages of rural tourism development, particularly in less developed regions. [2,22,32]
 Village collective-led	This type is grounded in village collectives, which conduct tourism development and operations through organizational structures such as village committees, cooperatives, or village tourism management companies. Villagers participate in rural tourism development and benefit distribution through two primary forms: village collective economic organizations and whole-village collective organizations. This approach increases farmers' incomes and is well-suited for villages with strong local development capacity. [21,43,49]
 Enterprise-led	This organizational model is primarily enterprise-based and falls under the category of external capital investment. Enterprises develop tourism resources through capital investment, taking responsibility for overall development and marketing. Specific forms include enterprise-led independent development and “enterprise + farmer” models, among others. This type currently represents the most widely adopted approach for organizing rural tourism development in China. [5,23,50]
 Farmer-led	This farmer-based model is commonly observed in the initial stages of rural tourism development or stems from farmers' inherent conservatism, leading them to develop and operate rural tourism services independently. Farmers autonomously conduct tourism reception by providing accommodation, catering, and other services. It includes the earliest forms, such as “agritainment” (Nongjiale), as well as models like “farmer + farmer” partnerships and individual farms that have emerged over the course of rural tourism. [2,24,47]
 Stock cooperation	Mixed type refers to the development and operation of rural tourism by multiple subjects jointly or by division of labor, of which the most typical is the joint-stock cooperation system, in which the government, collectives, enterprises and farmers, etc., participate in the development of rural tourism according to a certain proportion of shares, and the proceeds are distributed according to the corresponding shares. [25,32,46]
Legend	 Government  Enterprise  Farmer  Village collective

3. Methodology

Evolutionary analysis has been applied in sustainable tourism [66], which defines the notation and payoff for two stakeholders within a set of basis assumptions, indicating that

evolutionary analysis of multiple competitors is necessary. Based on that, this research constructed a three-party subject evolutionary game model, and based on each party's interest analysis, the parameters were identified in previous studies. The factors influencing the interests of each subject under different game strategies will be defined, and their corresponding scenarios will be explained in the hypotheses. The following hypotheses are proposed by analyzing the choice of strategies and the stabilization of strategy points of each party, and accordingly analyzing the influence of each element in the three-party game process:

Hypothesis 1. *government departments, including tourism development-related departments, village committees, village collectives and other grassroots governance-related departments as participating subject 1, so that $S_G = \{\text{members of the Finance Department, members of the Tourism Bureau, members of the Market Supervision Bureau, members of the Environmental Protection Bureau, members of the Natural Resources Bureau, members of village committees, members of village grassroots governance-related departments}\}$; including small, medium and large tourism enterprises, non-profit enterprises as participating Subject 2, so that $S_D = \{\text{management of small for-profit tourism companies, management of medium-sized for-profit tourism companies, management of large for-profit tourism companies, management of non-profit tourism companies}\}$; including village residents with different attitudes as participating subjects3, so that $S_R = \{\text{residents with supportive and positive attitudes towards tourism, residents with opposing attitudes, residents with neutral attitudes}\}$. All three parties are finite rational game players who continuously adjust their strategies based on self-interest, ultimately selecting the optimal strategy to maximize their own benefits.*

Hypothesis 2. *The strategy choice of the government department $G_i (i \in S_G)$ is $(g_1, g_2) = (\text{aggressive dominance, lax regulation})$, where the probability of government department G_i choosing aggressive regulation (g_1) is x_i (the total number of competent members of the government department G_i at time t is $N_i(t)$, and the number of people who choose aggressive dominance at time t is $n_i(t)$, so at time t $x_i = n_i(t) / N_i(t)$), then the probability of choosing lax regulation (g_2) is $1 - x_i$. The probability of a governmental subject entity taking proactive control is $x = \frac{\sum_{i \in S_G} n_i(t)}{\sum_{i \in S_G} N_i(t)}$, and the probability of governmental subjects conducting lax supervision is $1 - x$. The strategy choice of the tourism firm $D_j (j \in S_D)$ has a strategy choice of $(d_1, d_2) = (\text{long-term development, short-term development})$; the resident subject $R_k (k \in S_R)$ has a strategy choice of $(r_1, r_2) = (\text{active cooperation, passive participation})$. The same method of calculating the probability of government subjects can be learned as the probability of enterprise subjects choosing long-term development is $y = \frac{\sum_{j \in S_D} n_j(t)}{\sum_{j \in S_D} N_j(t)}$, the probability of enterprise subjects choosing short-term development is $1 - y$; the probability of resident subjects preferring active cooperation is $z = \frac{\sum_{k \in S_R} n_k(t)}{\sum_{k \in S_R} N_k(t)}$, and the probability that the resident subject chooses negative participation is $1 - z$.*

Hypothesis 3. *As the growth of tourism has a constructive effect on boosting the rural economy, whatever strategy the government chooses, it must regularly allocate funds to improve the infrastructure of the countryside in response to the central government's call (C_f). When rural tourism development is complete, the government sets the fares for scenic spots (R_t), and as the government grants a rural tourism development to a tourism enterprise, it collects regular taxes and fees from that enterprise (R_x). When the government actively guides rural tourism, it will provide policy facilitation, bank loans, project declaration and other facilitation measures to the enterprise (C_t); when the enterprise, following the development of rural tourism, the government will penalize tourism enterprises for neglecting the lives of residents and the protection of the environment for the sake of profits (M_t). Regardless of the strategy adopted by the government department, it is*

stipulated that if the development of a scenic spot has an excessive negative impact on the lives of rural residents, the residents should be compensated (M_g) and receive social prestige and punishment from the higher government department (M_{up}).

Hypothesis 4. Tourism enterprises may excessively damage the environment during the development of rural tourism for short-term interests, without maintaining the scenic spots at a later stage, bringing great potential impacts on local residents. In addition to receiving punishment from the government, they should also compensate the residents in accordance with the law (M_l), and their reputation in the industry will also decline, affecting the subsequent development of the enterprise (L_t). When tourism enterprises have a high level of completion in terms of scenic area development (C_d) and subsequent maintenance (C_p), they will generate corporate branding benefits, tourism project revenues (R_s), which can add to the subsequent development of the enterprise, in addition to long-term cooperation with the government, obtaining more approvals for tourism development projects and various facilities in the process of rural tourism development (R_p). To develop tourism in the long term, tourism enterprises will agree with residents to pay them a portion (∞) of the proceeds from tourism services as dividends to secure their cooperation.

Hypothesis 5. The development of rural tourism will inevitably lead to the expropriation of the houses of some residents, so the expropriation of their homes will subsidize the residents (R_r) to subsidize their livelihoods. If the residents actively cooperate with the development of rural tourism, they will receive varying degrees of economic benefits (R_j) through the sale of folklore and speciality products, and will have a voice in the rural tourism development process (R_p). When residents are not in agreement (i.e., when they participate negatively), poorer relationships between neighbourhood residents can lead to a reduction in the well-being of residents (C_r), and when tourism development is imperative, residents who are not ready to accept foreign visitors may be exposed to the impact of foreign culture, leading to a poorer living experience (M_c).

Hypothesis 6. The rural planner is a separate entity from the government, tourism companies and rural residents. This type of profession can act as a bridge between the three parties. When the government is actively leading the process, it will spend a certain amount of money (C_d) to invite professional rural planners to participate in a rural tourism development project, collect feedback from residents at various stages of tourism development, and provide feedback to government departments and tourism enterprises, so that government departments can easily monitor the level of maintenance of scenic spots and tourism services provided by tourism enterprises, and enterprises can also control the development process of scenic spots in real-time and adjust development strategies promptly. It is also convenient for enterprises to have real-time control of the situation in the development process of scenic spots and adjust their development strategies in time to reduce a certain percentage (α) of the maintenance costs of scenic spots and increase a certain percentage (β) of the income of residents. The primary aim of this separate subject is to determine whether including a rural planner could change the original game results for the three subjects, i.e., whether a more optimal solution can be obtained, thereby further enhancing the benefits gained by the three parties through accelerated tourism development.

A table of parameters for the three-subject game is developed based on the above assumptions as follows in Table 3:

Table 3. Tripartite game subject parameter settings.

Game Subject	Parameter	Parameter Definition	Remarks
Government	C_f	Financial allocations spent by the government to improve rural infrastructure	
	R_i	Financial revenue received by the government through taxation, etc.	
	R_j	Government's performance gains and enrichment image	
	C_t	Good policy environment, financial investment, special debts, bank loans, project declaration, etc. created by governments for corporate development of tourist attractions	
	M_t	Financial penalties imposed by the government on tourism enterprises due to the loss of residents' interests and the destruction of scenic spots in the course of their operation	
	M_g	Financial compensation for rural residents due to excessive impact on their livelihood	
	M_{up}	Penalties imposed by higher government departments on relevant departments due to failure to meet set development targets	
	β	Proportion of missing compensation to residents when there is collusion between the government and enterprises	
	δ	Unjustified gains made as a result of collusion between the government and enterprises	
Tourism Enterprises	R_s	Proceeds from short-term tourism projects	$R_s > C_d$
	R_l	Long-term tourism benefits	$R_l > C_p$
	R_v	The image and branding of the tourism company in the industry, etc.	
	R_p	Facilitation of various aspects of tourism opening by the government as a result of active and effective cooperation with the government	$C_t > R_p$
	C_d	Costs incurred for participation in the development of tourist attractions	
	M_l	Compensation to residents of the village for the excessive negative impact on their lives and the environment	
	α	The proportion of dividends paid to the village residents	
	C_p	Maintenance costs during the subsequent operation of the tourist attraction	

Table 3. Cont.

Game Subject	Parameter	Parameter Definition	Remarks
Village Residents	R_r	Financial compensation for residents in the early stages of tourism development	
	M_c	If the residents actively participate in the opening of a rural tourist attraction, the cultural impact will lead to cultural progress in the village; if they choose to participate passively, the cultural impact will lead to a decline in residents' life experiences.	
	R_k	Increased employment as well as increased economic returns to the village after the opening of the tourist attraction (when negative, meaning a brain drain from the village)	
	C_r	Decreased life experience for residents when passively participating in the development of a tourist attraction	
	M_v	Impacts on residents' lives and places of residence during the development and subsequent operation of tourist attractions	
	R_h	Residents' voice in the development of tourism scenic spots	

According to the above parameter settings (Table 3) and the various scenarios that may exist in the process of the practical tripartite game in 6 hypotheses, the payoff matrix of the tri-subject game is tabulated as follows in Table 4:

Table 4. The matrix of benefits of the tripartite game.

Strategy Choice			Benefits		
Government	Enterprises	Residents	Government	Enterprises	Residents
C	C	C	$-C_f + R_i - C_t + R_j$	$(1 - \alpha)R_l + R_v + R_p - C_d - C_p$	$\alpha R_l + R_r + M_c + R_k + R_h - M_v$
C	C	D	$-C_f + R_i - C_t - R_j - M_{up} + \delta$	$C_t + R_l - R_v - C_d - C_p + \delta$	$(1 - \beta)R_r - M_c - C_r - M_v$
C	D	C	$-C_f + R_i - C_t + R_j + M_t - M_g - M_{up}$	$R_s - M_l - C_d - M_t - R_v$	$R_r + M_c + R_k + R_h + M_g + M_l$
C	D	D	$-C_f - C_t + R_j + M_t - M_g - M_{up}$	$R_s - M_l - C_d - M_t - R_v$	$R_r - M_c - R_k - C_r + M_g + M_l$
D	C	C	$-C_f + R_i$	$(1 - \alpha)R_l + R_v + R_p - C_d - C_p$	$R_r + M_c + R_k + R_h + \alpha R_l - M_v$
D	C	D	$-C_f + R_i - R_j + \delta$	$R_l + R_v - C_d - C_p + \delta$	$(1 - \beta)R_r - M_c - C_r - M_v$
D	D	C	$-C_f + R_i - R_j - M_{up}$	$R_s - R_v - C_d$	$M_c + R_k$
D	D	D	$-C_f - M_{up}$	$R_s - R_v - C_d$	$-M_c - C_r$

From the hypothesis and Table 4, it is known that the equations of returns for the government, firms and residents are (1) to (6) when choosing between positive and negative strategies. (Equations (A1) and (A6) in Appendix A).

Where $u(i, x)$, $u(j, y)$ and $u(k, z)$ represent the anticipated benefits under active strategies selected by the government, firms, and local residents, respectively; and $u(i, 1 - x)$, $u(j, 1 - y)$, $u(k, 1 - z)$ represent the anticipated benefits under the negative strategy of the three stakeholders' choices as above.

Subsequently, $u(i, x) - u(i, 1 - x)$ is defined as the matrix A (in Appendix A). In the same way, matrices B and C can be obtained.

In the evolutionary game, according to the theory of replicative dynamics, the set of game subjects choosing a strategy will adjust their strategy choices based on the difference between their payoffs and the average payoff, thereby increasing their payoffs, as shown in Equation (A7).

The dynamic equation of the tripartite game is given by Equation (A7) as (A8), (A9) and (A10). (in Appendix A)

The matrices and parameters from the above analysis are brought into the above equations to obtain the replicated dynamic equations for the three-party game in the process of community change and digital transformation, and making $F_1(x_i, y_j, z_k) = dx_i/dt$, $F_2(x_i, y_j, z_k) = dy_j/dt$, and $F_3(x_i, y_j, z_k) = dz_k/dt$ are as (11), (12), and (13).

The evolutionary equilibrium point in the game model is then found through replicating the nature of the dynamic equations such that $F_1(x_i, y_j, z_k) = 0$, $F_2(x_i, y_j, z_k) = 0$ and $F_3(x_i, y_j, z_k) = 0$, respectively (Equation (A14)).

Taking $F_2(x_i, y_j, z_k) = 0$ as an example, when $z_k \neq \frac{R_l - C_p + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta}{R_p - \delta - \alpha R_l - x(C_t - 2R_v)}$, $y_j = 0$ or $y_j = 1$, and $\frac{dF_2(x_i, y_j, z_k)}{dy_j} = (1 - 2y_j)[(R_p - \delta - \alpha R_l - x(C_t - 2R_v))z + R_l - C_p + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta]$; when $z_k > \frac{R_l - C_p + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta}{R_p - \delta - \alpha R_l - x(C_t - 2R_v)}$, $F'_2(x_i, 0, z_k) > 0$, $F'_1(x_i, 1, z_k) < 0$, 1 is stable solutions, which means that when the probability of the government actively leading rural tourism development $z_k > \frac{R_l - C_p + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta}{R_p - \delta - \alpha R_l - x(C_t - 2R_v)}$, The probability that the tourism development company will adopt an aggressive strategy and that the two parties will eventually agree to cooperate increases; when $z_k < \frac{R_l - C_p + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta}{R_p - \delta - \alpha R_l - x(C_t - 2R_v)}$, $F'_2(x_i, 0, z_k) < 0$, $F'_1(x_i, 1, z_k) > 0$, 0 is a stable solution, which means that when the probability of the government taking an active role in rural tourism development $z_k < \frac{R_l - C_p + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta}{R_p - \delta - \alpha R_l - x(C_t - 2R_v)}$. The probability that a tourism development company will adopt an aggressive strategy decreases until it is zero.

When $z_k = \frac{R_l - C_p + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta}{R_p - \delta - \alpha R_l - x(C_t - 2R_v)}$, thus $F_2(x_i, y_j, z_k) = 0$. In this case, the government and local residents involved in tourism will prefer either a pure or a mixed strategy, leading to a mixed-strategy equilibrium among the three parties.

The following system of equations can solve the point of equilibrium of a tripartite game system:

$$E_1 = (0, 0, 0); E_2 = (1, 0, 0); E_3 = (0, 1, 0); E_4 = (0, 0, 1); E_5 = (1, 1, 0);$$

$$E_6 = (1, 0, 1); E_7 = (0, 1, 1); E_8 = (1, 1, 1);$$

$$E_9 = \left(\frac{C_p + R_s - R_l - 2R_v - \delta}{C_t + M_l + M_t - 2R_v}, \frac{M_t + R_j - C_t - M_g}{M_t - M_g + M_{up} + R_j}, 0 \right);$$

$$E_{10} = \left(1, \frac{C_r + 2M_c + R_h + 2R_k}{R_k - \alpha R_l - \beta R_r}, \frac{C_t - C_p + M_l + M_t + R_l - R_s + \delta}{C_t - R_p - 2R_v + \delta + \alpha R_l} \right);$$

$$E_{11} = \left(\frac{C_p - R_l - R_p + R_s - 2R_v + \alpha R_l}{M_l + M_t}, \frac{M_t + 2R_j - C_t - M_g}{M_t - M_g + R_j}, 1 \right)$$

The Jacobi matrix has been expressed in Equation (A15). According to Liapunov's first theorem: if the real part of all eigenvalues of the Jacobi matrix is negative, the equilibrium point is progressively stable; if the real part of at least one of the eigenvalues of the Jacobi matrix is positive, the equilibrium point is not stable; and if the real part of all the eigenvalues of the Jacobi matrix is negative, except for the eigenvalues whose real part

is zero, the equilibrium point is in the critical state, and the sign of the eigenvalues does not determine its stability. The stability analysis of each equilibrium point is shown in Table A1 in Appendix A. The stability judgment criterion provides a mathematical basis for the qualitative analysis of the equilibrium point of the game system. By symbolically discriminating against the real part of the characteristic value, a stable equilibrium solution with practical significance can be systematically screened out, laying the theoretical foundation for subsequent policy simulation and optimization recommendations.

4. Simulation Analysis

Based on the methodology and game model, this section examines the scenario hypothesis and conducts parameter analysis. The initial values of the parameters in the following table are set according to the analysis of the replication dynamic equations in the previous section, the parameters have been set in Table A2 in Appendix A, depending on expert assessment.

From the evolutionary path diagram in Figure 1, it can be seen that the results of the final game between government departments, tourism development enterprises and residents will converge to (1, 1, 1), i.e., the three subjects adopt the pure strategy of (active leading, long-term development, active participation), respectively, and the enterprises converge to 1 more quickly. In Figure 1, different colored lines represent different paths of convergence to Nash equilibrium under various decision-making scenarios.

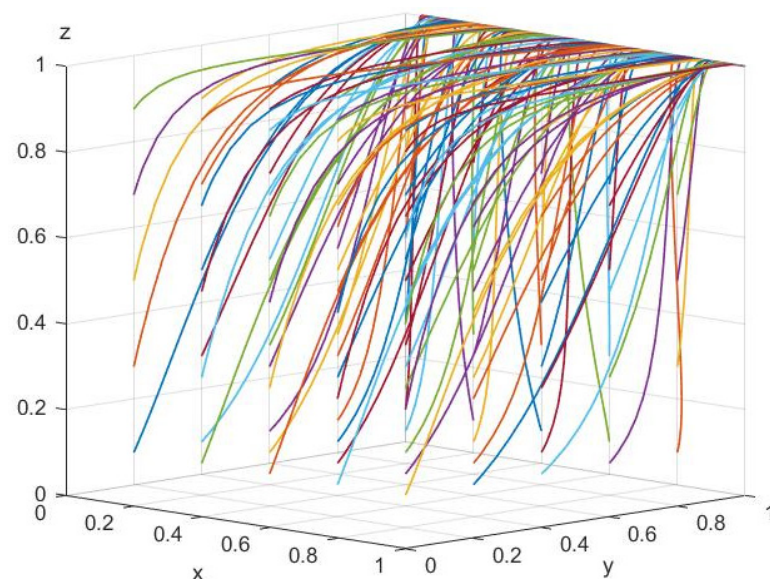


Figure 1. Evolutionary path diagram of the 50 times evolutionary game of the three parties.

These evolutionary results show that there is an optimal and stable state in the system, indicating that the interests of the three parties can be balanced through a collaborative mechanism; the rapid convergence of enterprise strategies reveals that it is the most sensitive to policy incentives and the market environment; this equilibrium point provides a theoretical anchor for the government to formulate accurate intervention policies. The three axes, x , y , and z , range from 0 to 1, indicating the trend towards the Nash equilibrium.

M_{up} is the penalty imposed by a higher-level government department when a rural tourism development department fails to meet a set target, and is interpreted here as the level of attention a higher-level government department gives to a rural tourism development project. The higher the M_{up} value, the higher the level of concern for the project from higher government departments. According to Figure 2, the higher the level of attention from the higher-ranked government, the faster the government's probability of adopting a

proactive and dominant strategy reaches 1. Therefore, to enhance government enthusiasm, the participation of government officials in the rural tourism development process can be increased by formulating reward and punishment measures for the relevant departments. The result indicates M_{up} has less impact on the convergence speed of government strategies, comparing with other parameters.

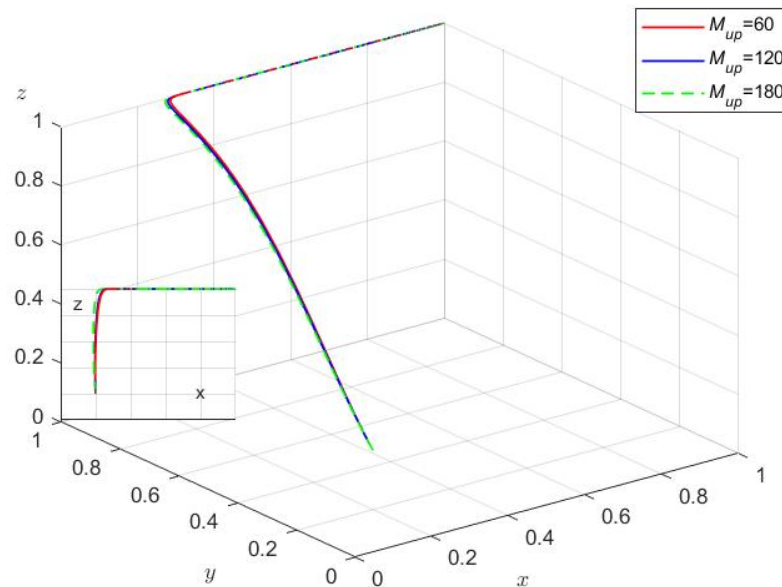


Figure 2. The influence of the higher-level government's attention to rural tourism on the government.

This finding indicates that top-down accountability mechanisms can effectively motivate grassroots governments to fulfil their duties, but they exhibit diminishing marginal returns. There is a need to combine other incentive measures (such as political recognition and fiscal subsidies) to form a portfolio of policy tools. It provides a quantitative basis for optimizing the effectiveness of government governance.

M_t is the financial penalty imposed on an enterprise when it chooses to develop for a short period and causes damage to the village residents, and R_p is the various facilities given to the enterprise when it achieves better results in developing the scenic area and outsourcing the project. The combination of the two represents the government's incentives and penalties for developing the area. As shown in Figure 3, an appropriate mechanism of incentives and penalties (mainly rewarding enterprises and penalizing them when their development is excessively detrimental to residents) can significantly increase the likelihood that enterprises will actively engage in the long-term development and maintenance of the area. M_t and R_p have a greater impact on enterprises.

This finding reveals that the government needs to develop a policy mix of rewards and punishments, where facility support R_p can reduce long-term operational costs for enterprises, while economic penalties M_t increase the cost of short-term speculative behavior. Parameter sensitivity analysis indicates that corporate decision-making is more susceptible to government regulatory tools, providing an entry point for targeted policy interventions. It also verifies the critical role of incentive-compatible mechanisms in the design of governance systems.

The difference between R_s and C_d is the benefit gained by the enterprise in short-term development. As can be seen from Figure 4., the greater the benefit, the greater the likelihood that enterprises will prefer short-term development (i.e., the slower it will reach the probability of choosing long-term development of 1), so the relevant government departments should appropriately adjust up the cost required for tourism enterprises to develop scenic spots, and control the revenue of enterprises to provide tourism services

when the scenic spot is initially developed, so as to avoid This will prevent enterprises from withdrawing their investment after gaining higher profits in the initial stage, causing greater losses to rural residents. R_s and C_d have a greater impact on enterprises.

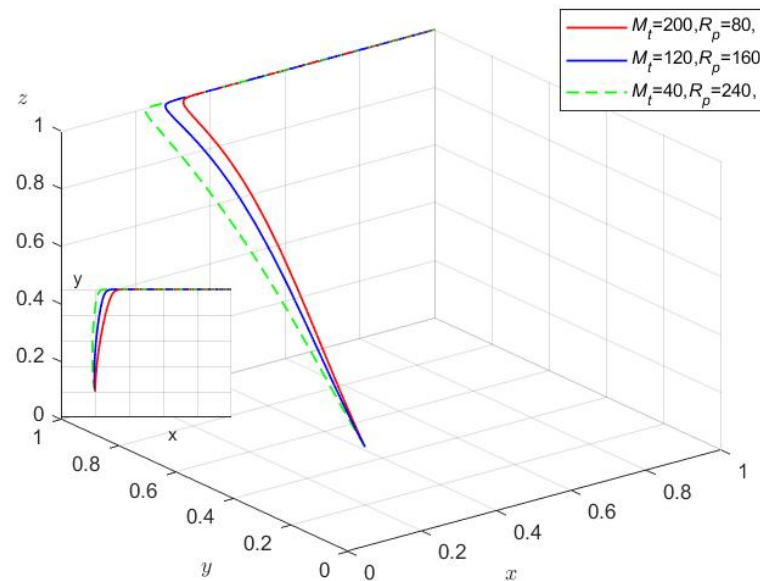


Figure 3. The impact of incentives and disincentives on the enterprise.

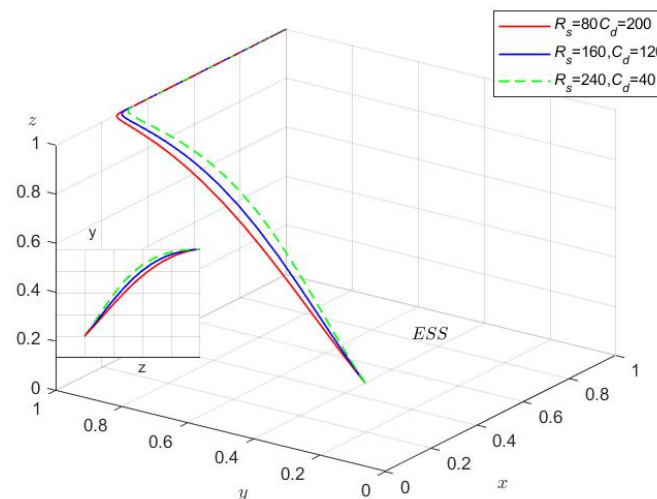


Figure 4. Impact of the benefits obtained by a firm in short-term development on the firm.

This result reveals an inherent conflict between short-term arbitrage motives and long-term investment willingness within enterprises, necessitating institutional designs that balance immediate returns and sustainable gains. The government can reduce opportunities for speculation by implementing dynamic benefit adjustment mechanisms (such as progressive taxation and performance bonds). It verifies the decisive role of cost–benefit structures in shaping corporate behavioral tendencies.

The difference between R_l and C_p is the benefit gained by the enterprise in long-term development. Figure 5 shows that when the difference between the long-term development benefits to the enterprise and the later maintenance expenditure is greater, the enterprise is more likely to develop over the long term and reach 1 faster. Therefore, relevant departments can provide concessions, policy facilitation, and increased subsidies to tourism enterprises engaged in long-term development to purchase materials, thereby improving the incentives for enterprises to participate in long-term development. R_l and C_p have a greater impact on enterprises.

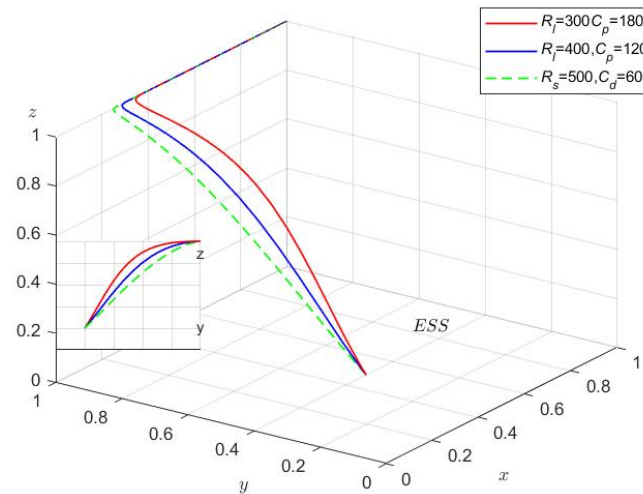


Figure 5. The impact of long-term benefits on the enterprise.

This result demonstrates that sustainable profitability is the fundamental driver of long-term corporate investment, and policy design must ensure enterprises achieve a reasonable return on investment. The government can optimize the corporate decision-making environment through a dual approach: reducing operational costs C_p and enhancing long-term returns R_l . This validates the positive correlation mechanism between effective incentives (government-led) and long-term behavior (tourism enterprises).

As can be seen from Figure 6, changing M_l and R_r , i.e., increasing the financial compensation to residents and the compensation to enterprises, only marginally increases the probability of active participation by residents. When residents are more motivated, the problem of “nail households” can be solved by increasing compensation for residential development. M_l and R_r have less impact on residents.

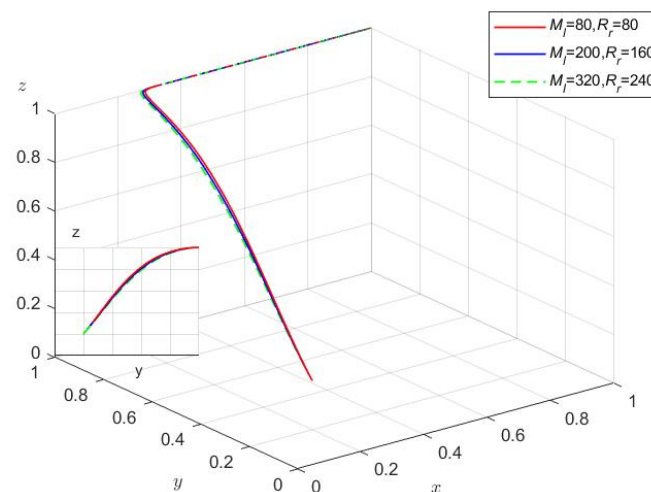


Figure 6. Impact of economic compensation on rural residents.

This finding reveals that relying solely on economic compensation to boost residents' willingness to participate has a ceiling effect. It is necessary to integrate non-economic factors (such as decision-making participation rights and cultural identity) to establish a comprehensive incentive system. It provides new perspectives beyond monetary compensation for addressing challenges such as land expropriation and demolition.

As seen in Figure 7, M_c , R_k and M_v reflect the cultural level and acceptance of new things by the village residents. When the residents have a higher cultural level and stronger acceptance ability, residents will quickly accept the new culture when they are faced with

it and integrate it into their own village culture, and the rapid acceptance of the new culture can enable the residents to quickly develop the retail, catering and accommodation industries when they are clear about the needs of tourists. The rapid acceptance of the new culture will enable residents to quickly develop retail, catering, and accommodation once they are clear about tourists' needs. Therefore, it is important to evaluate residents' knowledge and acceptance levels before developing a tourism enterprise. Alternatively, the government can provide funds to improve educational levels before development, thereby enhancing residents' literacy and acceptance levels. M_c , R_k and M_v have a strong influence on the population.

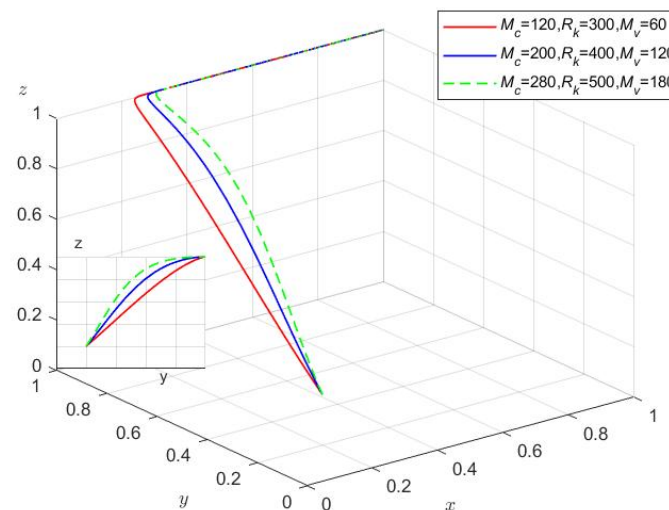


Figure 7. Influence of residents' literacy and acceptance level on residents.

This conclusion reveals that residents' cultural capital serves as the implicit infrastructure for the sustainable development of tourism communities; government investment in pre-education models can effectively reduce the risk of cultural conflicts and accelerate industrial integration; it verifies the critical role of improving human capital in the quality of community participation.

Figure 8 shows that the game between the three subsequent parties differs when the government chooses different initial strategies before tourism development. When the probability that the government prefers active domination increases, the government will dominate the tourism development project by formulating reasonable rewards and penalties, increasing publicity, providing convenience for enterprises and providing more preferential policies for residents, thus actively promoting the rapid completion of the project, thus is the whole The game reaches a stable point of (1, 1, 1) more quickly so that the three parties adopt a pure combination of strategies (active leadership, long-term development, active participation). Thus, when the initial strategy adopted by the company and the village residents differs, it also impacts the strategy adopted by the other two. The choice of the initial strategy has a greater impact on all three parties.

The results verify that the government's demonstration has traction in building a benign game ecology; that multi-subject strategies exhibit cross-sensitivity and require attention to the timing of policy interventions; and that they provide a theoretical basis for phased and differentiated policy promotion.

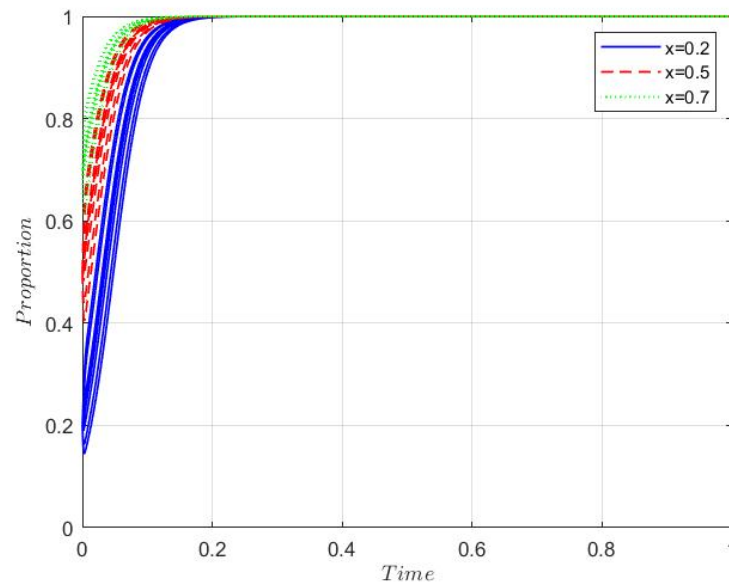


Figure 8. Simulation diagram of the government's evolution when the initial strategy differs.

5. Discussion and Implications

By using the game method, this study simulated the complex interactive relationship model of multiple stakeholders in rural tourism across various situations and summarized the concrete mode of effective cooperation between different stakeholders. Multiple results have been identified through the analysis:

- This evolutionary result shows that there is an optimal and stable state in the system, indicating that the interests of the three parties can be balanced through a collaborative mechanism; the rapid convergence of enterprise strategies reveals that it is the most sensitive to policy incentives and the market environment; this equilibrium point provides a theoretical anchor for the government to formulate accurate intervention policies.
- while top-down accountability mechanisms effectively prompt grassroots governments to implement their mandates, their marginal utility progressively diminishes. Therefore, supplemental incentives (e.g., political commendations and fiscal subsidies) should be incorporated to develop a diversified policy toolkit. These insights offer empirical support for optimizing governmental performance.
- The government needs to develop a policy mix of rewards and punishments, and such government regulatory tools provide an entry point for targeted policy interventions.
- The government can reduce opportunities for speculation by implementing dynamic benefit adjustment mechanisms as necessary institutional designs to balance immediate returns and sustainable gains.
- The positive correlation mechanism between effective incentives (government-led) and long-term behavior (tourism enterprises) suggests that policy design must ensure enterprises achieve a reasonable return on investment.
- It is necessary to integrate non-economic factors (such as decision-making participation rights and cultural identity) to establish a comprehensive incentive system.
- Government investment in pre-education models targeting residents' cultural identity and capital can effectively reduce the risk of cultural conflicts and accelerate industrial integration.
- In the development of RT, there is cross-sensitivity in multi-agent strategies, necessitating an emphasis on the timing of policy interventions to construct a positive gaming ecosystem.

Stakeholders play a crucial role in the development of rural tourism, and this is relevant to the sustainability of tourism destinations [32,33]. Complex interactive game relationships exist due to the pluralism and heterogeneity of varied stakeholders [37]. They can differentiate between actions and strategies based on the actual situation. Governments at all levels, enterprises and residents can achieve a win-win situation only by actively cooperating, which is consistent with the view emphasized by most existing literature studies. The significance of this study is to use the game method to predict the response strategies and outcomes of various entities under different circumstances, and to detail the situations of win-win cooperation among different stakeholders, which are actively led by the government, driven by long-term development by enterprises, and actively supported by residents. This model helps promote cooperation among multiple stakeholders in rural tourism and achieve sustainable development.

Inter-stakeholder cooperation is very complex due to the diversity and heterogeneity of stakeholders and is hindered by many factors. This is consistent with Waligo, Clarke [37], McComb, Boyd [33] and Saito and Ruhanen [29]. This study continues to deepen the multi-stakeholder approach, which includes local governments at all levels, enterprises, and residents. In their win-win cooperation model, they should implement appropriate action strategies to avoid conflicts between different stakeholders. Among them, the government is a key player in rural tourism [26,45]. Significantly different from Western countries, China's multi-level governments play a more important role in rural tourism development due to differences in the political system and culture [59,67]. This study found that government decisions affect enterprises' investment choices and the impact of tourism on residents. The government can boost participation across different levels within its administration by implementing reasonable incentive measures. By offering preferential policies, rewards, and punishments to enterprises, it actively promotes the smooth implementation of long-term tourism projects. In addition, the government can address the issues caused by a small number of residents who resist due to low compensation for demolition benefits by increasing the compensation for the demolition of residents' houses. What is unique is that the government's increase in economic and enterprise compensation for residents can only slightly increase the probability of residents' active participation. It may be due to the psychological imbalance caused by comparing compensation benefits between different residents. Dai and Fan [67] found that *guanxi* (a type of social capital) plays a vital role in the development of rural tourism. Residents will form different groups based on their family relations to advocate for their compensation in the house demolition, leading to varied opinions and reflections among residents.

5.1. Theoretical Implications

Innovations in this study are mainly reflected in content innovation and methodological innovation. In terms of content, this study innovatively refines and specifies strategic models for the cooperation and participation of different stakeholders in the development of rural tourism. This study clarifies the model of effective multi-party collaboration and cooperation in the process of rural tourism development. Although there are many studies on tourism stakeholders, they mainly focus on identifying, analyzing, and understanding the importance and role of stakeholders. Existing research agrees that multi-stakeholder cooperation and engagement are important for the sustainability of tourism destinations, but the specific contexts and modes of cooperation remain underdeveloped. Building upon the established importance of stakeholder collaboration and engagement, this study innovatively simulates strategic models for effective stakeholder cooperation, thereby complementing and deepening the research on complex stakeholder relationships in tourism. Methodologically, it introduces game-theoretic approaches to elucidate the complex rela-

tional models among multiple stakeholders. The findings reveal the complex interactions among multiple stakeholders and deepen the understanding of their relationships. Unlike previous methodologies relying on case studies or questionnaire surveys, this study innovatively employs game theory to simulate the differentiated action strategies of multiple actors and their specific outcomes across various scenarios in rural tourism development. Consequently, it constructs scenario-specific models to facilitate effective multi-stakeholder collaboration in rural tourism. The research results further deepen the understanding of the relationship among relevant stakeholders.

5.2. Practical Implications

This paper innovatively uses the game method to simulate various stakeholder interactions in rural tourism, offering specific practical guidance for promoting sustainable development in the future. Governments at all levels, enterprises and residents can work together to achieve win-win results. Specifically, the government's active leadership, enterprises' long-term development, and residents' active participation contribute to the sustainable development. Clear incentive and constraint mechanisms can be established across all levels of government to enhance officials' engagement in rural tourism development. Simultaneously, corresponding reward and penalty systems should be implemented for enterprises to guide their investment in tourism development. Well-designed incentive mechanisms not only significantly strengthen enterprises' initiative in scenic area development and long-term maintenance but also enhance the probability of sustainable scenic area operations. In terms of incentives, government departments can offer preferential policies for tourism enterprises, increase subsidies, reduce taxes, and so on, to increase enterprises' enthusiasm for long-term development. Regarding punishment, the relevant government departments should appropriately increase the costs enterprises incur in developing scenic spots, preventing investment withdrawals after enterprises achieve high profits in the initial stage. As tourism develops, local governments and enterprises need to assess the level of knowledge and acceptance among the rural population. Alternatively, the government should enhance residents' cultural awareness and acceptance ability by allocating funds to improve education levels before development.

6. Conclusions

This study aims to develop a tripartite game model to analyze the strategic choices of government departments, tourism enterprises, and rural residents in the Chinese context, thereby identifying optimal strategies for sustainable development. The conclusion is summarized from both methodological and practical perspectives: it verifies the applicability of game theory in tourism governance research, clarifies the specific implementation pathways for tripartite collaboration, and provides an operational theoretical framework for sustainable tourism development. This discussion deepens understanding in the following ways: it reveals the unique role of the government within the context of China's institutional characteristics, points out the limitations of economic compensation policies and the importance of social capital, and offers a cultural perspective on the complexity of resident group decision-making.

Moreover, this study simulates differentiated actions and specific outcomes for multiple stakeholders across various scenarios of Chinese rural tourism development using a game-theoretic research approach. It summarizes effective cooperation models, emphasizing that adopting appropriate strategies in cooperation models among stakeholders is conducive to reducing conflicts and promoting the sustainability of rural tourism. Active government leadership and business and resident participation are specific strategies for achieving win-win cooperation among stakeholders in the Chinese context. Government

decisions are particularly crucial, primarily manifested in two aspects: on the one hand, a rational system of rewards and penalties can motivate the enthusiasm of various government departments and enhance the commitment of tourism enterprises to long-term investments; on the other hand, the government's increasing compensation for residents in house demolition also has a positive impact on resident participation. In addition, enterprises cannot neglect to assess the level of knowledge and acceptance of the rural residents. The knowledge level and acceptance capacity of villagers also determine their level of participation in tourism development. Therefore, appropriate cooperative strategies among the government, enterprises, and residents are crucial for sustainability.

The limitations of the current study are also reflected in the simulation of technological means, because the initial value of the data is based on the phenomenon and related data for judgement, compared with the phenomenon of data where there is a certain level of uncertainty. Future studies can be focused on the long-term multi-temporal cross-section of the data collection as a model to extract the basis of a wide range of data collection. A wide range of data collection can also be developed in the future rural revitalization industry database, allowing this study to be a basis for research in the direction of the use of artificial intelligence models to assist decision-making and provide a solid foundation for judgment.

The future research direction will focus on refining the practical approach and themes that emerged in the trinity system: governmental mechanism design emphasizes institutional guidance, corporate regulatory measures focus on incentive compatibility, and resident capacity building prioritizes human capital appreciation. Furthermore, the historical and cultural context of detailed Chinese and foreign rural tourism cases will be examined in light of AI-based decision models to help develop a more comprehensive, systematic solution to promote the sustainable development of rural tourism.

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Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

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

Appendix A

$$\begin{aligned} & \left\{ u(i, x) = y_j z_k (-C_f + R_i - C_t + R_j) \right. \\ & + (1 - y_j) z_k (-C_f + R_i - C_t + R_j + M_t - M_g - M_{up}) \\ & + y_j (1 - z_k) (-C_f + R_i - C_t - R_j - M_{up} + \delta) \\ & \left. + (1 - y_j) (1 - z_k) (-C_f - C_t + R_j + M_t - M_g - M_{up}) \right\} \end{aligned} \quad (A1)$$

$$\begin{aligned} u(i, 1 - x) = & y_j z_k (-C_f + R_i) + (1 - y_j) z_k (-C_f + R_i - R_j - M_{up}) + y_j (1 - z_k) (-C_f + R_i - R_j + \delta) \\ & + (1 - y_j) (1 - z_k) (-C_f - M_{up}) \end{aligned} \quad (A2)$$

$$\begin{aligned}
u(j, y) = & x_i z_k ((1 - \alpha) R_l + R_v + R_p - C_d - C_p) \\
& + x_i (1 - z_k) (C_t + R_l - R_v - C_d - C_p + \delta) \\
& + (1 - x_i) z_k ((1 - \alpha) R_l + R_v + R_p - C_d - C_p) \\
& + (1 - x_i) (1 - z_k) (R_l + R_v - C_d - C_p + \delta)
\end{aligned} \tag{A3}$$

$$\begin{aligned}
u(j, 1 - y) = & x_i z_k (R_s - M_l - C_d - M_t - R_v) + x_i (1 - z_k) (R_s - M_l - C_d - M_t - R_v) \\
& + (1 - x_i) z_k (R_s - R_v - C_d) + (1 - x_i) (1 - z_k) (R_s - R_v - C_d)
\end{aligned} \tag{A4}$$

$$\begin{aligned}
u(k, 1 - z) = & x_i y_j ((1 - \beta) R_r - M_c - C_r - M_v) \\
& + x_i (1 - y_j) (R_r - M_c - R_k - C_r + M_g + M_l) \\
& + (1 - x_i) y_j ((1 - \beta) R_r - M_c - C_r - M_v) \\
& + (1 - x_i) (1 - y_j) (-M_c - C_r)
\end{aligned} \tag{A5}$$

$$\begin{aligned}
u(k, 1 - z) = & x_i y_j ((1 - \beta) R_r - M_c - C_r - M_v) \\
& + x_i (1 - y_j) (R_r - M_c - R_k - C_r + M_g + M_l) \\
& + (1 - x_i) y_j ((1 - \beta) R_r - M_c - C_r - M_v) \\
& + (1 - x_i) (1 - y_j) (-M_c - C_r)
\end{aligned} \tag{A6}$$

The matrix A

$$\begin{aligned}
A = & \begin{pmatrix} R_j - C_t & -C_t - M_{up} \\ M_t + 2R_j - C_t - M_g & M_t + R_j - C_t - M_g \end{pmatrix} \\
B = & \begin{pmatrix} (1 - \alpha) R_l + 2R_v + R_p - C_p - R_s + M_t + M_l & C_t + R_l - C_p - R_s + M_t + M_l + \delta \\ (1 - \alpha) R_l + 2R_v + R_p - C_p - R_s & R_l + 2R_v - C_p - R_s + \delta \end{pmatrix} \\
C = & \begin{pmatrix} \beta R_r + 2M_c + R_k + \alpha R_l + R_h + C_r & 2M_c + 2R_k + R_h + C_r \\ \beta R_r + 2M_c + R_k + \alpha R_l + R_h + C_r & 2M_c + R_k + C_r \end{pmatrix} \\
\frac{dx_i}{dt} = & x_i \cdot [u(i, x) - u(x, x)]
\end{aligned} \tag{A7}$$

$$\frac{dy_j}{dt} = y_j (1 - y_j) (z^T B x) = y_j (1 - y_j) \left(\sum_{k \in S_R} \sum_{i \in S_G} z_k b_{ki} x_i \right) \tag{A8}$$

$$\frac{dy_j}{dt} = y_j (1 - y_j) (z^T B x) = y_j (1 - y_j) \left(\sum_{k \in S_R} \sum_{i \in S_G} z_k b_{ki} x_i \right) \tag{A9}$$

$$\frac{dz_k}{dt} = z_k (1 - z_k) (x^T C y) = z_k (1 - z_k) \left(\sum_{i \in S_G} \sum_{j \in S_D} x_i c_{ij} y_j \right) \tag{A10}$$

$$\begin{aligned}
F_1(x_i, y_j, z_k) = & x_i (1 - x_i) (y_j z_k (R_j - C_t) \\
& + (1 - y_j) z_k (M_t + 2R_j - C_t - M_g) \\
& + y_j (1 - z_k) (-C_t - M_{up}) \\
& + (1 - y_j) (1 - z_k) (M_t + R_j - C_t - M_g))
\end{aligned} \tag{A11}$$

$$\begin{aligned}
F_2(x_i, y_j, z_k) = & y_j (1 - y_j) \\
& (x_i z_k ((1 - \alpha) R_l + 2R_v + R_p - C_p - R_s + M_t + M_l) \\
& + x_i (1 - z_k) (C_t + R_l - C_p - R_s + M_t + M_l + \delta) \\
& + (1 - x_i) z_k ((1 - \alpha) R_l + 2R_v + R_p - C_p - R_s) \\
& + (1 - x_i) (1 - z_k) (R_l + 2R_v - C_p - R_s + \delta))
\end{aligned} \tag{A12}$$

$$\begin{aligned}
 F_3(x_i, y_j, z_k) = & z_k(1 - z_k)(x_i y_j(\beta R_r + 2M_c + R_k + \alpha R_l + R_h + C_r) \\
 & + x_i(1 - y_j)(2M_c + 2R_k + R_h + C_r) \\
 & + (1 - x_i)y_j(\beta R_r + 2M_c + R_k + \alpha R_l + R_h + C_r) \\
 & + (1 - x_i)(1 - y_j)(2M_c + R_k + C_r))
 \end{aligned} \quad (A13)$$

$$\begin{cases}
 F_1(x_i, y_j, z_k) = x_i(1 - x_i) \left[\begin{aligned} & (R_j + yM_{up})z - y(M_t - M_g + M_{up} + R_j) \\ & + M_t - M_g - C_t + R_j \end{aligned} \right] = 0 \\
 F_2(x_i, y_j, z_k) = y_j(1 - y_j) \left[\begin{aligned} & (R_p - \delta - \alpha R_l - x(C_t - 2R_v))z + R_l - C_p \\ & + x(C_t + M_l + M_t - 2R_v) - R_s + 2R_v + \delta \end{aligned} \right] = 0 \\
 F_3(x_i, y_j, z_k) = z_k(1 - z_k) \left[\begin{aligned} & (R_h + \alpha R_l + \beta R_r - x(R_h + R_k))y \\ & + x(R_h + R_k) + C_r + 2M_c + R_k \end{aligned} \right] = 0
 \end{cases} \quad (A14)$$

The Jacobi matrix for this study was as follows:

$$J = \begin{bmatrix} J_1 & J_2 & J_3 \\ J_4 & J_5 & J_6 \\ J_7 & J_8 & J_9 \end{bmatrix} = \begin{bmatrix} \frac{\partial F(x)}{\partial x} & \frac{\partial F(x)}{\partial y} & \frac{\partial F(x)}{\partial z} \\ \frac{\partial F(y)}{\partial x} & \frac{\partial F(y)}{\partial y} & \frac{\partial F(y)}{\partial z} \\ \frac{\partial F(z)}{\partial x} & \frac{\partial F(z)}{\partial y} & \frac{\partial F(z)}{\partial z} \end{bmatrix} \quad (A15)$$

Table A1. Equilibrium point stability analysis.

Equilibrium Points	Jacobi Matrix Eigenvalues			Real Part Symbols	Stability Conclusions
	λ_1	λ_2	λ_3		
$E_1(0,0,0)$	$-C_r - 2M_c - R_k$	$C_t + M_g - M_t - R_j$	$\frac{C_p - R_l + R_s - 2R_v - \delta}{2R_v - \delta}$	$(-, X, -)$	Uncertainty points
$E_2(1,0,0)$	$-C_r - 2M_c - 2R_k - R_h$	$-C_t - M_g + M_t + R_j$	$\frac{C_p - C_t - M_l - M_t - R_l + R_s - \delta}{M_t - R_l + R_s - \delta}$	$(-, X, -)$	Uncertainty points
$E_3(0,1,0)$	$C_t + M_{up}$	$\frac{R_l - C_p - R_s + 2R_v + \delta}{2R_v + \delta}$	$\frac{-C_r - 2M_c - R_h - R_k - \alpha R_l - \beta R_r}{-C_r - 2M_c - R_h - R_k - \alpha R_l - \beta R_r}$	$(+, X, -)$	Uncertainty points
$E_4(0,0,1)$	$C_r + 2M_c + R_k$	$C_t + M_g - M_t - 2R_j$	$\frac{C_p - R_l - R_p + R_s - 2R_v + \alpha R_l}{2R_v + \alpha R_l}$	$(+, X, -)$	Uncertainty points
$E_5(1,1,0)$	$-C_t - M_{up}$	$\frac{-C_r - 2M_c - R_h - R_k - \alpha R_l - \beta R_r}{-C_r - 2M_c - R_h - R_k - \alpha R_l - \beta R_r}$	$\frac{C_t - C_p + M_l + M_t + R_l - R_s + \delta}{M_t + R_l - R_s + \delta}$	$(-, -, X)$	Uncertainty points
$E_6(1,0,1)$	$R_f - L_n - \alpha R_i$	$\frac{C_2 - C_1 + L_p + M + R_e}{C_2 - C_1 + L_p + M + R_e}$	$\frac{S - P_1 - P_2 - M - \alpha C_e}{S - P_1 - P_2 - M - \alpha C_e}$	$(-, +, -)$	Instability points
$E_7(0,1,1)$	$R_f - L_n - R_i$	$C_1 - C_2 - M - R_e$	$\frac{P_1 + P_2 - S + \alpha C_e - \beta C_e}{\beta C_e}$	$(-, -, +)$	Instability points
$E_8(1,1,1)$	$\frac{L_p - L_n + R_f + (1 - \alpha)R_i}{(1 - \alpha)R_i}$	$\frac{S - P_1 - P_2 - \alpha C_e + \beta C_e}{\beta C_e}$	$\frac{C_1 - C_2 - L_p - M - R_e}{C_1 - C_2 - L_p - M - R_e}$	$(-, -, -)$	Instability points
$E_9(x_1, y_1, 0)$	0	0	a_1	$(0, 0, +)$	Instability points
$E_{11}(1, y_2, z_2)$	0	a_2	a_3	$(0, -, -)$	Instability points
$E_{12}(x_3, y_3, 1)$	a_4	a_5	a_6	(X, X, X)	Instability points

Table A2. Parameter settings for the subject of the three-party game.

Game Subject	Parameter	Initial Reference Value	Remarks
Government	C_f	240	
	R_i	400	
	R_j	400	
	C_t	360	
	M_t	120	
	M_g	200	
	M_{up}	200	
	β	0.1	
	δ	120	
Tourism Enterprises	R_s	160	$R_s > C_d$
	R_l	400	$R_l > C_p$
	R_v	200	
	R_p	160	$C_t > R_p$
	C_d	120	
	M_l	200	
	α	0.1	
	C_p	120	
Village Residents	R_r	160	
	M_c	200	
	R_k	400	
	C_r	120	
	M_v	120	
	R_h	200	

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