

Article

Modeling and Simulation of Dissemination of Cultivated Land Protection Policies in China

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Abstract: Cultivated land protection is the top priority of the national economy in China and the livelihood of people. Cultivated land protection policies (CLPP) play an important role in the protection of cultivated land. However, the process of dissemination of CLPP on social networks of farmers has problems, such as distortion of policy content, single dissemination channels, low level of farmers' knowledge, and low dissemination efficiency. For revealing the characteristics of the dissemination of CLPP in the farmers' social networks (FSN), this study combines the Suspected–Exposed–Infected–Recovered–Suspected (SEIRS) epidemic model to construct a model of CLPP dissemination suitable for FSN. In addition, a numerical simulation of the dissemination process of CLPP is conducted on the FSN, and the influence of the structural characteristics of the FSN and different model parameters on the dissemination of CLPP is analyzed. Results show that (1) the dissemination rate between farmers in FSN has a significant impact on the scale and speed of CLPP. A greater initial dissemination rate corresponds to faster speed and larger scale of CLPP dissemination. (2) A greater node degree in FSN means stronger dissemination ability for CLPP. Therefore, identifying structural holes (opinion leaders) in FSN can effectively promote the dissemination of CLPP. (3) The SEIRS model can dynamically describe the evolution law of CLPP dissemination process over time through the four states of farmer nodes of suspected, exposed, infected, and recovered. Numerical simulation results show that the immune degradation rate is proportional to CLPP. However, the direct immunization rate is inversely proportional. The increase in immune degradation rate can reduce the number of recovered farmers and improve the efficiency of CLPP dissemination. On the basis of the abovementioned conclusions, this study draws policy recommendations to increase the scale and speed of CLPP dissemination in China.

Keywords: cultivated land protection policies; farmers' social networks; SEIRS model; numerical simulation; China



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1. Introduction

Cultivated land is a basic resource for human survival and development. In addition to being an important way of agricultural production, cultivated land has ecological service functions, such as water conservation, air purification, and provision of open space [1], as well as social functions, such as maintaining social stability and ensuring national food security [2]. Obvious differences exist in cultivated land resources in various countries in the world, and cultivated land resources in China present the characteristics of “one more, two less, and seriously polluted.” The total amount of cultivated land resources in China ranks fourth in the world. However, with the continuous acceleration of urbanization and industrialization, problems such as non-agricultural use of cultivated land (such as the illegal occupation of cultivated land to build houses in the rural areas), mass loss of

high-quality cultivated land (such as urban sprawl occupying cultivated land), and degradation of some cultivated land (such as heavy metal pollution of cultivated land) continue to emerge [3,4]. According to “Statistical Bulletin of China’s Land, Mineral, and Marine Resources” statistics, China’s cultivated land area in 2012 was 13,515.84 (10^4 hm^2). By the end of 2017, China’s cultivated land area had been reduced to 13,486.32 (10^4 hm^2). China has reduced the cultivated land area to 32.04 (10^4 hm^2) due to construction occupation, disaster damage, ecological restoration, and agricultural structural adjustment. In 2017, the per capita cultivated land area in China was 0.097 ha, which is consistently lower than the per capita arable land area in the world. At present, Chinese farmers own many pieces of land that are not evenly sized and are spatially disconnected, which is manifested in the cultivated land fragmentation. In the early stage of the market economy, the non-agricultural labor market was underdeveloped, and there were surplus labor in rural areas. Cultivated land fragmentation is conducive to decentralized management, reduces agricultural production risks, and allows labor to be rationally allocated and fully utilized. However, under the current market economy conditions where the non-agricultural labor market and the agricultural land transfer market are active, the cultivated land fragmentation increases the transaction cost of the cultivated land transfer market. In addition, with the continuous increase in labor production costs and the popularization of labor-saving technologies, the cultivated land fragmentation limits the use of agricultural machinery technology. Moreover, it will increase the commuting time and cost of agricultural labor between different lands. Therefore, the cultivated land fragmentation not only reduces the scale effect of agricultural production and management, but also increases the production cost of agricultural products. Further, it hinders the process of agricultural mechanization and the realization of modern agriculture, thereby reducing the level of agricultural income. China’s cultivated land is rated as 15 grades, the 1st grade is the best quality, and the 15th grade is the worst. The cultivated land of grades 1–4, grades 5–8, grades 9–12, and grades 13–15 are classified as excellent-level land, high-level land, medium-level land, and low-level land. By the end of 2016, the national average quality level of cultivated land was 9.96. Among them, excellent-level land accounts for 2.90% of China’s cultivated land, and low-level land accounts for 17.79% (the data comes from the Statistical Bulletin of China’s Land, Mineral and Marine Resources issued by the Ministry of Natural Resources of the People’s Republic of China). In addition, cultivated land soil pollution points in China exceeded the standard rate of 19.4%, of which the proportion of heavily polluted points reached 1.1% (Figure 1).

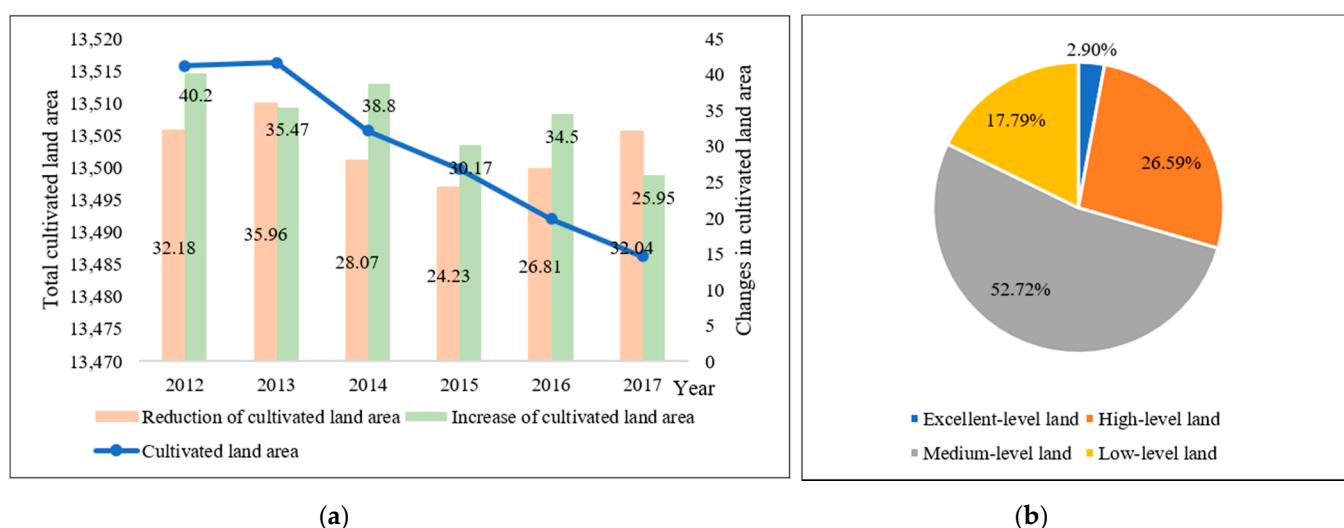


Figure 1. (a) Changes in cultivated land area in China from 2012 to 2017. (b) Grade structure of cultivated land quality in China.

The protection of and improvement in the quantity and quality of cultivated land cannot be delayed. Policy factors are important influencing factors of changes in cultivated land [5]. The cultivated land protection policy (CLPP) in China is a legal system formed to ensure food security and maintain cultivated land production capacity [6]. Since the 1980s, the Chinese government has promulgated a series of laws, regulations, and rules related to the cultivated land protection; thus, the most stringent cultivated land protection system in the world has been formed. China has established a complete and relatively strict CLPP system including basic farmland protection, dynamic equilibrium of the total cultivated land, land use control institutional system, crop rotation and fallow of cultivated land, and an approval system for conversion of cultivated land [7–9]. However, CLPP in China has problems such as weak enforcement, wide coverage, inadequate feedback mechanisms, and the need to improve the supervision system. First of all, the overall authority of the current CLPP is not strong. In the future, the Chinese government should continue to enhance the important position of cultivated land protection and make food security as top priority. In addition, although CLPP has been incorporated into China's Land Management Law as an independent chapter, the legal provisions for the cultivated land protection such as land conservation and intensive use, territorial spatial planning, and protection of farmers' rights and interests are still relatively weak. In the future, the Chinese government should focus on building a stricter legal system covering all the elements of cultivated land protection. Second, the monitoring mechanism for the implementation of CLPP needs to be improved. At present, a consistent data platform for cultivated land resources and a unified evaluation standard have not yet been fully established. Therefore, it is difficult to dynamically evaluate and monitor the quantity, quality, and ecological changes of cultivated land. In addition, the supervision and responsibility entities have not yet been clarified. This can easily lead to inefficient implementation of CLPP due to regulatory dislocation. The key to the CLPP is implementation. Therefore, ensuring the execution of CLPP is the key to realizing the value of CLPP.

Farmers, as the microscopic main body of cultivated land production, are the most direct participants and stakeholders in cultivated land protection. The research of related scholars has shown that cultivated land protection behavior of farmers is mainly affected by factors such as the characteristics of farmers (livelihood asset endowment of farmers), natural attributes of cultivated land, agricultural economic benefits, and external policy environment [10–12]. The Chinese government has also increased the participation of farmers in cultivated land protection by strengthening agricultural technology training, increasing various agricultural subsidy policies, and strengthening cultivated land protection compensation [13,14].

The implementation of CLPP depends on effective policy dissemination. The implementation effect of CLPP directly affects the realization of the goal of trinity cultivated land protection in data management and control, quality management, and ecological management and protection [15]. At present, the mass media represented by the Internet and TV, the organization dissemination based on the local government, and the interpersonal dissemination with the acquaintance society as the background, have become the media environment for farmers to understand the CLPP. In addition, the village, as the most basic administrative unit in China, is the key and basic point of CLPP. However, the specific CLPP dissemination and implementation process has problems, such as difficulty in implementing policies to farmers, low awareness and recognition of policies by farmers, deviations in policy understanding, and low efficiency of policy dissemination. The reasons are a lack of understanding of CLPP by many farmers, the problem of information asymmetry in dissemination of CLPP, and policy executors using information advantages to strategically profit from CLPP. This situation weakens the effect of the dissemination and implementation of CLPP to a certain extent. Farmers' understanding and recognition of CLPP determine the smoothness of its implementation. Moreover, the effective dissemination of farmland protection policies can reduce farmers' indifference or resistance to the

policies on the one hand; the government can obtain timely feedback from public opinion to improve the content of the policies on the other hand.

Each farmer lives in a complex social network (SN), which can promote policy dissemination among individuals [16]. The important basis for the inclusion of CLPP in SN in this study is that the behavior of economic entities is embedded in a concrete and real-time social connection system [17]. The limited access to information of farmers often places them in an incomplete information environment, and SN provides farmers with an important channel for disseminating CLPP [18]. The dissemination of CLPP in the SN is a complex and dynamic process, which is affected by many factors. These factors include the structural characteristics of SN [19], the level of livelihood assets of farmers [20], the media [21], and the professionalism and influence of policy issuers. Among them, the structure of the farmers' social network (FSN) can determine its function (such as policy dissemination function and social function among farmers), which in turn affects the process of CLPP dissemination. In a sense, the CLPP is an important factor embedded in the FSN. Only in the FSN can the CLPP give full play to its value and role. Therefore, studying the dissemination of CLPP from the perspective of FSN is feasible and necessary.

Thus, this study intends to analyze the dissemination mechanism of CLPP in FSN. The epidemic model is one of the microscopic dissemination models and has therefore been widely used in knowledge, information, low-carbon technology, and rumor dissemination [22–25]. In addition, the dissemination models of CLPP and infectious diseases are the same. Therefore, this study first analyzes the impact of the structural characteristics of the scale-free network on the dissemination of CLPP. This basic problem is solved by quantifying the relationship among the construction parameters, structural attributes, and CLPP dissemination of the scale-free network. On this basis, the Suspected–Exposed–Infected–Recovered–Suspected (SEIRS) model is used to numerically simulate the dissemination process of CLPP and analyze the dissemination mechanism of CLPP within the FSN. In this way, a scientific basis is provided for the government to effectively disseminate CLPP.

2. Literature Review

2.1. Research Progress on CLPP

Extant studies have shown that the academic community has conducted in-depth research on the CLPP from different perspectives. The focus is on the implementation performance of CLPP, the evolution and optimization path of CLPP, and the level of cognition of the farmers to the CLPP. Current studies evaluate the implementation performance of CLPP at a certain time or in a specific area from different perspectives. For example, Lv [26] used the C-D production function to study the contribution of the implementation of CLPP to grain output. The results of the study show that the total grain output can increase by 0.023% for every 1% increase in the implementation intensity of the CLPP. In addition, scholars have explored the evolution and optimization direction of CLPP from different backgrounds. For example, Wu [6] argued that the Chinese government has proposed two main policies to maintain the quantity and quality of cultivated land (cultivated land requisition–compensation balance and basic farmland demarcation, respectively). However, the cultivated land requisition–compensation balance policies can easily result in the conversion of high-quality cultivated land to industrial land and residential land. Therefore, Wu proposed that the Chinese government can regard the delineation of permanent basic farmland as the core system of farmland protection policies. A hierarchical protection system for basic farmland can be implemented to strictly restrict its conversion into construction land. Moreover, scholars have generally recognized that the effectiveness of the implementation of CLPP largely depends on the level of cognition of the farmers to the CLPP. Cao [27] believed that farmers can further enhance their understanding of CLPP and choice of environmentally friendly technologies by improving information channels and extension services. However, relatively few studies on the characteristics of the dissemination of CLPP in FSN are available. Farmers' access to correct and sufficient CLPP information is helpful in increasing their enthusiasm for cultivated land protection.

Therefore, promoting the effective dissemination of CLPP has become one of the important guarantees for improving the effectiveness of cultivated land protection work and achieving cultivated land protection goals in China.

As the main driving factor of environmental change and sustainable development, food production is related to global agriculture and food security, and the cultivated land protection is the fundamental prerequisite for ensuring food production. According to the United Nations, the global population will exceed 9.8 billion in 2050, and food demand will increase by more than 50% [28]. Increasing consumer demand and dietary changes have further increased the demand for food, posing severe challenges to global food security and ecological protection. Although the natural conditions, culture, history, social background, and economic conditions of each country are different, the common reason for the success of cultivated land protection in all countries is that land legislation is the fundamental measure of cultivated land protection. Cultivated land protection laws and regulations cover a wide range and a large number, and are continuously improved and implemented strictly. At the same time, severe sanctions are imposed on illegal activities. For example, since 1966, “the Farm and Ranch Lands Protection Program”, managed by the Natural Resources Conservation Service of the United States Department of Agriculture, has been the main policy of the federal government to prevent the conversion of cultivated land to urban land. The plan helps state, local governments, and non-profit conservation organizations to fund the purchase of easements on private farms and pastures, thereby protecting the sustainable development of cultivated land [29]. Marja [30] studied the effectiveness of Agri-environment schemes in the new EU member state (Estonia) in improving farmland biodiversity between 2002 and 2012. The results of the study show that the implementation of environmentally friendly management methods in farms can increase crop yields, increase farmland biodiversity, and improve soil structure. Therefore, for the widely accepted, simple but large-scale agricultural landscape greening, environmentally friendly management may be a viable alternative to organic agriculture. On the whole, the formulation and implementation of CLPP is of great significance for improving the cultivated land use efficiency, promoting the sustainable cultivated land use, and regional sustainable development.

2.2. Research Progress of Public Policy Dissemination

Public policy dissemination is not only an important content of public management research, but also the main direction of communication research. Policy dissemination refers to the transmission process of policy information in SN [31]. Policy dissemination can cultivate the audience’s recognition, understanding, trust, and support for the policies. In this way, the emotions of confrontation, resistance, and indifference can be effectively reduced. Accordingly, public policies can be implemented smoothly in a good environment. Current scholars mainly focus on the study of the mode of policy dissemination and the analysis of the affecting factors of the influence of policy dissemination. Mode research can be used to conduct intuitive analysis of the policy dissemination process. For example, Septiono [32] believed that smoke-free policies (SFA) in Indonesia adopt a vertical diffusion mode from region to province, as well as a horizontal diffusion mode between adjacent areas. The author also proposed that SFA should strengthen its dissemination in poor areas, underdeveloped areas, or areas where the tobacco industry is located to resist intervention by the tobacco industry in the tobacco control programs. Analysis of the influencing factors of the policy dissemination effect can provide reference for the government to optimize the policy dissemination path. For example, Alizada [33] analyzed the affecting factors of the global dissemination of two renewable energy policies (feed-in tariffs and renewable portfolio standards). The author proposed, through a logistic regression model and event history analysis, that learning and suasion are beneficial to the dissemination of renewable energy policies.

The research methods of public policy dissemination mainly focus on directed dyadic analysis [34], document-based comparison [35], and document search method [36]. The

current policy dissemination model only explores the laws of temporal–spatial dissemination of the same policies in different regions from the perspective of communication. However, qualitative research is often characterized by strong subjectivity, uncertainty, ambiguity, and controversy. It has difficulty in objectively and accurately describing the process of policy dissemination and analyzing the basic laws and characteristics of policy dissemination. The current exploration of the dissemination mechanism is mainly based on the epidemic models SIS [37], SIR [38], and SEIR [39]. The epidemic model uses differential equations to establish a propagation dynamics model, which can accurately describe the dynamics of policy dissemination over time to determine the law of policy dissemination and key parameters that affect policy dissemination. The goal of improving the efficiency of policy dissemination can be achieved by controlling the aforementioned parameters. Thus, this study first explores the dissemination characteristics, evolution process, and dissemination laws of CLPP in the FSN. On this basis, the epidemic model is introduced to construct the propagation dynamics model of the CLPP of the FSN. The influence of various dissemination parameters on CLPP dissemination is explored. Finally, the validity of the proposed model is verified by numerical simulation.

3. Material and Methods

3.1. Scale-Free Network

The FSN should be first modeled prior to simulating the dissemination of CLPP in the FSN. This study selects the scale-free network to represent the SN that CLPP relies on. This model was proposed by Albert and Barabási in 2002 [40]. The Barabási–Albert (BA) network is a theoretical model of the scale-free network. The BA network with a degree distribution of a power-law distribution $p(k) \propto k^{-\gamma}$ ($2 < \gamma \leq 3$) has strong heterogeneity characteristics. This network has similar characteristics to the network that CLPP dissemination relies on in the real world: A few nodes called Hub occupy a large number of edges. That is, farmers or local governments with richer SN are more likely to obtain the attention of other farmers and organizations. However, most nodes have few connected edges [41]. This study assumes m_0 initial nodes in the FSN, and these nodes are completely connected; the probability of policy dissemination between nodes is denoted as θ ; a new node with m ($m \leq m_0$) edges is added at each time interval. FSN is generated in this study on the basis of this rule. Each node represents a farmer in the society, and the edges between nodes represent the channel of CLPP dissemination among farmers. This study assumes N farmers in the final FSN and $m_0 * \frac{(m_0-1)}{2} + (N - m_0) * m$ edges in the FSN.

3.2. CLPP Dissemination Model

Infectious diseases seriously endanger human health (such as severe acute respiratory syndrome, Ebola virus, and COVID-19). A landmark work in the study of epidemic model is the compartmental modeling method proposed by Kermack and Mckendrick [42]. This method has been used to date and has become a subject: Epidemic dynamics. Epidemic dynamics is a mathematical model established by nonlinear dynamics. According to the general dissemination mechanism of epidemics, the dissemination process of epidemics is described through quantitative relationships, the change law of the number of infected individuals is analyzed, and the development pattern of epidemics is revealed [43]. The most basic SI model divides the population into two types: Susceptible and infected. However, this model ignores the situation wherein the disease is cured, and similar scenarios are rarely found in reality. Although the SIS model considers the repeated infection of the disease, it ignores the recovery of nodes in a susceptible state. The SIR model is improved on the basis of the SIS model, and the nodes in the SN are divided into three types: Susceptible, infected, and recovered. People who have recovered can resist the virus and will neither be infected by the virus nor spread it. With the deepening of research, scholars have added an exposed node (E) to the SIR model by studying epidemics in nature, and then obtained the SEIR model. The introduction of exposed nodes is used to simulate

patients who cannot disseminate the epidemic. In addition, patients in the eclipse period will transfer to the infected state with a time probability σ . However, susceptible people in the process of epidemic dissemination may not necessarily turn into exposed people with a certain probability. They can directly convert into recovered people through vaccination and refuse the dissemination of the virus. At the same time, the main difference between the SEIR and SEIRS models is that the latter considers that people who have recovered may lose resistibility and become susceptible again. The dissemination process of CLPP in the FSN has many similar characteristics to that in the SEIRS model in many aspects. Thus, this study uses the SEIRS model to explore the dissemination of CLPP.

On the basis of the traditional SEIR epidemic model, this study considers an important factor in the dissemination of CLPP, that is, agricultural subsidy policy (grain direct subsidies, seed subsidies, agricultural machinery purchase subsidies, and comprehensive subsidy for agricultural materials) [44]. Then, a SEIRS CLPP dissemination model is built on the basis of agricultural subsidies. Different from the classic SEIR model, when agricultural subsidies can affect farmers' planting behaviors to increase yields, recovered will revert to suspected because of the stimulus of agricultural subsidy policies. In SEIRS model, farmers can be divided into four states: Suspected, exposed, infected, and recovered. They represent (1) farmers who have not yet accepted CLPP, but have the potential to accept; the number at time t is recorded as $S(t)$. (2) Farmers who have been exposed to CLPP, but have not yet conducted policy dissemination; the number at time t is recorded as $E(t)$. (3) Farmers who have accepted the CLPP and conducted policy dissemination; the number at time t is recorded as $I(t)$. (4) Farmers who refuse to disseminate the policy after accepting the CLPP; the number at time t is recorded as $R(t)$. The SEIRS policy dissemination model is shown in Figure 2. Suspected farmers will be transformed into exposed farmers with a probability of β . Farmers in the eclipse period cannot disseminate the CLPP to other farmers yet. After a certain eclipse period, the exposed farmers will be transformed into the infected farmers with a probability of σ . After the policy information is obtained, infected farmers will quickly transform into recovered farmers with a probability of γ . The model has two additional parameters. One is the vaccination rate (μ). This parameter is affected by factors such as farmers' level awareness of CLPP, knowledge level of farmers, and whether the policy content is missing. In turn, suspected farmers can be directly transformed into recovered farmers without exposing or disseminating CLPP. The other is ρ . This parameter refers to the probability that recovered farmers will return to suspected farmers as time progresses. Table 1 compares the concepts in the SEIRS model with those in CLPP dissemination.

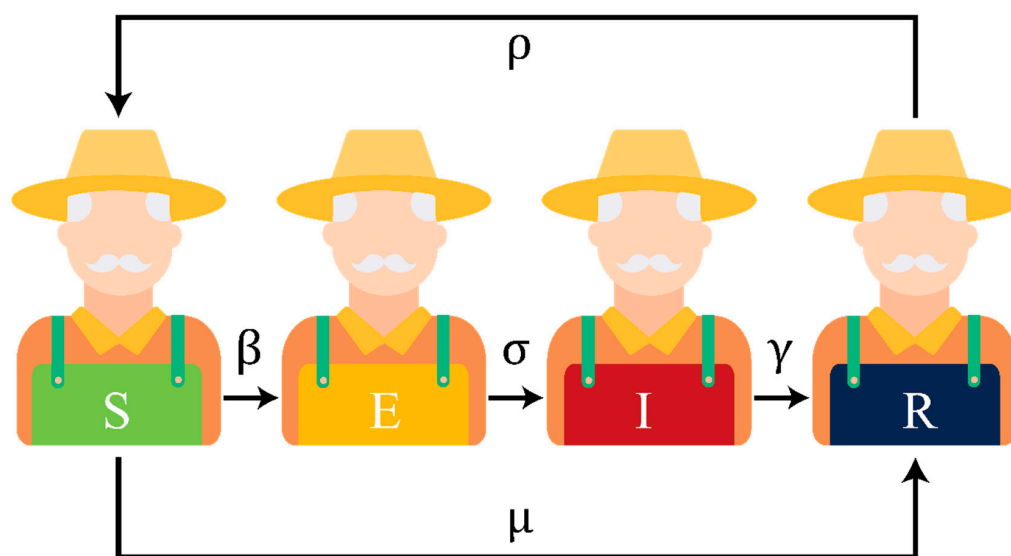


Figure 2. Diagram of cultivated land protection policies (CLPP) dissemination.

Table 1. Concept correspondence.

SEIRS Model	Parameter Description	Meaning in the CLPP Dissemination
Virus	CLPP	CLPP that needs to be disseminated
Suspected (S)	Potential CLPP recipients	Farmers who have not yet accepted CLPP, but have the potential to accept
Exposed (E)	Potential disseminators of CLPP	Farmers who have been exposed to CLPP, but have not yet conducted policy dissemination
Infected (I)	CLPP disseminators	Farmers who have accepted the CLPP and conducted policy dissemination
Recovered (R)	Rejector of CLPP dissemination	Farmers who refuse to disseminate the policy after accepting the CLPP
β	Dissemination rate	Probably of changing from S to E
σ	Prevalence	Probably of changing from E to I
γ	Recovery rate	Probably of changing from I to R
μ	Vaccination rate	Probably of directly changing from S to R
ρ	Immune degradation rate	Probably of directly changing from R to S

β , σ , γ , μ , and ρ are numbers between $[0, 1]$. This study assumes $S(t) + E(t) + I(t) + R(t) = N(t)$, where $N(t)$ is the total number of farmers in a certain village. The differential equation of the SEIRS model is:

$$\frac{dS}{dt} = (N - S) + \rho R - \beta \frac{SI}{N} - \mu S \quad (1)$$

$$\frac{dE}{dt} = \beta \frac{SI}{N} - \sigma E \quad (2)$$

$$\frac{dI}{dt} = \sigma E - \gamma I \quad (3)$$

$$\frac{dR}{dt} = \gamma I - R + \mu S - \rho R \quad (4)$$

For a certain node i in FSN, the conditional probability of connecting with adjacent nodes is:

$$f(Adj_i) = (1 - \prod_{j \in Adj_i \cap Latent} (1 - \theta) y_j) y_i \quad (5)$$

In the formula, Adj_i is the sum of the adjacent nodes of node i , $Latent$ is a collection of exposed farmers, $y_i = 1$ means the node is open, $y_i = 0$ means the node is close, and θ represents the dissemination probability between nodes. The model explanation is shown in Figure 3.

This study supposes that, for node i , the sum of its adjacent node sets is $Adj_i = \{1, 2, 3, 4\}$, where 2, 4 are closed nodes. At time t , if i is not closed, then it will interact with the unclosed node among adjacent nodes with probability θ . If interaction occurs between nodes and j is in the eclipse period, then β has a probability to make i conduct policy dissemination. If the probability of i is considered for policy dissemination from opposing events, then the formula is:

$$\beta \left(1 - \prod_{j \in Adj_i \cap not-seal \cap Latent} (1 - \theta) \right) \quad (6)$$

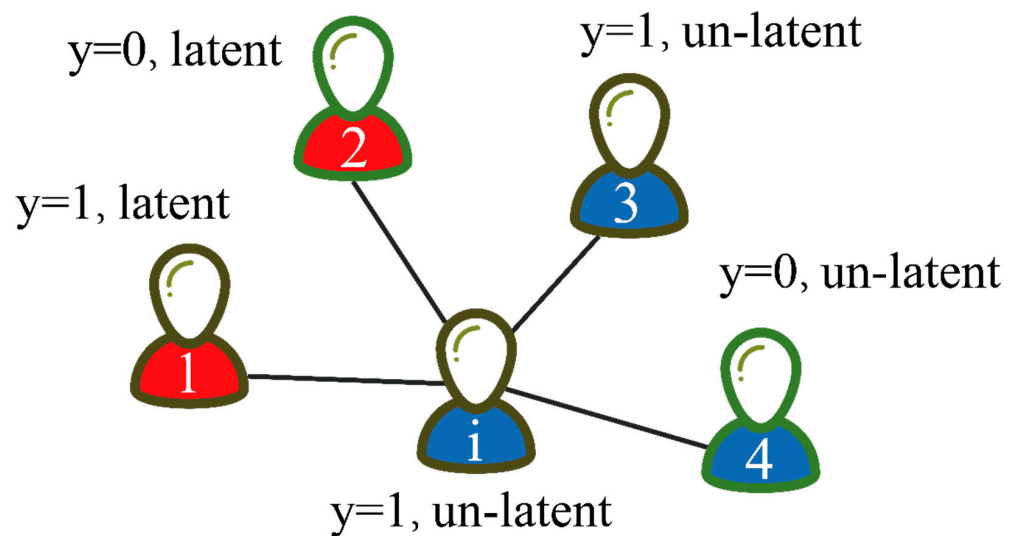


Figure 3. Diagram of farmers' social network (FSN).

To express whether it is closed in mathematics, this study needs to add the y_i variable. In each iteration process, the probability of i being infected is:

$$\beta f_i(Adj_i) = \beta \left(1 - \prod_{j \in Adj_i \cap Latent} (1 - \theta) y_j \right) y_i \quad (7)$$

Among them, $\beta f_i(Adj_i)$ represents the probability of spreading policies among farmers in the FSN. By bringing it into Formula (1), Formula (1) can be transformed into:

$$\frac{dS}{dt} = (N - S) + \rho R - \beta f_i(Adj_i) \frac{SI}{N} - \mu S \quad (8)$$

$$\frac{dE}{dt} = \beta f_i(Adj_i) \frac{SI}{N} - \sigma E \quad (9)$$

$$\frac{dI}{dt} = \sigma E - \gamma I \quad (10)$$

$$\frac{dR}{dt} = \gamma I - R + \mu S - \rho R \quad (11)$$

4. Results and Analysis

4.1. Impact of FSN on CLPP

The impact of CLPP (scale and speed) is affected by social interactions of farmers in FSN, such as dissemination, learning, and imitation. This situation will further affect the decision of whether to conduct CLPP dissemination by farmers. The analysis of the characteristics of FSN in this study mainly includes the dissemination probability θ of policies among farmers and the node degree M_0 . In Figures 4 and 5, the dissemination rates θ of CLPP are 0.0002, 0.0007, 0.003, 0.007, 0.03, 0.04, 0.05, 0.06, 0.3, and 0.5 for a total of 10 groups. The impact of the dissemination rate on the number of recipients of CLPP is explored. Figure 4 shows that, in the initial stage of CLPP, higher θ implies a greater number of policy recipients, faster speed of dissemination, and wider dissemination range. In a balanced state, lower θ means smaller dissemination range. As shown in Figure 5, greater dissemination probability of CLPP in FSN corresponds to more recipients of the CLPP. Among them, the darker the color, the greater the number of CLPP recipients. It can be seen from the Figure 5 that when the policy dissemination rate is lower than 0.03, the CLPP is difficult to disseminate. When the policy dissemination rate is greater than 0.06, the

dissemination capacity of CLPP shows an accelerated growth trend. Therefore, increasing the dissemination rate of CLPP can effectively promote the dissemination of policies.

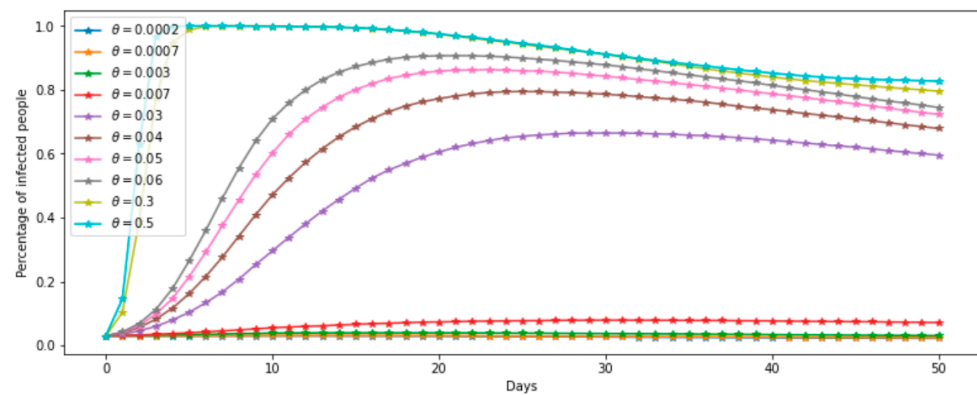


Figure 4. Impact of policy dissemination rate θ on the number of recipients of CLPP.

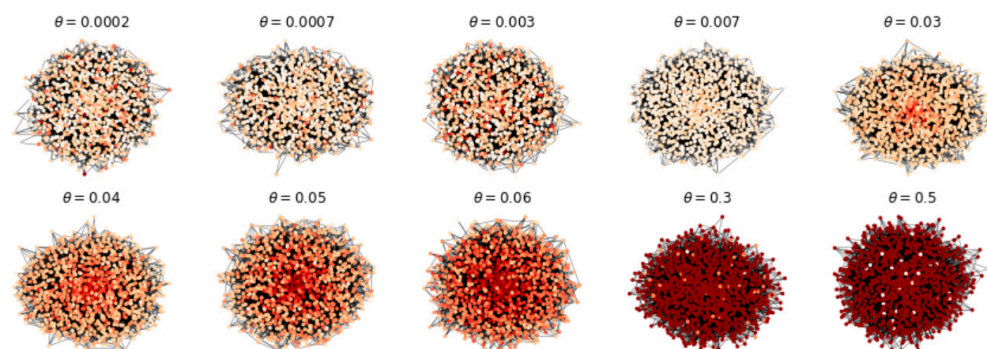


Figure 5. Impact of policy dissemination rate on the evolution of FSN.

The dissemination probability θ is related to the degree of farmers' attention to the CLPP, the attitude of their relatives and friends, the level of farmers' awareness of the CLPP, the media of the CLPP, and the authority of the disseminators. For example, although the popularity of mass media has generally increased the awareness and coverage of CLPP, organizational dissemination and interpersonal dissemination are more important in the process of specific implementation and operation. Among them, the organizational dissemination channels represented by villagers' meetings and publicity conferences can help farmers interpret CLPP in an interactive manner. Thus, these channels become a path for effective dissemination of policy information. However, the effect of dissemination is easily affected by factors such as the diathesis, work ability, and social status of the cadres of the grassroots organizations. However, the state of life, lifestyles, and living conditions of the vast number of farmers in China have great commonalities in geographical space, interests, hobbies, and attitudes. The common geographical relationship and custom culture result in common policy needs of farmers. This situation can effectively prevent the interruption and loss of policies and then complete the whole policy dissemination process. However, interpersonal dissemination has shortcomings such as small amounts of information and limited space range. The mass media (such as the Internet and mobile phones) have the advantages of chronergy, high credibility, and a large amount of information to obtain policy information. However, farmers have less contact with this channel. Thus, the three major policy dissemination channels should be opened up in the future to realize the unimpeded flow of policy information and maximize the effect of various CLPP.

The node degree M_0 represents the number of edges between a certain farmer and other farmers in the FSN. It can be used to measure the degree of direct contact between a certain farmer and other farmers. A basic phenomenon exists in the FSN, that is, a few

farmers have denser edges, and most farmers have fewer edges. From the perspective of FSN, the following explanations can be made: Modern social communication methods are more developed, the activity radius of farmers is enlarged, the social scope is wider, and the scale-free characteristic of FSN is more prominent. The enhancement of the scale-free feature will increase the dissemination speed of CLPP, and its effect is more obvious in the simulation, as shown in Figure 6. Figure 6 shows that the social organization structure of farmers will become closer when M_0 increases, and the average path length between two farmers will be shortened. When M_0 is 1, 2, 4, 6, 10, the average path length between nodes is 6.957, 4.099, 3.162, 2.841, and 2.553. The degree distributions all present power law distribution. Figure 7 shows that under the same disseminating conditions of the CLPP, the dissemination spread is carried out on the network with different connection parameters. As the average path length between nodes decreases, the dissemination speed of CLPP accelerates: When the average path length dropped 54% from 6.957 to 3.162, the dissemination speed increased by 3 times. When the average path length dropped by 19% from 3.162 to 2.553, the dissemination speed increased by 2 times. Therefore, closer social structure of farmers implies faster speed of policy dissemination and increased number of policy recipients.

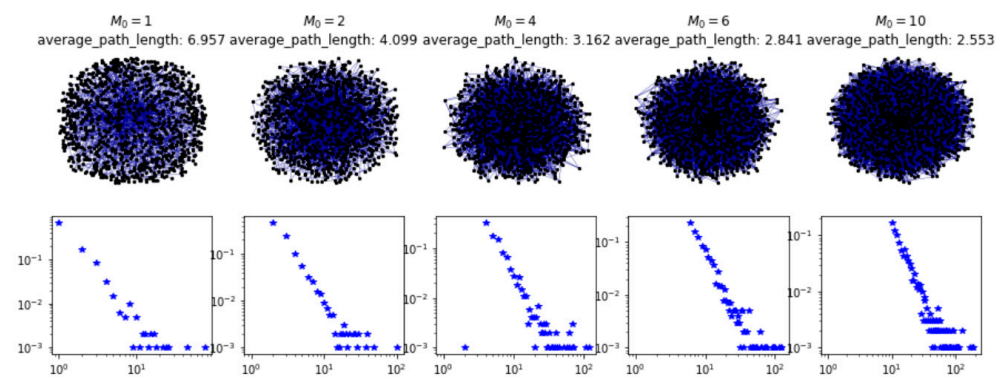


Figure 6. Evolution of the FSN under different node degrees M_0 .

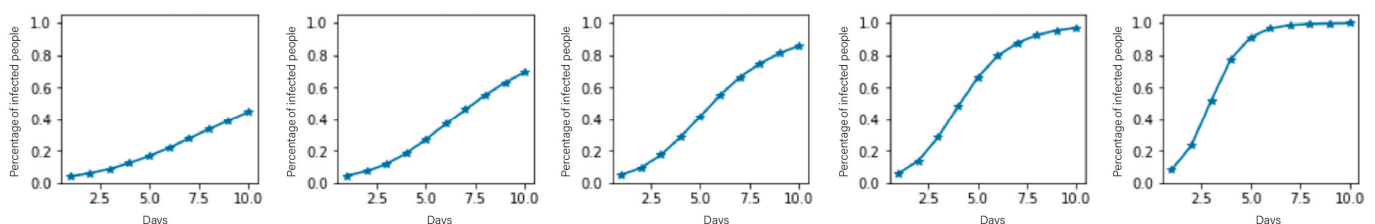


Figure 7. Influence of different node degrees M_0 on the number of policy recipients.

Rural China is a society of acquaintances based on kinship and blood relationships [45]. The mechanism of the FSN on the CLPP dissemination has the following aspects. (1) Policy information dissemination: As mentioned above, farmers' limited access to policies places them in an environment of incomplete information. However, the FSN provides an important channel for the CLPP dissemination. (2) Social learning: Many newly released farmland protection policies are unpopular to most farmers at the beginning of their dissemination. However, the farmers who master the policy first can provide the other farmers with opportunities to learn and imitate through the connection between the networks. Therefore, tighter SN means higher effectiveness of alleviating the policy information constraints of farmers, promoting farmers' learning of new policies, and enhancing the recognition of the quantity and quality protection of cultivated land. This situation will increase the level of perception that CLPP can generate economic, social, and ecological benefits, and ultimately promote the occurrence of CLPP dissemination.

This study conducts three sets of simulation experiments to explore the impact of key nodes (structure holes) on the CLPP dissemination. The first group is the control group, which does not control any key nodes. The second group is to control all the nodes with connected edges greater than or equal to 20 (type-I structure holes). The third group is to control all the nodes with the number of connected edges greater than or equal to 40 (type-II structure holes). As shown in Figure 8, if the type-I structural hole is controlled, then the dissemination scale of CLPP will become smaller. Moreover, the farmers occupying the type-I structural hole position can connect the originally unconnected farmers; accordingly, the average path length of the CLPP dissemination between the farmers will be shortened. This situation will accelerate CLPP dissemination and promote the effective interpretation and implementation of CLPP. Moreover, in view of the characteristics of scale-free networks, the dissemination of CLPP has only been delayed to a certain extent, and has not been fundamentally suppressed. The reason is that farmers have the characteristics of universal contact in FSN, which means that the nodes of farmers do not have to be contacted through key nodes, but can also be indirectly contacted through other nodes. If the type-II structural hole is controlled, then the dissemination scale of CLPP will become larger. The existence of type-II structural holes will result in no direct connection between farmers, which hinders the effective dissemination of CLPP.

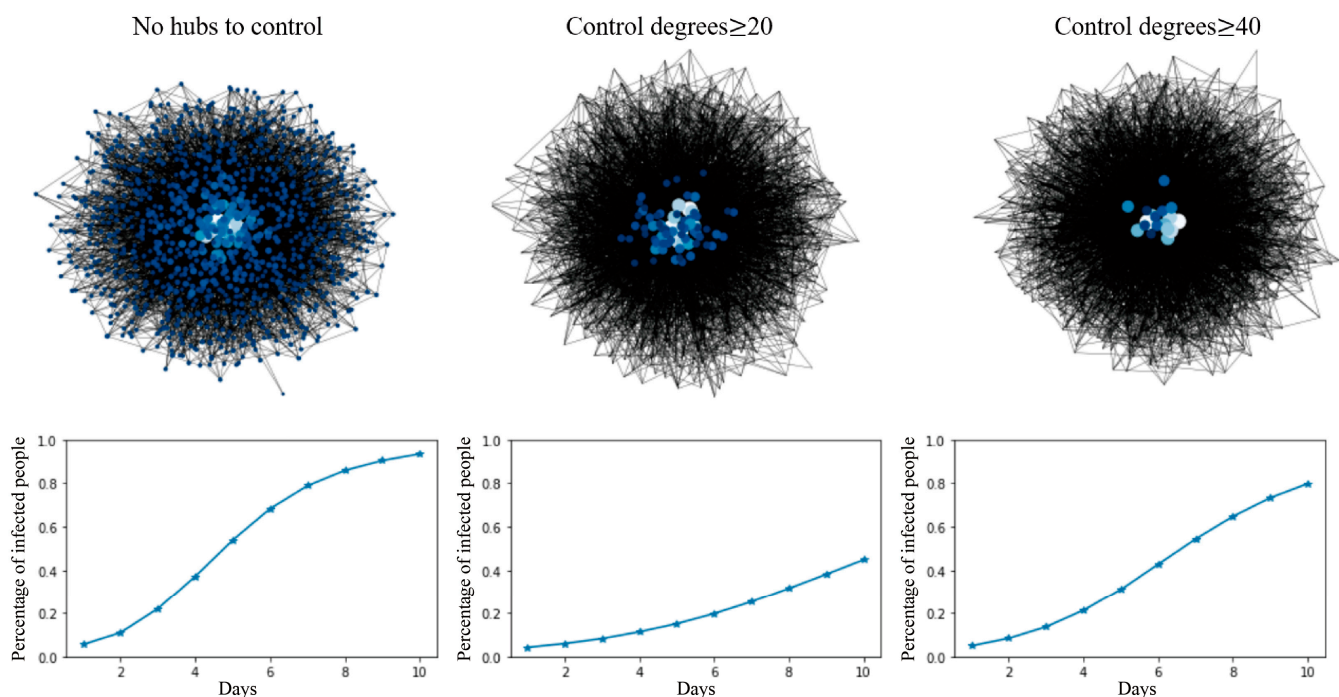


Figure 8. Impact of controlling key nodes (structure holes) on the number of policy recipients.

Structural holes often exist in the FSN. The structural hole is defined as the phenomenon that one or some individuals in the SN have direct connections, but the relationship with other individuals is interrupted. As shown in Figure 9, three members are present. Agents B and C are connected to agent A, but no connection exists between B and C. This lack of direct connection constitutes a structural hole. Farmers occupying these structural holes have information and resource advantages [46–48]. This information and the resources are valuable for policy dissemination. When farmers encounter policy information they do not understand, most of them choose farmers who have a good relationship with them and are more authoritative in policy interpretation for consultation. Authoritative members in the FSN (type-I structural holes) have become opinion leaders in their respective networks, and have a strong influence on whether farmers choose to accept the CLPP. In the complex FSN, farmers in structural holes often connect two or

more groups and act as bridge hubs because they have richer social capital. Furthermore, this situation has the dual significance of control and promotion in the dissemination of CLPP. Therefore, occupying or approaching more type-I structural holes is conducive to the dissemination of CLPP.

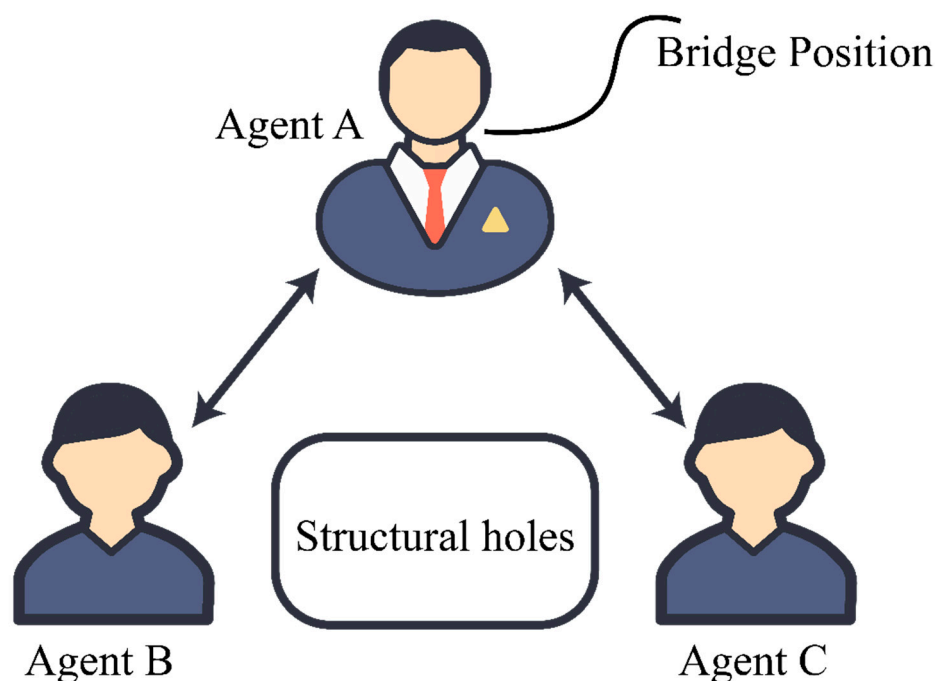


Figure 9. Diagram of structural holes.

However, the current dissemination effect of CLPP in China is unsatisfactory. The main reasons are, first, some government department staff members (referred to here as type-II structural holes) are not good at selecting appropriate and effective modes and media when disseminating CLPP. Second, the CLPP faces the problem of information asymmetry in the process of dissemination. Especially at the grassroots level, some village cadres have considered secreting part of the policy information or only informing relatives and friends in view of their private interests. Thus, the effectiveness of its dissemination and implementation is weakened. Therefore, the spread of CLPP has received serious restrictions which must be eliminated due to the existence of type-II structural holes.

4.2. Numerical Simulation Experiment and Analysis

This study uses Rstudio software to numerically simulate the spreading process of CLPP based on SEIRS model for verifying the correctness of SEIRS model solution and theoretical analysis. The controlled variable method is used to explore the impact of some important parameters in the model on CLPP dissemination.

4.2.1. Impact of Immune Degradation Rate ρ (Probably of Directly Changing from R to S) on the Dissemination of CLPP

In this article, ρ stands for agricultural subsidies. The policy dissemination situation should be compared under the two states of immune degradation rate $\rho \neq 0$ and $\rho = 0$ to analyze the impact of agricultural subsidies on the dissemination of CLPP. For insufficient agricultural subsidies, this study sets $\rho = 0$. That is, the current agricultural subsidy policies are insufficient to change the attitude of farmers to the dissemination of CLPP. If $\rho \neq 0$, then the total amount of agricultural subsidy funds has been continuously increasing, and the content of subsidies has been continuously enriched, which has become an important part of farmers' income sources and thus re-mobilized farmers' enthusiasm for publicizing CLPP. That is, at the next moment, the R farmers will be transformed into

the S farmers again with probability ρ . The remaining parameter values are set as follows: $N = 1500$, $\beta = 0.4$, $\sigma = 0.3$, $\gamma = 0.02$, $\mu = 0.001$. Figure 10 shows the evolution of the number of various types of farmers when the CLPP dissemination of the entire system reaches a balanced state. The figure also shows that the immune degradation rate ρ has a greater impact on I and R farmers, while the impact on changes in S and E farmers is small. With the increase in ρ , the peak value of I farmers increases and reaches a balanced state at a higher level. However, the number of R farmers decreases significantly and finally maintains a balanced state at a lower level. Therefore, good agricultural subsidy policies can promote the re-dissemination of CLPP.

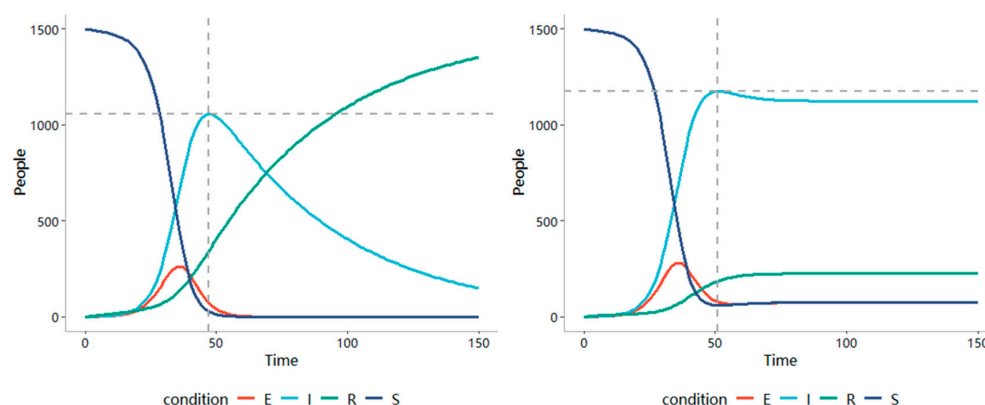


Figure 10. Impact of immune degradation rate ρ (probably of directly changing from R to S) on the dissemination of CLPP.

China has introduced a series of agricultural subsidy policies after 2004 to safeguard the interests of farmers, social stability, and food security [49]. However, many problems arise in the implementation process. (1) The subsidy standard is relatively low, and the increase in agricultural production costs has weakened the effect of the subsidy policies. Agricultural subsidies account for a low proportion of fiscal expenditures. In 2018, China's fiscal expenditure on agriculture, rural areas, and farmers was about 2.1 trillion yuan, and the four agricultural subsidies were only about 157.6 billion yuan, accounting for only about 0.7% of China's fiscal expenditure. Farmers' per capita agricultural subsidies are only about 500 yuan, which is only 5% of farmers' per capita net income, which is significantly lower than that of developed countries such as the United States, Japan, and the European Union (agricultural subsidies generally account for more than 20% of farmers' income, with a high of 40–50%). (2) The operation management mechanism is insufficient, and the subsidy object lacks effective adjustment. First, profit drivers exist in every link of the agricultural subsidy distribution chain. Problems of malfeasance and dereliction of duty by subsidy fund managers often occur as driven by economic interests and political achievements. In addition, the current grain direct subsidy policies are based on land contract rights and lacks subsidies for circulating land. This situation will not only dampen farmers' willingness to circulate land, but also increase the difficulty in disseminating CLPP. (3) The subsidy efficiency is low, and the subsidy pattern needs to be optimized. At present, the central and local governments directly transfer the subsidies to the bank cards of the farmers to ensure that the subsidies reach the farmers successfully. However, when the subsidies reach the farmers, their utilization method is difficult to control. This difficulty will cause agricultural subsidy funds to become the government's indirect income subsidies to farmers, and promoting the dissemination of CLPP will be difficult. Thus, the central government should accelerate the optimization of agricultural subsidy policies to promote their dual effect on increasing farmers' income and grain production, and thus transforming R farmers into S farmers. Finally, the probability that the dissemination of CLPP will reach an ideal state will increase.

In addition, China's agricultural subsidy structure has problems such as irrational and poor sustainability. Agricultural subsidy policy in China focuses on ordinary farmers, but insufficient subsidies for new types of cultivated land operators such as family farms, large professional households, and farmer cooperatives. This subsidy structure protects the backward production methods of scattered small farmers. Farmers in many regions of China do not cultivate or transfer their cultivated land. Even if the farmers sublease the cultivated land, they will increase the land rent to a certain extent. This not only increases the land use cost of the new cultivated land management entities, but also is not conducive to the circulation of cultivated land. This hinders the large-scale operation of cultivated land and restricts the popularization of mechanization, intensive, and standardized production methods of cultivated land. Although, in some pilot areas in China, some subsidies have been provided to the new types of cultivated land operators, the subsidies are generally insufficient, which is not conducive to fostering the main force of modern agriculture in the future. In view of this, future agricultural subsidies should fully consider the rights of survival and development of different entities, and new agricultural subsidies should be tilted towards the entities of large-scale operations.

Furthermore, the rational cultivated land circulation can promote the improvement of cultivated land use efficiency, and further promote the protection and rational use of cultivated land. However, agricultural subsidies can change the expected income of land management, which in turn changes the strategies and methods of land management of farmers, and has a certain degree of negative impact on the cultivated land circulation. On the one hand, agricultural subsidies have become part of the increase in cultivated land rent, and the increase in circulate costs will inhibit the cultivated land circulation, thereby affecting the efficiency of the allocation of cultivated land. On the other hand, direct grain subsidy policies in many regions of China only target the contractors of cultivated land, not the users of cultivated land. In addition, the local government distributes subsidies to land outflows, not to large grain farmers. Therefore, direct grain subsidies do not reflect the policy incentives for large grain farmers, and are no longer suitable for the needs of agricultural development in the context of large-scale cultivated land circulation. This has affected the normal circulation of cultivated land, and objectively is not conducive to the formation of large-scale cultivated land management. In view of this, how to adjust and improve agricultural subsidy policies in the future is an important research direction. In the future, when China's agricultural subsidies do not harm the contractor's vested subsidy benefits, incremental subsidies should be appropriately tilted to operators. Then resolve the conflict between agricultural subsidy policy and cultivated land circulation, realize the coordinated development of agricultural subsidy policy and cultivated land circulation, and promote the reasonable implementation of CLPP.

4.2.2. Impact of Vaccination Rate μ (Probably of Directly Changing from S to R) on the Dissemination of CLPP

In this paper, μ represents the farmers' perception. The difference in CLPP dissemination should be analyzed under the two situations of $\mu \neq 0$ and $\mu = 0$ to verify the impact of farmers' perception on the dissemination of CLPP. When farmers' perception of CLPP is high, this study sets $\mu = 0$. That is, the improvement in cultivated land fertility leads to an increase in output, the treatment of soil pollution leads to an improvement in the production environment of farmers, and the protection of cultivated land quality can ensure the health of agricultural products. The abovementioned measures can form interest perception in the psychology of farmers. This situation in turn encourages farmers to disseminate policies in their SN. When farmers' perception of the dissemination of CLPP is low, this study sets $\mu \neq 0$. That is, many new policies and technologies are unpopular to farmers and the relatively low interest of cultivated land protection will make farmers less active in protecting cultivated land, engaging in food production, and disseminating CLPP. This situation will lead to the next moment, that is, S farmers will directly transform into R farmers with μ probability. The remaining parameter values are set as follows: $N = 1500$, $\beta = 0.4$, $\sigma = 0.3$, $\gamma = 0.02$, $\rho = 0.01$. Figure 11 shows that increasing the direct

vaccination rate μ has a greater impact on I and R farmers, and the speed at which all types of farmers reach a balanced state can be accelerated. As μ increases, the number of I farmers will be decreased, and the range of changes in E farmers will be reduced. Thus, the time it takes for S farmers to change to R farmers will be directly reduced. Therefore, raising the level of farmers' perceived benefits of cultivated land protection can promote farmers' involvement in the dissemination of CLPP.

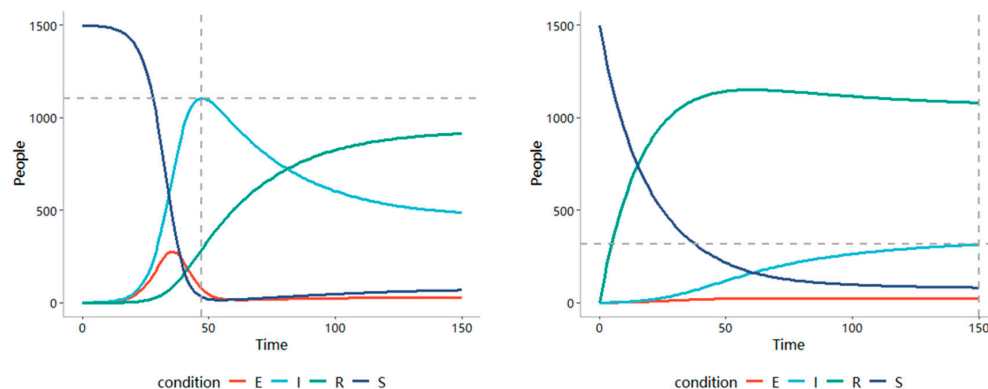


Figure 11. Impact of vaccination rate μ (probably of directly changing from S to R) on the dissemination of CLPP.

Farmers' evaluation of the benefits of implementing CLPP is the result of a combination of multiple factors. It is affected not only by information and public opinion, but also by factors such as farmers' livelihood asset status, objective adaptability, past risk experience, cognitive bias, and intuitive judgment. The perceived value of farmers as rational people is considered an important basis for whether a certain economic behavior occurs [50]. After farmers compare and weigh the benefits and costs of implementing CLPP by applying the theory of perceived value to cultivated land protection research, they will form a subjective understanding of value differences. Moreover, rational farmers often pursue maximization of income and minimization of costs. Therefore, the perceived value of farmers should include economic output, ecological service function, and social security values in the process of implementing CLPP. However, the social and ecological benefits brought by the protection of cultivated land resources belong to the public domain and have certain attributes of public goods. The positive external benefits brought by the protection of cultivated land are difficult to reflect in currency due to the non-exclusive nature of public goods consumption. Therefore, farmers often only pay attention to the economic value, but deliberately deviate from and shield government regulations on cultivated land environmental protection in the process of cultivated land utilization. In addition, according to land use indicators, areas with rapid urbanization, developed secondary and tertiary industries, and large areas of construction land can be used for non-agricultural development of cultivated land. However, areas with developed agriculture, superior terrain environment, and rich cultivated land resources must assume the responsibility of cultivated land protection and have no right to conduct non-agricultural construction of cultivated land. The abovementioned regulations meet the requirements of the spatial layout planning of productivity and are conducive to the large-scale operation of cultivated land and the effect of urban economic agglomeration. However, the fact that agriculture is a weak economic industry, which has a significant negative impact on farmers' perception of fairness in income distribution, is ignored in the distribution of land benefits. In some areas of China, farmers still violate the "Basic Farmland Protection Regulations", such as occupying cultivated land and adjusting agricultural planting structures without authorization [51]. Therefore, local governments and village collectives should give farmers more humanistic care and concerns. Increasing the level of economic compensation for cultivated land protection and implementing differentiated compensation methods are necessary. The demands of various stakeholders in cultivated land protection should be

balanced to improve the level of farmers' perceived benefits. Accordingly, the effective dissemination of CLPP can be guaranteed.

5. Conclusions and Policy Implications

This study combines the structural characteristics of FSN with the SEIRS model, constructs a CLPP dissemination model, and discusses the dissemination laws of CLPP in FSN. Numerical simulation is used to simulate the dissemination process of CLPP, and the characteristics of its dissemination law are observed by adjusting the main parameters. Additional scientific guidance and suggestions for the dissemination of CLPP are provided, which have certain theoretical and practical significance. The main conclusions of this study are discussed as follows:

- (1) The structural characteristics of the FSN have an important influence on the dissemination of CLPP. In the FSN, the greater initial dissemination rate of CLPP corresponds to larger scale and faster speed of CLPP dissemination. The time to reach the peak of dissemination is shorter, and the proportion of policy recipients is greater when the demonstration effect among farmers is more obvious. The CLPP dissemination rate in the FSN can be increased by increasing the total amount of farmers' policy information and improving efficiency of media utilization. However, incomplete modern network infrastructure construction in some rural areas of China and the limited cultural level of farmers have resulted in the inefficient dissemination of CLPP (the habit of farmers to obtain policy information is still based on interpersonal dissemination).
- (2) A greater node degree of the FSN means shorter average path length between farmers and more structural holes occupied, which are highly conducive to the dissemination of CLPP. Most farmers in the process of dissemination of CLPP in China have problems such as incomprehension of the policy and inconsistent understanding. Therefore, an effective method for CLPP dissemination is to find farmers who act as opinion leaders in rural society (type-I structural holes) and fully utilize the influence of opinion leaders to promote the dissemination of CLPP. When the CLPP is disseminated in the FSN, the structural holes occupied by village cadres (type-II structural holes) should be eliminated, and the sharing of policy information among farmers outside the type-II structural holes should be realized.
- (3) The following observations are obtained from the numerical simulation results of the SEIRS model. On the one hand, higher immune degradation rate ρ (agricultural subsidy policies) implies faster and wider dissemination of CLPP. Therefore, increasing the immune degradation rate ρ can transform R farmers into S farmers as much as possible. This situation increases the dissemination of CLPP. On the other hand, the vaccination rate μ (the level of farmers' perceived value) is an important factor in the dissemination of CLPP. Higher vaccination rate μ indicates shorter transition time from S farmers to R farmers and smaller range of the dissemination of CLPP.

On the basis of the abovementioned research conclusions, this study proposes the following policy recommendations:

- (1) Improving the policy dissemination rate. From the perspective of farmers, the dissemination of CLPP must be based on improving the knowledge of farmers. At this stage, problems such as limited education of farmers, poor adaptability to new media, and low media quality are the main obstacles affecting policy understanding. Therefore, the effective dissemination of farmland protection policies primarily considers the cultural level, level of policy acceptance, and habits of farmers. The local government should improve the re-education and training system centered on improving the quality of farmers to stimulate the initiative and enthusiasm of farmers' policy needs. From the perspective of local governments, the dissemination channels for CLPP need to be diversified. Local governments need to establish a sound policy dissemination network, change the single dissemination channel, fully utilize modern dissemination

technology, give full play to the role of new media, and enable the effective and rapid dissemination of CLPP.

- (2) Exerting the influence of opinion leaders (type-I structural holes) in FSN. The results of this study suggest that local governments should pay attention to cultivating farmers' opinion leaders who have a higher education level, a larger SN, and are good at accepting new things to promote the dissemination of CLPP. First, the local government should strengthen the construction of the FSN to improve and strengthen the relationship between farmers, and the FSN with significant network structure characteristics should be formed to establish an effective platform for promoting the dissemination of CLPP. In addition, local governments must fully utilize the demonstration effect of opinion leaders. Specifically, local governments need to treat opinion leaders as first-level dissemination targets. This task requires not only to increase their awareness of the dissemination of CLPP, but also to improve their sense of responsibility, policy literacy, and policy ethics. Second-level dissemination through opinion leaders to surrounding farmers will eventually achieve the popularization of CLPP.
- (3) Weakening the influence of grassroots cadres in the FSN. First, local governments should promote the openness of the CLPP dissemination process. Local governments should initiate the production of a manual for the dissemination of CLPP. They should also announce specific measures such as the allocation of funds for agriculture preference policy to ensure the transparency of CLPP. Furthermore, obtaining the complete content of the CLPP is convenient for farmers. In addition, the quality of policy disseminators needs to be improved. Local governments should strengthen ideological and political education for policy disseminators, strengthen their interpretation of CLPP, and enable policy disseminators to devote themselves to the CLPP dissemination. Finally, a third-party supervision mechanism for the dissemination of CLPP should be constructed. Improving the supervision and feedback mechanism can effectively monitor and intervene in the process of policy dissemination. Accordingly, the effectiveness of the CLPP dissemination can be enhanced.
- (4) Improving the immune degradation rate (agricultural subsidies). China's agricultural subsidy policy reform needs to start from three aspects: The amount of agricultural subsidies, the scope of agricultural subsidies, and the modes of agricultural subsidies. First, the amount of agricultural subsidies should be increased to mobilize the enthusiasm of farmers in production and ensure that grain production does not decline given that the comparative benefits of agricultural production are declining annually. Therefore, the total amount of agricultural subsidies should be continuously expanded in accordance with the principle that the increase in agricultural subsidies is significantly higher than the increases in fiscal expenditure and agricultural production costs. In addition, the scope and objects of agricultural subsidies need to be expanded, and agricultural subsidies should be promoted to tilt toward new agricultural business entities (family farms, farmer cooperatives, and large grain growers) and to protect the ecological environment (soil testing for fertilizer formulation). Finally, the various affecting factors of cultivated land protection behavior of farmers need to be analyzed, and agricultural subsidy funds should be arranged in a targeted manner. Differentiated agricultural subsidy policies need to be implemented, and the supervision of subsidy implementation should be strengthened to realize the optimization of agricultural subsidy modes. The abovementioned measures can promote the re-dissemination of CLPP.
- (5) Reducing the immunization rate (improving the perceived benefits of farmers). At present, the perception of economic value is still a key factor for farmers to protect their cultivated land. Therefore, local governments should actively promote land circulate and the development of agricultural socialized service systems to create favorable conditions for large-scale farmland management, increased grain production, improved agricultural efficiency, and enhanced farmers' income [52]. This situation

will increase farmers' perception of economic value of cultivated land protection and lower the threshold for farmers to participate in cultivated land protection. Farmers' perceptions of ecological and social values also play an important role in the decision-making process of whether to participate in cultivated land protection. Thus, the relevant departments should strengthen the popularization and publicity of environmental disasters in cultivated land production. Accordingly, farmers will have a comprehensive understanding of the environmental disaster risks faced in the process of cultivated land production and operation. The risk perception level of farmers needs to be improved and the concept of sustainable development of cultivated land for farmers should be established to improve their awareness of CLPP.

- (6) Build a dissemination system for CLPP in China. The construction of CLPP dissemination system now involves many policy information entities, including both the supplier and the demander of information. Therefore, the modern CLPP dissemination system should be led by government construction and management, with new farmers as the key dissemination media, and serving farmers as the fundamental goal. The central government has a large amount of useful agricultural information, and regularly releases statistical data, policies, regulations, and system construction to the agricultural sector through public services, which can promote the development of informatization of CLPP. In addition, county governments should be regarded as the main body of the disseminate of CLPP. County governments often cover all cultivated land protection information in a region. Therefore, the county government should be the main starting point of dissemination, which will help to form a standardized and effective CLPP information network and play a role in reducing the CLPP information asymmetry.

At present, although CLPP has constituted a dissemination system mainly based on administrative-led public welfare communication, and supplemented by multiple entities represented by universities, agricultural research institutes, leading agricultural enterprises, and agricultural cooperatives. However, there is no integration effect between these entities. The reason is that these entities follow different goals, have a weak sense of cooperation, and lack of motivation for cooperation. Therefore, there is a dilemma that even multiple systems cannot achieve effective dissemination. The dissemination of CLPP is actually a process of interactive communication and informal education, which is a long-term project. It is difficult for various entities in the traditional CLPP communication system to achieve long-term interaction. As a new type of professional farmers in the Internet age, new farmers have a strong initiative. After they enter agriculture, they will have an integrated effect with the traditional CLPP dissemination system. Moreover, new farmers pay attention to the introduction of cultivated land protection technology from universities, scientific research institutes, leading agricultural enterprises and other institutions, and promote cultivated land protection technology from laboratories to cultivated land. In addition, new farmers work together with traditional farmers through employment, cooperation, and other methods. In fact, a long-term interaction mechanism has been established, which can provide farmers with time guarantee for learning, observation, consultation, and answering questions. From a spatial perspective, due to the geographical proximity, new farmers make it easier for farmers to access and gradually understand the new CLPP and technologies, thereby effectively promoting the promotion and diffusion of CLPP. In view of this, the future should promote the integration of new farmers and traditional CLPP dissemination system, and then promote the effective dissemination of CLPP.

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