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Complexity Review of NIMBY Conflict: Characteristics, Mechanism and Evolution Simulation

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Abstract: In the process of modernization and urbanization, some government projects or facilities with negative externalities have caused the psychology of residents nearby to "Not in My Backyard" (NIMBY). That is, adopting strong and resolute, sometimes highly emotional collective opposition or even resistance behavior. This triggered a NIMBY conflict. From the perspective of Complexity, this study re-examines the characteristics and evolution mechanism of NIMBY conflict and draws the following conclusions: (1) NIMBY conflict is a complex system that interacts between multiple subjects and the environment; (2) Adaptability is the driving force for the evolution of NIMBY conflict. Through detectors, regularizers, and effectors, NIMBY subjects can be encouraged to gradually adapt to changes in the external environment and maximize their own interests; (3) In NIMBY conflict, the government conflict response method is more important than the intervention time. Residents' communication efficiency and connection probability will affect residents' behavior choices. The lower the residents' communication efficiency, the less likely it is to form a NIMBY conflict.

Keywords: NIMBY conflict; complex adaptive system; complexity characteristics; evolution mechanism; agent simulation

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1. Introduction

NIMBY is the acronym of the English phrase not in my backyard. It refers to the economic projects or public facilities planned by government departments (such as garbage dumps, nuclear power plants, funeral home, etc.), which produce benefits shared by the whole society, but the negative external effects are borne by nearby residents. For example, affecting the physical health of nearby residents, deteriorating the quality of the surrounding environment, etc., so they were dissatisfactory and excluded by the residents around the site selection [1]. The project or facility involved in this is the NIMBY facility. The NIMBY facility has sparked people's aversion and fostered a mentality of "not building in my backyard". That is, adopting strong and resolute, sometimes highly emotional collective opposition or even resistance behavior. This triggered a NIMBY conflict [2]. When NIMBY conflict intensifies and citizens' awareness of rights protection becomes stronger, a more extreme movement may emerge—"Build Absolutely Nothing Anywhere Near Anything", or BANANA. The concept opposite to NIMBY conflict is the neighbor-happy effect, that is, Please in My Backyard (PIMBY), which means that the construction of project facilities that is beneficial to the life of nearby residents and the development of the region. For example, it is beneficial to environmental protection, improving infrastructure, increasing employment opportunities, increasing fiscal revenue, etc., making the public support and welcome the construction of project facilities in their own backyards [3,4].

With the rapid advancement of urbanization, in order to meet people's "needs for a better life", urban infrastructure construction is increasing. Among them, constructing "NIMBY" facilities can enhance the overall interests of society. However, its apparent

negative externality has brought direct or potential harm to residents, and the resulting group conflicts occur frequently. For example, some environmental pollution projects (such as chemical projects, garbage disposal sites, incinerators, sewage treatment plants, etc.), risk-gathering facilities (nuclear power plants, gas stations, etc.) and psychologically unpleasant or disgusting facilities (such as funeral parlors, infectious disease hospitals, prisons, mental hospitals, elderly care centers, etc.), while benefiting all residents, inevitably threatens or damages the mental health, environmental interests, and economic interests of residents in the host community [5,6], which leads to frequent group conflicts. From the Guangdong Meijing Substation in 2006 to the Dalian PX project in Liaoning Province in 2011, the Ningbo PX project in Zhejiang Province, the Tianjin PC project, and the Shifang Hongda Molybdenum Copper project in Sichuan Province in 2012, to the Lianyungang Nuclear Power Plant project in Jiangsu Province in 2016, the scale of conflicts arising from NIMBY issues has been increasingly expanding, with escalating levels of confrontation. Moreover, these conflicts have exhibited a trend towards becoming "normalization" [7]. Typical mass protest behaviors include local people collectively petitioning, taking to the streets, besieging party and government agencies, sit-in petitions, gathering crowds to make trouble, and even setting fire to public facilities, etc. [8]. Therefore, some scholars have suggested that China has entered the "Nimby Era" [9]. The occurrence of the NIMBY conflict has aggravated social instability and uncertainty, damaged the government's public image, and endangered the safety of people's lives and properties. Therefore, properly resolving NIMBY conflict and changing "NIMBY" into "PIMBY" has become an important yardstick for measuring the governance capabilities of urban managers.

The study of NIMBY conflict began in the 1970s. O'Hare first introduced the concept of "NIMBY" into the academic circle [10]. It is used to represent residents' resistance to certain public facilities that can bring overall social benefits but have negative impacts on surrounding residents. O'Hare's interpretation and definition of NIMBY laid the foundation for the connotation of NIMBY conflict. Since then, most of the relevant researchers have defined the resistance movements of local residents triggered by NIMBY facilities as NIMBY conflict. For example, Popper, among others, believes that NIMBY facilities that can bring public benefits but have negative externalities often lead to opposition from surrounding residents and trigger NIMBY conflict. In the 1980s and 1990s, scholars began to discuss negative external effects, site selection conflicts and governance issues of NIMBY facilities. For example, Aldrich Daniel P. has proposed that civil society factors can influence the outcome of site selection. Specifically, when local civil society forces are highly concentrated, it becomes more challenging to successfully implement state-planned projects [11]. Walsh E. has studied the site selection controversy of modern incinerators from the perspective of equity and technology movements and found that technology movements are particularly affected by an interaction of factors which figure less proposed in equity movements [12]. Some scholars also believe that because the public lacks trust in the nuclear industry, the site selection and construction of nuclear power plants become difficult [13]. Later, it developed to study NIMBY conflict from the perspective of political democracy. For example, liberal Jewish organizations have discovered that in a typical free white community, factors related to social integration, such as political integration and life integration, influence the decisions of Jews when it comes to choosing their place of residence and conducting business [14]. After the 21st century, the research topic of NIMBY conflict has shifted with the changes in the social and political environment. For example, the development of informatization has prompted scholars to analyze the phenomenon of NIMBY from social networks, new media, etc. [15]; the scarcity of energy in the world has prompted scholars to pay more attention to nuclear energy, wind energy and other new energy facilities and the conflicts they bring, etc. [16]. With the complexity of NIMBY practice and the deepening of theoretical research, words such as "NIABY" (Not In Anyone's Backyard), "LULU" (Locally Unwanted Land Used), "BIYBTIM" (Better In Your Backyard Than In Mine), "NIMTOO" (Not-In-My-Term-Of-Office), "NOPE" (Not On Planet Earth), "NIMBY Syndrome" and "NIMBYism" have gradually appeared in the academic circle. The appearance of words

such as "NIABY", "LULU" and "NOPE" indicates that the range of objects of NIMBY resistance continues to expand. However, in essence, it still refers to the behavior and performance of local residents opposing the construction of NIMBY facilities, so most scholars still use the concept of NIMBY to conduct related research. The emergence of words such as "NIMBY Syndrome" and "NIMBYism" indicates that the incentives for NIMBY conflict are gradually increasing, and the fact that public facilities damage the natural environment and the health of residents is no longer the only or main reason for surrounding residents to initiate resistance. Subjective attitudes or psychology such as worries about potential risks, environmentalist trends, and doubts about policies and technologies have all become possible causes of NIMBY conflict [17].

The practical dilemma of the NIMBY conflict has attracted widespread attention from scholars. Scholars and research institutions from various countries have explored the nature of NIMBY conflict from different disciplines and theoretical perspectives, forming two fields of discussion: "Conflict Interpretation" and "Conflict Governance". The former focuses on the causes and evolution mechanism of the NIMBY conflict, while the latter focuses on the governance strategy of the NIMBY conflict. The interpretation of conflict is undoubtedly the core of scholars' attention because only by following the cause can we propose a targeted and operable governance strategy. For the interpretation of the conflict, scholars generally follow two primary paths.

The first path starts from the macro-external environment and believes that the occurrence of NIMBY conflict is restricted by the external environment and is a cluster behavior induced by rapid changes in social structure and situational factors. The representative views are as follows: The first is the "Social Transformation Theory". For example, based on the analysis of dozens of NIMBY incidents, Hu X.M and Wang F. found that China is in the period of industrialization and needs large-scale construction, and there are many new projects including NIMBY facilities, so there are more possibilities to trigger NIMBY conflict. At the same time, it is proposed that the Chinese-style NIMBY event presents a three-stage evolution logic of "project establishment-protest-stop", which has the characteristics of collusive decision-making, irrational protest, and no-winner outcome [18]. Guan Z.G. also analyzed the deep social background of mass protests caused by NIMBY facilities and believed that their country is in a period of social transformation, the political system is gradually opening up, and the government's ability to control residents is beginning to weaken, which increases the possibility of NIMBY conflict [19]. The second is the "Right Awakening Theory". For example, Sun X.Y. believes that the problem of NIMBY is an environmental struggle based on the improvement of public awareness of environmental protection [20]. Wang D.L. and Sun Q.Q. also pointed out that NIMBY conflict is a community practice and environmental movement that strives for rights and interests around the living environment. The "moral dilemma of environmental rights protection and the extrapolation of civic responsibilities, transition problem of emphasizing interests and ignoring the concept of environmental protection, and the priority of living environment and social development" element formed in NIMBY conflict constitutes the three dimensions of the NIMBY conflict rights and three differentiating concepts for both sides of NIMBY conflict [21]. Finally, "Network Field Theory". For example, according to the "discourse theory", Kang M. and Jang J. found that in the site selection process of radioactive waste disposal facilities, different subjects formed different framework strategies based on the discourse function to present their own views and try to obtain other subjects' recognition of their own views [22]. Yang Y.J. and Liu S.H. used the ternary space model from the perspective of field theory to analyze the NIMBY movement caused by the construction of a hazardous waste center in X town in the Pearl River Delta from the perspective of communication [23]. Taking the information cocoon as the analysis perspective, Chen Y. et al. constructed an analysis framework according to the rationale of individual-level information input-group-level information interaction and revealed the internal mechanism of the evolution of NIMBY cluster behavior in the Internet age through the case analysis of the Lianyungang anti-nuclear incident [24].

The second path starts from the micro-subject relationship and believes that the occurrence of NIMBY conflict is the balanced result of the interactive game between the groups involved and is the irrational behavior of the group caused by individual rationality. The representative views are as follows: The first is the theory of "Conflict of Interest Theory". For example, Liu D.H. is concerned about the game of interests between protesters, the government, and operating companies [25]. Hua Q.H. also believes that the conflict of interests and needs is one of the manifestations of NIMBY conflict [26]. Meng W. and Kong F.B. believe that the construction and operation of NIMBY facilities is "cost concentration-benefit dispersal" for community residents, but it is "cost dispersal-benefit concentration" for the government and enterprises. Both of these situations are manifestations of an imbalance in the distribution structure of policy interests and are the root causes of NIMBY conflict [27]. The second is the "Uneven Risk Distribution Theory". For example, Susana B. and Devine-Wright P. proposed to use "social representation theory" to explain citizens' different responses to renewable energy technologies, that is, how to influence audiences' attitudes through the role of representation, identity, and communication [28]. Hou G.H. and Wang Y.D. took the "Asuwei Garbage Factory Protest Incident (1994–2014)" as a blueprint and proposed a NIMBY risk chain system of "real risk-perceived risk-social stability risk". The determinant factors and generation mechanism have been preliminarily sorted out theoretically, and the "NIMBY risk chain evaluation index system" has been constructed [29]. Based on the empirical research on the development of coalmine facilities, Zhu Z.W. et al. explored the influencing factors and internal relationships that affect the acceptance of coal mine facilities by the local people and found that the local people believed that the unfair distribution of "benefit-risk" was the root cause of their initiation of NIMBY conflict [30]. Zhang H.Z. also pointed out that the site selection of NIMBY facilities is a process of risk allocation, and the injustice of risk allocation is an important reason for NIMBY conflict [31]. The third is the "Public Value Failure Theory". Wu Y.Z. and others regard the problem of NIMBY as a failure of public value management—that is, a structural conflict between government values and values pursued by society [32]. Yu P. and Chen Y. believe that environmental NIMBY governance from the perspective of public value pursues the maximization of the public value set, presenting a unity of political value, economic value, social value, and ecological value that coexist and interact with each other [33]. Finally, there is the "Lack of Trust Theory". Lu Y.X. et al. and Zhang L. et al. pointed out that the lack of public trust in the government hinders the communication of NIMBY risks, which is an important reason for the occurrence of many NIMBY movements [34,35]. In addition, some scholars have integrated the above elements and believe that subjective cognitive factors such as interests, risks, and trust can have an impact on social acceptance, leading to the occurrence of NIMBY conflicts. The essence of such research is to view social acceptance as a mediating variable that connects the aforementioned elements with avoidance conflicts. For example, Wang Yang's research suggests that self-efficacy plays a significant and positive role in shaping public acceptance, particularly through the perception of interest risk [36]. Li Wei, on the other hand, has proposed a cognitive-emotional coupling framework to uncover the underlying mechanisms behind residents' acceptance. Furthermore, by integrating the structural equation model and complex network dynamics, an acceptance-diffusion model has been developed, revealing that factors such as risk, benefit, trust cognition, and emotion directly impact residents' acceptance [37].

Although the existing NIMBY research results have deepened human understanding of the NIMBY phenomenon, the occurrence process of NIMBY conflict, and its evolution processes, due to the dynamics and uncertainty of the NIMBY conflict occurrence environment and the complex and changeable conflict process, the conflict results are complex and challenging to control. At the same time, the process of conflict involves intricate relationships among multiple stakeholders, which makes the Complexity characteristics of NIMBY conflict particularly prominent. That is to say, the evolution of NIMBY conflict is essentially a complex phenomenon generated by the interaction of micro-subjects within

the system in an objective environment [38]. However, the academic community has not yet explored the interaction mechanism between the behavior of various stakeholders in the NIMBY conflict and the macro-environment. Although scholars have also attempted to explore the relationship between stakeholders, for example, Prados studied the relationship between economic activities and rural development, treating enterprises and residents as key players in NIMBY conflict in their neighborhoods [39]. However, it is undeniable that in the management context of China, the construction site selection of NIMBY facilities cannot be separated from the government's leadership or support, and current research has overlooked the government as a key subject. So, in China's governance scenario, how does the behavior of various stakeholders (mainly residents, government, and related enterprises) interact with the macro-environment in NIMBY conflict? What are the influencing factors? In order to solve the above problems, this paper re-examines the characteristics of NIMBY conflict from the perspective of complex adaptation theory. On this basis, based on the stimulus–response model in complex adaptive system theory, this paper profoundly analyzes the various subjects in NIMBY conflict and their interaction mechanism with the environment, builds a stimulus–response model to explain NIMBY conflict, and uses the Agent simulation method to simulate the evolution process of NIMBY conflict, to provide a new reference for NIMBY governance. The conclusion not only enriches the scope of application of complex adaptation theory, but also expands the research boundary of NIMBY conflict, which has certain theoretical significance and practical value.

2. Complexity Characteristics of NIMBY Conflict

With the development of society and the improvement of human cognitive ability, the scale of the system that human beings pay attention to is increasing, and the function and structure of the system are becoming increasingly complex. Therefore, scholars have proposed the concept of a complex system. Since Bertalanffy first proposed the concept of complex systems in 1928, and Qian Xuesen proposed complex giant systems, the development of complex system theory has gone through three generations: from the 1930s to the 1950s, complex systems were called the "Cybernetics Era". New concepts such as information, control, and feedback study the operation of the system, and find that there are universal control laws in the fields of biology and engineering [40] (pp. 2–35). The second-generation complex system concept originated from the synergy theory and dissipative structure theory in the 1970s. Scholars began to pay attention to the individual in the system but believed that the individual was static rather than dynamic. That is, the individual lacked goals and directions and could not change their behavior habits through the accumulation of learning and experience [41] (pp. 1–23). In the 1990s, scholars began to pay attention to the interaction between individuals and the environment in the system. J.H.Holland of the Santa Fe Institutes (SFI) in the United States proposed the Complex Adaptive System (CAS) theory for the first time on the basis of years of research on complex systems and proposed the concept of "Adaptive Subject". That is, at the micro level, the subject with adaptability fits to the environment in the process of interacting with the environment. At the macro level, the interaction is between subject and subject, and subject and system. It is manifested as a complex evolution process such as system emergence, nonlinearity, and hierarchical structure [42] (pp. 4–16), which opens up a new field of vision for studying the behavior of complex systems. The core idea of CAS theory is "adaptability creates complexity". Members in the system are adaptive subjects, who constantly "learn" and "accumulate experience" in the interaction with the environment, so as to adapt to the environment and other subjects and promote the development and evolution of the system. From the perspective of management, NIMBY conflict is a typical representative of this kind of complex adaptive system. The "Person" is the basic unit of adaptive subjects in the process of NIMBY conflict, including governments, enterprises, and residents. The "Aggregation" of people forms conflict subjects such as government–business complexes and resident organizations, that is, higher-level subject units. The continuous interaction between subjects and between subjects and the environment makes the overall state of the

community present a complex state of complex nonlinear dynamic changes. Therefore, Complex Adaptive System Theory provides a reasonable window for interpreting the complexity of NIMBY conflict. Starting from the complex adaptive system theory, the complexity characteristics of NIMBY conflict mainly include the following aspects:

- Aggregation. The NIMBY conflict system is a multi-dimensional network structure composed of stakeholders such as residents, government, and related enterprises. At the subject level, each stakeholder is represented as a single node, and at the same time, each single subject node will form a new subject due to incentives such as value and interest convergence and identity recognition. During this process, subjects are not simply gathered mechanically, and the original subject nodes do not disappear, but a new type of higher-level subject nodes appears better to adapt themselves to changes in the living environment. At the aggregation layer, the subject appears as a group composed of a certain number of homogeneous individuals, such as a community alliance composed of residents of anti-NIMBY facilities. Although each resident has different specific cognitions and risk perceptions about NIMBY facilities, residents are not isolated actors. Once stimulated by changes in the external environment (for example, residents are not invited to participate in decision-making during the site selection process of NIMBY facilities), residents will have the same emotions and value appeals and thus gather together to form a new organization, in a more powerful way express group needs. Similarly, the local government and related companies will also form a growth alliance driven by the same interests and form a "political and economic integration of government and business" at a higher level to respond to residents' protests against NIMBY jointly.
- Nonlinearity. The evolution process of NIMBY conflict involves multiple stakeholders. There are many correlations among the subjects and among the members within the subject. They interact, influence each other, and restrict each other. A particular behavior or multiple behaviors have intricate nonlinear relationships rather than a simple linear relationship. Openness between subjects and between subject and environment, capable of exchanging information and energy, have a solid ability to actively adapt and adjust their behavior according to changes in the other party or the environment. For the "government-business" growth alliance that supports the construction of NIMBY facilities, residents can gather together to fight against it or choose to compromise. On the contrary, residents pre-emptively unite to oppose the construction of NIMBY facilities, and the government may suspend or even completely stop the construction of related facilities in response to public opinion. However, in the process of stalemate with residents, the government will also ally with enterprises under the lure of the interests of relevant enterprises to form a growth alliance and form an anomie situation of confrontation with residents. It can be seen that the interaction between the subjects of NIMBY conflict has a feedback nature, and the mutual influence between them is connected into a ring, and the input result is returned as the cause, which can actively adapt to each other, rather than a simple, passive, one-way chain of cause and effect. The nonlinear relationship between subjects is the primary source of NIMBY conflict complexity.
- Dynamic. The behavior of stakeholders in the NIMBY conflict is dynamic. The development and changes in the external environment make NIMBY conflict always in the process of dynamic changes. Relevant stakeholders will continue to absorb relevant resources, learn from the behavior of other subjects, and accumulate their own experience according to changes in the external environment to adjust their behavior and improve their organizational structure. For example, residents will adjust their own action strategies according to the government's NIMBY facility construction plan; the government will also make changes to the decision-making model, compensation plan, and even the entire construction plan based on the feedback from local residents, thereby promoting the evolution of the entire NIMBY system to a higher level. This characteristic is evident in the evolution of the government's decision-making model

in the site selection process for NIMBY facilities and the change in the form of residents' protest organizations.

- Flow characteristics. In order to make full and effective use of external and internal information resources (NIMBY facility characteristics, site selection, EIA reports, etc.), it is necessary to exchange information and experience promptly among the various subjects, and the information flow between subjects presents the characteristics of fluidity and multi-directional transmission. During the construction of NIMBY facilities, relevant government departments will publicize the social and economic value of NIMBY facility construction and related compensation information to residents to persuade residents to accept the construction of NIMBY facilities. Due to the asymmetry of information, residents who are information-disadvantaged parties may believe the one-way propaganda of the government and choose to compromise and accept. In contrast, some residents who are sensitive to NIMBY facilities and have substantial information collection and absorption capabilities will learn and use relevant legal knowledge to actively fight, and at the same time publicize their views to other residents.. Therefore, there is a multi-directional flow of knowledge and information among the subjects of NIMBY conflict. In addition, the construction of NIMBY facilities involves a lot of human resources, material resources, and financial resources, so there are also energy flows of human, material, and financial resources in the leading network. Flow is not always there. It appears or disappears according to the suitability of the subject.
- Hierarchy. The theory of complex adaptive systems believes that the scale of the system is vast, and it often reflects the characteristics of a hierarchical structure. The main body in the system will form a "self-organized" subsystem layer in a specific environment. The main body in the system will create a "self-organized" subsystem layer within a particular environment [43], and the subsystem layer can be decomposed into several subsystem layers. The subsystems at different levels are connected to each other. NIMBY conflict runs through different subsystem layers. The conflicts faced by stakeholders at different system layers are the structural emergence of conflicts between subjects at the previous (next) system layer. Still, the sharpness of conflicts at different levels is different. In addition, the diversity of NIMBY conflict subject characteristics, information exchange between subjects, and differences in capabilities enable NIMBY conflict to occur at different system levels of individuals, groups, and organizations. Therefore, the complexity of NIMBY conflict has the characteristics of multi-structure and multi-level.

3. Stimulus–Response Model of NIMBY Conflict Evolution Mechanism

3.1. Fundamentals of the Stimulus–Response Model

The American behavioral psychologist Watson first proposed the stimulus–response model to explain the root of human behavior, later used by Holland to describe the adaptability of complex systems [44], that is, the ability to respond between subjects in a complex system and after interacting with the environment. Since then, the stimulus–response model has become the core mechanism of complex adaptive system theory. The model consists of three elements: detectors, IF/THEN rules (rulers or execution systems), and effectors [45] (see Figure 1). The detector is the organ for the subject to receive external environmental stimuli, representing the ability of the system subject to extract information from the external environment. The IF/THEN rule is the core organ for the subject to process information after receiving information and specifies the rules for the subject to respond based on the information; The effector is the response of the subject, which is used to output the behavior or behavior result of the system subject. The basic principle of the stimulus–response model is that the system's main body senses external environmental stimuli through detectors, classifies and filters the received external environmental information, and then matches with the rule set. The information is processed repeatedly through the rule set to find the optimal matching method, and new matching rules may

be activated during the process. The effectors are then activated, i.e., the system subject performs adaptive behavior [46].

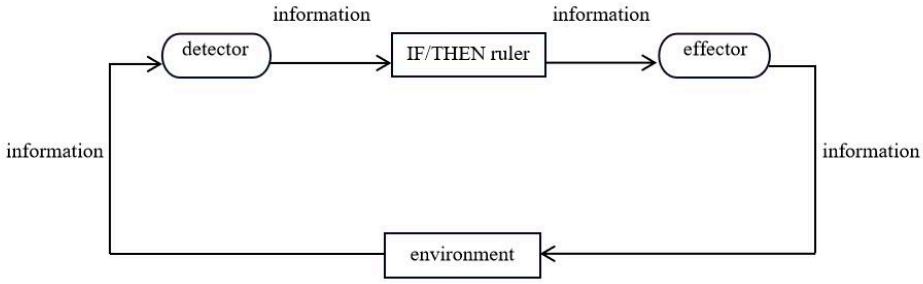

Figure 1. Stimulus–response model.

3.2. Adaptability Mechanism of NIMBY Conflict System

The core of the stimulus–response model is to explain the adaptability of complex systems. Therefore, when constructing the stimulus–response model of NIMBY conflict, it is necessary first to analyze the adaptive mechanism of the NIMBY conflict system. According to the complex adaptive system theory, the adaptive mechanism of complex systems can be divided into two levels: micro-adaptability and macro-adaptability [43]. Adaptability at the microcosmic level is mainly that the main body of the system constantly "learns" or "accumulates experience" through the interaction between each other and the environment to adjust its behavior and improve the organizational structure. Adaptability at the macro level refers to the interaction between subjects and the environment, which leads to the whole system's evolution [47,48]. From the reality of NIMBY conflict, combined with the theory of complex adaptive systems, we can consider that NIMBY conflict is essentially a complex adaptive system. Still, it pays more attention to the interaction, mutual influence, and restriction between relevant stakeholders. In fact, the evolution process of the NIMBY conflict is a tripartite game process among residents, government, and related enterprises. They unite or confront each other with the goal of maximizing their respective interests [49]. In the initial stage of site selection or construction of NIMBY facilities, various stakeholders "emerge" into new interest groups at a higher level due to the convergence of values or interests, identity recognition, etc. Afterward, these new groups interact and adapt to each other as well as between the groups and the environment. In the process, each subject adjusts its behavior and organizational structure according to its own "learning" or "accumulated experience" In summary, the adaptability of the micro-subjects in NIMBY conflict creates the complexity of the macro system of NIMBY conflict.

3.3. Stimulus–Response Model of NIMBY Conflict System Evolution

According to the stimulus–response model and the adaptive mechanism of the NIMBY conflict system, a stimulus–response model of the NIMBY conflict system evolution is constructed as shown in Figure 2.

- Detector. The external environment of the NIMBY project includes the political environment, economic environment, cultural environment, and social environment from the macro level. When the external environment changes, the system subject will perceive various information about the external environment through the detector. However, objectively speaking, the macro environment is relatively stable for a period of time, and its change is relatively slow. Therefore, the system subject perceives more environmental changes closely related to a NIMBY project, such as NIMBY project site selection, NIMBY project construction, environmental assessment report, land acquisition compensation, etc. Such information is mainly led and released by the government [50,51]. At the same time, the change in the macro environment is reflected primarily on the change in government behavior. Therefore, although the government is the subject of interest game in the system, its behavior is also an essential symbol of the external environment of NIMBY conflict.

- Ruler. Ruler is an integral part of the stimulus–response model and a way for the system subject to screen information-matching behavior. Combined with the reality of NIMBY conflict, it mainly includes the following steps: first, information recognition. A NIMBY system subject will further filter and classify the information obtained from the detector, eliminate redundant information, and identify information highly related to its interests. Secondly, interest risk perception. Interest is the root of the behavior of the system subject. The essence of NIMBY project construction is the redistribution of interests and risks. Therefore, according to its information, the system subject will perceive and evaluate the interests and risks brought about by the NIMBY project construction. The community alliance dominated by residents and the government-led growth alliance in the NIMBY system often have different interpretations of NIMBY risks and interests. Finally, the system subject will choose to adopt individual or group behavior according to the perceived benefits and risks. When individual behavior is difficult to maintain their reasonable interests, the system subject will "glue" with individuals whose values and interests appeal to converge [52].
- Effectors. Effectors are behaviors or behavior results made by system subjects. The NIMBY system subject performs various behaviors after matching with the ruler through its perception of the external environment. Suppose some residents find that the government has not followed the legal procedures in the NIMBY project site selection process. In that case, they will invite residents to participate in the hearing and ask for their opinions. They will immediately inform other residents around to rally against the illegal operation of the government and even petition. Under the pressure type system, the government is greatly influenced by superiors and public opinion. If the government suffers tremendous pressure from superiors and public opinion due to residents' petitions, the government will appease and guide the residents and suspend, delay, or stop the construction of the NIMBY project; relevant enterprises will also adjust their own behavior according to the environment and the behavior changes of other subjects [53].

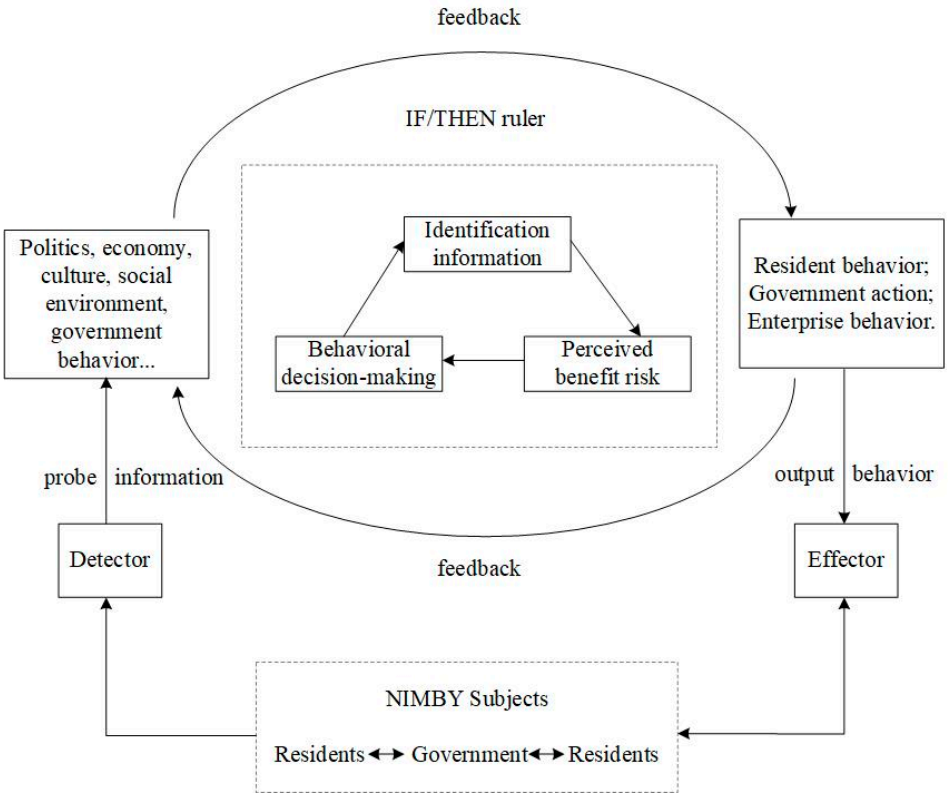

Figure 2. Stimulus–response model of NIMBY conflict evolution mechanism.

In general, the stimulus–response model evolved by NIMBY conflict is a cycle process of continuous optimization. Through "stimulus–screening-matching-reaction-viewing-optimization", the system subject is gradually adapted to changes in the external environment to maximize its interests.

4. Construction of Agent Evolution Simulation Model of NIMBY Conflict

4.1. Simulation Method

Traditional research methods are challenging to apply when studying complex systems, and modeling and simulation provide a new way to solve these problems. The simulation adopts a top-down integrated approach. That is, by observing the complex system, in reality, we can abstract the simple rules that individuals follow, simulate the interaction between individuals in the computer, and observe their emerging macro-behavior to explain and understand the complex phenomena of the system. Currently, there are many methods of social simulation, such as system dynamics, micro-simulation, permutation model, multi-layer simulation, cellular automata, agent simulation, etc. Among them, agent simulation has become a meaningful way to study complex social phenomena by constructing artificial societies for computing experiments [54]. This research uses the Q-learning algorithm in Agent simulation to simulate the evolution process of NIMBY conflict.

Q-learning is a common reinforcement learning method (also known as incentive learning), often used in discrete and small-scale research [55]. There are three core elements: State, Action, and Reward. The core idea of the algorithm is that the agent will take some action under a certain state at a certain time, and the environment will give feedback on the corresponding Reward according to the agent's behavior. Q (Quality) is a Q-table matrix composed of State and Action, which is used to store Q values and represent the rewards obtained by the agent when taking actions in a certain state. The agent will choose the corresponding behavior according to the size of the Q value and optimize its behavior through continuous learning and accumulation of experience to achieve the purpose of obtaining maximum benefits. The iteration of the Q value follows the Bellman equation:

$$Q'(s,a) = Q(s,a) + \alpha\left[R(s,a) + \gamma max Q\left(s',a'\right) - Q(a,a)\right] \quad (1)$$

In the equation, Q(s, a) and R(s, a), respectively, represent the expected reward and current reward obtained by the agent when it takes a actions in s states, Q(s′, a′) represents the expected reward obtained by the agent when it takes a′ actions in the next state s′, $\alpha \in [0, 1]$ represents the learning rate of the agent, and α is larger, indicating that the faster the agent updates information, the less it retains previous training experience; $\gamma \in [0, 1]$ is the discount factor. The larger the γ is, the more long-term benefits are considered by the agent. On the contrary, the more immediate benefits are concerned. In the initial state, all Q values in Q-table are 0. At the same time, in order to avoid the possible local optimal solution, it is also necessary to assume that the intelligent experience will explore the unknown new strategy and use the exploration results for more effective iteration, that is, use the exploration/utilization strategy [56], expressed by the exploration rate of ε. In the process of reinforcement learning, the intelligent experience explores the optimal strategy in the previous experience with a probability of ε, and conducts new exploration with a probability of $1 - \varepsilon$.

In the process of Q-learning reinforcement learning, agents take certain actions after observing the environment and constantly learn and iterate their actions based on the feedback and return of the environment to achieve the goal of maximizing benefits. Although the NIMBY conflict involves three subjects—residents, government, and related enterprises—the evolution process of the NIMBY conflict is mainly the conflict between the community alliance dominated by residents and the government-led growth alliance. Residents will take action according to the government's behavior and take further action according to the government's feedback transformation strategy. Therefore, in this study, residents are regarded as agents. The government is regarded as the real environment of agents. In combination with reality, the government's main goal of NIMBY governance

is to conduct risk management and control. It is hoped that the residents can understand the social and economic benefits of NIMBY projects and then withdraw from NIMBY's resistance behavior. The goal of the residents is to maximize their interests.

4.2. Residents' Behavior Strategies and Evolution in the Evolution of NIMBY Conflict

During the evolution of the NIMBY conflict, according to different environments, conditions, and conflict stages, residents may take four actions: Wait, Appeal, Fight, or Exit. In the initial state, it is assumed that residents will choose to be waiters, petitioners, or protesters according to their perception of the interests and risks of the NIMBY project. When residents think that the construction of the NIMBY project can not only promote local economic and social development but also improve the overall social benefits, their perception of the project benefits is greater than the project risk perception, and these residents will not participate in NIMBY group events from the beginning. When residents believe that the negative externalities of NIMBY projects not only harm the ecological environment, but also endanger the health of residents and even the long-term development of their children and grandchildren, or are harmed due to other rights, the project risk perceived by the residents is greater than the project benefit, and this part of the residents will appeal and fight. There are also some residents who do not have a clear perception of the risks and benefits of the NIMBY project and will adopt a wait-and-see strategy.

The change in residents' behavior is a sign of NIMBY conflict evolution. According to the theory of the Complex adaptive system, the behavior change of the system subject results from interaction with other subjects and the environment. Therefore, the learning interaction among residents and the government feedback as the environmental representation are two significant factors that induce the change in residents' behavior. Residents conduct interactive learning through communication networks. After receiving feedback from the government, residents will measure the cost and benefit of their behavior to choose whether to change strategies and behaviors. Maslow believes that rational people have five levels of basic needs and show a trend of increasing demand intensity. When a level of demand has not been met, rational people will not change their needs and reduce to a lower level of demand [57]. The intensity of demand for watching, demanding, and fighting is increasing, so residents will not reduce their own needs and return to a lower level of demand. However, it should be pointed out that the particular situation of the petitioner in the state of appeal, claimants drop out because their demands are met or join protests when their demands are not met as expected, but when the appeal of the petitioner is low, it may return to the state of observation. However, no matter the initial residents, they will eventually converge to the exit state because NIMBY group events will always end. Therefore, there are eight possible behavior change paths for residents (as shown in Table 1).

Table 1. Evolution Path of Residents' Behavior in the Evolution of NIMBY Conflict.

SN	Behavior Change Path
Path 1	Wait—Exit
Path 2	Wait—Appeal—Exit
Path 3	Wait—Fight—Exit
Path 4	Wait—Appeal—Fight—Exit
Path 5	Appeal—Exit
Path 6	Appeal—Fight—Exit
Path 7	Appeal—Wait—Exit
Path 8	Fight—Exit

In the initial state, it is assumed that the residents are in the three states of wait, appeal, and fight with the same probability. The state space set is S ($s = \{\text{wait}, \text{appeal}, \text{fight}\}$), the optional behavior set is A ($a = \{\text{wait}, \text{appeal}, \text{fight}\}$), and the ultimate goal is to exit. The objective function is $Argmax\{Q(s,a)|s \in S, a \in A\}$, that is, the intelligent experience

selects the behavior set with the largest Q value. The agent's strategy selection follows the following equation:

$$\pi(s) = \begin{cases} Argmax[Q(s,a)], if\varepsilon \leq 1-\varepsilon \\ a_{random}, otherwise \end{cases} \quad (2)$$

In Formula (2), ε is the exploration rate, and a_{random} is the random action in the current behavior set.

4.3. Environment Settings during NIMBY Conflict Evolution

The interaction between the subject and environment in complex systems is an important factor affecting system evolution. This study characterizes government feedback as the external environment of the NIMBY system. According to reinforcement learning, the government determines the return R value of residents through feedback, thus affecting the behavior change of residents. In NIMBY conflict, the government's feedback mainly refers to the government's ability to respond to conflict events. Therefore, the R value is determined by the government's ability to respond to conflicts. The government's conflict response capability is mainly related to its response method and response intervention time [55], which means the government's conflict response capability is a function of the response method and response intervention time. See Formulas (3) and (4) for details:

$$R = f(Method, Time) \quad (3)$$

$$\begin{cases} R(s,a) = u_1 \times Method_S^R + u_2 \times Time^R \\ u_1 + u_2 \end{cases} \quad (4)$$

In Formula (4), u_1 and u_2, respectively, represent the weight of the coping style and time in the government's conflict response capability, and the weight is determined by taking a positive integer at random. $Method_S^R$ represents the return R obtained by different coping styles in the state S, and $Time^R$ represents the R value obtained by different coping interventions.

Faced with the NIMBY cluster behavior of residents, the government can often effectively guide citizens' behavior and resolve conflicts by adopting the correct response. In this study, the government's coping styles are divided into good, general, and poor, as shown in Formula (5). The government's different coping styles will affect the residents' perception of the benefits and risks of the NIMBY project, thus affecting the residents' behavior change. The government will give different positive feedback (negative value) or negative feedback (positive value) according to the behavior of agents (residents). Residents will try to focus on any kind of behavior and gradually maximize their benefits through continuous learning and accumulated experience to strengthen learning. Positive feedback does not mean encouraging this kind of behavior but guiding residents to exit the state as soon as possible and end the conflict. Therefore, if the government responds better to residents in a certain state, the return value R of the better response is set to a negative value. It shows that the government's conflict response method has played a role, can better guide residents' behavior, and reduce the frequency of residents' transfer to this behavior.

$$R_{Method} = \begin{cases} -1, \ Good\ way, \ effectively\ guide \\ 0, \ General\ way, \ passive\ neglect \\ 1, Poor\ way, \ forced\ suppression \end{cases} \quad (5)$$

The intervention time of conflict response is the time choice for the government to intervene in the NIMBY cluster process. Suppose the government can intervene as early as possible in the initial stage of the NIMBY project site selection or construction, actively communicate and understand residents' reasonable demands, and resolve residents' fears and doubts about the NIMBY project. In that case, it may effectively prevent residents' NIMBY complex from evolving into NIMBY conflict. Assuming that the evolution time of

NIMBY conflict from germination to outbreak is T, the three-way time node is taken as the government's response intervention time. The setting principle of the R value is the same as above, as shown in Formula (6):

$$R_{Time} = \begin{cases} -1, Early\ intervention, 0 \sim \frac{T}{3} \\ 0, Intermediate\ intervention, \frac{T}{3} \sim \frac{2T}{3} \\ 1, Late\ intervention, \frac{2T}{3} \sim T \end{cases} \quad (6)$$

5. Analysis of Agent Evolution Simulation Results of NIMBY Conflict

5.1. Experimental Simulation

The research uses Matlab R2020a to program and simulate the complex evolutionary process of the NIMBY system. The specific steps are as follows:

Step 1. Initialize the value. In addition to the feedback from the external environment, residents' learning is based on their own experience or communication between individuals. The network structure among residents has an essential impact on residents' learning, so it is necessary to set the network structure among residents. As a topological structure, the small world network can better reflect the real interpersonal network [58], so this study uses the small world network to simulate communication among residents. Each node in the small world network represents a resident, and each resident has the right to choose behavior freely and can choose any behavior in the behavior set A. The connection between nodes indicates the interaction between residents, that is, the communication and exchange among residents, which determines the efficiency of information transmission among residents. In this study, the average communication efficiency and relationship strength are used to express the mutual learning among residents, that is, the information transmission efficiency (Formula (7)). The relationship strength is expressed by the random connection rate P, $p \in [0 \sim 0.1]$. The larger the p value is, the more closely the individuals in the network node are connected. The average communication efficiency is expressed by e, $e \in [0 \sim 1]$, and the larger the e value is, the more successful the individuals in the network node can transfer information to another individual.

$$\begin{gathered} \text{Small world network information transmission efficiency = random} \\ \text{connection rate} \times \text{average communication efficiency} \times \text{total number of people} \end{gathered} \quad (7)$$

The research assumes that the number of residents of agent in NIMBY system is 900, the learning and communication follow the rules of small world network, and the initial state is set as 300 waiters, 300 petitioners, and 300 protesters, respectively. The values are shown in Table 2.

Table 2. NIMBY conflict evolution simulation initialization parameters.

Category	Parameter	Value	Meaning
Small World Network	N	900	Total number of residents
	K	30	Initial average number of connections
	e	0.1	Average communication efficiency
	p	0.01	Random connection rate
Q-learning	α	0.1	Learning rate
	γ	0.8	Discount factor
	ε	0.1	Exploration rate
	R_Method	−1	Government response
	R_Time	1	Government response time

Step 2. Agent reinforcement learning process. In the evolution process of the entire NIMBY conflict system, residents make iterative behavior choices and change through individual exchanges and government feedback.

Step 3. Adjust the parameters. Observe the influence of different parameter settings on NIMBY conflict evolution.

5.2. Result Analysis

5.2.1. The Government's Conflict Response Capability (When e = 0.1, p = 0.01)

First of all, it is assumed that the government intervened in NIMBY conflict late, but took a better response to actively guide the residents, that is, $R_{Method} = -1, R_{Time} = 1$. The change in the number of people in each state after 100 simulation iterations is shown in Figure 3a. At the initial stage of NIMBY project site selection or construction, the government did not intervene in time to resolve NIMBY risks. As a result, residents in a wait state quickly chose to fight. The number of protesters increased, and the number of quitters was almost zero. Then increase the number of iterations to 1000, and the number of people in each state changes, as shown in Figure 3b. It can be seen from Figure 3b that the number of people in all states changed dramatically when the number of iterations reached about 750. The number of quitters increased sharply, while the number of waiters, petitioners, and protesters decreased rapidly, especially the number of protesters. The results show that the government has realized that the mass behavior of the people has reached a severe state and can respond to the dissatisfaction of the people in a better way.

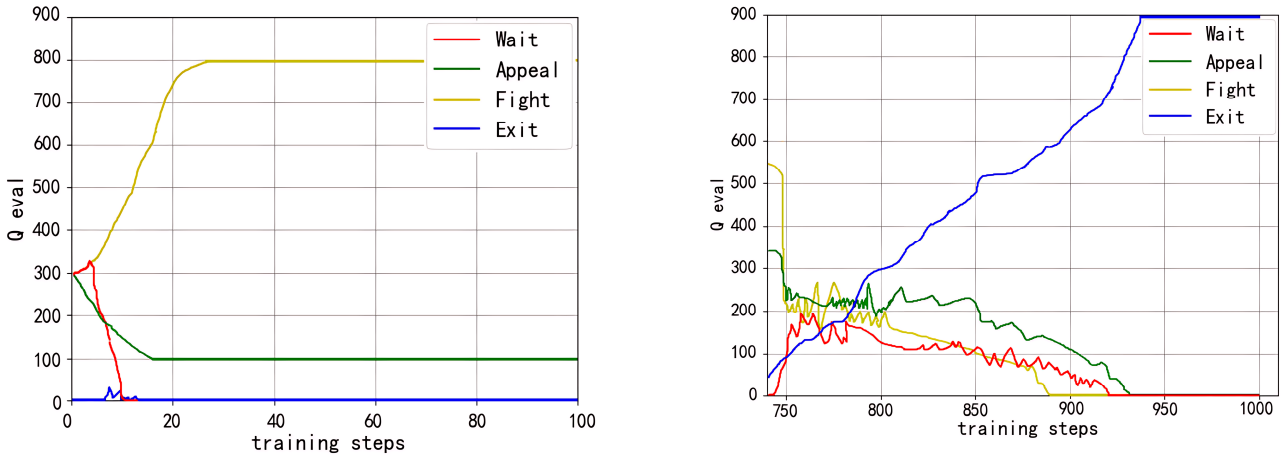

Figure 3. When the government intervened late in the NIMBY conflict, but took a better approach (**a**) $R_{Method} = -1, R_{Time} = 1$ After 100 iterations, the number of people changes; (**b**) $R_{Method} = -1$, $R_{Time} = 1$ After 1000 iterations, the number of people changes.

Change the response time of government conflict and assume that the government can actively respond to NIMBY conflict in its infancy. The experimental simulation results are shown in Figure 4. By comparing Figures 3b and 4, it can be found that if the government intervened in the NIMBY conflict late and took a better response, the number of waiters, petitioners, and protesters began to change after about 750 iterations, and the public gradually withdrew. However, if the government responds to the intervention early, the residents will exit at a fast rate after about 300 iterations. The above results show that in the evolution process of NIMBY conflict, the earlier the government starts to respond, the sooner residents can converge to exit.

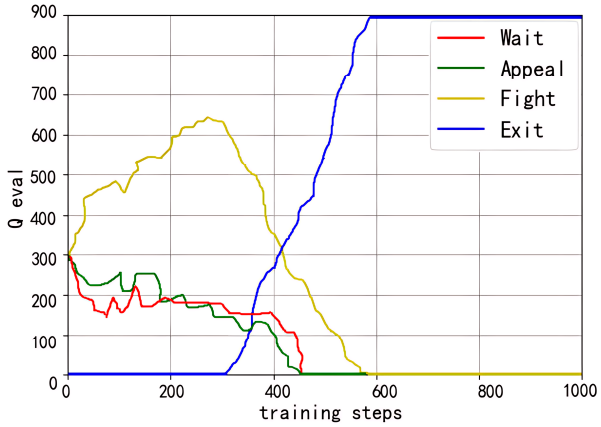

Figure 4. $R_{Method} = -1, R_{Time} = -1$. After 1000 iterations, the number of people changes.

Next, change the government's conflict response style. The government adopts a poor response style, namely, $R_{Method} = 1, R_{Time} = -1$. The experimental simulation results are shown in Figure 5. It can be seen from the comparison between Figures 4 and 5 that the government's conflict response style will also change the convergence process. If the government does not adopt a better response style, even if the response time is earlier, the governance effect of the NIMBY conflict will be difficult to achieve the desired goal. As shown in Figure 3b, if the government can intervene in the NIMBY conflict at an early stage and adopt appropriate handling methods when the number of iterations reaches about 300, the number of quitters will show a sharp increase, and the number of protesters will also decline rapidly. According to the observation of Figure 5, although the government started to intervene in the NIMBY conflict earlier, it did not take the appropriate response, which did not ease the residents' panic about the NIMBY project, but further exacerbated the contradiction between the residents and the government, leading to the rapid growth of the number of protesters at the beginning, and led to a large number of waiters to join the ranks of petitioners or protesters. When the number of iterations reaches about 750, the number of petitioners and protesters starts to drop sharply, while the number of quitters shows a trend of sharp increase. The change in the number of people fighting may be due to a long time of fighting, and some residents choose to compromise, or they may choose to quit because their emotions have been soothed in the process of fighting. Therefore, in the evolution of NIMBY conflict, the way of conflict response is more critical for the government's conflict response capability than the time of conflict response intervention.

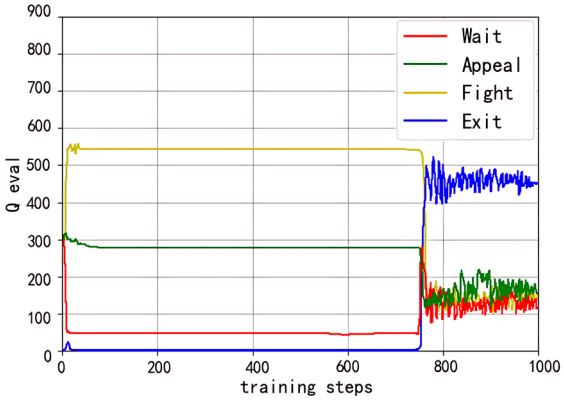

Figure 5. $R_{Method} = 1, R_{Time} = -1$. After 1000 iterations, the number of people changes.

5.2.2. Communication between Individuals (When $R_{Method} = -1$, $R_{Time} = -1$)

Assuming that the communication between residents is invalid and the communication efficiency is 0, which means when e = 0.1 and p = 0.01, the changing trend of the

number of people in each state is shown in Figure 6. When communication between residents fails, they are isolated from each other. Residents can only make behavioral changes based on the benefits obtained from government feedback. Through the observation of curve changes, it can be found that the number of waiters has shown a trend of first rising and then declining over time, which may be due to the fact that some of the petitioners in the state of appeal have turned from appeals to wait due to their low appeals. The number of protesters increased slightly at the beginning, then decreased rapidly under certain fluctuations, and then decreased slowly. The number of quitters did not change significantly in the initial state, but after that, although the number of quitters fluctuated to a certain extent, it still showed a sudden rise. It can be seen that when communication among residents is ineffective, it is challenging to form NIMBY cluster behavior and NIMBY conflict breaks out.

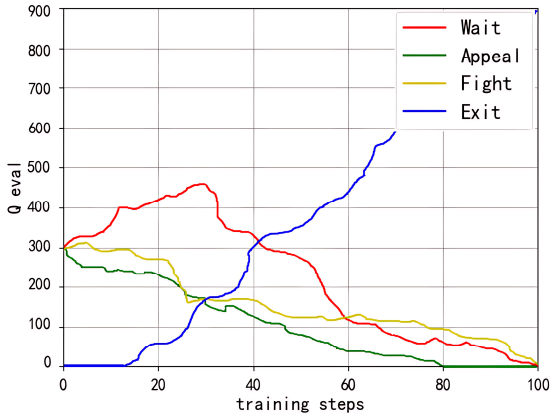

Figure 6. $R_{Method} = -1, R_{Time} = -1$; e = 0.1, $p = 0.01$, the number of people changes.

When the communication efficiency between residents is set as e = 0.1, and the random connection rate is set as p = 0.01 and p = 0.08, respectively, the changing trend of the number of people in each state is shown in Figures 4 and 7. Through the observation and comparison of the two images, it can be found that when p = 0.01, the residents begin to withdraw gradually after about 300 iterations, and the public is basically in an exit state after 300 iterations. When p = 0.08, after 130 iterations, the number of residents in the exit state starts to increase, and after about 135 iterations, the number of residents is basically in the exit state. Therefore, it can be seen that a strong resident relationship can accelerate the convergence of residents to the exit state.

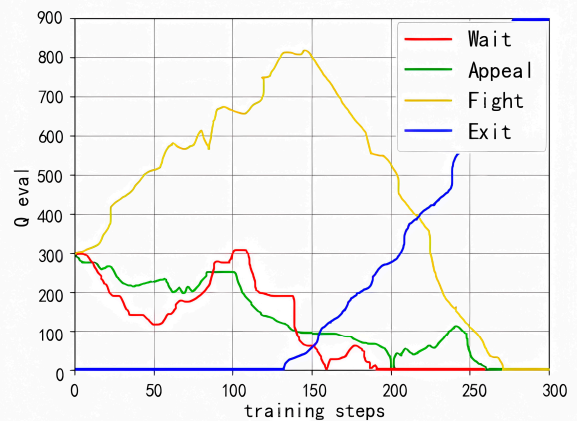

Figure 7. $R_{Method} = -1, R_{Time} = -1$; e = 0.1, $p = 0.08$, the number of people changes.

When the connection probability between residents is set as p = 0.01, and the residents' communication efficiency is set as e = 0.1 and e = 0.8, respectively, the changing trend of

the number of people in each state is shown in Figures 4 and 8. It can be found that lower residents' communication efficiency will reduce the number of petitioners and protesters. Due to ineffective communication among residents, individuals are isolated from each other, and it is challenging to form large-scale group appeals. The number of petitioners shows a downward trend, while the peak number of protesters is less than 650 (see Figure 4). When the communication efficiency among residents is improved, the residents can successfully transmit information, so the change rate of residents' behavior is also fast (see Figure 8).

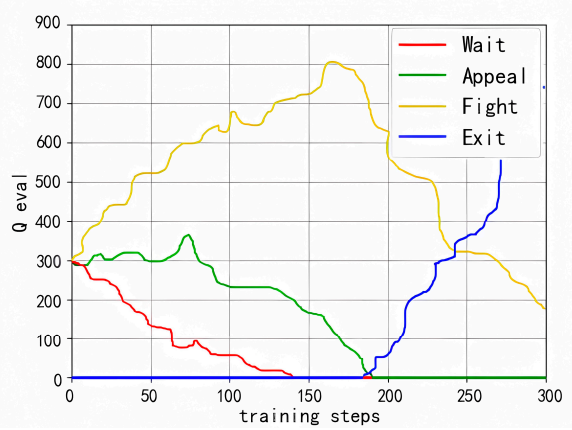

Figure 8. $R_{Method} = -1, R_{Time} = -1$; e = 0.8, p = 0.01, the number of people changes.

It can be seen from this that when the communication efficiency among residents is low, it is difficult for individuals to carry out effective information transmission and communication is not smooth. At this time, even though residents have many dissatisfactions with the NIMBY project and become appealers or even protesters, it is challenging to form group strength due to mutual isolation, and individual strength is very weak, which will cause residents to change to a withdrawal state quickly. However, with the arrival of the significant data era, the speed and frequency of information exchange have been growing unprecedentedly. It is easy for residents to aggregate NIMBY projects on the network and then evolve into offline NIMBY conflict. Therefore, to block the formation of NIMBY conflict, it is necessary to strengthen the conflict response capability of the Complex adaptive system.

6. Conclusions and Discussion

The construction of public infrastructure in the process of urbanization has improved the quality of life of residents. However, NIMBY projects are also prone to lead to NIMBY group events due to their specific negative externalities. Complexity is an important characteristic of NIMBY projects. Although current scholars' research has deepened human understanding of the phenomenon of NIMBY, they often ignore its complexity. Few studies use complex adaptive system theory to analyze the NIMBY conflict. From the perspective of complexity, this study re-examines the characteristics and evolutionary mechanism of NIMBY conflict and draws research conclusions and corresponding policy recommendations.

First, NIMBY conflict is a complex system with multiple subjects and interactions with the environment, characterized by aggregation, nonlinearity, dynamics, flow characteristics, and hierarchy. Therefore, when government departments plan economic projects and arrange public facilities, they need to fully consider the possibility and complexity of NIMBY conflicts. On this basis, the government, in the process of policy design and behavior adjustment, can avoid or reduce the negative external impact brought by NIMBY facilities, reduce or eliminate the dissatisfaction and exclusion of surrounding residents, prevent, avoid and resolve social conflicts, and strive to achieve "PIMBY".

Secondly, a stimulus–response model of the evolution mechanism of NIMBY conflict is constructed based on the complex adaptive system theory. Adaptability is considered

the driving force for the evolution of the NIMBY conflict. Through detectors, rulers, and effectors, the NIMBY subjects gradually adapted to external environmental changes to maximize their interests. Based on the research results, the government can start from the three aspects of "demonstration investigation-rule setting-feedback mechanism" to establish a policy cycle system to match the characteristics of the adaptive and gradual development of NIMBY subjects. In this way, mutual understanding between the people and the government can be achieved, and the additional transaction costs brought about by NIMBY conflicts can be resolved.

Finally, using Agent simulation technology to simulate the evolution mechanism of NIMBY conflict, the results show that: in NIMBY conflict, the government conflict response method is more important than the intervention time; residents' communication efficiency and connection probability will affect residents' behavior choices. The lower the residents' communication efficiency, the less likely it is to form NIMBY conflict. Stronger resident relations can accelerate residents' convergence to the exit state, which in turn affects the evolution of the NIMBY conflict. Therefore, in the process of dealing with NIMBY conflicts, the government should not only increase the response speed, but also pay attention to the construction and application of social media and network platforms, and strengthen the connection with the public, so as to alleviate residents' resistance and NIMBY behavior. It is even more important to choose an appropriate response method to avoid social panic. The first is to strengthen the supervision of public opinion in the process of NIMBY conflicts and use the authority and accuracy of government information to guide public opinion and reduce public panic. The second is to pay attention to the environmental protection demands of residents and establish an efficient official response model. Actively conduct sufficient policy communication with residents to reduce policy misunderstandings caused by irrational communication and accelerate residents' understanding of public facilities. For example, the introduction of the public participation system from the site selection of NIMBY facilities, the strengthening of the environmental protection supervision of the operation of NIMBY facilities, and the establishment of a communication and consultation mechanism for NIMBY conflicts effectively regulate NIMBY conflicts in three links of "before-in-process-after" [53].

Based on the theory of complex adaptation and the adaptive mechanism of the NIMBY conflict system, this paper constructs a stimulus–response model for the evolution of the NIMBY conflict system, then uses simulation technology to simulate and study the process and mechanism of interaction between micro-subjects and macro-environment in the process of NIMBY conflict from a dynamic and complex adaptive perspective, which has certain theoretical significance and practical value. Firstly, the research expands the application scope and boundary of complex adaptation theory. Secondly, the stimulus–response model and simulation model of the evolution of NIMBY conflict system are constructed, which provides a new perspective and framework for deepening the research on NIMBY conflict-related fields. Finally, the research breaks the limitation of separating micro-subjects and macro-structures in previous studies on NIMBY conflicts, deepens the understanding and understanding of NIMBY conflict phenomena and evolution mechanisms, and provides reference and reference for NIMBY conflict governance.

There are also some research limitations in this paper, which need to be discussed in the future. At present, both theoretical exploration and empirical research are far from enough, and a lot of work still needs to be completed in the future to expand and support it. From a theoretical point of view, although this paper proposes a stimulus–response model for the evolution of the NIMBY conflict system, its applicability needs to be empirically tested and enriched. The interaction between the subject and the external environment in NIMBY conflict and its influencing factors need to be further explored. At the same time, the current agent simulation only uses government behavior to represent the external environment, ignoring the influence of other external environments such as network public opinion, opinions of experts and scholars, etc. The simulation model can be further improved in future research. From the perspective of empirical research, this paper mainly conducts

research from the perspective of logical deduction, lacking the support of empirical research. In the future research, it is necessary to start with specific NIMBY conflict cases and use the stimulus–response model of NIMBY conflict system evolution as the theoretical basis to conduct case analysis or multi-case comparative analysis of some typical cases to improve the theoretical framework.

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