Simulation Model of PPP Project for Geological Disaster Prevention Based on NETLOGO

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ABSTRACT

Geological disaster prevention project is a complex system engineering, and it involves many stakeholders. At the same time, geological disaster prevention projects related to people's lives and property safety. How to carry out scientific and effective management is an urgent problem to be solved. In order to achieve the scientific and dynamic management of geological disaster prevention projects, the paper establishes a simulation model of PPP project for geological disaster prevention based on netlogo. The model can describe the change of the system entropy and the income of stakeholders. Through the analysis of the research, the model is effective, and it can realize the scientific, effective and dynamic management of the PPP project for geological disasters prevention .

KEYWORDS: public private partnership; geological disaster prevention; simulation model; netlogo software

INTRODUCTION

Geological disaster is a geological phenomenon, which is caused by natural or man-made factors, which are harmful to people's life and property safety, such as landslide, debris flow, ground subsidence, ground subsidence, ground subsidence and other geological phenomena. Geological disaster prevention project is a complex system engineering, it involves many stakeholders, how to carry out the scientific and effective management is very important. This aspect is related to people's life and property safety, on the other hand, it also determines the order of the project operation of the project. At present, the research on PPP project for geological disaster prevention mostly focus on the framework, risk, capital structure and contract and other aspects of the PPP project model, and the research on the simulation of PPP project is rare[1-8]. In the course of the operation of the PPP project for geological disaster prevention, the government and the social capital are to maximize the benefits of oneself, while ignoring the overall interests of the system [9-10]. Geological disaster prevention of PPP project management process is dynamic and constantly changing. In order to make a scientific description of the image, and to study the problem of PPP project management, the paper takes the dynamic perspective and the simulation of the research. The paper uses the popular social science simulation software netlogo to simulate the process, and then realizes the smooth implementation of the PPP project for geological disaster prevention.

In considering the swarm, repast, netlogo, startlogo and other software, the thesis uses netlogo as the project finance integrated management simulation tools because the following reasons[11-14]:

(1) NETLOGO ’s capability and compatibility is good, and can be combined with other software and tools together organically. It is easy to simulate.

(2) NETLOGO is close to the machine programming language. Using this tool is good for Compilation and simulation results.

(3) The netlogo platform have 2D and 3D view. People can observe the simulation process using 3D view, and can understand the changing of the image between the simulation bodies.

(4) NETLOGO is the programmable autonomous platform of social science and natural phenomena, and the PPP project for geological disaster prevention belongs to social science. Using netlogo is helpful to study more deeply.

(5) By using netlogo, project financing entropy will be the output variables of the system. People can observe easily the change of the system entropy in the process of PPP project for geological disaster prevention.

ESTABLISHMENT OF THE SIMULATION MODEL

Simulation model hypothesis

The process of PPP project for geological disaster prevention is a complex giant system. It experiences a long time. It will produce all kinds of contradictions between the various stakeholders. Stakeholders have their own internal organizational system. Therefore, in order to make that simulation can be scientific and reliable operated, the simulation model set the following hypothesis.

(1) PPP project for geological disaster prevention discuss two simulation subjects which involve owners and social investors, no longer consider other subjects.

(2) All simulation subjects maximize its own interests in order to achieve the goal. And it achieved the overall system optimization through the coordination mechanism within the system.

(3) Because of the simulation software and the environment, each simulation results have some differences, but the differences are generally small, does not affect the final simulation results.

Construction of simulation model

In the simulation model, the turtles are represent with people, sky color people represent social investors; patches represent government. Different colors of patches represent government with different attributes. That is, patches with color of green, violet, yellow, pink respectively represent good and package government,ungood and package government, ungood and unpackage government ,good and unpackage government.

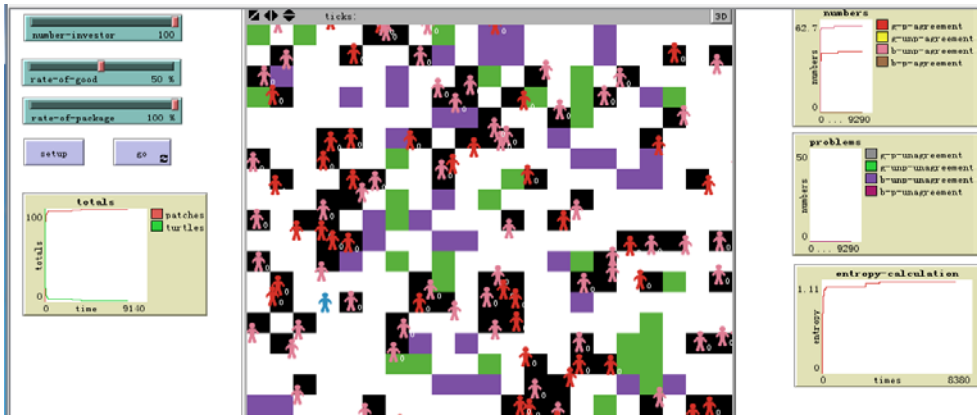

Figure 1: The simulation interface of PPP project for geological disaster prevention

Simulation parameters setting

The total investor of simulation system was 100. Investor can be adjusted by sliding button (range 0 to 100, this setting value can also be changed) . The probability of good project (rate-of-good) can be adjusted by sliding button (in the range 0 to 100%) . The probability of packaging project (rate-of-package) also can be adjusted by sliding button (in the range 0 to 100%) .

When the model is initialized, the simulation system model generate number-investor number of social investment which is green color according to the parameter (number-investor) ,and located respectively at central of white patch. At the same time model set the value to four different owners of the project according to the parameters (rate-of-good, rate-of-package) .That is namely good and package government with color of green, ungood and package government with color of violet, ungood and unpackage government with color of yellow, good and unpackage government with color of pink.

Simulation process

After the simulation starts, social investors (Investor) began to move. If it meets a suitable project owner, they will have reached an agreement of purchase.

If it encounters a suitable project owner whose color is green, then the government color changed to black, at the same time, social investors (Investor) color changed to red.

If it encounters a suitable project owner whose color is yellow, then the government color changed to black, at the same time, social investors (Investor) color changed to orange.

If it encounters a suitable project owner whose color is violet, then the government color changed to black, at the same time, social investors (Investor) color changed to pink.

If it encounters a suitable project owner whose color is pink, then the government color changed to black, at the same time, social investors (Investor) color changed to brown.

If it encounters a unsuitable project owner whose color is green, then the government color changed to black, at the same time, social investors (Investor) color changed to gray.

If it encounters a unsuitable project owner whose color is yellow, then the government color changed to black, at the same time, social investors (Investor) color changed to lime;

If it encounters a unsuitable project owner whose color is violet, then the government color changed to black, at the same time, social investors (Investor) color changed to violet.

If it encounters a unsuitable project owner whose color is pink, then the government color changed to black, at the same time, social investors (Investor) color changed to magenta.

At the same time, the simulation system can draw real-timely the number of the total social investors (Investor) through the brush, the number of four social investors (Investor) which reached an purchase agreement, the number of four social investors (Investor) which did not reach a purchase agreement and the change of whole simulation system entropy (entropy-calculation) . Therefore, according to the change of system entropy, we can adjust the parameters in simulation system (number-investor, rate-of-good, rate-of-package etc.) to change the whole simulation system entropy, so as to realize the goal of PPP project for geological disaster prevention.

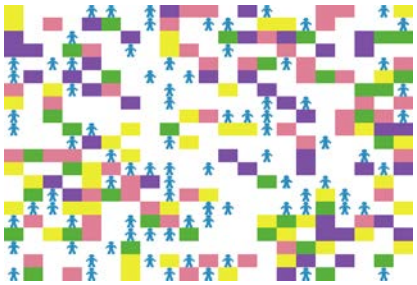

Figure 2: NETLOGO patch diagram

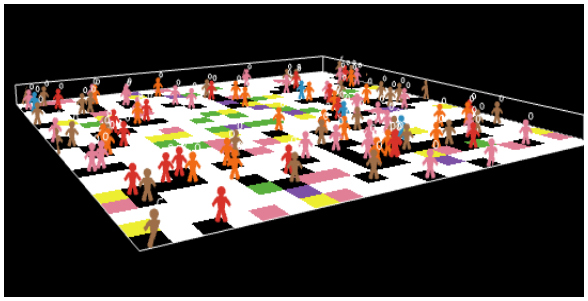

Figure 3: NETLOGO 3D interface diagram

ANALYSIS OF SIMULATION RESULTS

When the number of parameters of social investors (number-investor) changes ,while the other parameters are fixed.

(1) when number-investor=100, rate-or-good=50%, rate-or-package=50%,the change of system entropy can be seen in fig.4.

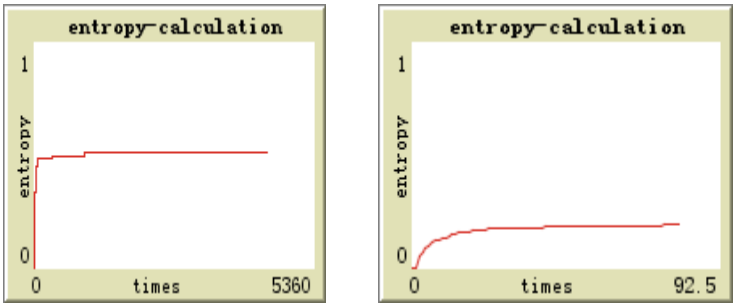

Figure 4: Variation of system entropy (a)

The simulation results analysis: from the above figure we can see when the rate-or-good=50%, rate-or-package=50%,the system entropy does not change; and when number-investor from 20 has been changed to 400, system entropy parameter (entropy-calculation) changes from 0.13, 0.19, 0.35, 0.48, 0.54 to 0.61.This said that with the increase of social investors in the simulation system, the system entropy increases gradually. When the owners of the project quantity do not change, the increase of social investors brought down of the possibility to reach an agreement. At the same time ,system entropy increase.

(2) When the number of parameters of social investors (number-investor) isn't changed and rate-or-package=50%, the parameter rate-or-good is changed, the change of system entropy can be seen in fig.5.

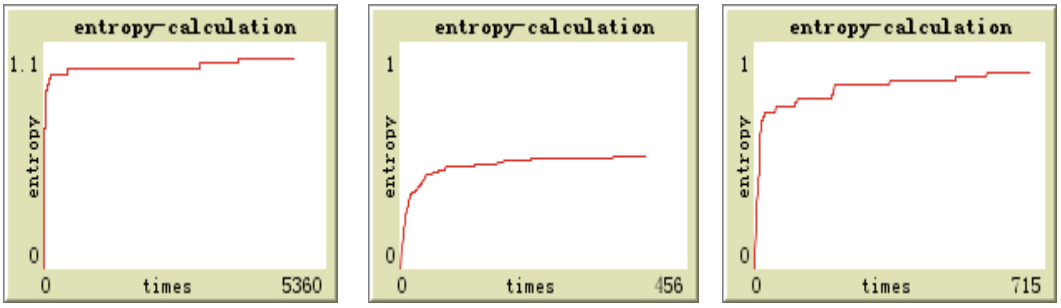

Figure 5: Variation of system entropy (b)

When the rate-or-good changed from 0 to 100%,the system parameters(entropy-calculation) varies from 1.02, 0.70, 0.51, 0.61until to 1.09, This shows a rising trend after the first reduction. In the simulation system, the possibility of winning good resources will increase with the reduction of good projects, and the entropy of system gradually reduced.But when the number of packaged projects reduced to a certain extent, social investors are dissatisfied with the quality of projects. This increases the consideration and cost when buying, and the system entropy is also gradually increasing.

(3) When the number of parameters of social investors (number-investor) constant, rate-or-good=50%, the parameter rate-or-package is changed, the change of system entropy can be seen in fig.6.

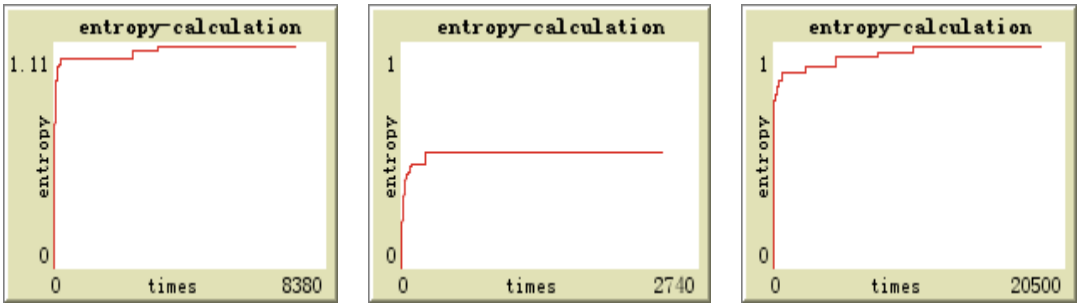

Figure 6: Variation of system entropy (c)

When the rate-or-good changed from 0 to 100%,the system parameters（entropy-calculation）varies from 1.02, 0.70, 0.51, 0.61, until to 1.09.This shows a rising trend after the first reduction. In the simulation system, the possibility of reaching an agreement will increase with the reduction of packaged projects, and the entropy of system gradually reduced. But when the number of packaged projects reduced to a certain extent, social investors are dissatisfied with the project. This increases the consideration and cost when buying, and the system entropy is also gradually increasing.

changes of the multi variable parameters

(1) When the number of parameters of social investors (number-investor) unchanged, the parameter rate-or-good and rate-or-package changes from 0 to 100%, the change of system entropy can be seen in fig.7.

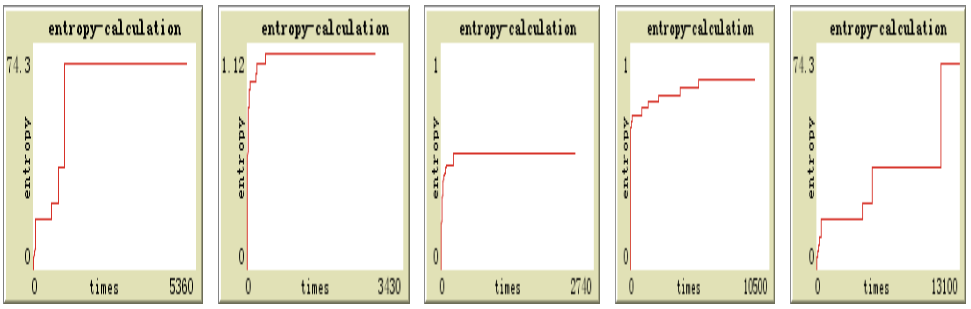

Figure 7: Variation of system entropy (d)

(2) When the number of parameters of social investors (number-investor) unchanged; the parameter rate-or-good changes from 0 to 100%; the parameter rate-or-package changes from 100% to 0, the change of system entropy can be seen in fig.8.

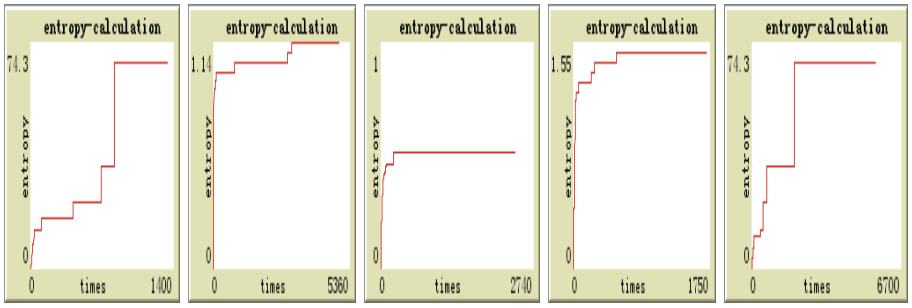

Figure 8: Variation of system entropy (e)

CONCLUSION

The process of PPP project for geological disaster prevention is relatively complex. Both sides in the game continue bargaining. All interests subject continuously game according to the changing environment. The result of the game mainly changes in their income and the system entropy. In order to study this phenomenon, the paper uses netlogo simulation software, and built the simulation model of PPP project for geological disaster prevention. However, due to the fact that the PPP project simulation model involves more stakeholders, the paper abandons a part of unimportant stakeholders. How to fully describe the dynamic change of the whole system is a direction for future research.

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