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Research Article

Incentive Mechanism for Inhibiting Developer's Moral Hazard Behavior in China's Sponge City Projects

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As a new sustainable urban development concept, the Sponge city has an important influence on the stormwater treatment. The low-impact development (LID) system of nonpublic lands plays an important role in the entire construction of Sponge city. In the nonpublic lands' LID system construction, a principal-agent relationship exists between the government and developer and the effect of construction mainly depends on the developer's operation and management. Due to the asymmetry of information and the different benefit goals, the developer could be prone to take moral hazard behavior to damage the project and public's interests. In this paper, based on the principal-agent relationship between the government and developer in Sponge city projects, principal-agent incentive models under the existence of developer's moral hazard tendency were constructed to help the developer invest an optimal efforts level. The results show that an increase in incentive intensity would increase the developer's optimal level of productive efforts in the presence of developer's moral hazard tendency; this can indirectly cause an increase in total output performance of Sponge city, thus realizing a "win-win" effect between the government and developer. Likewise, a larger incentive intensity can also help reduce the developer's moral hazard tendency. The more obvious moral hazard tendency of developer, the larger incentive coefficient should be. The findings provide reference for government seeking to specify incentive contracts from a theory perspective and curbing developer's potential moral hazard behavior in Sponge city projects.

1. Introduction

In recent years, the natural hydrologic cycle was changed in cities with the rapid development of the economy and continuous acceleration of urbanization in China [1], which results in ecological damage, water environment deterioration, and runoff pollution [2, 3]. Water issues including more urban flooding disasters, groundwater overexploitation, and water pollution are increasingly prominent [4, 5]. Traditional water management methods can no longer meet the requirements of sustainable urban development. In response to rising urban water-related problems, in 2014, the Chinese National government proposed to construct "Sponge city" to manage urban stormwater and fund the development of "Sponge city" demonstration projects in thirty pilot cities across the country [6, 7]. As a new concept of urban stormwater management, Sponge city can provide a natural and low-impact way to deal with flood disasters [8]. The Sponge city has changed the traditional rainwater management method and established a new concept of "urban can be like a sponge, with a good ability to adapt natural environmental changes and solving stormwater problem through the natural processes of infiltration, detention, storage, and purification" [9] (Figure 1).

The Chinese "Sponge city" concept is similar to the water-sensitive urban design (WSUD) in Australia [10], the low-impact developments (LIDs) in the United States [11], the Blue-Green Cities (BGCs) in the United Kingdom [12], and low-impact developments urban design (LIDUD) in New Zealand [13], which have a good resilience in adapting

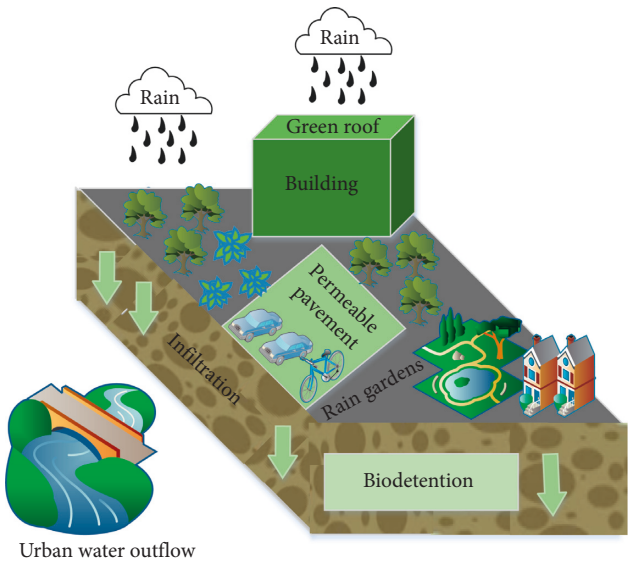

Figure 1: Schematic diagram of the Sponge city concept.

to environmental changes and aim to reduce the negative effects of stormwater. The Sponge city includes three construction systems, that is, low-impact development (LID) system at the source, urban pipe duct drainage system (UPDDS) at the midway, and excessive rainfall runoff discharge system (ERRDS) at the terminal. Among them, the LID system, as an alternative to using conventional management facilities, can absorb urban stormwater at the source through infiltration, detention, storage, and purification [14, 15]. Typical LID facilities, such as pervious pavements, cluster layouts, rain gardens, and grass swales, have proven to be effective for reducing urban stormwater [16, 17].

LID systems are implemented on both public lands and nonpublic lands. It is worth noting that the nonpublic lands account for approximately 75% of the total lands of Sponge city [18]. The LID system construction of nonpublic lands plays an important role in the entire construction of Sponge city. However, the construction effects of "Sponge city" pilot cities are not desirable and many cities still suffer from severe urban flooding (including megacities of Beijing, Nanjing, and Shanghai) [19]. The main reason is that the government focuses on the technologies of LID system rather than construction management, which leads to the low construction performance of Sponge city projects. Although the technical indicators of LID facilities are critical, the management of the LID system construction, such as implementation level of LID indicator and operation performance, is equally important in Sponge city projects.

In general, the government typically launches Sponge city projects to meet the needs of the public and entrust the developer to carry out the construction of the LID system on nonpublic lands by signing the contract. Thus, a principal-agent relationship exists between the government and the developer, the government as the principal incorporated LID system construction indicators into the land leasing contract, and the developer as the agent is responsible for the construction and implementation [6]. However, the two parties do not share the same goals due to the conflicts in profits because the government targets maximizing project benefits, whereas the developer pursuits its own economic profits. Due to the asymmetry of information and the different benefit goals of the both parties, the developer could be prone to take moral hazard behavior, such as cheating in work and using inferior materials.

Moral hazard behavior is a kind of common behavioral phenomenon in social-economic activities [20, 21] and may increase under the circumstances of information asymmetry and lack of supervision. In a Sponge city project, the moral hazard behavior exhibited by the developer does seriously affect the construction performance and the implementation of LID indicators, which may lead to failure of the project and harm the public interests [22]. In turn, preventing the moral hazard behavior could keep the Sponge city projects healthy and sustainable. As such, understanding such behavior and determining ways to prevent the occurrence of such moral hazard behavior are critically important. However, in Sponge cities' study, a majority of researchers mainly focus on the LID techniques, such as the control techniques of runoff quantity and quality [23, 24], bioretention facility [25], and ground detention and monitoring techniques [26]. A limited number of studies have investigated the managerial problems of Sponge city construction. For instance, Chui et al. discuss the optimal LID design scheme focusing on the lowest cost [27]. Li et al. evaluate the LID system construction performance in Shenzhen by using the Storm Water Management Model (SWMM) and the analytical hierarchy process (AHP) method [28]. Ma et al. believe that the scientific management provides support for the construction of a Sponge city and the construction of a Sponge city needs the combination of the technology and management [6, 29].

Many researchers have found that the incentive mechanism has a significant effect on constraining agents' moral hazard behavior based on principal-agent theory [30, 31]. Desai et al. [32] find that, in corporate governance, the reputation incentive to the project manager can solve the problem of moral hazard behavior. Bartling and Siemens [33] find that flat-wage contracts are more likely to be optimal incentive contracts to envious agents with moral hazard in firms. Liu et al. [34] construct a principal-agent incentive model to inhibit investors' opportunistic behavior in PPP projects. These extant research achievements have provided a powerful reference point for this paper. However, the current studies of how the incentive mechanism works in Sponge city projects still contain the "incentive absence" phenomenon; the incentive mechanism is not sufficiently complete. Specifically, few scholars pay attention to the incentive mechanism for solving moral hazard problem in the Sponge city projects.

In view of this finding, faced with the developer's moral hazard tendency, this paper constructs an incentive model for inhibiting developer's moral hazard tendency, after analyzing the principal-agent relationship between the government and developer. This paper is organized as follows: Firstly, the principal-agent relationship between the government and developer is discussed in the Sponge

cities. Secondly, incentive mechanism in the presence of moral hazard tendency in developer is constructed, followed by a discussion of the model. Finally, a case study is presented using this incentive mechanism. Some relevant recommendations are proposed. This study is aimed at reducing the developer's moral hazard tendency, improving the operating and managing efficiency in Sponge city. The main contributions of this paper are as follows: (1) Based on the linear incentive framework of Holmstrom and Milgrom (1991) [35], the incentive mechanism under the existence of developer's moral hazard behavior is constructed to expand the research on optimal incentive contracts in Sponge city projects. (2) This paper uses the theoretical model to analyze the impacts of the developer's moral hazard behavior on the design of the incentive contract. The results show that the incentive measures provided by the government needs to consider the developer's moral hazard tendency.

2. Principal-Agent Relationship between the Government and Developer

In the Sponge city projects, based on the contractual relationship between the government and developer, a principal-agent relationship exists between both the parties. The government as the principal typically launches Sponge city projects and grants the rights of construction to the developer (as the agent) by signing the contract. The government is at an informational disadvantage, whereas the developer is at an informational advantage. The two parties maintain asymmetrical information. Moreover, the two parties exhibit conflicts in profits due to the different targets. The government aims to achieve the construction goals of the Sponge city for urban sustainable development, whereas the developer pursuits its own economic profits. According to modern corporate governance theory [34], the principal-agent relationship between the government and developer is mainly reflected in the following aspects:

(1) The ownership and the operating right are separate. The construction of the LID system involves more technical and management issues, and the Sponge city project is a complex system. With the advancement of social technology, the requirements for construction project management are continually increasing. It is neither necessary, nor economically viable, nor even possible for a government to organize the construction work by himself or herself. The only rational choice for a government is to entrust the developer to carry out the construction of LID system. In this process, a principal-agent relationship is established between the government and developer. This is done by signing a contract that formally separates the ownership and control of the project [36]. The government owns the ownership of the project, whereas the developer can make decisions and control over specific actions in the processes of construction, based on the principal-agent contracts.

(2) There is an information asymmetry between the developer (as the agent) and the government (as the principal). The LID system is featured on complex construction techniques and is set in scattered construction sites. During the construction, the government is at an informational disadvantage and can neither accurately obtain developer's information nor thoroughly grasp the developer's effort levels. It is difficult for the government to supervise the developer's construction behavior. Therefore, the allocation of risks between the government and the developer may not be optimal [34].

(3) The benefit goals of the government and the developer are different. In the Sponge city, conflict of interest exists between the government and developer due to the different targets because the government wants to maximize the project benefits to achieve urban sustainable development, whereas the developer focuses on its own profits during the construction. Building a LID system not only increases the construction cost but also has little effect on the land development [6]. So, the developer lacks the motivation to construct the LID system meticulously. Moreover, the developer may take some actions that go against project interests to chase a higher profit.

(4) Uncertainty exists with regard to implementation environments and agency results. Due to the uncertainty exists in the implementation of the LID system, the contract signed by the government and the developer cannot cover all the circumstances in the whole process [37]. In addition, the specific evaluation criteria of LID construction indicator have not been issued by the government and the government has not yet supervised the construction process of the Sponge city, which increases the risks of project and may give the developer the space to escape from its construction responsibility. This increases the uncertainty of the contractor's agency results.

In the principal-agent relationship between the government (as the principal) and developer (as the agent) in Sponge city projects, it is critical to understand and determine the ways to motivate the developer to ensure that the developer can implement the indicators of the LID system to promote project performance, while pursuing self-interests.

3. Problem Description and Basic Hypothesis

3.1. Problem Description. A Sponge city (LID system) project will enter a construction period after the principal-agent contract is signed by the government and the developer. The construction effect of the LID system mainly depends on the construction and management of the developer. However, the developer's construction and management efforts are similar to being trapped in a black box (Figure 2) [38]; that is, the information asymmetry exists between the government and the developer in this black box, and the developer has

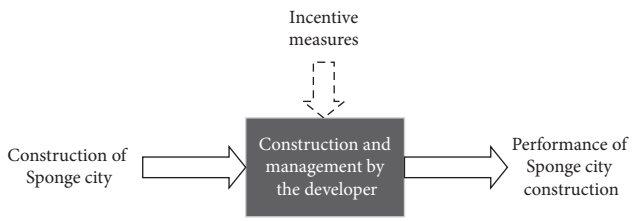

Figure 2: Black box of developer construction and management.

sufficient information and is likely to hide behavior and hide information to take moral hazard behaviors, whereas the government has minimal information and cannot grasp the effort levels of the developer but only judge by the construction performance of the developer.

Incentives are considered as one of the most effective measures for solving this problem [39]. The government's incentive measure for developers is the key to opening the "black box" of Sponge city construction. The government will possibly obtain the ideal information on construction performance of Sponge city by inputting incentive measures to "black box". Otherwise, the developer will not exert its real capacity to implement the construction indicators of the LID system, and the "black box" is unable to output the ideal performance information of Sponge city. Therefore, the focus on opening the "black box" in Sponge city lies in how the government designs the incentive measures to motivate the developer, thus preventing the occurrence of moral hazard behavior by the developer.

3.2. Basic Hypothesis. The following hypothesis must be formulated to analyze the principal-agent model:

Hypothesis 1. e is set as the developer's effort level in the construction of Sponge city; higher e implies a higher level of productive efforts that are derived from the developer. $c(e)$ is set as the cost of productive efforts of the developer during the construction process; $c(e)$ is a strictly increasing convex function. The cost function of such efforts can be expressed as follows [40]:

$$c(e) = \frac{qe^2}{2}, \tag{1}$$

where q is the cost coefficient of productive effort.

Hypothesis 2. In Sponge city, λ represents the moral hazard behavior tendency level of the developer and $\lambda \in [0, 1]$. The higher λ means the developer's moral hazard behavior tendency is higher and the developer is more likely to take moral hazard behavior. If $\lambda = 0$, it means that the developer is not possible to take moral hazard behavior. h is set as the level of moral hazard behavior by the developer. The output of the moral hazard behavior by the developer in the project is D. The total output of moral hazard behavior can be expressed as follows:

$$D = \lambda(h + \varepsilon), \tag{2}$$

where ε denotes the random interference variable, which is subjected to a normal distribution; that is, $\varepsilon \sim N(0, \sigma_1^2)$. σ_1 is set as the degree of influence of uncertain factors. The larger the σ_1^2, the stronger the influence of uncertain factors.

In the Sponge city construction, the cost function of the developer in pursuing moral hazard behavior can be expressed as

$$c(h) = \frac{dh^2}{2}, \tag{3}$$

where d is the cost coefficient of the developer in pursuing moral hazard behavior.

Hypothesis 3. The total output performance of Sponge city is X; the total output performance (X) is related to the effort level of the developer (e), the investment level of the developer' own resources (a), and the degree of influence of uncertain factors (θ). The larger a indicates the more resources are invested into the Sponge city construction, and larger e represents a higher level of developer's productive efforts. According to Tirole [41], the total output X can be expressed as

$$X = ae + \theta, \tag{4}$$

where θ denotes the random interference variable, which is subjected to a normal distribution; that is, $\theta \sim N(0, \sigma_2^2)$. θ and ε are mutually independent.

When the developer has moral hazard behavior in the Sponge city construction, the moral hazard behavior would affect the overall benefits of the Sponge city construction. At this point, the overall benefits of the Sponge city can be expressed as $X - D$; that is

$$X - D = ae + \theta - \lambda(h + \varepsilon). \tag{5}$$

Hypothesis 4. According to the classic assumption of principal-agent theory, the government is risk-neutral, but the developer (as agent) is risk averse, with a risk evasion coefficient of ρ.

4. Incentive Model

4.1. Model Establishment. Weitzman [42] proposed and analyzed the rationality of linear incentive. Holmstrom and Migrom [35] proved that the linear incentive can achieve optimal results. At present, the incentives contracts in engineering projects mostly adopted linear incentive contracts [43]. This paper also adopts in the form of a linear incentive. Therefore, the benefits of the developer given by the government can be expressed as follows:

$$S = b + z = b + \beta(X - D), \tag{6}$$

where b is the fixed-guaranteed income, which can be understood as the target cost in Sponge city projects. z is the incentive part by government, which is related to the developer's production output; β represents the incentive coefficient, $\beta \in [0, 1]$. Logically speaking, the developer would decide their efforts levels based on the incentive level by the government.

(1) The net benefits of the developer: according to Hypothesis 2, the output of the moral hazard behavior by the developer in the Sponge city construction (D) is exclusively collected by the developer. The total benefits of the developer with moral hazard behavior (Y) is determined by the fixed-guaranteed income (b), the incentive income by the government (z), and the output of the moral hazard behavior (D). So, the total benefits of the developer with moral hazard behavior (Y) is

$$\begin{aligned} Y &= b + z + D = b + \beta(X - D) + \lambda(h + \varepsilon) \\ &= b + \beta[ae + \theta - \lambda(h + \varepsilon)] + \lambda(h + \varepsilon). \end{aligned} \tag{7}$$

The benefit of the developer is Y; the total expenditures incurred by them include the level of resource investment (a), the cost of productive efforts $c(e)$, and the cost moral hazard behavior $c(h)$. Thus, the net income of the developer (π) is

$$\begin{aligned} \pi &= Y - c(e) - c(h) - a \\ &= b + \beta[ae + \theta - \lambda(h + \varepsilon)] + \lambda(h + \varepsilon) \\ &\quad - a - \frac{qe^2}{2} - \frac{dh^2}{2}. \end{aligned} \tag{8}$$

According to the above assumptions, the developer is risk-averse and the deterministic equivalent income can be used to replace the developer's risk-return [44]. The certainty equivalent net benefit can be set as

$$\begin{aligned} \pi &= Y - c(e) - c(h) - a = b + z \\ &\quad + D - c(e) - c(h) - a \\ &= b + \beta(X - D) + \lambda(h + \varepsilon) \\ &= b + \beta(ae - \lambda h) + \lambda h - a - \frac{qe^2}{2} - \frac{dh^2}{2} \\ &\quad - \frac{1}{2}\rho\left[\beta^2\sigma_2^2 + \lambda^2\left(1 - \beta^2\right)\sigma_1^2\right]. \end{aligned} \tag{9}$$

(2) The net total benefits of the government: the government benefit is the output performance of Sponge city X. According to Hypothesis 3, the overall benefits of the government is $X - D$ and the total expenditure of the government is S. According to Hypothesis 4, government is risk-neutral and the expected net income of the government is

$$\begin{aligned} E(Z) &= E(X - D - S) \\ &= E(X - D) - E(b) - E(z) \\ &= (1 - \beta)(ae - \lambda h) - b. \end{aligned} \tag{10}$$

(3) Incentive model: according to the above analysis, the incentives of the developer with the moral hazard behavior in the Sponge city projects are equivalent to solving the following constrained programming problem:

$$\max E(Z) = \max(1 - \beta)(ae - \lambda h) - b, \tag{11}$$

$$\begin{aligned} \pi &= b + \beta(ae - \lambda h) + \lambda h - a \\ &\quad - \frac{qe^2}{2} - \frac{dh^2}{2} - \frac{1}{2}\rho \\ &\quad . \left[\beta^2\sigma_2^2 + \lambda^2(1 - \beta)^2\sigma_1^2\right] \geq U\,(\mathrm{IR}), \end{aligned} \tag{12}$$

$$\begin{aligned} \max \pi &= b + \beta(ae - \lambda h) + \lambda h - a \\ &\quad - \frac{qe^2}{2} - \frac{dh^2}{2} - \frac{1}{2}\rho \\ &\quad . \left[\beta^2\sigma_2^2 + \lambda^2(1 - \beta)^2\sigma_1^2\right] (\mathrm{IC}). \end{aligned} \tag{13}$$

According to the incentive model, the developer's productive efforts should be subjected to the above-mentioned incentive compatibility constraints. According to the first-order optimal solutions to Equations (11)–(13), the optimal productive efforts level, moral hazard behavior level, and incentive coefficient of the government are calculated, respectively, as follows:

$$e = \frac{\beta a}{q}, \tag{14}$$

$$h = \frac{\lambda(1 - \beta)}{d}, \tag{15}$$

$$\beta = 1 - \frac{\rho q d \sigma_2^2}{a^2 d + \rho q d \sigma_2^2 + \lambda^2 a^2 q + \lambda^2 \rho q d \sigma_1^2}. \tag{16}$$

4.2. Model Analysis. According to the results of the incentive model from Equations (14) to (16), the following analyses are obtained:

Equation (14) shows that the developer's optimal effort level (e) is correlated positively with the investment level of the developer' own resources (a), but negatively with the cost coefficient of developer's productive effort (q). That is, the more resources invested by the developer in the project, the lower the cost coefficient of productive efforts and the higher developer's efforts level will be. Equation (15) indicates that the level of developer's moral hazard behavior (h) is determined by the moral hazard behavior tendency level (λ) and cost of the developer in pursuing moral hazard behavior (d). h increases with the increased level of moral hazard behavior tendency (λ) and a decreasing cost of developer's moral hazard behavior (d). That is, the higher the level of moral hazard behavior tendency by the developer, the lower the cost of moral hazard behavior and the higher the level of developer's moral hazard behavior will be. Meanwhile, Equation (16) illustrates that the government's incentive coefficient (β) increases in line with the increased moral hazard behavior tendency level (λ), which means that when

developers have an increased moral hazard behavior tendency level, the government should increase the incentive coefficient to inhibit this kind of behavior. In addition, the more investment that is placed on resources of the developer (a), the higher the government's incentive coefficient (β) will be. This in turn clearly indicates that the incentive coefficient offered by the government to the developer becomes bigger and the investment level of the developer' own resources (a) will increase. Therefore, a higher level of incentive coefficient to developer can ensure that the developers would invest more resources to implement the Sponge city projects.

When $\lambda \neq 0$ (that is, the developer has moral hazard behavior tendency), Equation (15) is $h \neq 0$. This explains that, the developer is more likely to adopt moral hazard behaviors under the existence of moral hazard tendency. In particular, when $\lambda \neq 0$ (that is, the developer has no moral hazard behavior tendency), Equation (15) is $h \neq 0$; that is, developer would not take moral hazard behaviors. In conclusion, the developer's moral hazard tendency would induce moral hazard behavior. Conversely, when the developer's moral hazard tendency is zero, the moral hazard behaviors of developer are almost nonexistent.

4.3. Model Discussion. The main conclusions of this paper are as follows:

(1) Equation (14) illustrates that the developer's optimal effort level (e) is independent of his/her moral hazard behavior tendency (λ). So, no matter how the degree of moral hazard behavior tendency (λ) is, the greater the government's incentive coefficient (β) and the higher the developer's optimal effort level (e) will be. Moreover, since the total output of Sponge city is $X = ae + \theta$, the total output of Sponge city (X) increases in line with the increased developer's optimal effort level (e), which means that an increasing incentive coefficient (β) can indirectly cause an increase in total output performance of Sponge city (X). Therefore, the government can encourage the developer to invest an optimal efforts level by setting a higher incentive coefficient, which can realize a "win-win" effect on both parties.

(2) From Equation (15), it can be seen that according to $\partial h/\partial \beta < 0$, the developer's moral hazard behavior (h) is a decreasing function of the government's incentive coefficient (β); that is, the higher the incentive coefficient (β), the lower the developer's moral hazard behavior (h). This implies that when the government improves the incentive intensity for developer, the likelihood of moral hazard behavior by developer will reduce.

(3) From Equation (16), an increase investment level of the developer's own resources (a) and the increased moral hazard behavior tendency level (λ) will cause an increase in the government's incentive coefficient (β). According to the above analysis, there are great possibilities for the developer to adopt moral hazard behaviors under the existence of moral hazard behavior tendency. So, during the contract negotiation stage, the government should analyze the developer's moral hazard behavior tendency to determine the incentive coefficient. Therefore, once moral hazard behavior tendency exists, the government needs to increase the incentive coefficient to inhibit the developer's moral hazard behavior tendency. In addition, the increasing incentive coefficient can encourage developers to invest more resources in the construction of the LID system.

In the construction of Sponge city projects, the developer's moral hazard behavior is a kind of common behavioral phenomenon and occurs constantly. Furthermore, the supervision over the Sponge city projects' process has not yet been carried out by the government, which provides greater scope for the developer to engage in moral hazard behavior. So, in order to ensure the full implementation and successful completion of the Sponge city, the government should analyze the developer's moral hazard behavior tendency in a scientific and rational method, and on this basis, the government need to formulate a reasonable incentive coefficient to motivate the developer to invest higher levels of productive efforts.

5. Case Study

City A plans to take "Sponge city" construction in a nonpublic land C, government A aims to achieve the urban sustainable development goals of the Sponge city. The land C should have good resilience in adapting to environmental changes and dealing with natural disasters and can absorb water, store water, permeate water, and purify water during the rain, then release, and use the stored water. The A city's government department would sign a land leasing contract with developer B. The construction requirements and related parameters are incorporated into the principal-agent contract, and the developer B is responsible for the construction and implementation in nonpublic lands C. During the negotiation phase of the Sponge city project, the government should determine the incentive coefficient (β) and the government should pay the final reward for developers when the project is well-constructed. The incentive coefficient would be formulated as follows.

In the negotiation phase, the government should determine the incentive coefficient (β) based on the level of the moral hazard behavior tendency in developer B. The government can obtain developer B's risk evasion coefficient value ρ, the cost coefficient of developer's productive effort (q), and the investment level of the developer' own resources (a) based on the previous projects that B has participated in. Although it remains more of an art than a science, attempts can be made to calibrate for these values. The relative parameter values are listed in Table 1. To set a reasonable incentive coefficient, the relationship between the incentive coefficient (β), the developer's optimal effort level (e), the level of developer's moral hazard behavior (h), and the moral hazard behavior tendency (λ), the cost coefficient of the

Table 1: Values of relative parameter.

Parameters	Values
ρ (risk evasion coefficient)	0.85
q (cost coefficient of productive effort)	0.8
a (investment level of resources)	0.35
σ_1^2 (influence of uncertain factors)	0.4
σ_2^2 (influence of uncertain factors)	0.4

developer in pursuing moral hazard behavior (d) is analyzed. The analysis results are shown in Figures 2–4.

Figures 3 and 5 show that the overall trends of e and β against the changes of d and λ are similar. When d is constant, both the developer's optimal effort level (e) and the incentive coefficient (β) increase as the developer's the moral hazard behavior tendency (λ) increases. It implies that the government should determine the larger incentive coefficient (β) when the developer has a greater moral hazard tendency (λ). So, the more obvious the moral hazard tendency of the developer, the larger the incentive coefficient should be. In addition, since $\partial e/\partial \beta > 0$, the larger incentive intensity can increase the developer's optimal effort level (e). Logically, the bigger the cost coefficient of developer's moral hazard behavior (d) is, the lower the moral hazard behavior tendency (λ) will be. So, when λ is constant, both e and β decrease when cost coefficient of developer's moral hazard behavior (d) increases. Figure 4 indicates that when cost coefficient of the developer in pursuing moral hazard behavior (d) increases and developer's the moral hazard behavior tendency (λ) decreases, it would cause an increase in the developer's moral hazard behavior level (h). In particular, when $\lambda = 0$ (i.e., the developer has no moral hazard behavior tendency), $h = 0$, which means that no matter what the d is, the developer has not adapted the moral hazard behavior.

The government should determine an incentive coefficient after comprehensively analyzing the developer's moral hazard behavior tendency. In addition, the government can make some appropriate clauses, such as heightening the intensity of legal sanction, to keep the level of moral hazard behavior (h) as low as possible. After the above work is completed, the government can use certain questionnaire tests and other methods (such as interviewing, psychological tests) to gain the developer's moral hazard behavior tendency (λ). Assume the $\lambda = 0.3$ and $d = 0.4$, according to Equation (16), $\beta = 0.259$. The government shall determine incentive coefficient value of 0.259 ($\beta = 0.259$) in the contract and should provide an extra 0.259 times of construction cost as an incentive to the developer when the LID system construction indicators reach the demonstrative standard. The developer B is encouraged to strive toward the construction standard and can obtain a certain bonus after reaching the basic standard. The incentive contract may first be guaranteed to inhibit the developer's moral hazard behavior. Moreover, Sponge city effect under such incentive contract could be achieved, thus realizing a "win-win" effect between the government and developer.

6. Conclusion

As a new sustainable development concept, the Sponge city has an important influence on the urban water treatment. In the Sponge city projects, a principal-agent relationship exists between the government and developer based on the contractual relationship. The effect of the Sponge city projects depends on the operation and management of the developer during the construction to a large extent. Due to the asymmetry of information and the different benefit goals of both the parties, the developer is more prone to engage in moral hazard behavior, which in turn has the potential to harm the project and public benefit. This paper constructs the incentive mechanisms under the existence of developer's moral hazard tendency, after analyzing the characteristics of the principal-agent relationship between the government and the developer in Sponge city projects. The results show that the government's incentive for the developer can effectively reduce his/her moral hazard tendency. The developer with moral hazard tendency would be more inclined to invest an optimal efforts level after acquiring a higher incentive, and a larger incentive intensity can help developers invest more resources in the construction. Therefore, the government should determine a greater incentive coefficient for the developer in the presence of moral hazard tendency, and this can also indirectly cause an increase in total output performance of Sponge city, thus realizing a "win-win" effect on both parties. To conclude this paper, the following countermeasures are put forward:

(1) In the tendering stage, the government should examine the developer's potential moral hazard behavior tendency and can reduce developers' moral hazard tendency by designing reasonable contract clauses after the developer was selected.

(2) In the construction stage, the government can reduce the moral hazard tendency of developers by strengthening supervision. Once found that the developer did not implement the LID system construction indicators during the construction process, the government can impose strict penalties on the contractor.

(3) When the project is constructed, the government needs to pay the final incentive for developers based on the construction performance. The assessment of LID system construction effect is the basis for incentives for Sponge city projects. So, the government should make an objective and effective assessment method to assess the effect of Sponge city projects.

The incentive mechanisms in the presence of developer's moral hazard tendency aim to guarantee the Sponge city's construction objective, inhibit developer's moral hazard

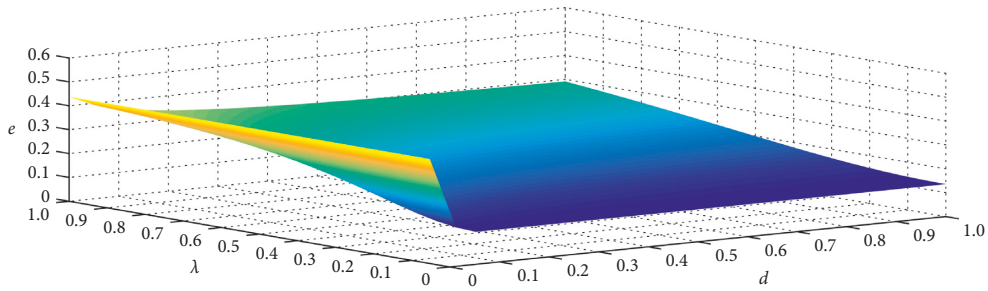

Figure 3: Developer's optimal productive efforts level e.

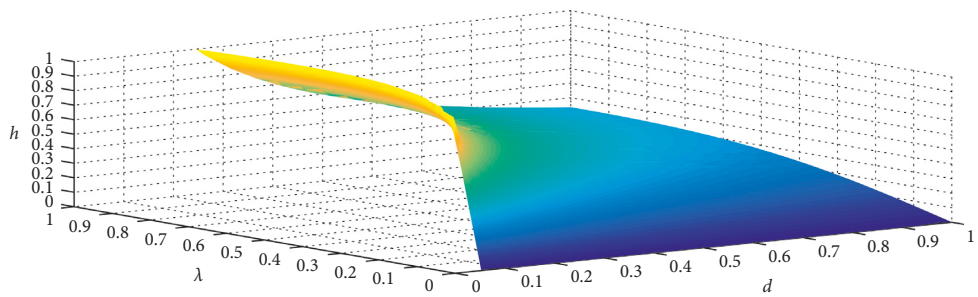

Figure 4: Developer's moral hazard behavior level h.

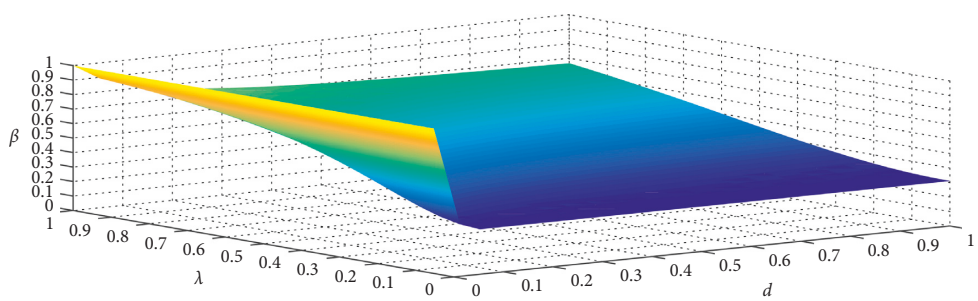

Figure 5: Incentive coefficient for developer β.

behavior, improve the efficiency of project construction and management, and reduce supervision cost.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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