

Original Research

Research on the Current Situation, Influencing Factors and Governance Countermeasures of Public Participation in Citizen Post Station Co-Production under the Background of “Internet + IoT”: an Example of Urban Post Station of Environmental Governance

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Abstract

From the perspective of embedded governance and public participation, public service co-production has become a common phenomenon, among which the co-production behavior in the field of environmental governance is particularly prominent. In the governance process of “Zero-waste City” and “smart city”, the “environmental protection post station” has served as a forward position, opening up the “last kilometer” of grass-roots governance, which is conducive to promoting public participation and co-production in social governance. On this basis, the current situation, influencing factors and governance countermeasures of public participation in the co-production of citizen post stations are discussed with citizen post stations of environmental governance as an example. The results show that: (1) In the field of environmental governance, there is a common phenomenon of “strong willings and weak behaviors” in the co-production of citizens, who do not understand the function of citizen post stations and seldom use the digital governance platform of the government. (2) In the field of environmental governance, citizens’ co-production behavior is affected by individual characteristics, co-production capacity and perceived factors. (3) Among the individual characteristics, the age and political outlook of the public will affect their co-production behavior. (4) Under the background of government digital governance, citizens’ co-production behavior will also be significantly affected by their environmental cognitive ability and new media use ability. (5) The citizens’ co-production behavior

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in citizen post stations of environmental governance will be affected by self-efficacy, significant perception of public service and satisfaction perception and other factors. Therefore, it is necessary to formulate differential incentive strategies according to individual characteristics in the future citizen post station construction, so that more subjects can participate effectively. Perhaps, we should also enhance public awareness and participation with the help of new media, pay attention to the cultivation of citizens' co-production capacity and the improvement of public perception factors, promote the co-production of citizen post stations in a more diversified way.

Keywords: Citizen Post Station, co-production, environmental governance, public participation, logistic regression

Research Background

With the rapid development of science and technology and the construction of intelligent city, multi-functional citizen post station came into being in the process of public life and urban governance under the background of "Internet + IoT" and has developed into a "sharp weapon" of grass-roots governance. It is a venue that provides public services for people, including charging, temporary rest, providing convenient services, emergency supplies, etc. Some scholars also refer to it as urban post station, Some stations provide comprehensive public services, while others provide specialized public services, covering areas such as basic convenience services, medical rescue, emergency services, environmental protection, etc. At present, it has become a more important focus issue on how to make rational use of smart citizen post stations to promote economic development and improve the performance of urban governance. After entering the post-pandemic era, many nucleic acid detection kiosks in the pandemic period have also been transformed into multi-functional citizen post stations in China, and the ways of public participation have gradually increased. Some of the renovated citizen post stations have multiple functions such as omni-directional monitoring, wisdom storage, self-help retail, cultural and tourism publicity, convenient services, art appreciation, leisure and entertainment, children's activities, intelligent reading, equipped with materials and emergency equipment, old materials recycling, intelligent garbage sorting and so on. Public services exist in all aspects of urban governance, appropriate and effective supply of public services will improve the quality of life of the public and meet the needs of public life. Among them, the citizen post stations of environmental governance are closely related to the life of the public, and the co-production of environmental governance can promote the quality of public service supply to a certain extent. For example, in China, Nanjing combines the construction needs of "Zero-waste City" to build "recyclable materials" self-service intelligent recycling stations and "environmental protection post stations" to put in intelligent recycling equipment. After putting recyclable items into the self-service intelligent recycling bin, residents can receive corresponding remuneration and points to exchange

for convenient services or daily necessities. Not only that, the construction of environmental protection post stations can also provide rest and dining, emergency medicine, charging and other convenient services, but also let sanitation workers have a place to rest, it can be said to kill more than one stone. The "environmental protection post station" has become the forward position of grass-roots environmental governance, opening up the "last kilometer" of environmental governance, which is conducive to promoting public participation and co-production in environmental governance. Accordingly, this work takes the citizen post stations of environmental governance in China as an example to discuss the current situation, influencing factors and governance countermeasures of public participation in the co-production of citizen post stations.

Co-production is an innovative point of view put forward by the new public governance theory. In this concept, the public has changed from a simple passive receiver to a complex role of both consumers and producers, which can participate in and play an important role in the planning, design, provision and evaluation of public service supply. In addition, co-production can also systematically integrate resources with different sources, levels, structures and contents, so as to effectively improve the efficiency and quality of public services and create rich and unique public value [1]. Therefore, it is extremely important and necessary to explore the influencing factors of co-production and encourage citizens to participate in co-production for building a high-quality public service supply system, promoting public participation and improving governance performance. Environmental governance is a process of collective action, which needs to consider the interests and demands of multiple subjects [2]. Currently, the practice of digital governance is widely carried out in various countries, which significantly reduces the cost of public participation in the co-production of environmental governance, and improves the transparency and public participation of environmental governance. The effectiveness of environmental governance, a typical public service, depends on the joint participation and co-governance and sharing of multiple subjects such as the government and the public. Digital governance emphasizes technological empowerment, new media embedded

in co-production, and various subjects intertwined and intertwined. Thus, this study is beneficial to promote the co-production of citizen post stations, and then improve the performance of environmental governance, reduce the cost of environmental governance, and promote the development and improvement of environmental protection citizen post stations, and strongly promote the construction of interactive three-dimensional, multi-dimensional cooperative environmental governance pattern and pluralistic cross, balanced and collaborative governance system.

Literature Review and Research Hypotheses

Co-production is one of the more ordinary ways of public participation in the field of public service. In the early days, Ostrom constructed a theoretical model of co-production, which described co-production as a combination of government input and public input. She holds that these two types of inputs are complementary and substitutable in the process of co-production [3]. The new public governance theory regards co-production as the core of public service operation. In this perspective, the public sector, market entities, third-party organizations and public individuals participate in the supply of public services through cooperative governance [4]. In the past, scholars agreed that co-production serves as an extremely key factor in improving the quality of public services, improving the efficiency of public services, meeting the needs of public services, and solving the problems of social governance [5]. It should be pointed out that the co-production theory especially emphasizes the joint participation of state actors and lay actors in the provision of public services to describe the synergy between the government and the public [6-7]. In the process of environmental governance, the importance of citizens' co-production behavior, as an alternative to the government's high-cost administrative regulation and post-remediation of environmental pollution [8], has been fully demonstrated [9]. The public is encouraged to play a more and more active role in shaping a good environment [10]. On the other hand, public participation in the creation of environmental value has also become an important part of improving the environmental assessment system [11]. Public participation in environmental co-production can enhance public trust in the government, improve the agreement between public services and public needs, and the public's understanding and satisfaction with the government will also be improved [12-13]. The theory of co-production has always paid attention to the participation behavior of the public following self-interest, social norms and public interest in public service. For example, the theory of co-production is very concerned about the active participation and compliance of the public in garbage classification in the early days of its origin. Whether the public cooperates

or not determines whether the public service of garbage recycling can really create a wide range of value and whether it can really achieve results [14]. Therefore, the theory of co-production regards the public as an equally important partner with the government in public services, and constructs the interactive mechanism and cooperation system between the government and the public, which makes co-production one of the important theories of the Post-New Public Management paradigm [15-18]. This study combines the use of citizen post stations with the theory of co-production, which has extremely critical theoretical value and practical significance.

Previous empirical studies on the influencing factors of co-production mostly focus on four categories: individual factors of citizens, organizational factors of public services, social environmental factors and the nature of public services, and these four factors may also affect each other [19]. Most researchers argued that variables at the individual public level have a great impact on co-production. Due to the great changes in the role of the public in the supply of public services, the role of the public has changed from a simple passive receiver to a participant and producer in this mode of public service supply, this means that the public has a certain initiative in the supply of public services, the action is out of positive psychology, the value created is more efficient than the traditional supply model, and the provision of public services is close to the actual demand. Therefore, this study will explore the possible influencing factors of co-production from the perspective of the public.

Existing studies have concluded that individual characteristics such as education, gender, age and place of residence will have a potential impact on citizens' co-production behavior [20]. Among them, gender factors are often seen in a variety of related studies, and some scholars believe that women are more likely to participate in co-production [21]. However, some retort that China's male citizens are more concerned about environmental issues and have more opportunities to participate in the public sphere than women, and are more likely to produce co-production behavior. Therefore, the following hypothesis is put forward:

H1: Gender has a positive impact on citizens' co-production behavior in the field of environment;

Age is one of the components of individual characteristics. Previous studies have agreed that there is a correlation between age and co-production behavior, but there is no unified conclusion on its influence situation. Some scholars believe that young people will have more passion and vitality to participate in co-production. However, some scholars believe that in the process of co-production of public services in the field of the environment, the elderly have more free time and a stronger willingness to participate [22-23]. Generally, older people in China will have more say. Therefore, the following hypothesis is put forward:

H2: Age has a positive impact on citizens' co-production behavior in the field of environment;

In the Chinese context, the political outlook may affect the public's preference for co-production, because in the process of party cultural construction, managers often advocate Members of the Communist Party of China to actively participate in the supply of public services with high public demand. In the practice of environmental governance, the organizational requirements and the influence of social norms will make capable Members of the Communist Party of China often play an exemplary and leading role in the process of public service supply. Therefore, the following hypothesis is put forward:

H3: Political outlook has a positive effect on the citizens' co-production behavior in the field of environment;

Citizens' co-production capacity usually refers to the time, knowledge, capacity and other resources that the public have when they participate in co-production. Most of the co-production requires the public to have at least one of the resources mentioned above [24], and it can be said that the co-production capacity is one of the conditions for the public to implement the co-production behavior. In recent years, the rapid development of Internet technology has enabled the co-production in many fields of social governance to be held online with the help of new media platforms, such as public supervision and reporting of surrounding environmental pollution in the field of environmental governance, feedback on their own environmental demands, and so on. The application of modern information technology and the new paradigm of digital government governance break the gap in the way local government officials understand the needs of the public, increase the public's willingness to participate in co-production, and can greatly promote the development of co-production [25]. Under the background of digital governance of the environment, the public is required to have a certain amount of new media usage ability to participate in co-production. Therefore, the following hypothesis is put forward:

H4: New media usage ability has a positive impact on citizens' co-production behavior in the field of environment;

Environmental cognitive ability determines the public's environmental literacy. Environmental cognition refers to people's systematic and organized emotional, cognitive and behavioral tendencies towards environmental issues and related activities, including the degree of concern for the environment, views on environmental protection behavior, mastery of environmental protection knowledge, and so on [26-27]. In the previous literature on public participation in environmental governance, the theories on the relationship between attitude and behavior are mainly planned behavior theory and normative activation theory. Previous studies have confirmed that the promotion of environmental awareness is closely related to the

formation of moral norms and the promotion of social responsibility. In the field of environmental governance, once the individual's own moral norms are activated, it will strengthen the individual's pro-environmental behavior and co-production behavior [28]. To sum up, public participation in environmental governance is often affected by its environmental cognitive ability. Therefore, the following hypothesis is put forward:

H5: Environmental cognitive ability has a positive influence on citizens' co-production behavior.

The public with co-production capacity may not necessarily participate in co-production, and the willingness and behavior of co-production will also be affected by public perception factors, including self-efficacy, public service significance perception, government satisfaction perception and so on. These factors reflect the psychological state of the public when they implement co-production behavior. Among them, self-efficacy refers to the degree to which the public believes that they can influence public services and make a difference in a meaningful way. To a certain extent, the public knows that they have the ability to plan, design, supply and evaluate public services, and are willing to bear the corresponding responsibility, which directly shows that the public has self-efficacy. Under the background of digital governance of the environment, self-efficacy have an important impact on the public's co-production behavior [29-31]. Self-efficacy is usually divided into two categories. One is internal efficacy, that is, the public's perception of their ability to understand and participate in co-production capacity, and the other is external efficacy, which refers to the public's perception of the importance and outcome of their participation, that is, the perception of the influence of their own behavior [32-34]. Previous studies have pointed out that the public with a stronger sense of self-efficacy is more likely to resonate with the public interest and stimulate their inherent motivation to participate in public services. In other words, the higher the self-efficacy, the easier it is for the public to participate in co-production [35-37]. Therefore, the following hypothesis is put forward:

H6: Self-efficacy has a positive impact on citizens' co-production behavior in the field of environment;

Public service significance perception refers to the degree to which the public, or those around it, need public services. When the public themselves or their relatives and friends suffer from the problem of lack of public services in related areas, they will actively participate in co-production, which is particularly obvious in the field of social governance with greater public demand and more types of services, that is, the stronger the public service significance perception, the more the public tends to participate in co-production [38].

Therefore, the following hypothesis is put forward:

H7: Public service significance perception has a positive impact on citizens' co-production behavior in the field of environment;

Public service satisfaction perception reflects the public’s impression of the government and the image perception of the government. Some studies have shown that if the public has a high public service satisfaction, the performance expectation of their participation in co-production is often high, and their enthusiasm for participation will also increase. Simply put, if citizens' public service satisfaction to the government is relatively high, their trust in the government will also be enhanced, thus enhancing their willingness to participate in co-production [39-40]. On this basis, the following hypothesis is put forward:

H8: Public service satisfaction perception has a positive impact on citizens’ co-production behavior in the field of environment.

Research Design

Data Source

The statistical data used in this study come from the first-hand data obtained from the questionnaire survey conducted by the research team. Considering that China has a vast territory and many provinces, The survey was conducted in May, 2023, with an ongoing survey of people from 31 provinces of Chinese mainland. Finally, 200 questionnaires were collected, of which 168 were valid, including 87 males and 81 females, with a more balanced ratio between men and women. In addition, the samples are widely from 31 provinces, which are well representative and meet the needs of the research.

Variable Measurement and Operation

Dependent Variables

This work focuses on the research of citizens’ co-production behavior in the field of environmental governance, so the question “have you used citizen post stations of environmental protection in the past two

years” is set in the dependent variable design part, and the evaluation standard of “yes = 1, no = 0” is used for quantitative measurement.

Independent Variables

The independent variables of this study are divided into three parts: individual characteristics, citizens’ co-production capacity and public perception. The specific independent variables, measurement items and assignment methods are shown in Table 1.

Individual characteristics are composed of age, gender, and political affiliation, where “age” is the difference between 2023 and the respondent’s own year of birth, and the variable form is a continuous numerical variable. The gender assignment standard is “female = 0, male = 1” and the political appearance assignment standard is “Non-Member of the Communist Party of China = 0, Member of the Communist Party of China = 1”.

In the process of digital intelligent governance, the design, promotion and use of citizen post stations depend more on new digital platforms such as new media and Internet + platform. Therefore, combined with the new characteristics of technological governance, this study divides the citizens’ co-production capacity into new media usage ability and environmental cognitive ability. The related variable measure uses the Five Point Likert Scale, and the larger the value of the option, the stronger the ability of the public in this area.

In this study, public perception includes self-efficacy, public service significance perception and public service satisfaction. Self-efficacy mainly measures the ownership of responsibility, focusing on internal self-perception, in order to understand the sense of responsibility of public participation in citizen post station co-production. Public service significance perception mainly measures the public’s awareness of the importance of environmental protection stations and the demand for citizen post stations. The related variable measure uses the Five Point Likert Scale, and

Table 1. Independent variables and measurement methods.

Dimensions	Variables	Questions
Individual characteristics	Gender	Gender of the interviewees
	Age	Age of the interviewees
	Political Outlook	Whether the interviewee is a Member of the Communist Party of China
Co-production capacity	New Media Usage Ability	Whether to understand and use the environmental protection station through the digital platform
	Environmental Cognitive Ability	Whether to master the knowledge of environmental pollution control, garbage classification and so on
Public perception	Self-Efficacy	It is the duty of every citizen to use citizen post stations to protect the environment
	Public Service Significance Perception	Environmental protection post station is a very important public service, and everyone needs it
	Public Service Satisfaction	The work of the local government in protecting environment is satisfactory

the larger the value of the option, the stronger the public perception in this aspect.

Econometric Model Selection

The dependent variable of this study is dichotomous, so the empirical study is carried out by using Logistic regression analysis, and the calculation formula is as follows:

$$\ln\left[\frac{p}{1-p}\right] = b_0 + \sum(b_i \times x_i) \quad (1)$$

Where, p represents the probability of public participation in co-production, x_i represents the factors that affect co-production behavior, and b_0 and b_i represent the regression coefficients of each factor. In the process of analysis, a model containing all variables is established to determine whether all hypotheses are valid; insignificant variables with a p value greater than 0.05 are eliminated, and model 2 is established to observe whether the remaining hypotheses are established again after excluding the untenable hypothesis. in order to draw the final conclusion.

Results of Data Analysis

Sample Characteristics and Descriptive Statistics

Stata16 is used to make preliminary statistics on the individual characteristics of the 168 samples in this study. The results showed that the distribution of sex and age was balanced and met the requirements of the study. In terms of education level, the respondents with junior high school education or above are the most, which is in line with China's policy of implementing nine-year compulsory education. In terms of political outlook, most of the respondents are not members of the Communist Party of China, accounting for 92% of all respondents, which is also in line with the actual situation in China. These show that the recovered samples have good representativeness and objectivity, and are suitable for quantitative analysis.

The results of descriptive statistical analysis of variables are shown in Table 2. The average value of

citizens' co-production behavior is 0.18, indicating that most of the public seldom participate in co-production in the field of environmental protection. The average value of new media usage ability is 2.04, indicating that respondents are less likely to use new media to participate in co-production. The average value of environmental cognitive ability is 3.58, indicating that most of the subjects have strong awareness of environmental cognition and environmental protection. The average value of public service significance perception is 2.22, indicating that the public demand to solve the surrounding environmental problems is low. The average value of public service satisfaction is 3.15, indicating that most of the public are satisfied with the environmental governance work of the local government. The average value of self-efficacy is 3.01, which is between public service significance perception and satisfaction perception. It is worth noting that the standard deviation of new media usage ability is the largest among all variables, followed by the standard deviation of public service significance perception, which indicates that there are obvious differences between different groups at the new media usage ability and public service significance perception levels. The average value of environmental cognitive ability is much higher than that of new media usage ability. In field investigations and interviews, it is also found that although most of the public have a strong awareness of environmental protection, they do not understand the functions of citizen post stations, and they use less of the government's digital governance platform, which leads to less participation in environmental co-production. This directly confirms that there is a common phenomenon of "strong willings and weak behaviors" in the co-production of the public in the field of environmental governance, and the Chinese government's ability of digital environmental governance also needs to be improved. This is due to the "digital divide" and cognitive bias caused by the lack of publicity and popularization of citizen post stations and digital governance platforms. On the other hand, the reason lies in the lack of incentive compatible system, institutional block and "policy implementation deviation".

Table 2. Descriptive statistical analysis results.

Variable	Mean	Standard Deviation	Max	Min
Co-production behavior	0.18	0.25	1	0
New media usage ability	2.04	1.68	4	1
Environmental cognitive ability	3.58	0.37	4	1
Self-efficacy	3.01	0.97	4	1
Public service significance perception	2.22	1.21	4	1
Public service satisfaction	3.15	0.92	4	1

Binary Logistic Regression Analysis

The results of Logistic regression are shown in Table 3. Obviously, citizens' co-production behavior will be affected by three kinds of factors: individual characteristics, citizens' co-production capacity and public perception. In the individual characteristics, the age and political outlook of the public will affect their co-production behavior in the field of environmental governance. Citizens' co-production behavior will be significantly affected by the public's own new media usage ability and environmental cognitive ability. In addition, a series of perceptual factors such as self-efficacy, public service significance perception and public service satisfaction will also have a significant positive impact on the public's co-production behavior. To sum up, all independent variables except gender are significant. What is more, the elderly, Members of the Communist Party of China, those with stronger new media usage ability and environmental cognitive ability, higher self-efficacy, public service significance perception and public service satisfaction are more likely to implement citizen's co-production behavior in the field of environmental governance.

Conclusions, Countermeasures and Suggestions

Highlight the Dominant Position of the People and Formulate Differentiated Incentive Strategies According to Individual Characteristics

According to the empirical analysis results of this study, age and political outlook of individual characteristics have a significant impact on co-production

behavior in the field of environmental governance, and the research of this paper is consistent with the conclusions of previous studies. Therefore, in the process of the construction and use of citizen post stations, it is necessary to formulate differentiated incentive strategies according to the individual characteristics of the public in order to form the widest range of public participation. Perhaps, targeted and diversified incentive schemes can be formulated in combination with different group characteristics, such as credit score incentives, in-kind incentives, and the provision of convenient services for people free of charge, so that more subjects can participate in environmental governance, follow the governance concept of "co-governance and sharing", and absorb more co-production forces.

Improve Public Environmental Awareness with the Help of New Media and Pay Attention to the Cultivation of Citizens' Co-Production Capacity

According to empirical analysis, co-production capacity has a positive impact on co-production behavior. Therefore, the public who participate in the co-production of environmental governance are required to have a certain ability to use new media and environmental awareness. Government managers should pay attention to the cultivation of citizens' co-production capacity, reduce the threshold of participation in co-production, and increase the probability of the public implementing co-production behavior, because the awareness of environmental protection and citizen post stations and the ability to use information technology is one of the factors that determine whether the public participates in co-production. Environmental awareness has a positive impact on citizens' co-production behavior,

Table 3. Logistic regression results.

Variable	Model 1			Model 2		
	Coefficient	Standard Deviation	P value	Coefficient	Standard Deviation	P value
Gender	1.187	0.110	0.071			
Age	0.962	0.007	0.000	0.962	0.002	0.000
Political Outlook	1.288	0.326	0.000	2.528	0.379	0.000
New media usage ability	1.963	0.685	0.000	3.776	0.753	0.000
Environmental cognitive ability	0.865	0.168	0.000	0.689	0.096	0.000
Self-efficacy	1.128	0.125	0.018	1.128	0.043	0.000
Public service significance perception	1.985	0.201	0.000	1.981	0.208	0.000
Public service satisfaction	1.682	0.036	0.000	0.561	0.034	0.000
Log likelihood	-168.518			-185.958		
Wald chi2	186.60			188.68		
Prob > chi2	0.000			0.000		

which requires the government to cultivate citizens' co-production capacity from the knowledge and skills owned by the public. In the past few years, the rapid development of the Internet has enabled the promotion and education of knowledge and skills in co-production to be carried out with the help of the rapidly developing media. This indirectly implies that it is necessary to promote the co-production of environmental governance in a more diversified way, enhance the ability of public participation with the help of new media, and use the "Internet +" platform and digital tools to promote and promote all kinds of citizen post stations. to enhance the citizens' co-production capacity.

Attach Importance to the Role of Public Perception and Encourage the Public to Extensively Participate in the Construction and Improvement of Citizen Post Stations

Public perception factors will have a significant positive impact on the co-production behavior of public environmental governance. This suggests that in order to attract the public to actively participate in the co-production in various fields from the perspective of psychological factors, and to promote the construction and improvement of citizen post stations, government managers may formulate relevant policies or cooperate with third-party institutions to provide psychological guidance to the public, so that a wider range of public citizens can have the inherent motivation and self-efficacy to participate in co-production, so as to promote the further development of co-production. Alternatively, it may also be possible to establish a sound communication and coordination mechanism to enhance public trust and satisfaction with the government, optimize the public's personal experience in co-production, and create a good governance atmosphere. In the future, it is necessary to make the results of governance benefit the people more, better and more fairly, increase the frequency of citizens' co-production behavior, broaden the breadth and depth of their participation, and effectively promote the construction and development of citizen post stations.

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Conflicts of Interest

The authors declare no conflicts of interest.

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