Effectiveness of Space Sharing Through Collaborative Planning: A Study of 175 Cases of Community Football Field Planning in Guangzhou

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Abstract: The concept of "shared development" promotes space sharing through planning interventions. While empirical studies commonly suggest that collaborative planning leads to positive outcomes in space sharing, practical experiences demonstrate that independent efforts can also yield satisfactory results, and collaborative endeavors may fail to achieve sharing goals. The effectiveness of collaborative planning mechanisms for achieving space sharing remains underexplored in the existing scholarship. Through examining 175 sites selected in the Community Football Fields Plan in Guangzhou, the paper explores the effectiveness of space sharing through collaborative planning within the same institutional framework. Based on survey data on participatory processes and implementation results, a preliminary logistic regression model is used to quantitatively assess the relationships between the strength of participatory mechanisms, relative effectiveness, and boundary of space sharing achieved through collaborative planning. The findings support the hypothesis that as collaborative planning becomes more comprehensive, the likelihood of establishing stable and enduring space sharing significantly improves. Notably, the P-value and OR-value of collaborative efforts levels indicates that collaboration can effectively address various challenges, such as land-use right constraints and discrepancies between current situations and land-use goals. Additionally, the study notes that external factors, represented by subsequent events, can influence and even overturn outcomes achieved through collaborative efforts. The study provides new theoretical inspirations and empirical support for detailed planning and implementation in the era of urban regeneration.

Keywords: detailed planning; existing land stock development; collaborative planning; space sharing; planning effectiveness

From the perspective of the discipline of urban planning, the connotation of "sharing" encompasses the values of equitable and inclusive humanistic care, resource-sharing oriented toward efficiency, and socially co-governed processes of consultation and co-construction [1]. Spatial sharing serves as a theoretical tool for implementing the "shared development philosophy" and achieving the goal of "common prosperity" [2]. How to achieve spatial sharing through planning intervention is a critical issue in detailed spatial planning and urban renewal in the era of stock development. Extensive practice has shown that planning collaboration, through design innovation driven by collective intelligence, often results in optimal comprehensive benefits, overcoming barriers of property rights or investment conditions to achieve spatial sharing outcomes [3-6].

However, there are reflections on this: in some cases, outstanding solutions created independently by talented design teams without the need for deep collaboration among diverse local stakeholders can also achieve high-quality spatial sharing results [7-9]; in other instances, insurmountable obstacles may prevent spatial sharing even after planning collaboration is successfully completed. This suggests that planning collaboration does not necessarily guarantee better spatial sharing outcomes, and there must be an operative boundary yet to be described. Nonetheless, theoretically, planning collaboration is a robust and clear intervention pathway for achieving spatial sharing. This study bypasses the limitations of conventional planning projects, which are difficult to compare and replicate, by using the planning of small community football fields in Guangzhou as a case study. These projects share the same institutional environment and funding conditions and aim to achieve the same planning goal. Using the spatial sharing observation framework of "co-use, co-benefit, and consensus," this study examines the effectiveness of spatial sharing under different degrees of collaboration. Based on the specific scenarios of planning formulation and implementation, a concept of planning collaboration encompassing "scheme co-design, interest negotiation, and action synergy" is developed. A preliminary argument for the theoretical mechanism, implementation effects, and operative boundaries of achieving spatial sharing through planning collaboration is then proposed using quantitative measurement methods.

1. Theoretical Framework

1.1 The Contemporary Concept of Spatial Sharing Features the Multi-Dimensions of Co-Use, Co-Benefit, and Consensus

Starting from the root definition of "sharing," spatial sharing generally refers to the cooperative behavior in which people, based on certain community relationships, unite to use spatial resources according to a shared set of rules for production, construction, use, and benefit distribution, aiming to survive in the environment and pursue a more comfortable state of living [10-12]. Spatial sharing has always been prevalent throughout human history, with its forms enriched over time by advancements in technology and society [13-14]. It can be considered a dynamic, evolutionary process in which diverse actors collectively shape public spaces, continuously updating people's perceptions. Phenomena such as shared housing [15], shared workshops [16], and even interactions between virtual and physical shared spaces [17-18] have evolved from emerging concepts into widely recognized practices.

Under the development philosophy of the new era, spatial sharing has the direct function of ensuring "the fruits of development are shared by the people." By exploring its dynamic evolution from the material to the immaterial dimension, the contemporary concept of spatial sharing follows the following logical progression: Sharing begins with the material dimension of co-using space through various forms [19-20]. Subsequently, people derive shared benefits from co-using the space [21-22], which subtly shapes a consensus on the rules of co-use and co-benefit. This consensus ensures that people are subjectively motivated to actively maintain the operation of the spatial sharing mechanism [23-24]. Based on this logic, a preliminary analytical framework for observing spatial sharing can be formed, as shown in Table 1.

Table.1 A preliminary analytical framework for observing space sharing

Observable Series of Imaging	Definition	Observation Object	Ideal State	Observable Series of Imaging
Material Dimension ↓ Immateria	Shared Space	Space resources are collectively used by a certain group of people	The physical reality of space usage, human behavior, etc.	Users can unobstructedly and at a low cost obtain spatial usage rights that meet their needs and correspond to maintenance obligations.

I Dimension	Mutual Benefit of Space	The reproduction of spatial resources brings certain benefits to stakeholders	Economic and social benefits of space production, etc.	Stakeholders in space production can obtain mutually beneficial and sustainable returns.
	Consensus on Space	Users and stakeholders of spatial resources have a shared understanding of space sharing	Agreements and perceptions of spatial stakeholders, etc.	Spatial sharing rules that satisfy users and stakeholders, along with a shared understanding of agreements on associated rights and responsibilities.

Assuming the formation of stable spatial sharing as an ideal state to strive for, space sharing involving "co-use," "co-benefit," and "co-consensus" should be assessed based on the following definitions. These three aspects are inextricably linked and mutually interactive:

(1) Co-use: Space is used by different groups either simultaneously or at different times. People participating in co-use can access the space to meet specific needs without encountering barriers or requiring ownership. They also bear corresponding responsibilities for space maintenance.

(2) Co-benefit: The space brings benefits or generates profits for its users. Stakeholders share these profits, which are mutual and sustainable.

(3) Co-consensus: Spatial sharing leads to the growth of local knowledge, fostering a shared sense of responsibility (awareness of accountability) among all users and stakeholders. This awareness is formalized or informally agreed upon in rules governing spatial sharing, supported by enforceable rights and responsibilities.

(4) Interrelation among the three elements: The co-use of spatial resources creates the possibility of mutual benefits, and rational profit incentives sustain co-use. Co-use also lays the foundation for consensus formation. Once established, consensus reinforces subjective considerations for co-use. Mutual benefits influence the formation of rules regarding shared spatial resources, and these consensuses, in turn, standardize the rules of profit distribution. The distortion of any single element or the failure of any linkage will obstruct the stability of spatial sharing.

1.2 Collaborative Planning Intervening in Physical Space, Benefit Distribution, and Group Cognition

Collaborative planning has become a widely recognized working method under the joint influence of China's planning governance practices and the introduction of Western ideas [25-26]. For example, the cross-regional water resource governance of the Pearl River starting in the 1980s emphasized collaborative efforts, proposing that "controversial issues be objectively demonstrated, fully addressed through democratic consultation, mutual understanding, and assistance, by comparing multiple proposals to reach a solution acceptable to all parties" [27]. A review of the dissemination, understanding, and acceptance of Western collaborative planning theories in China over the past 30 years [28] found that Chinese scholars, unlike the critical tradition in the West, follow the developmental tradition by drawing inspiration from ideas such as "inclusive dialogue," "rational communication," and "consensus building" and applying these concepts to local planning work.

Generally speaking, the core task of collaborative planning is to produce design schemes and implementation agreements jointly recognized by diverse stakeholders [29-30]. In situations where conflicts of interest may lead to confrontation or social problems, collaborative planning mobilizes stakeholders' enthusiasm and autonomy to optimize design schemes and facilitate project implementation [31-33]. In areas where conflicts are not severe, collaborative planning is more effective than traditional top-down planning methods in leveraging local knowledge, fostering cultural capital, and optimizing the overall environment [34-36].

The collaborative planning process can be succinctly divided into three steps: co-design of plans, negotiation of benefits, and coordinated actions. These steps progressively intervene in the physical spatial form of the planning object, the distribution of production-related benefits, and the collective cognition of relevant stakeholders:

(1) Plan Co-Design: Transforming Physical Space

Plan co-design adheres to initial value orientations and incorporates diverse participation methods to integrate stakeholder opinions and demands, creating co-created design plans that guide physical space transformation.

(2) Benefit Negotiation: Addressing Benefit Distribution

Collaborative planning incorporates pre-emptive measures for addressing conflicts of interest by engaging stakeholders in negotiations, exploring possibilities for the project's economic, social, and cultural capital benefits, and jointly discussing expected comprehensive benefits and their distribution. This approach increases the likelihood of final planning agreements meeting stakeholders' expectations, easing conflicts arising from physical space changes.

(3) Coordinated Actions: Reshaping Group Cognition

Through plan co-design and benefit negotiation, the final step of collaborative planning forms a multi-party agreement on rights and responsibilities. This produces coordinated actions among diverse stakeholders, fostering mutual understanding and trust, as well as a shared definition and consensus on planning issues, ultimately reshaping collective cognition.

1.3 Theoretical Framework and Hypothesis: Collaborative Planning for Achieving Stable Space Sharing

Aligned with the three-dimensional objectives of space sharing, collaborative planning offers a relatively comprehensive implementation pathway (Fig. 1). Through plan co-design, benefit negotiation, and coordinated actions, collaborative planning intervenes in physical space, benefit distribution, and group cognition, fully aligning with the goals of co-use, co-benefit, and co-consensus. This leads to a preliminary hypothesis: when aiming for space sharing, collaborative planning interventions are more likely to result in the ideal outcomes of space sharing. Conversely, the absence of collaborative planning increases the likelihood of space-sharing failures. Collaborative planning, therefore, provides a robust pathway to achieving space sharing (Fig. 2).

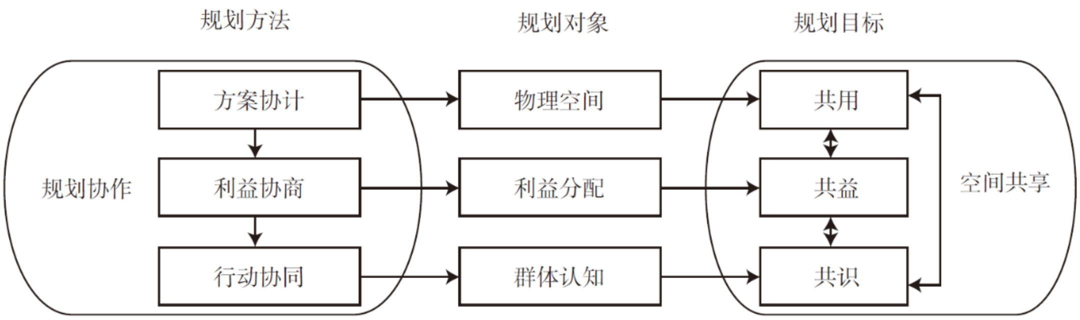


Fig. 1: Initial theoretical framework for collaborative planning to achieve space sharing.

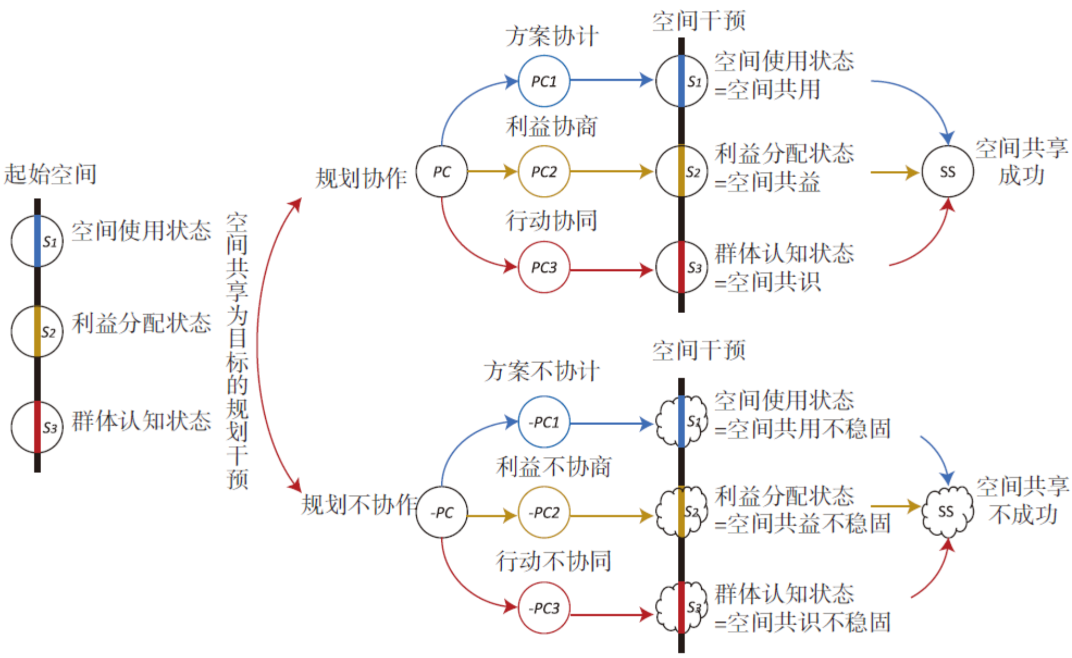


Fig. 2: Hypothesis of correlation between completeness of collaborative planning and space sharing status.

However, as mentioned in the introduction, there are real-life cases of high-quality spatial sharing achieved through excellent original designs without multi-stakeholder collaboration. Similarly, projects that complete collaborative processes may still fail to sustain spatial sharing. The key to testing this hypothesis lies in determining whether, under comparable conditions, collaborative planning is more effective than non-collaborative approaches.

2. Research Design and Data Collection

Given that each planning project cannot be replicated for controlled experiments, this study adopts a quasi-natural experimental approach based on a case study of Guangzhou's community small-scale football field planning. This involves multiple site samples under the same spatial sharing objectives, institutional environment, and funding conditions to test the above theoretical hypothesis.

2.1 Case Background

2.1.1 Planning Motivation

In response to national top-level design promoting football, and leveraging Guangzhou's mature conditions for sports development, the city developed the "Guangzhou Football Pilot City Work Plan (2014–2016)" in 2014. The plan set out to build 100 football fields by the end of 2016, enhancing sports accessibility for the public, promoting equalization of basic public sports services, and further emphasizing Guangzhou's unique football identity. The three-year construction of 100 community small-scale football fields became one of ten key public livelihood projects, receiving prioritized oversight from the municipal people's congress and special construction funding from the city government.

2.1.2 Project Process and Collaborative Planning

Adhering to the principles of planning-led, rational site selection, community proposals, and respecting community preferences, the project underwent a "three-up, three-down" collaborative planning process. This involved multiple iterations of technical planning recommendations and grassroots site proposal consultations (Fig. 3). The primary collaborators were government departments, local units, and planning institutions.

Through evaluations incorporating site characteristics, demand-supply considerations, planning indices, and layout requirements, 100 finalized sites completed the full collaborative planning process. Others failed due to lack of consensus in research, negotiation, or operational agreements.

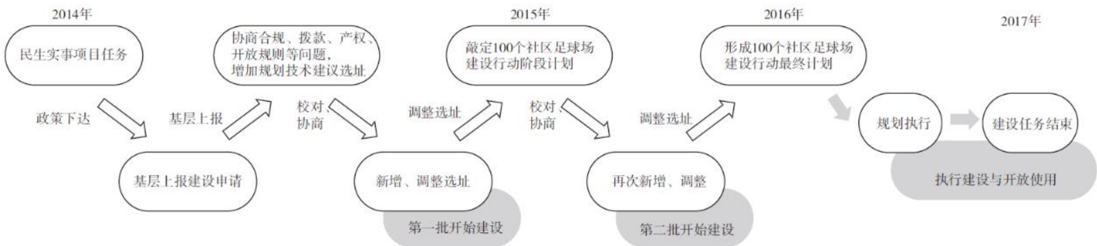


Fig. 3: The multiple upward and downward communication stages and main contents of collaborative planning of football fields.

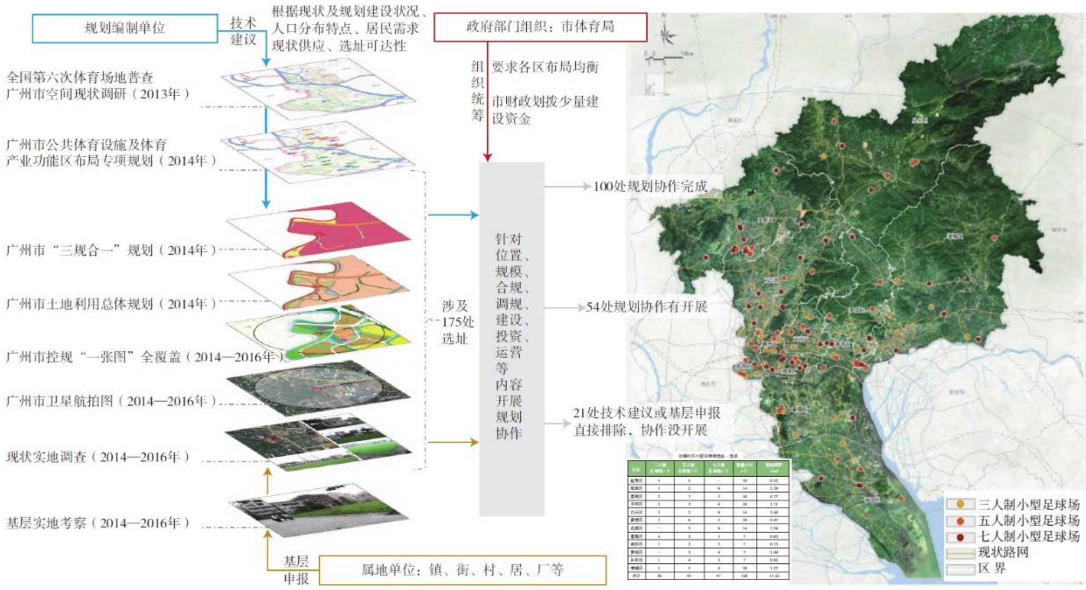


Fig. 4: Planning and site selection process and results (2014–2016).

2.1.3 Construction Outcomes

By 2017, Guangzhou had completed its community football field construction tasks (Fig. 5). The municipal sports bureau established the "Interim Measures for the Planning, Construction, and Use Management of Community Small-Scale Football Fields," tailoring management to land ownership, responsible management entities, and community service objectives. Many fields were made available for free or discounted public access and listed on the official sports venue reservation system "Mass Participation."

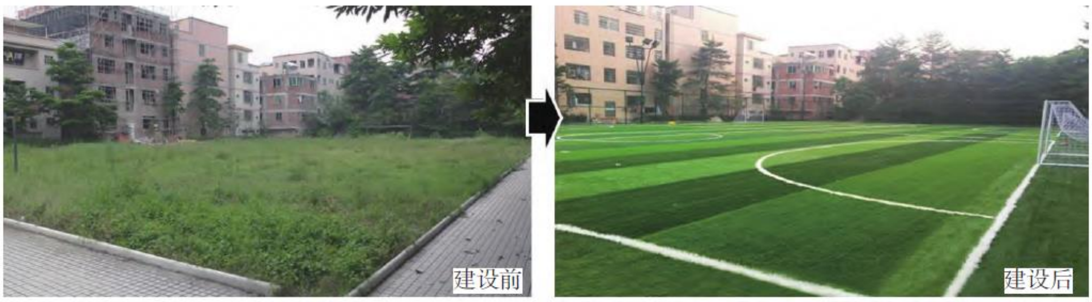


Fig. 5: Comparison of the current situation of a community football field before and after the development.

Fig. 6: Football field management regulations tailored to different onsite situations.

2.2 Research Design

2.2.1 Definition of Spatial Sharing in This Empirical Study

In the same social environment, under identical governmental systems and economic support conditions, the construction of over a hundred community football fields was promoted. This process involved 175 locations with varying levels of planning collaboration: no collaboration, partial collaboration, and full collaboration. After completion, these fields were in use for 6–8 years. This empirical study allows a comparative analysis of the effectiveness of planning collaboration versus non-collaboration in achieving the same spatial sharing goals.

The spatial sharing design expectations for community football field planning are relatively straightforward:

(1) Spatial Co-Use: The selected location serves as a community football field primarily for local residents, being regularly open for use and maintained in accordance with its management guidelines.
(2) Spatial Co-Benefit: Users gain access to a venue primarily for football activities, while the operators or managers of the field receive economic benefits or corresponding performance rewards for their responsibilities.
(3) Spatial Consensus: The community football field fosters a popular atmosphere for football in the community and is maintained and preserved by stakeholders.

Therefore, the judgment of spatial sharing outcomes for current field samples should be based on whether the fields remain in normal operation years after their construction. If a community football field no longer exists, is blocked, severely damaged, abandoned, or if residents believe the field should be repurposed, this constitutes a failure of spatial sharing. All other cases are considered successful spatial sharing, where the facility remains a stable public sports venue.

2.2.2 Factors Affecting Spatial Sharing Outcomes and Logistic Regression Model

The logistic regression model is widely used to study the occurrence probability of categorical events and has applications in areas such as disease cause diagnosis, economic forecasting, and behavioral predictions. In human settlements research, it is commonly applied to analyze factors driving settlement evolution[40-41], probabilities of behavioral events[42-43], urban disaster prevention[44-45], and urban poverty[46-47]. The prerequisites for using this model include: The dependent variable is categorical. The residuals and dependent variables follow a binomial distribution. The variables have non-linear relationships. Observations are independent. The sample size meets the 10 EPV (Events Per Variable) rule[48]. The model involves checks for sample size conditions and variable collinearity. After integrating the empirical data, robustness and significance tests must be conducted.

A binary logistic regression model is suitable for testing the hypothesis of this study: Does the degree of planning collaboration significantly influence the probability of spatial sharing outcomes? Theoretically, planning collaboration can robustly shape spatial sharing outcomes. The higher the degree of planning collaboration in the site selection and construction of community football fields, the more stable the eventual spatial sharing result, i.e., the higher the probability of spatial sharing success during follow-up observation. Since the original spatial function and land ownership characteristics also have a significant theoretical impact on the outcomes, these factors must also be included as independent variables:

(1) The degree of planning collaboration positively impacts spatial sharing. Planning collaboration, as a critical factor, is a process of resolving conflicts, bridging differences, and building consensus. The degree of collaboration is classified into three levels: no collaboration, partial collaboration, and full collaboration. Sites with higher planning collaboration completion rates are more likely to exhibit successful spatial sharing outcomes after being built.
(2) Similarity between original site function and planning vision positively impacts spatial sharing. Given the direct link between site development difficulty and implementation feasibility, the closer the similarity between the original function of the site and the planning target function, the more favorable the spatial sharing outcome of the community football field, resulting in a higher probability of success.
(3) The degree to which the landowner provides public sports services positively impacts spatial sharing. As community football fields are public activity spaces that require periodic free or low-cost access, the more the landowner is responsible for providing public sports services, the more favorable the spatial sharing outcome, increasing the probability of success.

Based on these considerations, a binary logistic regression model was constructed to study the effects of planning collaboration degree and original site status on spatial sharing outcomes. The spatial sharing result is classified into two categories: success and failure. Assuming the probability of spatial sharing success is (p), and the probability of failure is (1-p), the model is expressed as follows:

$$S_t = In\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 P_C + \beta_2 So_1 + \beta_3 So_2 + \varepsilon$$

Where: Dependent variable (S_t): The spatial status during follow-up. (p): Probability of spatial sharing success. (1-p): Probability of spatial sharing failure. β0: Constant. Independent variable (PC): Planning collaboration completion degree. Independent variable (So1): Similarity between site's original function and planning vision. Independent variable So2: Degree of landowner responsibility for public sports services. ε: Random disturbance term. See Figure 7 for the experimental methodology framework.

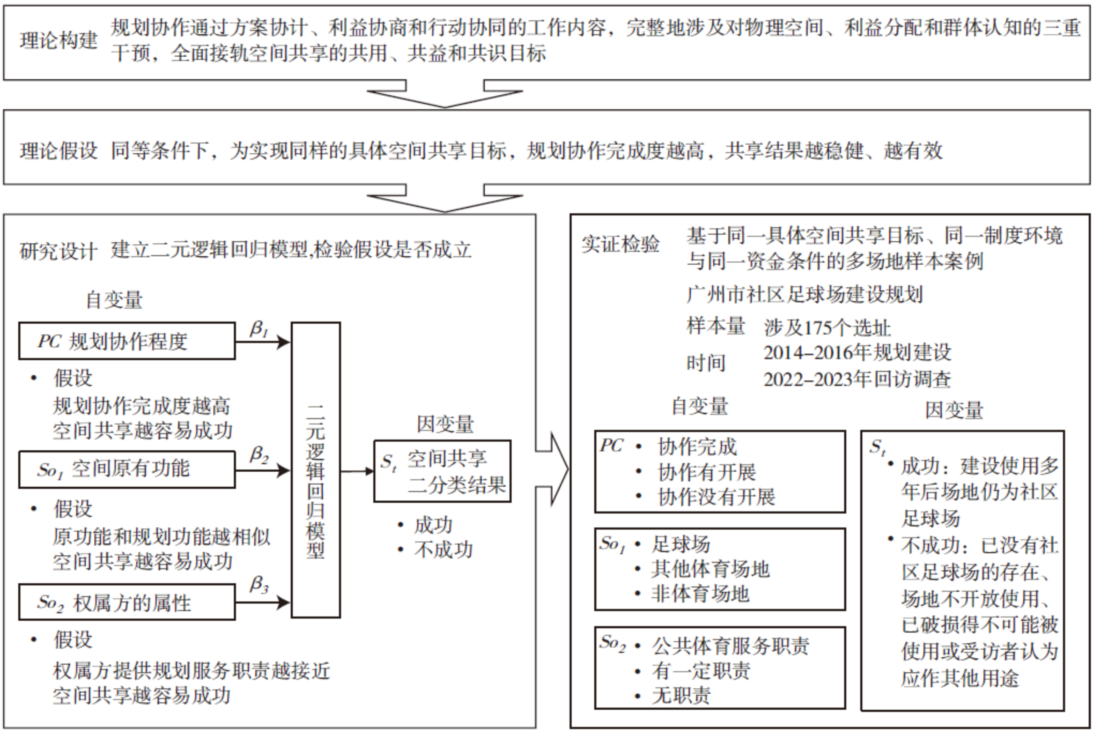


Figure 7: Framework of experimental methodology.

2.3 Data Collection and Variable Assignment

2.3.1 Data Collection

The research data were sourced from complete planning processes and outcome information gathered during the 2014–2016 construction planning period. On-site revisits conducted from July 2022 to February 2023. Satellite imagery and online reviews from January 2013 to October 2022. Historical and current data for 175 field samples were comprehensively obtained, including site collaboration processes, planning status, original site functions, land ownership details, construction completion status, current spatial use, damage and maintenance conditions. Random interviews with field users or nearby activity participants were conducted to understand current field usage, focusing on questions such as: "Is this field open for use?" "Have you personally engaged in football activities here?" "Have you observed others using this field for activities?" "Do you believe this community football field should be repurposed for other uses?"

2.3.2 Variable Assignment

(1) Planning Collaboration Completion Degree (PC):

This ordinal variable is classified as follows: No planning collaboration: Site selection was based on grassroots reporting or technical suggestions, but subsequent technical inspections determined the land unsuitable or local authorities rejected the proposals, preventing further collaboration or operational discussions. Partial planning collaboration: Collaborative discussions

were conducted among stakeholders, addressing issues such as compliance, cost-benefit considerations, and future operational management terms, but no agreement was reached.
Full planning collaboration: Collaborative discussions led to agreement, and the site was included in the construction task list.
(2) Similarity between Site's Original Function and Planning Vision (So1):
This ordinal variable is classified as follows: Highest similarity: The site was originally used for football activities. Moderate similarity: The site was used for other sports activities. Lowest similarity: The site was used for non-sports purposes.
(3) Degree of Landowner Responsibility for Public Sports Services (So2):
This ordinal variable is classified as follows: Highest: The landowner is a government sports agency, sports institution, or a cultural and sports park/center. Moderate: The landowner is a public sector agency or institution with some public service obligations, such as schools, village collectives, community collectives, or private sports enterprises. Lowest: The landowner is an entity with no relevant obligations, such as a confidential agency or other types of businesses.
(4) Current Spatial Sharing Status (S_t):
This binary variable is defined as follows: Success: The site has essentially formed a small public football field primarily used by community residents. Failure: The site does not meet the above definition. By February 2023, 97 fields were classified as spatial sharing successes, and 78 fields as failures. Broader public services (e.g., other types of public activities or economic/social benefits) provided by the fields are not included in this model's definition of spatial sharing success. See Table 2 for details.

Tab.2 Variable definition and value assignment

Variable Type	Variable Definition	Variable Assignment
Dependent Variable	Current Spatial Status (St)	Space sharing successful = A small public football field primarily used by community residents has been formed. Space sharing failed = The community football field no longer exists, the field is not open for use, it is too damaged to be used, or respondents believe it should be repurposed.
Independent Variable	Degree of Planning Collaboration (PC)	2 = Collaboration completed 1 = Collaboration initiated 0 = No collaboration undertaken
	Similarity between Original Function and Planning Vision (So1)	2 = Football field 1 = Non-football sports facility 0 = Others
	Obligation of the Site's Ownership Entity to Provide Public Sports Services (So2)	2 = It is their responsibility 1 = Some responsibility 0 = No responsibility

2.3.3 Model Applicability Principle Testing

(1) Sample Size Testing

According to the 10 EPV (Events Per Variable) principle, the minimum required sample size for a single classification in this study is 78 cases. This allows for 7 independent variables to be included in the model. Currently, there are 3 independent variables, which complies with this principle.

(2) Multicollinearity Testing

After assigning values, multicollinearity diagnostics were performed on the independent variables (Table 3). Using the degree of similarity between the functional characteristics of the site itself and the planning objective (So1) as the dependent variable, a multiple linear regression analysis was conducted. The results show that all tolerance values are greater than 0.1, and the variance inflation factors (VIFs) are all less than 10, indicating that the diagnostics have been passed. Therefore, there are no multicollinearity issues among the independent variables, and further binary logistic regression analysis can be conducted.

Tab.3 Calculation results of collinearity tolerance and variance inflation factor for independent variables

Collinearity Diagnostic Index	Tolerance	VIF
Constant	——	——
So2	0.999	1.001
PC	0.999	1.001

Note: The dependent variable for the collinearity test is So1.

3 Analysis Results

3.1 The Higher the Completion Rate of Past Planning Collaboration, the Higher the Probability of Current Spatial Sharing Outcomes

3.1.1 Quality of the Logistic Regression Model

The regression calculation was conducted using SPSS Statistics 24 software. The quality of the model was comprehensively evaluated using measures such as the goodness-of-fit index, classification table test, and predicted probability histogram. It was found that the model quality is satisfactory.

Both the Cox & Snell R^2 and Nagelkerke R^2 values are greater than 0.1. The closer these values are to 1, the higher the explanatory power of the model. See Table 4.

Tab.4 Goodness-of-fit test of model of community football fields

Goodness-of-fit indices for the model	Cox-Snell R^2	Nagelkerke R^2
Results	0.526	0.704

The results of the sample classification table indicate that, without considering the influence of any other independent variables, the probability of successful spatial sharing of community football fields is the original proportion of 55.4% in the sample. The simulation classification table results show that the overall prediction accuracy of the model is 91.4%, with a prediction accuracy of 93.8% for successful spatial sharing and 88.5% for failure, both of which are relatively high, indicating that the model is quite feasible. See Table 5.

Tab.5 Prediction accuracy of model of community football fields

Accuracy	Model Sample Classification	Model Prediction Classification / %
Overall accuracy of the classification table prediction results	55.4% (original probability in the sample set)	91.4

Accuracy of successful outcomes in the shared prediction space	——	93.8
Accuracy of unsuccessful outcomes in the shared prediction space	——	88.5

The histogram of predicted probabilities intuitively demonstrates that predicting the degree of spatial sharing stability through the completion of planning collaboration is relatively feasible. In the figure, the horizontal axis represents the predicted probability of shared stability after several years (0 indicates the site disappears and sharing fails, 1 indicates the site remains and sharing succeeds), while the vertical axis represents the observed actual frequency. According to the original hypothesis, all "1s" should fall on the right side of the 0.5 threshold on the horizontal axis, and all "0s" should fall on the left side, resulting in a distribution with fewer values in the middle and more at both ends. The output results show that the model's prediction accuracy is relatively high. See Fig. 8.

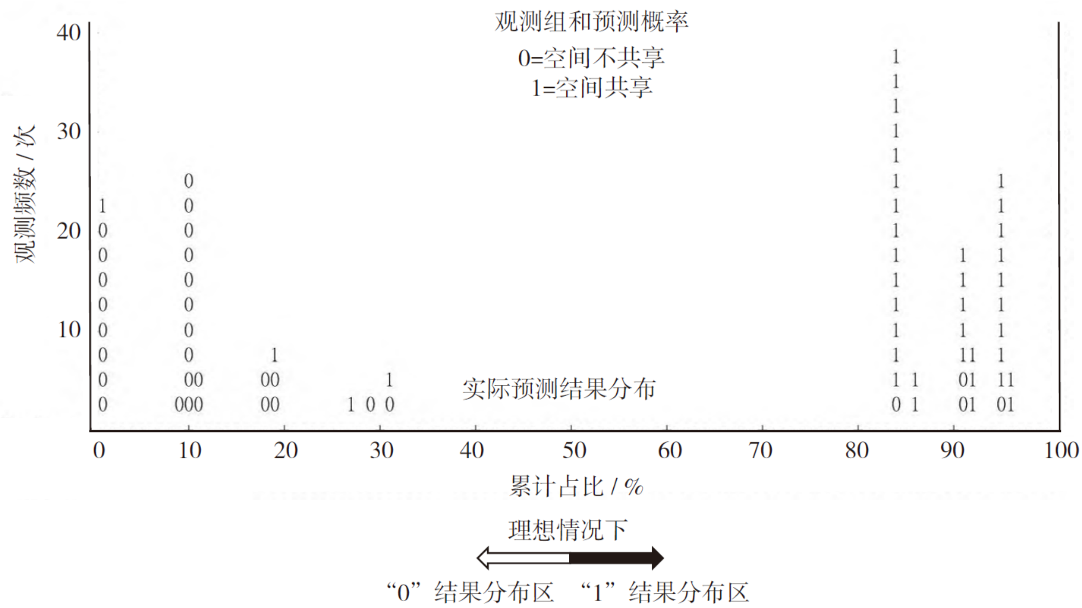


Fig. 8 Model prediction probability histogram

3.1.2 Analysis of Regression Results for Variables

The regression coefficients of three independent variables and their hypothesis test results are presented in Table 6. It can be observed that the p-values for Planning Collaboration Completion Degree (PC) and Similarity between Site Functionality and Planning Target Functionality (So1) are less than 0.05, indicating that these two factors are significant. Exp(B), or the odds ratio (OR), indicates the multiple by which the probability of successful spatial sharing increases with a one-level rise in the independent variable. For example, if a site originally designated for non-football sports purposes becomes a small community football field, its likelihood of success is 1.913 times higher than that of lower-tier sites. The OR value for the independent variable PC reaches 47.85, significantly exceeding those of other variables. This suggests that a one-level increase in this variable substantially enhances the likelihood of successful spatial sharing. This finding aligns with intuitive expectations, marking it as a turning point in spatial sharing outcomes.

Fig.6 Results of independent variables for the model

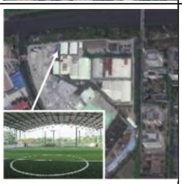
Independent Variable	Regression Coefficient	Standard Error	Wald Value	Df Value	P Value	Exp(B)
So1	0.648	0.319	4.129	1	0.042	1.913
So2	0.110	0.485	0.052	1	0.820	1.117
PC	3.868	0.512	57.074	1	0.000	47.850
β_0	-6.210	1.111	31.224	1	0.000	0.002

On the other hand, the effectiveness of the independent variable "the extent to which the land rights holders undertake the responsibility of providing public sports services" (So2) is not significant. This indicates that the hypothesis "the more clearly the land rights holders assume the responsibility of providing public sports services, the higher the success rate of community small football fields" is not significant. Considering the tipping-point effect of planning collaboration factors, it can be demonstrated that planning collaboration effectively overcomes the constraints of the land rights holders' responsibilities, breaking the shackles of property rights and enabling territories not explicitly responsible for providing community football field facilities to make land available for such purposes.

3.2 Demonstration of Intervention Boundary Limitations in Atypical Samples Reflecting the Theoretical Mechanism

By the conclusion of this study, most of the site samples replicated the overall mechanism of the theoretical framework. However, a small number of site samples exhibited atypical situations. For instance, large-scale demolitions in the area due to late-stage factors inevitably erased already-built community football fields; some sites, not included in the city's construction plan after the planning stage, proceeded with construction autonomously, forming spontaneous actions; in some cases, sites originally intended as football fields but not realized through collaborative planning were found repurposed for other functions during follow-up visits. These results, categorized as "collaborative planning completed but deviating from spatial sharing goals" (Table 7) and "collaborative planning not completed but spatial sharing achieved" (Table 8), though rare, highlight the inherent intervention boundary limitations of the theoretical mechanism for achieving spatial sharing through collaborative planning in a real-world context.

Tab.7 Cases and analysis of community football fields undergoing complete collaborative planning but failing to achieve space sharing goals

Site Number	Site Conditions during the Planning Period (2014–2016)	2017 Site Conditions	2022 Site Conditions	Analysis of the Reasons for the Demolition of Community Football Fields
60				Overall demolition and reconstruction of the area
75				Overall demolition and reconstruction of the area

91, 92				Overall demolition and reconstruction of the area
107				Overall demolition and reconstruction of the area
132, 134				Converted back into a basketball court. Residents suggested renovating the basketball court into a multi-purpose football and basketball court. The final follow-up found that football activities were not frequent; it was mainly used for parent-child leisure and basketball.
145, 146				Overall demolition and reconstruction of the area

Fig.8 Cases and analysis of community football fields without undergoing complete collaborative planning but achiev‐ ing space sharing goals

Site Number	Site Condition During Planning Period (2014–2016)	Site Condition in 2022	Planning Period	Land Owners hip	Cause Analysis of the Community Football Field Formation
28			Leveled ground designated as a plaza	A District Governme nt	The district government later invested in the construction by itself
38			Abandoned town sports park with an 11-a-side football field, leveled ground	A Town Governme nt	The town government repaired and reopened it from 2017 to 2022
87			Open-air dirt football field in an area undergoing state-owned enterprise redevelopment, with relatively	A State-Owned Enterprise	Redevelopment of the area, self-modified construction

			level ground		
98			Located in the sports ground of the health park in the bonded zone	A Bonded Area Park	Tennis court in the park was converted into a football field
154			The site was the community sports ground of the Guangzhou Railway Section, with a high utilization rate, but the football field was old and in poor condition, making it difficult to use	A Communit y	The community upgraded and renovated it by itself
166			Currently a village sports ground, damaged and in need of reconstruction	A Village Committee	The community upgraded and renovated it by itself

3.2.1 Planning Collaboration Completed but Deviating from Spatial Sharing Goals

An analysis of the current status and causes of nine locations deviating from the goal of community football fields revealed the following: comprehensive demolition of the area is the main reason, accounting for the removal of seven sites (Table 7, site numbers 60, 75, 91, 92, 107, 145, 146). This is an uncontrollable, subsequent factor. Additionally, two other sites (Table 8, site numbers 132, 134) were converted into basketball courts. This shift occurred because residents initially hoped for dual-purpose courts during the planning phase, and artificial turf was not installed. Over time, basketball activities became more popular, leading to the transformation of the fields into basketball courts, with football markings and facilities removed.

3.2.2 Planning Collaboration Not Completed but Spatial Sharing Achieved

A review of 75 locations that were not selected for funding by the municipal sports bureau as community football fields was conducted. Using satellite imagery and on-site investigations, the study assessed whether these sites had become community football fields. Among the 11 locations originally planned for football or other sports during the planning stage, five remain or have even seen self-improvement (Table 8, site numbers 38, 87, 98, 154, 166). These fields were recognized by local governments or community groups as football venues.

Among the 64 locations not designated as football fields during the planning phase, one site located within a district cultural park (Table 9, site number 28) later had a community football field added by the district government. One key factor is that the landowner explicitly bore the responsibility of providing public sports facilities.

4. Conclusions and Discussion

Reflecting on the planning process for 100 community football fields in Guangzhou, the "three-up, three-down" collaborative planning approach actively engaged stakeholders in community construction. From 2014 to 2016, the planning process identified 175 sites, and the construction tasks were completed in 2017. Revisiting all selected sites from July 2022 to February 2023 revealed that most collaboratively planned community football fields remain in use, with relatively stable spatial sharing conditions. A small number of locations where planning collaboration was not completed have also achieved the goal of becoming community football fields. Specifically, among the 100 completed collaborative cases, only nine have been repurposed. Of the 75 sites not collaboratively developed, five of the 11 originally sports-related sites have become community football fields, and one of the 64 non-sports-related sites independently developed into a football field. The remainder have been repurposed.

Using a comprehensive research approach involving planning participation, on-site investigations, random interviews, and logistic regression models, this study tested the theoretical mechanism that "planning collaboration can more robustly achieve spatial sharing." Through a binary logistic regression model that links planning collaboration, initial spatial conditions, and long-term spatial sharing outcomes, the study quantitatively demonstrated that planning collaboration plays a significant role. Although collaboration does not guarantee 100% success in achieving spatial sharing, it significantly mitigates practical challenges such as land ownership restrictions and discrepancies between site conditions and goals. The model's tested p-value of less than 0.05 indicates that both planning collaboration and the initial designation of space for sports purposes have a significant positive effect on spatial sharing outcomes. Among these, planning collaboration is crucial for community football field construction, serving as a catalyst for activating idle community spaces or improving the quality of public spaces. The odds ratio (OR) for planning collaboration surpasses other factors, suggesting that each step forward in collaboration completion greatly increases the likelihood of successful spatial sharing.

Furthermore, comprehensive demolition of areas driven by overarching social and economic needs can completely overturn established spatial sharing outcomes, presenting an unpredictable subsequent factor. This finding supplements the theoretical framework by delineating its boundaries: strong subsequent external factors beyond the framework's control can negate the achievements of planning collaboration.

It is also essential to acknowledge the limitations of this empirical study. The specific goal of spatial sharing examined here is relatively singular, with evaluations of shared use, benefits, and consensus simplified. Future studies could enhance the "granularity" of spatial sharing observations, such as incorporating measures of resident perceptions or monitoring field usage frequency. Additionally, the cases studied have not encountered significant conflicts. Sustained community activity demand and field maintenance and operation remain critical to ensuring the durability of community football fields as shared spaces. Observation periods should be extended, such as further investigating whether communities undertake self-renovation after site depreciation. Lastly, other potentially critical independent variables not included in the model warrant further consideration.

In conclusion, while spatial sharing can indeed be achieved without planning interventions, planning collaboration effectively overcomes challenges related to original spatial functions or land ownership, facilitating more robust and efficient spatial sharing. The degree of planning collaboration significantly influences spatial sharing outcomes: the higher the level of coordinated design, interest negotiation, and action collaboration, the greater the likelihood and stability of achieving spatial sharing.

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