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Research on the water service systemic design in Shanghai community park

——Illustrated by the example of the Songhe Park

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ABSTRACT

Since the implementation of reform and opening-up policies, the construction of community parks and relevant water service has gradually received a wide range of public attention. In recent years, the problem of water service in Shanghai community parks has become increasingly prominent. Community parks rely excessively on tap water in the water services, which causes water pollution. Simultaneously, sewage discharge pollutes the downstream rivers, resulting in ecological, economic and social problems. These problems are profoundly affecting people's living quality. How to explore water service sustainability that can satisfy the current demand is the main issue facing the current community park in Shanghai. The systemic design provides feasibility for optimizing the current water service in Shanghai community parks. The systemic design discovers and analyzes problems from a systematic perspective, combines interdisciplinary knowledge and works together to solve water-related issues in the community parks so as to achieve the “zero emissions” and sustainable development.

This study uses systemic design, eco-design and other methods to define diversified issues, such as water waste and pollution that are currently occurring in the water activities of community parks in Shanghai. This study takes the Songhe Park in the Yangpu District of Shanghai as an example to design the water service system through quantitative and qualitative researches based on the current situation of the water service in the Songhe Park. The aims are as follows: to achieve a zero emission of water from the input water of community park, to achieve the water recycling inside the park during the operation process and to export clean water for the downstream river channel.

Based on the water service systemic design for Songhe Park, an artificial wetland system conforming to the general situation of Songhe Park is constructed to assist the positive development of water service system. The preceding system purifies water for Songhe Park and exports clean water to serve the park and its surrounding communities. The water service system of Songhe Park is designed to improve the ecological, social, cultural and economic benefits of the park, and to bestow Songhe Park with the functions of saving water, storing water, purifying water and exporting clean water. In addition, this system also enables Songhe Park to become a place with picturesque landscape, interactive functions and harmony atmosphere for neighbors. In the long-term goal, water service system in the Songhe Park will also serve the surrounding communities, so that families and shops in the surrounding communities are able to reduce tap water consumption and increase social benefits correspondingly.

The design of the water service system in the Songhe Park is an exploration of applied design, which brings about practical value and innovation, and effectively solves the water-related problems in the community parks. Ultimately, the author carries out design assessment, universal exploration, analyzes the deficiency of the research and the further direction of work in order to provide references for the optimization design of water service in other community parks.

Key words: sustainable design, systemic design, water service, community park, artificial wetland design

CONTENTS

Chapter 1 Introduction

1.1 Research background

1.1.1 Shanghai water problem is highlighted

Water is the most important substance on which people depend for survival. With the urbanization of Shanghai in the past 40 years, the extensive use of water resources and the demand for water have increased with various activities, and the water problem in Shanghai has also intensified.

In terms of quantity, the total amount of water resources in Shanghai is sufficient, but per capita freshwater resources lack water demand and is a water-deficient city. The water pollution of rivers in Shanghai is relatively large. The main pollution indicators are ammonia nitrogen and total phosphorus, and the water pollution inside the city is relatively serious. At present, the water quality of Shanghai is in the category II-IV except for the surface water quality of the Yangtze River. The water quality of other rivers and rivers in the city is basically V and below [1]. Among the major river sections in Shanghai in 2016, IV-V river sections accounted for 49.8%, and inferior V-type river sections accounted for 34%. Although the water quality improved much in 2015, the water quality of Class IV and below still accounted for a large proportion. Proportion[2]. Problems such as water pollution and shortage of freshwater resources have threatened Shanghai's economic development and the quality of life of residents.

The water problem brings environmental and social costs. On the one hand, it increases the cost of water purification and water supply pressure, on the other hand, it leads to deterioration of the ecological environment and harm to human health. At the same time, the use of extensive tap water has led to tight water supplies and increased economic costs. It is imperative to explore a sustainable development path for water resources that is suitable for Shanghai's current social needs.

[1] Xu Hui. Current Water Conservancy Problems and Countermeasures in Shanghai[J]. City Construction Theory Research: Electronic Edition, 2011(22).

[2] Shanghai Environmental Protection Bureau. Shanghai Environmental Status Bulletin [M]. Shanghai Environmental Protection Bureau, 2016.

1.1.2 Demand for stock optimization in community parks

Since the reform and opening up, China's urbanization process has been fast and large, and urban development has been carried out in an extensive and extensional model with the goal of pursuing quantity. At present, the development intensity of Shanghai is close to the development limit of urban space, bringing a the problems of the series of cities, such as the tight development space, the destruction of ecological resources, the disorder of the internal order of the city, and the boring urban space, have affected the quality of life of the citizens. To improve the city's competitiveness, human settlements and ecological space, China's urban space development needs to change from an expansionary barbaric expansion development model to a stock optimization optimization development model.

In the urban space, the open space of the city as an open, urban space for activities and exchanges is the key space of the city. As one of the open spaces of the city, community parks have profound research significance. Most of the activities in community parks are closely related to the surrounding residents. It is not only the basic place for daily activities of residents, but also an important carrier for carrying residents' happiness. Community parks are the most important place for interaction between the surrounding residents and one of the sources of vitality within the city.

Figure 1.1 Yanchun Park, Yangpu District, Shanghai (Source: author)

Community parks are characterized by close interaction with the community. The role of community parks is not only to provide residents with a venue for basic activities, but also for the community's sponge. It has rich vegetation and water environment and has a prominent role in water. Community parks can collect water, rainwater, drowning water, regulate water, and provide water services to the community. In the case of rain, community parks can absorb most of the rainwater and drowning water; when there is no rain, they can play the role of the community park to store water and save water in the park's tap water.

There are 10 community parks in Yangpu District, Shanghai. In 2016, the total water consumption of tap water was as high as 57,400 tons, and the total water fee was 281,300 rmb. The average daily water consumption per community park was 15.46m^3. Take Songhe Park in Yangpu District as an example. The water consumption of tap water is more than 8 m^3 per day. The tap water is mainly used in water services such as tea houses, public toilets, free drinking water supply, plant irrigation, and landscape pools. In addition to the large amount of tap water, there are also problems such as water waste, low utilization of water, low rainwater collection and utilization, lack of live water circulation in the landscape pool, deterioration of water quality and water quality downstream of the river. These water problems directly lead to an increase in environmental and social costs.

The current community parks in Shanghai, while providing convenience to residents on certain water services, such as free supply of drinking water, tea houses and public restroom services, are based on the daily use of tap water, in the government and The maintenance of the relevant units in the case of economic subsidies, lack of efficiency and vitality. The same use of tap water and waste also occurs in plant irrigation, landscape water use and other activities in community parks. The water problem in community parks is not only in the waste of tap water, but also in water pollution. The non-circulating, eutrophic viewing pool in the community park flows to the downstream water quality of the city canal; and the market stalls around the community park and some of the wastewater generated by the restaurants are also discharged into the rainwater pipeline, which finally passes through the rainwater pipeline. Discharged to the Huangpu River, the long-term will seriously affect the water quality of the river.

Combining today's society, exploring new and intensive urban development models, optimizing the water service operation mode of community parks, is conducive to promoting the sustainable development of the environment, economy and society of parks and cities. The optimization of stocks in community parks can make cities healthier and more energetic, meet the spiritual and behavioral needs of residents, improve economic efficiency and achieve ecological sustainability, and have reference and universal significance.

1.1.3 Accelerate the demand for the construction of Shanghai ecological civilization

In 2013, the Ministry of Water Resources proposed to accelerate the construction of water ecological civilization. A year later, the Shanghai Municipal Government responded to the call for the publication of relevant documents to accelerate the construction of Shanghai's water ecological civilization and implement the most stringent water management system. As a pilot area for ecological civilization construction, Minhang District has achieved good results in reducing water pollutants. In 2016, Shanghai fully implemented the national requirements for water ecological civilization construction, and issued opinions and implementation plans; the Shanghai Municipal Government listed the “Water Pollution Prevention Action Plan” issued by the state as the key work of the year and formulated the implementation plan; in the same year, Shanghai The “Water 10 Articles” was fully implemented, and the target task of preventing and controlling water pollution was fully implemented in the form of time and space and events [3]. Since the "13th Five-Year Plan", Shanghai has entered a critical period of comprehensively promoting the construction of water ecological civilization. The construction of water ecological civilization in public open spaces such as community parks is an urgent need. In 2018, the Yangpu District Government has set up special funds to support the green space water quality control in the district. The Planning Bureau has publicly tendered the community park water quality treatment plan.

The current water problem in Shanghai community parks is the key concern of Shanghai's ecological civilization construction: water shortage, water environment remediation, optimal allocation of water resources and efficient use. At present, water problems such as water waste and water pollution in community parks and surrounding communities are becoming increasingly severe in urban development. Promote the conservation and recycling of water resources in community parks, find community cooperation, establish water service systems, systemically link water use and

[3] Shanghai Environmental Protection Bureau. Shanghai Environmental Status Bulletin [M]. Shanghai Environmental Protection Bureau, 2016.

purification, promote water recycling and reduce water pollution, and achieve sustainable development of community park water ecology. The main task of ecological civilization construction is also the way out for the development of community parks in the future.

1.2 Research questions

With the urbanization process in China for 40 years, the water problem in urban open space has been particularly prominent in recent years. Due to the growing demand for good living and the lack of resources for residents, the imperfect establishment and management of the ecological civilization system, combined with the limitations of past landscape design, led to waste of water resources in the community park, irrational use and water pollution, and affecting downstream rivers. The phenomenon of water quality continues to increase. At the same time, it is difficult for community parks to play the role of urban sponges, and it is difficult to cope with urban shackles. The water problem has become a serious problem in community parks. To build a beautiful China, we need to promote green development, water conservation, green production and consumption. How to reduce water waste and water pollution in community parks, improve the quality of water services in parks and enrich water service activities in parks, and achieve the coordination of ecological, social, economic and cultural benefits of community parks? The author will focus on water waste, irrational use and water pollution problems caused by people in community park activities, such as over-reliance on high-quality tap water, low utilization of natural rainfall and water, and low efficiency of irrigation. The pool water is not circulating, and the water quality is poor, which affects downstream rivers, etc., improving water resources waste, deterioration of water quality in landscape waters, and pollution of downstream water quality. Turn waste into resources, build sustainable urban open space, improve economic efficiency, reduce waste of resources, and establish an open space activity culture that tends to zero emissions.

1.3 Research objects, research scope and research methods

1.3.1 Objects

This paper takes the water service system of the community park as the research object. The following is an explanation and definition of the research object. The interpretation of the research object can be divided into keywords to explain, which can be divided into community parks, water services, systems.

(1) Community Park

Community parks are a type of urban park in urban parks with strong community attributes. Urban parks can be divided into comprehensive parks, community parks and pocket parks by size and function. Take Yangpu District of Shanghai as an example. There are 4 large-scale urban comprehensive parks such as Gongqing Forest Park, Huangxing Park, Yangpu Park and Jiangpu Park. There are also 10 Fuxing Island Park, Neijiang Park, Songhe Park and Yanchun Park. Community parks, as well as small-scale pocket parks or group green spaces. The location of the community park is a park serving the community residents. It has certain service facilities and organizational forms and has certain regional characteristics and close interaction with the surrounding residents.

(2) Water service

In the context of the research object, water mainly refers to the water that appears in community parks and surrounding communities. Mainly include tap water, rainwater, river water, pool water, wastewater, sewage, water, etc.

Service is a series of activities that form a process and generate value to users[4]. The water service in the research object refers to various valuable activities generated in the community park, using water as a carrier for people or things. The water service here includes both manual and natural services. For example, community park staff heated tap water to provide drinking water supply services for tourists; tea house staff in community parks heated tap water and added tea leaves in water to make tea water service for tea house consumers; rainwater provides natural moisture for park plants

[4] Patricio L, Fisk R P, Cunha J F E. Designing Multi-Interface Service Experiences: The Service Experience Blueprint [J]. Journal of Service Research, 2008, 10(4): 318-334.

Supplementary service. Linking these water services together to form a holistic water service relationship is a comprehensive utilization of water.

(3) System

A system refers to a set of components that the system interacts with for a common purpose[5], containing elements, interconnections, and functions or purposes[6]. The context of the research object is to integrate the comprehensive utilization services of water in community parks and achieve common goals. System theory and methods are described in detail in Chapter 2.

1.3.2 Definition of research objects

The definition of the research object is derived from several major levels. First, because the subject of the paper is system design, defining the research object in the first level is to study a system. The first level is the system design. System design research needs to follow the guiding principles of system design, including: Input and Output, Relationships, Auto-generation, Act local, and people at the center of design. (Man at the center of the project). The principles and methodology of system design will be elaborated in Chapter 2.

The definition of the second level is the carrier of systematic research. The system design mainly studies the problems of social systems, and has a wide range of applications, including industrial and agricultural production, waste treatment, medicine, transportation, public management, daily life, food related, resource use, and environmental development. Combined with the current situation in China, the problems of environment and resources are particularly serious. The development of cities has led to an increase in the contradiction between people and the environment. Water problems endanger people's lives and even the quality of life. In the second level of system carrier definition, the research on water resource allocation, rational utilization and pollution reduction is defined in the water environment and resource system. Therefore, the second level is defined as the water service system.

The definition of the third level is the research subject. It is not easy to find out for the current environmental problems. In the process of urbanization construction in China for the past 40 years, the extensive development has brought a series of problems

5 Forrester J W. Principles of systems [J]. 1968.
6 Meadows D H. Thinking in Systems [J]. Psychiatric Interviewing Primer, 2008, 20(4): 595-596.

to the inner space of the city. At the same time, with the improvement of people's living standards, the backward urban supporting facilities and management and services are difficult to match the development of today's society. Among them, the problems of community parks in urban open spaces are more prominent. Because the community parks planned 40 years ago and even in the early days of the founding of the People's Republic of China are difficult to match the current social form, the phenomenon of water waste and water pollution is increasing. If the problems in the community parks are improved, it will bring tangible ecological benefits to the community residents and society. On the subject of the study, locate in the community park.

Based on the definition of three levels, the final research target is the community park water service system.

1.3.3 Research scope

This topic is based on the system design perspective to optimize the community park water resources allocation service research, aiming to use the system design method to solve the problem of adequate and rational use of water in the process of community park water service and improve water quality and improve the water environment. The spatial scope of the study is community parks and surrounding communities. The scope of the research involves ecology, economics, sociology, design, philosophy, engineering, and so on.

Under the guidance of the methodology and principles of system design, constructing a community park water comprehensive utilization service system requires knowledge support in ecology, economics, sociology, design, philosophy, engineering, etc., as shown in Figure 1.2.

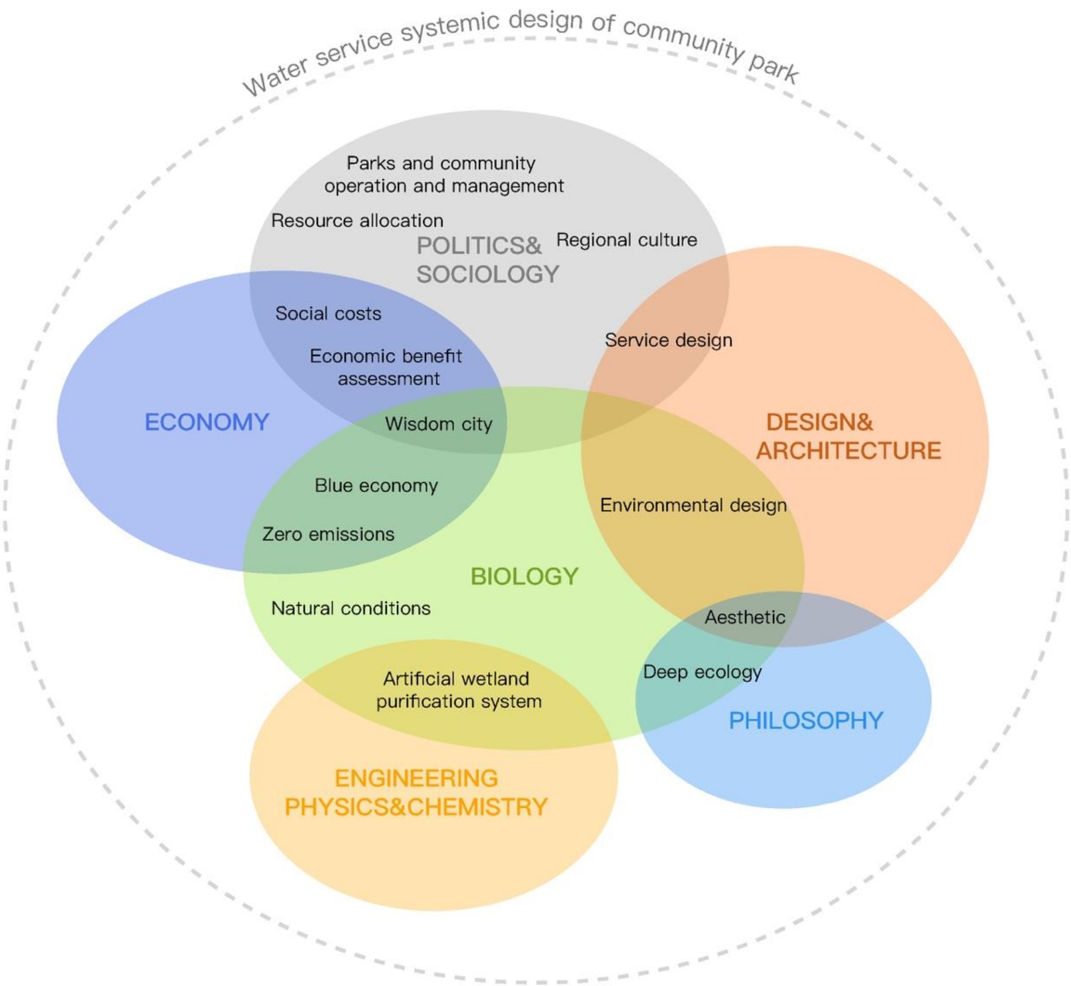

Figure 1.2 Design scope of community park water comprehensive utilization service system (Source: author)

As can be seen from Figure 1.2, the ultimate goal of each subject knowledge is to achieve the construction of a comprehensive water utilization service system. The research of this subject is to study the community park water comprehensive utilization service system, instead of studying the water treatment technology principle. Technology as a means of intervention will act on the integrated water services system. The design and research of the water comprehensive utilization service system requires a diversified design method (system design method, constructed wetland design method, etc.) and analytical tools (such as mathematics, economy, history, etc.) to promote the design to achieve the desired goal.

1.3.4 Research methods

In the six chapters of this paper, different research methods are used respectively. All research methods are carried out around the system design method to achieve the purpose of designing the Songhe Park water comprehensive utilization service system.

(1) Literature search

Read relevant literature on community park water service design, including systematic design, ecological design, environmental design, blue economy, circular economy, sustainable design, deep ecology and other theoretical works. Understand the context of theoretical development, principles and methodology, and have a solid understanding of the theory. At the same time, collect useful data related to community park water research as a reference for research data.

(2) Case study

Study the case of water service system design at home and abroad, from the system design, environmental design, ecological design and other disciplines, comprehensively analyze the advantages and disadvantages of the case with ecological, economic and social benefits. Summarize the common characteristics of typical cases and draw general conclusions. Find out the method suitable for the design of water service in Shanghai community park and apply to the design of the water comprehensive utilization service system of Shanghai Community Park.

(3) Data collection

Data collection is mainly used in water data and tourist information collection. For example, collect data on the amount and cost of tap water use in community parks in Shanghai, data on the amount and cost of tap water use in community residents, surrounding markets, and stores with outstanding water consumption, data on the quantity and quality of water in community parks and communities, and community park visitors. Quantity, identity, participation in activities, etc. Data collection mainly collects hard data.

(4) Questionnaire survey and object interview

Conduct field research on community parks and surrounding communities in Shanghai to collect feedback from visitors and managers. Questionnaires and interviews were conducted with tourists and community residents in community parks. An in-depth understanding of water use in community and community parks, understanding their water habits and listening to their advice can help design the water service system and create a water environment that will satisfy residents and visitors. Interviews with community park managers and staff of relevant organizations to gain insight into the data and management practices of community parks and communities.

(5) Participatory diagnostic survey

For some data without specific numerical references, a participatory diagnostic survey is used. Participate in the process of the incident, gain an in-depth understanding of the water use of various parts of the community park and the life of the community residents, and draw general conclusions. Compared with quantitative research on data collection, questionnaires, interviews, and participatory diagnostic surveys are more qualitative.

(6) Summary and analysis of data summary

Organize and analyze relevant data collected from community parks and surrounding communities. Try to explore the feasibility of the design, the general rules of the design and application of the community park water service system and find the commonalities and differences of different cases.

(7) System design method

System design is the main design tool for the design of community park water comprehensive utilization system. Using the guiding principles and design methods of system design, combined with the research and the willingness of tourists, study the current operation process of water-related projects in community parks and surrounding communities, the quantity and quality of input and output, and conduct feasibility analysis and system design. The water problems that have contributed to community parks have been effectively addressed.

The guiding principles and methodology of system design are detailed in Chapter 2.

(8) Artificial wetland design method

The method of artificial wetland design is a wastewater treatment technology method designed to promote the comprehensive utilization service system of water. The method mainly transforms and upgrades the observation pool in Songhe park, helps the water comprehensive utilization service system to realize wastewater reforming water, promotes water resource recycling, and provides self-generated power for the system.

1.4 Research framework

The research on the design of community park water comprehensive utilization service system is divided into five stages: background research, theoretical research, investigation and research, design practice and summary, as shown in Figure 1.3.

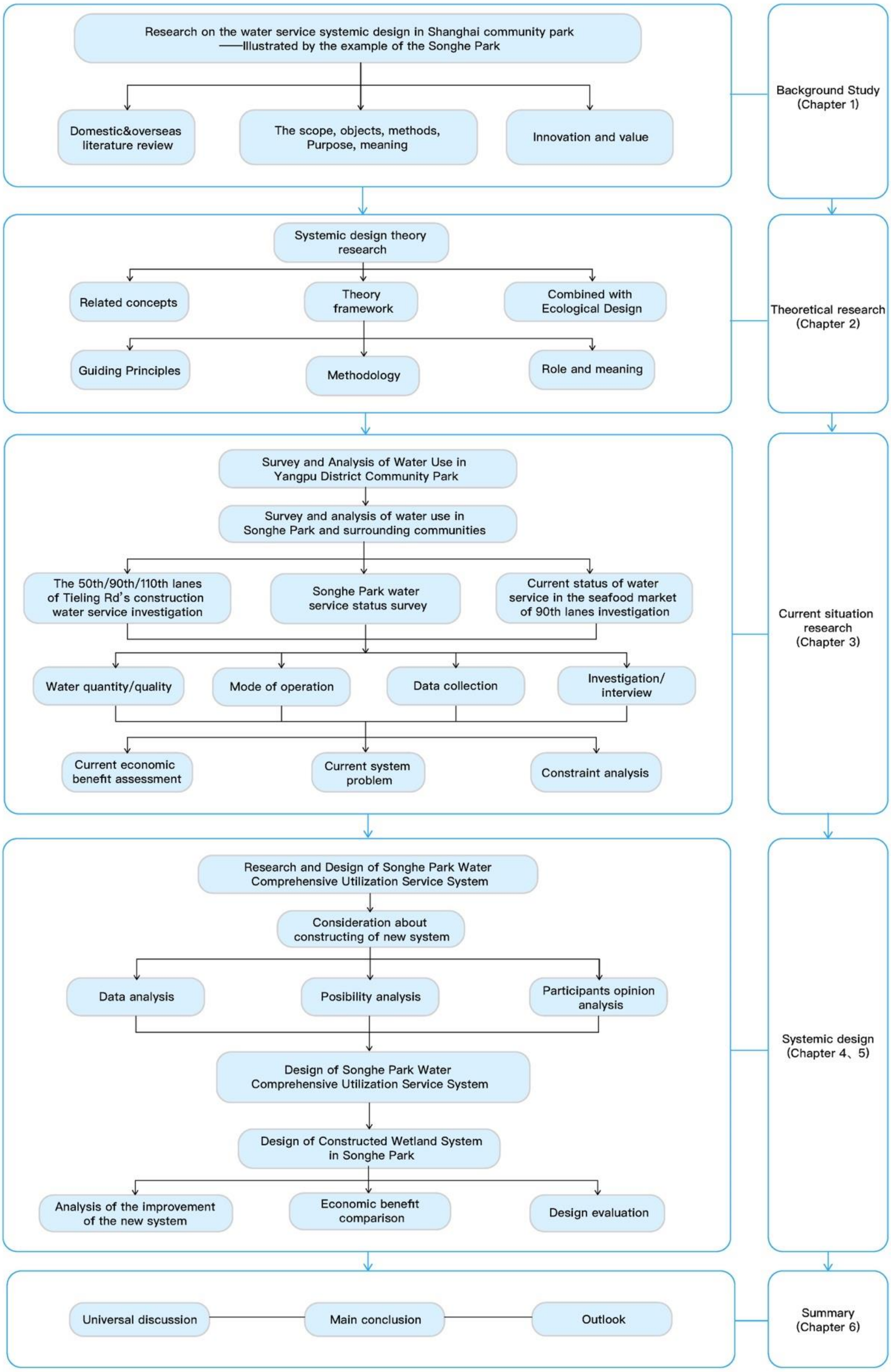

Figure 1.3 Research framework (Source: author)

1.5 Research purposes and research significance

1.5.1 Research purposes

The purpose of this research is to solve the problem of water waste and pollution in community parks, as well as to enhance the water environment and enrich water activities, to achieve sustainable development of community parks and to meet current water service needs. Optimize the unreasonable use of water in the current community park's water service process, resulting in water waste and poor water and water interaction experience. Design an open water service system that does not generate waste and promotes the efficiency of water services in the community parks and the improvement of the water environment. The study studied the water source, water operation process and water output of the community park. The research goal is to finally solve the water-related problems currently occurring in Shanghai community parks.

The community park has solved the water-related problems in the park through a series of practices. Community parks can increase the utilization rate of water by cooperating with the community, reduce or even eliminate the use of tap water, achieve zero discharge of tap water, reduce social costs and increase economic benefits; improve water environment through technological intervention and improvement of water services. Quality, realizing water purification in the park; activating the water in the garden to enhance the water landscape and hydrophilic experience; through the internal force of the park constructed wetland system, the water is purified and serves the downstream river; meanwhile, the park design Constructed wetlands will become a sponge in the community, with the function of collecting water, rain, drowning and regulating water. Through the ecological and economic improvement of community parks, the community's neighborhood relationship will be improved, and the individual's quality of water ecological civilization construction will be improved. The ultimate goal of the research is to make the ecological and economic aspects of community parks in water services. Social and cultural benefits have been improved and coordinated.

1.5.2 Research significance

At present, there are many attempts at the domestic and international research on park water system and play an ecological demonstration role. However, for the design of community park water service system, how to properly integrate the local community situation, establish a connection between the park and the water activities of the surrounding park community. At the same time benefiting from the park, reducing water waste and water pollution, there are still many gaps in meeting the needs of current community activities.

The design of community park water comprehensive utilization service system is a breakthrough in interdisciplinary research, involving system design, ecology, environmental design, economics and other subject knowledge. Integrating these disciplines with systematic thinking will solve water-related problems as a whole. The current problem of community park water is essentially a systemic problem, requiring systematic solutions, and system design has greater application significance. The optimization of the water service system not only solves the problem of water itself, but also solves many related problems of the park and community environment. Establishing and cultivating sustainable communities is one of the biggest challenges facing China at present. System design brings complete solutions for community park water service design and has important value in the application of this research field.
Community parks do not have the large area of lake water and rainwater in some urban parks to satisfy their own recycling. For example, Songhe Park, which covers an area of 1.4 hectares, not only has a large amount of tap water inside, but also continuously exports wastewater to affect downstream rivers. Here, considering the essential characteristics of community parks is to closely connect with the community, serve the community, establish community connections, use the ecological conditions in the park, and carry out system design to solve the problem of water waste and water pollution, realize circular economy, sustainable Development and promotion of ecological civilization have profound ecological, social and economic significance.

At the same time, the research on water comprehensive utilization service system is also of educational significance. The study evokes people's attention to water ecology, promotes the harmonious coexistence of people and the environment, and revitalizes the spirit of ecological wisdom in deep ecology: respecting nature and cultivating symbiotic consciousness, which has profound educational significance.

1.6 Innovations in research

Research has been innovated both in theory and in practice.
In theory, the system design appears in an interdisciplinary manner, integrating the knowledge of ecology, economics, sociology, design and other disciplines, and using the holistic thinking to open up the innovative ideas of community parks in the sustainable design of water services. The community park water comprehensive utilization service system design uses the theory and method of system design and ecological design and environmental design to form an innovative water service design theory research perspective.

In practice, the design of the system and the design method of the constructed wetland system makes the water problem of the community park more completely solved. In the design dimension, the water problem has been more fully understood and resolved from the original design of the ecological sewage treatment design to the different levels of regional culture, service, community connection, management, and concept awareness.

1.7 Domestic and foreign literature review

The design of community park water comprehensive utilization service system is a breakthrough in interdisciplinary research. It involves the intersection of system design, ecological design and environmental design. There is not a large number of ready-made case studies, but the research can be divided into community parks and water service systems. Design and water ecological design to study, will inspire the community park water comprehensive utilization service system design.

1.7.1 Overview of system design research

Systemic Design (also known as Systematic Design) is a cross-disciplinary discipline based on the development of systems. The system is a long-standing discipline with complete theories, guiding principles and methods. The systematic research and development will be introduced in detail in the system development process of Chapter 2. The following sections summarize the research and development of system design.

With the transformation of the scientific paradigm in the 20th century, breakthroughs have been made in the study of systems in various scientific fields. The American Austrian biologist Von Bertalanffy proposed the General System Theory in the 1930s, which gave the system theory a complete theoretical framework and methodology. Then the general system theory as the theoretical support of the system science, coupled with the theory of dissipative structure proposed by the Belgian physical chemist Ilya Prigogine, made the research of nonlinear systems spread in various fields, including natural sciences. social science.

In the 1950s, the chief task of designers in western developed countries was to get rid of war and the atrocities and looting brought about by war as soon as possible. In the 1980s, with the economic recovery and stability, the main social contradictions have changed, the role of designers. It is an attempt to rebalance the relationship between production, the environment and society. With the linear production mode of industrial society increasing the social cost, the research of nonlinear systems gradually involves ecological and economic benefits such as ecological environment, industrial and agricultural production, economy and management. System design is produced under such a background.

At the beginning of the 21st century, the design department of the Polytechnic University of Italy focused on the ecological problems brought about by the production and consumption of industry and agriculture, focused on providing solutions to waste problems, integrating environmental theory and biology based on cybernetics and complexity system theory. The theories of some theorists in the disciplines of science, design and architecture, economics, philosophy, etc. (Figure. 1.4), to study a problem that focuses on solving industrial and agricultural waste, improving ecological, social and economic benefits, and promoting sustainable development. Methodology, this is the system design.

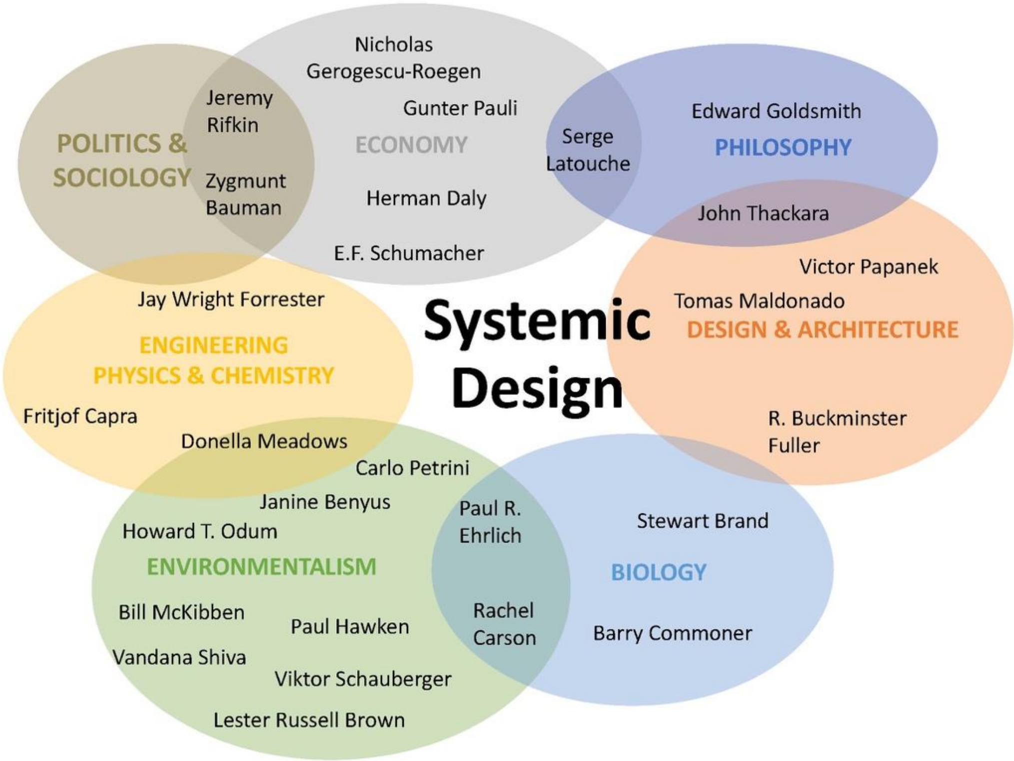

Figure 1.4 Discipline and Theory Researchers Related to System Design

(Source: System Design Theory and History Courseware, University of Turin University, 2017)

The system design has made substantial changes to the production and operation methods, so that the production mode is no longer enthusiastic about the repeated linear production mode of the mechanical unit, but the systemized production mode is used to enhance economic and social benefits. At present, the system design has been developed and promoted in theory, and its practical application is extensive. System design in industrial and agricultural production and processing, industrial farming activities, retail trade, on-site activities (exhibitions, etc.), transportation, collection and utilization of medical waste, comprehensive utilization of household food and water resources, comprehensive utilization of natural resources in villages or autonomous regions, etc. There are successful examples that have a range of influence in European countries. The guiding principles and methods of system design will be elaborated in the second chapter of system design theory.

1.7.2 Overview of water service system design research

There are many successful examples of system design in the design of water service systems. The book *Systemic design* [7] introduces the design of water service systems in the villages of Laguna Stan, India. Water problems have jeopardized the survival of villagers due to the severe water shortage caused by over-exploitation of water resources by village residents in their past lives and production, and the continuous deterioration of water quality caused by sewage discharge. System design Through the comprehensive investigation of the village's water-related activities, we have discovered various water-related problems, such as the generation of wastewater and water pollution, the inappropriate use or treatment of wastewater, and the management of water supply. In response to these status quo issues, the system design re-analyzes the quantity and quality of the current output, transforms the waste back into the system and becomes a resource, creating a self-generated system. For wastewater contaminated by excreta, first establish public toilet management and collect excreta and turn excrement into farm compost, which prevents pollution from occurring at the source; for industrial production wastewater, use constructed wetland system to collect and purify, and cheese factory Abandoned whey is dried to become a nutrient; for drinking water treatment, Solar Water Disinfection is used to provide a reliable source of drinking water for local residents. The redesigned material flow is reused in the new system, combined with other technologies to promote the purpose of system optimization, reducing ecological pollution and disease in the villages of Lagunstan, obtaining safe drinking water sources and more reclaimed water, and upgrading The economic benefits, the villagers' lives are restored to health and vitality.

1.7.3 Overview of research on community parks

China's "Urban Green Space Classification Standards" (CJJ85-2002T) defines community parks, which are concentrated green spaces with certain activities and facilities and serving residents within a certain range of residential land. The community park is a kind of park green space and belongs to the urban green space. Foreign researchers classify urban green space into a kind of urban open space. In 1877, the Metropolitan Open Space Act was promulgated in London, England, and the

[7] Bistagnino L. Systemic design: designing the productive and environmental sustainability [M]. Slow food, 2011.

concept of open space was born. The concept of open space first attracted attention in the urban planning community and was theoretically researched and practiced[8]. More disciplines have also joined the research, and it has become a research hotspot of multidisciplinary research. Community parks (also known as neighborhood parks) and other urban parks are a type of open space in the city. In the classification of urban parks, there are mainly four types of parks with different specifications and functions: comprehensive type (G11), community type (G12), special type (G13) and pocket type. The innovative design of community parks is one of the hotspots of urban open space research.

In foreign countries, the study of community parks began in the 1970s. Researchers used surveys to inform community residents about their willingness to community parks and determined the form of community parks based on residents' needs and on-site observation techniques.[9] In the 1980s, researchers focused on residents' perceptions of community park landscapes and aesthetic forms, and the differences between traditional urban parks and gardens. The use of community parks has been widely discussed in recent years. The researcher's focus shifted from landscape design and planning design to the interaction and cooperation of community parks and residents, the fairness of residents' use, and safety and ecological benefits.[10]

At the beginning of 2000, the Web-based spatial decision support application was researched and developed, and the development of technology enabled the effective management of the ecological problems of community parks. Researchers such as Ghaemi[11] developed a web-based interactive park analysis tool by summarizing the research of previous researchers. With the support of geographic information system (GIS) analysis tools and geospatial data, users are provided with a large number of detailed geospatial information data sets. The tool solves the groundwater recharge rate of community parks, improves stormwater runoff and water quality, strengthens the health of the basin, protects and restores biodiversity, and improves ecological benefits. It also promotes the health of community parks and enhances the community. Park interaction with residents and space security.

[8] Zhang Hongou, Qi Qianhua. Research Progress of Open Space in Foreign Cities[J]. Urban Planning Journal, 2007(5):78-84.

[9] Claire Cooper Marcus, Caroline Francis, Yu Kongjian. Humanity Site - Urban Open Space Design Guidelines [M]. China Building Industry Press, 2001.

[10] Fu Wei, Luo Tianqing. A review of research on community parks at home and abroad [C]// Proceedings of the 2014 Annual Meeting of the Chinese Society of Landscape Architecture (Volume 2). 2014.

[11] Ghaemi P, Swift J, Sister C, et al. Design and implementation of a web-based platform to support interactive environmental planning [J]. Computers Environment & Urban Systems, 2009, 33(6): 482-491.

There are in-depth and detailed research literatures on the design and management of community parks, functions and forms, and the interaction between the community and the community. The book "Planning Neighborhood Space with People"[12] explores in detail the form and function of neighborhood space (including community parks), planning and design, and ways and means of managing operations. The book has been produced worldwide. Certain influence. With the environmental, social, economic, and cultural issues brought about by the development of urbanization, and the concept of sustainable development gradually deepened into the hearts of the people, after the 1970s, developed countries in Europe and the United States explored the neighborhood space (including community parks) and produced Innovative design in a variety of different spaces, functions and themes. In terms of space innovation, community-themed neighborhoods such as community gardens, urban farms, roof gardens, and residential green spaces are derived; in terms of functions, spa gardens, roof gardens, butterfly gardens, and cognitive gardens are also derived. The treatment of gardens and other functionally oriented neighborhood spaces[13]. These novel neighborhood spaces bring innovative ideas and new value to the design of community parks.

Most of the domestic research on community parks still stays in the landscape planning and design, especially in the small-scale landscape design level, lack of in-depth study of social and ecological benefits, but in recent years, some studies have studied community parks from different perspectives. the design of. Qu Yaqin and other researchers[14] proposed different venues for designing community parks based on age and psychological behavior, such as designing play sites for community children, and designing design elements such as plants, game equipment, pavement, terrain, and water. Xu Wenhui and Han Long[15] proposed the design principle of humanized communication space: satisfying the basic needs of residents, paying attention to spiritual creation, respecting regional culture, emphasizing the sharing characteristics of space, and promoting the positive development of neighborhood relations. At present, community parks face the problem of transformation in our country. In the context of the zero-growth of open space in the high-density urban old city of Beijing and

12 Hester R T. Planning neighborhood space with people /[M]// Planning. Neighborhood space with people. Van Nostrand Reinhold Co. 1984.

13 Cai Jun. Community Garden as a Way for Urban Sustainable Development and Environmental Education Taking New York City as an Example[J]. Landscape Architecture, 2016(5): 114-120.

14 Qu Yaqin, Zhang Jianlin, Yang Hui. On the Design of Children's Activity Sites in Community Parks[J]. Shanxi Architecture, 2007, 33(10): 358-359.

15 Xu Wenhui, Han Long. Design Method of Communication Space in Residential Areas[J]. China Urban Forestry, 2012, 10(1): 27-29.

Shanghai, it is an important task to improve the quality of urban space and establish an ecological and service-oriented community space.

At present, the design of domestic community parks is gradually learning the social, economic, cultural and environmental values brought by the design of foreign community parks, exploring and cooperating, increasing mixed functions, opening up and enhancing community cohesion, and researching the space of community parks. Design, focus on small-scale spatial experience, consider the experience of residents in community parks, and emphasize the communication and interactivity of space and community. Shanghai Chuangzhi Farmland, completed in 2016, is the first community garden in Shanghai to be built in a city block. It provides space for horticulture and communication for community residents, as well as ecological activities such as rainwater harvesting, various composting facilities, and small greenhouses. It has also established a mechanism for cooperation with the government, enterprises and the public, which is conducive to improving the efficiency of public space management and operation; Chuangzhi Agricultural Park has brought new inspiration to the innovative design of domestic community parks.[16]

1.7.4 Summary of research on water use in community parks and community buildings

Reclaimed water, also known as reclaimed water, generally refers to beneficial non-potable water that meets certain usage requirements after wastewater or rainwater has been properly treated.[17] The water quality of the reclaimed water is between the upper water (tap water) and the sewage (sewage).

The use of reclaimed water originated in Japan. Since the 1960s, Japan began to use reclaimed water, and it has reached the world's leading level in the use of reclaimed water.[18] The essence of the use of water is to improve the utilization of water resources and reduce the use of tap water. In some water-deficient countries such as Japan and Israel, reclaimed water is very popular; developed countries such as the United States

[16] Liu Yuelai, Yin Kezhen, Wei Wei, et al. Exploration of Implementation Mechanism of High-density Urban Community Garden——Taking Shanghai Chuangzhi Agricultural Park as an Example[J]. Shanghai Urban Planning, 2017(2):29-33.

[17] Yuan Shuqing, Lu Chunguang, Zhao Zhulin. Discussion on How to Develop Urban Reclaimed Water Utilization[J]. Inner Mongolia Water Resources, 2009(6): 100-101.

[18] Wang Lingling, Shen Wei. Application Progress and Development Status of Rainwater, Sewage and Intermediate Water in Urban Green Space System at Home and Abroad[J]. Environmental Science and Management, 2008, 33(3): 45-47.

and Germany have mature water reuse applications. In China, in 1958, the research of Zhongshui was included in the national research project.[19] Zhongshui has strict specifications and requirements for use. Reclaimed water is the recycling of urban sewage and cannot be used as drinking water, but it can be used as building and urban miscellaneous water, landscape environmental water, supplementary water source, industrial water, etc. When water is used for different purposes, its water quality should comply with the relevant provisions of national standards.

At present, the use of water in urban parks has been widely practiced. Represented by Beijing Nanguan Park, the reclaimed water reuse of Nanguan Park proves that Zhongshui not only uses toilet water, plant irrigation water, garden road flushing water, but also lake water supply, landscape water, and urban river water use. [20] The water area of community parks is generally small, and there is less practice in the use of water. At present, with the construction of water ecological civilization, the water purification and the use of water in community parks have gradually gained attention.

Water in community buildings can be effectively utilized. After the urban water supply is used, 80% of the water is converted into sewage. After being collected and treated by the water system, about 70% of the water becomes reclaimed water and can be recycled.[21] In the United States, many community buildings, office buildings, hotels, etc. have special water reuse systems, which are reused after simple collection and treatment of wastewater, reducing water bills. Since 1987, Beijing has been equipped with building water facilities for buildings of a certain building area and has begun the development of water in buildings.[22] At present, some new large-scale buildings have designed advanced water reuse and treatment systems. For example, the Tencent Binhai Building enables the treated water to be used for waterscapes, green irrigation, cleaning, and indoor toilet flushing around the building.

1.7.5 Summary of research on constructed wetland wastewater treatment

Constructed wetland is one of the most popular sewage treatment technologies; it is an ecological sewage treatment process with the best ecological landscape effect and high effluent quality. Constructed wetland sewage treatment systems have been widely

[19] He Wei. Definition of Zhongshui[J]. Construction Science and Technology, 2006(8): 72.
[20] Liu Jianhong. Application of Zhongshui in Landscaping Industry[J]. Beijing Garden, 2003(4): 42-45.
[21] Yuan Shuqing, Lu Chunguang, Zhao Zhulin. Discussion on How to Develop Urban Reclaimed Water Utilization[J]. Inner Mongolia Water Resources, 2009(6): 100-101.
[22] Huang Xinjie, Ma Zhong, Chang Dunhu. From the water in the building to the water in the community—— Taking Beijing as an example[J]. Environmental Protection, 2008(18): 4-7.

used in developed countries since the 1970s. China began research on constructed wetlands during the “Seventh Five-Year Plan” period.[23]

The water purification capacity of constructed wetlands is determined by the size of the wetland, and the daily processing capacity ranges from tens of liters to several thousand tons. A small constructed wetland system built in the green space of private villa gardens, with a daily sewage treatment of only a few hundred litres.[24] The Beijing Olympic Forest Park, built in 2008, has a 41,500 m^2 composite vertical flow constructed wetland system with a treatment capacity of 2 600 m^3 /d.[25]

The number of cases of applying constructed wetlands in the community has also increased. Changjiang Tongjiang Garden uses 4,400 m^2 of artificial wetland with vertical subsurface flow and cleans the living drainage of 205 households in the residential area; the current sewage treatment capacity is about 70 m^3/d, and the long-term scale sewage treatment capacity is about 140 m^3/d.[26] Shanghai World Expo Chengdu Water Park demonstrates the application of new wetland systems in urban parks. Constructed wetland has the characteristics of low construction and maintenance cost and high effluent quality and has broad application prospects in purifying the water quality of community parks. More case studies will be further detailed in Chapter 4, Water Comprehensive Utilization Service System Wastewater Treatment Methods; the design study of community park constructed wetland systems will be elaborated in Chapter 5.

1.7.6 Summary of literature review

By summarizing the literature review at home and abroad, it is found that foreign community parks and community connections, water service design, water use, and constructed wetland technologies have deep and mature theoretical research and successful cases in their respective fields, and they are combined to innovate. This will help to solve the water-related problems existing in community parks from multiple dimensions and levels, promote the sustainable development of park water services, and improve the quality of community park water services.

[23] Li Yang, Zhou Xiaode, Miao Deyu, et al. Discussion on Wastewater Treatment Technology of Constructed Wetland[J]. Water Resources Science and Technology, 2007, 13(1): 55-57.

[24] Huang Guangyu, Chen Yong. Ecological City Theory and Planning Design Method [M]. Science Press, 2002.

[25] Wu Zhenbin, Xie Xiaolong, Xu Dong, et al. Application of Compound Vertical Flow Constructed Wetland in Dragon Water System of Olympic Forest Park[J]. Chinese Water and Wastewater, 2009, 25(24): 28-31.

[26] Zhang Dan, Guo Yongqing. Experience in the Design of Constructed Wetland in Tongjiang Garden[J]. China Construction Information: Water Industry Market, 2007(12): 66-68.

1.8 Chapter summary

This chapter is the basis of research and clarifies the context of research. Through the research background: water shortage and water pollution, the demand for the optimization of stocks in community parks, and the needs of water ecological civilization construction, we have drawn research questions: how to reduce water waste and water pollution in community parks and improve water in parks. The quality of service and the enrichment of water services in the park have enabled the ecological, economic, social and cultural benefits of community parks to be improved and coordinated. Find solutions to problems based on research questions. Based on the current situation of community parks and the principles of system design, the water service system of community parks is deduced, and community parks and surrounding communities are defined. To solve the problem of water waste and pollution in community parks, as well as to improve the water environment and enrich water activities, and to use research methods such as systematic design to establish a comprehensive water utilization service system to solve the water-related problems currently occurring in community parks. The significance of research for sustainable development.

Based on research questions, this chapter provides a literature review. The development of community parks, system design, water service system design, water use in community parks and communities, and sewage treatment in constructed wetlands at home and abroad are reviewed. At this stage, all research directions have been studied in depth, but it is also found that the design of community park water comprehensive utilization service system is an interdisciplinary research, which is based on the optimization of community park water resources allocation service from the perspective of system design. Shanghai Community Park has a unique regional culture, spatial layout and operation mode. The design of water comprehensive utilization service system needs to integrate all aspects of literature review and innovate to solve it.

Chapter 2 Theoretical Research and Methods

2.1 Related Concepts

The main theory of water comprehensive utilization service system at community parks is systematic design theory. Before study on the theory, related concepts will be listed and interpreted so as to assist better understanding on significance of the system. These concepts are related to systematic design theory, reflecting sustainable development and overall system thinking.

2.1.1 Blue economy

The concept of Blue Economy is initiatively proposed by Gunter Pauli, the founder of Zero Emission Research Innovation Foundation (ZERI). The Blue Economy is a series of utilization through learning on natural energy based on zero emission so as to achieve ecological sustainability and significantly improve economic benefits. The Blue Economy is a way of turning waste into nutriment and economy. It is also an inclusive way of economic growth.

If the Blue Economy is seen as the first step of large-scale consumption and uncontrolled emission of wastes in industrial society, it is the reformed version of economy. The blue economy has overcome the limitations of the green economy, which can’t be popularized in an all-round way, requires high economic costs to support production and operation, and only provides service for small-scale of people. Blue Economy calls for people to re-evaluate wastes and discover more values in resources. It provides an inspiring way of thinking that can generate countless revenue possibilities. In the book of "Blue Economy" 2.0[27], it describes a study based on physical, chemical, biological and other methods to improve utilization. Many artificial systems mentioned in this book, such as farming and food processing systems aim at building connections with wastes and nutrients in order to bring added values for wastes, form a self-sufficient model, and open new roads for creating livelihood, providing food security and solving employment problems.

[27] Gunter Bowley. Blue Economy 2.0 - Latest Report to the Club of Rome [M]. Xuelin Press, 2017.

The design of comprehensive water utilization system at community parks is closely related to Blue Economy. The system design will create new economic value by re-recognizing and utilizing the outputs of the existing system, which is in accordance with the logic of the blue economy in essence. Meanwhile, as a model of simulation from nature, the Blue Economy is a self-created development mode. Under the self-created system design, both natural system and social system learnt from the previous are to achieve self-maintenance effect, which reflects sustainable performance and goals of system design.

2.1.2 Zero emission

Zero emission refers to activities that minimize waste emissions and are infinitely close to zero emissions. It has two meanings: from the perspective of quantity, it is to control and reduce the waste produced in the process of industrial production; on the other hand, from the point of view of quality, those wastes will deserve proper handling and utilization. Through certain technologies, the wastes can be transformed into useful products, and the process of production can be close to zero emission.

In 1994, the concept of Zero Emission was first proposed by the United Nations University. At that time, the United Nations Headquarters was set in Japan, while the EBARA contributed to the birth of the concept of zero emission and became an advocate and an executor of the concept and theory of the United Nations on zero emission. The central idea of zero emission is that in the production activities of various industries, the wastes produced in the production process becomes useful and valuable, minimizing the environmental load. Objects of wastes have expanded from original wastewater and gas into latter wastes like kitchen leftovers, fruits peels, coffee residue cellulose, oil and others produced in the process of production from various industries. With advancement of theory and technology, Zero Emission has gradually brought profound ecological and economic values to human society.

In the 1970, China began to explore Zero Emission in some industrial sectors. At that time, research focused on Zero Liquid Discharge (ZLD) of industrial wastewater. Due to extensive industrial production and construction from 50s to 70s, the waste liquid containing organic chemicals was discharged directly to rivers, leading to ecological and environmental damages as well as costs. The problem of sewage discharge has been paid much attention. Later the Zero Emission firstly was implemented in water and achieved certain results. With progress of technologies, many domestic wastewater treatment technologies have been developed.

Zero Emission is a profound ecological concept and connotation of system design, whose main purpose is to make the output within the system tend to Zero Emission and reduce ecological footprints.

2.1.3 Circular Economy

Circular Economy is one of core idea of Zero Emission concept, referring to an economic developing mode oriented by resource efficiency and environmental benefits and constructed according to "resources- products-renewable resources".

The early concept of circular economy was the spaceship theory proposed by American economist Baud in 1960s. He believes spacecraft is an independent system relying on limited energy for operation. Once the energy is exhausted, it will cease to operate, leading to be destroyed. The way to extend life duration is to achieve internal resource recycling and minimize emission of wastes. Circular Economy is a mobile economy based on material circulation which is in line with sustainable development concept.

The Circular Economy is different from traditional economy (economy in traditional industrial society), which is a linear economic mode and open loop economic mode with one-way-flow of "resource-products-emission on wastes". The logic behind this economic model is based on people's unrestricted access to natural resources, reflecting on high intensity resource exploitation, inefficient utilization and high quantity of wastes emission. Costs of this economy mode are declining of life quality and even destruction on living environment. In essence, the circular economy is the revolution of the traditional economy, abandoning a large number of productions, consumption and discarded economic growth mode. Through saving and recycling resources utilization, it could achieve a harmonious coexistence of economic development mode with environment.

The Circular Economy brings deep reflection on people and lays a challenge traditional economic development view. From a broad sense, Blue Economy is also belonging to Circular Economy while both their purpose is to put forward sustainable economic development mode.

2.1.4 Linear and nonlinear

Linear refers to proportional and straight-line relationship among quantities, representing for smooth rectilinear motion, while nonlinear is relationship not in accordance with proportion and straight lines, representing for irregular motions and sudden changes.

In general minds, linear relationship is normally regular, simple, independent, mechanical and single, while nonlinear relationship is complex, non-intuitive, unpredictable, interactive, chaotic and self-organized.

Modern physics holds that people can't see anything absolutely static in the world, so problems could not be treated with linear and mechanical thinking. In nature, almost all phenomena are nonlinear ones. Researchers from Ross School in New York including Stewart[28] believe nonlinear phenomena also occupy most of inanimate world. Non-linearity has following features:

Complex and chaotic (classical chaos);

Due to complexity of problems, it is impossible to predict exact results. Research paradigm is transferred from quantitative analysis to qualitative analysis;

Striking differences on causality reflect self-organized features.

Nonlinear dynamics is the first mathematical method to solve complex nonlinear phenomena. The transformation from linear to non-linear thinking is essentially from mechanical to systematic thinking. Because most of systems in the nature world are essentially nonlinear, scientists, mathematicians, biologists, engineers and other scientists to explore natural systems have been attracted. Meanwhile, a large number of economists, sociologists, industrial designers and production managers are also involved while they implement study on human social system by imitate life system. Through imitation on imitate life system, it has achieved ecologically healthy operation through man-made social system, as well as brought social, economic and environmental ecological benefits. Both life science and social science can be viewed in a systematic view of life. In essence, they belong to complex nonlinear system, rather than mechanical linear system. Substances continue to flow through open ecosystems to maintain their healthy and stable forms with growing, declining, renewing and developing. [29]

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[28] Thompson J M T, Stewart H B, Turner R. Nonlinear Dynamics and Chaos [J]. Mathematical Gazette, 1987, 71 (456): 562.

[29] Capra F, Luisi P L. The systems view of life : a unifying vision[M]. Cambridge University Press, 2014.

The nonlinear system is a self-created system far from equilibrium. At present, the water service at Songhe Park is a closed linear system, bringing ecological problems. The design of community park water comprehensive utilization service system is open and nonlinear. Through the complexity and dynamics of the system, it could form a sense of overall cooperation and the ability to produce self-sustainment, making it in line with the goal of self-generated system.

2.1.5 Ecological city

The concept of Ecological City is proposed by UNESCO from the Man and Biosphere Project (MAB) in 1971 (Song, 2008). The Ecological City is guided by ecology, which contributes to the coordinated development of society, economy, culture and nature. It is an artificial complex ecosystem emphasizing the ecological behavior of the city. Ecological City mainly targeted the formal urbanization movement with the core of industrial civilization and carried out criticism deeply on all sorts of disadvantages in industrial cities.

Under the feature of harmony, efficiency, sustainability, integrity and regional nature, the Ecological City reflects ecological behaviors embodied in food, clothing, residence and traveling. It pursues harmony relationship between nature and humans as well as highly efficient utilization of resources. Ecological City is very concerned about resources and wastes. Seeing from the perspective of water resources, it also pays great attention on highly efficient utilization and reducing water consumption. Meanwhile, it also requires recycling use of wastewater and reduces emission on sewage discharge.

Community parks and surrounding communities are actually epitome of a city, while wisdom of ecological city is also penetrated in water comprehensive utilization system of community parks. How to improve utilization rate of water resources, create harmonious and healthy places for parks and communities, reduce water pollution, promote vitality of space as well as realize sustainable development both community parks and water resources. Water comprehensive utilization system is a complex ecosystem, covering the dimensions of society, economy, culture and nature. Through overall understanding about visitors' behaviors at community parks, community management (social level), costs of water service operation (economic level), community regional culture, willingness of residence (cultural level), water quality and water ecosystem (natural level), it is beneficial to establish a high coordinated water comprehensive utilization service system.

2.1.6 Deep ecology

In 1970s, Norway philosopher Arne Naess has proposed the concept of Deep Ecology, which is a new scientific understanding about life at all levels in the life system including organisms, social system and ecosystems.[30]

Deep Ecology and Shallow Ecology are paradigmatic transformations. Meanwhile, they also have differences. Shallow Ecology emphasizes anthropocentrism and environment is placed at a dominant position while Deep Ecology is anti-anthropocentrism, advocating respect for intrinsic values of all life.[31] It has made a profound philosophical answer about how to deal with the relationship between human and environment, and how to achieve sustainable development. The purposes of Deep Ecology are to cultivate ecological philosophy, advocate values entered in ecology, and introduce ecological ethics standards. We can understand ecological wisdom deeply based on reflection on ecological crisis through questioning ecological values. The Deep Ecology has two top principles: self-actualization and centralism principles.

Self-actualization is the key element of Ecological wisdom. The “self” introduced by the author is the combination with nature rather than a narrow concept. It is recognized in ecological system and consciousness. People need to regulate themselves, realize themselves, help others realize themselves, and promote the establishment of symbiotic relationship among people and environment. Self-actualization is an intrinsic spiritual value, promoting common belief between individuals as a key element. To truly solve ecological problems, it is required to start from inner hearts, explore love and care around, and achieve harmony between people and environment.

Ecological centrism is the essential principle of Deep Ecology, embodying equality, while it believes each species has an equal intrinsic value and plays it unique role in ecological system. People should not pursue certain benefits at the cost of reducing diversified development of ecology. According to the principles of ecological centrism, both humans and non-human beings are equal in front of the ecological system. People have no right to reduce diversity of other species, or privilege power of

[30] Capra F, Luisi P L. The systems view of life : a unifying vision[M]. Cambridge University Press, 2014.

[31] Næss A, Drengson A R, Devall B. Ecology of wisdom: writings by Arne Naess [M]. Counterpoint, 2008.

overriding other species. Facing with ecological system, species are at equal positions, while humans and other species are interdependent and correlated.

Self-actualization and ecological centrism penetrate into each other. The ecological centrism provides a platform to the former one while the values of self-actualization affect ecological system. They have a uniformed goal of building s sustainable ecological system.

The transformation of ideas is the way to realize the ecological wisdom. Nash points out that our values, institutions and lifestyles require fundamental changes[32]. At present, many human activities are destruction of life rather than enhancement. In Deep Ecology, a deeper ecological perspective of values is needed to judge life instead of taking interests of people as the starting point. It should be focused on the whole ecological system. For present life and future, peoples' activities should be implemented under the premise of reducing the impact on the environment. Establish an eco-conscious value system that links the environment, institutions, lifestyles, etc. Inclusive plans are demanded for viewing and treatment of problems.

The Deep Ecology has many applications in the design of water utilization system in community parks. It reflects overall systematic view starting from the benefits of the whole ecology, searching for interconnections and building benign system framework. The application of systematic design can be divided into stages of reflection and action. The first is reflections on the pollution and waste of water resources in the community parks and putting forward the question why they would lead to such results; whether activities are carried out centered in the ecology; whether there are symbiotic consciousness and common goal. In view of the current problems, it is urgent to change ideas, realize self in the ecosystem, adjust the connections in the system, realize internal interconnections and dependence, as well as establish a harmonious and orderly system. A healthy system depends on all internal relations. In the design of community park water comprehensive utilization system, a symbiotic relationship is established to achieve a virtuous cycle of the ecosystem.

2.1.7 Summary of related concepts

Common goal of Blue Economy, Circular Economy, Ecological City and Deep Ecology is to maintain the good ecological benefits of the society, seek development in

[32] Næss A, Drengson A R, Devall B. Ecology of wisdom: writings by Arne Naess [M]. Counterpoint, 2008.

the case of respect for nature and establish a sustainable and systematic development model.

These concepts have brought profound enlightenment to the thinking of system design. The Blue Economy, Zero Emission and Circular Economy provide the thought of waste changing resource output economy; linear and nonlinear concepts distinguish between mechanical thinking and system thinking so as to promote transformation. Because most of the systems in nature are essentially nonlinear, better understanding of the characteristics of nonlinear phenomena helps to build a good system of self-creation; the Ecological City has defined a healthy urban system as a whole in the social, economic, cultural and natural levels; Deep Ecology emphasizes ecological consciousness from the philosophical level, shaping ecological wisdom, and embracing ecology from inner minds.

Understanding of related concepts will help us gain a deeper understanding of system design and better design ideas.

2.2 Definition of systemic design

2.2.1 Concept of systemic design

Systemic Design is also known as systematic design based on the research and development of system thinking. It is also a comprehensive interdisciplinary subject. Theory of Systemic Design starts from sustainable development perspective and designs an open system without waste production. Its design goal is to benefit the whole society, improve the quality of the environment, and provide a sustainable future for mankind.

The Polytechnic University of Turin defines the Systemic Design as the followings: it is a theory of design based on cybernetics and complexity system theory; it studies the current production and operation of industry and agriculture, changes the output chain mechanism produced in the process of operation, and turns waste into resources; its goal is to eliminate wastes during industrial and agricultural production or operation processes. The essence of this system design for studying social ecology is to imitate and learn the principles of nature's metabolism. All wastes are resources and can be reused.

Applying the life system in social system and solving current social problems of systemic thinking have become the main research direction of system design. The purpose of systemic design is to to advocate a new economic model, with all kinds of activities coexisting equally, becoming an integral part of the entire relationship system; meanwhile, to establish an open system aiming at connecting other production activities with local social and cultural backgrounds. The application scope of systemic design is relatively large including agricultural production, waste treatment, medicine, transportation, public management, daily life, food related, resource use, environmental development and other systems.

The position of system Design Knowledge is Value, Humanities, Economy and management oriented. While Meaning and Function also occupy a certain proportion, and also involve Fine Arts and Technology away from Form shown in Figure 2.1.

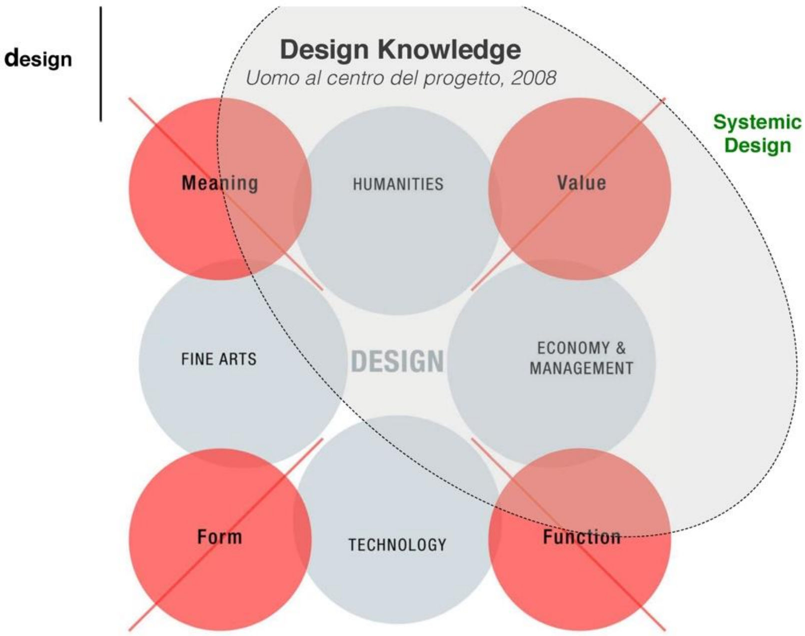


Figure 2.1 position of system design in design knowledge framework

(source: courseware of system design theory and history course of Politecn Turin, 2017)

2.2.2 Framework of systemic design

System design revolves around the three dimensions of relationship, development and characteristics. In the term of relationship, it includes balance, interaction, components and system quality; in development, it consists of Blue Economy, process, self-creation, and sustainable development; features contain cognition, behavior, community and global culture, such as Figure 2.2. Objects of Systemic Design could be environment, people, communication, products and systems.

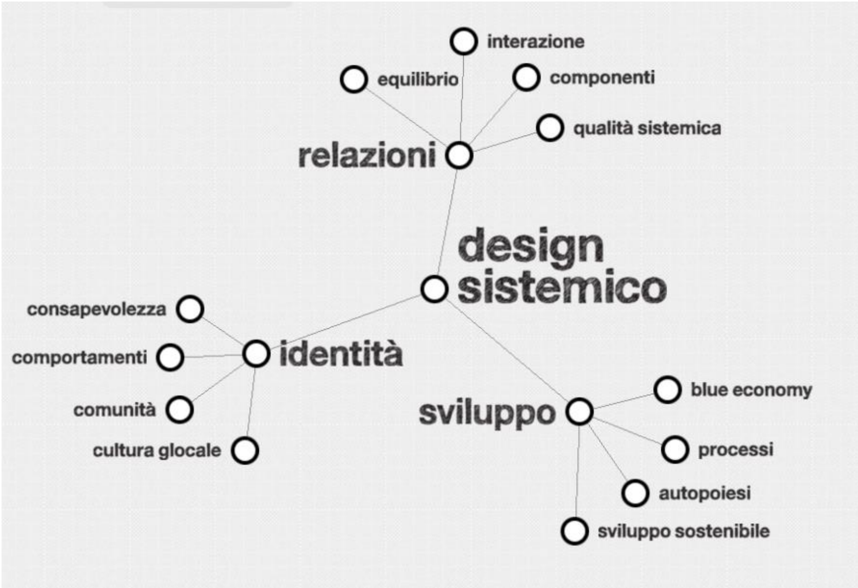


Figure 2.2 framework for system design (source: www.systemicdesign.org)

The Systemic Design n focuses on ecosystem, resources, sustainability and geographical design in terms of environment. This study is a systematic design of water comprehensive utilization services in community parks, mainly involving the sustainable design of water resources and environment. In the sustainable design, main design elements are balance, community, behavior, system quality, self-creation, blue economy and sustainable development; through interconnection among them, relationship is produced as the design of water comprehensive utilization service system in community parks, for example, figure 2.3.

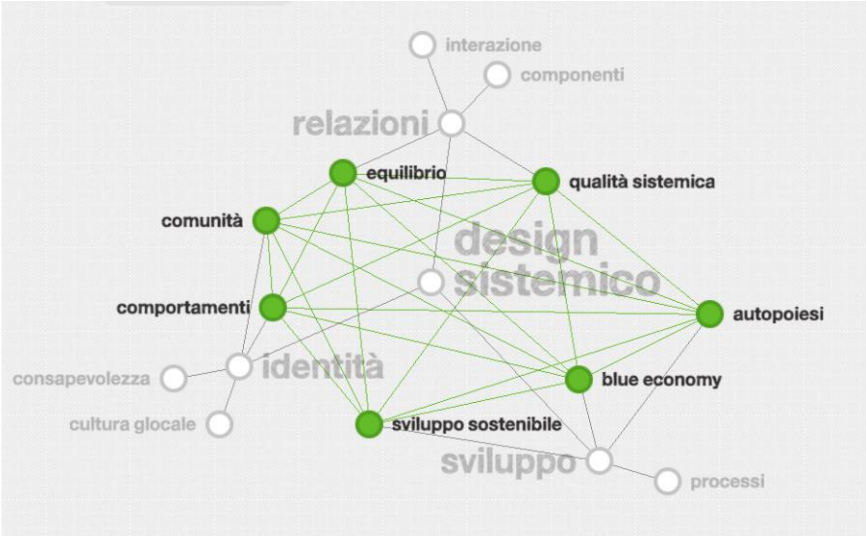


Figure. 2.3 element relationship of sustainable design in system design

(source: www.systemicdesign.org)

2.3 Development process of system

Systems originated from Greek philosophy in the 5th century B.C., and Aristotle was the first philosopher wrote about system. The ancient Greek philosophers and scientists realized that the universe is an organism order instead of mechanical operation. They recognized the universe as an integral organism[33]; After a period of silence in the middle ages and the Renaissance, the mechanical world outlook was studied and developed in the 17^{th} century, promoting systematically studies in the following periods; until the beginning of 20^{th} century, modern physics and biology re-explored and re-defined science while the mechanistic world view holding by Newton and Descartes was transferred into an organized and comprehensive systematic view, promoting the development of system.

The early systematic thinking appeared in the beginning of 20^{th} century, and biologists put forward concept of food chain. In the book of “Animal Ecology” [34], the concepts of food chain and food cycle are introduced. At first the concept of the food chain was called the "super organism" by ecologist Frederic Clements (1874-1945), and later the British plant ecologist AG Tansley (1871-1955) created the "ecosystem" to describe the animal and plant communities. Following ecological thinking was

[33] Capra F, Luisi P L. The systems view of life : a unifying vision[M]. Cambridge University Press, 2014.
[34] Elton C. Animal ecology. [J]. Animal Ecology, 1927(1): 187-188.

established to promote ecological methods of system[35]. In the ecology of 19th century, the ecological communities were regarded as an organism connected by network. When the concept of the ecosystem was gradually formed, the concept of network was becoming more and more prominent in ecology. Systems thinkers began to use network models at all system levels, viewing organisms as networks of cells, organs, and organ systems. The movement of substances and energies through ecological system are recognized as continuation of organisms.

The development of modern physics has laid the paradigm of today's system. In 1920s, the quantum theory of Einstein revealed that there was no isolated element in the natural world while they are performed in unified, integrated, different and complex networks. The world can not be analyzed as an isolated element of isolation[36].

Alexander Bogdanov, a Russian scientist, philosopher and medical researcher, proposed the Tektology theory in the beginning of 20th century, which has clarified the principles of all biological and abiotic structural organization.

In 1937, Austria biologist von Bertalanffy of American nationality put forward the general system theory, becoming the milestone in the development process of system theory. In 1968, Bertalanffy published his monograph "general systems theory, basic, development and application"[37]. He gave a definition about the essence of system and proposed systematical thinking and methodology, completely describing the theoretical framework of organizational principles in life system. Later, the concepts of systematical thinking and theories are used universally. General systems theory is a holistic science. It is proposed that an organism is an open system that needs to survive through an endless stream of substances and energy.

From 1950s to 60s, systematic research based on cybernetics had a great impact on engineering and management. The theory of cybernetics promotes the systematic research. Forrest[38], the American computer engineer and system scientist, is the founder of System dynamics, which defines the system as a set of components that collaborate for common purposes.

In 1969, the Belgian physicist Prigogine Ilya Prigogine put forward the theory of dissipative structure[39] at the International Conference on theoretical physics and

[35] Capra F, Luisi P L. The systems view of life : a unifying vision[M]. Cambridge University Press, 2014.
[36] Capra F, Luisi P L. The systems view of life : a unifying vision[M]. Cambridge University Press, 2014.
[37] Bertalanffy L V. General system theory; [M]. George Braziller, 1968.
[38] Forrester J W. Principles of systems [J]. 1968.
[39] Shen Xiaofeng, Zhan Yuhua. Theory of Dissipative Structure and Dialectics of Nature[J]. Dialogue in Dialectics of Nature, 1980(2): 37-43.

biology. The theory of dissipative structure has made the development of the system into a new stage, so that scientists in various fields are more focused on exploring the basic rules of the open systems based on dissipative structures. The application of the dissipative structure theory has almost opened all the fields of science, making the research of the system no longer confined to hard sciences such as mathematics, physics and biology. It can also be used in social sciences such as urban service and renewal, environmental protection, recycling of resources, product design, even social system, enterprise management, law and others. All of them have been developed well.

By the end of 1970s, with the development of the new mathematical framework complexity theory (also known as nonlinear system theory) in the development of computer, plus with the emergence of the self-creation concept, system has made great breakthroughs and affected[40] so far. In the 21st century, system science has become an interdisciplinary subject. Countries in Europe and the United States carry out systematic research in all fields.

In 1980s, the theory of self-creation was introduced to the social system by German sociologist Niklas Ruman, while all types of theories and methods on social system gradually established and completed[41]. At the beginning of 21st Century, Italy Politecn Turin defines ecosystem design as a cross discipline based on system theory in the branch of social production system. The systematic design integrates the system theory, method and design, proposing a sustainable design solution. The system is designed to solve the wastes' phenomenon of industrial and agricultural production and operation so as to establish a culture tending to zero emission as well as improve social, ecological, economic and cultural benefits.

2.4 Guiding principles of system design

System design is carried out based on five guiding principles including input and output, relationship, self-creation, localization and human-centered design. Those guiding principles are essential guidance tools for system design, reflecting structural relationship of design and differences from linear relation. It is shown as the following figure 2.4

[40] Capra F, Luisi P L. The systems view of life : a unifying vision[M]. Cambridge University Press, 2014.
[41] Li Hengwei, Xu Yi. From Bio-original to Social Self-generated [J]. Research on Dialectics of Nature, 2014(4): 22-29.

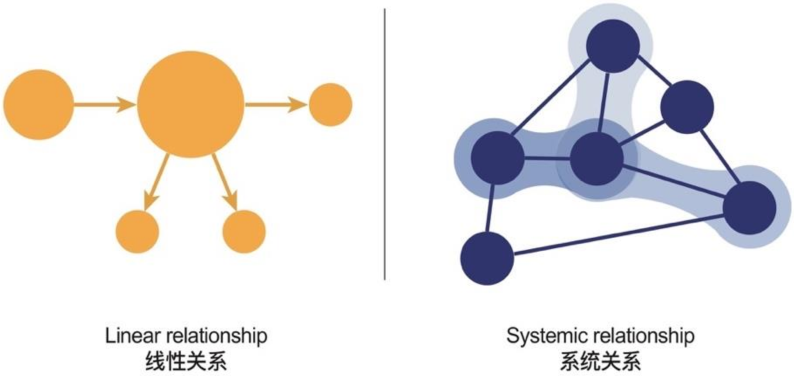


Figure 2.4 Linear and Systematic Relations (Source: author)

2.4.1 Input and output

Input and output mainly refer to systematic input (resources) and output (wastes). First of all, the systematic mode is an open and dissipative structure, which needs continuous flow of resources as the energy support for operation. Systemic design is learning from nature’s metabolic principles, while input and output become important features of open system. Meanings of input and output principles are output produced in one system becomes a resource in another system. The connotation of systematic model is sustainable development, which is different from the linear model of waste neighborhood avoidance. The purpose of the system design is to eliminate waste and establish a culture that tends to zero waste discharge. Therefore, the principle of systemic design is to turn wastes of one system into resources of another system and create new benefits.

2.4.2 Principle of relationship

Relationships are the main presentation of the system and constitute the whole system, reflecting principles of input and output. Turning wastes into resources requires external cooperation and relationship is achieved. Through the establishment of the relationship, original closed linear system is turned into an open system. In the production and operation of social industry and agriculture, the interrelated models provide a variety of possibilities to solve the system problems. Relationship could be seen as internal and external aspects. In the external relationship of system, each relationship may be a potential strategic element of system design.

2.4.3 Auto-generation

Auto-generation refers to the system can be self-repeated production to maintain their own development and evolution. This self-motivation is characteristic of the self-generated system, reflecting features of life, which is different mechanical system without life. The auto-generation system could produce unconscious sense of system cooperation and correctly organize a systemic operation as an organic organization. Systematic design studies the characteristics of natural life system, compares the system of social problems into a life system, and defines auto-generation as internal engine. Meanwhile, it is also a complex system and realizing dynamic operation through mutual involvement and cooperation within the system.

2.4.4 Principle of act locally

Act locally refers to the system design based on local and taking local operation background as priority. Through deep understanding about local features, best solutions could be found at local places. Under the background of operation within this system, local resources like humans, materials, cultures and nature are estimated so as to explore new opportunities, establish connections and solve systemic problems. The act locally actually sets a distance range for system connections, enabling the system to focus more on solving local problems. Through the study of the environment in the system, solutions could be explored with local unique features effectively. This way of establishing local contacts is better than non-local ones, strengthening effectiveness of contacts and giving a design that meets the needs of local people.

2.4.5 Human at the center of the project

Human at the center of the project refers to the establishment of relationships between people and their environment, bringing people together with time, space, regions and operational process of system. Huamnan at the center of the project is different from product-centered design, while human and product represent two value orientations. Products emphasize market and economic value, form and packaging, symbolic status and so on, while people emphasize humanization, culture and respect, morality and ethics, social value and other aspects. Design is the enhancement of life rather than destruction of life. Human at the center of the project embodies common values of the people orientation, respecting the common value of society, ecology, economy and culture.

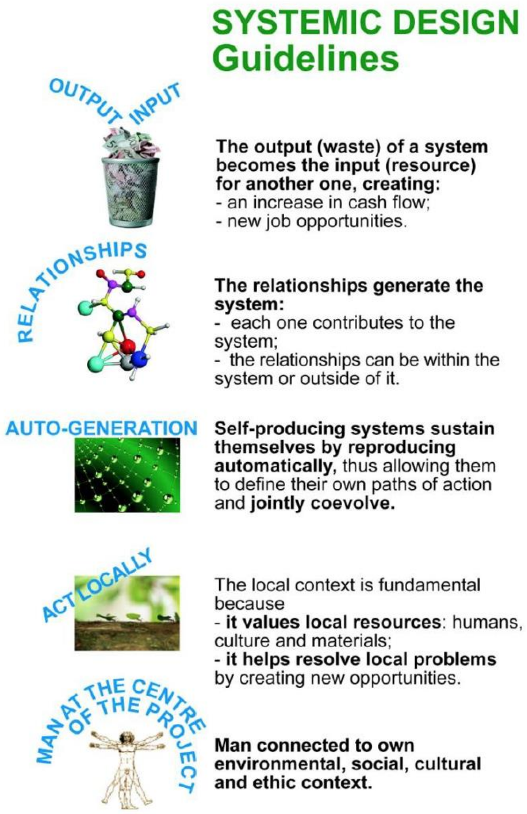


Figure 2.5 System Design Guidelines (Source: Luigi Bistagnino System Design, 2011)

2.5 Systemic design method

The core method of systemic design is output of one system is seen as input of another system, as shown in figure 2.6. Through this relationship, the systemic design is to build a zero-emission culture that combines local culture with community and produce sustainable products or services.

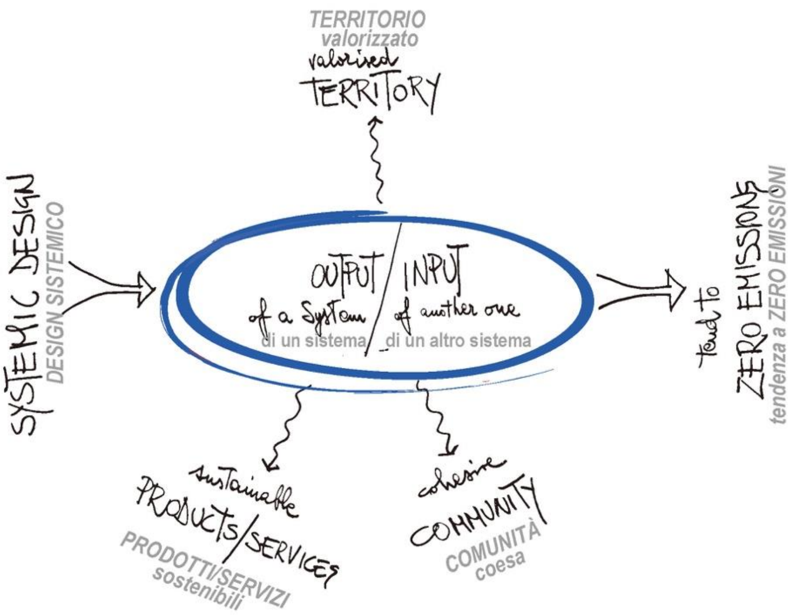


Figure 2.6 summary of system design method

(Source: http://www.systemicfoundation.org/systemic-approach/)

Systemic design is to promote design process through consideration of all variations, which are specifically materials and energy flows of current system, as well as relationship motivated by these operations. Through a comprehensive investigation and study of these variables, based on the guiding principles of system design, a positive feasibility strategy is explored, and the system design is obtained. The following are the method steps of the systemic design.

2.5.1 Comprehensive investigations

Through comprehensive investigations on status of current system, research is carried out about input and output involved in every step of production and operation process. Quantitative research is to study the quantity of inputs and outputs; quality research is to study the types, composition, uses and benefits of inputs and outputs. Through the analysis of quantity and quality, values of input and output materials could be gained. And then, relationship of all parts internal the system could be investigated to understand the products or services that the system has already realized and the logistics information like operational management mode. Make a comprehensive survey of the current situation of the system to understand the purpose of the current system operation.

Regions are the focus of consideration. Understanding the physical, social, cultural, value and impact created by the process of system actuality. Secondly, implement research on local governments and institutions providing services and influencing current system operation so as to understand logical relationship back the current system. A comprehensive survey of the system analysis diagram is presented to list each system process. The system consists of system, input and output. Input and output are a material object, the system is a network relationship. Input enters the system and then flows out of the system to become output. Normally speaking, a whole system contains many small systems, while each small system has various process links. The constituent unit of a process link is "input-process-output". "Process" represents a system field flow. "Inputs and outputs" represent the flow of material in the system; their relationship is the relationship between a matter flowing into a system process. Listing each process in the status quo system is helpful to recognize and discover problems as shown in figure 2.7

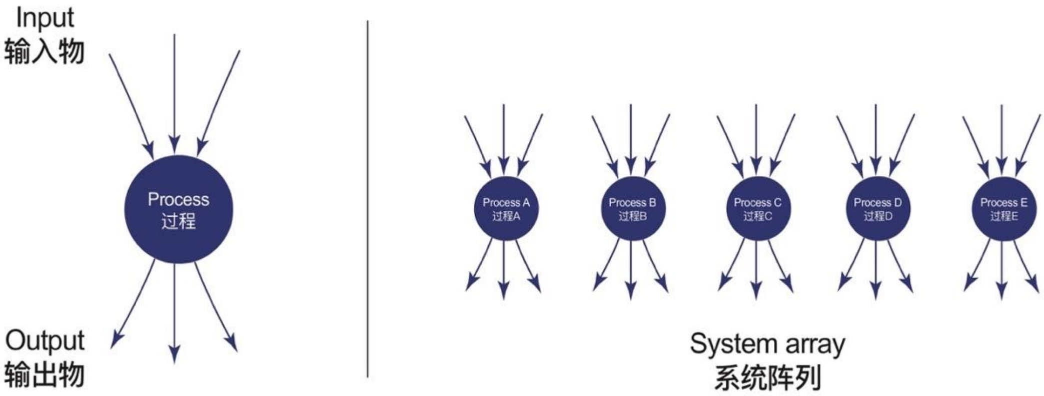


Figure 2.7 System design process analysis diagram (Source: author)

2.5.2 Problems' finding and analysis

Through overall investigation, social, cultural, environmental and economic problems of system will be explored. After problems being found, specific research analysis on reasons and structures will be carried out so as to analyze current issues as well as implement key evaluations on quantitative and qualitative indicators. After having a comprehensive understanding on current situations, further feasible analysis will be given.

2.5.3 Feasible analysis

After key evaluations on all quantitative and qualitative indicators, trying to solve problems and giving a picture about possible interference design.

Based on guiding principles of systemic design, taking system as a whole subject for research, redefining will possibly produce useful relationship based on feasible analysis. In this process, it aims at opening correlations among systems, improving efficiency of production and operation, making system more ecological. Guidance behind is man at the center of the project, which must be combined with various factors like environment, culture and societies surrounding. Based on nature as the most efficient system, behaviors from humans should be tended to natural system so as to communicate, interact and produce harmony.

2.5.4 Establishment of system

According to establishment of feasible analysis, new relationship is built actively among subjects of system. Turning output materials into input ones means creating a new coordinated system among society, culture, environment and economy, as shown in figure 2.8.

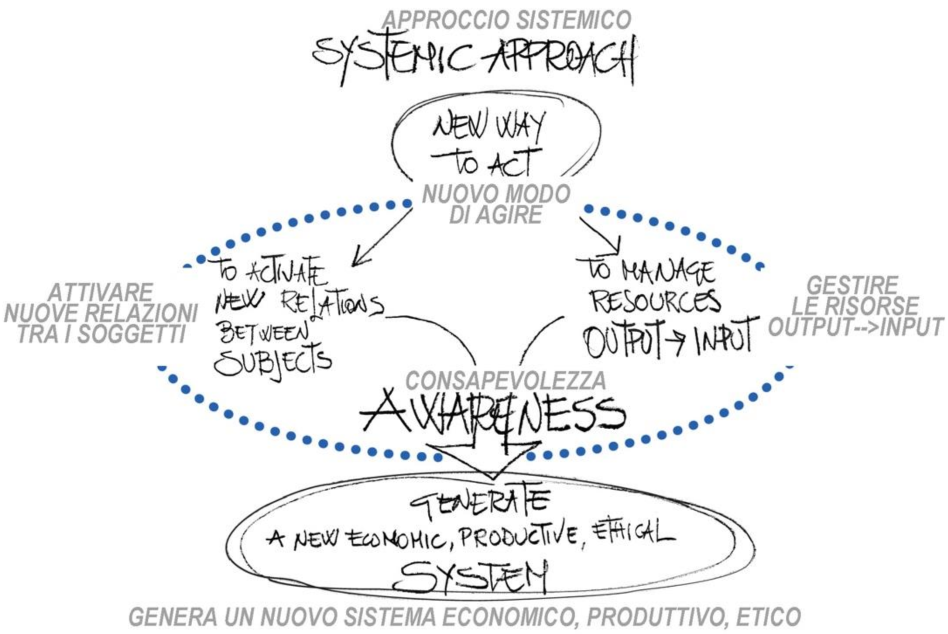


Figure 2.8 thinking on systemic design

(Source: Luigi Bistagnino "Open systems" lecture PPT, 2017)

Purpose of systemic design is to change wastes into useful resources and eliminate over-costing. Based on guiding concept of ecology-oriented benefits and environmental protection, it attempts to connect on system output into another system, build recourses flow and achieve effective utilization for output materials in the whole system, as shown in figure 2.9. Due to complexity of system, there are huge differences on causes, while connections of output materials need continuous calculations to reach expected systemic design.

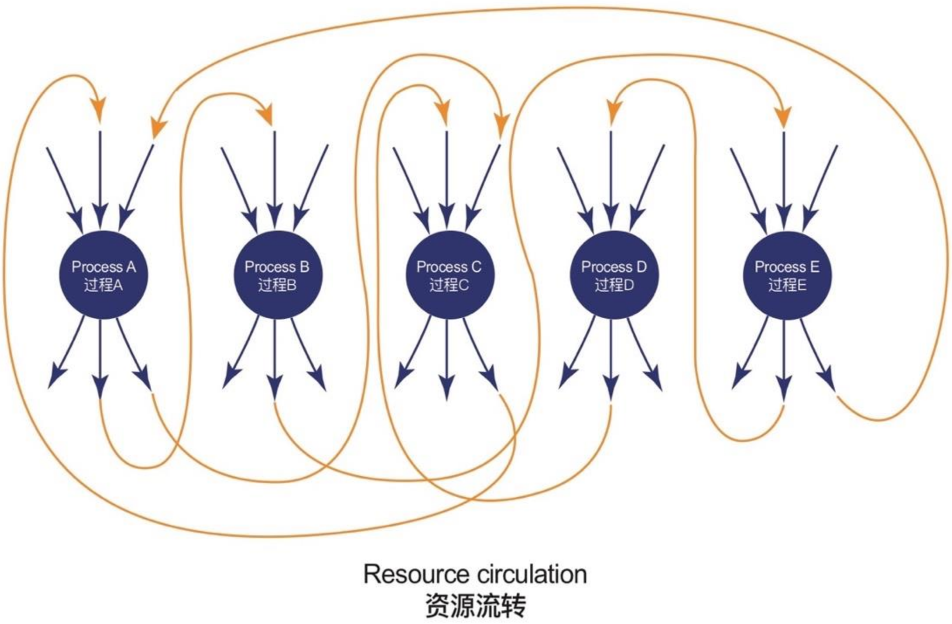


Figure 2.9 process analysis on systemic design (source: author)

Recent and long-term plans will be determined in the design, while recent design plan will be focused on solution to specific problems, reaching ecological, economic, cultural and social benefits; in the long-term design planning, it will trigger more possibilities in potential optimization, create a more open, optimized and comprehensive system with expended scope of service and larger design dimension.

2.6 "Systemic design + product /service design" mode

Systemic design is an interdisciplinary subject actively integrating knowledge from all subjects and various technologies to achieve objects of systemic design. Cooperation based on multidisciplinary is the basic feature of systemic method[42].

[42] Bistagnino L. Systemic design: designing the productive and environmental sustainability [M]. Slow food, 2011.

Combined with products and service design, the systemic design is feasible. Bistagnino[43] mentioned in his book Systemic Design, under theme of open and cross disciplinary, technologies from various fields could be fully used to promote "Zero Emission of system". The systemic design contains technologies from many areas and realizes cooperation on the common goal of low emission. When those products or service design are in line with input and output principles of systemic design, they would bring positive systemic effects, produce new possibilities, and generate more profits. Powerful technologies supports are necessary for those products and service design. As application methods, technologies themselves are not concerned too much, while systemic design achieve expected goals through assistance from those special technologies.

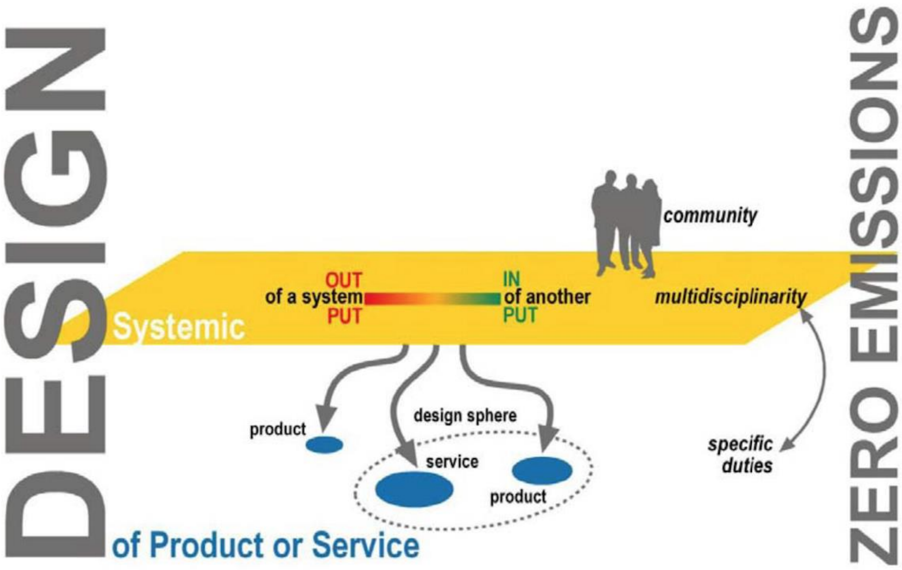


Figure 2.10 system design combined with product and service design

(Source: Luigi Bistagnino, Systemic design, 2011)

In the comprehensive utilization service system design of community parks, through mutual effect on systemic design and artificial wetland system, systemic problems could be solved from different levels so as to realize self-adjustment and maintenance with much flexibility, becoming an auto creative system with higher efficiency. Based on combination with systemic design theory supported by control and complex systemic theories as well as wetland ecological theory under ecology

43 Bistagnino L. Systemic design: designing the productive and environmental sustainability [M]. Slow food, 2011.

disciplines, systemic design of water comprehensive utilization service at community parks could be built together with water service, water environment, water purification and water experience. It is available to fix water service problems at community parks purposely.

2.7 Economic evaluation on systemic design

Under the circumstance of energy planning trend, it also brought economic benefits especially when output materials of one system were turned into input materials of another system, brining much added value of resources ——“Systemic Design”[44] has proved with practice based on comparison of modes of linear systems that systemic production and operational mode could bring bigger economic benefits and more employment opportunities.

2.8 Meaning and functions of systemic design

Systemic design provides an overall and open systemic structure method, analyzing and solving problems with systemic thinking. Functions and meaning of systemic design are obvious. Comparing with linear system, the systemic design has brought solutions on coordinative development from different environments, societies, economies and cultures.

2.8.1 Functions of systemic design

Systemic design has following functions:

Turning wastes into resources has promoted utilization rate of resources and economic benefits. The systemic design focuses on wastes processing during production and operation of system, turning wastes into resources, and making the system tend to zero emission as well as achieve the most optimized resource use.

After adjustment and optimization on ecological system, inner parts of the system realized healthy operation which is beneficial to cooperative development among different components.

[44] Bistagnino L. Systemic design: designing the productive and environmental sustainability [M]. Slow food, 2011.

Environmental conditions could be improved because of reducing on wastes production and access. Environment will be getting better obviously.

Creating more profits and enhancing social economy development. Systemic design could bring possibilities to profits and employment rate for enterprises, creating economic and social benefits.

2.8.2 Meanings of systemic design

The systemic design has established a culture tending to zero emission on wastes. It has brought feasibility for coordinate development on environment, society, economy and culture. Meanwhile, through multidisciplinary method, the systemic design has built connection among disciplines, helping to find new research fields and solutions as well as promoting development of various subjects.

Currently, China is still the largest developing country, while linear agricultural productions and activities related to living are producing large amount of wastes, leading to damage on surviving environment and added social costs. In our country, systemic design has practical significance. At current stage, all activities should be carries out under supports of systemic design theory.

2.9 Conclusion

In this chapter, the theory and method of systemic design on comprehensive water utilization service at community parks are interpreted. Research on theory and method are led by systemic design theory. In the first section, related concepts involving in systemic design theory is clarified to enhance understanding about the theory; in the second section, concepts, developing process, guiding principle, method, economic evaluation, functions and meaning of systemic design are given. Common goal of systemic design is combined with other technologies. In the systemic design research of water comprehensive utilization service at community parks, systemic design together with sewage disposal and other technologies promote establishment of auto creative system jointly.

Chapter 3 Survey and Analysis of the Status Quo of Songhe Park Water Service

3.1 Yangpu district community park survey

Songhe Park is located in Yangpu District, Shanghai. It is one of the many community parks in Yangpu District. Before studying the water use situation in Songhe Park, the community parks in Yangpu District were first investigated separately, and the common rules and characteristics were found to help the study of Songhe Park. The research value of Songhe Park is not only in Songhe Park itself, but also has reference and application value to Yangpu District and other communities in Shanghai, resulting in greater social, ecological and economic benefits. There are many community parks in Yangpu District and Shanghai. There is a need to conduct basic research on community parks that match the type of Yangpu District.

3.1.1 Community park survey and analysis

Yangpu District is located in the northeast direction of the center of Shanghai, adjacent to the waters of the lower reaches of the Huangpu River. In 2016, the resident population was 1,130,200. It has a subtropical monsoon climate with four distinct seasons. It is cold in winter and hot in summer. The average annual temperature is 17.1 °C and the highest temperature is 38.5. °C, the minimum temperature is -4.8 °C; sufficient sunshine, the annual sunshine time is 1493.2 hours[45]. Rain and heat in the same season, the rain is full; the annual precipitation in the district is 1649.1 mm, and the rainfall in the flood season from May to September accounts for about 70% of the annual rainfall; the maximum daily rainfall is about 250-350 mm; the average rainfall is 76-79 mm/day, mainly in summer, the number of days is about 2-3 days; the rain period is concentrated in the spring rain, plum rain and autumn rain; the relative humidity is generally 60% in winter and 45-65% in summer[46].

In 2015, the public green area of Yangpu District reached 471.66 hectares, of which the park area was 218.80 hectares, and the green coverage rate of the whole

[45] Shanghai Yangpu District Statistics Bureau. Yangpu District Statistical Yearbook 2016[M]. Xuelin Press, 2016.
[46] Shanghai Statistics Bureau. 2017 Shanghai Statistical Yearbook [M]. China Statistics Press, 2017.

district reached 25.42%; the number of visitors in the whole year reached 18.28 million[47]. There are 15 parks in the district, including 10 community parks, including Minxing Park, Huimin Park, Boyang Park, Neijiang Park, Songhe Park, Gongnong Park, Pingliang Park, Yanchun Park, Fuxing Island Park and Siping Technology. park. These community parks range in size from 0.8 to 7 hectares, most of which cover an area of about 1.5 hectares. The layout of these parks is mainly Jiangnan courtyard type, plant landscape is spread all over the park, and there are children's activity areas and fitness areas, and is separated from the surrounding environment through the wall; there are also modern landscape layouts such as Siping Science Park and Folk Star Park. Community park.

These community parks are surrounded by communities and are closely integrated with surrounding communities, streets and shops, and are the main open spaces for residents of the surrounding communities. Tourists in community parks are mainly residents from surrounding communities; the closer the residents live to the community parks, the greater the proportion of tourists.

3.1.2 Survey and analysis of water use in community parks

In community water services, community parks mainly serve tea houses, landscape water supplements, public restrooms, drinking water supplies, and plant irrigation. Among them, Songhe Park, Pingliang Park, Yanchun Park and Neijiang Park are equipped with tea houses; the Star Park, Songhe Park, Neijiang Park, Fuxing Island Park, and Boyang Park Park have designed fountains or viewing pools; all parks are equipped. Public restrooms and drinking water services; in summer and autumn, all parks provide tap water supplement irrigation.

The water in the park tea house mainly includes cleaning, disinfection and boiling water.



[47] Shanghai Yangpu District Statistics Bureau. Yangpu District Statistical Yearbook 2016[M]. Xuelin Press, 2016.

Figure 3.1 Water use type in Yanchun Park tea house (Source: author)

The water consumption in the park tea house is based on the number of tea house guests per day. All community park teahouses are open from 6 am to 11:30 am, with an average of 40 people drinking tea per day (Source: Yangpu Landscaping Construction Maintenance Co., Ltd., 2017).

Figure 3.2 Statistics on the number of people who drink tea every day in Yanchun Park Tea house (Source: author)

The park provides drinking water services to visitors from 6:30 to 11:00 in the morning and from 1:00 to 5:00 in the afternoon.

Figure 3.3 Neijiang, Pingliang, Siping Technology, Songhe Park drinking water supply

(Source: author)

Each community park is equipped with at least one public restroom, and some community parks also have toilets in the tea house. The opening hours of the restroom are based on the opening hours of the park.

Figure 3.4 Neijiang, Yanchun, Pingliang, Songhe Park public restroom

(Source: author)

In 2014-2017, all community parks in Yangpu District will spend an average of 279,610 rmb per year on the water fee. The average annual expenditure per community park is 28,325.76 rmb. The annual water fee for most community parks with a scale of 1-2 hectares is about 15,000. Rmb; the annual water consumption of these community parks is basically stable, as shown in Table 3.1.

Table 3.1 Water Supply Cost of Yangpu District Community Park in 2014-2017 (Source: Yangpu Landscaping Construction Maintenance Co., Ltd.)

Year	Mingxing Park（rmb/rmb）	Huimin Park（rmb/rmb）	Boyang Park（rmb/rmb）	Neijiang Park（rmb/rmb）	Songhe Park（rmb/rmb）	Gongnong Park（rmb/rmb）	Pingliang Park（rmb/rmb）	Yanchun Park（rmb/rmb）	Fuxing Island Park（rmb/rmb）	Siping Technology Park（rmb/rmb）	Total（rmb/rmb）
2014	76811.1	28212.5	20040.22	12773.9	11757.16	58597.49	15617.5	33628.1	17401	10019.45	284858.42

2015	87709.9	22656.8	17566	17625.9	12175.64	58059.81	11580.4	41621.7	12344.73	-	281340.88
2016	91805.07	21239.46	21138.09	13674.1	14443.05	62828.85	15377.75	25439.63	9456.12	5937.11	281339.23
2017	87317.68	13943.31	15102.26	18917.6	12081.68	34605.26	14127	25526.76	10294	25250.44	257165.99
Average	85910.94	21513.02	18461.64	15747.88	12614.38	53522.85	14175.66	31554.05	12373.96	13735.67	279610.05

Taking 2016 as an example, the water consumption of all community parks in Yangpu District is as high as 57,063 m^3. In the four seasons, the average water consumption in summer and autumn is higher than that in spring and winter, mainly due to the need for tap water replenishment and increased water supply during the irrigation season.

Table 3.2 Water consumption of tap water in Yangpu District Community Park in 2016 (Source: author)

Month	Mingxing Park (m^3)	Huimin Park (m^3)	Boyang Park (m^3)	Neijiang Park (m^3)	Songhe Park (m^3)	Gongnong Park (m^3)	Pinglian g Park (m^3)	Yanchun Park (m^3)	Fuxing Island Park (m^3)	Siping Technology Park (m^3)
Jan	2089.14	496.55	357.88	206.98	186.59	1442.71	163.14	450.65	160.82	54.43
Feb	1789.37	319.12	226.35	219.20	202.90	1035.90	202.90	369.08	105.02	28.82
Mar	1543.67	299.76	326.27	190.67	187.59	970.65	242.65	451.69	160.08	147.29
Apr	1622.16	341.57	292.61	199.84	151.92	856.30	399.69	547.51	160.08	156.90
May	1439.39	358.90	310.98	190.65	236.55	1304.04	400.69	406.82	221.24	100.97
Jun	1594.63	328.31	304.86	242.67	262.04	1150.10	427.20	441.49	200.86	100.97
Jul	1290.80	361.22	385.41	229.41	245.62	1074.65	196.78	431.29	172.31	100.97
Aug	1373.41	373.18	617.89	307.92	202.91	1033.88	223.31	460.86	160.09	100.97
Sep	1776.13	403.76	531.21	349.72	255.92	1031.83	249.80	403.76	152.94	100.97
Oct	1291.82	485.33	367.05	260.00	574.03	976.77	214.11	390.50	141.72	117.41
Nov	1347.90	313.01	290.58	189.64	232.47	972.69	203.92	421.09	145.80	100.97
Dec	1577.31	253.88	302.82	203.92	209.02	972.69	214.11	417.01	148.86	100.97
Total	18735.73	4334.58	4313.90	2790.63	2947.56	12822.21	3138.32	5191.76	1929.82	1211.66

Rainwater is mainly used in the park for viewing pools, fountains and plant irrigation. The Stars Park, Songhe Park, Neijiang Park, Fuxing Island Park, and the fountains or viewing pools in the Poyang Park are mainly composed of rainwater and tap water. Plant irrigation in all parks consists of rainwater and tap water, respectively.

Figure 3.5 Neijiang Park Viewing Pool (Source: Author)

The observation pool is connected to the city canal, and when the water level is full, the pool water will be released into the city canal. The parks close to the city canal are Siping Science Park, Songhe Park, and Fuxing Island Park. The water is not used in the park.

Figure 3.6 Yangshupu Port next to Songhe Park (Source: author)

3.1.3 Summary of water use in community parks

The size and layout, staff composition and operational management of community parks in Yangpu District are similar. In terms of water services, the types of services are abundant, and at the same time, the park has a greater dependence on the use of tap water. All water service projects involve tap water and the annual water fee is high. In addition to the observation pool and the fountain can collect rainwater, other groundwater loss is more serious. At the same time, the park's wastewater is not recycled, and all wastewater is dumped into the sewage pipeline.

Songhe Park is one of the community parks in Yangpu District. Its water service type includes all the types that appear in these community parks and is more representative in the study of water service systems. This paper selects Songhe Park for in-depth research.

3.2 Overview and characteristics of Songhe park and surrounding communities

3.2.1 General situation and features of songhe park

Songhe Park belongs to Siping Road, Yangpu District. Siping Road covers an area of 2.75 square kilometers and has a population of about 96,000. It accounts for 8.81% of Yangpu District's population[48]; among them, 10.7% under 18 years old, 35.2% at 18-35 years old, 35- 60 years old accounted for 29.1%, 60 years old and above accounted for 25%. There are 23 neighborhood committees and 70 communities in the district jurisdiction, as well as various agencies, institutions, enterprises and colleges. The community represents a large proportion of the community retired elderly, administrative and management personnel, knowledge and technology. The characteristics of diverse components such as personnel, students and migrant workers.

The streets of Siping Road are characterized by a severe aging community. The elderly over 60 years old account for 25% of the total, but at the same time, the population quality and community civilization are relatively high. There are excellent educational resources such as Tongji University and Yangpu High School. The tertiary education has a population of 39%[49]. Siping Road has won the title of several national and municipal civilized community units. In 2017, 10 communities won the 2015-2016 Shanghai Civilized Community[50]. Siping Road Street integrates community unit resources to provide lectures or training for community residents. At the same time, it also has community micro-renewal projects in cooperation with Tongji University's School of Design and Innovation, such as Siping Space Creation, to promote the vitality

48 Shanghai Yangpu District People's Government. Yangpu District Zhi--The first [EB/OL].http://www.shyp.gov.cn/shyp/zjyp-ypqz/20171020/34043.html, 2011- 10-19, 2018-03-24.
49 Yangpu Times. “Gold Ideas” Transformation Creates “Boutique Siping” [EB/OL]. http://www.yptimes.cn/html/2016-08/09/content_3_1.htm, 2016-08-09 / 2018-04-18.
50 Shanghai Civilization Network. 2015-2016 Shanghai Civilized Community, Civilized Village [EB/OL].http://sh.wenming.cn/2017grc/201704/t20170417_4186030.htm, 2017-04-18 /2018- 04-18.

and cultural development of the community. In the health and sports undertakings, it also fully meets the needs of community residents and outsiders.

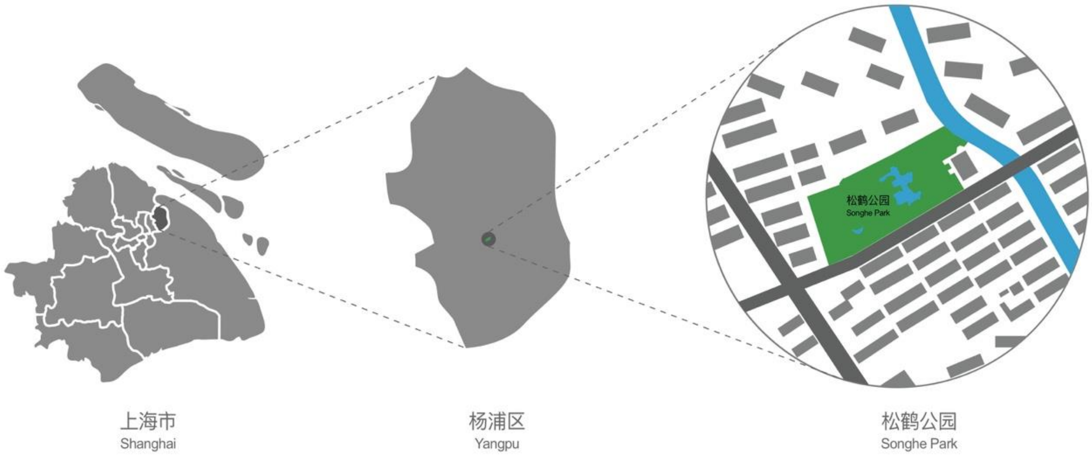


Figure 3.7 Songhe Park location (Source: author)

Songhe Park is located at No. 240 Fushun Road, near the northeast of the intersection of Tieling Road and Fushun Road. It is adjacent to the dormitory apartment of Tongji University Zhangwu Campus in the north, Yangshupu Port in the east, and the 90 Tieling Road in the west. The cell, as shown in Figure 3.8.

Figure 3.8 Map of Songhe Park (Source: author)

Songhe Park was opened to the public in October 1986. Covering an area of 1.4 hectares, the park is a traditional Jiangnan courtyard style, mainly composed of green spaces, water bodies, building facilities and road floors. In July 2008, the Yangpu District Government re-planned the layout of the park according to the needs of the residents in the surrounding communities of the park, added an activity fitness area, and deployed a rich variety of plants. The green area of Songhe Park is 8400m2, accounting for 60% of the total park area; the central viewing pool area is 1300m2, and the fountain area is 50m2 (source: Yangpu Landscaping Construction Maintenance Co., Ltd., 2017).

Figure 3.9 Overview of Songhe Park (Source: author)

In addition to providing scenic views, event venues and facilities, the park also provides a number of functional services for the convenience of the public, such as reception tea house, public restroom, drinking water supply, strollers and wheelchairs, sewing kits, crutches, umbrellas, convenience medical kits, maps and newspapers; Wednesday, the park director's reception day is held, and visitors are provided with green maintenance knowledge consultation services.

The author visited Songhe Park on the spot, surveyed 102 visitors in the form of questionnaires and interviews; interviewed the director of Songhe Park and two on-duty staff and tea house administrators in the form of an outline interview; Shanghai Yangpu Landscaping Construction Maintenance Community park management staff in the office of the limited liability company; Yangpu garden workers obtained the basic information, water related materials, park management and residents' opinions of Songhe Park.3.2.1 Overview and characteristics of Songhe park.

松鹤公园 2017年 3 月游人量表

日 期	人数	日 期	人数	日 期	人数	日 期	人数
1	2810	9	2945	17		25	
2	1645	10	3203	18		26	
3	1987	11	3252	19		27	
4	3045	12	3014	20		28	
5	1650	13	2819	21		29	
6	2853	14	2959	22		30	
7	1721	15		23		31	
8	2672	16		24			

Figure 3.10 Songhe Park Tourists (Source: author)

According to the survey statistics, Songhe Park has an average of 2,617 people entering the park every day, and the average number of people in the park during the opening hours is 225. The ratio of men to women is basically balanced, and overall men are slightly more than women. The age structure of the Songhe Park tourist population and the age structure of the resident population in Yangpu District are basically similar, mainly to the elderly. The 65-year-old has the most upstream population, accounting for 34.31%; followed by the 50-65 age group, accounting for 27.45%, as shown in Figure 3.11. The smaller the age group, the smaller the proportion. The population under the age of 18 is basically a child-oriented group, and they are accompanied by parents to play in the park.

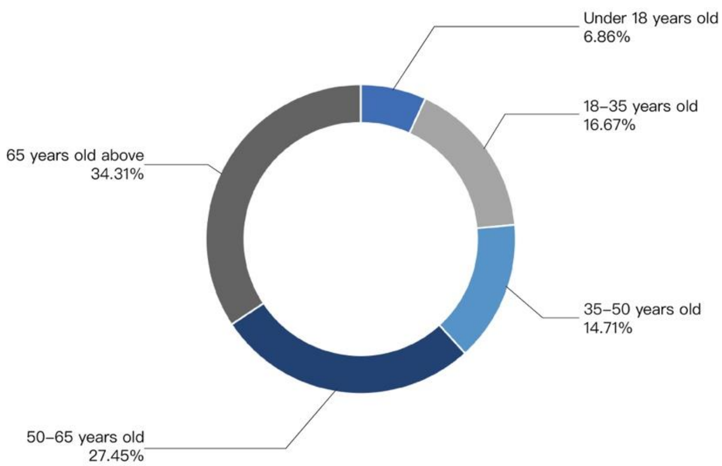


Figure 3.11 Proportion of age structure distribution of tourists in Songhe Park

(Source: author self)

In the occupational distribution of tourists in Songhe Park, workers, corporate clerks and intellectuals accounted for more than 80% of the occupations and retired people, of which workers accounted for the most, accounting for 29.41%, as shown in Figure 3.12. The tourists in the park have a high overall cultural quality.

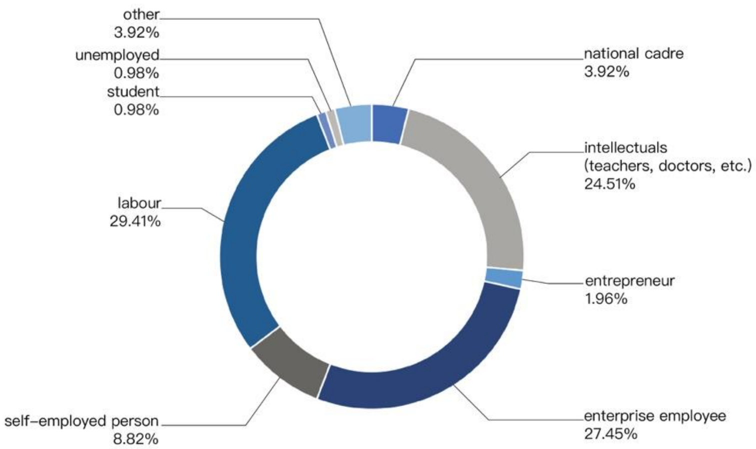


Figure 3.12 Proportion of occupational distribution of tourists in Songhe Park (Source: author self)

88.24% of the visitors came from Yangpu District. The largest proportion of tourists is the two households with more households near the park. The 50th district of Tieling Road opposite the park accounts for 24.51%; the other residential area of Anshan Sancun, which is diagonally opposite the park, accounts for 13.73%. The 90th and 110 Tieling Road next to the park accounted for 11.76% and 9.8% respectively, as shown in Figure 3.12. The distribution of tourist addresses reflects that the residents of Songhe Park are mainly composed of surrounding residents; the more residential places are located near Songhe Park, the more tourists there are in the residential areas with more households.

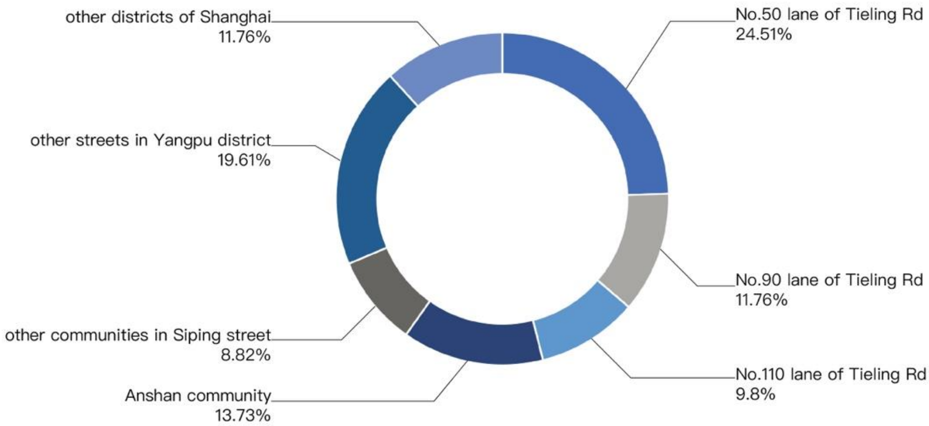


Figure 3.13 Proportion of the address of tourists in Songhe Park (Source: author)

In addition to special circumstances (rainy days, etc.), 64.71% of visitors come to Songhe Park at least once or more every day. The daily time and activities are relatively fixed. More than half of the tourists come to the park every morning and afternoon. Take a walk. 13.72% of visitors come to the park two or three times a week, and 6.86% of visitors come to the park once a week or choose to come to the park on weekends, as shown in Figure 3.13. Visitors stay in the park mainly in 0-half hours, accounting for 30.39%, 19.61% of visitors stay in the park for half hour, 1-2 hours account for 20.59%. The longer visitors stay, the fewer visitors park have.

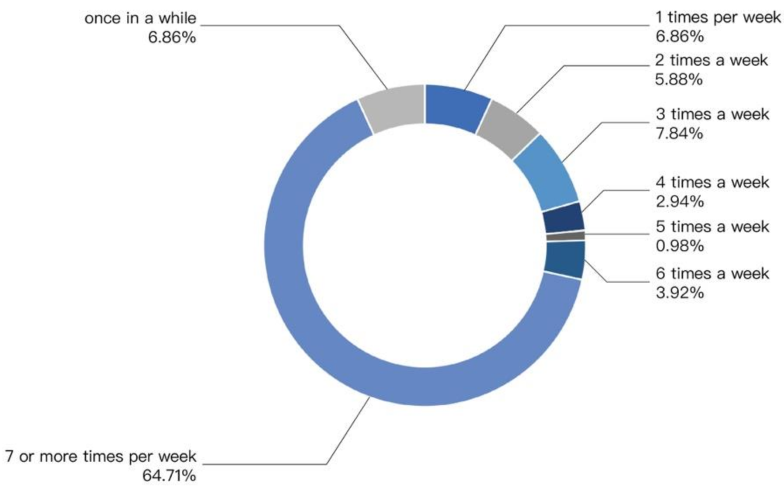


Figure 3.14 Proportion of the number of visits to the park in Songhe Park (Source: author)

The activities of tourists in Songhe Park are mainly walking, chatting, enjoying the scenery, accompanying children, drinking drinking water and using public restrooms, as shown in Figure 3.15. In the water service activities, 39.22% of tourists come to Songhe Park to get free drinking water, 67.73% of tourists use public restrooms, and 5.88% of tourists visit the park tea house.

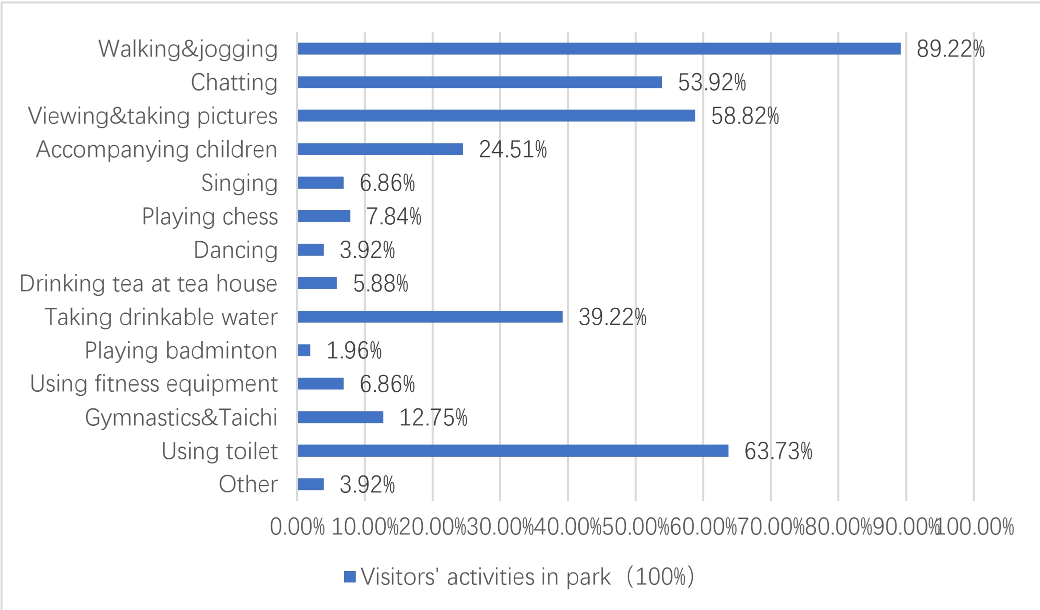


Figure 3.15 Songhe Park tourist activities composition (Source: author)

3.3 Investigation on the current situation of various water services in Songhe park

This section provides a detailed survey of the various water services in Songhe Park. A detailed analysis of the types of water services, the types of water use, the quantity and quality of water, and the current status of water services.

3.3.1 Overall situation of water service

In the water service, Songhe Park mainly provides services such as public restrooms, drinking water supply, tea house, viewing pool and fountain for viewing and storage, drainage, and plant irrigation. In the use of water, Songhe Park mainly uses tap water and rainwater. Rainwater mainly serves the water body supplementation of the viewing pool and plant irrigation. Tap water mainly serves tea houses, drinking water supplies, public restrooms, plant irrigation, and water replenishment of viewing pools and fountains. The average annual tap water cost of Songhe Park is 12,614.38 rmb. The research time of this case is from September 2017 to February 2018. To ensure the integrity of the data research, the research data of this case is the water related data of Songhe Park in 2016.

In 2016, the annual water consumption of Songhe Park was 2,947.56 m^3, and the water fee was 14,443.05 rmb (source: Yangpu Landscaping Construction Maintenance Co., Ltd., 2017). Among them, the water consumption of tap water in public restrooms accounts for about 50% of the total, the water consumption of plant irrigation tap water accounts for 27.58%, and the drinking water supply accounts for 7.4%, as shown in Figure 3.16.

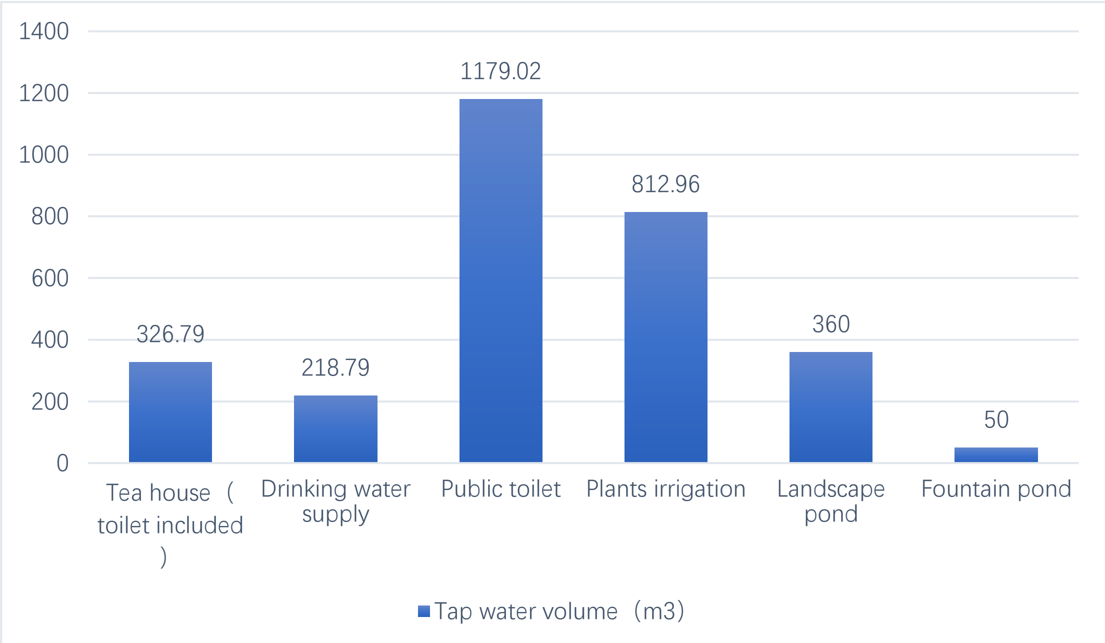


Figure 3.16 Water consumption of tap water for various services in Songhe Park in 2016

(Source: author)

In terms of seasonal water consumption, Songhe Park uses more water in spring and autumn than in spring and winter, as shown in Figure 3.17. Among them, the annual water consumption is the most, with a monthly average of 354.14 m^3; the spring water consumption is the least, and the monthly average is 192.02 m^3. On the one hand, due to the special situation in October, the monthly average value was increased; on the other hand, the increase in the water consumption of tap water was mainly related to the weather. In the summer and autumn, the highest temperature in Yangpu District is above 38 °C, and the water demand for plant irrigation and tap water supply increases.

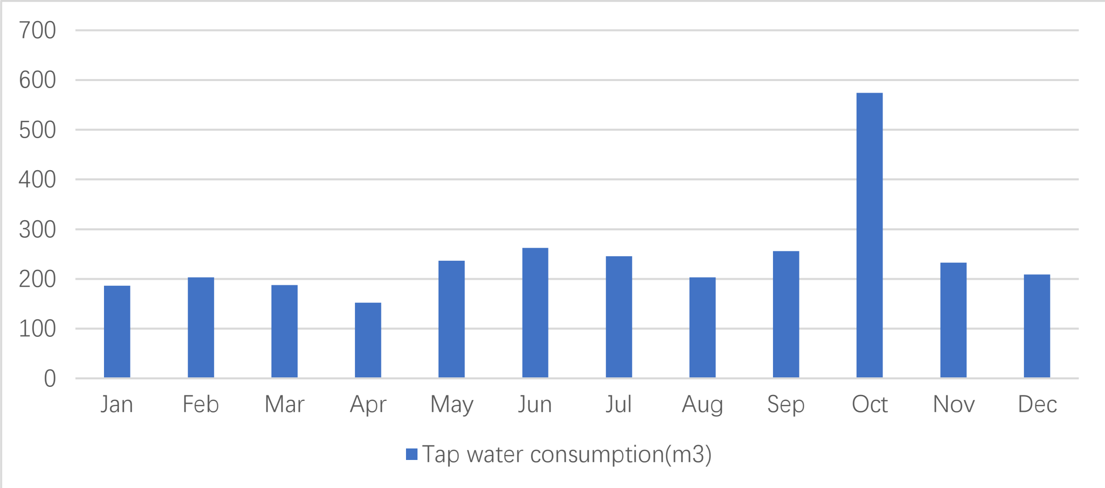


Figure 3.17 water consumption per month in songhe park in 2016

(Source: yangpu landscaping construction and maintenance co., LTD)

Figure 3.18 shows that the water consumption of Songhe Park in October is higher than that of other months. This is due to the change of pool water in the observation pool in the park. The increase is about 360 m^3, and the normal month. The water consumption should be between 200-300m^3, as shown in Figure 3.17. Comparing the water consumption of tap water in Songhe Park from 2014 to 2017, it is found that the monthly water consumption is more balanced every year; the water consumption from May to November is higher than other months, mainly due to seasonal water use.

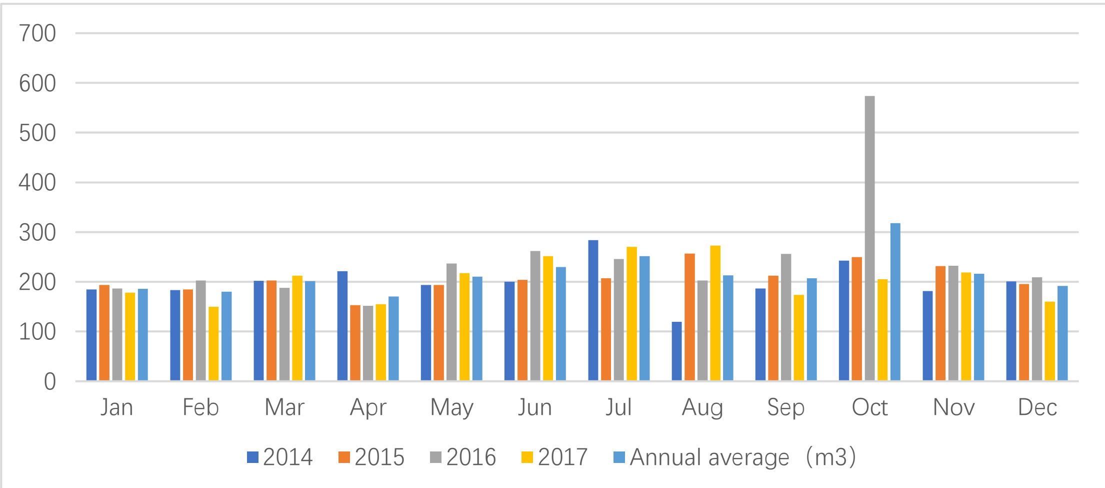


Figure 3.18 Water consumption statistics of tap water in Songhe Park in 2014-2017(Source: Yangpu Landscaping Construction Maintenance Co., Ltd.)

In terms of rainwater utilization, the main rainwater utilization in Songhe Park is the observation pool, fountain and plant irrigation. The viewing pool and fountain have the function of storing rainwater. Rainwater utilization is also reflected in plant irrigation. As a major source of water for park plants throughout the year, rainwater plays an important role.

On the drainage, the park's wastewater is mainly discharged to the sewage and rainwater pipelines and the Yangshupu Port. Part of the park's surface drainage (including rainwater and tap water) is evaporated and another part flows into the rainwater pipeline. Wastewater generated during the operation of public restrooms, tea houses and drinking water supplies is mainly discharged into sewage pipes. The water in the observation pool consisting of rainwater and tap water, when the water level exceeds the warning line, the pool water will flow to the overflow, and the overflow pipe will be drained to the Yangshupu Port on the east bank of the park. In the utilization of wastewater, Songhe Park has no interception wastewater and is recycled.

3.3.2 Investigation of drinking water supply water service

Park guards are on duty to provide free drinking water to visitors daily from 6:30 to 11:00 and from 1:00 to 5:00 pm. In the input of drinking water services, there are mainly tap water, mainly used for boiling water and cleaning. In 2016 (366 days), the supply of drinking water in Songhe Park was 216.96 m^3. According to the survey, the drinking water bucket is 0.03 m^3, the average daily demand is 25 barrels in the summer, and the average demand in other seasons is 18 barrels. Cleaning water is also used during the operation of the drinking water supply. According to the survey, the average daily use of clean water is 0.005m^3, which is 1.83m^3 for the whole year.

On the output, there are mainly drainage, residual water and tea slag that falls from tourists. On the drainage, the operation of the drinking water supply mainly produces clean drainage and residual water as well as tea residue. The clean drainage produced during the operation of the free drinking water supply in 2016 was approximately 1.83 m^3, and these drainages were flowed into the sewer line. In terms of residual water, the tourists poured the discarded tea into the waste water bucket, about 4 barrels per day, an average of about 15L per barrel, and the total amount reached 21.96m^3; the remaining water was poured into the nearby rainwater pipeline; About 0.1 kg of tea residue was produced, and the total amount was about 36.6 kg throughout the year.

Figure 3.19 Songhe Park drinking water supply (Source: author)

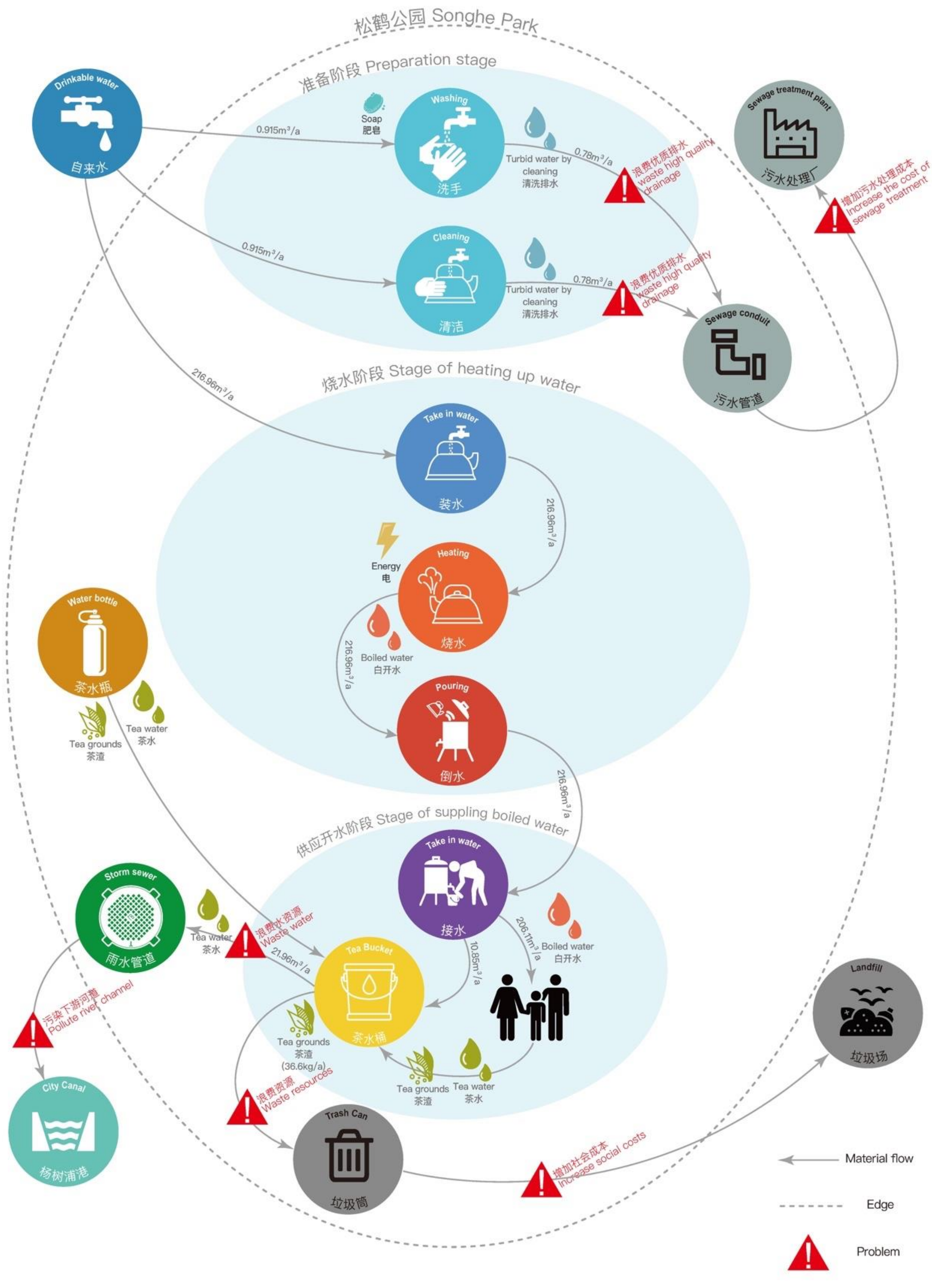


Figure 3.20 Analysis of the status quo of drinking water supply service in Songhe Park (Source: author)

3.3.3 Investigation of tea house water service

The tea house is located on the west bank of the viewing pool and has an area of 150 square meters. The tea house is open daily from 6:00-11:00 am. The tea fee is 2 rmb per person. In 2016, Songhe Park drinks about 40 guests a day. In the tea house water service input, the tea house mainly inputs tap water and tea and related detergents. On the output, there are mainly tea residue, residual water and drainage.

Figure 3.21 Songhe Park Tea house (Source: author)

Tea house water is mainly used in boiling water, teacup disinfection and cleaning, site cleaning and tea house restrooms. The following is a detailed analysis of water consumption.

(1) boiling water

The volume of the kettle in the tea house is $0.005m^3$; the average number of water boiling in the tea house is 10 times per day; the water consumption in the tea house every day is:

$$0.005\times10=0.05m^3$$

(2) Disinfection of tea sets

Tea utensils are sterilized by adding water to the disinfection tank and soaking the teacup. The disinfection tank water is replaced once every two days. The size of the disinfection tank is 0.3m×0.50m×0.20m, and the height of each discharge water is 0.10m. The average disinfection water is:

$$0.30\times0.50\times0.10=0.015m^3$$

Average daily disinfection water:

$$0.0015\div2=0.0075m^3$$

(3) Tea set cleaning

The teacup cleaning water is mainly used for flushing the teacup after disinfection. The average water consumption for cleaning a cup is about 0.0005m^3, and the average number of people using the tea house cup per day is half of the number of people drinking tea. Under the average of 40 guests per day, there are 20 Teacups are used, and the cleaning water is about:

$$0.0005\times20=0.01\ m^3$$

(4) Site cleaning

The tea house is cleaned on the floor, tabletop, etc. before closing every day. On average, two barrels of 10L tap water are used per day, for a total of 0.02 m^3.

(5) Tea house Toilet

In 2016, the water consumption of the public restroom in the tea house was 294.76m^3, of which the water for flushing was 221.07 m^3, the water for washing hands was 58.95m3, and the water for toilet and floor cleaning was 14.74m^3.

(6) Annual water consumption of tea house tap water

Tea house tap water annual water consumption = boiling water + teacup disinfection water + tea set cleaning water + site clean water + tea house washroom water.

$$(0.05+0.0075+0.01+0.02)366+294.76=326.79m^3$$

Figure 3.22 Analysis of the current status of the water service of tea house in the Songhe Park (Source: author)

3.3.4 Investigation of public toilet water service

There are three public washrooms in Songhe Park, which are located at the entrance to the park, in the park and in the tea house. The entrance and the public restroom in the park are located in the same building, and the tea house restroom is in the tea house. In order to facilitate the division of water service processes in the system, in this study, it is divided into park restrooms and teahouse restrooms. The water usage of the teahouse toilets is attributed to the tea house water system, and the water usage of the entrance and the public restrooms in the park are studied together and collectively referred to as the park restroom.

Figure 3.23 Songhe Park Toilet (Source: author)

According to Yangpu Landscaping Construction Maintenance Co., Ltd., the annual water consumption of the toilets in the park and the tea house accounted for about 50% of the total; in 2016, the total water consumption in the restrooms and teahouses of the park was 1473.78m^3, of which the water consumption in the park toilets accounted for 80%, tea house washroom accounts for 20%. The water used in public restrooms mainly includes flushing water, hand washing water, toilet seats and floor cleaning water. In the on-site participatory diagnostic survey, it was found that the proportion of water used in public toilets accounted for about 75% of flushing toilet water, 20% of hand washing water, and 5% of toilet seat and floor cleaning water.

Water consumption in the park restroom:

$$1473.78\times 80\% = 1179.02\text{m}^3$$

Tea house washroom water consumption:

$$1473.78\times 20\% = 294.76\text{m}^3$$

According to the “Code for Design of Water in Buildings” (GB50336-2002), in the domestic water, the water supply of the recyclable project is 100%, and the loss of 15% is removed, and the general displacement is 85%; this study is for Songhe Park and The discharge of recyclable items in the residential waters of the community (except plant irrigation) is calculated in accordance with 85% of the water supply.

The displacement of the public restroom is calculated as 85% of the water supply. It is concluded that the displacement of the toilet in the park and the restroom of the tea house are 1002.17m^3 and 250.55m^3 respectively.

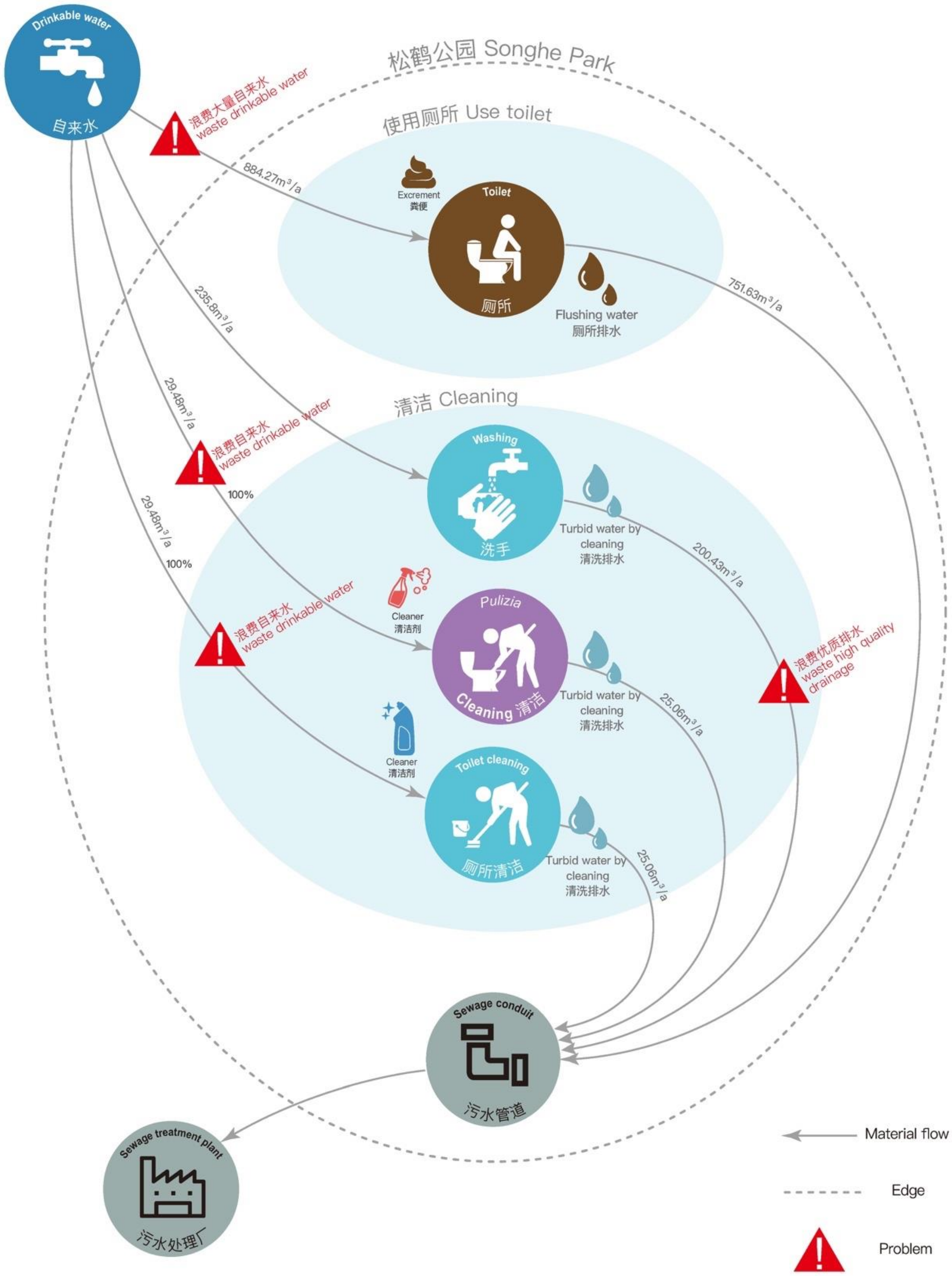


Figure 3.24 Analysis of the current status of the water service of public toilets in the Songhe Park

(Source: author)

3.3.5 Investigation of water treatment in fountains

The fountain is located at the entrance of the park with an area of 50 m^2, a water depth of about 0.5 m and a water storage capacity of about 25 m^3 (source: Yangpu Landscaping Construction Maintenance Co., Ltd., 2017). The fountain mainly provides visitors with a view of the flowing water landscape. The water in the fountain is composed of rainwater and tap water. When the water level exceeds the warning height, the water will flow into the overflow at both ends of the fountain. The overflow will drain the water to the Yangshupu Port (city canal) next to the park. The park replaces the pool water for the fountain twice a year. The garden maintenance staff removes the old pool water by pumping the water, cleans the mud at the bottom of the pool, then connects the tap water source irrigated by nearby plants, and drains the tap water to the fountain with water pipes. About 50 m^3 of tap water is used. In terms of rainwater harvesting, the 2016 rainwater harvest in the Yangpu District was calculated to be 82.46 m^3 in 2016. In the output, the fountain is mainly composed of wastewater and sludge, and the two are not used in the park.

Figure 3.25 Songhe Park fountain (Source: author)

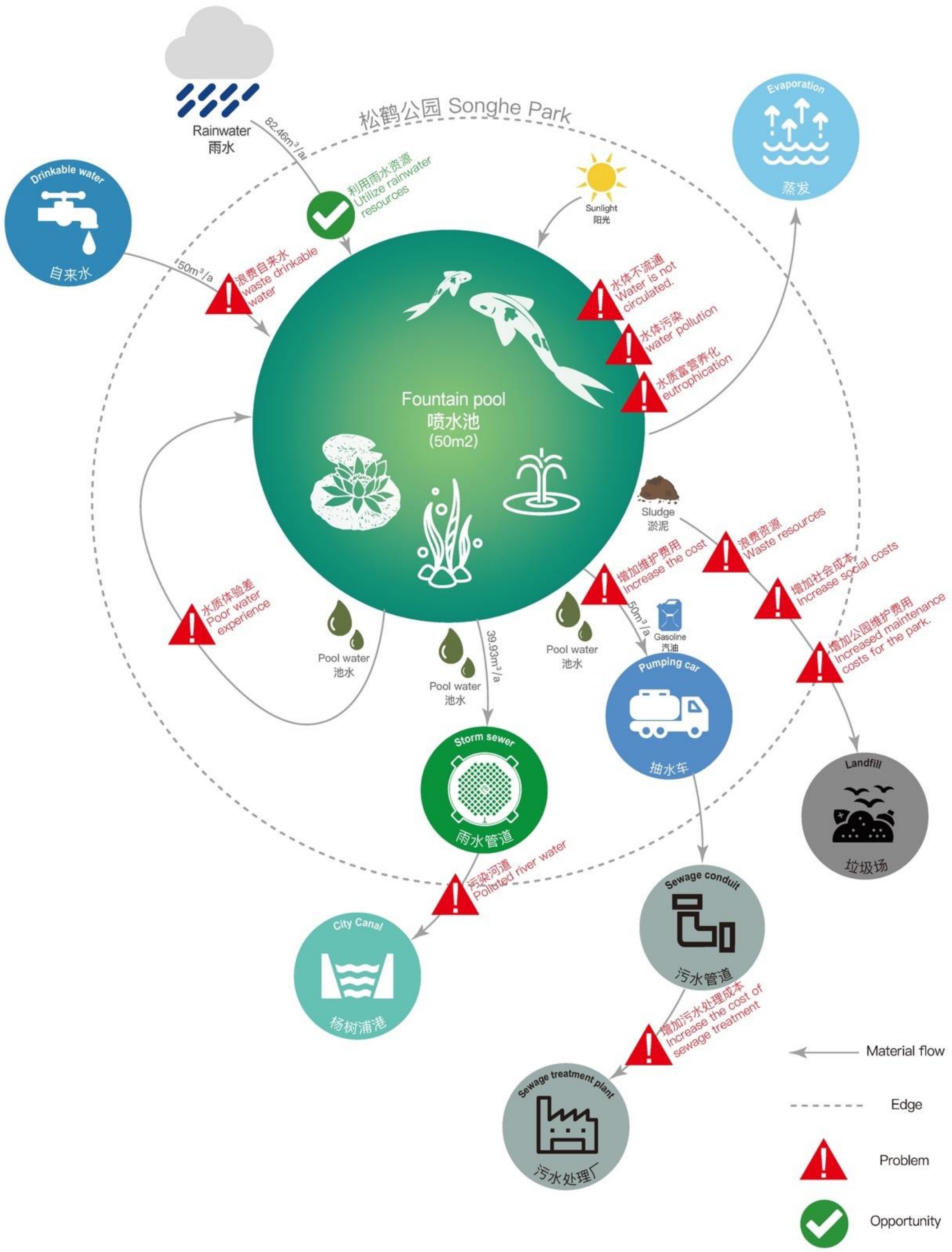


Figure 3.26 Analysis of the current status of the water service of the fountain in Songhe Park (Source: author)

3.3.6 Investigation of the viewing pool water service

The viewing pool is located in the center of Songhe Park, with an area of 1,300 m^2, a water depth of 0.6-0.9 m, an average water depth of 0.75 m and a water storage capacity of approximately 975 m^3 (source: Yangpu Landscaping Construction

Maintenance Co., Ltd., 2017). The viewing pool mainly provides visitors with ornamental water and aquatic landscape services. The water in the observation pool consists of rainwater and tap water. When the water level exceeds the warning height, the pool water will flow into the overflow, and the overflow pipe will discharge the water to the Yangshupu Port next to the park. From time to time, the park will clean the mud and green algae at the bottom of the pool and replace the pool water. The turbid pool water will be pumped out by the pump, and the sludge at the bottom of the pool will be cleaned and the tap water will be put into clear water. In 2016, the tap water of the observation pool will be about $360m^3$. Based on the annual precipitation of 1649.1mm in Yangpu District in 2016, the rainfall collection in the observation pool in 2016 was 2143.83 m^3. More than 2000 m^3 of drainage per year is flown to Yangshupu Port, accompanied by water pollution. The observation pool is close to the tea house. During the investigation, it was found that some tea and tea and household garbage would be dumped into the viewing pool.

Figure 3.27 Songhe Park Observation Pool (Source: author)

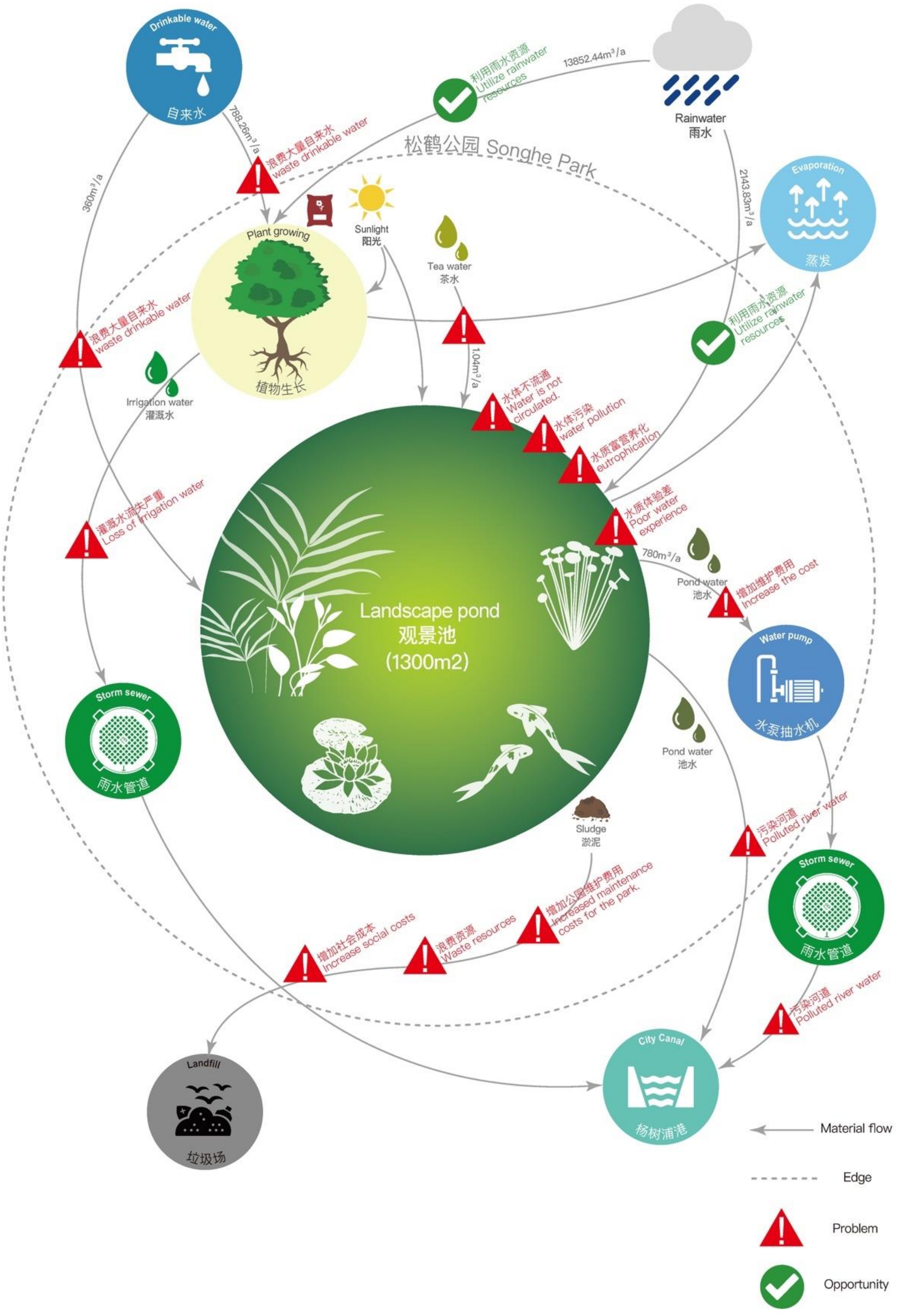


Figure 3.28 Analysis of the current status of the water service of Observation Pool in Songhe Park (Source: author)

3.3.7 Investigation of plant irrigation water service

In the plant irrigation water service, the water is input with rainwater and tap water. On the water output, a small part of the drainage is flown into the rainwater pipeline; on the water output, the water is basically not wasted and wasted. The main problem with plant irrigation is the dependence on tap water.

Figure 3.29 Plant irrigation in Songhe Park (Source: author)

(1) Rainwater irrigation

The green area of Songhe Park is 8400 m^2, calculated based on the annual precipitation of 1649.1 mm (1.6491 m) in Yangpu District in 2016. The irrigation amount of rainwater is:

$$8400\times1.6491\approx13852.44m^3$$

The annual rainwater irrigation capacity of Songhe Park is about 13852.44m^3.

(2) Tap water irrigation

There are 5 tap water irrigation interfaces in Songhe Park distributed in the garden. The tap water is sprayed on the plants by the garden maintenance personnel in the form of water pipes. Due to the uncertainty of the number and number of tap water irrigation days, the annual irrigation water volume of tap water is difficult to calculate directly, but it can be calculated by the exclusion method. Firstly, the water activities that are not affected by the season are excluded: water in the tea house, water in the public restroom, water in the observation pool and fountain, and then the water activities affected by the season - free drinking water supply, and the last tap water is the irrigation of tap water plants. the amount:

$$2947.56-50-360-1179.02-218.79-326.79=812.96\ m^3$$

In 2016, the amount of tap water irrigation in Songhe Park was 812.96 m^3.

This study makes a data projection to prove the accuracy of the irrigation plant value. From Yangpu Landscaping Construction Maintenance Co., Ltd. and Songhe Park, in 2016, Songhe Park mainly used tap water to supplement the irrigation amount of 800 m^3; the irrigation season was mainly concentrated in summer and autumn; the month involved in irrigation was February and March and from May to November. The number and number of irrigation days per month in Songhe Park are uncertain, depending on the meteorological conditions at that time. Songhe Park is irrigated on average from one to two times a week between May and November, except for rainy days; in July and August, it is almost necessary to irrigate every day; in addition, there will be appropriate supplementary irrigation in February and March.

In addition to the above-mentioned estimated amount of tap water irrigation in Songhe Park in 2016, the remaining water service activity in 2016 was 2134.6 m^3, and the average monthly water consumption was 177.88 m^3. The month without tap water irrigation in 2016 (January, April) In December, the average water consumption is 182.51 m^3, which is close to the monthly average water consumption except for the preliminary inferred tap water irrigation water. The error rate is 2.6%, which has certain reference value. It is concluded that the data of the tap water irrigation amount of 812.96 m^3 in 2016 is basically accurate.

3.4 Investigation on the current situation of various water services in surrounding communities

After investigating the current status of various water services in Songhe Park, the status of water services in the community buildings around Songhe Park will be investigated. The purpose of the survey of various water services in the community buildings around Songhe Park is to understand the current situation of water services around the park, analyze the existing problems and opportunities, and find an optimization plan for the establishment of Songhe Park water services from a broader perspective.

A large number of residential buildings in Yangpu District were built in the 1920s. In the 1950s, a new residential area was planned between Jiangjiang Road and Gompang (Shanghai Yangpu District People's Government, 2011). The style was new style; by the labor at that time Model and advanced producers took the lead in living in a new home. Songhe Park was built in 1986 and was awarded the National Greening Advanced District in the same year. From 1992 to 1993, the surrounding communities of Songhe Park were built one after another. The 6-storey garden residential community became the new style at that time. The community is close to Songhe Park. The combined layout is formed at this time.

The author conducted research on three communities around Songhe Park, namely, 50, 90 and 110 of Tieling Road. These three communities are the shortest distance from Songhe Park and have a close interaction with Songhe Park. The feasibility of further design is high. It should be mentioned that the southwest direction of Songhe Park is the residential area of Anshan Sancun. In the survey of Songhe Park tourists, 13.73% of the tourists live in the community. Due to the district is separated from Songhe Park by a distance, the design is not as good as the 50, 90 and Tieling Road, so no further research is done. To the north of Songhe Park is the student apartment of Zhangwu Community of Tongji University. However, because the student apartment and Songhe Park are not connected to each other, and the interaction with Songhe Park is weak, no further research on the student apartment is made.

3.4.1 Investigation on the current situation of building water service in the NO. 50, 90 and 110 Tieling road

The 50 Tieling Road belongs to the Jiangjiang Road, which has 1,250 households in 2017. The streets of Siping Road, which belong to the 90 and 110 Tieling Road, are 360 and 300 households in 2017 respectively. The following is a survey of household water use information in the three communities.

In the household statistics, the average number of households per household is about 2.87, and the number of households with 1-3 is 71.43%, as shown in Figure 3.30. According to the household statistics of the residents' neighborhood committees of 50 and 90 Tieling Road, there are more elderly families, and the number of households aged 60 or above in the three lanes accounts for about 60%. Family monthly income is generally between 4000-8000, as shown in Figure 3.31.

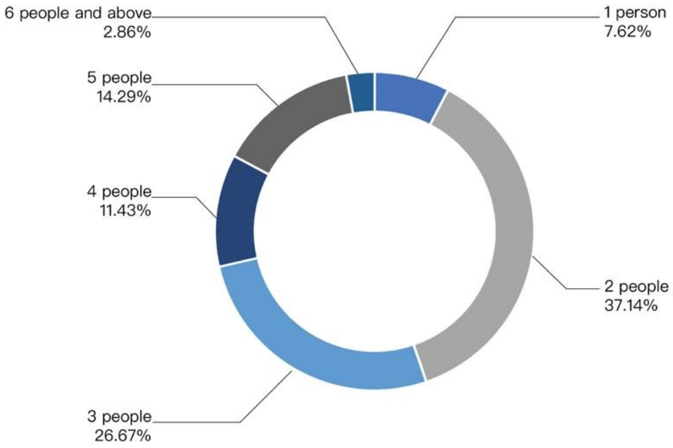


Figure 3.30 Proportion of the number of households in the 50, 90, and 110 of Tieling Road (Source: author)

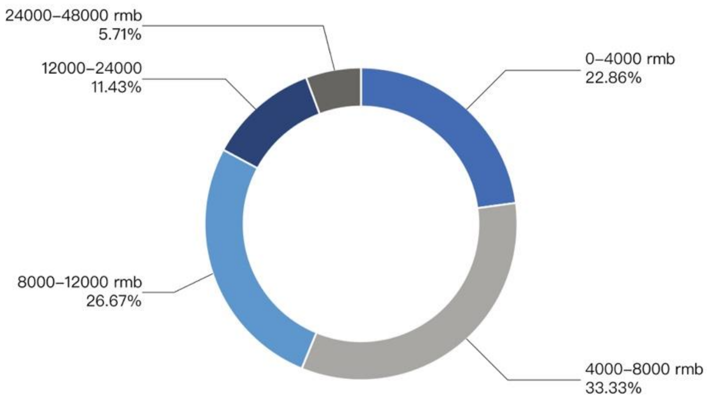


Figure 3.31 The monthly income of the family in the 50, 90, and 110 of Tieling Road (Source: author)

The average monthly water fee for the three-zone households is 38.86 rmb; the monthly average water fee for 29.52% of households is about 40 rmb, as shown in Table 3.3. The survey found that the lower the number of households, the lower the water fee, and the older the family, the lower the water fee. 59.05% of the households have a habit of saving water, and the households of 19.05 have a very good habit of saving water. Residents achieve water conservation in terms of total water use, use of more water, and some tips.

Table 3.3 Statistics on tap water charges for residents of 50, 90, and 110 villages on Tieling Road (Source: author)

Selection	Total	Percentage
Around 10 rmb	6	5.71%
Around 20 rmb	12	11.43%
Around 30 rmb	18	17.14%
Around 40 rmb	31	29.52%
Around 50 rmb	28	26.67%
Around 60 rmb	10	9.52%
The number of valid entries for this question	105	

Through the statistics of the number of households, water price and annual water fee, it is concluded that the annual average water consumption per household in the 50, 90, and 110 Tieling Road is 135.17m^3, as shown in Table 3.4. According to the average number of households per household, the per capita annual water consumption is 47.1m^3, which is slightly lower than the national standard (GB50336-2002). The per capita annual water consumption reference range is 54.75~69.35m^3. The main factor contributing to this result is the large proportion of households over the age of 60 and the low water consumption.

Table 3.4 Study on water consumption of tap water in residential areas of 50, 90 and 110 in Tieling Road (Source: author)

Type	50 Tieling Rd	90 Tieling Rd	110 Tieling Rd
Households	1250	360	300
Number of households aged 60 or above	775	209	165
Number of households aged 60 or below	475	151	135
Comprehensive water price （rmb/ m³）	3.45		
Annual water fee（rmb）	466.32		
Annual average water consumption （m³/household·per year）	135.17		
Tap water consumption (m³/year)	168962.5	48661.2	40551
Note: The number of households in residential areas is changing dynamically throughout the year, and the data collection time is November 2017. The jurisdiction of the residents' committee of 90 Tieling Road includes the 90, 110, and 120. The number of households in the 110 community is provided by the 90 residents' neighborhood committee.			

The main water categories for the three plots are flushing, cleaning, kitchen and diet, showers, washing, laundry and cleaning, and watering. Among them, showers, laundry and cleaning, kitchen and food and water consumption ranked the top three in the category of household water consumption.

According to the national standard “Water Design Code for Buildings” (GB50336-2002), it is found that the proportion of residential water used in the general household is the shower, laundry and flushing water, as shown in Table 3.5. The categories of residential water consumption in the 50, 90, and 110 Tieling Road are similar to those of national standards.

Table 3.5 Domestic water consumption and percentage of residential buildings
(Source: National Standard "Design Code for Water in Buildings" (GB50336-2002))

Type	Residential buildings	
	Water volume（L/person·d）	（%）
Flushing the toilet	32～40	21.3～21
Kitchen	30～36	20～19
Showering	44～60	29.3～32
Washing	10～12	6.7～6.0
Laundering	34～42	22.6～22
Total	150～190	100
Note: Showering include bathtubs and showers		

The percentage of water consumption in each category of the three lanes cannot be accurately calculated due to lack of specific calculations but can be provided according to the national standard “Water Design Code for Buildings” (GB50336-2002). Combined with the household survey statistics, as shown in Table 3.6.

Table 3.6 Statistics on water consumption of various activities of residents in the 50, 90, and 110 Tieling Road (Source: author)

Type		50/90/110 Tieling Rd	
		Water consumption（m^3/household·per year）	（%）
Flushing the toilet		27.55	21
Kitchen		24.92	19
Showering		38.04	29
Washing		7.87	6
Cleaning	Laundering	22.3	17
	Sweeping	7.87	6
Other（Watering flowers）		2.62	2

Total	131.17	100
Note: Showering include bathtubs and showers		

In the displacement statistics, according to the reference value of the national standard (GB50336-2002): 85% of the water supply and make some adjustments to the actual situation of the 50, 90, 110 community of Tieling Road. Kitchen water contains non-recyclable items: dietary water; kitchen displacement is calculated by multiplying the kitchen water consumption by 20% of the dietary water by the drainage rate. Other (watering flowers) water is not in the category of recyclable items, so no drainage statistics are available.

It is calculated that the drainage volume of the 50, 90, and 110 Tieling Road is sufficient, and the annual average drainage volume is 20,6720.5 m^3, as shown in Table 3.7.

Table 3.7 Statistics on the displacement of various activities of residents in the 50, 90, and 110 Tieling Road (Source: author)

Type		50/90/110 Tieling Rd		
		Displacement （m^3/year）	Drainage percentage （%）	The percentage of water consumption （%）
Flushing the toilet		46084.19	85	21
Kitchen	Non cooking	28528.3	85	13
	Cooking	-	-	6
Showering		63640.07	85	29
Washing		13166.91	85	6
Cleaning	Laundering	37306.25	85	17
	Sweeping	13166.91	85	6
Other（watering flowers）		-	-	2
Total		206720.5	-	100

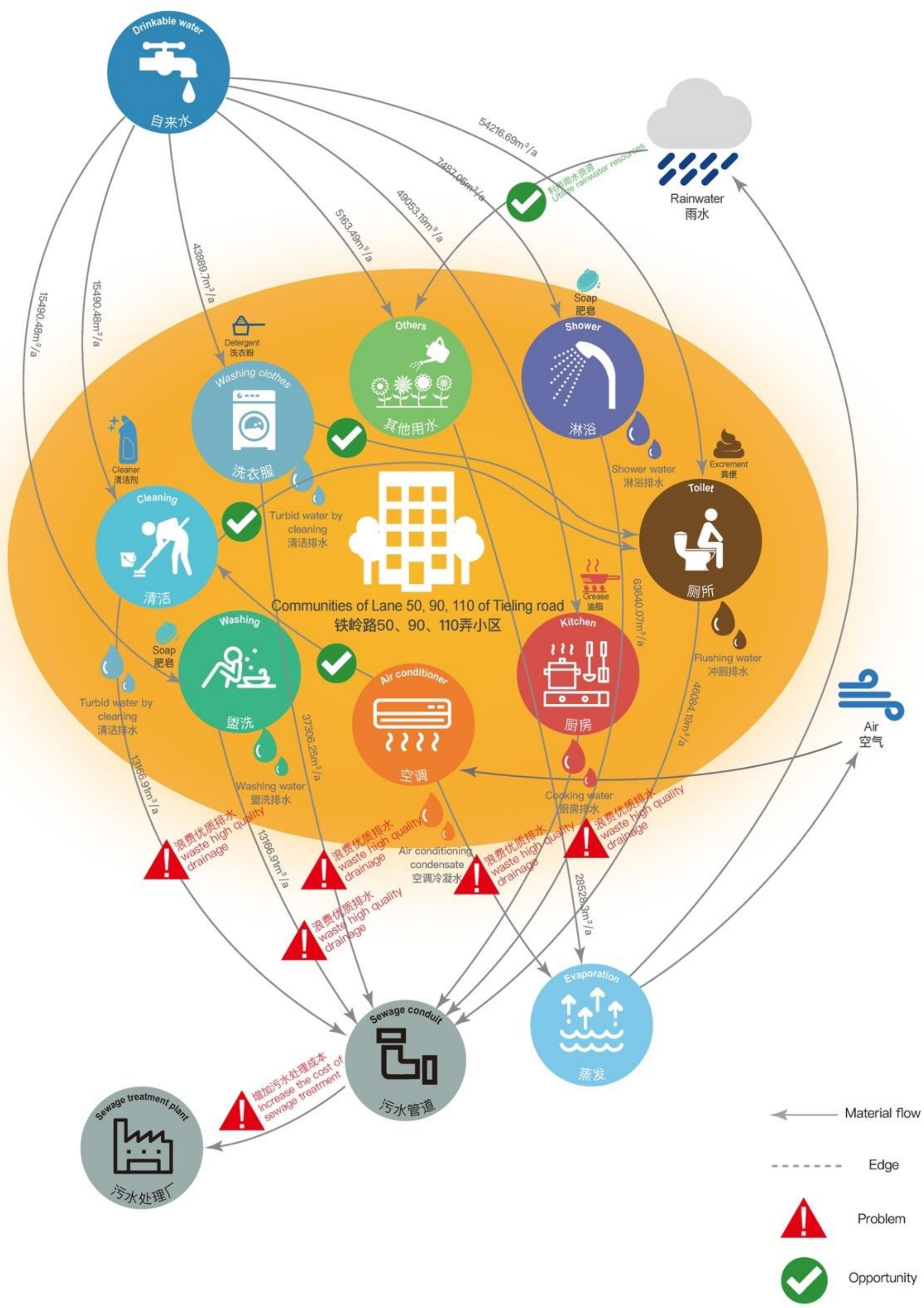


Figure 3.32 Analysis of the current situation of building water service in the 50, 90, and 110 Tieling Road (Source: author)

3.4.2 Investigation on the status quo of stall water service in Tieling road seafood Market

There are 6 stalls on the Tieling Road along the section of the 90-round community. Perennial sales of squid, octopus, flower carp, squid, squid, squid, squid, river bream, black fish, scutellaria, lobster, river prawn, hairy crabs and other varieties.

The author visited and found that seafood stalls use a large amount of tap water to breed seafood every day. Some of the culture water is not used for a long time and is discharged to the rainwater pipe at the storefront door, causing a large waste of water. At the same time, the cultured drainage is discharged directly into the rainwater pipeline without treatment. It will cause pollution to the downstream Yangshupu Port.

Figure 3.33 Tieling Road Seafood stands (Source: author)

According to the on-site interview, the average annual water consumption per household in Tieling Road is 300m^3. These tap waters are used as aquaculture water. According to the drainage rate of 85%, the aquaculture drainage of each household aquaculture drainage is 255m^3 per year. All booths have a total drainage of 1530m^3 per year, as shown in Table 3.8.

Table 3.8 Water consumption and percentage of seafood stalls at Tieling Road (Source: author)

Stand number	6
Average water consumption per stand (rmb/year)	1500
Comprehensive water price（rmb/ m^3）	5
Total water consumption per stand (rmb/year)	300

（m^3/year）	
Aquaculture water percentage	100%
Aquaculture water consumption（m^3/year）	300
Aquaculture water drainage percentage	85%
Displacement of stand aquaculture water （m^3/year）	255
Note: The price of tap water for industrial and commercial use in Shanghai is 2.89 (rmb/m^3), the price of drainage is 2.34 (rmb/m3), and the price of integrated water is 5 (rmb/m^3).	

3.4.3 Overview of the current status of water services in Songhe park combined with surrounding communities

The author links the current status of water services in Songhe Park and surrounding communities, and studies the current situation of Songhe Park water service in the context of Songhe Park and the surrounding communities. On the whole, the water input of Songhe Park and surrounding communities is mainly tap water and rainwater. There is no connection between the two on the water service; there is some intersection between the two on the water output. The drainage of Songhe Park mainly flows into the sewage and rainwater pipelines; the drainage of the surrounding communities mainly flows into the sewage pipelines; the drainage of the seafood market of Tieling Road flows into the rainwater pipelines, as shown in Figure 3.33.

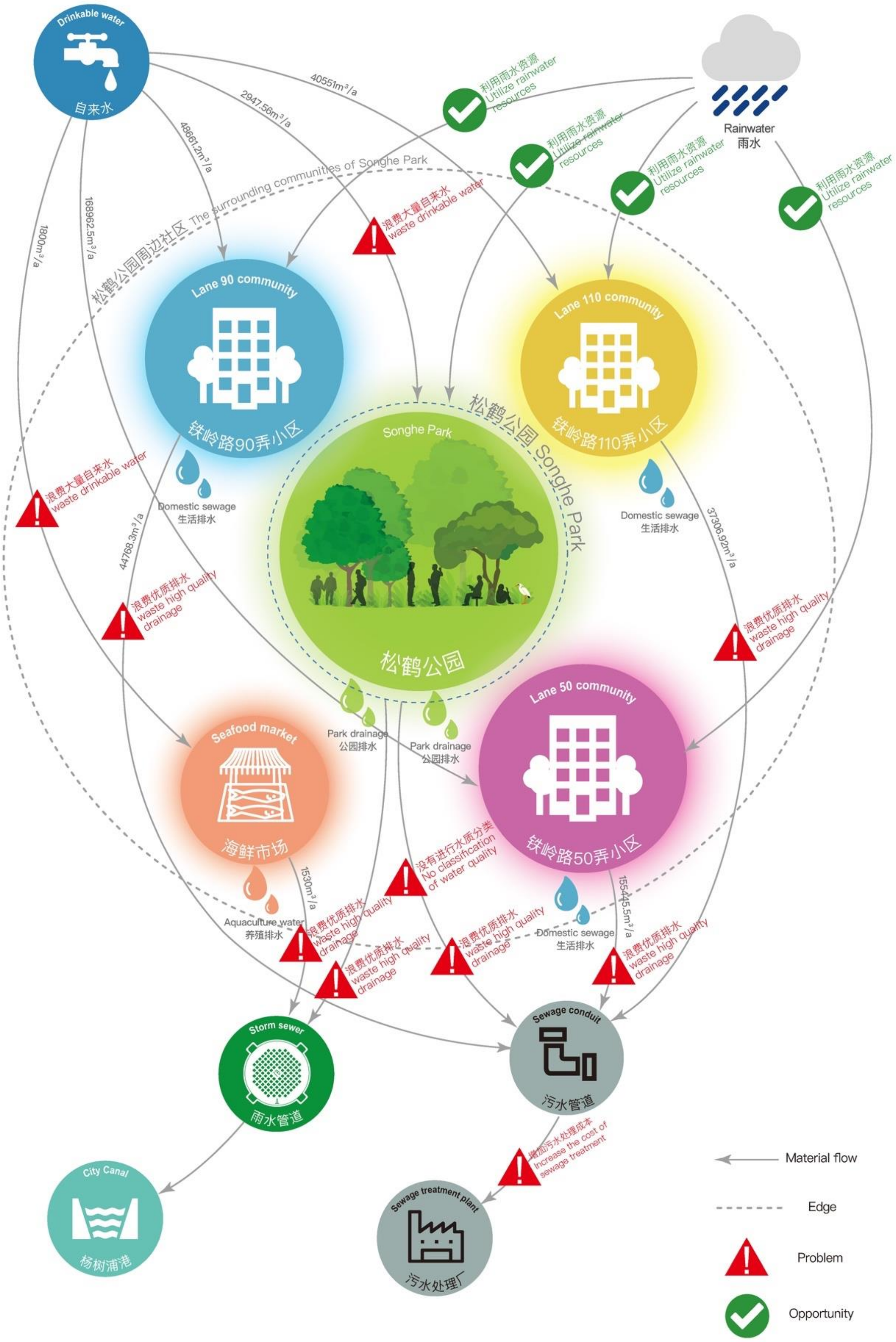


Figure 3.34 Analysis of the current status of water services in Songhe Park combined with surrounding communities (Source: author)

3.5 Songhe park water service status system analysis

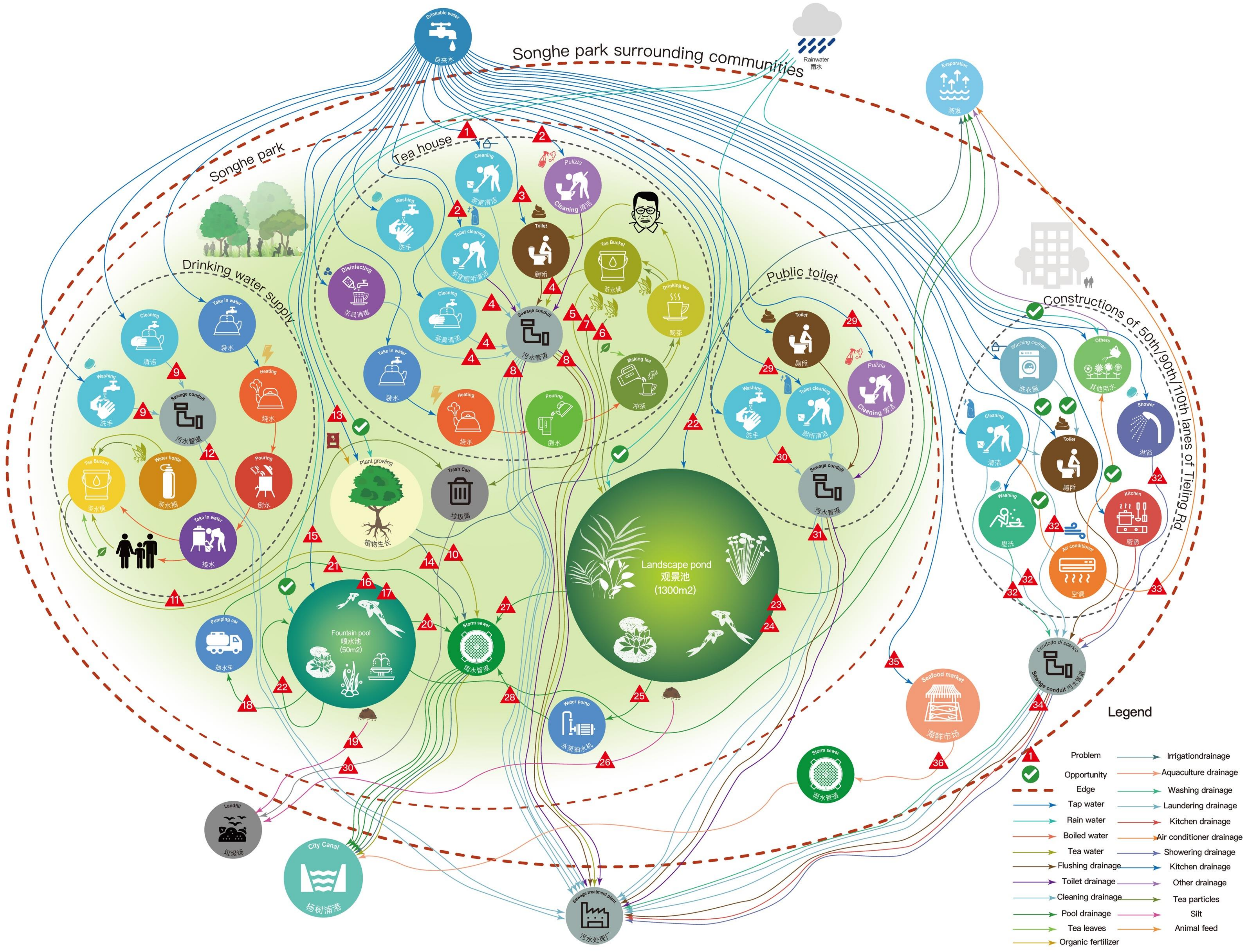
In the last two sections, the author conducted a separate study on the current status of each type of water activity in the life situation of Songhe Park and surrounding communities, but there is no connection analysis as a whole, and there are limitations in vision. Now, Songhe Park is combined with the surrounding communities to conduct a detailed and detailed study of the current situation of the Songhe Park water service system, and to discover the current system problems and promote optimal design.

3.5.1 Songhe park water service status system analysis

System analysis of water service status in songhe park is shown in figure 3.35.

Figure 3.35 Songhe Park Water Service Status System (Source: author)

See next page, A3



Drinkable water
自来水
Rainwater
雨水
Songhe park surrounding communities
Songhe park
Tea house
Drinking water supply
Public toilet
Constructions of 50th/90th/110th lanes of Tieling Rd
Evaporation
蒸发
Cleaning
茶室清洁
Pulizia
Cleaning 清洁
Washing
洗手
Toilet cleaning
茶室厕所清洁
Toilet
厕所
Tea Bucket
茶水桶
Drinking tea
喝茶
Disinfecting
茶具消毒
Cleaning
茶具清洁
Sewage conduit
污水管道
Making tea
冲茶
Take in water
装水
Heating
烧水
Pouring
倒水
Cleaning
清洁
Washing
洗手
Take in water
装水
Heating
烧水
Sewage conduit
污水管道
Tea Bucket
茶水桶
Water bottle
茶水瓶
Pouring
倒水
Take in water
接水
Plant growing
植物生长
Trash Can
垃圾筒
Toilet
厕所
Pulizia
Cleaning 清洁
Washing
洗手
Toilet cleaning
厕所清洁
Sewage conduit
污水管道
Washing clothes
洗衣服
Others
其他用水
Shower
淋浴
Cleaning
清洁
Toilet
厕所
Washing
盥洗
Kitchen
厨房
Air conditioner
空调
Condotto di scarico
Sewage conduit 污水管道
Fountain pool
喷水池
(50m2)
Landscape pond
观景池
(1300m2)
Pumping car
抽水车
Storm sewer
雨水管道
Water pump
水泵抽水机
Seafood market
海鲜市场
Storm sewer
雨水管道
Landfill
垃圾场
City Canal
杨树浦港
Sewage treatment plant
污水处理厂
Legend
Problem
Opportunity
Edge
Tap water
Rain water
Boiled water
Tea water
Flushing drainage
Toilet drainage
Cleaning drainage
Pool drainage
Tea leaves
Organic fertilizer
Irrigationdrainage
Aquaculture drainage
Washing drainage
Laundering drainage
Kitchen drainage
Air conditioner drainage
Showering drainage
Kitchen drainage
Other drainage
Tea particles
Silt
Animal feed

3.5.2 Current system problems

Tea house

Problem 1: Tea house cleaning relies on tap water.

Problem 2: Tea house restroom cleaning relies on tap water.

Problem 3: Tea house flushing tap water has a large amount of water.

Problem 4: Tea house washing, tea set cleaning, tea set disinfection, tea house cleaning and high-quality drainage of remaining tea are flowed into the sewer.

Problem 5: Tea is poured into the viewing pool, causing water pollution in the pool.

Problem 6: Tea slag is poured into the viewing pool, causing pollution of the pool water.

Problem 7: Tea slag is thrown into the trash can, causing waste of resources.

Problem 8: A large amount of tea house drainage increases the pressure and cost of sewage treatment.

Drinking water supply

Problem 9: Clean, hand-washed high-quality drainage is drained into the sewer.

Problem 10: The remaining tea is poured into the rainwater pipeline, causing. pollution in the downstream Yangshupu Port and increasing social costs.

Problem 11: Tea slag is thrown into the trash can, causing waste of resources.

Problem 12: A large amount of drainage increases the pressure and cost of sewage treatment.

Plant irrigation

Problem 13: Depending on tap water irrigation, tap water has a large amount of water.

Problem 14: The loss of irrigation drainage is large, resulting in wasted water.

fountain

Problem 15: Relying on tap water to renew the water in the fountain, tap water has a large amount of water.

Problem 16: The water at the bottom of the pool is not circulating, causing water pollution, eutrophication and odor.

Problem 17: The water quality experience is poor, and it has a sense of alienation from visitors. .

Problem 18: Increase water maintenance costs and labor costs.

Problem 19: Silt is transported to the dump, causing waste of resources.

Problem 20: The drainage of the pool body is discharged into Yangshupu Port, which increases the pollution of the lower reaches of Yangshupu Port.

Problem 21: The pump pulls away the polluted pool water and discharges it into the rainwater pipeline, increasing the pollution downstream of Yangshupu Port.

Viewing pool

Problem 22: The tap water is used to update the water in the viewing pool, and the tap water has a large amount of water.

Problem 23: The water at the bottom of the pool does not circulate, causing water pollution, eutrophication, and odor.

Problem 24: The water quality experience is poor, and it has a sense of alienation from visitors.

Problem 25: Increase water maintenance costs and labor costs.

Problem 26: The amount of sludge is large, and the sludge is transported to the dump site, causing waste of resources.

Problem 27: The drainage of the pool body into the Yangshupu Port has increased the pollution in the lower reaches of Yangshupu Port.

Problem 28: The pump pumped away the polluted pool water and discharged it into the rainwater pipeline, increasing the pollution downstream of Yangshupu Port.

Public restroom

Problem 29: Public restroom cleaning relies excessively on tap water.

Problem 30: High quality drainage is drained into the sewer.

Problem 31: Increase sewage treatment costs.

Community Buildings of 50, 90, 110 Tieling Road

Problem 32: High quality drainage is drained into the sewer.

Problem 33: Most of the air conditioning drains are lost and are not being collected.

Problem 34: Increase sewage treatment costs.

Seafood market

Problem 35: The amount of tap water used is large.

Problem 36: A large amount of aquaculture drainage is lost; at the same time, pollution is caused to the downstream Yangshupu Port.

3.5.3 Summary of current system problems

In the current situation of Songhe Park water service system, there are mainly the following major problems.

In the water input, almost all water services rely on tap water, and some water services use too much water and water fees. In the operation of water, various water services have not cooperated with each other, and some water services are wasted and water pollution is generated. In the water output, various types of waste (various types of drainage, tea residue and sludge) produced by various water services are not recycled; a large amount of high-quality drainage is wasted to the sewage pipeline, causing loss of resources and increasing sewage treatment costs; It was flown to Yangshupu Port, which aggravated downstream pollution.

3.6 Analysis of the constraints on the status quo of Songhe park water service

The problem of the current system restricts the benign development of the current status of the water service system in Songhe Park. The following is an analysis of the constraints on the status quo of Songhe Park water service from the operation, management and policies of the park water service status system, tourist behavior, and community links.

3.6.1 Analysis of current system operation constraints

Analysis of the constraints of the current system operation is mainly based on input, operational processes and output analysis.

On the basis of the current system input, the water consumption of the tap water is large and the water fee is high. On the one hand, the park does need more water. On the other hand, the park's various water services are over-reliant on tap water, and almost no other water source is used. In addition to tap water, other water sources are more passive. The park is not very efficient for rainwater, and is mainly used for natural irrigation as well as for viewing pools and fountains. In addition, the park lacks access to other water sources. From the input point of view, the park obtains the water source in the most convenient way, and no other way to obtain other water sources. The tap water is easy to obtain, so the tap water in the park is large.

In the current system operation process, the water use process in the park is wasted and the water pollution is caused by the linear operation mode of various water service operations in the park, the unreasonable water use process and the inappropriate design layout or technical process. Various types of water services in the tea house, public restrooms and free drinking water supply produce a variety of different quality wastewaters. These wastewaters are not analyzed for quality. They are reused once or reused after treatment but are directly discharged to the sewage. Pipes or rainwater pipes that cause water waste and water pollution. In plant irrigation, part of the water is evaporated or absorbed, and the other part is flowed to the ground rainwater pipeline. There is no effective water use method to keep the water in the soil, resulting in wasted water. In the observation pool and the fountain, the aquatic plants can not play the ecological role and the inappropriate design layout leads to the decline of the water quality of the pool and the pollution of the water body. At the same time, no effective technical process is used to improve the water quality, and frequent replacement of the pool water leads to waste of water.

In the current system output, the reason for the generation of various types of waste (different types of drainage, tea residue and sludge) is that under the linear operation mode, various water services only focus on services and lack of attention to waste. Waste becomes a resource for another system. The reason for the large loss of high-quality drainage is that the drainage of the park and surrounding communities has not been discharged by means of wastewater and sewage, and there is no interception and utilization of high-quality drainage, resulting in a large amount of high-quality drainage loss. The large amount of polluted water is flowing to Yangshupu Port. The main reason for the increase of downstream pollution is that the polluted pool and aquaculture drainage in the park's observation pool and fountain are incorrectly discharged into Yangshupu Port, resulting in downstream water pollution.

3.6.2 Analysis of policy and management constraints

The water service operation of the park has always been a state of loss, and policy-dependent, relying on government subsidies to maintain. Most of the park's water services are traditional projects that have been preserved since the opening of the park. It is a charitable activity designed to serve residents. Although some water services have been satisfied by residents in terms of political achievements, with the development of the times, the limitations of water services have become more and more obvious.

In terms of policy, the water service operation of the park does not consider social, ecological, cultural and economic benefits. At present, the biggest problem of park water service is that the demand for tap water is increasing, and water pollution is becoming more and more serious. A major cause of the increase in water problems is the impact of policy support. Since there is no need to participate in market competition, the park does not require efficiency in the use of tap water. It needs to be used when it is needed. It is not necessary to consider the problem of drainage pollution when it is used up. At the same time, there is no connection between each project in water operation. There is no systematic integration of its own resources for comprehensive utilization of water. In view of the status quo, although the park is actively trying to change, this year also publicly bidding to control the water quality of the viewing pool, but it has not fundamentally solved the water problem, water pollution and resource consumption still exist.

At present, the water service road of the park is entering a fork point. It is a sustainable service that chooses to maintain service by means of high consumption and high emission and quick results, or to choose social, economic and ecological benefits. In essence, the current problems in the water service of the park are caused by the backward management thinking. Water services are not considered in conjunction with environmental and social costs. In the current situation, various types of water services are in a linear mode of operation, and the cost, resource consumption and pollution are also increasing while providing water services to residents.

3.6.3 Analysis of the constraints of tourist behavior

The impact of visitors' behavior on park water services is mainly in tap water usage: over-reliance on public restrooms and extensive access to park drinking water.

The survey found that 65.69% of the park visitors use the public restrooms of the park; 14.7% of the visitors use the public restrooms 3 times or more per day; in the interview with the tourists, the park has the largest number of toilets every day from 6 to 7 in the morning, and needs to be queued. The restrooms; most of the visitors are surrounding residents; 1.96% of the residents use the park toilets 5 times or more per day, as shown in Figure 3.35, and even use the park restroom during the day. In the survey of surrounding residents, it was found that residents only use the park bathroom. The object is mainly for the elderly over 65 years old who live on the lower floor. Tourists' dependence on the toilets has increased the amount of water used in the park.

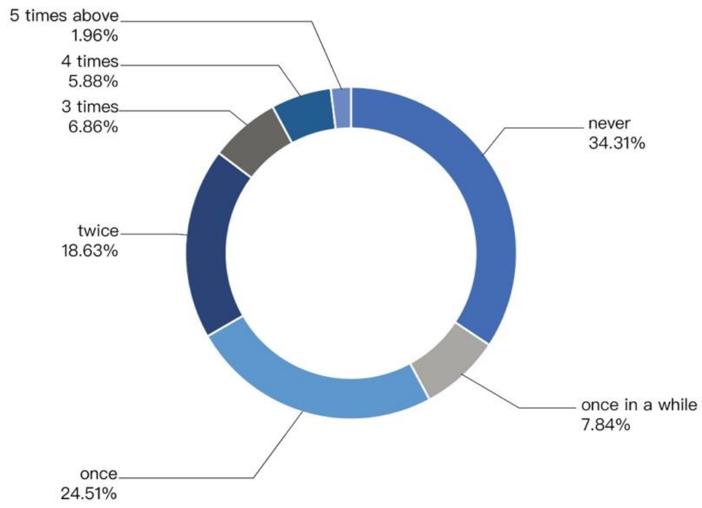


Figure 3.36 Percentage of times a visitor uses the public restroom in Songhe Park every day (Source: author)

In the free drinking water supply, more than 40% of visitors come to the park every time to have the habit of purchasing free drinking water; the age group for drinking water is mainly residents near 50 years old. Among them, tourists who took more than 1000ml of drinking water accounted for 2.94%, 250-500ml accounted for 10.78%, and 500-1000ml accounted for 12.75%, as shown in Figure 3.37. In the survey of surrounding residents, although 29.52% of the residents had the habit of purchasing drinking water from the community self-service water dispenser, and rarely used the park drinking water, 9.52% of the residents still specialized in the park drinking water every day. A small number of residents carry two large empty bottles of drinking water for household use, and the loading capacity is more than 1000ml, which causes the drinking water supply burden of the park to be too large. In the face of such a situation, the park duty officer said that the provision of drinking water supply services in the park is of a public nature and cannot prevent residents from over-filling water. It can only increase the supply of drinking water.

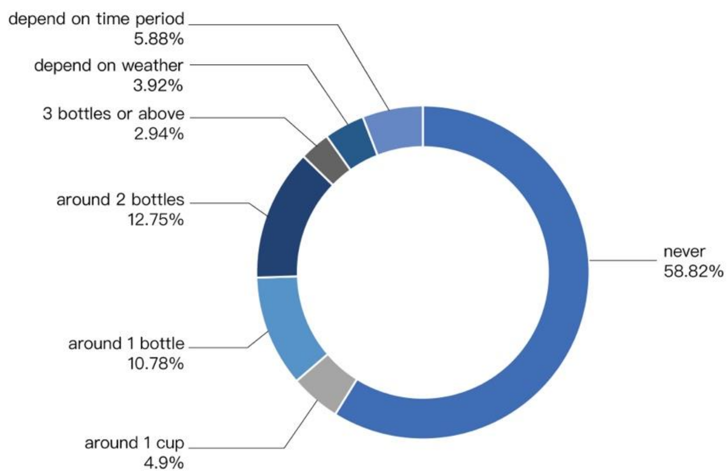


Figure 3.37 Percentage of drinking water for each visitor (source: author)

On the one hand, tourists have a large demand for water, on the other hand, they lack the concept and willingness of sustainable development of public space. Some users said that drinking water and using the bathroom in the park can save half of the water every day; the government's expenditure and water pollution will be the responsibility of the government department, and there is no need to worry about the individual.

3.6.4 Analysis of community connection constraints

At present, the water service between Songhe Park and the surrounding communities is relatively isolated and lacks links. The surrounding communities have good resources, location and cultural conditions. From the perspective of resources, the surrounding communities have rich drainage resources; from the location point of view, the two locations are adjacent to each other; from the cultural point of view, Songhe Park is integrated with the surrounding communities, Songhe Park serves the residents of the surrounding communities, and residents Relying on the park, there is no cultural barrier. Songhe Park did not use the resources, location and cultural conditions of the surrounding communities to achieve win-win cooperation, making the park's water service operation more passive, and did not solve the problem of the park water service status from the perspective of community cooperation.

3.7 Investigation on the current status of water service economy in Songhe park

3.7.1 Park related expenditures on water services

(1) Water fee

In 2016, Songhe Park paid a total of 14443.05 rmb of water.

(2) Water body maintenance costs

Water cleaning costs include water maintenance and labor.

The water body maintenance fee is also the garbage fee of the park. The water maintenance fee (garbage fee) of the park for one year is calculated according to 4 rmb/m2. In 2016, the water body maintenance fee of Songhe Park is:

$$(1300+50)\times 4=5400\text{rmb}$$

(3) Greening and cleaning labor costs

In Songhe Park, two green cleaning workers are responsible for park landscaping, water maintenance and public restroom cleaning. The annual salary of workers is 48,000 rmb. The annual salary of workers in the park is:

$$48000\times 2=96000\text{rmb}$$

(4) Gasoline fee

The gasoline fee mainly includes the cost of using the gasoline pump and the sprinkler to use the diesel pump.

The pump pump is $45m^3$ for 1 hour, 4L of gasoline is required, and the average pumping capacity is 11.25 m^3 with 1 liter of gasoline. The water volume of the observation pool is $780m^3$, calculated from the average price of No. 93 gasoline in Shanghai in 2016. The calculation is based on the observation of the pool water in two years. The pumping cost of the pump in 2016 is:

$$5.87\times 780\div 11.25\div 2=203.49\text{rmb}$$

The pumping cost of the fountain in 2016 is:

$$5.87\times 25\times 2\div 11.25=25.52\text{rmb}$$

The sprinkler is mainly used for water absorption in park fountains. The sprinkler from the starting point Yangpu Park to Songhe Park is about 3.9 kilometers away, and the round-trip is 7.8 kilometers. The fountain is used twice a year for water absorption. In 2016, the average price of No. 0 diesel in Shanghai was 5.52 rmb/L. The gasolinel consumption of Dongfeng 145 sprinklers was about 18L. The gasoline consumption for the water pump in Songhe Park in 2016 was:

$$3.9\times2\times2\div100\times18\times5.52=15.50\text{rmb}$$

The 2016 fasoline fee for Songhe Park in water related services is:

$$203.49+25.52+15.50=244.51\text{rmb}$$

(5) Boling water and electricity fees

The electricity used by Songhe Park belongs to non-resident users (schools, nursing homes, public buildings, etc.), with a power of less than 1 kV and a unit price of 0.641 (rmb/kWh). The free drinking water supply and tea house boiling water in Songhe Park are all all-electric electric kettles with rated voltage of 220V, power of 1500W and capacity of 5L. The average time of boiling water is 10 minutes, and the power consumption of each water is 5L. :

$$1.5\times10\div60=0.25\text{kW}\cdot\text{h}\ \text{(degrees)}$$

In 2016, the amount of water in the park tea house was 18.3m^3. In 2016, the annual cost of boiling water in the tea house was:

$$18.3\times1000\div5\times0.25\times0.641=586.52\text{rmb}$$

In 2016, the free drinking water in the park was 216.96 m^3. The annual electricity supply for free drinking water is:

$$216.96\times1000\div5\times0.25\times0.641=6953.57\text{rmb}$$

In 2016, Songhe Park's annual water and electricity bills are:

$$586.52+6953.57=7540.1\text{rmb}$$

(6) Tea costs

The tea house purchases 500 grams of green tea and the unit price is 50 rmb. The tea house averages 40 guests per day. The 2 tea leaves are used to make a cup of tea. The 2016 park tea cost is:

$$40\times366\times2\div500\times50=2928\text{rmb}$$

(7) Tea house manager fee

The tea house is equipped with an administrator. The annual salary is 27,600 rmb without calculating the overtime, insurance and other expenses.

(8) Cleaning related expenses

Figure 3.38 Disinfection tablets, soap and washing powder used in the Songhe Park tea house (Source: author)

Disinfecting tablets cost 20 rmb per bottle, each containing 100 pieces of disinfection tablets. The tea house has about 3 pieces of disinfection tablets for each disinfection cup. The disinfection time is 2 days. The cost of using the disinfection tablets throughout the year is:

$$366\div2\times3\div100\times20=109.8\text{rmb}$$

The tea house purchases soap for the tea house staff to clean and use. The price per piece of soap is 2 rmb per piece, and the average monthly consumption is 2 pieces. The annual consumption of tea house soap is:

$$2\times2\times12=48\text{rmb}$$

The guards on duty are also using soap to clean the supply of free drinking water. The price of each piece of soap is 2 rmb per piece, and the average monthly consumption is 2 pieces. The cost of using the soap on duty guards throughout the year is:

$$2\times2\times12=48\text{rmb}$$

Tea house to buy washing powder clean tea house tables and chairs and floor, 5kg washing powder unit price is 40 rmb. Every day, the tea house consumes about 50 grams of washing powder. The cost of using washing powder for the whole year is:

$$50\times366\div5000\times40=146.4\text{rmb}$$

There are three public washrooms in Songhe Park, including the entrance to the gate, the park and the teahouse washroom. Toilet cleaning is mainly used on floors, walls, doors and windows, toilets and urinals in public restrooms, and is cleaned at least once a day. The toilet bowl and urinal are cleaned using toilet liquid. The unit price of 1200ml toilet liquid is 9.5 rmb, and the daily consumption is about 200ml. The cost of using toilet liquid for the whole year is:

$$200\times366\div1200\times9.5=579.5\text{rmb}$$

The bathroom floor, wall and doors and windows use floor cleaner. The price of 2000ml floor cleaner is 25 rmb, the daily consumption is about 200ml. The cost of using floor cleaner for the whole year is:

$$200\times366\div2000\times25=915\text{rmb}$$

Songhe Park spent the total cost of cleaning related in 2016:

$$109.8+48+48+146.4+579.5+915=1846.7\text{rmb}$$

(9) Staff on duty

There are 3 on-duty staff in Songhe Park, including a head of the park and two guards. They are responsible for the daily management of the park and are responsible for all aspects of the daily free drinking water supply. Without calculating other expenses such as overtime pay and insurance premiums, the annual salary of the director is 120,000 rmb, and the annual salary of the guards is 100,000 rmb. Songhe Park’s annual expenditure for duty personnel is:

$$120000+100000\times2=320000\text{rmb}$$

In 2016, Songhe Park's water-related expenses totaled 476,002.36 rmb, as shown in Table 3.9.

Table 3.9 Statistics on water related expenses of Songhe Park in 2016 (Source: author)

Serial number	Type	Expense(rmb)
1	Water fee	14443.05
2	Water maintenance fee	5400
3	Green cleaning labor costs	96000
4	Gasoline fee	244.51

5	Boling water/electricity fee	7540.1
6	Tea	2928
7	Tea house manager	27600
8	Cleaning related expenses	1846.7
9	Staff fee	320000
Total		476002.36

3.7.2 Park-related income from water services

(1) Tea house charges

In 2016, Songhe Park Tea house has an average of 40 guests per day. The tea house fee is 2 rmb. The annual tea house income is:

$$40 \times 2 \times 366 = 29280\text{rmb}$$

Table 3.10 Statistics on water related services revenue of Songhe Park in 2016 (Source: author)

Items	Income(rmb)
Tea house fee	29280
Total	29280
Note: Government subsidies are not included in income.	

3.7.3 Summary of economic status

Songhe Park spent about 476,002.36 rmb on water-related services in 2016, with an income of 29,280 rmb. In the absence of government subsidies, equipment input costs and equipment depletion costs, the water service cost of Songhe Park is a serious loss. In addition to the salary of the park staff and workers, the water service consumption and related maintenance expenses are 32,402.36 rmb, and the expenditure still exceeds the income expenses.

3.8 Analysis of economic benefit constraints

The economic benefits and the status quo of the system are positively correlated. The more water resources are used, the greater the cost; the lower the efficiency of water operation, the greater the economic cost. The main factors causing low economic returns are the following three aspects.

On the one hand, the park has low income. The water service of Songhe Park is a public welfare service, focusing on serving the masses and not on economic benefits. For instance, free drinking water supply is a large convenience service in Shanghai City Park. The park provides free services such as water and water for tourists. The annual consumption of electricity and tap water is large, but the income is zero. The tea house is also a public welfare role. From the opening of the park, only the tea fee of 2 rmb per person is charged. Basically, only offset the salary of the tea house administrator.

On the other hand, the park spends a lot. Songhe Park has a large demand for water, which is highly dependent on tap water, resulting in high water costs. On a yearly basis, each water service project in the park requires a certain amount of water. At the same time, however, the park did not save water costs, and used rainwater or reclaimed water, which did not generate value in resource utilization.

In the third aspect, the park water service operates inefficiently and generates more related costs. For example, the observation pool and the fountain need regular maintenance of the water body; the tourists feed the fish, and the excrement of the ornamental fish increases, and the sludge accumulates. At the same time, the reason for the closed design of the pool body is that the water body is not circulating, and the water quality is reduced, resulting in having to use the water pump to pump the old water away. Increased expenses related to expenses such as maintenance costs, labor costs, water charges, and other resources (gasoline, diesel) consumption.

The fundamental reason for the low economic efficiency is that the economic balance and expenditure cannot be balanced in the context of public welfare services, and the water operation under the linear mode has intensified the economic efficiency. However, in the case of low economic efficiency, the maintenance of water service operations cannot be further carried out, resulting in a positive correlation between the waste of the current system and economic consumption.

3.9 Summary of this chapter

This chapter takes Songhe Park as an example to investigate and analyze the current status of water services in Yangpu District Community Park. Before studying Songhe Park, we first studied the general situation of community parks in Yangpu District and learned about the basic situation of water services in 10 community parks in Yangpu District. Then select a community park representative - Songhe Park for in-depth research and analysis. Afterwards, a comprehensive survey of the general situation and characteristics of Songhe Park and its surrounding communities and various water services was carried out, and the current water service status systems were analyzed. Then the water service status system within the research scope was integrated into Songhe Park water. The service status system observes and analyzes in a more holistic and comprehensive perspective and finds problems in the current system. According to the status quo problem, the constraints of the water service status system of Songhe Park were analyzed. At the same time, the economic benefits of Songhe Park were investigated and analyzed.

Chapter 4 Water service system design of songhe park

After analyzing the current water service system of songhe park and the surrounding communities, it is found that there are a series of problems and related constraints. In this regard, the author finds out countermeasures to improve the current system. The feasibility analysis on the resource flow planning of the current system and water purification design of songhe park was carried out, and the improvement strategy was put forward to build a sustainable water comprehensive utilization service system of songhe park.

4.1 Thinking of new system construction

The purpose of the new system is to solve the problems in the current system. In view of the constraints of the current system, the new system can seek solutions from the dimensions of system optimization measures, the perfection of policies and management, the transformation of consciousness and the increase of community connection.

4.1.1 System optimization thinking

System design thinking is based on problems in the current system.

On the input of the new system, on the one hand, water should be saved from tap water. On the other hand, other available water sources should be added, and reclaimed water instead of tap water should be considered in various activities. Reduce the use of tap water by diverting tap water and reduce water bills.

In the operation process of the new system, in view of the problem of water waste and water pollution in the current system, the water service links can be systematically optimized. Re-evaluate the quantity and quality of water used in each step of the system to reduce water wastage. Analyze the cause of the water pollution problem in the observation pool and the fountain in the current situation system, rethink the problems such as the current poor fluidity of the water body, the ecological function of the aquatic plants, the sediment deposition, and the poor water quality, re-architect the system relationship, and consider establishing A cost-effective water purification treatment system to reduce water pollution. The water purification treatment system can meet the possibility of other water services at the same time, and it is feasible to consider the use of medium water sources for water input. At the same time, consider changing the design and functional layout of the pool to promote the possibility of water quality improvement.

The new system can analyze the quality, quantity and use of all kinds of wastes produced in the current system, and make the wastes become resources in another system. The Park and neighboring community buildings are discharged by sewage and sewage diversion system to collect high-quality wastewater and turn the wastewater into resources to serve the park. There is also a large amount of polluted water flowing into Yangshupu Port in the current system. If the water quality of the observation pool and fountain is improved, and other wastewater such as aquaculture and drainage is not discharged into the rainwater pipeline, the park and surrounding communities will discharged the non-polluted water into Yangshupu Port.

In summary, the system optimization can use reclaimed water instead of tap water; re-adjust the viewing pool and fountain layout; establish a water purification treatment system for the observation pool; control other wastewater discharge channels; and turn the output into resources.

4.1.2 Improvement of policy and management

The water service of the park should strengthen the construction of water ecological civilization, actively implement water conservation and optimize water quality actions; at the same time adapt to the development requirements of the new era, increase the water services required by residents, gradually improve the water services of the park, and consume water services and resources. Find a balance point to meet the needs of sustainable development; establish a model water comprehensive utilization service system.

The park needs to strengthen the management of water services, control the resource consumption and environmental pollution in the water service sector, actively find feasible ways to reduce resource consumption and environmental pollution.

4.1.3 Increase community contact

Develop social, cultural and material resources available in the environment around Songhe Park. The surrounding community has abundant drainage resources to solve the problem of excessive dependence on tap water in the current situation; the park also serves the surrounding residents and outputs clean water for the downstream rivers; at the same time, the park should fully consider the wishes of the residents and meet the service needs of the residents. Through the integration of regional culture, it is possible to cooperate with surrounding communities and establish mutual help.

4.1.4 Change of consciousness

Conceptual awareness needs to be gradually changed from the previous dependence on water resources to the protection of water resources. Under the general trend of the construction of aquatic ecological civilization, the construction of the new system related reducing the use of tap water, waste recycling, reuse of reclaimed water and so on. It requires a shift in participants' awareness, prompting a change in behavior.

4.2 Opinion polls

Based on the survey of the main participants of water service in songhe park and the surrounding communities, the author collected their willingness and Suggestions on the establishment of water comprehensive utilization service system.

4.2.1 public opinion survey of park visitors

The author mainly used questionnaire and in-depth interview to investigate park visitors. This paper mainly investigates the attitudes of visitors to water in the park, the attitude to improve the water environment in the park, the attitude to build artificial wetland, the attitude Type of water service, the attitude to whether they are willing to use the water service park in the surrounding buildings and relevant Suggestions.

In view of the water environment in the park, whether it is water quality, aquatic plants and water smell, most visitors are dissatisfied. Visitors mainly reflect the view of the pool and water fountain turbid, not clear enough; At the same time, the smell of water, especially close to the tea house toilet water is not circulating, garbage and silt accumulation; Abnormal smell in water also causes upset stomach and other conditions. The visitors thought that the aquatic plants were sparse, which had neither ornamental effect nor effective Water purification effect, and the plant waste was floating on the water. It is necessary to improve the water environment of the park.

In the above view of the viewing pool, 64.71% of the visitors supported the improvement of the viewing pool in songhe park. 66.67% of the visitors think that the main function of the viewing pool is ornamental, 58.82% think that it Should have the function of water storage, and 46.08% think that the function of water purification is also important.

55.88% of visitors supported the design of the viewing pool as a wetland landscape to improve the water quality, as shown in figure 4.1. Some visitors think that wetland landscape can cultivate different aquatic plants to achieve different levels of landscape to enhance the beauty of the The viewing of the pond, Than 40% of the visitors want to keep the shape of the pond as it is. 25.49% of the visitors want to accept minor adjustments, and 29.41% of the visitors want to accept any design.

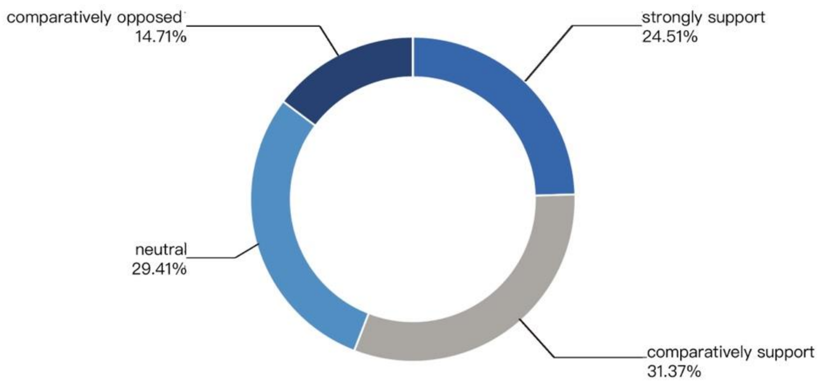


Figure 4.1 attitudes of visitors towards the design of the park viewing pool as a wetland landscape (source: author)

Most visitors support the Songhe Park as a water-saving park; they believe that water conservation responds to policy demands, while saving costs and improving other aspects of the park. In terms of water use, visitors generally adopt the attitude of using water in parks, as shown in Figure 4.2. Visitors can understand the significance of water conservation, but they also say that the use of reclaimed water needs to meet relevant water quality standards. 6.86% of the visitors said they did not accept the use of reclaimed water in the park. Some of the visitors were young women. They were worried about the impact of reclaimed water on sanitation and could not accept the use of reclaimed water without knowing it. Visitors also think that the water contains bacteria, causing pollution in the park, and at the same time worrying about the impact of children's health.

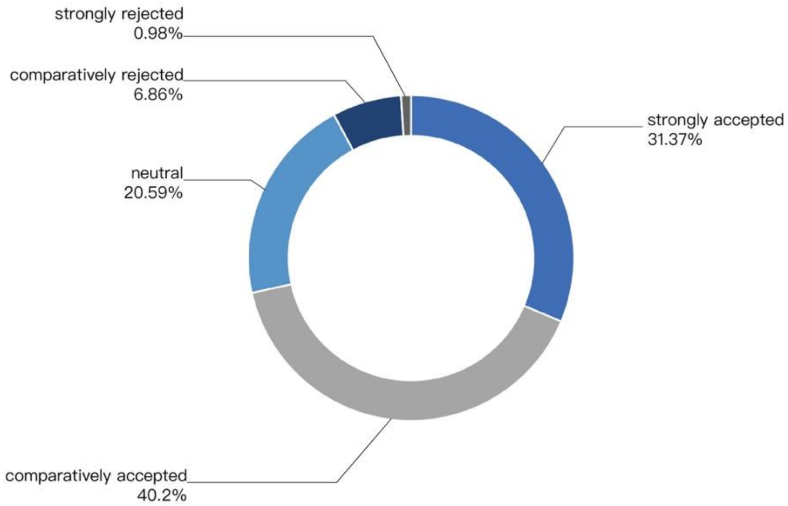


Figure 4.2 Visitors' attitude towards the use of water in the park (Source: author)

Generally speaking, visitors hope to improve the water service quality and efficiency of the park, bring convenience to life; improve the water quality of the park, improve the water ecological environment of the park; support the use of reclaimed water; enhance the hydrophilic water play experience, enrich the park's water activities. From the perspective of tourists, the main design points of the comprehensive utilization of water service system are as follows:

(1) As most of the visitors are the surrounding residents, they have feelings for the layout design of the Songhe Park, so the design of the water quality improvement of the viewing pool can be adjusted on the original basis to maintain the affinity of the original environment. Design the mini constructed wetland landscape and try to reduce the change and retain the water surface.

(2) reclaimed water is one of the sources of water. High quality drainage through multiple channels can be used as reclaimed water source and ensure that reclaimed water is used in accordance with water quality standards.

(3) Increase other water services, such as summer cooling spray, improve the opening time of the teahouse, so that the tea house becomes one of the space for viewing the waterscape.

4.2.2 Community residents' opinion poll

The author investigates the residents of 50, 90 and 110 Tieling Road in the form of questionnaires and in-depth interviews. This paper mainly investigates the community residents'desire to get the type of water service in the park, their attitude towards water saving in the park and their willingness to use the reclaimed water service park in the surrounding buildings.

Residents affirmed the park's water service to bring convenience to their lives. 79.48% of the residents use the park toilet every day, 16.19% of them use it at least twice a day; 19.05% of the residents often go to the park to get drinking water. Residents hope to get drinking water supply, public toilets, water landscape, water quality improvement, summer cooling spray and other water services, as shown in Figure 4.3.

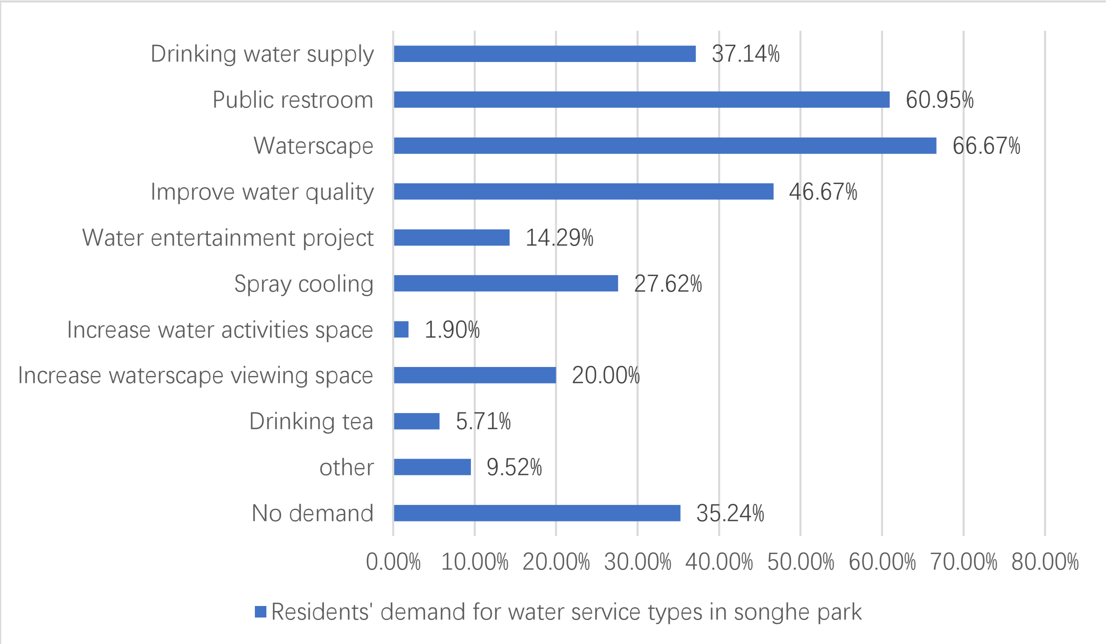


Figure 4.3 Residents want to get the type of water service in the park (Source: Author)

Residents generally support the park to save water, and 55.24% of the residents support the park to use the high-quality drainage of residential buildings as the reclaimed water source for the park. At the same time, residents support households to implement sewage and wastewater diversion systems, establish a reclaimed water collection system, collect high-quality drainage and reuse, and reduce household and park water fees. Residents hope that the reclaimed water collection will bring common benefits to families and parks. In the family, you can also use the water, which can bring tangible living convenience to the residents; but the residents are generally unwilling to bear the cost, hoping to have relevant policy support.

In the water as water aquaculture, seafood market business views showing two views of half of people believe that water can be used as a breeding water; they are willing to reduce the cost of water use in another part of the businesses that use water to worry about the water quality on the survival of seafood, causing losses. Meanwhile, some residents believe in aquaculture seafood possible health threat.

4.2.3 Investigation on Residents' Committee of 50th and 90th Tieling Road

The person in charge affirmed the value and significance of the collection and utilization of the reclaimed water, and also supported the practice; however, it said that the construction of the water collection system needs to be supported by relevant policies, and the cost of construction and management needs to be assessed, and who will bear the cost of construction. At the same time, the water storage equipment should not occupy the public space of the community and affect normal traffic.

4.2.4 Investigation of related managers of Matsue Park

The author interviewed Shanghai Yangpu Landscaping Construction and Maintenance Co., Ltd., Songhe Park Director and duty personnel (including teahouse management personnel) on the design of Songhe Park water comprehensive utilization service system.

Shanghai Yangpu Landscaping Construction Maintenance Co., Ltd. (hereinafter referred to as the garden company) is responsible for the daily operation of the community park. The relevant person in charge of the garden company said that it has been paying close attention to the problem of water waste and pollution in Songhe Park. It also pointed out that the other nine community parks in Yangpu District are facing the same problem. Due to the limitations of the water structure of the park, the water pollution in the park and the downstream of Yangshupu Port requires the investment, manpower and equipment to be rectified every year. Other water services rely on tap water, but the water consumption is increasing every year.

At present (2018), the garden company has been entrusted by the relevant departments to carry out actions on the water environment management of the Yangpu

District Community Park, and publicly invite the public to bid for the water quality improvement plan. The garden company manages and maintains the park from the work content, and essentially recognizes the sustainable development of water services. The company is in favor of using water in the park as one of the park's water sources. The person in charge believes that Zhongshui can be obtained from the wastewater of the park and surrounding communities and is satisfied by simple diversion and purification.

The person in charge of the garden company also counts that Songhe Park has an annual operating cost of more than 500,000. The use of water can reduce the water fee of the park, and the water body can reduce the related expenses. If these measures can be applied to other community parks, each year. Save hundreds of thousands of dollars on water services in community parks. However, the need for pipeline renovation and the construction of a purification system requires a mature design, and there is no further action plan in this regard.

The director of Songhe Park and the staff on duty expressed support for the park to save water and improve the water environment of the park. At the same time, it also pointed out that the current management of the park on water services is difficult. The director thinks that the original design of the park's observation pool and fountain is mainly for viewing function. The bottom of the pool is closed. The water is not flowing, and the water quality will only get worse and worse. Every year, the water is replaced, or the bottom of the pool is cleaned. Considerable trouble, it is recommended that the pool water can be circulated and purified, reducing water pollution and unnecessary management costs. The director also believes that the use of tap water as the main water for the park since the establishment of the park, such as flushing water and plant irrigation water, is indeed quite wasteful. If the pipeline can be retrofitted, the addition of the water pipeline will be beneficial to the future water service operation.

4.3 Feasibility analysis of output

The output of the current system mainly includes all kinds of drainage, tea dregs and silt. The quality of the output produced in the current system and the backflow of the new system are analyzed to find the new system connection.

4.3.1 Feasibility analysis of tea residue utilization

Tea slag contains water and dry matter; its main chemical components are crude protein, crude fiber, vitamins, tea polyphenols, amino acids, alkaloids, etc.[51]. Tea slag is widely used to control the environment and improve water quality. It can also be used as organic fertilizer raw materials, raw materials for activated carbon, raw materials for animal feed, raw materials for edible fungus culture materials, and raw materials for extracting active ingredients[52]. Tea slag contains a large amount of protein, which is hydrolyzed by the action of soil microorganisms and can be directly converted into nitrogen fertilizer. It is a natural fertilizer for plants[53].

Figure 4.4 Tea slag quality analysis chart (Source: author)

Making tea residue into fertilizer can improve soil fertility, improve soil structure and promote plant growth. There are many plants in Songhe Park and surrounding communities, and there is a certain demand for fertilizer. The development of tea residue as a raw material for tea residue is a way to improve economic efficiency and reduce waste of resources. At the same time, it can reduce the damage of fertilizer to soil fertility and promote plant growth. Using tea residue to make tea residue fertilizer, the soil can completely digest the waste tea residue[54]. The tea residue is added with fermenting bacteria, and the lignocellulose in the tea residue is biodegraded by microbial technology, and the solid waste of tea residue can be effectively treated[55]. At present, Hu Minqiang[56] and other researchers added Trichoderma fermentation

51 Liu Hongyun, Liang Huiling. Study on the Application of Tea Dregs as Feed[J]. Feed Research, 2004(9): 19-20.
52 Xie Feng, Jin Lingli, Tu Juan, et al. Research Progress in Comprehensive Utilization of Tea Wastes[J]. Agricultural Science & Technology, 2015, 31(7): 1552-1557.
53 Qiu Fangfang, Yang Xiaoping. Application of Tea Dregs Fertilizer[J]. Fujian Tea, 2011, 33(6): 21-23.
54 Qiu Fangfang, Yang Xiaoping. Application of Tea Dregs Fertilizer[J]. Fujian Tea, 2011, 33(6): 21-23.
55 Xi Beidou, Liu Hongliang, Bai Qingzhong, et al. Research status of biodegradation of cellulose and lignin in composting[J]. Chinese Journal of Environmental Engineering, 2002, 3(3):19-23.
56 Hu Minqiang, Wang Yuefei, Xu Xiazhong, et al. Experimental study on the fertilizer efficiency of tea residue bio-clean organic fertilizer[J]. , 2006, 32(3): 145-147.

metabolites in tea residue, developed tea residue organic fertilizer, and concluded that tea residue fertilizer is higher than inorganic fertilizer, and has a greater buffer on soil acidification. It also purifies sewage and removes odors. Tea residue becomes a clean and efficient bio-organic fertilizer.

4.3.2 Feasibility analysis of sludge utilization

The observation tank sludge contains a large amount of water, organic matter, sludge surface organisms, mineral sediments and fish manure. The main components are organic compounds, carbohydrates and nitrogenous compounds. The sludge contains available nutrients such as organic matter, potassium, nitrogen, phosphorus, various vitamins and minerals, which are potential plant growth and utilization values[57].

Figure 4.5 Silt quality analysis chart (Source: author)

Silt has a high economic value and is widely used. The sludge can be made into a highly efficient and clean fuel[58], and can also be made into fertilizer or ecological building materials. Combined with the situation of Songhe Park, sludge can be used as a fertilizer for plant growth. Songhe Park has a green area of 8,400 square meters and requires about 1334 kg of organic fertilizer per year. Silt fertilizer is a good organic fertilizer. It can be used for plant growth to prolong flowering period, be highly efficient and clean, and not pollute.

The average annual sediment thickness of a fishpond is 10-12cm[59], and the average value is 11cm. The Songhe Park observation pool and the fountain produce 148.5m^3 of sludge (wet sludge with a moisture content of 99%). For the treatment of the current sludge, 7.4m^3 sludge fertilizer (concentrated dewatered sludge with a water content of 80%) can be produced by simple composting, drying and disinfecting the sludge.

57 Hong Jianping, Yao Haiping, Liu Jiping, et al. Analysis and Evaluation of Silt Resource Utilization in Shanxi Zhangze Reservoir[J]. Journal of Soil and Water Conservation, 2006, 20(6): 153-156.
58 Dou Guangyu. Silt can also be used as energy source [J]. Earth, 2005(2): 13-14.
59 Zhang Wanxiang. Ecological Function and Control Measures of Mud in Farming Ponds[J]. Guide to Fisheries, 2003, 28(3): 22-22.

Although it is not the same as the nutrient structure and use efficiency of other organic fertilizers, it can also meet the annual fertilizer use of the park and can be distributed to surrounding residents.

Although the sludge of the current system can produce economic value after treatment, the generation of sludge is also an environmental problem that affects water quality. In the new system, the generation of sludge should be reduced, the goal of zero emission should be established, and the amount of sludge should be reduced. Silt is a deposit formed by the action of physicochemical organisms in a closed, static, flowing environment of water. Establishing a flowing water environment can effectively reduce the amount of sludge.

For the sludge fertilizer produced after the current sludge treatment, due to the large amount, it needs to be properly disposed. An economically viable way of sludge treatment is to make sludge fertilizer before the winter fertilization in the park. After meeting the demand of the park plants, it is distributed to the surrounding residents. The surrounding residents have planted more horticultural plants, which have a certain demand for fertilizers. Silt fertilizers can help the residents to plant horticulture.

4.3.3 Feasibility analysis of residential building wastewater utilization in 50, 90, 110 Tieling Road

Community building wastewater can be effectively utilized. After the urban water supply is used, 80% of the water is converted into sewage, but after being collected and treated by the water system, about 70% of the water becomes recycled water and can be recycled[60]. This kind of reclaimed water is the result of purification of all sewage. If it is to provide high quality medium water for Songhe Park, it will use sewage and wastewater to separate and collect high quality wastewater, and the water quality will be higher.

The advantages of water in community buildings are high quality, large quantity, stable supply all year round, fixed source, no infectious or radioactive wastewater, and quality controllable. After purification and compliance with national water quality standards, the reclaimed water can be reused.

The indicators for building domestic drainage water quality are mainly BOD5,

[60] Yuan Shuqing, Lu Chunguang, Zhao Zhulin. Discussion on How to Develop Urban Reclaimed Water Utilization[J]. Inner Mongolia Water Resources, 2009(6): 100-101.

CODcr and SS. Different categories produce different levels of drainage pollution, as shown in Table 4.1. According to the national standard "Code for Design of Water in Buildings" (GB50336-2002) and the method of using recycled water for "Urban Sewage Recycling - Landscape Environment Water Quality" (GB/T 18921-2002), the water source of the medium water should be low in pollution concentration. High-quality living and miscellaneous drainage with stable water supply, namely shower drainage (including bath and shower), wash drain, air conditioning condensate, laundry and clean drainage; while taking into account the reduction of water treatment costs, simplifying the process of water treatment, water Sources and locations should be as close as possible.

Table 4.1 various discharge pollution concentrations of residential buildings
(source: code of design for water in buildings (GB50336-2002))

Category	Residential		
	BOD5	CODcr	SS
Flushing	300～450	800～1100	350～450
Cooking	500～650	900～1200	220～280
Shower	50～60	120～135	40～60
washing	60～70	90～120	100～150
Laundry	220～250	310～390	60～70
Comprehensive	230～300	455～600	155～180

According to Table 4.1, the drainage drainage and washing drainage have the highest quality, followed by the laundry drainage; the flushing and kitchen drainage quality is the lowest. In combination with the residential water use category of the 50, 90, and 110 residential areas of Tieling Road, the quality of the water sources in the buildings that can be selected from high to low are:

(1) Drainage of the shower

(2) Washing drainage

(3) Drainage of air conditioning circulating cooling system

(4) Drainage for washing and washing

(5) Drainage of the kitchen

(6) Drainage of toilet

From the perspective of quality, the main water sources in buildings are shower, toilet and condensation drainage; At the same time, the drainage of washing and cleaning can also be utilized; And the discharge pollution concentration of the kitchen and flushing toilet is higher, do not suit to be used as reclaimed water source, because this is in the choice of reclaimed water source can choose above in addition to the kitchen and other drain outside flushing toilet. According to the code for the design of water in buildings (GB50336-2002), it is generally required that the collection rate of drainage shall not be less than 75%; In this study, recycling projects in songhe park and community residents' water use were uniformly calculated according to the collection rate of 75% of the water supply. The displacement of the three buildings can be collected is about 193631m^3/year, with an average of 530.5 m^3 per day (air conditioning condensation water cannot be counted, so it is not included in the displacement).

4.3.4 Feasibility analysis of wastewater utilization in songhe park

The main types of drainage in songhe park are toilet drainage, cleaning drainage of toilet, quality cleaning drainage, tea water, pool water, etc. In the choice of medium water source, the high pollution concentration of flushing and cleaning discharge of toilet is not considered.

High-quality cleaning and drainage include washing hands, cleaning and disinfection of tea utensils, which mainly contains water, detergent, washing powder, disinfection tablets, particle impurities, dust and bacteria. The main ingredients of cleaning materials such as detergent are surfactant, bacteriostat, various auxiliaries and other additives. Such drainage can be disinfected sterilization, odor elimination, oxidative decomposition of harmful substances; Its pollution concentration is low, equivalent to residential building laundry drainage, can be used as a source of water.

Figure 4.6 quality analysis of clean drainage (source: author)

The remaining water of tea mainly contains water-soluble substances, impurities and bacteria in tea. The water-soluble substances mainly include tea polyphenols, alkaloids, amino acids and sugars. Tea has the function of removing bacteria, removing stains and peculiar smell. Is a kind of exploitable resource, can be used as medium water source?

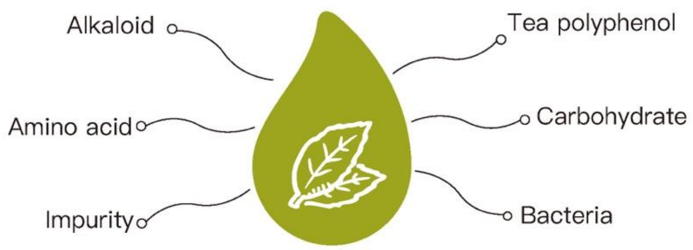


Figure 4.7 tea quality analysis chart (source: author)

Pool water and ground water drainage water is composed of tap water and rainwater. Rainwater mainly contains water, sulfur dioxide, nitrogen dioxide, minerals, particulate impurities and bacteria. The PH value of rainwater in Shanghai in 2016 was 5.22, which was slightly acidic[61]. The pollution concentration of rainwater source is low, which can be used as medium water source.

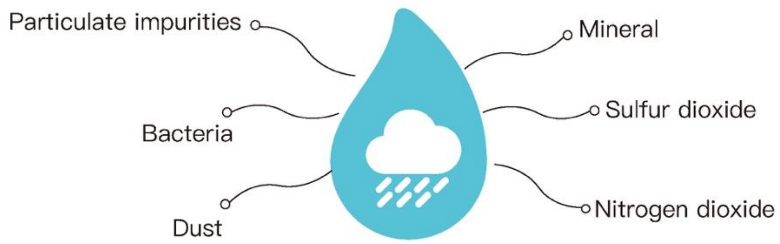
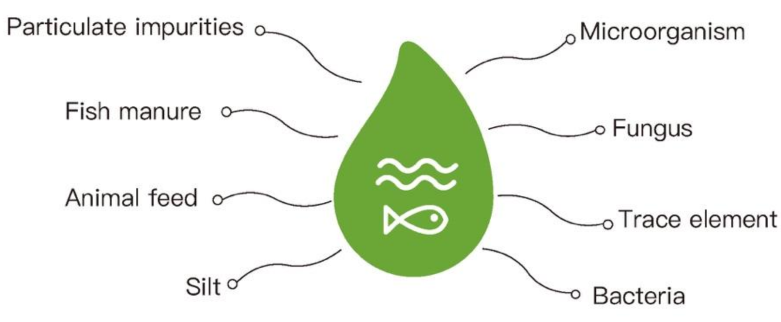


Figure 4.8 quality analysis of rainwater (source: author)

The water in the pool mainly contains microorganisms, fungi (algae plants), microelements, particle impurities, fish dung, feed, silt, bacteria and other substances. PH range is 6.5 ~ 8.5; The water is rich and green. Pool water pollution is low, can be used as a source of middle water.



[61] Shanghai Environmental Protection Bureau. Shanghai Environmental Status Bulletin [M]. Shanghai Environmental Protection Bureau, 2016.

Figure 4.9 pond water quality analysis (source: author)

The surface drainage mainly contains trace elements, particle impurities and other substances. Due to the complexity of pollutants on the ground, high concentration of COD and heavy metal, the water quality of surface drainage in initial runoff was poor. So, it's not a source of intermediate water.

To sum up, songhe park can collect and utilize general clean drainage, tea water and pool water. Statistics show that songhe park can collect general cleaning drainage of 263.77m^3/year, tea water of 25.62m^3/year and pond water of 2636.29m^3/year.

4.3.5 Feasibility analysis of drainage utilization in the seafood market of Tieling Road

The cultured drainage in the seafood market mainly contains organic matter and nutrients (nitrogen, phosphorus), feed and excreta. Currently, the drainage of farmed water is discharged to the rainwater pipeline, which increases the pollution of Yangshupu Port and needs improvement in the discharge channel. On the other hand, the aquaculture drainage component is simple, the pollutant concentration is low, the pollution type is small, the water quality is stable, and the culture drainage can be reused by simple biological purification treatment[62]. According to the collection rate of 75% of the water supply, the seafood market can collect 1350 m^3 of water per year, an average of 3.7 m^3 per day.

4.3.6 Feasibility analysis of building drainage collection project

The residential buildings 50, 90, 110 in Tieling Road and the public restrooms in Songhe Park, the original drainage pipes of the teahouse buildings are combined with sewage and wastewater and are provided with sewage pipes and wastewater pipes. The middle water collection system can separately collect the wastewater by means of the method of intercepting the wastewater, so that the sewage waste merges into the waste and wastes. At present, there are many projects for wastewater interception of old buildings at home and abroad. Generally, the wastewater interception is carried out before the drainage is collected, and the wastewater drainage pipeline is added to obtain

[62] Feng Hong. Study on the treatment of aquaculture wastewater by sequencing batch biofilm method [D]. Beijing University of Chemical Technology, 2014.

the water source. The method has a small amount of engineering, is easy to construct, and has low cost.

These buildings are closest to the park, with high quality water sources, short pipelines and low costs. Reclaimed water can be used to bring tangible benefits to parks and communities as well as downstream rivers.

4.3.7 Feasibility analysis of rainwater harvesting project

In the collection and utilization of rainwater, the rainwater of the park pool can be mainly collected. It is convenient to collect rainwater from the pool body of the park, and the collection amount is large, and the rainwater can be effectively stored and used. Although the amount of rainwater collected by underground rainwater pipelines is large, the initial runoff pollution is relatively high, and it is difficult to control the quality of rainwater. At the same time, the rainwater is seasonal, and the monthly collection quantity is unstable, which is difficult to be used as a fixed water source for medium water. Technically, the underground pipeline rainwater needs to be collected through the pipeline and then enters the filtration system to abandon the sewage interception and sedimentation before entering the water storage system. It is necessary to renovate the current rainwater pipeline, which increases the difficulty and cost of the work. The collection of building rainwater is complicated in the construction of the collection system. It is necessary to establish a relatively complicated collection system or to reconstruct the building. The cost is high, and maintenance is required.

Songhe Park should be adapted to local conditions, using economical and simple rainwater harvesting methods suitable for park scales; discarding complex and inefficient methods will help save costs and improve operational efficiency.

4.4 Analysis of water demand in the comprehensive utilization service system of water

In the current situation system research and opinion polls, it is found that in the demand for water, Songhe Park is mainly used for landscape water and non-direct contact with human body.

4.4.1 Analysis of quality requirements for reclaimed water

Songhe Park is located in Shanghai, China, so the water quality standards for all activities are implemented in accordance with China's water quality requirements.

The projects involved in reclaimed water in Songhe Park mainly include plant irrigation, flushing water, cooling spray water, and clean water for teahouse and washroom. Due to the high requirements for drinking water quality, the water quality should meet the water quality standards of the "Sanitary Standard for Drinking Water" (GB5749-2006). In order to ensure the safety of drinking water for tourists, the water should not be considered as a source of drinking water. The water quality range of other water sources is within the "Classification of Urban Sewage Recycling" (GB/T 18921-2002), and the water quality of the projects involving Zhongshui only needs to meet the various water quality requirements in the standard.

According to the type of water used in the park, the order of water quality demand from high to low is: recreational landscape water (summer cooling spray), waterscape water (viewing pool and fountain), river landscape water (Yangshupu Port), Urban greening miscellaneous water (plant irrigation in the park), flushing of miscellaneous water and cleaning of miscellaneous water (tea house and public restroom).

The summer cooling spray is a new water project after the park poll. The water type is recreational landscape water (human body non-systemic contact water). If water is used as landscape environment water, the water quality should meet the water quality standard of recreational landscape water (waterscape) in "Urban Sewage Recycling-Landscape Water Quality" (GB/T 18921-2002).

The river landscape water is the park that supplies clean water to Yangshupu Port. The water quality exported to Yangshupu Port shall comply with the water quality standards for ornamental landscape environmental water (river type) of "Urban Sewage Recycling-Landscape Water Quality" (GB/T 18921-2002).

Water for fountains is water for waterscapes, water for water for waterscapes, water quality should meet the water quality of ornamental landscape water (waterscapes) in Urban Wastewater Reuse-Landscape Water Quality (GB/T 18921-2002) standard.

Plant irrigation water belongs to urban greening miscellaneous water. If the reclaimed water is used as urban green water, the water quality should meet the urban greening water quality standard in "Urban Wastewater Recycling-Urban Miscellaneous Water Quality" (GB/T 18920-2002).

Flushing water is used for flushing miscellaneous water. If reclaimed water is used for flushing miscellaneous water, the water quality should meet the water quality standards for flushing water in “Urban Sewage Recycling-Urban Miscellaneous Water Quality” (GB/T 18920-2002).

Clean water is mainly used in the teahouse of the park and the window sill of the public restroom and the cleaning of the floor and the cleaning of the toilet. It belongs to the construction miscellaneous water, and the water quality should be in accordance with the "Urban Sewage Recycling - Urban Miscellaneous Water Quality" (GB/T 18920-2002). The road cleans the water quality standards.

If the reclaimed water service park is used for aquaculture water outside the park, the water quality will have higher requirements. According to the Code for Design of Wastewater Recycling Engineering (GB.T50335-2002), urban sewage recycling can be used in aquaculture, and the water quality should meet the Fishery Water Quality Standard (GB11607-1989), which is equivalent to the environmental quality of surface water. Class III water quality in the Standard (GB3838-2002).

4.4.2 Quantity demand analysis of recycled water

Water demand for flushing water is 3.02m^3 /d; On the irrigation water for plants, the water requirement in the irrigation of plants is 2.23m^3/d except for rainwater irrigation. Clean water includes window and floor cleaning and toilet cleaning in teahouse and public toilet. Water consumption in teahouse and public toilet is 0.06m^3/d and 0.16m^3/d respectively. The cooling spray water is mainly used in summer. The water consumption of the spray machine is 0.3m^3 per hour, which is calculated as 8 hours per day. The water requirement of the cooling spray machine is 2.4 m^3 per day. River landscape water is used to transport clean recycled water for yangshupu port. The water quantity is the remaining recycled water for clean water every day after meeting the water demand of the above project. There is no fixed quantity requirement, which depends on the water purification capacity.

4.4.3 Summary of reclaimed water demand

Pine crane park comprehensive utilization of water service system demand of reclaimed water at least 12.94 m^3 / d (as shown), water quality to meet the surface water environment quality standard "(GB3838-2002) in Ⅲ class water quality standard, such as table 4.2.

Table 4.2 Statistics of reclaimed water demand in songhe park water service system

(Source: author)

Type	Water demand （m^3/d）	Water quality requirements
Flushing water	3.02	Water quality standards for flushing water
Plant irrigation	2.23	Urban green water quality standard
Washing water	0.22	Water quality standards for road cleaning
Fountain water	0.14	Water quality standards for ornamental landscape water (waterscape)
Cooling spray (summer only)	2.4	Water quality standards for recreational landscape water (waterscape)
River landscape water	⩾0	Water quality standards for ornamental landscape water (river courses)
Aquaculture water	4.93	Surface water type III water quality standard
Total	⩾12.94	Surface water type III water quality standard

4.5 Water service system wastewater treatment methods

The main wastewater treatment methods are compared as follows, and the suitable treatment methods for songhe park are selected.

4.5.1 Comparison of wastewater treatment methods

The wastewater treatment methods are divided into physical method, chemical method, physical chemical method and biological treatment method. Currently, there are many kinds of sewage treatment technologies, including activated sludge process, biofilm process, ecological treatment system and MBR process (qian yuting, 2017). These processes have their own advantages and disadvantages. A general comparison is made as follows, as shown in table 4.3.

Table 4.3 comparison of sewage treatment methods (source: author)

process		advantages	disadvantages	form
Activated sludge process	A/O process	Pollution removal phosphorus removal nitrogen removal efficiency, high water quality, quantity	It has certain requirements on wastewater, needs to cultivate activated sludge, high	Structures and electromechanical equipment
	A/A/O process			
	Oxidation ditch process			

	The SBR process		treatment cost, large area, high energy consumption, needs to build structures, and some processes have high requirements on automation	
	CASS/CAST process			
Biological membrane	Biological aeration filter	Microorganism quantity is much, place water ability is strong, net water amount is big, sludge yield is little, do not breed mosquito and odour easily	It needs more filler, difficult to control active organisms, and turbid effluent	construction
	Biological contact oxidation			
Ecological treatment system	Constructed wetland technology	Improve the environment, low construction cost, easy management, good effluent effect, simple process, and good coordination with the natural environment	It is susceptible to diseases and pests and has limited water purification capacity	It can form aquatic ecological landscape
	The oxidation pond	Simple structure, suitable for local conditions, low construction cost and low sludge production	It has a large footprint and is prone to odor, sludge is difficult to handle, and is affected by temperature.	Water ecological landscape
The MBR process		Good effluent quality, high pollutant removal rate, low sludge production, small footprint, no restrictions	Complex process, high equipment cost, high energy consumption, difficult to manage membrane contaminants, pretreatment of influent water	construction

Activated sludge process, biofilm process and MBR process have great advantages in the quantity and quality of purified water and sludge production control, but all need to establish a different type of sewage treatment equipment, which has high cost and maintenance cost. The area is large, the appearance of the structure is difficult to coordinate with the community park, and it needs frequent management and maintenance, which is suitable for use in professional sewage treatment plants.

The ecological treatment system not only has an ecological landscape, but also has a harmonious connection with the landscape of the community park. The construction and management cost is low, the effluent quality is high, and the production potential of natural resources is fully utilized, and the work effect is good.

4.5.2 Selection principles of wastewater treatment methods

The selection of wastewater treatment methods should meet the quality and quantity requirements of the effluent of the water comprehensive utilization service system. Select low cost, high return, meet the tourists willing to waste water treatment methods; At the same time, it can improve and enhance the water landscape of the park by giving priority to the landscape effect.

4.5.3 Determination and demonstration of wastewater treatment methods

Songhe park has a 1300m^2 viewing pool with moderate water volume and is adjacent to and connected to the river channel with good water storage and drainage conditions. Combined with the conditions, functions and demands of songhe park, the quantity of reclaimed water is not large, the quantity and quality of wastewater sources are stable, and the water quality changes little. Therefore, the wastewater treatment system can establish an ecological treatment system.

In the ecological treatment system, it is mainly divided into artificial wetland technology and oxidation pond. In the park, artificial wetland system is applied more. Constructed wetland system not only has the strong water treatment ability, but also has the aquatic plant landscape. Since the first artificial wetland was established in Britain in 1903, a number of demonstration projects have been set up around the world, ranging from large lakes to small wetlands in villas and gardens.

Artificial wetland system of effluent water quality can reach the national standard "surface water environment quality standard" (GB3838-2002) Ⅱ-V class water quality standard[63], according to the plant inside the pool, packing and process of different and different water quality.

In order to prove the artificial wetland can under the condition of pine crane park construction and meet the pine crane park daily water demand, the following list of four typical, effluent water quality conforms to the urban sewage recycling - landscape water quality standard (GB/T 18921-2002) and more artificial wetland cases as pine crane park construction feasibility of artificial wetland construction reference.

He qiang et al.[64]applied SBR sewage treatment technology and subsurface flow artificial wetland technology to the artificial wetland project in a dormitory area of a university in chongqing for the purification treatment of domestic wastewater and toilet sewage. The constructed wetland area of the project is only 9.3m^2, while the sewage treatment capacity is up to 1.5m^3/d, and the surface load of the wetland is 0.16m^3/m^2/ d. The main factor of this value is the advantage of SBR wastewater treatment technology. The SBR reaction pool covers an area of 1m^2, with a depth of 1.3m. The combined constructed wetland covers an area of less than 11m^2. The success of this project brings enlightenment: the miniature constructed wetland can also have good water quantity and quality.

Ma wei and Cheng Yuanyuan stated that although the high-water yield is mainly caused by the high-water quality of the project, which is mainly caused by rainwater, it also brings some reference value: the pure constructed wetland has high water purification efficiency[65].

Yu tongliu et al.[66] constructed wetland project in lantian ecological park of honghu lake, hubei province, covering an area of 1440m^2, with poor water quality, mainly catering, toilet sewage and other domestic wastewater; After the basic treatment of septic tank, the sewage is discharged to the artificial wetland combined with surface flow and undercurrent, as shown in figure 4.10. The sewage treatment capacity is 40m^3/d, and the wetland surface load is 0.028m^3/m^2/ d. The project proves that the water under the condition of water quality of sewage, after dealing with the basic septic tank,

63 Kang Junli. Feasibility of Constructed Wetland Ecosystem in Urban Wastewater Reuse[J]. Environmental Sanitation Engineering, 2004, 12(2): 114-117.

64 He Qiang, Liang Jianjun, Chai Hongxiang, et al. Experimental study on the treatment of domestic sewage by combined process of SBR and constructed wetland[J]. Construction Science and Technology, 2008(14):16-20.

65 Ma Wei, Cheng RmbRmb. Water reuse technology of constructed wetland in a residential area in Sichuan[J]. Sichuan Environment, 2014, 33(2): 95-97.

66 YU Tong-Li, YANG Ji-Hong, HUA Liu, et al. Demonstration Project of Hotel Sewage Treatment of Hotel Sewage in Scenic Spots[J]. Science and Technology Pioneering Monthly, 2008(4):131-133.

artificial wetland still has the ability to purify the national standard "surface water environment quality standard" (GB3838-2002) in Ⅳ class water quality standards.

Figure 4.10 water purification system of honghu lantian ecological park (source: author)

The area of constructed wetland in Chengdu Living Water Park of Shanghai World Expo is 500 m^2 [67]. As shown in Figure 4.11, by constructing horizontal subsurface flow constructed wetland, the class IV water quality in the Surface Water Environmental Quality Standard (GB3838-2002) can be treated as class III water quality standard with the treatment capacity of 15 m^3/d and the wetland surface load of 0.03 m^3/m^2/d. This project proves that the effluent quality of pure constructed wetland can reach a higher water quality standard.

[67] Liu Xuexiang. Constructed Wetland Treatment System of Chengdu Living Water Park in Shanghai World Expo[J]. Shanghai Construction Science & Technology, 2010(6): 62-64.

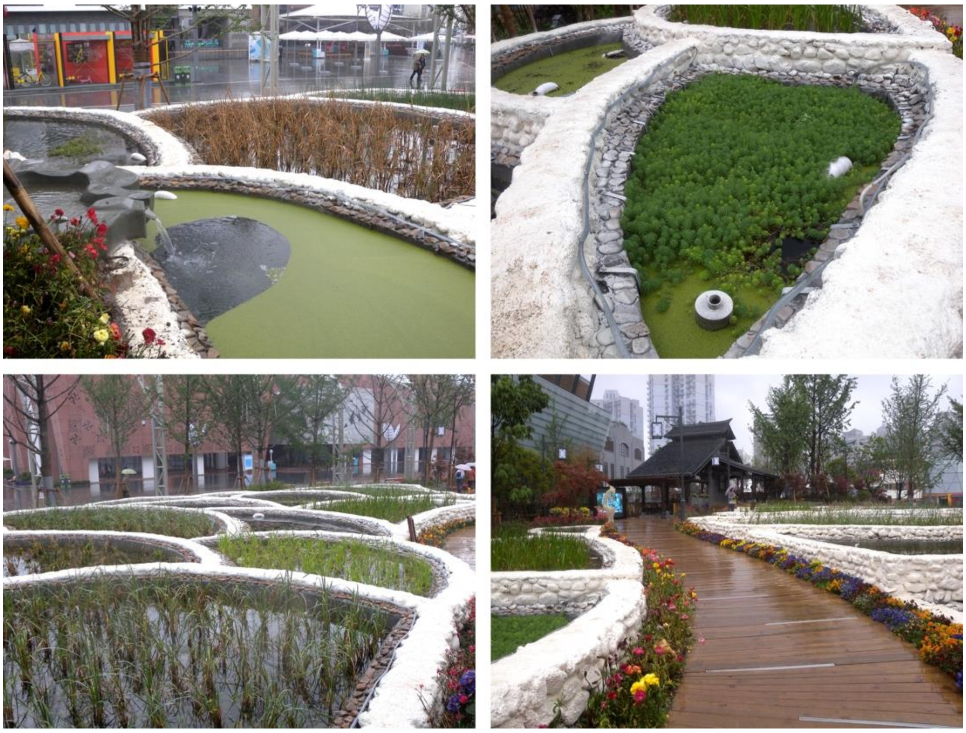


Figure 4.11 chengdu live water park of Shanghai world expo (Source: http://bbs.zhulong.com/)

The four artificial wetland demonstration project from technology combined with different conditions, such as size, inlet water quality factors proved that artificial wetland effluent water quality can meet the national standards "surface water environment quality standard" (GB3838-2002) in Ⅳ class above water quality standard, even can reach Ⅲ water, artificial wetland system design in the pine crane parks provides practice basis, such as table 4.4.

Table 4.4 main reference data of the constructed wetland demonstration project (author)

pproject	inflow water quality	main processing technology	constructed wetland area （m^2）	main plants	effluent quality	wetland surface load （$m^3/m^2/d$）	handling capacity （m^3/d）
Dormitory area of a university in Chongqing	Domestic wastewater, toilet sewage	SBR sewage treatment process and subsurface flow constructed wetland	9.3	Windmill grass and candied Canna	Standard for landscape environmental water quality (GB/T18921-2002)	0.16	1.5

A district in Sichuan	Rainwater, swimming pool water	Subsurface flow constructed wetland	16667	reed	Standard for landscape environmental water quality (GB/T18921-2002)	0.08	1339
Lantian ecological park, Honghu, Hubei	Catering sewage, toilet sewage and another domestic wastewater	Septic tanks combined with surface flow and subsurface flow constructed wetlands	1440	Water bamboo, reed, cattail	Type IV water quality standards for surface water environmental quality standard (GB3838-2002)	0.028	40
Live water park in chengdu, Shanghai world expo	Low concentration of domestic wastewater, rainwater	Horizontal subsurface constructed wetland	500	Cattails, reeds, rushes, etc	Type III water quality standards in the "surface water environmental quality standard" (GB3838-2002)	0.03	15

The viewing pool area of Songhe Park is 1300 m^2. If the viewing pool is transformed into a constructed wetland system, the daily sewage treatment of each constructed wetland per square meter in the above four demonstration projects is calculated. The reclaimed water outflow is far more than the daily demand of the park's reclaimed water. According to the surface load of constructed wetland in Chengdu Living Water Park of Shanghai World Expo is 0.03 $m^3/m^2/d$, the theoretical reclaimed water discharge from Songhe Park is 39 m^3. According to the daily demand of reclaimed water 12.94 m^3 in the park, the reclaimed water from the constructed wetland system can fully meet the reclaimed water demand of the park, and the water quality can meet the Class III water quality standard of the Surface Water Environmental Quality Standard (GB3838-2002).

4.5.4 Summary of wastewater treatment methods

From the above demonstration, the constructed wetland system has brought practical feasibility to the Songhe Park wastewater treatment. Constructed wetland system can be competent in terms of function and demand, landscape, economy and residents'wishes. It is a kind of wastewater treatment scheme with high cost performance. Therefore, constructed wetland technology is chosen as a technology for wastewater treatment in pine crane park.

The design of constructed wetland system will be discussed in detail in the fifth chapter.

4.6 Songhe park water service system design

4.6.1 Design principles

Songhe park water service system design mainly around the system design principles, universality principles and participants'opinions.

4.6.2 Design objectives

The design of water utilization system for pine crane park is divided into short-term and long-term objectives.

From the current point of view, the design goal is to improve the ecological, social, cultural and economic benefits of water services in Songhe Park; so that Songhe Park not only has the functions of water saving, water storage, water purification, but also a landscape, interactive, and promote harmonious neighborhood relations. The design will improve the efficiency of the park's water service and export clean water to the park's internal water service, Yangshupu Port and the surrounding seafood market, as shown in Figure 4.12.

In the long run, the water service system of Songhe Park will map the surrounding areas to serve the surrounding communities, so that families and businesses in the surrounding communities can reduce the water consumption and improve social benefits.

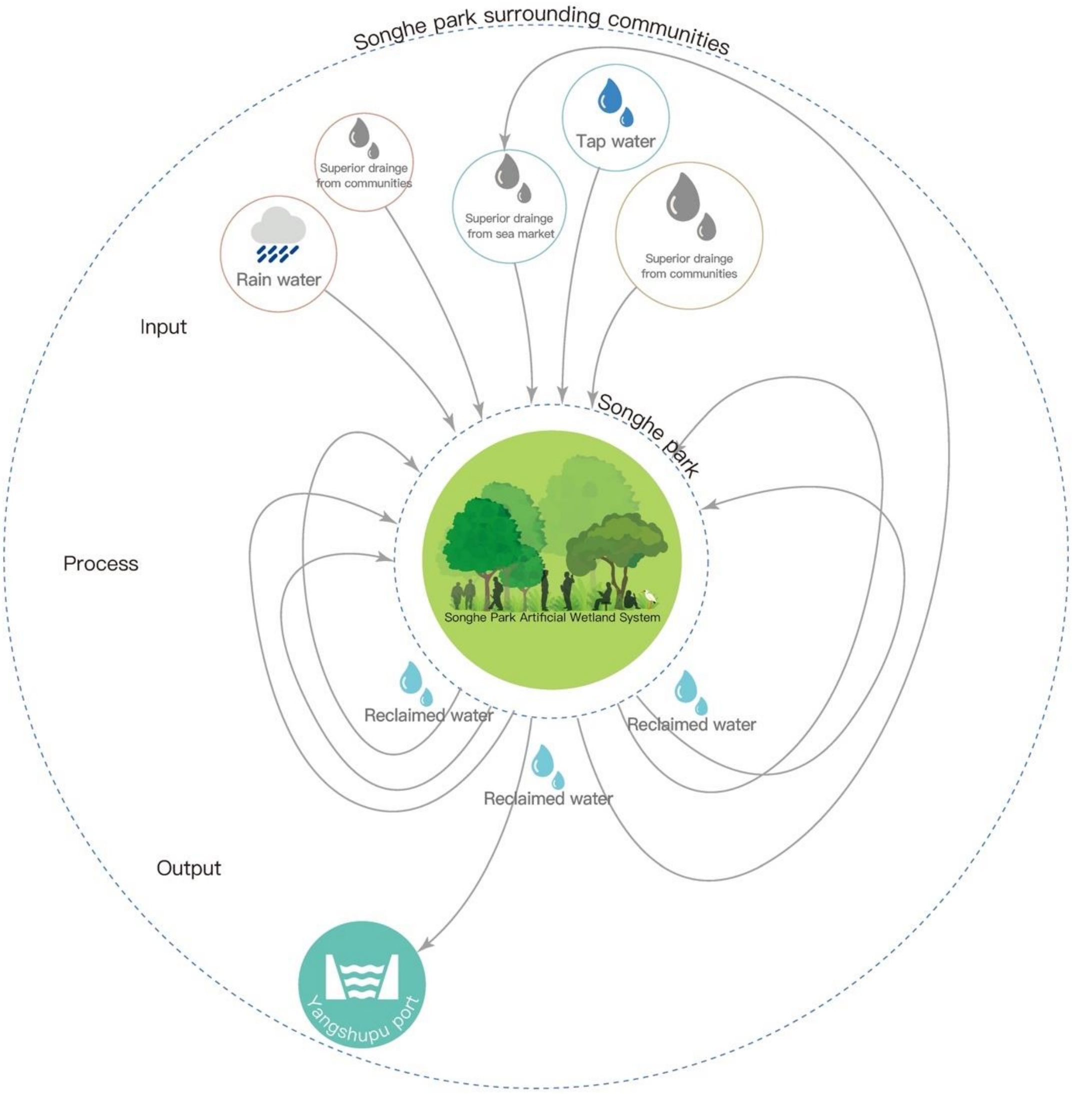


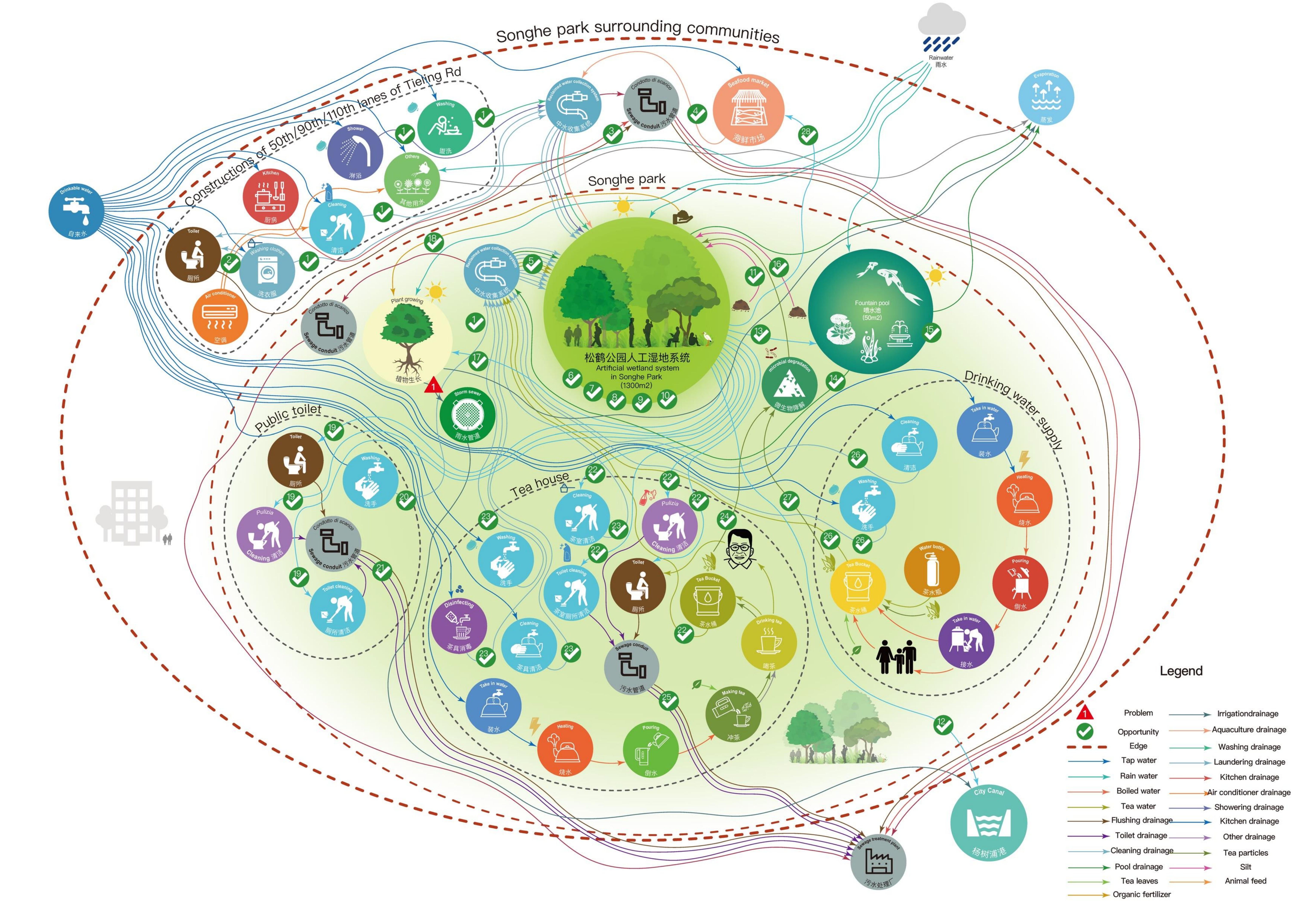
Figure 4.12 design objective of water service system in pine crane Park (Source: author)

4.6.3 Establishment of a new system

The design of the Songhe Park water service system is mainly established from three parts of the system, namely water input, water operation and water output. In the input, through the establishment of community cooperation, the use of water in the surrounding communities, reduce the use of tap water; in the process, improve the efficiency of water services, collect various types of wastewater, through the establishment of artificial wetland systems, to achieve water purification in the park, and to achieve Circulating water; on the output, exporting clean water, serving the downstream rivers and surrounding seafood markets; and establishing a sustainable, self-generated water comprehensive utilization service system as a whole, as shown in Figure 4.13. From the original linear model that relies on tap water consumption to a resource recycling model that uses recycled water. At the same time, the new system also increases the utilization of other outputs, making system waste tend to “zero emissions”.

Figure 4.13 Songhe park water service system design (source: author)

See next page, A3



Songhe park surrounding communities
Constructions of 50th/90th/110th lanes of Tieling Rd
Songhe park
Drinkable water
自来水
Rainwater
雨水
Evaporation
蒸发
Kitchen
厨房
Shower
淋浴
Washing
盥洗
Others
其他用水
Cleaning
清洁
Toilet
厕所
Washing clothes
洗衣服
Air conditioner
空调
Reclaimed water collection system
中水收集系统
Condotto di scarico
Sewage conduit 污水管道
Seafood market
海鲜市场
Plant growing
植物生长
Storm sewer
雨水管道
松鹤公园人工湿地系统
Artificial wetland system
in Songhe Park
(1300m2)
Fountain pool
喷水池
(50m2)
microbial degradation
微生物降解
Public toilet
Pulizia
Cleaning 清洁
洗手
Toilet cleaning
厕所清洁
Tea house
茶室清洁
茶室厕所清洁
Disinfecting
茶具消毒
茶具清洁
Take in water
装水
Heating
烧水
Pouring
倒水
Making tea
冲茶
Drinking tea
喝茶
Tea Bucket
茶水桶
Sewage conduit
污水管道
Drinking water supply
Water bottle
茶水瓶
接水
City Canal
杨树浦港
Sewage treatment plant
污水处理厂
Legend
Problem
Opportunity
Edge
Tap water
Rain water
Boiled water
Tea water
Flushing drainage
Toilet drainage
Cleaning drainage
Pool drainage
Tea leaves
Organic fertilizer
Irrigationdrainage
Aquaculture drainage
Washing drainage
Laundering drainage
Kitchen drainage
Air conditioner drainage
Showering drainage
Kitchen drainage
Other drainage
Tea particles
Silt
Animal feed

4.6.4 **Design points of the new system**

The new system identified 28 feasible points. After the improvement and optimization of the problems in the current system, the problems in the current system are effectively solved and expressed in the form of feasible points in the new system. Each feasible point in the new system is explained below.

Tieling road 50, 90, 110 residential buildings

Feasible point 1: separate sewage and wastewater, discharge the shower, toilet, cleaning and washing water into the raw water collection pipe, and collect the water regulating pool in songhe park, so as to provide the water source for songhe park. This method solved the problem of large water consumption of tap water, and reduced water consumption by more than 80%.

Point 2: collect air conditioning and drainage, and use more water, saving some household water.

Feasible point 3: divide domestic sewage and wastewater, reduce the discharge of domestic sewage and reduce the cost of sewage treatment.

Viewing the pool

Feasible point 5: use rainwater and high-quality drainage as pool water source; Reduced the amount of tap water used and the cost of the park; Rainwater and good drainage turn into recycled water after purification, instead of replacing the pool water by using tap water.

Feasible point 6: the artificial wetland system is established on the observation pond, which collects the high-quality drainage for community residents' life and various water activities in the park. Through natural ecological treatment, the drainage is transformed into reclaimed water (intermediate water), and a stable output is obtained. This practice enables the park to be self-sufficient in water and realize the self-creation of the system.

Feasible point 7: the artificial wetland system design enables the water in the pool to circulate, which solves the problem of increasing water pollution and silt caused by the static water in the pond.

Feasibility point 8: the constructed wetland system restores the water quality and reduces the eutrophication and water pollution.

Feasibility point 9: the improvement of water quality brings the improvement of water quality experience: the water becomes clear and the peculiar smell decreases; Improved park quality, improved landscape efficiency, and increased opportunities for people and water to interact.

Feasible point 10: the artificial wetland system planted aquatic plants, improved the water environment landscape, and improved the ornamental value; At the same time, there is no need for fish feeding to make the system more ecological.

Feasibility point 11: reduce the formation of silt; At the same time, the generated silt is returned to the constructed wetland system for treatment, which reduces the treatment cost and improves the economic efficiency.

Feasible point 12: the artificial wetland system is used to export clean water from yangshupu port all year round, and the water quality meets the requirements of "urban sewage recycling -- water quality for landscape environment" (GB/T 18921-2002); Middle water serves the urban landscape of downstream river channels and reduces the cost of water quality control.

Fountain

Point 13: replace the original tap water with recycled water, reduce the use of tap water in the park and the cost.

Feasible point 14: the water in the pool is sent back to the regulating pool of the constructed wetland system, and then flows back to the fountain after purification. The water circulation of the fountain is realized, the water quality is improved, and the water pollution is reduced.

Feasible point 15: the improvement of water quality brings the improvement of water quality experience: the water becomes clear and the peculiar smell decreases; Improved park quality, improved landscape efficiency, and increased opportunities for people and water to interact.

Feasible point 16: reduced the silt production; At the same time, the generated silt is returned to the constructed wetland system for treatment, which reduces the treatment cost and improves the economic efficiency.

Plant irrigation

Point 17: use recycled water instead of tap water to irrigate plants, reducing the amount of tap water used in parks and reducing costs.

Point 18: artificial wetland systems ferment, dry and disinfect silt by composting, mixing tea leaves, making silt fertilizer, and growing plants in the park.

Public restroom

Point 19: use recycled water instead of tap water for toilet cleaning and flushing, which reduces the use of tap water in the park and costs.

Point 20: hand-washing water is discharged into the park's raw water collection pipe to provide water source for the park.

Feasible point 21: the diversion of sewage and wastewater from public toilets reduces the discharge of sewage and reduces the cost of sewage treatment.

Tea house

Point 22: use recycled water instead of tap water to clean the teahouse, clean the teahouse toilet, and use water for flushing, which reduces the use of tap water in the park and costs.

Feasible point 23: hand-washing drainage, tea service cleaning and drainage, tea house cleaning and drainage, tea service disinfection and drainage, and surplus tea water are discharged to the park raw water collection pipe to provide water source for the park.

Feasible point 24: the tea residue is recycled and used, and the fermentation bacteria is added and degraded into organic fertilizer through microorganisms.

Feasible point 25: divide teahouse sewage and wastewater, reduce the discharge of domestic sewage and reduce the cost of sewage treatment.

Drinking water supply

Point 26: kettle cleaning and drainage, hand washing, and residual tea water are discharged to the park raw water collection pipe to provide the park with water source.

Point 27: the tea residue is recycled and used, and the fermentation bacteria is added and degraded into organic fertilizer through microorganisms.

Seafood market

Point 4: aquaculture drainage is discharged to the raw water collection pipe of songhe park, providing the park with water source, solving the problem of loss and waste of aquaculture drainage and pollution of downstream river channels.

Point 28: midwater is used for seafood farming, providing businesses with options for aquaculture sources and reducing reliance on tap water.

4.6.5 Summary of Problem Solving for New Systems

The establishment of the new system has brought tangible optimization to the water service of Songhe Park. The new system has a great contribution to the resources, environment, services and economy of Songhe Park and its surrounding areas.

The new system solves the problem of large water consumption in the park's tap water. The artificial wetland system established by the new system turns wastewater into reclaimed water, reduces the water consumption of tap water in Songhe Park, makes tap water tend to zero emissions, reduces the pressure on urban water supply, and reduces the energy consumption of urban sewage treatment and tap water production. The new system also provides water services for the seafood market.

The new system solves the problem of water pollution. The new system optimizes the water environment of the park by establishing a constructed wetland system, which improves water quality, reduces water odor and turbidity, and promotes the interactive experience of human and water environment.

The new system solves the problem of waste and makes waste tend to zero emissions. The wastewater of the current system is effectively controlled on the new system. High quality wastewater is collected and recycled for recycling. At the same time, the tea residue and sludge in the system became organic fertilizer.

The new system improves the efficiency of water service in the park and reduces the maintenance of water.

The water in the new system meets the water quality requirements. The purified water quality of the constructed wetland system meets the water quality requirements of the park and surrounding areas.

In terms of economy, the new system reduces the maintenance cost of tap water and water body, increases the income of waste-changing resources; reduces the cost of tap water production and sewage treatment, brings social benefits; reduces labor costs; and reduces water purification of downstream rivers cost.

The new system also has unresolved issues. Plant irrigation efficiency has not been resolved, and some irrigation drainage is lost to the ground.

4.7 New system upgrades

The new system has brought improvements in logistics, services, ecology, economy and culture.

4.7.1 Changes in logistics

Under the new system, the water consumption of the tap water in songhe park has been significantly changed and reduced. Based on the original scale, the water consumption of tap water decreased from 2947.56 m^3/year in 2016 to 532.76 m^3/ year, which reduced by 553%; The use of tap water in public toilets decreased from 1179.02 m^3/ year to 235.8 m^3/ year. The water consumption of teahouse decreased from 326.79 m^3/ year to 80 m^3/ year. Provision of free drinking water has been reduced from 218.79 m^3/ year to 216.96 m^3/ year. However, plant irrigation, viewing pool and fountain are no longer dependent on tap water, and a total of 1222.96 m^3/ year of tap water is saved among the three.

Songhe park's displacement is 3867.86 m^3/year (2016; Excluding surface rainwater and irrigation drainage); High quality clean drainage (including handwashing, cleaning, disinfection of tea utensils, etc.), tea remains and viewing pool water are collected to the middle water pipeline, a total of 2865.68m^3/ year. The shower, lavatory, cleaning, laundry drainage and air-conditioning condensation water of the buildings in tieling road 50, 90 and 110 are collected to the middle water pipeline, a total of 193631m^3/ year. The aquaculture displacement collected by the seafood market is 1,350 m^3/ year. The new system has collected about 197846.68 m^3/ year of high-quality drainage from the park interior, surrounding communities and seafood market, of which 7803.7 m^3/ year is used for the artificial wetland water source in the new system, and the rest drainage will be further utilized in the long-term goal.

The artificial wetland system, with a water volume of 7803.7m^3/ year, provides water for the cleaning of the viewing pool, fountain, teahouse and toilet of songhe park, as well as for the irrigation of plants. It also supplies clean water for the yangshupu port and the aquaculture for the seafood market. The design of the artificial wetland system in songhe park will be detailed in chapter 5.

The constructed wetland system also reduced the amount of silt in songhe park, from 148.5 m^3/ year to 17.56m^3/ year.

The new system collected 65.9kg/ year of tea leaves. Tea leaves and silt are combined to make fertilizer for plants to grow.

4.7.2 Improvement of water quality

Artificial wetland system brought the ascension of water quality, water from the surface water environment quality standard "(GB3838-2002) of bad V kind into Ⅲ class. At the same time, the water environment of the viewing pool and the fountain has been substantially improved, and the water pollution has been effectively controlled, making the water environment of the park get a better experience.

4.7.3 Waste turned resources

All of the current drain is fed into the sewer line. The new system carries out sewage and wastewater diversion, collects high-quality drainage, and is purified through the artificial wetland system, so that it can be reused in various water services in the park.

Tea leaves are made into organic fertilizer. The tea residue was decomposed by mixed fermentation bacteria under the action of microorganism. The soil was mixed with 1:5 quantity to make organic fertilizer[68]. Tea residue mixed with soil yields better organic fertilizer. Through the treatment of the constructed wetland system, the tea residue mixed silt can produce the high-quality organic fertilizer of 0.39 m^3/ year.

The method of constructed wetland silt treatment will be detailed in chapter 5.

4.7.4 Improvement of water services

The new system brings comprehensive improvements to the park's water service, both in terms of quantity and quality of water and in terms of system operation.

In terms of park water demand, the new system can not only meet the current park water demand, but also increase the supply of various types of water, such as free drinking water and tea supply, while economic benefits are improved. There are also new water projects, such as cooling spray in the summer. The new system also serves the perimeter of the park. Seafood markets get recycled water use services. In the long term, the new system will also serve the residents of the surrounding communities and provide them with access to central water.

The new system not only provides sufficient demand for water, but also provides

[68] Tea residue composting method. China Tea Network [EB/OL]. http://www.zgchawang.com/knowledge/show-82565.html, 2014-12-31 /2018-04-18.

water quality services. Ⅲ artificial wetland system can purify the surface water quality, and can satisfy the park in addition to drinking and nearly all water projects outside of direct contact with the skin. The improvement of water quality reduces the pollution of water environment and provides the service of beautifying the environment. In parks, improved water quality brings better experiences and promotes interaction between people and water. At the same time, the improvement of water quality also serves the park, and the water quality of yangshupu port has been improved. The park exports renewable water to yangshupu port all year round, which can reduce water pollution in yangshupu port, reduce water treatment cost in yangshupu port and improve social benefits.

As a result of the improvement of water quality, the former semi-closed state of the teahouse to re-inject vitality. Under the new system, the teahouse will be open for visitors to view the water. Water services create opportunities for communication while promoting the utilization of teahouse space.

The new system reduces water maintenance processes. Under the action of artificial wetland system, the water in the park is less polluted and the maintenance cost is low. The artificial wetland system does not need to be maintained all the year round. It only needs to harvest the aquatic plants of the wetland in summer and autumn. And the regular monthly cleaning of the initial sink into the mud. Compared with the current system, the artificial wetland system of the new system saves a lot of manpower and cost by eliminating the need to regularly replace and clean up the water in the park pools.

4.7.5 Promotion of community communication and cooperation

The new system, which brings parks and communities together in a interdependent way, promotes win-win cooperation. The two share resources, information, behavior, culture and other community elements with each other to facilitate communication. These exchanges help to create a dynamic, non-linear network of communication in motion, form a model of self-creation system, reduce problems in the current system, and promote the benign and stable development of parks and communities.

Community cooperation also promotes neighborhood harmony. Residents are willing to participate in communication and sharing, and their behaviors change from passivity to initiative, which reduces the waste of resources and pollution in water service, improves the efficiency of system operation, and also creates a stable and healthy community atmosphere.

4.7.6 Change of ideas

The establishment of the new system changed the participants' previous development concepts. The participants established the idea of deep ecology. The manager changes from the previous water service mode which relies on high consumption and pollution to the sustainable water service mode. From the mode of operation that relies on government subsidies to the mode of operation that moves towards ecological intelligence. With the change of concept, individual visitors start from saving water and protecting the environment, which drives the healthy operation of the whole system.

4.8 Economic benefit analysis of the new system

The operation of the new system has brought about an increase in economic efficiency.

(1) economic benefit evaluation of tap water

The new system saves a total of 11,832.52 Rmb / year for the water cost of songhe park under the scale of the current system. At the same time, if the merchants in the seafood market use the medium water as aquaculture water, it can save 9,000 Rmb / year.

(2) economic benefit evaluation of related maintenance costs

The establishment of the constructed wetland system enables the water in the viewing pool and the fountain to circulate. In 2016, the oil fee generated by the water pump suction operation in the park was 244.51 Rmb, which was saved under the new system.

(3) economic benefit evaluation of organic fertilizer

The artificial wetland system can process tea residue and mixed silt to produce high quality organic fertilizer of 0.39 m^3/ year. The unit price of organic fertilizer purchased by the park is 3.75 Rmb /kg, and the value of organic fertilizer is 1462.5 Rmb. Songhe park buys about 5,000 Rmb of organic fertilizer annually, which can save the park 14,62.5 Rmb.

(4) water maintenance fee

The water body maintenance workload of the new system is more than half that of the past. If the water body maintenance fee is 4 Rmb /m2 in previous years, a total of 5400 Rmb / year is calculated, the water body maintenance cost under the new system is 50% of that in previous years, which is 2,700 Rmb / year. At the same time, less water maintenance means less labor for workers; A reduction in the amount of labor under the same wage is equivalent to a rise in wages.

The new system can save 16239.53 Rmb / year for songhe park by calculating the service scale of the current system without calculating the cost of pipeline transformation and the construction of artificial wetland system. This part of the benefit does not include the benefits of providing aquaculture for the seafood market and the export of high-quality middle water from yangshupu port.

4.9 Design evaluation

The design of water service system in songhe park brings efficient and multi-dimensional optimization to water service in songhe park. It has improved water quality and water service, improved water environment, turned waste into resources and materials, improved economic benefits, promoted the exchange and cooperation between communities, and formed the concept of sustainable development. The new system also provides intermediate water services to communities around songhe park. The design achieves the short-term goal: to solve the problems of water waste and pollution in songhe park; Clean water was exported for yangshupu port. Improved the overall quality of park water service.

Water service system is a complex ecosystem that covers the dimensions of society, economy, culture and nature. The design is in line with the concept of eco-city, and reflects the overall coordinated development of society, economy, culture and nature of water service. The design conforms to the idea that waste produces economic value advocated by blue economy. Wastewater, tea dregs and silt have been effectively treated and utilized, contributing to the zero discharge of water service. In terms of concept, the design changes the attitude of tourists, residents, relevant managers and organizations towards ecology from passive to active, contributing to the generation of ecological wisdom in deep ecology.

In water services, the new system brings the quantity and quality of water used to meet demand, while increasing water activity and consumption. The new system basically solved all the problems in the current system. At the same time, however, there are some problems with the new system. Some of the available resources (such as ground rainwater) have not been utilized in consideration of the treatment cost. Therefore, the utilization and treatment technology of the available resources can be analyzed and evaluated in depth in the further design.

In terms of economic benefits, the cost of pipeline renovation and artificial wetland system construction is estimated to be about 100,000 Rmb by referring to the above relevant demonstration projects and combining with the situation of songhe park. The new system is expected to take about six years to recover its costs. But six years later, the new system will be profitable and will reduce the park's operating expenses. In the long term, the new system will serve the residents of the surrounding communities, and in the future, it may be necessary to add the regeneration water purification equipment to assist the artificial wetland system to divert the wastewater. In terms of cost, the construction of long-term goals needs more cost. Combined with the current situation, the new construction needs to wait for the new system to be put into practice and tested on the short-term goals, and then input after obtaining the benefits.

Although pine crane park comprehensive utilization of water service system remains to be verified in actual operation management, but in general, water system design for the pine crane park service has injected new vitality, make water service operation mode by the original linear model into a system, water supply service since the creation motive, contributed to the benign operation of the system, realize the sustainable development. The evaluation of artificial wetland system design will be described in chapter 5.

4.10 Chapter summary

After the investigation and analysis of the current water service system in songhe park in the last chapter, the integrated water utilization service in songhe park is designed in this chapter. At the beginning of this chapter, the new system design is conceived, and then the feasibility of various output of the current system is analyzed one by one. Understand participants' willingness and Suggestions for new system construction; Analyze the quantity and quality requirements of water in the new system; And determine the method of wastewater treatment; Finally, the design of water service system in songhe park is obtained. After the design of the new system, the current improvement and economic benefits of the new system are analyzed, and the design of the new system is evaluated.

Chapter 5 Design of constructed wetland system in Songhe park

This chapter is a detailed description of the design of the constructed wetland system in the new system in Chapter 4. Songhe Park water service system design is inseparable from the clean water support of the constructed wetland system. As a key function of the water service system, the constructed wetland system can bring water quality improvement to the water service system and improve the self-generated power of the water environment. The design of the constructed wetland system in Songhe Park is mainly based on the form of constructed wetland, the choice of matrix fillers and aquatic plants.

5.1 Design Vision

The constructed wetland system design combines the water demand in the Songhe Park water service system and considers the aesthetics of the landscape and the will of the visitors and follows the design principles to design an artificial maintenance and efficient water purification on the park's viewing pool. wetlands.

5.2 Design principles

(1) Promote system design principles

System design is the main content of this topic. Artificial wetland design needs to assist system design and produce good system effects. Assist in the comprehensive utilization of water services systems to achieve common sustainable development goals.

(2) Respect the principle of residents' opinions

Residents have a unique feeling for Songhe Park, which is in its own living environment. At the same time, the design ultimately serves the residents, and the design needs to fully respect the wishes of the residents. Give priority to the constructive opinions of residents in the case of measuring other principles and make a design that meets the needs of residents.

(3) Economic principles

The purpose of the constructed wetland system design is to purify water and increase water utilization and reduce park economic expenditure. Improving economic efficiency is also the purpose of systematic design. The design of constructed wetland system needs to consider economic benefits and reduce unnecessary waste.

(4) Landscape optimization principle

The constructed wetland system is designed to enhance the landscape rather than the landscape.

(5) Safety principles

The design fully considers the safety of residents' activities,

(6) The principle of adapting to local conditions

Make full use of the original landscape pool conditions and improve them to eliminate the factors that hinder water purification and promote the design of water purification. At the same time, combined with the actual water demand of the park and other water service functions, the scale of the constructed wetland design is evaluated to meet the current needs.

(7) Long-term principle

Constructed wetland systems are designed to consider long-term benefits and reduce unnecessary engineering.

(8) Universal principle

The application and promotion of artificial wetland system design has practical significance. There are several community parks in Yangpu District and Shanghai, and the status quo is similar to Songhe Park. The design of constructed wetland system should have certain universal applicability, which is beneficial to solve similar water treatment problems and improve overall social benefits.

5.3 Design indicators

The design index of artificial wetland in Songhe Park is determined according to the overall situation of the comprehensive utilization service system of water, as shown in Table 5.1. In terms of quantity, the demand for medium water is at least 12.94 m^3 / d; from the quality point of view, the water source is mainly low-pollution domestic drainage, the influent water quality is equivalent to the surface water inferior V, and the effluent water quality needs to meet the surface III water quality; In terms of cost, it is advisable to make simple modifications to the viewing pool, reduce the construction of structures, and satisfy the functions of multi-purpose, namely water ingress, clean water and water storage; from other needs, combined with landscape design and residents' wishes, retain More than 500m2 of water surface. At the same time, the design also needs to consider the conditions of special weather conditions. When extreme weather or special circumstances, it is necessary to suspend or reduce the amount of water inflow. When cleaning water, it is necessary to increase the hydraulic retention time to ensure the quality of the effluent. In emergency, tap water can be used; And the design of the outlet pool needs a certain capacity buffer to meet the needs of use.

Table 5.1 main indexes of artificial wetland design in songhe park (Source: author)

Pool water area（m^2）	1300
Depth（m）	0.75
Influent water quality	5 types of surface water
Effluent water quality	3 types of surface water
Medium water treatment（m^3 / d）	⩾12.94
Retain water surface area（m^3）	⩾500

5.4 The application form

The main forms of constructed wetland include free surface flow, horizontal subsurface flow and vertical subsurface flow. By referring to the technical and economic indicators of the main constructed wetlands at present, as shown in table 5.2, it can be found that the constructed wetlands with undercurrent have higher benefits. After evaluating three kinds of technical and economic indexes of artificial wetland, this paper considers the design of wetland form based on the current situation, design indexes and principles of songhe park.

Table 5.2 technical and economic indicators of main constructed wetlands

(Source: liu xuexiang, 2010)

Form of Wetland	Effective wetland	Treatment of	Investment

	area/m^2	water/$m^3 \cdot d^{-1}$	estimation/ RMB • t^{-1}
Free surface flow constructed wetland	500	7.5	858
Horizontal subsurface flow constructed wetland	500	15	975
Vertical subsurface flow constructed wetland	500	20	1085

In the amount of water treatment, under the same effective wetland area, the subsurface flow wetland is more than the surface flow wetland, and the construction cost is higher, and the process is more complicated. On the water quality, according to the technical process, the effluent water quality of the constructed wetland system can reach the surface water. Environmental Quality Standards (GB3838-2002) Class II-V Water Quality Standards[69].

According to the design index, the Songhe Park constructed wetland system is designed to select a composite artificial wetland combining surface flow and horizontal submerged flow. The design is primarily based on ecological, landscape and economic benefits. The advantage of surface flow constructed wetland is that it has a water surface landscape; combined with the landscape design and residents' wishes, retaining the water surface landscape of more than 500m^2 is conducive to maintaining the rhythm of water and plants; but the disadvantages are also obvious, the water volume is only horizontal subsurface flow. Half of the horizontal subsurface flow constructed wetland has a water volume of 15 $m^3 \cdot d$; the horizontal subsurface flow is suitable for the current situation of the park observation pool and does not need to be structurally modified. Combining the advantages of both, you can meet the needs of design indicators.

In order to save costs and the harmony of the wetland landscape, the inlet and outlet pools can be considered for design in the viewing pool. Combined with the design of the constructed wetland system, the three find a balance between the amount of water handled and the economy.

69 Kang Junli. Feasibility of Constructed Wetland Ecosystem in Urban Wastewater Reuse[J]. Environmental Sanitation Engineering, 2004, 12(2): 114-117.

5.5 Related case studies

In the case of compound constructed wetland, there are many successful examples of the combination of surface flow and horizontal undercurrent. The artificial wetland demonstration project of honghu lantian ecological park has proved that the compound constructed wetland combined with surface flow and horizontal subsurface flow has good water purification capacity. As shown in figure 5.1, domestic sewage (including toilet and kitchen drainage) successively passes through the water bamboo shoot, reed and cattail areas of the artificial wetland with a horizontal undercurrent of 1.2m depth, and then enters the artificial wetland with a surface flow of aquatic plants such as honglian. The system has a sewage treatment capacity of 40m^3/d; The surface load of the wetland was 0.028m^3/m^2/ d, and the hydraulic residence time was 3.4d. Effluent water quality reaches the surface water environment quality standard "(GB3838-2002) regulation of Ⅳ water quality standard[70].

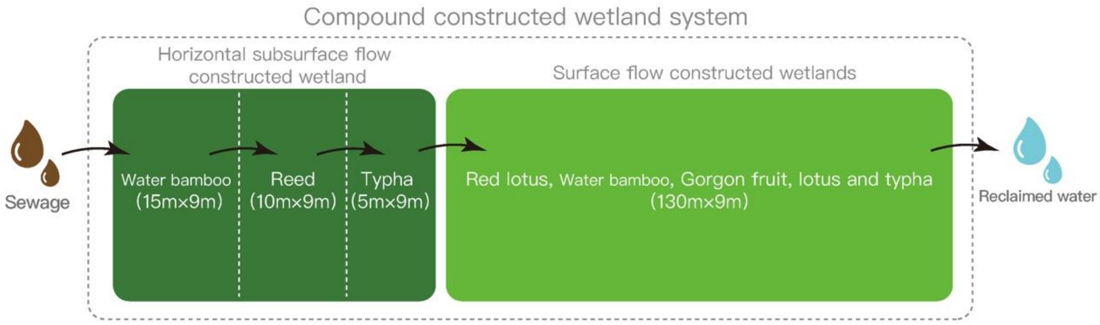


Figure 5.1 Honghu Lantian Ecological Park Complex Constructed Wetland System

(Source: author)

The composite constructed wetland design utilizes different wetland conditions to achieve different treatment effects. Horizontal subsurface wetlands allow wastewater to seep through the interior of the packing. Through the flow of fine voids, the wastewater is effectively treated by the surface of the filler and microorganisms on the roots of plants[71]. Surface wetlands remove organic matter from wastewater mainly through biofilms on the roots and stems of plants that grow under water[72]. Both

[70] YU Tong-Li, YANG Ji-Hong, HUA Liu, et al. Demonstration Project of Hotel Sewage Treatment of Hotel Sewage in Scenic Spots[J]. Science and Technology Pioneering Monthly, 2008(4):131-133.

[71] Liu Chaoxiang, Hu Hongying, Zhang Jian, et al. Treatment of Rural Sewage by Surface Flow and Subsurface Flow Ecological Bed[J]. China Water & Wastewater, 2002, 18(11): 5-8.

[72] Li Yang, Zhou Xiaode, Miao Deyu, et al. Discussion on Wastewater Treatment Technology of Constructed Wetland[J]. Water Resources Science and Technology, 2007, 13(1): 55-57.

horizontal subsurface flow and surface flow have advantages. The horizontal subsurface flow has a better removal rate of COD in wastewater than surface flow, and the effluent water quality is higher, and the efficiency is higher[73]. The surface flow wetland compensates for the inability to fully exert the root system of the horizontal subsurface wetland packing layer, and has a good effect on the removal of ammonia nitrogen in the wastewater, and has a water body landscape[74]; the combination of horizontal subsurface flow and surface flow design can have pollutants Better integrated purification.

5.6 Structure design of constructed wetland system

The artificial wetland design will cover an area of 1300m^2, and the viewing pool with an average depth of 0.75m is divided into four parts: adjustment pool, horizontal subsurface flow artificial wetland and reservoir. After preliminary filtration, the wastewater enters the horizontal subsurface flow wetland, then enters the surface flow wetland, then enters the storage pool, and finally enters the middle water pipeline and the downstream yangshupu port, as shown in figure 5.2. The effective area of the constructed wetland is 1155m^2, the amount of wastewater input and treated water is 21.38m^3 /d, and the surface load of the wetland is 0.019m^3/m^2/ d. Meet the demand of water in the service system of water comprehensive utilization system. At the same time, the design considers the management and maintenance of wetlands, which can treat the silt generated by artificial wetlands.

The designed area of the regulating pool is 55m^2, the water depth is 0.75m, and the water capacity is 41.37m^3. The storage capacity of the regulating tank is designed according to the amount of wastewater entering each day, extreme weather and special circumstances. The regulating pool is mainly used for water storage and pretreatment. The role of pretreatment is to lighten the load of wetland pollution, filter impurities, stabilize water quality and collect silt. The adjustment pool is mainly equipped with grille and sedimentation tank. The regulating tank is used for precipitation and filtration of water as well as collection of primary silt.

The effective wetland area is 300m2 and the water depth is 0.75m. The horizontal

[73] Liu Chaoxiang, Hu Hongying, Zhang Jian, et al. Treatment of Rural Sewage by Surface Flow and Subsurface Flow Ecological Bed[J]. China Water & Wastewater, 2002, 18(11): 5-8.
[74] Li Yang, Zhou Xiaode, Miao Deyu, et al. Discussion on Wastewater Treatment Technology of Constructed Wetland[J]. Water Resources Science and Technology, 2007, 13(1): 55-57.

subsurface flow wetland is divided into cattail pond with an area of 120m^2 and reed pond with an area of 180m^2. Among them, the reed pond has an area of 30 m2 as the treatment area for sediment silt. The designed treated water amount of the horizontal subsurface flow artificial wetland is 8.1 m^3/d (the silt treatment area is not calculated). The wastewater enters the cattail and reed pond in turn. The length and width ratio of the horizontal subsurface flow artificial wetland was adjusted through the design of cement barrier, so that the water flow distance was increased, and the purification effect was improved.

The effective wetland area is 885 m^2 and the water depth is 0.75m. Designed treated water capacity is 13.28 m^3·d. The surface flow wetland is mainly divided into lotus area (300m^2) and water lily area (300m^2). The artificial wetland of surface flow will retain the ornamental fish in the original viewing pool as a part of water purification in the artificial wetland system.

The designed area of the reservoir is 55m^2, the water depth is 0.75m, and the water capacity is 41.37m^3. The water in the constructed wetland is collected after purification. The water in the reservoir flows to the middle water pipe and downstream of yangshupu port.

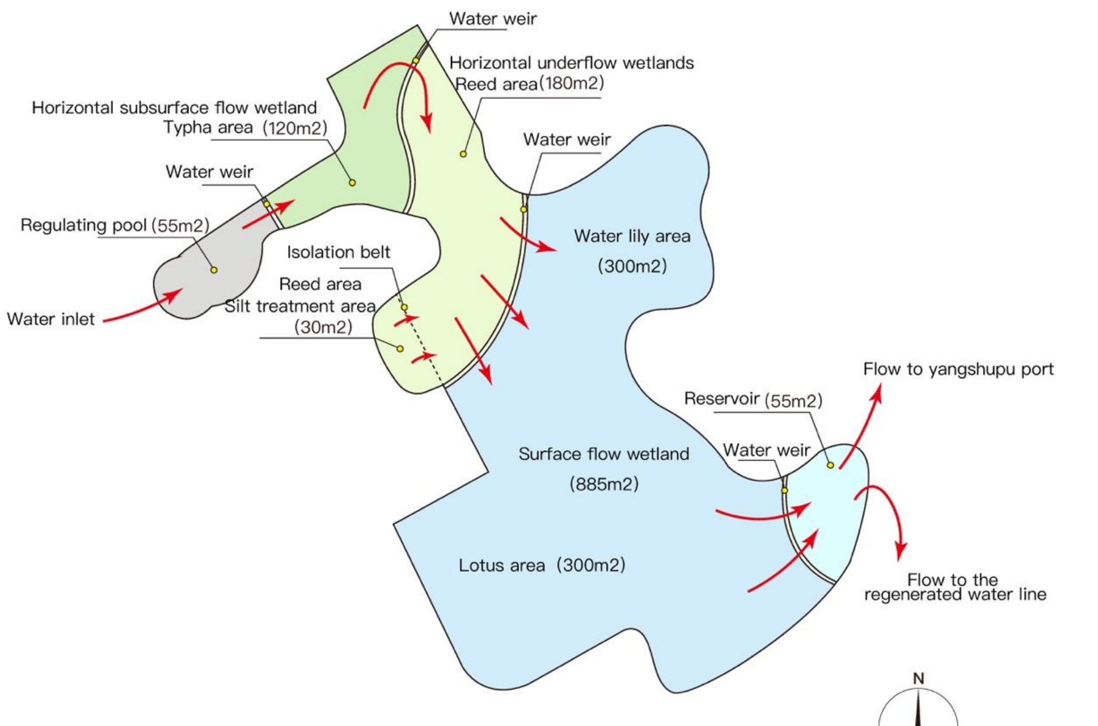


Figure 5.2 Plan of constructed wetland system design for Songhe Park Observation Pool

(Source: author)

5.7 Selection and design of matrix filler

The selection of matrix filler mainly follows the principles of functionality and economy. The use of matrix filler in horizontal subsurface flow constructed wetlands.

At present, artificial wetland bed matrix fillers mainly include soil, gravel, gravel, fine sand, coal slag, etc. The main function of the matrix is to provide stable adhesion surface for the growth of microorganisms, as well as to filter pollutants[75]. Each matrix has unique properties. In this design, the quality of wastewater intake is good, and the load of wastewater treatment is low. According to the successful example of chengdu active water park of Shanghai world expo, gravel and stone coal cinder have good wastewater treatment effect[76]. Under high hydraulic load, the decontamination index is still superior to other main fillers. The water quality and effluent quality indexes in this design are very similar to the live water park, which can use the design technology of the active water park for reference to achieve the effect of wastewater treatment.

Figure 5.3 gravel and stone cinder (photo: https://www.vcg.com/)

In terms of economy, mainly from the packing price and transport costs, to take the right packing in place. Gravel and cinder are easily available in Shanghai, and the packing price is low, compared with other packing, there are obvious economic advantages.

The filler is laid on a level undercurrent constructed wetland with a depth of 0.75m.

[75] Liu Xuexiang. Constructed Wetland Treatment System of Chengdu Living Water Park in Shanghai World Expo[J]. Shanghai Construction Science & Technology, 2010(6): 62-64.
[76] Liu Xuexiang. Constructed Wetland Treatment System of Chengdu Living Water Park in Shanghai World Expo[J]. Shanghai Construction Science & Technology, 2010(6): 62-64.

The design is designed with four layers. The first layer is the coal slag layer with particle diameter around 3cm, and the laying thickness is 0.15m. The second layer is fine gravel with particle size around 4cm, and the laying thickness is 0.2m. The second layer is the middle gravel with the grain size around 6cm at the bottom, and the laying thickness is 0.2m. Coarse gravel with a diameter of about 8cm at the bottom and a thickness of 0.2m; Each layer is separated by a fibrous layer to achieve the effect of the isolation filler.

On the packing charge, the cost of gravel and stone cinder is 25,920Rmb, as shown in table 5.3.

Table 5.3 list of cost of matrix filler (source: author)

	Unit-price (t/Rmb)	Packing density (kg/m^3)	Accumulation volume (m^3)	Packing quality (t)	Amount (Rmb)
Gravel	80	1600	180	288	23040
Stone coal cinder	80	800	45	36	2880

5.8 Selection and design of aquatic plants

In the selection of aquatic plants, mainly follow the principles of functionality, local, ornamental. In terms of functionality, it is required to have good water purification capacity, pollution resistance capacity and ability to cope with extreme weather and prevent diseases and pests. Locally, plants that are readily available in Shanghai are required to be economic and cultural. In ornamental, a certain flowering period is required to form aquatic plant landscape. Based on the above principles, the lotus, water lily, reed and cattail are finally selected.

In the surface flow artificial wetlands on the planting of water, floating plants. The anhydrous plants are lotus flowers and the floating plants are water lilies. Other plants do not need substrates to sustain growth, except for the lotus flowers, which need to be set separately in the soil of the bottom of the basin. Lotus and water lily have certain effect on water purification[77].

[77] Zhang Zhiqin, Fang Di'an, Xu Weihong, et al. Effects of lotus and water lily on landscape water purification[J]. Jiangsu Agricultural Sciences, 2009(5): 320-322.

Figure 5.4 lotus, water lily and duckweed (source: http://www.zw3e.com/)

Cattail and reed were planted respectively in subsurface flow artificial wetlands. The cattail planting area is 120 m^2; The reed planting area is 180 m^2.

Reed is the first choice for artificial wetland plants. Reeds are effective in removing heavy metals, organics, nutrients and toxins from sewage and silt. Reed has strong decontamination ability, can absorb nutrients in sewage, especially heavy metals and other pollutants have significant adsorption; At the same time, the roots of reeds are well developed, which is conducive to the growth and attachment of microorganisms. The root of the reed has a high REDOX potential, which provides continuous energy for microbial activity. Reed is also hydrophilic and can effectively flow sewage in the substrate layer[78].

Cattail has ornamental and powerful decontamination ability. According to experiments conducted by Qian Mingfei et al.[79], cattail has better removal effect on COD_{Mn}, total phosphorus and total nitrogen than reed, and is suitable for the treatment of low-concentration wastewater. The combination of cattail and reed makes the wastewater treatment more comprehensive.

78 Wang Quanjin. Application of Reed Constructed Wetland in Environmental Protection[J]. Journal of Environmental Engineering, 2005, 6(8):1-5.

79 Qian Mingfei, Li Yong, Huang Yong. Comparison of Purification of Micro-polluted River Water by Reed and Cattail Constructed Wetland System[J]. Industrial Water & Wastewater, 2008, 39(6): 55-58.

Figure 5.5 reed and cattail (source: https://www.vcg.com/)

In the aquatic plant planting, different amounts are planted according to different conditions of plants, as shown in table 5.4; The total cost of all aquatic plants is 5,724 Rmb.

Table 5.4 list of aquatic plant filler costs (source: author)

	Density (unit /m^2)	Unit price (Rmb/unit)	Unit price （Rmb/m^2）	Planting area （m^2）	Total price （Rmb）
lotus	3	6	6	300	1800
Water lily	2	5	10	300	3000
reed	20	0.15	3	180	540
typha	16	0.2	3.2	120	384

5.9 Artificial wetland silt treatment design

Artificial wetland is a new kind of silt treatment technology at present. It not only has good effect on silt treatment, but also does not need to rely on resources and energy consumption. The effect of constructed wetland silt treatment is related to the silt load, Plants and substrates.

The design of silt load, Amand and Leckner[80] showed that the silt load in the wetland system was adapted under 60 kg/(m^2·a). Silt load of artificial wetland in songhe park is about 50 kg/(m^2·a).

In terms of the selection of plants, it is believed that reeds are most widely used in artificial wetland silt treatment at present, and at the same time, they have the best effect on desiccation and Stabilization of silt. At the same time, reed wetlands enrich heavy metals in silt[81]. Combining with landscape consideration, reed is selected as the plant for silt treatment. The artificial wetland of songhe park in the horizontal subsurface flow wetland Set aside 30 m^2 as the silt treatment area.

On the other hand, the same process and the same design form are beneficial to the unity of wetland design. On the other Hand, it can save cost.

Studies by Bianchi[82] and other researchers have confirmed that the silt moisture

80 Åmand LE, Leckner B. Influence of fuel on the emission of nitrogen oxides (NO and N 2 O) from an 8-MW fluidized bed boiler ☆[J]. Combustion & Flame, 1991, 84(1 – 2) :181-196.

81 Li Juan, Xiao Enrong, Wu Zhenbin, et al. Process of treating excess sludge by constructed wetland[J]. Environmental Chemistry, 2017, 36(10): 2172-2183.

82 Bianchi V, Peruzzi E, Masciandaro G, et al. Efficiency assessment of a reed bed pilot plant (Phragmites australis) for sludge stabilisation in Tuscany (Italy) [J]. Ecological Engineering, 2011, 37(5):779 -785.

content can be reduced by 70% within three days, which proves that artificial wetlands have a good dehydrating effect. Intermittent mud entry was conducted every month for 2-3 days and 14-21 days for drying[83]. Experiments conducted by li Juan[84] showed that the water content of silt treated by constructed wetland method decreased from 99.00% to 99.51% to 55.06%-70.08%, while the removal rate of volatile solids (VS) reached 55.7%, which can stabilize the silt.

After the artificial wetland is designed, the amount of silt in the viewing pool and water fountain is greatly reduced, leaving only the primary silt. Silt generally accounts for 0.3% ~ 0.5% of sewage treatment capacity (97% by moisture content)[85]. Lu zhi et al. (2007) found that the amount of mud deposited at the beginning accounts for about 75% of the silt. The wastewater inflow of the artificial wetland system in songhe park is 7803.7m^3/ year (excluding rainwater). The sludge collected accounts for 0.3% of the sewage treatment capacity, and the initial sediment amount accounts for 75% of the silt amount calculated. The preliminary sediment amount in the regulating pond is 17.56m^3/ year.

The purpose of silt treatment is to turn waste into resources. Silt has been analyzed for fertilizer in chapter 4. Mixing the silt with the tea dregs after fermentation yields more organic fertilizer. Through calculation, the artificial wetland system regulating pool can be cleaned up once the silt quality after the mixed fermentation was 17.63 m^3/ year and the average monthly silt quantity was 1.47 m^3. The water content of silt decreased from 99% to 55%, and the dry silt fertilizer could be produced about 0.03 m^3 per month and 0.39 m^3 per year. According to the annual use of 1334kg of organic fertilizer in songhe park, 390kg of organic fertilizer can be saved in the whole year.

[83] Nielsen S. Sludge treatment and drying reed bed systems [J]. Ecohydrology & Hydrobiology, 2007, 7(3-4): 223-234.

[84] Li Juan, Xiao Enrong, Wu Zhenbin, et al. Process of treating excess sludge by constructed wetland[J]. Environmental Chemistry, 2017, 36(10): 2172-2183.

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Figure 5.6 dry clay fertilizer (source: https://www.vcg.com/)

5.10 Design sketch of constructed wetland system

The artificial wetland system is designed for functional, landscape, economic and cultural purposes. The constructed wetland system can effectively solve the water quality problem of the park and cooperate with the water comprehensive utilization service system to achieve the goal of the system approaching zero discharge.

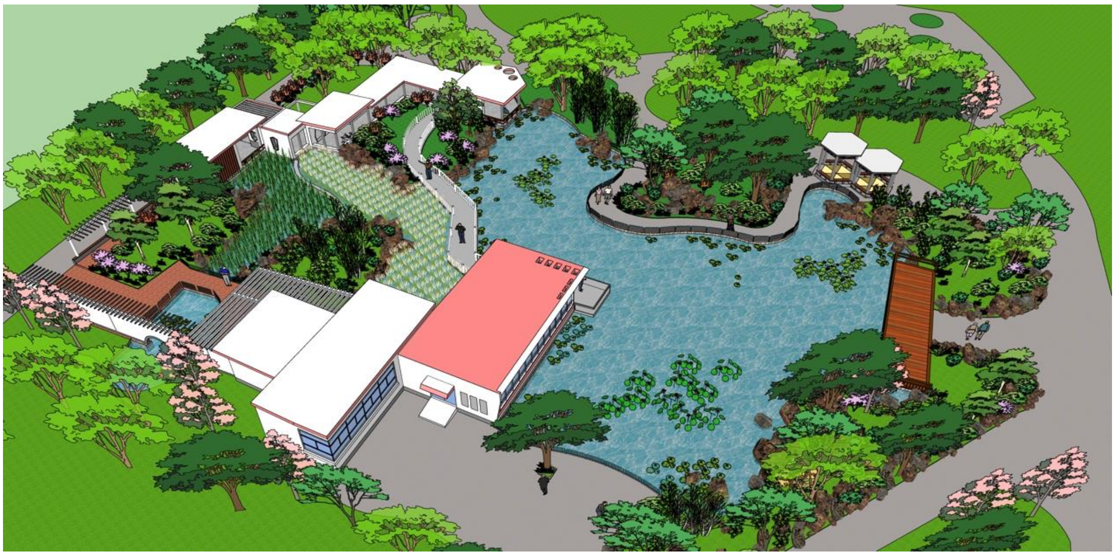

Figure 5.7 Songhe Park constructed wetland system design (Source: author)

Figure 5.8 Songhe Park constructed wetland system design (Source: author)

Figure 5.9 Songhe Park constructed wetland system design (Source: author)

Figure 5.10 Songhe Park constructed wetland system design (Source: author)

Figure 5.11 Songhe Park constructed wetland system design (Source: author)

Figure 5.12 Songhe Park constructed wetland system design (Source: author)

5.11 Design and maintenance

Constructed wetland system forms a self-generating system under the interaction of matrix, microorganism and plants. It does not need to rely on other power and energy to maintain the system operation, and the operation cost is low. Just harvest the aquatic plants in the wetlands in summer and autumn every year, one day at a time. The harvested plants can be reused as green feed for fish farming[86].

[86] YU Tong-Li, YANG Ji-Hong, HUA Liu, et al. Demonstration Project of Hotel Sewage Treatment of Hotel Sewage in Scenic Spots[J]. Science and Technology Pioneering Monthly, 2008(4):131-133.

According to the practical experience, the normal operation period of the constructed wetland system is about 10-15 years, and it takes about 15 years to clean the packing bed, which can be put back into use after cleaning[87].

The artificial wetland silt treatment area maintenance is also relatively simple. The artificial wetland shall process silt once a month. Dry sludge is collected monthly. Desiccation silt can be removed by using an electric shovel to take the above part of the plant root[88]. As the running time accumulates, the reed bed in the silt treatment area will be physically blocked, and the packing bed in the silt treatment area will be cleaned once in about 3 years to achieve the best working condition.

5.12 Design evaluation

The design of artificial wetland system in songhe park is evaluated from ecology, economy and environment. The design meets the demand of water quantity and quality and water environment purification in songhe park. The main contribution of constructed wetland system is to provide robust water quality purification service for water comprehensive utilization service system.

The artificial wetland system is an open and self-generating system, designed in line with the economic model of waste to resources advocated by blue economy and circular economy, and established the ecological benefits that tend to zero emission. The integrated water use service system of constructed wetland system jointly creates an ecological community park with harmonious development of society, economy, culture and nature as a whole and embodies the wisdom of eco-city.

In terms of the ecological benefits, the artificial wetland system effectively disposed most of the waste in the water service system, so that the waste was reused, and the tea residue was treated as organic fertilizer for the park plants. Meanwhile, the amount of waste has also been greatly reduced, with the amount of silt reduced from 148.5m^3/ year (wet sludge with water content of 99%) to 17.56m^3/ year. The water consumption of tap water in the park decreased from 2947.56 m^3/ year (2016) to 532.76 m^3/ year. Songhe park's displacement is 3867.86 m^3/ year (2016; Among them, 2865.68 m^3/ year of high-quality drainage is transported to the middle water pipeline for the

[87] Baidu Encyclopedia. Constructed Wetland [EB/OL]. https://baike.baidu.com/item/ constructed wetland/6266398?fr=aladdin, 2018-01-24/2018-04-18.

[88] Sun Xiujuan. Research Progress in Sludge Treatment by Constructed Wetland Method[J]. Zhejiang Chemical Industry, 2012, 43(4):32-35.

effective treatment of artificial wetland system, and the sewage discharge rate is reduced by 74.1%, realizing the goal of zero discharge of water service. At the present stage, the water volume in the constructed wetland system is 7803.7m^3 /year, and the water volume is about 21.38m^3 per day, which meets the water use demand in the park at the present stage. At the same time, it also supplies high-quality water for breeding in yangshupu port and the seafood market.

In terms of economic benefit, artificial wetland system brings the main economic value for the new system. The economic benefit analysis of the new system is described in chapter 4. Constructed wetland system has produced economic benefits in water, water and related maintenance and other waste utilization. Based on the current situation, the artificial wetland system saves RMB 16239.53 /year for songhe park (excluding the economic benefits of water service outside the park). The budget for the reconstruction and construction of the artificial wetland system in songhe park is about 60,000 Rmb, including the cost of gravel and coal cinder (25,920 Rmb), plant costs (5,724 Rmb), cement concrete and other building materials (about 15,000 Rmb) and labor costs (about 15,000 Rmb). The cost of the constructed wetland system is expected to take about four years to recover and begin to profit after the fourth year. The artificial wetland system design has plasticity. In the future, the constructed wetland system can be modified and designed according to the needs or cooperate with other water treatment equipment based on the profits and the construction of the middle water pipeline infrastructure to provide more high-quality middle water for the park and surrounding communities.

The design of constructed wetland system is oriented by balancing waterscape and water purification efficiency. In the environment, the constructed wetland system brings the improvement of water quality, which makes the water in the park clear and the peculiar smell decreases. At the same time, reeds and cattails in the subsurface flow area as well as lotus and water lilies in the surface flow area enrich the water plant level in the park. The water area is preserved, which makes the layout of plants and water more reasonable, and also meets the demand of visitors to appreciate the water scene. On the whole, the water environment of the park has been qualitatively improved.

As the design of constructed wetland system only remains on the theoretical level, the actual removal rate of pollutants may be different. At the same time, the operational efficiency of the constructed wetland system is different from that of the mature period, and the working efficiency of the constructed wetland system still needs further demonstration in other special cases, such as the impact of special weather. On the docking with the project, the design still needs to go further and conform to the construction specifications.

5.13 Chapter summary

This chapter describes the design of artificial wetland system in songhe park. According to the demand of water service system in songhe park, the artificial wetland system is designed. After the assessment of the quantity and quality of the reclaimed water in the previous chapter, the structure, matrix filler, aquatic plants and other functions of the artificial wetland in songhe park were analyzed based on the opinion survey, design principles and current conditions, and the design of the artificial wetland system in songhe park was finally determined. Finally, the design is evaluated.

Chapter 6 Summary and Outlook

6.1 Main conclusions

Taking the Songhe Park in Yangpu District of Shanghai as an example, the paper discusses the problems of water waste, water pollution, low water ecological service capacity and poor economic benefits of water services in Shanghai community park water services. Through the in-depth investigation and research on the water service of Songhe Park and surrounding communities in the early stage: the quantity and quality of various types of water in the water service were analyzed, and relevant participants were deeply investigated to find out the Songhe Park and surrounding communities. The status quo system of water-like services; and lists and summarizes the problems existing in the current system and analyzes the constraints of the current system. After analyzing the situation of the current system, thinking about the construction of the new system, carrying out relevant feasibility analysis, conducting public opinion survey, and finally designing the Songhe Park water service system. In the new system, the design of the constructed wetland system is included based on the operational requirements of the system. Solving the problem of the status quo of Songhe Park water service by means of system design combined with constructed wetland design brings ecological, cultural, economic and social benefits.

The water problems in Songhe Park are essentially interrelated, and the system design method is the right choice. The systematic design minimizes water discharge and pollution, improves water service efficiency, and brings considerable economic benefits. Compared with the original state, the improvement is obvious. The system design realizes the internal production of the system with the help of the water ecological design. After the wastewater is purified, it is reused, which improves the ecological efficiency and realizes the circular economy.

In this study, Songhe Park was taken as an example to establish a self-generated system model of community park water service. The community park water service system has been transformed from a linear model that relies on tap water consumption to a systematic model of reclaimed water use. This research has been innovative in both theory and design.

In theoretical innovation, based on the combination of system design theory supported by cybernetics and complexity system theory and wetland ecology under the ecological discipline, the community park water comprehensive utilization service system is designed to integrate water service with water environment and water purification and water experience. The holistic study has been integrated with methodological innovation.

In design innovation, the design of the system combined with the design of the constructed wetland system provides innovative innovation in the community park water service design. The new system not only solves the problem of the status quo of water service, but also brings about the improvement of ecological, cultural, economic and social aspects, and the effect exceeds the expected imagination.

6.2 Discussion on universality

The design of the Songhe Park water service system has certain reference application value to Yangpu District and other community parks in Shanghai. The research and design of the water service system of Songhe Park was based on the qualitative research of the other nine community parks in Yangpu District. The research mainly analyzed and designed based on natural conditions, park location and attributes, park design and layout, policies and standards, residents' opinions and lifestyles, regional culture, and technical feasibility. In other community parks in Shanghai, these conditions are basically similar, so the new system is basically suitable for the design of water service systems in other community parks in Shanghai. At the same time, the design should also be considered in conjunction with specific situations. Some community parks have different conditions, and the location, design and layout of the park, as well as the identity of the visitors and the age distribution will be different. For example, some community parks do not have tea houses, some community parks do not have a viewing pool or away from urban canals, and some community parks are built in new urban areas. These factors will affect the internal connections of the system and bring different results. However, the new system has profound guiding significance in the innovation of water service ideas, the integration of water resources in community parks, and the needs of water ecological civilization construction. The new system can bring a common goal to different community parks - sustainable development, which is universally applicable to other community parks in Shanghai.

6.3 Outlook

The research on the systematic design of water service involves the intersection of multiple disciplines, and each discipline needs to be integrated to achieve the design goal. In the process, the breadth and depth of the discipline research are inevitable, especially in the design of constructed wetland system. Since the author is not an ecological major, there is a lack of comprehensive learning about ecological knowledge and the lack of practice in water management techniques. In the research of artificial wetland system in this paper, it mainly relies on literature reading, demonstration engineering analysis and related technical and theoretical guidance of the instructors and lacks experimental demonstration results. The design is subject to further practical verification.

The design of the water service system is imperfect. In the short-term goal, the new system did not carry out in-depth water-saving design, such as plant irrigation using rainfall sensors to detect soil moisture content, and the central control management system to control irrigation design to achieve more precise irrigation, thereby saving more water. Insufficient utilization of rainwater collection, no reformation of park hard floors or building roofs and green spaces to collect more rainwater. In the long-term goal, the park can be thoroughly evaluated, and more sustainable measures designed to improve the water service efficiency of the park and provide economically viable water services to the surrounding communities.

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Data collection, He Binghua;
Investigation and interview, You Fangzhou;
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