同濟大學
TONGJI UNIVERSITY

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# Study and Application of systemic design to cooking system in vegetarian restaurant ——LOHASTIME as an example


Candidate: Zhang Anqi
Student Number: S227150
School: College of Design and Innovation
Discipline: Engineering
Major: Industrial Design Engineering
Supervisor: Professor Pier Paolo Peruccio


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# ABSTRACT

Kitchen waste is a resource that is misplaced. At present, China's daily kitchen waste generated by each city is no less than 6,000 tons. Kitchen waste contains a large number of animal and vegetable proteins and oils, which are rich in nutritive value. However, because of the huge output, high water content, corrosion and deterioration, and poor classification in the prior period, it has led to difficulties in recycling. The restaurant is one of the main sources of kitchen waste. The restaurant's after cooking process is unreasonable, and the kitchen waste is not recycled according to the nature.

The research methods mainly include the literature review, field investigation method, and data analysis method. Literature review provides a summary of studying backgrounds and systemic theory; field investigation acquires the necessary data through the one-day observation, interviews and questionnaires of the research base, and the measurement of related items，the actual data obtained and the use data Analytical methods were used for qualitative and quantitative analysis.

Through field investigation and analysis of the LOHASTIME vegetarian restaurant, it was found that the utilization of water resources and kitchen resources was not efficient, resulting in the waste of resources and the increase of operating costs. Optimizing the restaurant's cooking process and strengthening enterprise cooperation not only achieved zero discharge of kitchen waste, but also effectively improved the restaurant's efficiency and provided a new economic model for restaurant operations.

Through the investigation and analysis of systemic design cases, the current situation of restaurant kitchen waste was revealed, which provided a theoretical basis and technical support for the system design of restaurants afterwards. In this paper, the systemic design is applied to the analysis of the kitchen restaurant's process flow in the vegetarian restaurant, and the system-executable solution to solve the restaurant-kitchen waste problem is explored; the possibility of localization of the resource through the connection with the local environment is explored; The systemic design flow chart for the LOHASTIME Vegetarian Restaurant provides a reference for other systemic design projects.

**Key words**: systemic design, after cooking process optimization, resource localization, economic evaluation

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# 1. INTRODUCTION

## 1.1 RESEARCH BACKGROUND

### *1.1.1 Development and Characteristics of Chinese Catering Culture*

**History**

China has a vast territory, a large span from north to south, rich products and diverse climates. After a long history of changes in the dynasty and historical changes, a profound Chinese food culture has developed. From an extensional perspective, China's food culture can be classified in terms of times and techniques, regional and economic, ethnic and religious, food and utensils, consumption and levels, folk customs, and functions. It shows different cultural tastes and reflects different use of value.

The Zhou and Qin Dynasties were the shaping stages of China's diet culture, with cereals and vegetables as staple foods. The introduction of a large amount of raw materials for fruits and vegetables and cooking methods in the Western Region has

*Fig 1.1: The Chinese Feast*

greatly enriched the variety and culture of diets. New cooking and by-products production began to appear. People began to use vegetable oils. Tofu was also invented in the Han Dynasty by Liu An, a Huainan king. The bean meal served as a staple food in the Han Dynasty.

The Tang and Song dynasties were the peak period of Chinese food culture. Based on the diet of the Han Dynasty, they greatly enriched the way of cooking and variety of dishes. Ming and Qing Dynasties was another peak in the diet culture. It was the continuation and development of the Tang and Song food customs. At the same time, it was mixed with Manmeng characteristics. The dietary structure has changed a lot. Staple food: glutinous rice has been completely eliminated and the pockmarks have been eliminated from the staple food lineup. With crushing oil, the bean meal is no longer a staple food and becomes a dish. The proportion of wheat in the northern Yellow River Basin has increased greatly, the surface has become the staple food in the north after the Song Dynasty, and it has been introduced on a large scale again in the Ming Dynasty. Potato, sweet potato, and vegetable cultivation have reached High standard and become the main dish. Meat: Artificial livestock and poultry become the main source of meat. The Manchu delegation represented the highest level of food culture in the Qing Dynasty.

**Shanghai Restaurant and City Life**

The development of modern Shanghai restaurant industry is closely related to the development of Shanghai as a whole. With the prosperity of Shanghai's industry and commerce, the diet is booming. The influx of various food restaurants is largely due to the fact that local populations gather in Shanghai in order to meet the needs of different groups of people. The distribution and development of Shanghai restaurants are closely

related to the prosperity and development of Shanghai cities. In the 19th century, Shanghai's cities were centered on the county seat and the concession, and they expanded from south to north and from west to east as industrialization expanded. The development of cities has promoted the formation of urban zoning. Shanghai cities are gradually divided into functional areas: industrial areas, commercial areas, residential areas, and cultural areas. The catering industry is mainly located in the business district.

Shanghai's diverse restaurants also reflect the changes in Shanghai's social and economic environment over time. In the 19th century, in Shanghai, Suxi, Ningbo, and Anhui restaurants were the first, followed by Beijing-Tianjin-Hebei cuisine in Shanghai, and Cantonese, Sichuan, and amaranth were flourishing. It was not until the 1920s that Shanghai's local cuisine began to evolve into a kind of cuisine from the popular food on the streets. The local cuisine is characterized by "Liquor Red Sauce", which is sweet and salty, oily but not greasy, and fully combines Suxi cuisine with sixteen local flavors.

**Shanghai cuisine**

The development of local cuisine has a fish-water relationship with the local economy and culture. The development of Shandong cuisine is related to Confucius. The development of Anhui cuisine is related to Anhui merchants. In modern Shanghai, due to the concentration of industry and commerce and cultural people, internal and external exchanges. Frequently, Shanghai's food culture is widely available and gradually becomes the meeting point of domestic and foreign food culture.


*Fig 1.2: Traditional Shanghai cuisine*

Shanghai cuisine constantly absorbs the strengths of foreign dishes, especially Suzhou tin dishes. In the middle of the 20th century, it has formed a variety of fresh materials, medium variety, and moderate taste. Many local restaurants have created housekeeping dishes and cultivated a group of local gangs. The chefs greatly improved the taste of the local cuisine. The dishes are thick, thick and marinade penetrated into the interior of the dishes, especially tasty, but there is no lack of light and elegant, fresh and beautiful. Shanghai, as an international metropolis, has been developing with the development of the times and has gradually formed a blend of Chinese and Western cultures and is compatible with the Shanghai culture.

The traditional Shanghai cuisine uses only a single seasoning such as soy sauce, salt, and MSG, and the modern Shanghai cuisine uses a variety of compound seasonings in addition to the black peppers and butter in Western cuisine, the red pepper in Sichuan,

and the awkwardness in Xinjiang. The dishes have more novel flavors. In fact, the essence of Shanghai-style cuisine lies in compatibility and development and development in improvement. The new Shanghai cuisine is not a traditional dish. It is based on the mature local cuisine. It widely absorbs local flavors at home and abroad and improves development to form unique Shanghai cuisine. Shanghai is an immigration city with a large population and mixed tastes. Its new Shanghai cuisine will surely adapt to this feature.

**Shanghai Vegetarian Restaurant**

In the 19th century, Chenghuang Temple was Shanghai's economic and religious center, and Shanghai's first vegetarian restaurant was also opened here. Shanghai's vegetarian restaurant is open mainly to counties and concessions. 1920-1930 was the period when the Shanghai food market started its vegetarian restaurant. First, because of Shanghai's economic recovery in the 1920s, and second, the rapid development of Buddhism in Shanghai. Many Shanghai's social celebrities in the same period advocated the concept of healthy food, making the opening of the vegetarian restaurant reach its peak in the 20th century. Nevertheless, by 1947, the number of vegetarian restaurants in Shanghai was only 34, accounting for 2.87% of the total number of restaurants. (Tang Yanxiang, 2008)

So far, there are more than 100 vegetarian restaurants in Shanghai, mainly in the four regions of Huangpu, Pudong, Jing'an and Xuhui. Among them, the most concentrated are the vegetarian restaurants near Huaihai Road and Beijing West Road. Beijing West Road is one of the main arteries of the former Shanghai Concession West District and is also a famous commercial district in Shanghai. The prosperous economic environment and the historical background of the development of vegetarian culture

have contributed to this phenomenon. Shanghai's vegetarian restaurant has a long history of traditional vegetarian restaurants such as Kung Lin and Ju Ling. Small and refined are the characteristics of most vegetarian restaurants. The research object of this thesis “Lok livelihood and humanistic comfort museum” has two branches in Shanghai. This research takes Pudong shop as a research object and conducts on-the-spot observation and measurement.

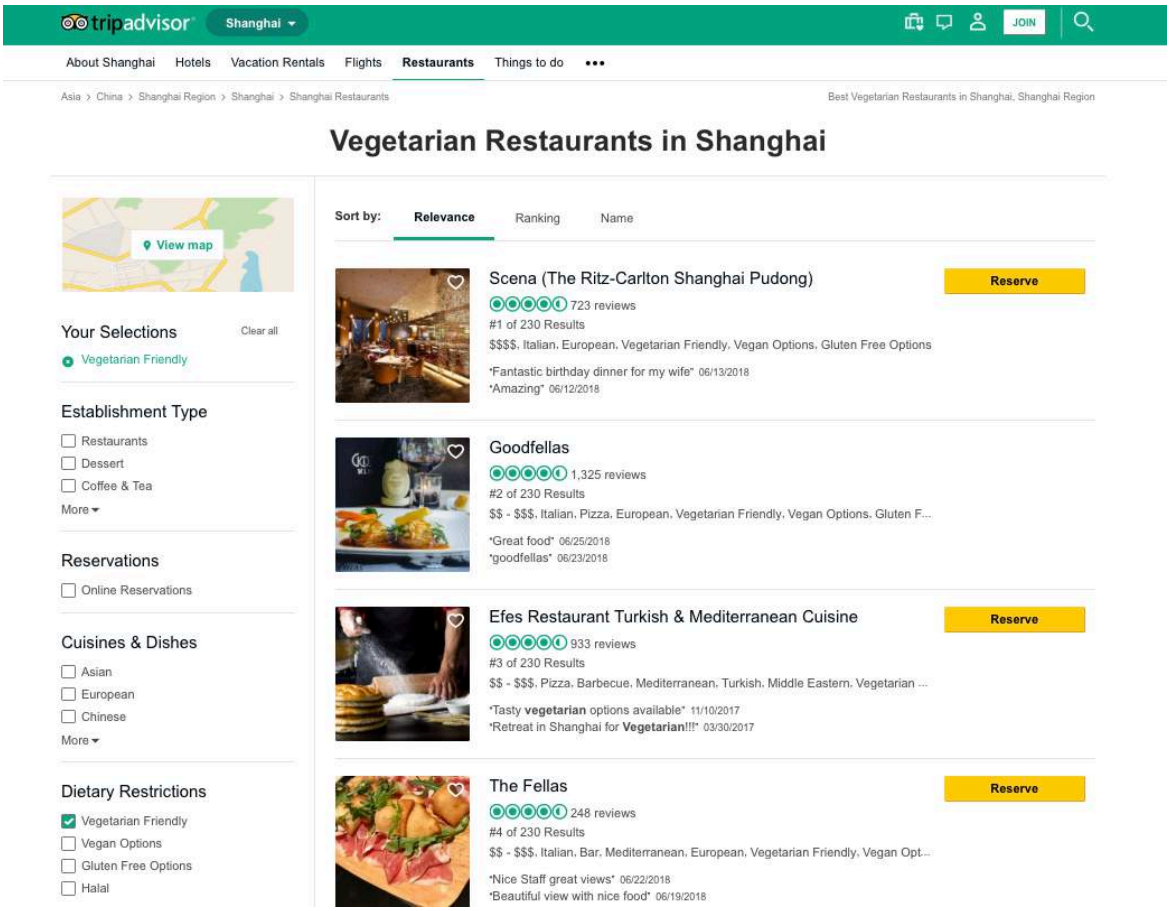


*Fig 1.3: Vegetarian restaurants in Shanghai*

### *1.1.2 Kitchen Waste Collection and Treatment*

**Kitchen waste definition**

China's food waste is rich in organic substances such as starch, fat, protein, and cellulose, nitrogen, phosphorus, potassium, calcium, and various trace elements; toxic

and harmful chemical substances (such as heavy metals, etc.) have little content and are of high utility value. However, food waste is extremely perishable and carries bacteria, which can easily cause secondary infections. Shanghai is located in southeastern China. It has a complex diet structure and produces a large amount of food waste. Compared with the coastal cities in the south, it has high oil content and less impurities, and has huge recycling value.

**Food Waste Treatment Technology and Status Quo**

In Shanghai, Xining, Ningbo, Suzhou and other places, some restaurant wastes implement fixed-point recovery policies, timely recovery, sorting, processing of kitchen waste, avoiding waste of resources and secondary pollution of the public environment. However, the coverage of this policy is small and the cost of transportation processing is high. At present, most small and medium sized food and beverage outlets in Shanghai are still adopting a unified management system of discarding and recycling.[1] Food and kitchen waste recycling is not timely. It is mixed with residential garbage, and it is difficult to sort and reduce the value of recycling. There are three main technologies for

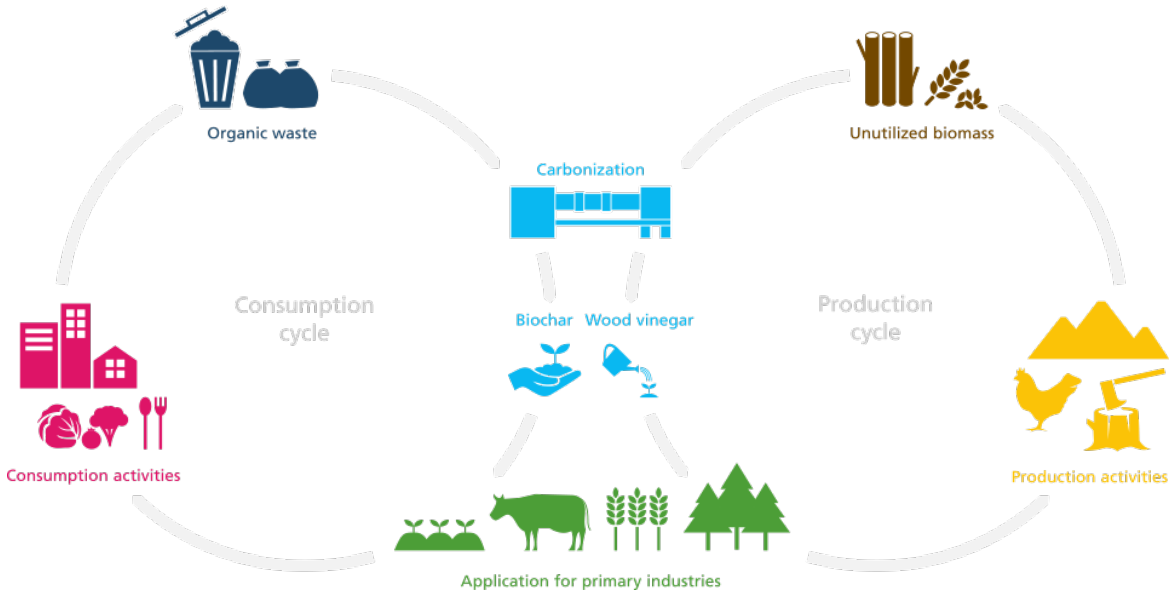


*Fig 1.4: Food Waste Treatment*

[1] Zhang Qinfang, "Summary of waste disposal technology of kitchen waste" *China Biogas* 30, no.1(2012): 22

the treatment of urban solid kitchen waste: incineration, landfill, and microbial fermentation. The three methods are relatively mature, but each has its own drawbacks. Incineration is the combustion reaction between flammable solid wastes and oxygen in the air at high temperatures, which causes oxidation and decomposition to achieve capacity reduction, detoxification, and energy recovery. Large incineration volume, good volume reduction, and heat generated by the incineration process are used to generate electricity to enable the energy of the waste.[2] But there are many deficiencies in the incineration technology to deal with the kitchen. First of all, due to the fact that the moisture content of food waste in China is more than 70%, the utilization of heat energy is low. Secondly, food waste contains a large amount of lipids. During the combustion process, an important factor for the production of dioxins is formed under the catalysis of heavy metals. More serious secondary pollution is caused. Third, the treatment of restaurant-kitchen-garbage increases the consumption of incinerated fuel and increases the processing cost. Fourth, the incineration investment is too high, the operating cost is high, and the management level and equipment maintenance requirements are high. Less domestic application experience. (Zhang Qingfang, 2012)

Landfilling method is the main method for municipal solid waste disposal in various countries in the world. It disposes domestic garbage underground, and degrades macromolecules into small molecules using aerobic microorganisms, facultative anaerobic microorganisms and anaerobic microorganisms, 2003). As a traditional waste disposal method, landfill treatment is widely used due to its large amount of processing, no pretreatment, low operating cost, and simple process and technical operation. However, landfill disposal also has the disadvantage of occupying a large amount of land and having limited processing capacity. Food and kitchen wastes have high moisture content and are easily corroded. Landfills are liable to form leachate and

[2] Lixu, "Study and consideration on national policies and local regulations on kitchen waste" *Environmental Science & Technology* 34, no.12H(2011):405

pollute groundwater and soil and produce odors, causing irreversible secondary pollution to the surrounding environment. (Zhang Qingfang, 2012) Microbial fermentation is divided into aerobic composting and anaerobic fermentation.

**Kitchen waste recycling requires the support of a complete industrial system**

The harmlessness and resource utilization of food waste requires systematic industrial chain support. In the entire process of discarding-sorting-transporting-pretreatment-processing, kitchen waste requires not only government support and perfect system, but also needs the cooperation of all stakeholders. First of all, it is necessary to raise the awareness of all stakeholders and environmental protection; secondly, based on the material links between local industries, a complete industrial ecological chain is formed to realize the material circulation within the system.

**Necessity and Significance of Recycling Kitchen Waste**

As a super-sized city, Shanghai has a population of 24.15 million people. The huge output of kitchen waste is scattered and the cost of recycling is high, making it difficult. The quality and purity of food waste recycling directly affect the efficiency and safety of subsequent recycling. If not handled properly, not only will there be a lot of waste of resources, but it will also cause damage and pollution to the residents' health and the environment.

The resource utilization of food waste is a systematic project. Only from the perspective of the system, the quality and safety of food waste in every link of the resource system can be ensured to ensure the harmlessness and maximum use of food waste. Sustainable urban development is of great significance.

Through the author's research, it was found that half of food and kitchen waste was generated from food and vegetable waste generated from food processing, and half of it was from food waste after processing. However, 83% of the current literature is focused on discarding, recycling, sorting, and disposal of food waste, and less than 20% of the food waste generated during food processing is studied. The high-quality food scraps produced during the processing of ingredients are discarded together with the rest of the kitchen waste, causing unnecessary waste. The author will use the method of system design to analyze and research the process of restaurant-kitchen garbage production and provide a new perspective for the resource utilization of food waste.

## 1.2 RESEARCH OBJECT AND SCOPE

System theory is a methodology for understanding the world. It uses the world as a system and puts concrete problems on the system level to analyze qualitatively and quantitatively. It finds out the root causes of problems in the system and changes them through the optimization and design of the system. The mode of operation of the system to find new ways to solve the problem. This article will use systematic theory as a guiding ideology, through the qualitative and quantitative research on the process of cooking in the vegetarian restaurant, using the systemic design method to explore a new model of urban food waste maximization and food waste processing.

This series of articles focuses on the LOHAS vegetarian restaurant. The small vegetarian restaurant has a sound kitchen equipment and management system. It has a smaller body and is relatively easy to research. It provides a typical case for exploring the maximum utilization of kitchen food waste resources in the city and the new model of food waste disposal. Compared with common food waste, vegetarian food waste is relatively simple, providing the possibility of qualitative and quantitative analysis of food waste. The LOHAS boasts a more advanced system management philosophy. The

restaurant has a strong sense of environmental protection and sustainability. In the future, it will prepare to cooperate with an ecological farm, establish links with the surrounding ecology to reduce costs, and establish a new economic profit model. This provides the possibility for systemic design applications.

This series of articles systematically researches the process of the kitchen cooking process in the restaurant, analyzes the fruit and vegetable materials and water resources in the restaurant's cooking process qualitatively and quantitatively, and finds the reasons that lead to the low utilization rate of resources. Through the method of systemic design, the restaurant's kitchen process is optimized to achieve “zero emissions”; the connection between LOHAS and the surrounding commercial ecology is established; the systematic solution for vegetarian kitchen waste is explored. Through the economic evaluation of the old and new systems of LOHAS, find out new economic growth points for restaurant operations and quantify systemic design results.

## 1.3 RESEARCH PURPOSE AND SIGNIFICANCE

This series of articles will use the system theory as the guiding ideology, through the qualitative and quantitative research on the restaurant's cooking process, using the systemic design method to explore the new optimization model of restaurant kitchen waste resource utilization. The structure and quality of the system determine the output of the system. The problem of urban kitchen waste arises from the linear production model of urban catering industry. This series of articles use the systemic design method to determine the reasons for the low resource utilization rate through the qualitative and quantitative analysis and research of the kitchen process. The systemic design optimizes the flow in the kitchen, maximize resource utilization, reduce waste, and realize “zero

emissions". This series of articles will also explore the new economic model of cooperation between urban catering systems and related systems by strengthening the cooperation between vegetarian restaurants and neighboring ecological farms and provide catering industry operations. Strengthen regional co-association, provide new models and new methods for the systematic treatment of urban kitchen waste, and through the economic evaluation of the system, find new economic growth points and quantify design results.

With the accelerating process of urbanization in China, the urban population has grown rapidly, and the city's food waste has become huge and difficult to handle. Urban food waste is "misplaced resources." The systematic treatment of food waste can not only reduce environmental pollution, but also bring new profit models by strengthening the links between local companies.

Through the exploration of systematic solutions for urban food waste in the city, people will bring new perspectives to solve problems, change the linear thinking paradigm, and shift people's attention to "quantity" to attention to "quality", to "part" to "system". As a part of the world system, human beings can only continue to develop in accordance with the rules of the world's system.

## 1.4 CONCEPTUAL RESEARCH FRAMEWORK

A research framework is an analytical tool with several variations and contexts, used to make conceptual distinctions and organize ideas. Conceptual frameworks are abstract representations, connected to the research project's goal, that direct the collection and analysis of data.

The research that has been conducted for this paper could be mainly divided in three complementary parts as the figure 1.5 showed below. As already mentioned, I have been working on the part 2. The three parts have something in common, we shared the similar introduction in the first chapter. I did the research of the LOHAS vegetarian restaurant linear system, analyzed the after cooking process, water resources problems, kitchen waste problems and I also focus on four kinds of cases study which can be used in the systemic design. The following research framework graphically illustrates the work that has been done. It has not to be read in a hierarchical order, but as an association of thought processes. It is a joint work of both candidates and that's why it is marked with a grey background.


*Fig 1.5: The research framework of the three papers. In orange the parts of my competence*

# 2. OVERVIEW OF SYSTEMIC DESIGN THEORY

## 2.1 THE DEVELOPMENT AND CHARACTERISTICS OF SYSTEM

### *2.1.1 Transformation of Thinking Paradigm: From Mechanical Determinism to Systemic Theory*

The general systemic theory of Bertalanffy, and the complex adaptive theory studies the decentralized control of the group from the bottom up, and thinks that the simplicity of the individual implies the complexity of the system, acknowledging the disorder and randomness within the system, and proposing that complex systems exist only in the "Edge of Chaos", chaos and disorder are the root causes of system complexity, while adaptability maintains the complexity of the system. With time going by, the interdisciplinary application of system theory is more and more concerned and perfected. In the the 1970s, biologists Humberto Maturana developed the theory of self-organizing systems.[3] Self-organizing system is the characteristic of all living system, which has the following characteristics:

• Self-Organization: The system has a relatively stable structure and pattern, manifesting the nature and goal of the system. The system can use the element to undertake self-generation and self-organization, develops and evolves towards certain direction.

• System boundary: The system has boundaries and the boundary belongs to a part of the system and is composed of the element organizations in the system and is relatively independent of the external environment.

• Open System: The system is an open system, and exchanges material, information and energy with the outside world through the boundary.

• Feedback loop: There are feedback loops inside the system, and the system state can adjust through the external environment and maintain the relative stability and

[3]Linyi, "General systems theory studies the past, present and future" *Journal Of Air Force Engineering University(Natural Science Edition)*3, no.1(2002):1

purposiveness.

• Exchange of material: information and energy with the outside world: the system relies on the external environment to provide material, energy and information exchange to maintain the function and stability of the system. Once the system is disconnected from the environment, the system will stop functioning.

The theory of self-organization reveals the general characteristics of living system and provides an important theoretical basis for the description and modeling of the real world's complex system. The system design methods and tools used in this paper are also based on the self-organizing characteristics of the system.

Systemic theory is the methodology of people's understanding and cognition of complex dynamic systems, and the system is optimized and regulated by analyzing the structure and nature of complex systems. From mechanical determinism to system theory, people's cognitive and thinking paradigm of the world has changed radically: people no longer focus only on the part, but more on the relationship between part and part, part and the system, the system and the environment. Human beings have sailed into a new era of the information society, and all scientific and technological activities constitute an unprecedented complex and massive system. The application of system thinking will enable us to better deal with the complex problems and dynamic changes in the social structure, use system tools to draw and express the system model, and analyze and optimize the system with the help of the model.

### *2.1.2 The Characteristics of Real Systems: Taking the Social and Cultural System as An Example*

All real systems are self-organized living systems with dissipative structure. The system is interconnected by the elements of the system, forming complex interlaced loops. The

interactions between elements and elements, between elements and systems, and between system and environment embody the characteristics and attributes of the system. Showing relatively stable structure and property, the system has boundary, and

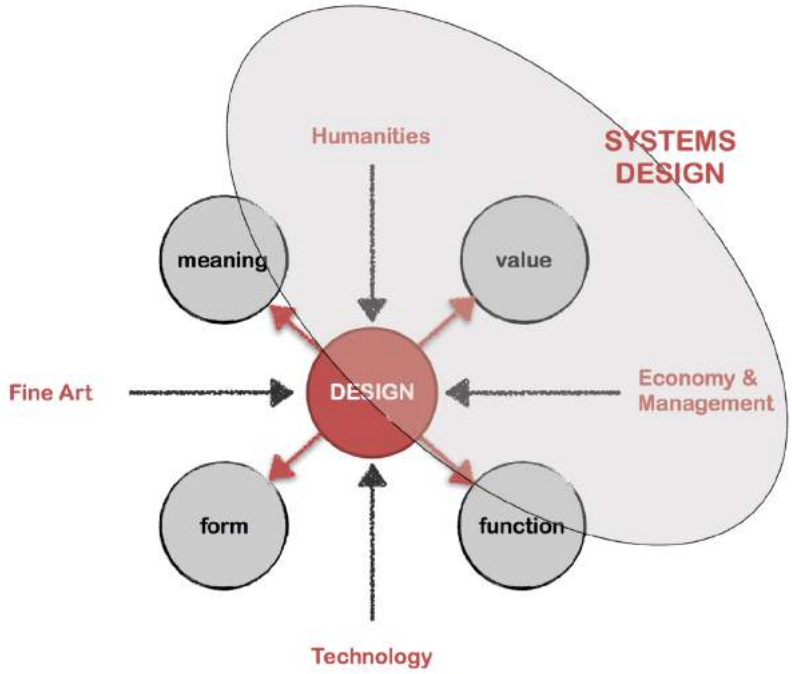


*Fig 2.1: Systemic Design*

is capable of self-organization and iteration. System is relatively independent, but it achieves dynamic balance by exchanging energy, material and information with external environment through the boundary. The real system is an adaptive dynamic system with multiple threads, which is different from the mechanical system, and the real system is always iterative and developing towards a certain direction, showing a certain purpose. The mechanism of real system iterative and evolution comes not only from external stimulation, but also from internal complex dynamics.[4] For example, our social system is a complex real system. If the elements of a mechanical system are considered to be "energy associations", then the elements of a sociocultural system are "information associations". The social culture system can be regarded as a collection of elements formed by the interconnection of information, which is formed by the

[4] Chen Yizhuang, "On the Difference Between Von Bertalanffy' General System Theory And Santa Fe Insitute's Complex Adaptive Systems Theory" *social science* 9, no.2(2007):5

emergence of the meaning in the interaction network of individuals. (Jamshid Gharajedaghi, 2014) To understand the social and cultural system, we must first understand the concept of culture and social learning. Knowledge is people's abstract image based on the real world. The image unified into a meaningful psychological model and formed a world view. Image leads to the interaction between men and the environment and affects each other. Spreading through languages, knowledge forms a general consensus among some people, who gather together through an unique structure and forms a common cultural background. The social culture system is composed of small systems with different cultural backgrounds, and the exchange of knowledge and information between different small systems maintains the dynamic stability of the system and develops and iterates towards a certain direction. Culture is the blueprint of system development, which determines the direction of system development from the structure and is the internal factor of system iteration. When thinking and optimizing the social culture system, it is a key to the think of the cultural background and the definition of the system boundary.

## 2.2 PATTERNS AND PRINCIPLES OF SYSTEMIC DESIGN

Systemic design is a method of designing a system. Through the systemic design of modern linear production systems, the links between elements and elements within the system, the external environment of the system and the material energy exchange are reconstructed, the self-organization characteristics of the system are restored, and a virtuous circle of material and energy resources within the system is realized and for maximize utilization. System-based systemic design has a complete set of guiding principles:

**Change the Output of One System to the Input of Another System**

Turn the output of one linear production line into the input of another production line. Because the linear production model does not follow the principles and characteristics of the system operation, the large amount of waste generated during the processing of resources is treated as waste disposal or disposal. Turning the output of one production line into the input of another production line enables the timely and effective use of waste resources, avoiding the waste of resources and the pollution of the environment, and even lowering the cost of the enterprise and realizing more resource sharing.

**Focus on the Local Environment and Culture**

Global production opens the global market for commodities. A Chinese-style porcelain may have its origins in China, but it is produced in Japan and eventually sold to the United Kingdom. This globalization process has promoted the development of the global economy and has also spawned a rich commodity culture. Products are produced according to market demand, purchased by consumers worldwide, and eventually abandoned. With the smooth flow of logistics and information, the acquisition and consumption of resources no longer follow the principle of localization. This has separated local production from the relationship with the local environment and other enterprises and increased the transportation costs and energy consumption of production. Caused unnecessary waste of energy and environmental pollution; on the other hand, the cultural meaning of local production has gradually disappeared. Production is out of the local context and forms a closed linear system. Strengthening the link between production and local contexts and establishing local production ecological chains can not only reduce environmental pollution, make effective use of resources, but also increase local economic income by creating new opportunities.

**Concern for Individuals and Concern for Relationships**

Systematic thinking emphasizes the relationship between elements and elements, between elements and systems, between elements and the external environment. The

mutual relations and combination of elements in the system determine the mode and nature of the system. Only by changing the system's mode can the nature and output of the system be changed. The linear production thinking that pursues yield and efficiency pays more attention to the product and production itself, while ignoring the correlation and impact between the production system and the environment and the social system.[5] The production system referred to that includes not only industrial production systems but also agricultural production systems. For example, farmers use chemical pesticides to spray on crops in order to reduce pest rates. During this period of time, it did reduce agricultural damage and increase crop yields. However, the use of long-term chemical pesticides not only pollutes crops and land, causing food safety hazards. Pesticides can also infiltrate into groundwater, causing a wider range of pesticides along with ecological cycles. Pollution. (Rachel Carson, 1962) Nothing is isolated. Think of the problem in the context of the system to better reveal the nature of the problem and find a systematic solution.

**Build an Open System**

Using system design thinking and design methods, in the local environment, the exchange and correlation of the material and energy between the system and the system is reconstructed. The openness of the system not only ensures the system's activity, but also enriches the cooperation model between systems and creates new economic values.

**Human-Centered**

Modern production systems are centered on consumption (products). Products are given meaning. When people purchase products, they consume not only the functions of products, but also the symbol of their personality and status. As shown below:

[5] Zhang Jici, “Systematic analysis of animal husbandry” *Livestock research* 1, no.2(1985):359

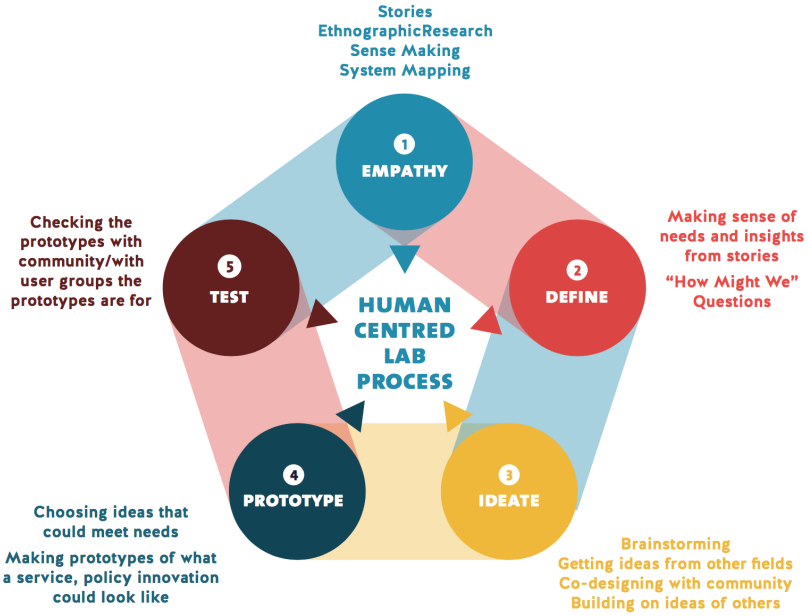


*Fig 2.1: Human-centered (Source: Courseware revision at Turin University of Technology)*

The systemic design emphasizes the people-centered consumer culture, emphasizes the connection between people and the natural environment, and the local context, emphasizing the real needs and quality of life of people. Different regions have different living habits and needs. Respect for geographical differences and cultural design can truly meet the needs of people in different regions. The system design proposes to change "consumer" into "participant". Consumption is no longer the end of the cycle, but it is part of the cycle to participate in the system operation.

## 2.3 SUMMARY OF THIS CHAPTER

This chapter explains the theoretical background of system design through the history of system theory development, system theory theory, and characteristics of real systems. Then through the system design model, guiding principles, a comprehensive introduction to the system design method. System design is the main design method

used by the author in this study. The application of the system design in the cooking process of the vegetarian restaurant is a new attempt. Through the optimization of the restaurant's cooking process, the cooperation between the restaurant and related companies is strengthened, and a systematic plan for urban restaurant kitchen waste disposal is explored.

# 3. STUDY ON METHODOLOGY OF SYSTEMIC DESIGN

## 3.1 SYSTEMIC DESIGN METHOD

### *3.1.1 The Tools and Steps of Systemic Design*

Based on the guidance of the system design principles and the analysis of the linear system, the systemic design method is a way to assist system tools in optimizing the flow of material in the system and realizing the "zero discharge" of the system resources by means of design. Take system circulation diagram and water pipe diagram for example, systemic design also has a set of tools and procedures to describe the system:

**Define System Territory**

The region of the system is the material and cultural background of the research system. Through the research on the natural condition, resource type, traditional culture and living custom of the external environment, the system region is defined and the system problem is studied under the regional background.

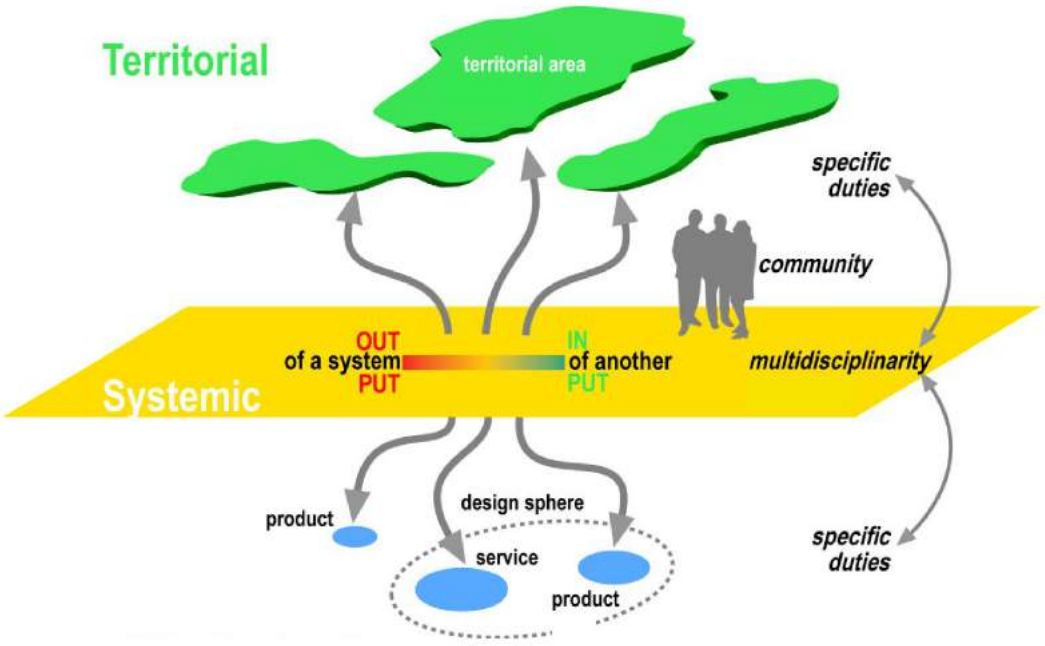


*Fig 3.1: Define System Territory*

**Analyze All Elements Related to the System and Related Matter and Energy Flow**

Find out all the relevant actions within the system, and the material and energy flow through each action within the system, define the input and output of the system as a whole, analyze the source and destination of the material and energy sources of the inflow system, establish the relationship between the system and the external environment, and understand the system overview. As in the agricultural plant system, it will be divided into preparation, sowing, growth, fertilization, disinsection, and harvest. As a resource, water flows through the whole system, and finally return to groundwater through the absorption and filter of soil.

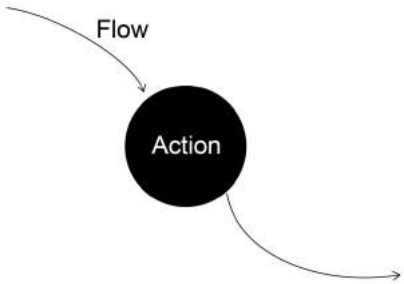


*Fig 3.2: Action and flow (Resource: author)*

**Determine the Input and Output of Each Action and Establish the System Association**

The input and output of material and energy are analyzed respectively in the system, then the interrelated actions are connected according to the flow order of material, and the system model is established.

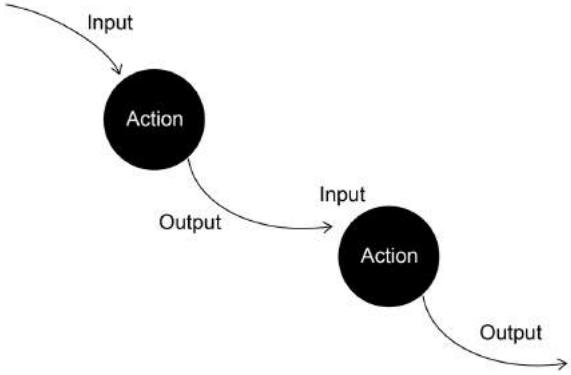


*Fig 3.3: Input and output (Resource: author)*

**Use Qualitative and Quantitative Analysis of the System Diagram to Find Out the System Problems of the Linear Systems**

The material flow in the system is graded and numerically measured based on the system association, which will be brought into the system for further adjustment. Mark the existing problems of the linear system and find the key to the problem.

**Conduct Systematic Optimization of the System**

Analyze the problems of linear system, look for the best solution, and design and optimize the linear system: 1. Maximizing utilization of resources 2. Improve the quality of the system output 3. Strengthen the association of the system and local, making the system's output into another system's input.

### *3.1.2 Method of Describing System: System Circulation Diagram and Water Pipe Diagram*

The real world is a large and complex open self-organizing living system, and study on it will lose some practical significance for any realistic problem if divorced from its background and system. System thinking based on system theory is the methodology and toolkit to help us better deal with problems in complex dynamic systems. Systematic thinking is mainly based on the basic theory of four dimensions: Social culture system, holistic thinking, logistic thinking and design thinking. System thinking tools: System cycle diagrams can help us establish system models to identify causal associations within the system:

**Define System Suspension and System Boundary**

We know from the above theory that it is not practical to make the problem analysis without taking the system environment and background into consideration. When analyzing system problems, we introduce the concept of "hanging pendulum" to define

the system boundary of the problem. Suspension plays the role of goal, policy, external impetus or system result in the system. (Dennis Sherwood, 2014) Theoretically, the world is a complete system, but the study of all factors does not help us to solve the problem better.

**List All the Elements Within the System**

Find out the nature of the system problem, and define the system boundaries, then analyze and identify all the system factors related to the system problem.

**Establish A System-Wide Association to Form A Feedback Loop**

After identifying the relevant factors of the system, based on the real system, the factors within the system are established and the loop is formed. There are only two kinds of associations between elements in real system: s-type association and o-type association.
S type association: The interrelated factors move in the same direction
O type association: The interrelated factors move in the opposite direction
These causal associations are interconnected to form feedback loops, and the feedback loops are intertwined to form the whole system. The system cycle diagram is basically complete, and the visualized graphics make the complex system problem more intuitive.

**Exchange of the System and External Environment**

Self-organizing system maintains its own stability and operation through the exchange of energy and material with external systems. The last step to complete the system cycle diagram is to analyze the external environment of the problem system and the internal system to find out the energy or material flow of the system.[6]

[6] Chen Yizhuang, "On the Difference Between Von Bertalanffy' General System Theory and Santa Fe Insitute's Complex Adaptive Systems Theory" *social science* 9, no.2(2007):7

The system cycle diagram can describe the correlation and change in the system more intuitively and dynamically and help us to analyze the model and causal connection behind the dynamic complexity of real system, and solve the problem better. The real system is composed of the reciprocal positive feedback loop and the negative feedback loop, which determines the system's objective and stability.

It is worth mentioning that the establishment of the system cycle diagram is related to the user's mental model. The system cycle diagram reflects the user's view of the system, and the same system is modeled by different people, which produces different system cycle diagrams. However, no matter what language is used to describe the system, the nature of the system will not change.

With the development of information technology, people begin to use computer modeling technology to simulate the real system and analyze the dynamic change of stock-flow in the static system cycle diagram, which is called system dynamics. The plumbing diagram or the "stock-and-flow diagram" depicts the system over time.

## 3.2 ECONOMIC BENEFIT EVALUATION OF SYSTEMIC DESIGN

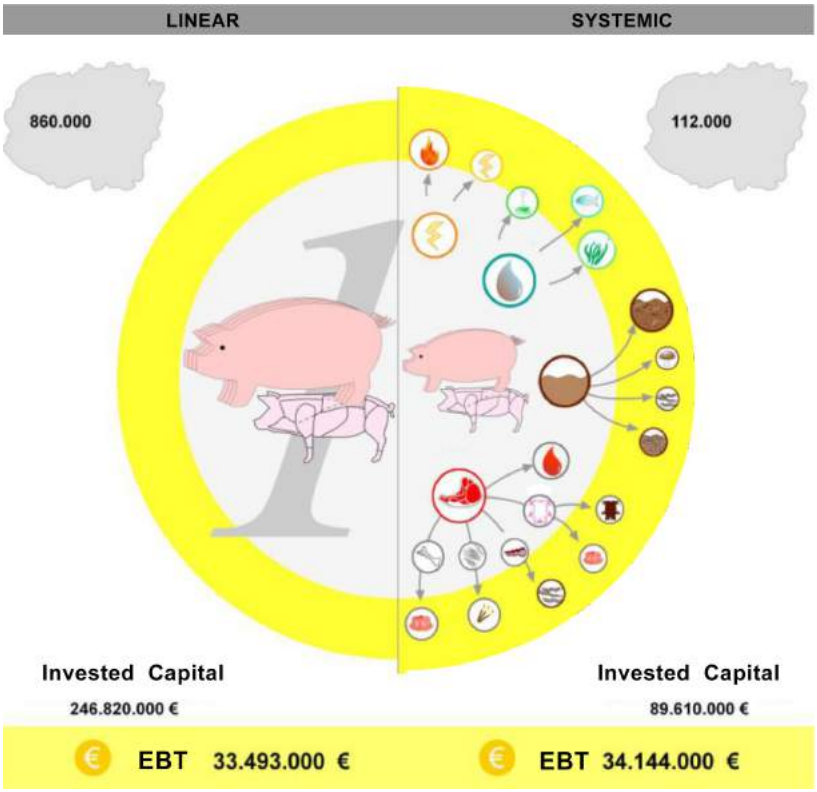


*Fig 3.4: Comparison of economic benefits before and after system design*

Systemic design can bring considerable economic benefits. Figure 3.5 shows the comparison of the economic benefits before and after the system design. The figure on the left shows the quantity, cost, and pre-tax profits of the local pig industry; the figure on the right shows the number of livestock after system design. , reorganized the flow of input and output resources and energy in the open system, such as in-depth analysis of pork components, and divided the output of pork resources into bone, hair, skin, blood and organic waste, and different outputs correspond to different The use of channels, which greatly improved the efficiency of the utilization of pork resources, also indirectly reduced the input costs of related industries, increased the pre-tax profits of the local pig industry, and balanced the relationship between economic growth and geographical resources. To promote the development of diversified industries.

## 3.3 SUMMARY OF THIS CHAPTER

This chapter mainly describes the methodology of systemic design. It introduces the tools and steps of systemic design, the method of describing the system, and the economic evaluation of the systemic design. Through the guidance of methodology, it provides a solid theoretical basis for the restaurant's systemic design.

# 4. CASE STUDY AND ANALYSIS OF SYSTEMIC DESIGN

## 4.1 THE RELATED SYSTEM OF JAPANESE TRAMPS AND WASTE RESOURCE RECYCLING

Tokyo has undertaken a massive renovation of its urban image since its successful bid for Olympics. There were many tramp-gathering areas, such as the west of Ikebukuro West Gate Park, Shinjuku City Hall underground, Ueno Park and so on. Because of the government's image renovation project, their areas of activity have been significantly reduced, and some homeless people were even forced to "move" to Chiba and Jade. A large tramp parade was staged in 2010 near the "Sky Tree" in Tokyo in protest at the new government's "ban on free cans and waste paper" in Tokyo's Mexican field. Tramps and low-income people who joined this parade played the slogan "You can't sacrifice the poor for the good of Sky Tree" "Don't treat us as criminals." But the government kills two birds with one stone: on the one hand it protects the interests of local resource-recycling companies, and on the other hand, the low-income groups and tramps who rely on the recycling of resources are driven out of the field.

**Income Sources for Tramps**

Begging in the streets is illegal in Japan, and using children for begging is a felony: under Article 1.22 of the Light Crimes Act, begging and soliciting for begging on the streets will be punishable by detention and fines, and the use of children for begging, in accordance with Article 34.1.2 of the Child Welfare Act, shall be punishable by imprisonment for 3 years and a fine of less than 1 million yen. So activities like "begging for the disabled", "kidnapping children to beg", will be immediately banned in Japan, which is a fairly effective decree. As a result, tramps have to "fend for themselves" or opt for "government aid".

The main sources of income for tramps are as follows:

(1) Pick up trash off the streets

(2) Stealing rubbish from refuse collection station

Collecting rubbish along the street is laborious, and the high-quality of Japanese residents makes it hard to see rubbish in the street near the residential area. There are empty bottles of cartons on the streets near the bustling restaurants and nightclubs. And that is the reason why tramps often gather in areas like Ikebukuro, Shinjuku, and Shibuya. The price of a kilo of aluminum cans is 65 yen (about 4 yuan) in 2008. The latest price in 2015 has risen to 100 yen/kg.

*Fig 4.1: Japanese Tramp*

When there are more tramps, there will naturally be turf battles. Tramps who still want to pick up rubbish to earn money, have to stare at the rubbish in those rubbish stations. It is illegal in Japan for a homeless man to take away the rubbish from the rubbish station. In all towns and villages in Japan, the recycling of resources is required to be operated in the form of a company, through the submission of applications to the local government, and pay a certain "operating margin", then the government will issue the company's "Resource Recovery License." These companies can then drive garbage trucks to designated rubbish stations to collect rubbish, and classify them, then sell to

paper mills, metal processing plants and so on. People who live in Japan can find garbage trucks that recycle waste paper, bottles and cans, and so on, don't belong to one company.

From the point of view of these resource recycling companies, the operating margin paid to the government can be regarded as a kind of "protection fee", which, in this form, can ensure that they have the right to reclaim all the rubbish in an area. Once scavengers and tramps go to the dumpsters to take away valuable waste like paper, and aluminum cans, the benefits of the recycling companies will fall, and the tax paid to the government will be reduced, and the jobs that can be solved will disappear. As a result, the government will stand together with the recycling companies to boycott tramp's "theft of rubbish".

**Daily Dining of Tramps**

For the majority of homeless people living in urban areas, there is no condition for their own cooking: because most of them live in parks and buildings, and these areas are protected by fire regulations, so tramps who have a picnic in these areas will be arrested by the police in the name of violating the law.

However, they have another advantage: picking up rubbish to eat.

Most convenience stores, fast-food restaurants and supermarkets have strict rules about the shelf-time of prefabricated foods: box lunches, rice balls, fried fries and chicken nuggets, and so on, which have to be destroyed theoretically after a short period of time. And some tramps will visit these store bins at a proper time to dig out those discarded food to eat. All the convenience stores in Japan are throwing away more than 360,000 box lunches a day, or 180 million yen (about 11 million RMB), which is a huge waste. Some local volunteer agencies in Japan have been working with the chain convenience stores to classify and heat those box lunches that are to be expired and distribute them

to tramps.

As for drinking water, since most of the parks have potable faucets, drinking water is not a problem. For some working tramps, they will choose to buy beer from cheap vending machines. They will not go to the convenience stores or supermarkets at the peak of the passenger flow, but mostly in the late night to buy some food and wine unobserved.

Japan has a very sophisticated waste separation and recycling system. Household garbage is referred to as "waste", and the waste is divided into three categories: general waste, industrial waste and toxic and hazardous waste. Household waste belongs to the general waste. At present, the household waste in Japan is mainly divided into combustible rubbish, nonflammable rubbish, coarse rubbish and resource rubbish.

**Introduction of Domestic Waste Recycling System in Japan**

• Combustible waste includes kitchen waste, newspapers, cartons, cartons, magazines, old cloth, packaging containers and so on. Garbage Discard method: Put them into the city designated garbage bag.

• Nonflammable waste includes metal, glass, broken electrical appliances, ceramics, plastic and so on. Garbage Discard method: put them in transparent or translucent plastic bag.

• Coarse waste includes white household appliances (televisions, air-conditioners, refrigerators/cabinets, washing machines), metal, furniture, bicycles, pottery porcelain, irregular shape of cans, bedding, mats and so on. Garbage Discard method: First, measure the size of the rubbish. The length of the longest part being more than 50cm,


*Fig 4.2: Japanese dustbin*

the item will be identified as large garbage. Items that are longer than 2m or weigh more than 70kg will not be collected. You need to reserve a large garbage reception center for processing. Second, discard after the payment of coarse waste disposal fee.

• Resource waste includes beverage bottles, brown bottles, colorless transparent bottles, and bottles that can be directly recycled. Garbage Discard method: empty the tank, rinse it, then put it into transparent or translucent plastic bag to discard. In the implementation process, the dumping of waste is different according to the type of the garbage. It should be in accordance with the garbage disposal calendar (pictured below), to be dumped to the designated garbage point at the set date and time (before 8 o'clock in the morning). Combustible waste must be installed in a combustible waste bag made by the city government. For the management of garbage classification and convenience for foreigners, regulations on the disposal of garbage have foreign language version. For example, the classification and dumping method of household waste, published by Cicheng County Zhubo in 2015, is available in English, Spanish, Portuguese, Chinese, Korean, Thai, and many other language editions.

• Meticulous garbage classification and recycling has become the daily life habits of all Japanese people. The garbage points on the streets of Japan usually use shrouds to prevent wind blowing away the waste and the possible spread of the smell.

**The Process of Collecting and Transporting Domestic Waste**

The collection and transshipment of refuse is the responsibility of each district, and each district will make a detailed collection plan based on the types of rubbish produced in each district and the seasonal variation of refuse production, so as to make reasonable adjustments to the setting and frequency of collection of refuse collection points. For some cities with a larger range of transport, refuse transfer stations are usually set up to transport rubbish from medium to large vehicles, thus increasing the efficiency of refuse collection.

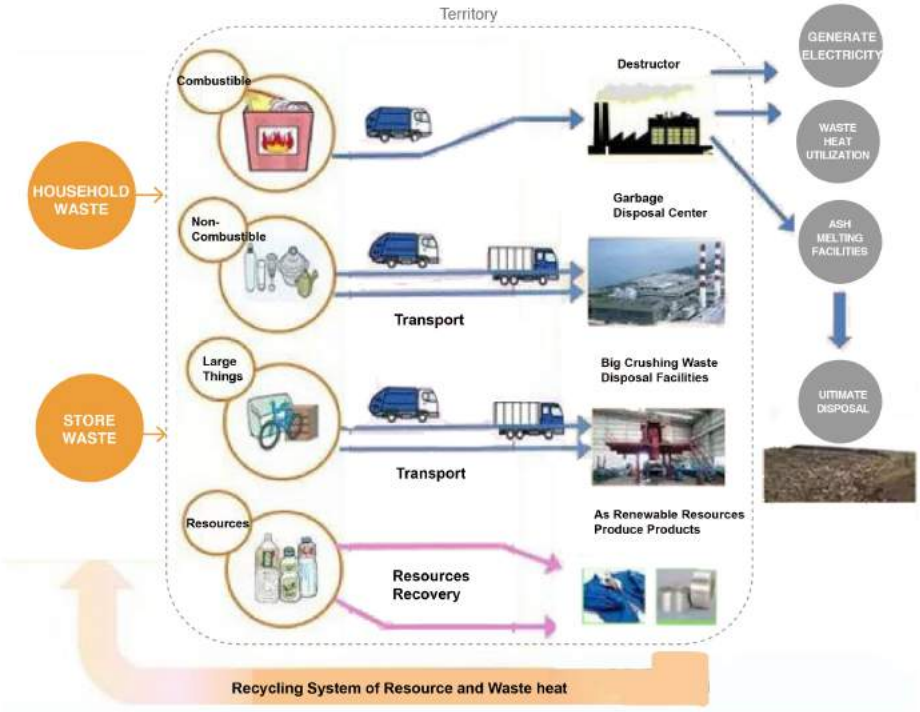


*Fig 4.2: Japanese Tramp and Waste Resources Related Systems*

The proportion of waste collection and transportation in the waste disposal industry is extremely high, so that the cost can be reduced by increasing the efficiency of waste

collection and the quality of public services can be maintained and improved.

In the process of collection and transport, the use of transit point transport methods are used: the garbage collected by the small car will be compressed into the container through the feeding bucket. The relay station can compress three two-ton vehicles into a container. Containers packed with garbage are transported through large container trucks to landfills or waste incineration plants.

**Technology of Recycling Solid Waste in Japanese Cities**

Since the new century, relying on the perfect legal system, Japan has established the waste disposal system in which the State, the local public organization, the enterprise and the national are respectively responsible, and has pushed the circular economy unceasingly, enhanced the resource utilization efficiency, and becomes the important impetus for the environmental protection and social development. This section takes waste plastics and waste home appliances as an example to briefly introduce the recycling process and technology of solid waste in Japanese cities.

**(1) Recycling of discarded plastic bottles and provision of recycled materials to resource recycling enterprises**

Japan used to be the world's second largest plastic production country. Waste plastics recycling has been a serious social problem plaguing Japan. So the recycling of waste plastics has maintained a positive attitude. After the establishment of the 3R (reduce, reuse, recycle) policy, with the concerted efforts of the three parties, the Government, enterprises and the public, gradually began to classify and recycle discarded plastic bottles, discarded cans and so on as a renewable resource to produce new products. By 2010, a total of 628,000 t of PET drink bottles were collected in Japan, of which 298,000 t was reclaimed and reused domestically and exported to 330,000 t in China and other countries. There are 172,000 t recycled PET waste bottles in Japan were used to to

obtain high-quality pet flat film Renewable raw materials after crushing and cleaning, of which 49% for the production of plastic film, 34% production of chemical fiber, 11% for the chemical method "bottle to bottle" production.

Take the recycling of plastic bottles for example, before discarding the drink bottles, the following steps are required: drink light or pour light, wash the bottle, remove the cap, tear off the label, squash, and finally, take it to to the designated location around the "resource garbage" day according to the garbage collection rules, or throw to the mall or convenience store set up a plastic bottle recycling box. In order to improve the quality of recycled products, the recycling center will remove foreign bodies, caps and trademark paper from the recycled waste plastic bottles before it compressing packaging into a bottle of bricks, and then providing them to renewable enterprises resources. Recycling waste plastic bottles according to the method of recycling resources, effective measures will be taken to prevent two of pollution in the process of recycling and reproduction. For example, waste water produced in the process of recycling will be purified before it being discharged to prevent pollution. Recycling of waste plastic bottles is relatively easy to obtain products with high purity. Recycled products of waste plastic production that usies this feature are: fiber products, such as gifts, shirts, carpets and so on; plastic bottle products, such as detergent plastic bottles, cosmetics containers, etc.; membrane products, such as cartons, boxes, boxes and other partitions; others such as stationery and containers.

**(2) Recycling technology of waste household appliances in Japan**

Regarding the reuse of four kinds of products: refrigerators, washing machines, air conditioners and televisions, Japan stipulates that manufacturers, sales shops and consumers should bear different obligations. Specific requirements are: household appliances manufacturers and importers of the above 4 kinds of home appliances have

the obligation to recycle and commercialize, that is, a certain proportion from the waste appliances to recycle useful resources, and then made products for sale. The obligation of stores is to retrieve the same product that was previously sold in the store, or to return it to the plant at the time of the renewal of the purchase request. Consumers have to follow these procedures and obligations in the abandonment of specified household appliances: ① contact the sales shop in which they buy the original product, or the one they will purchase the same product at, to help them take away the discarded products, ② consumers need to pay costs on collections and removal, and the recycling fee.

Using the technology that aims to effectively use resources and apply harmless treatment on hazardous materials, and continuously improving all technologies including operational technologies, the recycling of waste household electrical appliances in Japan has a stable operation with a large number of processing performance. According to MOEJ's report in 2011, since April 1, 2001, when Japan's "home appliance Recycling Law" was implemented, waste home appliances recycling rate continuously rises. Data show that: Air conditioning for the recovery rate of 89% (the legal standard is 70%), the CRT TV is 79% (the legal standard is 55%), the LCD and Plasma TV is 83% (the legal standard is 50%), the refrigerator and freezer is 79% (the legal standard is 60%), the washing and drying machine is 87% (the legal standard is 65%), All exceed the statutory standard. The recycling rate of home appliances has exceeded the legal recovery rate for 11 consecutive years. In addition, about 1466 tons, 282 tons, 2 tons of freon were recycled and decomposed from the refrigerant recycled from air-conditioning, refrigerators and freezers, washing machines. Some 421 tonnes of freon have been recycled and decomposed from the insulation of refrigerators and freezers.

In the past, the main processing technology of waste home appliances was only screening and magnetic selection after the crushing of machine. Now, in order to achieve a high level of resource recycling and improve the purity of the recovery, the general process is that the workers sort materials first, and then use the machine to break them, which improves the work efficiency. And not only the metal materials have been recycled, plastics and other materials have been effectively recycled, too. Refrigerators and air-conditioning contain freon that will break the ozone layer. Hence, in the resource recycling, focus should be set on the recovery of liquid freon and insulation layer of freon. Full account should be taken into the safety of employees and the environmental issues of areas around the facility.

**The Process of Establishing A Recycling System**

It is the result of the joint efforts of the whole society for Japan's household waste treatment to facilitate the circular economy. It does not only rely on the construction of the legal system, the administration of the government, but also on the participation of all the public, and their consciously abiding by the classification rules. And the most important point is the long-term systematic education and to cultivate civic awareness of environmental protection from a young age.

**(1) A perfect construction of legal system**

In the 1970s, Japan issued the Law on Waste Disposal and Cleaning. And in 1986 the Air Pollution Control Act was enacted to specify the facilities for the incineration of domestic waste. In the 90 's, in order to achieve the "zero emissions" of "recycling society" ideal, Japan put forward the slogan of "environmental statehood", and introduced a series of laws and regulations, which is the most important guarantee of the Japanese resource recycling utilization and environmental protection. These laws can be divided into three levels: the first level is the Basic Law, that is, the Basic Law

on the Establishment of a Circular Society; the second level is comprehensive law, the Law on Waste Management and Public Cleanliness and the law on Promoting the Effective Use of Resources; the third level is specific laws and regulations for the nature of various products, such as the Containers and Packaging Materials Recycling Law, Home appliances Recycling Law, Food Recycling Law, Building and Materials Recycling Law, Vehicle Recycling Law, Green Procurement Law and so on. The legal coverage of these laws is broad, the operability is strong, the responsibility is clear, specific stipulations are made to the disposal and resource recycle of different industry waste and were successively implemented.

**(2) Comprehensive and systematic publicity and education**

The national concept of garbage classification in Japan comes from the persistent national education. Included in the Compulsory Education Law, environmental education becomes a compulsory course in primary and secondary school. Japanese children have been taught to classify rubbish, recycle resources and so on. In daily life, children can also classify household rubbish, and divide the leaves, glass bottles, cans, newspapers, other living rubbish into different bags.

**Advantages and Disadvantages in Practice:**

**Advantages:**

Each year about 45 million tons of garbage comes from Japanese households. According to calculations by the Japan Environmental Design Corporation, if all of the organics are recycled, about 11 million tons of bioethanol can be produced each year. These ethanol can also make about 10 million tons of plastic. This output is equivalent to the amount of plastic used in Japan for one year.

**Disadvantages：**

Nowadays, our country relies on the government's propaganda and advocacy and people's apparently weak conscious awareness on the recycling of waste products. This is far from enough. It is necessary to adopt laws and regulations to set the recycling of used products to the obligations of each of the corresponding entities (governments, enterprises, and the public), and strive to ensure that all citizens participate.

## 4.2 CASE STUDY ON THE PRODUCTION AND USE OF ENVIRONMENTAL ENZYMES

Eco-enzymes are one of the enzymes. They are brown liquids produced by anaerobic fermentation of food waste (fresh garbage) mixed with sugar and water. They have good environmental protection effects such as household cleaning, purifying groundwater, and purifying the air. Eco-friendly enzymes are produced and used by almost every household in the South Pacific Islands and are generally seen in places where environmental protection is promoted, such as Thailand, Malaysia and Japan. Environmental enzymes are mainly promoted by non-governmental organizations and environmental public welfare organizations in China. Enzymes are simple and easy to use and are widely used in home and agriculture.[7]

**Environmental Enzyme Production Method:**

The ratio of making environmentally friendly enzymes is 3:1:10, that is: 3 litters, 1 sugar, and 10 waters. Sugar includes (brown sugar, brown sugar, or molasses) Fresh garbage Including (vegetable leaves, fruit peels, etc.) Containers: Plastic containers with sealed lids

Step 1: Fill the plastic container with 60% raw water. (For example, a five-litre can is filled with three liters of water. The container must have a screw cap.)

[7]Wen Yaxiong, “Enzyme technology and application status of enzyme fertilizer in China” *Hunan Agricultural Science* 31,no.1(2016):112

Step 2: One-tenth of the amount of water is the amount of brown sugar or brown sugar needed. (A litre of water equals one kilogram of weight. So, three liters of water must be filled with 300 grams of brown sugar or brown sugar.) Pour the sugar into the water and stir gently to melt it. (You can use your hand to stir.)

Step 3: Three-tenths of the amount of water is the amount of fresh fruit and vegetables needed. (For example, three liters of water should be filled with 900 grams of fruit and vegetable waste.) Put the fruits and vegetables into the sugar water and mix well. We must immerse all the fruits and vegetables in the water.

Step 4: Tighten the plastic bottle cap and date the bottle. Place in a cool, airy place. (Leave some space in the container to prevent the enzyme from overflowing the container when fermenting)

Step 5: During the first month of the production process, gas will be generated. The bottle cap will be loosened once a day and immediately closed. Release the gas that has expanded due to fermentation.

Step 6: One month later, there should be no more expanding gas (plastic bottles no longer bulge). Continue to stand still until the expiration of three months.
Step 7: From time to time, press the garbage floating on the liquid surface to soak it in the liquid.

**Production Process and Precautions**

• Avoid using glass or metal containers that cannot expand.

• The enzyme raw materials (such as: vegetable residue, peel) can be sliced, the smaller the cut, the more helpful the decomposition.

• Enzyme raw materials to avoid the use of fish, meat or greasy kitchen (but can be used for composting), there will be rancid.

• If you want to make the enzyme have a fragrant smell, you can add fruit peels such as orange peel, lemon peel, and banlan leaf.

• Containers for the installation of enzymes must retain 20% of the fermentation space.

• If it is not possible to collect enough fresh rubbish at one time, fresh rubbish can be added one after another. The three-month period starts from the last day of joining.

• Mark the date of manufacture on the container. Decomposition and fermentation of enzyme raw materials lasted for 3 months. Please be patient and let the whole process complete.

• When making enzymes, please be happy. With love, the quality of enzymes will be better.

• Eco-enzymes should be placed in the air, in a cool place, away from direct sunlight. Do not put it in the refrigerator. Low temperatures will reduce the activity of enzymes. The fermentation process 1, brown sugar water needs to cover up the residue, peel and other enzymes raw materials. If the raw material floats on the surface, stir it into black sugar water.

• In the initial stage of production, the bottle cap needs to be opened every day to allow the fermentation gas to circulate. When the lid is opened, the “zigs” sound is heard. This is the sound of fermentation.

• If you do not open the bottle, the bottle will be stretched. When the gas is full and cannot be released, it may even explode. Please pay attention.

• the fermentation period can be used after 3 months. The best of 6 months or more, the longer the fermentation period, the better the effect, the more mellow. Pay attention to the changes in the fermentation process. 1. If the enzyme liquid is black, it means that the corruption is unsuccessful. Add brown sugar and continue fermenting for 3 months.

• If insects or fly eggs are found, the lids need to be sealed to allow the eggs to lose

their chance of contact with air and decompose spontaneously, thereby enhancing the protein of the enzyme.

• If it appears white on the surface, it means it is very successful. This layer of white film can be rubbed directly on the skin as a skin care product. Results Acceptance and Usage 1. Enzymes are the finished product of the time. Successful enzyme liquids are brownish yellow and smell like oranges.

• the resulting enzyme liquid, after dilution, can be used as a cleaning agent, is a good helper for clean work in life.

• After the enzyme residue is dried in the sun, it is crushed and buried in the earth, which can be used as fertilizer; adding a toilet can purify the septic tank.

• enzyme residue can be retained in the container, as the parent of the enzyme, adding fresh enzyme raw materials, and then re-fermentation, aging enzymes can increase the age of enzymes

**Enzyme Fermentation Process and Collection**


*Fig 4.1: Enzyme fermentation process*

**The Use and Benefits of Environmentally Friendly Enzymes**

• Reduce waste and exhaust gas Reduce waste generated by garbage and garbage. (Discarded fresh garbage and kitchen waste will release methane emissions, which is 21 times higher than carbon dioxide contributes to global warming.)

• Save money Kitchen waste and fresh garbage are environmentally friendly cleaners, saving household expenses.

• A good helper for life can be used as: natural cleaners, air purifiers, laundry detergents, bath liquids, car care agents, softeners, organic fertilizers and so on.

• Remove pesticides from vegetables and fruits Soak all the vegetables and fruits in diluted enzyme water (2 tablespoons of enzyme: 1 liter of water) for 45 minutes to remove herbicides, insecticides, pesticides, heavy metals, bacteria, and parasites. Eggs and other eggs. After the vegetables are cut, they continue to soak in the enzyme water, and they are taken out when cooking. The vegetables are very green and delicious after frying, and the fruits are very sweet.

• Home cleaning enzyme diluted to remove a variety of strange smells such as cigarette odor, car exhaust, gas and so on. At the same time increase the air oxygen content. Can remove mold, grime, dirt, oil, etc., cleaning floor, air conditioner, toilet, kitchen exhaust fan, greasy walls and other effects. In addition, with the use of enzymes, the number of flies, mosquitoes, rats and cockroaches will also decrease.

• Personal Hygiene Enzymes can decompose and destroy microorganisms that are harmful to the human body. Diluted enzyme liquids are added during bathing, shampooing, and washing. They can take care of personal hygiene and promote skin health to achieve maintenance.

• Reduce electromagnetic wave hazard Place the fermented enzyme next to the electronic equipment to reduce its electromagnetic wave. And then reduce the body's pain. (Long-term use of electronic equipment with electromagnetic waves will cause people to feel physical fatigue, tired eyes, shoulder pain, headaches, sleepiness, anxiety, etc. Electromagnetic waves will also reduce human immune function, reduce calcium

in the body, and cause abnormalities. Production, abortions, visual disturbances, impede cell division, such as: cancer, leukemia, brain tumors, etc. Electromagnetic waves are most harmful to babies, developing children, the elderly, pregnant women and fetuses, and people sensitive to electromagnetic waves.)

**Environmental Enzyme External Method**

• Environmental enzymes 50ML: a variety of lotions or detergents 50ML: 250ML ratio of water blending shake, placed the next day, used for shampooing, bathing, can decompose and eliminate harmful microorganisms, and promote cell regeneration. Toilets, kitchen dishes, stove cleaning. Degreasing, deodorizing, reducing chemical damage to skin and groundwater. Pour two or three caps into the laundry to reduce the amount of detergent or liquid and wash it after half an hour of soaking. This has unexpected results.

• Environmental enzyme 1: water 1, for hemorrhoids, anal fissure, anal fistula, hemorrhoids after cleaning coated in the affected area.

• Environmental enzymes 50ML, water 200ML, used for face flapping, facial masks, moisturizing, whitening, blemish.

• Directly dyeing and immersing with environmental enzyme liquor, smear or cotton wool, gauze soaked the affected area, knife wounds, burns, burns, sunburn, mosquito bites, various bruises, athlete's foot, onychomycosis, paronychia, Eyes, rich hands, eczema, urticaria, sore redness, allergies, itching, bismuth bromine, young beans and other skin diseases, diabetic foot wound healing.

• Add 30M of environmental enzymes in warm water at about 43 degrees, and add half a cup of bath to the bathtub to help excrete toxins and heavy metals from the body.

• After the fruits and vegetables are washed away with impurities, add half a pot of water to the three bottle caps for environmental enzymes for 45 minutes to effectively eliminate pesticides, herbicides, insecticides, ripening agents, swelling agents, eggs,

heavy metals and other toxic and harmful substances in fruits and vegetables. substance.

**Environmental Enzymes for Other Uses**

• Horticulture or farming: Diluted with water 1000 times, can be used as a natural exterminator, herbicide and organic fertilizer, and can stimulate plant hormones, improve the quality of fruits and vegetables and increase production. Continuously pouring environmental enzymes on the land for three months can improve soil quality and allow the land to return to life.

• Household cleaners: Use environmentally friendly enzymes to incorporate shampoos, shower gels, dishwashing agents, and laundry water to reduce chemical constituents. (Ratio: 1 part of environmental enzyme: 1 part of washing strip: 5-10 parts of water.)

• Clean air: 200-500 times dilution, moist air, sterilization and deodorization, remove decoration pollution.

• Improve hair quality: 5-10 times dilution + 1 shampoo, anti-dandruff (depending on individual constitution), inhibit hair loss (do not use hair dryer after washing)

• Car maintenance: add 30 ml of enzyme in car tank, Reduce engine temperature.

• Dry goods bubble: According to the amount of foam to add appropriate enzymes, can accelerate the bubble hair dry goods.

• Insect repellent suppression: 10-50 dilution, enzyme odor can achieve insect repellent effect.

• Medical assistance: The liquid mouth gargle to bad breath, the treatment of oral ulcers to reduce tooth decay, smear wounds, can promote healing (a tingling sensation, can be diluted in small amounts)

• Improve vision: The liquid wipes around the eyes and improves the dryness of the eyes. (Dilutions of 500 times pure water can drip the eyes)

**Advantages and Disadvantages in Practice:**

**Advantages:**

The ozone obtained from the production of environmentally friendly enzymes has a bactericidal function, can increase the oxygen content in the air, reduce the exhaust gas and toxic gases in the air, and can also decompose artificial chemical pollutants and ointments in ditches. The use of environmentally friendly enzymes instead of chemical cleaning products in the home can also purify rivers and seas to the sewers and achieve environmental protection.

**Disadvantages：**

There are many kinds of raw materials for producing enzymes, and the sanitary conditions are relatively high. It is difficult for the family to meet the requirements when making homemade products, and there are certain risks. Due to uncontrolled and aerobic fermentation of various bacteria, the enzyme contains a large amount of mold and Staphylococcus aureus. Even if the mold is removed, stubborn mycotoxins, such as patulin and aflatoxin, are powerful carcinogens. Therefore, environmental enzymes must not be eaten. Although the incubation period of mycotoxin is as long as 20 years, people who have been drinking enzymes around the country are now suffering from terminal diseases such as liver cancer and stomach cancer.

## 4.3 SHANGHAI STREET “SHARED FRIDGE” SHARING FOOD ACTIVITIES

A "shared refrigerator" appeared on the door of a restaurant near Shanghai Xikang Road. The original intention of the store's refrigerator was: I hope that everyone would share their extra safe food with other people in need, and in turn, make a contribution to environmental protection. force. The restaurant will replenish the refrigerator once a day at noon and in the evening. The main thing is that employees do more food and

some foods that are not up to standard. The average daily dose is about 25 boxes. There are also eager customers who put food in the refrigerator.

Specifically, the so-called "shared refrigerator" is to share in your own refrigerator those foods that are reaching their shelf life but that they do not consume at one and a half. They should be shared in a public refrigerator for those who need it.

According to statistics, the world's first "shared refrigerator" was born in Spain. A small city with a population of less than 30,000 has been loved by the local residents since the launch of the world's first "shared refrigerator". Every day, there are many People will come to share refrigerators to donate food. Of course, anyone is free to take it. The purpose is simple: call on everyone not to waste any food.


*Fig 4.2: Shanghai street "Shared Fridge"*

The "shared refrigerator" set up in Shanghai also has the same purpose: I hope everyone can share their extra safe food with other people in need, and then contribute to environmental protection.

What happened in 168 hours after the "shared refrigerator" was placed?

In the first half an hour, no one came to take food... One after another, many passers-by stopped to look curiously. Later, the restaurant's morning food will be collected for one and a half hours, and the afternoon light will be brought out by 8 pm. Almost no looting,

no waste. Everyone just quietly opens the refrigerator to take away food.

They have workers on the construction site, but also homeless people who recycle waste, and of course, Aunt Nata, who we expected. However, during the operation of the hotel, the waiter standing at the door will take care of the refrigerator. They will remind them that they will receive it on demand and leave it for other people in need. Once, it was the security of the construction site on the opposite side. It was a middle-aged man. He was very embarrassed. He learned that he could get it for free after he took it. The volunteer said that he could get one copy at a time and not much. Tell a colleague in need. Later, some of the migrant workers on the construction site often came to take it, but they never took it.

"They only have 15 yuan a day for meals. They only have 3,000 yuan a month for wages. The cheapest meals around them have to be 20 or 30 yuan. However, these people do not receive food for themselves, according to their size. A food is not enough to eat."

One of Shanghai's aunts happily fetches food every day, taking only one snack at a time. She said that her son is happy. Volunteers always thought she was a nearby resident. Once I talked, I discovered that she had deliberately taken a bus from the outskirts. Her son had become an adult with mental retardation, his wife died early, his health was not good, and his retirement salary was also very low. The snacks in the refrigerator are usually not bought by their mother and child.

A mother took the children to school, shared the refrigerator, asked the children about the situation, and explained the situation to the children. Then she took pictures in front of the refrigerator, hoping to let them remember this moment. And let each child receive a moon cake, said that they know how to help and help others, and said that there will

be excess food in the family after the child must be brought to the refrigerator.

As a new attempt for public welfare projects, the "Shared Refrigerator" achieved a gentle interaction between strangers.

When we are treated with tenderness in this world, every love and goodwill deserve to be cared for. Please don't covet the immediate interests, ask for the right amount of food according to your needs, and don't waste food while doubling your love. In this way, the original intention of sharing food with the "shared refrigerator" is not violated.


*Fig 4.3: Shanghai street "Shared Fridge"*

**Advantages and Disadvantages in Practice:**

**Advantages:**

"Sharing refrigerators" can not only avoid "waste on the tip of the tongue", but also help the food to be delivered to the people in need, optimize the allocation of resources, and build a low-cost society.

**Disadvantages:**

The phenomenon of "more than one person" is serious and difficult to manage; food hygiene and safety problems in refrigerators are difficult to guarantee; whether food taken from the refrigerator will cause secondary pollution; and food stored in refrigerators will be out of date.

## 4.4 INTERNET + RENEWABLE RESOURCES RECOVERY SYSTEM

Hangzhou Best Use Information Technology Co., Ltd. was established in August 2011. After many years of practice in the field of waste circulation, it has explored a reverse “Alibaba” model from the end of the back feeding to create an automatic match for offline logistics. Closed-loop eco-chain with automatic docking of funds, combined with IOT, cloud video, big data, 3S (GIS, GPS, RS) and other latest technologies, aiming at reducing circulation and improving circulation efficiency. And display, renewable energy industry transformation and upgrading of new Internet companies.

With the increase of national investment in the field of renewable resources, encouraging "Internet +" to intervene in the traditional recycling industry, the company reviewed the situation, first built an Internet recycling platform, collected and integrated traditional recyclers, and used information for efficient matching, so that waste recycling like "drop "Dribbing a car" is just as convenient; afterwards, the system was used to organize logistics, and the goods of the recyclable tricycles were directly docked to the manufacturers through a mobile recycling vehicle. Under the strong and effective technical supervision, a car-to-door connection for skipping the recycling site manufacturers was formed. "The model has thus opened up the circulation from residents to manufacturers. Later, the company further developed in the horizontal plane. First, it expanded the coverage, covered the services in cities such as Yinchuan, Nantong, Hefei, Ningbo, and Jinchang; and broadened the service categories, making

outstanding progress in the field of low-value recyclables. The establishment of a waste recycling service recycling network in the Qiaosi area of Hangzhou; a good model must not only meet the present, but also face the future. In the context of continuous reduction of recyclers, cleaners continue to participate in the collection of waste products, the company is also deeply involved. Garbage classification work, using advanced technology and ideas to promote the development of the convergence of the two networks.

**Business Model Introduction**

**1.Industrial Model**

The company exerts efforts from both ends to firmly grasp the main recycling group in the entire recycling industry. The front-end dispatches bills through the system to provide more simple, more efficient, and more profitable receiving channels for recyclers, and the back-end provides more for recyclers. High-quality, more reliable, and more stable shipping channels. In the middle, more wide-ranging recycling categories are expanded for recyclers to achieve drainage and control of recyclers. At the same time, recyclers and end manufacturers are encouraged to join the entire waste network as key nodes. The system platform builds a city recycling industry park and aims to build an Ali platform for the scrap industry.

### (1) Front-end Organization

#### a. Organize Recyclers

Incorporating recyclers into the system, through simple training and unification of decoration, re-integration into the recycling industry with a new image, through the system to send a single agreement to the two parties to reach a consensus of cooperation, to complete the early collection of recycling workers; in the long-term cooperation process In the search for a comprehensive high-quality recovery personnel in the region to build backbone recovery team, as well as regional service team, while broadening the service content, to achieve the transformation of traditional recyclers

*Fig 4.4: Recycler Training Transformation*

#### b. Organization System

After the system receives the order, it will automatically calculate the nearest recycler and issue a notification message. The recycler will receive the order, use our smart portable scale to receive the goods and complete the order, and the two parties will mutually evaluate each other to form their own evaluation system, through the user's Feedback forms elimination mechanisms and continuously optimizes the service system.


*Fig 4.6: Residents to Recyclers*

**(2) The Middle Link**

**a. Collaboration Recycling Station**

There are currently two types of organization in the midfield. One is to select appropriate cooperation sites within a certain area, transform the recycling station, display images, upload cards, and transfer funds automatically to form a complete set of standardized recycling operations. To the site, at the same time help the site to expand the scale, break through the embarrassment of traditional site owners staring at money to see the goods.

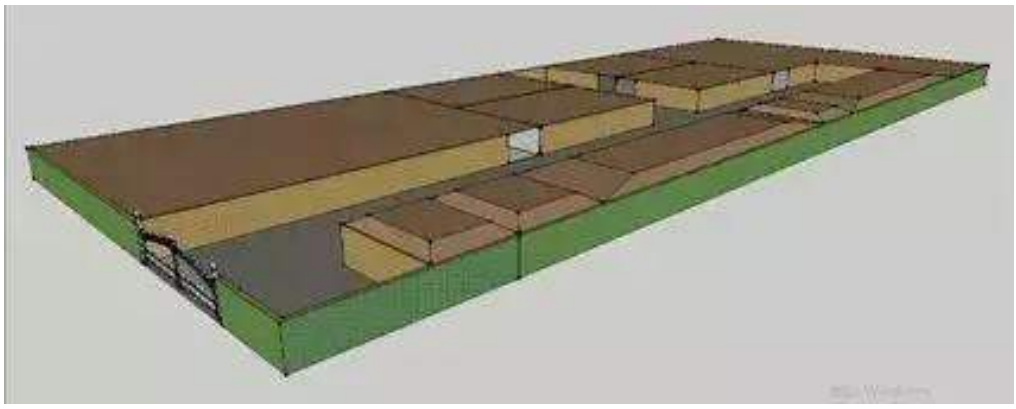

*Fig 4.7: Functional partition image display*

*Fig 4.8: Weighing upload, credit card settlement*

**b. Car to Car Docking Mode**

The second is to arrange a mobile recycling vehicle in an area that the site failed to radiate. The area is usually designated with reference to the recyclable vehicle transport capacity, the concentration rate of the recyclables, the roads and the layout of the community, and a medium-sized (3.8 m - 4.2 m) mobile recycling vehicle is arranged to inform the surrounding recyclers at a certain time through the system. Send goods to the designated location within the segment to achieve cargo docking of small tricycles and large trucks. The goods on the tricycles of the recyclables are transported directly to the manufacturers or designated locations. Funds are paid by the consignee in advance, and payments are made in proportion to the operating costs in the traditional model. For each corresponding entity, it is equivalent to the manufacturer's scheduled goods, we organize the transportation.


*Fig 4.9: Car to Car Docking Mode Process*

### (3) End Morphology

#### a. Build Recycling Industry to Effectively Combine Waste Products and Garbage

Take the recycling industry park as a consortium, seek cooperation from end manufacturers, strive for maximization of profits, build waste industry ecology with end-feedback, and combine government waste classification to form a long-term effective publicity system and share common resources to save costs.

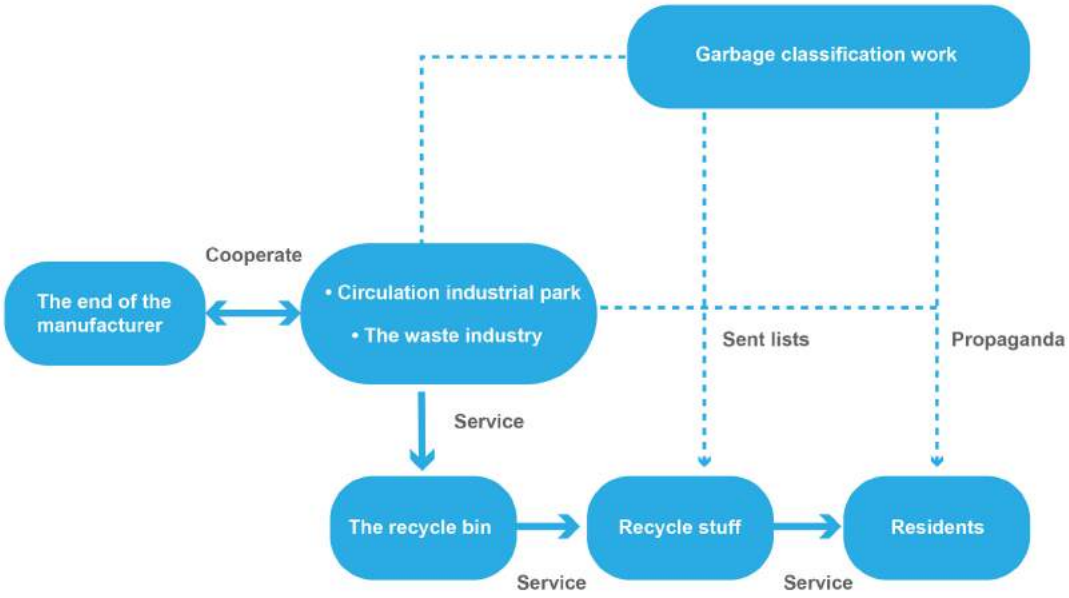


*Fig 4.10: Combined Mode*

#### b. Organization Form

Taking the recycling industrial park as a platform, attracting recycling sites and qualified manufacturers to enter the company by shares, and using standardization, informatization, and service awareness as content assessment sites and recycling personnel, to promote better and worse. As a third party, the recycling industry park has a platform for information and capital.

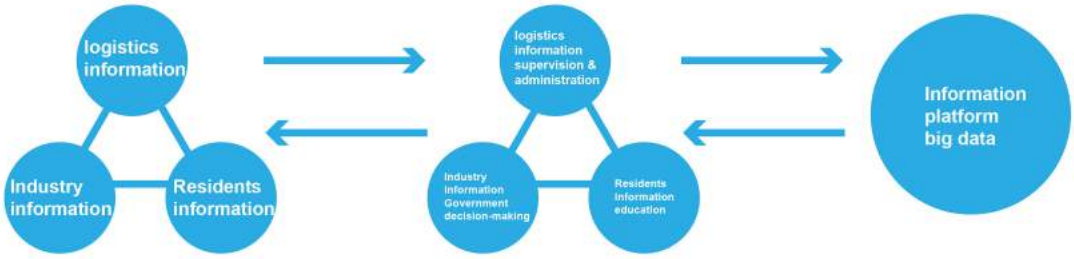


*Fig 4.11: Capital Platform*

**2. Profit Model**

**(1) Spreads of goods**

After the platform is established, it uses the similar group purchasing model to control the optimal shipping channels and profit from it.

**(2) City joining fee**

For the national export model, seek local franchisees and collect franchise fees.

**(3) Government Purchase Services**

The company is currently working on the waste classification business to promote the integration of the two networks. With the implementation of national policies, there are 46 key cities for garbage classification in the country with related needs.

**(4) Producer purchase index**

With the implementation of the producer responsibility system, there is a strong demand from manufacturers for the recycling and reuse indicators of waste.

**Advantages and Disadvantages in Practice:**

**Advantage:**

• From the business model point of view, the traditional recycling industry is organized into a network from the line, changing the ecological pattern of the original mess, and opening all the easily blocked links in circulation. First, the recycling industry park broke the weak situation of the strong recycling sites at the end manufacturers and balanced the pricing power. Second, it weakened the role of recycling sites, strengthened standardization operations, and used mobile recycling vehicles to solve the problem that some areas could not open recycling sites. Circulation; finally using the power of public welfare propaganda to obtain residents' orders, the system

efficiently matches the recyclers' door-to-door recycling, increasing the efficiency and restraining the recycler.

• From the service model point of view, we define the target customers as recyclers, recyclers, and government departments, firmly grasp the needs of customers, proceed from the garbage separation framework, insert waste recycling into the market, and guide the development of the industry through marketization. Reduce costs and improve operability.

• From the perspective of technological innovation, the most important is to use force from both ends to form a complete set of management and control system. Funds can be directly paid to residents from the end, the data collection capability is strengthened, and the informationization of the traditional waste industry is opened up. Ways, and the formation of a set of operating standards to guide the transformation and upgrading of the original industry under the new rules.

**Disadvantages**:

The project has good development prospects. In the future, with the further deepening of waste classification, the conversion of waste and waste products will be realized. Dispose of the waste industry across the country to allow waste products to flow throughout the country and incorporate scrap into the Internet and Internet of Things systems. Big data in the future will not only tell you what you need, but also tell you what is not needed.

The project is based on the original industry to upgrade rather than replace the original industry, promote multi-win cooperation and win-win, is to squeeze out the waste water industry for many years to evaporate to let everyone distribute, so the resistance encountered is small, the cost is also Lower.

At present, the situation facing waste recycling bins is becoming more and more rampant, the living space is getting smaller and smaller, and the impetus for transformation and upgrading is becoming more urgent. The government is increasingly pressing on the classification of garbage and improving the appearance of the city and regulating the needs of recyclers. All of these provide a solid foundation for the project.

Promoting the transformation and upgrading of the entire industry is a huge systematic project that requires multiple parties to work together. The capital and scale are the biggest dilemmas faced by the project. At the government level, more policy support is needed, for example, to increase the guidance for the transformation of recycling sites. And some concessions on taxation in the field of waste circulation and so on.

## 4.5 SUMMARY OF THIS CHAPTER

This chapter mainly elaborates the relevant cases and analysis of system design and provides practical technical support and support for the restaurant system design afterwards. The kitchen wastes exported from the restaurant mainly include the following recycling and recycling methods: They are placed in a shared refrigerator to allow homeless people to take their own food, make them into environmentally friendly enzymes, and incorporate into the resource recovery system of related companies.

# 5. THE RESTAURANT SURVEY DATA ANALYSIS

## 5.1 THE LOHASTIME VEGETARIAN RESTAURANT AFTER COOKING PROCESS

At LOHAS kitchen, daily processing of commonly used ingredients and foods with a higher order quantity is started at 9:00 a.m. for the delivery of fresh fruits and vegetables. After the fruits and vegetables are delivered to the warehouse, they can be processed. Restaurants can be roughly divided into the following process: purchase - storage - cleaning - cut with - cooking - food - dump - clean. Cleaning-cutting-cooking-cooking mainly focuses on the 9:00-12:30 in the morning and 4:30-6:30 in the afternoon; the cleaning of the trays and the cleaning of the store are done at 7:00 pm daily 30-9:30.

According to the author's observations and interviews, it was learned that during the cutting phase, the rough processing steps of the food ingredients produced a large amount of fresh fruit and vegetable peels, as well as poor taste or poor taste in the fruits and vegetables. This type of kitchen waste is of high quality and has a high value of recyclability; a large amount of plastic packaging waste is generated during the process of packing the ingredients, plastic packaging bags and other packaging should not be degraded and should be discarded separately from food and kitchen waste; after rough processing The ingredients can be cut after further cleaning. Cutting steps to complete the ingredients cut, sub-equipment. The food waste produced by the cutting is less scraps of ingredients, but the yield is low but the quality is high. The linear system diagram of the preparation process is shown in Figure 5.1:

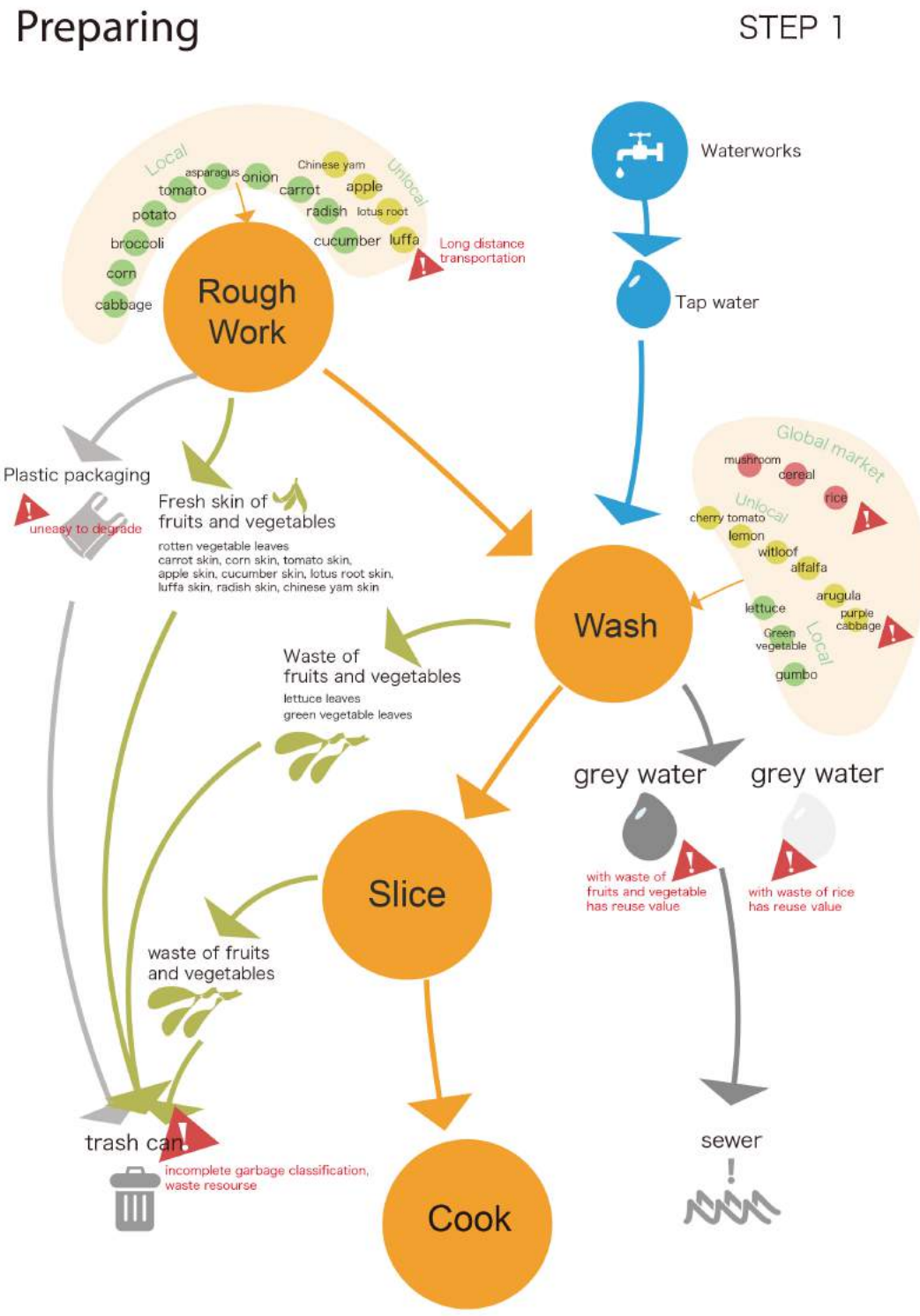


*Fig 5.1: The linear system of the preparation process*

Brewing broth is an important part of vegetarian cooking. The finished soup stock will be used for subsequent seasoning, while the rest of the soup will not be worth eating. It will be discarded and wasted. Standing ingredients or items with a higher order quantity will be cut in advance. After the guests order, assistants will supplement the dishes according to their needs. The cooking and loading process does not generate food waste, but it consumes a certain amount of water. The linear system diagram of the cooking process is shown in Figure 5.2.

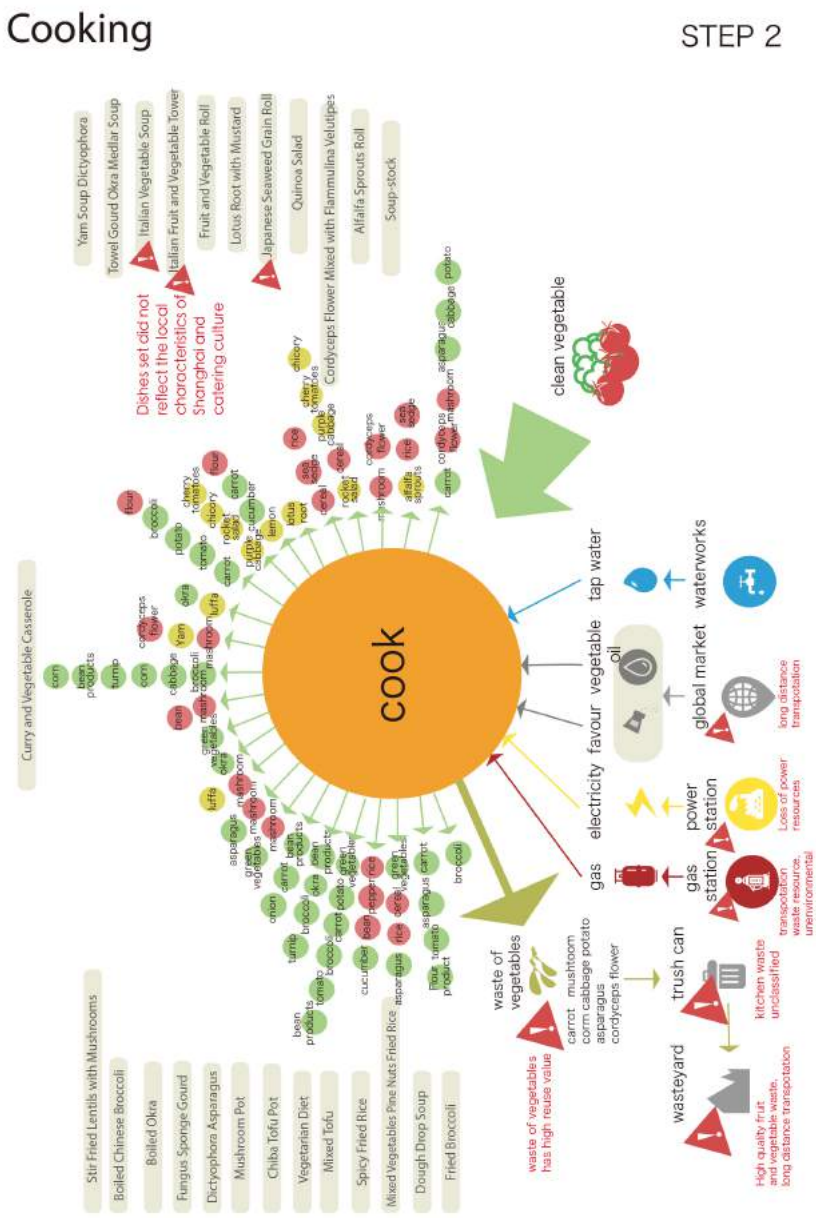


*Fig 5.2: The linear system of the cooking process*

The rest of the guests' food will be uniformly dumped into the kitchen waste bin by the assistant. This type of kitchen waste contains high oil content, large output, and low recycling value. There was only one cleaning tank in the kitchen at the time of LOHAS. After the cleaning staff flushed the tray with Chong Lin, the detergent was applied for secondary cleaning. Finally, the tableware was rinsed to complete cleaning. The cleaning step is performed on a single tableware unit, which has low efficiency and high water consumption. This not only increases the restaurant's operating costs, but also causes a lot of waste of resources.


*Fig 5.3: LOHAS restaurant cleaning process*

Through the analysis of the LOHAS cookware process, the linear system is sorted out as shown in Figure 5.4:

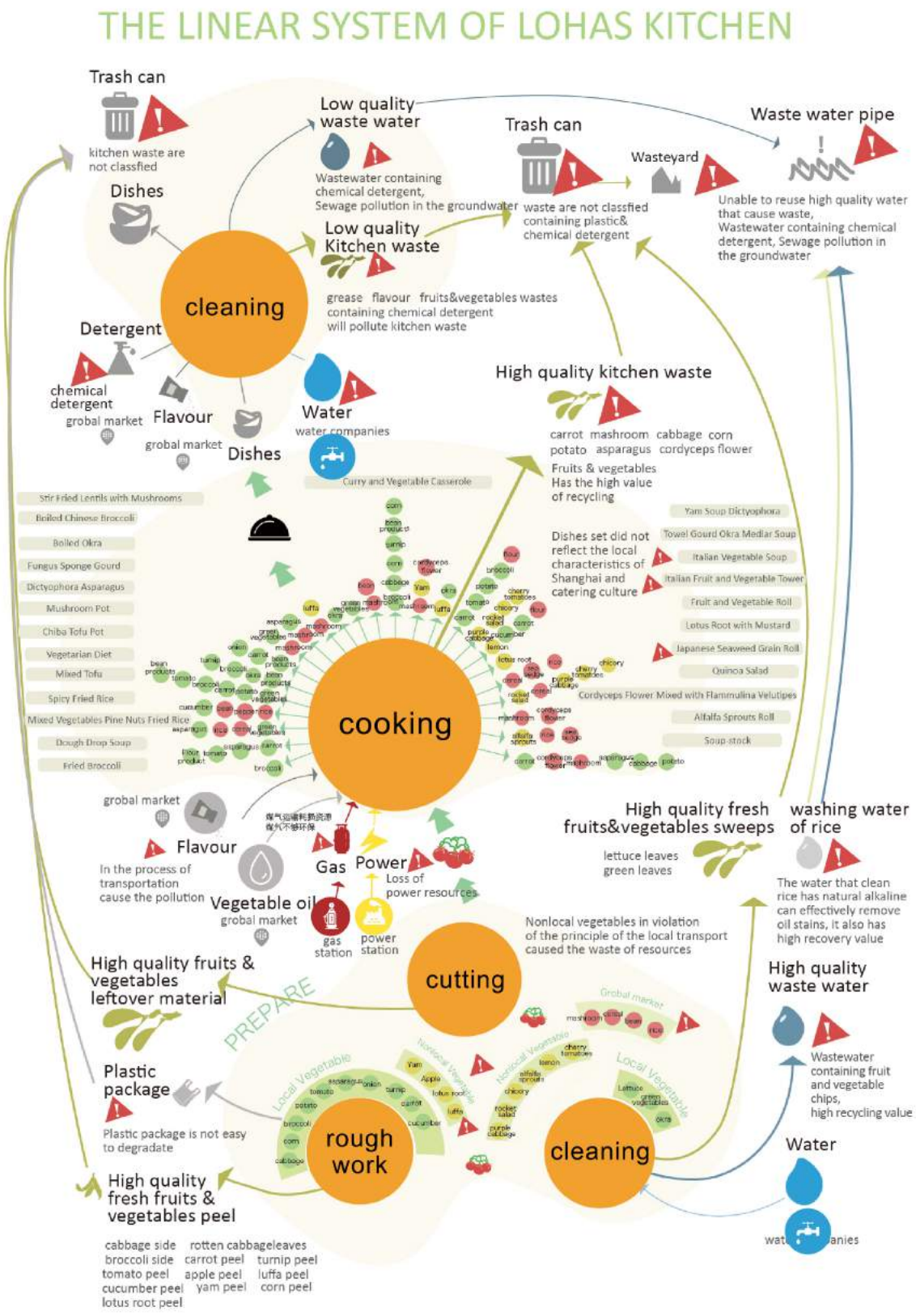


*Fig 5.4: LOHAS restaurant linear system*

## 5.2 WATER RESOURCE AND VEGETARIAN KITCHEN WASTE ANALYSIS

**Water Resources Analysis**

Through the analysis of the linear system, it can be seen that the use of water resources comes from preparation, cooking and cleaning. In food roughing and cutting, water is used to wash vegetables. Waste water after use contains components such as dirt, vegetable peels, pesticides, and dust, as shown in Figure 5.5.


*Fig 5.5: Analysis of water quality after cleaning food ingredients*

According to the author's records, during the food preparation process, 5 bottles of water are used to wash vegetables every day:

That is, M1=5*V cleaning tank=5*61.5=307.5L=0.307T;

When Leho prepares rice twice a day, when washing rice, use 4L rice cooker liner soaking panning, washing rice water consumption: M = 2/3 * 4L = 2.67L; then a day of rice consumption is:
M=2*2.67L=5.34L=0.00534T

During the cooking process, cooking a pot of soup consumes two pots of water, and the soup is cooked twice a day:

The consumption of M2 = 4 * V soup pot = 4 * 7.96 = 31.84L = 0.03184T;

During the cooking process, Mushroom Mushrooms, Chiba Tofu Mushrooms, and Porcelain Roasting, Stewed Assorted Old Tofu, Noodle Soup, Italian Vegetable Thick Soup, Loofah Okra Soup, and Zhuji Yam Health Soup have relatively large water consumption. The rest of the cooking dishes consume less water. According to the author's understanding of winter soup quail type, pasta spot type single large amount, the author observed during the observation soup quail single order amount is 30, 18 quail class, 12 soup pot;

The water consumption of 1 soup broth was: M=2/3V wok = 2/3*7.48 ≈ 4.99L = 0.00499T;

The water consumption of 30 soup pots is: M=30*W one pot = 0.1497T

The rest of the cooking water consumption is not large, the amount of single-day cooking for 48 dishes, a dish of water consumption 2 two, that is, 0.1L;

48 dishes of cooking water consumption: M=48*0.1L=4.8L=0.0048T

The amount of water consumed for cooking one day is:

M = 0.00534 + 0.03184 + 0.1497 + 0.0048 ≈ 0.19T (rounding only retains two decimal places.)

The amount of water consumed during the day of washing and cooking of vegetables and fruits is:

M=0.307+0.00534+0.03184+0.1497+0.0048≈0.50T (rounded down to two digits after the decimal point.)

The most water resources were lost during the cleaning stage. When using chemical detergents to clean dishes, the used water contains: food residues, vegetable oils,

surfactants, seasonings, and salts.


*Fig 5.6: Water quality analysis after washing dishes ingredients*

According to the interview, the cleaning staff did not close the water for an average of 1.5 hours to clean all the dishes. The flow rate of hose water at Lohan was V = 0.69 m3/s. The water consumption for 1.5 hours of continuous use is:

M=0.69*60*60*1.5=3726L≈3.72T

Wipe the desktop daily. The amount of water used to mop the floor is the amount of water in two buckets, ie:

M=2*V cleaning bucket=2*26.84=53.68L≈0.054T

The water consumption in the cleaning stage is:

M=0.054+3.72≈3.77T

According to calculations, the water consumption of the restaurant during the time of LOHAS is:

M=0.5+3.77=4.27T

According to the average monthly calculation of 30 days, the water consumption per month in winter is:

M=4.27*30=128.1T

Shanghai's commercial water fee is P=4.6¥/m3, then the monthly water fee cost is:

P=4.6*128.1=837.66 RMB

**Kitchen Waste Analysis**

At the time of LOHAS restaurant kitchen waste is mainly generated from preparation, stock preparation and food dumping; LOHAS kitchen food waste is uniformly disposed of at the community garbage collection office and cleaned up by the community.

Although classified bins were set up to hold non-kitchen-kitchen and kitchen-kitchen litters such as plastic bags, the actual classification situation was not optimistic; while Lehwood did not classify the different quality of the kitchen-kitchen litter, the food waste was the main components are 80%-90% of water, rice, flour, fresh vegetable peel, food waste, vegetable oil, seasoning.


*Fig 5.7: Analysis of solid content in kitchen waste*

According to research, the average restaurant food waste generated by LOHAS is approximately two barrels per day. It is reported that the weight of a barrel of kitchen waste is about 2.8KG, and the weight of two barrels is M=2.8*2=5.6KG. According to Figure 4.3, the monthly consumption of vegetables in LOHAS is:

M=50+45+75+30.3+44.6+74.5+90+44+58.9+36+75+75+74+58.9+26.6+37.8+50.9+5

9.3=930.8KG

Calculated according to 30 days a month, the daily consumption of vegetables is:

M=930.8/30=31.02KG

The loss rate of vegetables in the LOHAS Veggie Restaurant is:

5.6/31.02 ≈ 0.18 ≈ 18%

According to the restaurant's daily orders, the specific composition of the kitchen waste will vary slightly, but the main components of the kitchen waste are roughly the same. According to the loss rate of vegetables, the proportion and content of different types of vegetables in the monthly kitchen waste can be roughly estimated.

The current restaurant's vegetarian kitchen garbage contains a large amount of fresh fruit and skin, the highest proportion of which are Chinese cabbage, broccoli, tomatoes, green leafy vegetables, white radish, carrots, and onions. Among them, Chinese cabbage and broccoli have the smallest proportion of available food and the highest amount of waste because of the needs of dishes. Vegetarian food kitchen waste does not contain animal fats, and its composition is relatively simple and its recycling value is high. According to the fresh vegetable peel in the vegetarian kitchen waste, it can be made into a by-product of environmental enzymes, etc., on the one hand instead of chemical detergents, to reduce water pollution; on the other hand, improve resource utilization, expand the development of by-products. The recycling and utilization of vegetarian food waste will be one of the key points in the design of this system.

## 5.3 THE LOHASTIME VEGETARIAN RESTAURANT AND ECOLOGICAL FARM

The consumption of fresh vegetables in the LOHAS VAT vegetarian restaurant is very large. At present, the main channel for restaurant purchase is the vegetable distribution market. This procurement model can not trace the source of fruits and vegetables to ensure quality. Shanghai has four distinct seasons and the area of arable land is limited. The supply of vegetables in this Municipality is partly from local cultivated land, and

partly from arable land. In the course of transportation, foreign vegetables will be damaged by 20%, causing waste of resources, and will also consume energy and pollute the environment. The eco-farm to be collaborated in the future with LOHAS is located in Nanhui Town, Pudong New Area, Shanghai, with an acreage of 30 acres. Through cooperation with eco-farms, the first is to ensure the quality of the supply of food ingredients and solar terms, reduce the cost of vegetable purchases; Second, through the exploration of cooperation models with ecological farms, expand business and increase economic income.

## 5.4 THE LOHASTIME VEGETARIAN RESTAURANT AFTER COOKING PROCESS LINEAR SYSTEM ANALYSIS AND ECONOMIC ASSESSMENT

Through the qualitative and quantitative analysis of the linear system of the LOHAS Veggie Restaurant in the previous section, the linear system of the LOHAS vegetarian restaurant was shown in Figure 5.8.

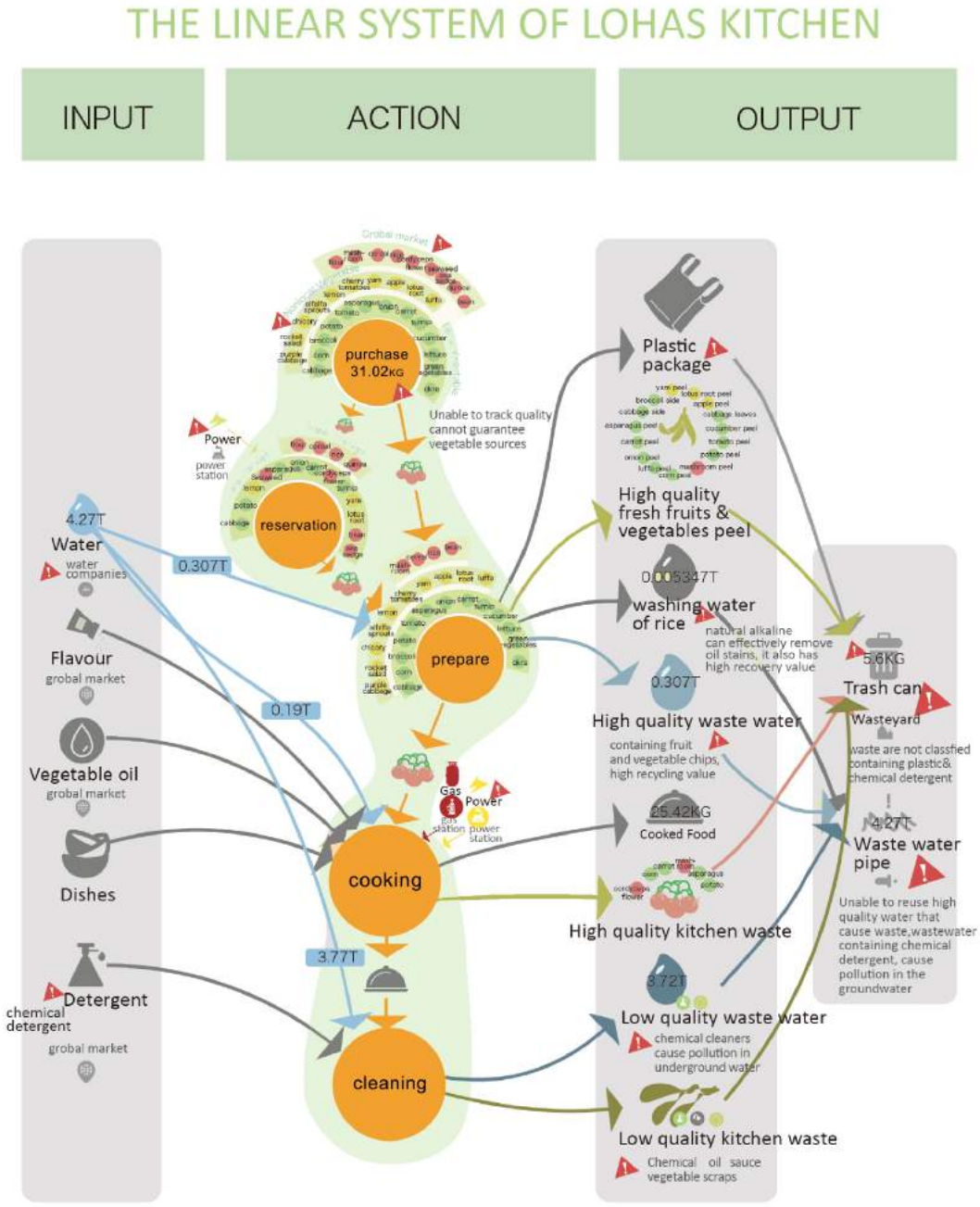


*Fig 5.8: Analysis of Linear System of after cooking in LOHAS*

At present, there are still many problems in the restaurant during the Lohas. From the perspective of the kitchen process:

**Vegetable Procurement Channels Cannot Trace The Source Of Vegetables And Ensure Vegetable Quality**

According to the author's interview, the feedback of the daily food waste generated by

the staff at the time of the Lohas was highly correlated with the quality of the vegetables purchased on the day, and the quality of the vegetables was good or bad and was very unstable. The vegetables purchased by LOHAS came from the vegetable distribution market. The sources of vegetables could not be tracked, and the quality fluctuates. This not only increases the restaurant's purchase costs during the music market, it also has hidden dangers in food safety. The system design promotes compliance with local principles and strengthens the relationship between research objects and local materials.

**Kitchen Food Waste Is Not Completely Categorized, And Utilization Of Food Waste Is Not High**

During the time of LOHAS, there were two sorting trash cans, which were distinguished by different colors. One placed a plastic package, and the other placed a kitchen-generated vegetarian kitchen waste. However, according to the author's interview and observation, the classification of food waste at the time of LOHAS is not thorough, and the habit of discarding the garbage by employee classification has not yet been established, and the phenomenon of losing the wrong garbage often appears. As shown in Figures 4.10 and 4.11, at the time of LOHAS' cooking, a large amount of fresh fruit and vegetable waste was produced during the preparation stage, which resulted in high quality, high recycling value, and a large proportion of all vegetarian kitchen waste. Uneaten vegetarian kitchen waste contains a large amount of soup oil, which is of low recycling value. At present, these two quality food wastes are uniformly discarded, resulting in the loss of the value of vegetarian food waste recycling.

**The Cleaning Pool Is Not Standardized And Water Resources Are Wasted**

At the time of LOHAS, there was only one cleaning pool in the kitchen. It was not possible to divide the pool to clean the vegetables and fruits and clean the dishes. Chong Lin's cleaning method can not maximize the use of water resources, and the amount of losses is large. Clean tap water is of higher quality after it has been washed, and can be

recycled. It uses other steps that do not require high water quality to reduce water waste and reduce operating costs. The Taomi water produced during the washing stage is naturally alkaline and is a good material for natural degreasing and decontamination. Currently, such water resources are not fully utilized. The author will carry out systematic design and research of water resources reuse through further analysis of the cleaning steps.

**Analyze from The Perspective of The Restaurant Kitchen Space Planning:**

**• Restaurant Kitchen Space Is Compact, Operation Settings Are Not Consistent with The Habits of The Kitchen Process**

At the time of LOHAS, the kitchen area was small, and the current cutting, cleaning and cooking processes were concentrated on the same side of the kitchen space. In busy times, there are four staff members in the after cooking process space, which causes inconvenience in operation and affects work efficiency. The author will put forward suggestions for improving the operation space of the kitchen after analyzing the operation process and behavior of the kitchen staff.

**Analysis from The Restaurant Business:**

**• Higher Operating Costs**

According to the author's research, LOHASTIME current monthly rent is 11,000 (including property costs), the gas cost is about 250, the electricity fee is about 1,000 yuan, the monthly water fee is about 839 yuan, and the monthly purchase of food is 7091 yuan. The monthly salary is a total of 30,000 yuan; as shown in Figure 4.12, among the monthly expenses of LOHAS, the proportion of rent and foodstuffs purchase is the largest, which is 55% and 35% respectively.

When Lehman currently earns about 50,000 yuan per month, the monthly profit/loss

situation during the winter season at LOHAS:

50000-11000-30000-250-1000-838-7091=-179 yuan

At the time, LOHASTIME Restaurant has invested 800,000 for the purchase of equipment and home improvement, on-platform launch, and store design. The restaurant is not profitable at the moment and the balance sheet is negative.

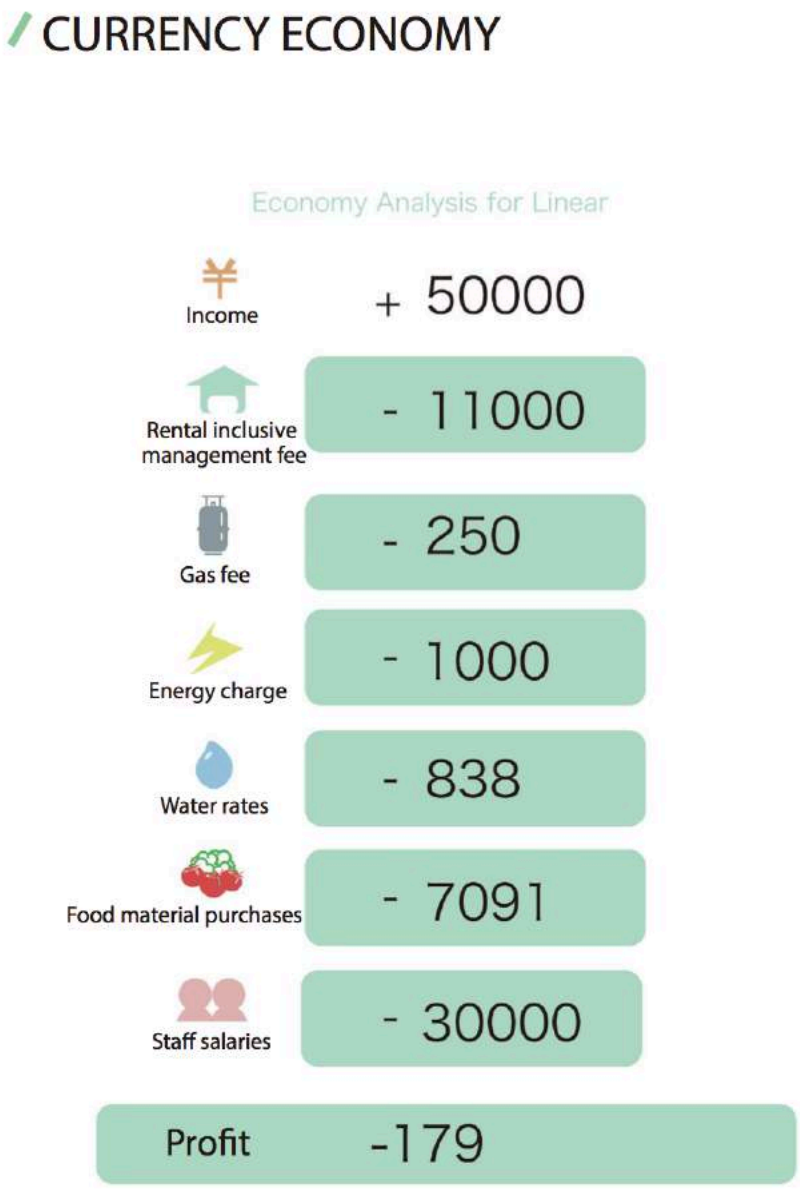


*Fig 5.9: LOHAS linear system economic evaluation*

**• LOHAS Restaurant Has A Single Business Model with A Small Passenger Flow**

The authors distributed 25 questionnaires, including 16 women and 9 men. They investigated the ways in which the guests learned about the restaurant and the reasons for choosing the restaurant during the study, as well as the views on the current sustainable design of kitchen waste. According to the author's questionnaire survey, most of the guests in the LOHAS vegetarian restaurant learned about the restaurant through the Internet platform or recommended by friends. The source of the guests is not limited, but most of them are young people seeking healthy life or animal protection intentions. The author will explore the possibility of a diversified business model at the time of LOHAS by expanding the types of sales at LOHAS and developing by-products.

**• Regional Cooperation is Not Perfect**

System design emphasizes the linkage and cooperation between the system and the external environment. LOHAS Vine Vegetarian Restaurant is located in Pudong, Shanghai. Currently, Pudong and its related companies do not understand and are relatively isolated. Resources that have not been fully used in a small system cannot be circulated and the cycle is realized. It is this linear closed mode that has led to the massive generation and waste of urban rubbish. The Loh Chiu Eco Farm is located in Pudong South East. The author will explore the cooperation and association that can be established between the Lohas and ecological farms through the system design method. From the perspective of strengthening regional cooperation, we explored the systematic treatment plan for vegetarian food waste at the time of LOHAS.

## 5.5 SUMMARY OF THIS CHAPTER

This chapter mainly analyzes the status quo of the vegetarian restaurant at the time of LOHAS and the linear system of the kitchen. Divide the LOHAS cook-time process

into 5 steps. In the large kitchen system, use the system design tools to perform the qualitative and quantitative analysis of the material flow and energy flow of the steps, from the current status of LOHAS business, system flow and space. The perspective of the layout illustrates the current problem of back kitchen operation, finds contact points for subsequent systematic design and optimization, and quantifies the current business situation of LOHAS through the economic evaluation of the LOHAS linear system and helps identify new economic opportunities and also through the comparison with the data after the system design, data validation for the optimization of the system.

# 6. CONCLUSION AND OUTLOOK

## 6.1 CONCLUSION

This article focuses on the analysis and research of relevant cases of system design and the problems found in existing systems through investigation. The scope of the case covers well-established and successful system design practices at home and abroad. It analyzes the advantages and disadvantages of each case in reality and provides a practical and feasible technical foundation for the subsequent system design.

The output of a system is determined by the nature and structure of the system. The discussion of system problems needs to be placed in the context of the system to make sense. The system design provides a systematic perspective and new model for urban kitchen waste disposal. Concern over people's dietary waste itself, shifting to thinking about a linear system that generates food waste, shifting attention from people to quality, re-establishing kitchen waste and other elements inside and outside the system correlation, the realization of the system material circulation. The application of the system design in the LOHAS Veggie Restaurant provided a typical case for the processing of kitchen waste in the small and medium catering industry in the city and provided a new solution for the processing mode of urban kitchen waste.

This article provides a feasibility guide for the establishment of a regional co-association, establishment of related enterprise ecosystems, and strengthening of multi-dimensional cooperation between enterprises and enterprises. The exchange of goods between LOHAS and ecological farms not only effectively solved the problem of transportation and disposal of food waste, but also expanded their profit models, promoted local economic development, and achieved win to win cooperation.

The systemic design is a human-centered design that emphasizes the true relevance of people to the surrounding environment. The re-planning and application of kitchen waste of different quality not only changed the company's single profit model, but also changed the role of consumers. It involved consumers as part of the system to participate in the system cycle, making the system full of material The loop.

Systemic design builds a complex network of consumers and businesses, corporate and local environments, and companies and related companies, achieving system stability and balance.

## 6.2 DIRECTION FOR FURTHER WORK

This thesis still has the following deficiencies:
The ecological farms that were co-operated by LOHAS were still under construction. This study failed to obtain detailed data. A collaborative project with reference significance was proposed based on the characteristics of ecological farms. In the subsequent work, the author will continue to maintain communication with the heads of LOHAS and the ecological farm and deepen the research.

This article proposes solutions for packing first-level leftovers into a shared refrigerator in the community to help homeless people. The implementation of this concept not only requires the support and assistance of the person in charge at the time of LOHAS, but also requires communication and cooperation with other relevant persons in the community and fails to provide a detailed implementation plan. The concept of sharing the refrigerator in the community is not the author's initiative. In the next step, the author will study and learn from the successful experiences of existing cases, deepen the association between the music and the community, and deepen the implementation plan.

System design is based on system theory. It is different from local solution based on linear system. It pays more attention to the nature of the problem. System design may not be the ultimate solution to the problem, but it changes the way people look at the problem and provides a system context and perspective for solving the problem. No problem arises out of thin air and is isolated. Interdisciplinary thinking and application of system design will bring new possibilities for the solution of social linear system problems.

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