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

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ABSTRACT

At present, in China, every restaurant in the city generates no less than 6,000 tons of food waste. Food waste contains a large number of animal and plant proteins and oils, which are rich in nutritive value. However, because of the huge output, high moisture content, corrosion and deterioration, and poor classification in the previous period, it has led to difficulties in recycling. The restaurant is one of the main sources of kitchen food waste. The restaurant's kitchen process is unreasonable, and kitchen waste is not recycled according to quality. This article mainly uses the system design method, and takes the vegetarian restaurant LOHAS vegetarian restaurant as the specific research object. Explore systematic solutions to food waste problems.

Through investigation and analysis of LOHAS vegetarian restaurant, it was found that the utilization of restaurant water resources and kitchen resources was low, resulting in the waste of resources and the increase of operating costs. This article uses the systemic design method to qualitatively and quantitatively analyze the problems in the system and classify them according to the quality of water resources and kitchen resources. Optimizing the restaurant's kitchen process and strengthening business cooperation not only achieved the "zero discharge" of restaurant-kitchen garbage, but also effectively improved the restaurant's efficiency, and provided a new economic model for restaurant operations.

This article and two other articles form a series. My colleague Jiang Mengqi focuses on researching and analyzing various aspects of the current status of LOHAS vegetarian restaurant. The other colleague Zhang Anqi focuses on the analysis of the linear system under the current status of the restaurant. And this article combines two Colleagues' data and analysis results focus on the process and method of using systemic design and service design thinking and methods to optimize the design of the kitchen process for vegetarian restaurants, propose a systematic implementation plan to solve the problem of kitchen waste, and realize the localization and sustainability of resources. This series of articles can provide reference for other similar systemic design projects.

Key words: Systemic design, kitchen process improvement, localization of resources, economic evaluation, service design

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1 INTRODUCTION

1.1 RESEARCH BACKGROUND

1.1.1 Shanghai Vegetarian Restaurant

The vegetarian population is rapidly increasing and has become a popular trend. China has also started to pay more attention to vegetarianism. Taiwan is the province with the largest number of vegetarian groups in China. By the end of 2016, 13% of Taiwanese people were vegetarians, and there were nearly 6,000 vegetarian-friendly restaurants in Taiwan. According to the survey results, among the Shanghai residents, vegetarians already accounted for 0.77% (dairy: 0.45%, vegan: 0.12%).

As a population superpower, the current number of vegetarian groups in China is already relatively impressive. The demand for vegetarian market is high, and the development prospects are good. With people's increasing attention to personal health, food safety and environmental protection, together with the publicity and promotion of major public welfare organizations, we have reason to believe that more people will begin to slowly accept plant-based diets.

The flow of food in the vegetarian restaurant is simpler than that of the ordinary restaurant, and the type and quality of the vegetarian food waste are also easier to measure. These provide a realistic basis for the qualitative and quantitative research in the systematic design process.

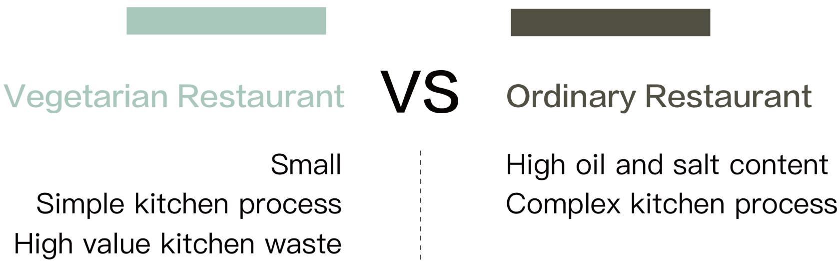


Fig 1.1: The comparison between vegetarian restaurant and ordinary restaurant

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.

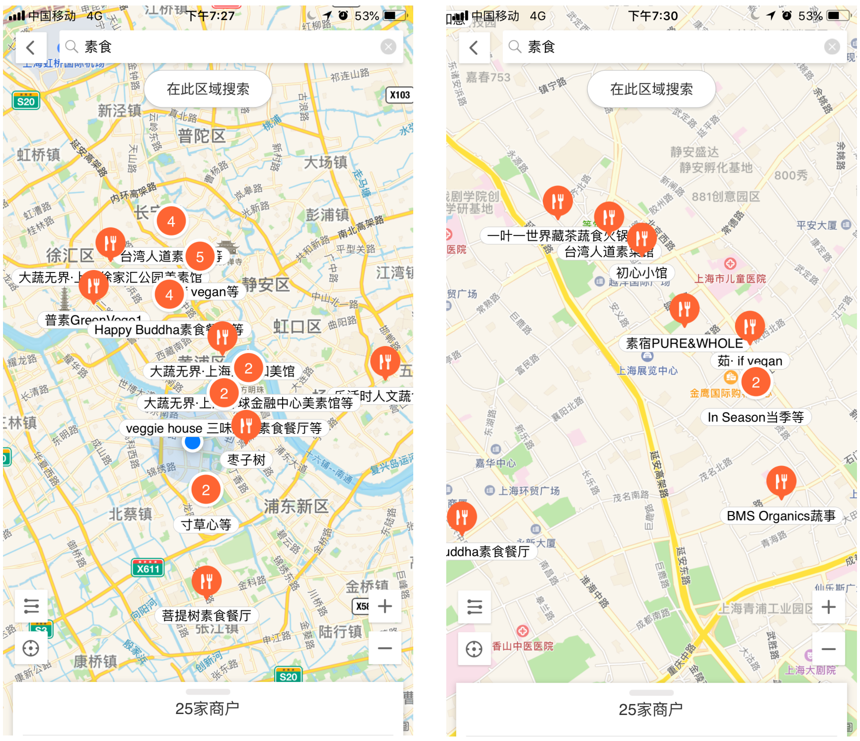


Fig 1.2： Shanghai's vegetarian restaurant distribution in 2018

1.1.2 Catering industry development and issues

The development of China's food culture has a long history and a wide range of varieties. In 2016, the national catering revenue was 3.5779 trillion yuan, accounting for 10.8%

of the total retail sales of social consumer goods (combined with the China Chamber of Commerce for Industry), which was an increase of 0.1% from 2015. The tertiary industry accounted for 21.02% of China's GDP in 1978, and it accounted for 48.1% in 2014. (From Yujia, 2016) The catering industry, as the mainstay of the tertiary industry, has played an important role in improving the quality of life of the nation, absorbing employment, and industrial linkages. In order to seek greater profit margins, the restaurant has changed from a simple food provider to a provider of experience and service, and has continuously improved its management and service capabilities. The catering industry has demonstrated its diversified, personalized, informational and popular market characteristics. With the continuous development and expansion of the catering industry, the problems in the operation and management of the industry are also becoming increasingly prominent:

(1) Inappropriate handling of kitchen waste causes waste of resources and environmental pollution

(2) Restaurant kitchen management is not standardized

(3) There is no complete industrial ecology of food waste recycling

(4) Influenced by traditional cooking and eating culture

1.1.3 Kitchen Waste Treatment

In Shanghai, Xining, Ningbo, Suzhou and other places, some restaurant 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. 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 the treatment of urban solid kitchen waste: incineration, landfill, and microbial fermentation. The three methods are relatively mature, but each has its own drawbacks.

The exploration and development of restaurant food waste disposal in foreign cities takes longer, and the classification, collection, treatment and industrial ecological construction of food wastes are more mature than in China. Japanese nationals have a strong awareness of the separation of kitchen waste and food. Kitchen wastes are strictly sorted and discarded at the source before they are harvested. This greatly increases the utilization of food waste. France encourages people to compost at home. The fertilizer produced was used to add fertilizer to the urban soil and effectively reduced the weight of food waste. Kitchen waste requires not only government support and perfect system, but also needs the cooperation of all stakeholders.

1.1.4 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.

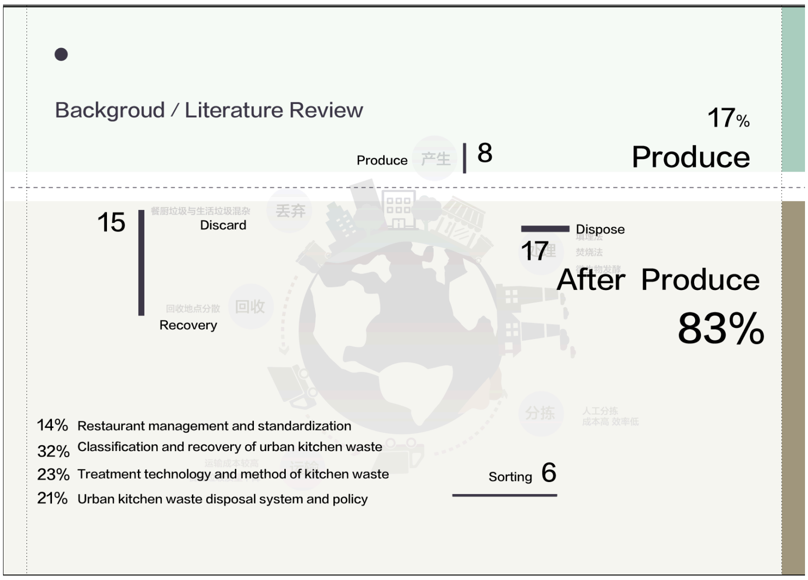


Fig 1.3: Literature Review

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. It is a vegetarian restaurant located in Lujiazui, Shanghai. The restaurant is based on the concept of health and environmental protection. It uses seasonal vegetables to cook dishes and has strong seasonality, attracting a large number of young diners. The founder of LOHAS is very concerned about environmental protection issues. During the operation of the restaurant, efforts were made to try and adjust issues such as food waste and improper processing of kitchen waste. For example, she sets classified dustbin garbage bin in the kitchen. It is encouraged to discard the higher-quality vegetable and fruit wastes and unusable food waste during the operation of the kitchen. According to the amount of food consumed by the customers, the size of the trays is regularly adjusted to reduce food waste on the table. The fruits and vegetables that are of poor quality cannot be used, and employees are encouraged to make them staff meals to reduce waste. Although the founder has made many attempts to solve the problem of waste of resources, the results have been poor due to lack of theoretical guidance. Moreover, these measures have not been planned from a systematic perspective. It is only the optimization of single points that do not systematically solve the problem.

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.

Fig 1.4: LOHAS vegetarian restaurant

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 RESEARCH FRAMEWORK

I and the other two partners formed a combination to complete the project and wrote three papers in three different areas.

In order of content, my partner Jiang Mengqi is responsible for the first part: research. My partner Zhang Anqi is responsible for the second part: analysis of the status quo, that is, the linear system. I am responsible for the third part: according to their results, elaborate the process and results of systemic design and service design. The framework of the paper is shown in the figure below.

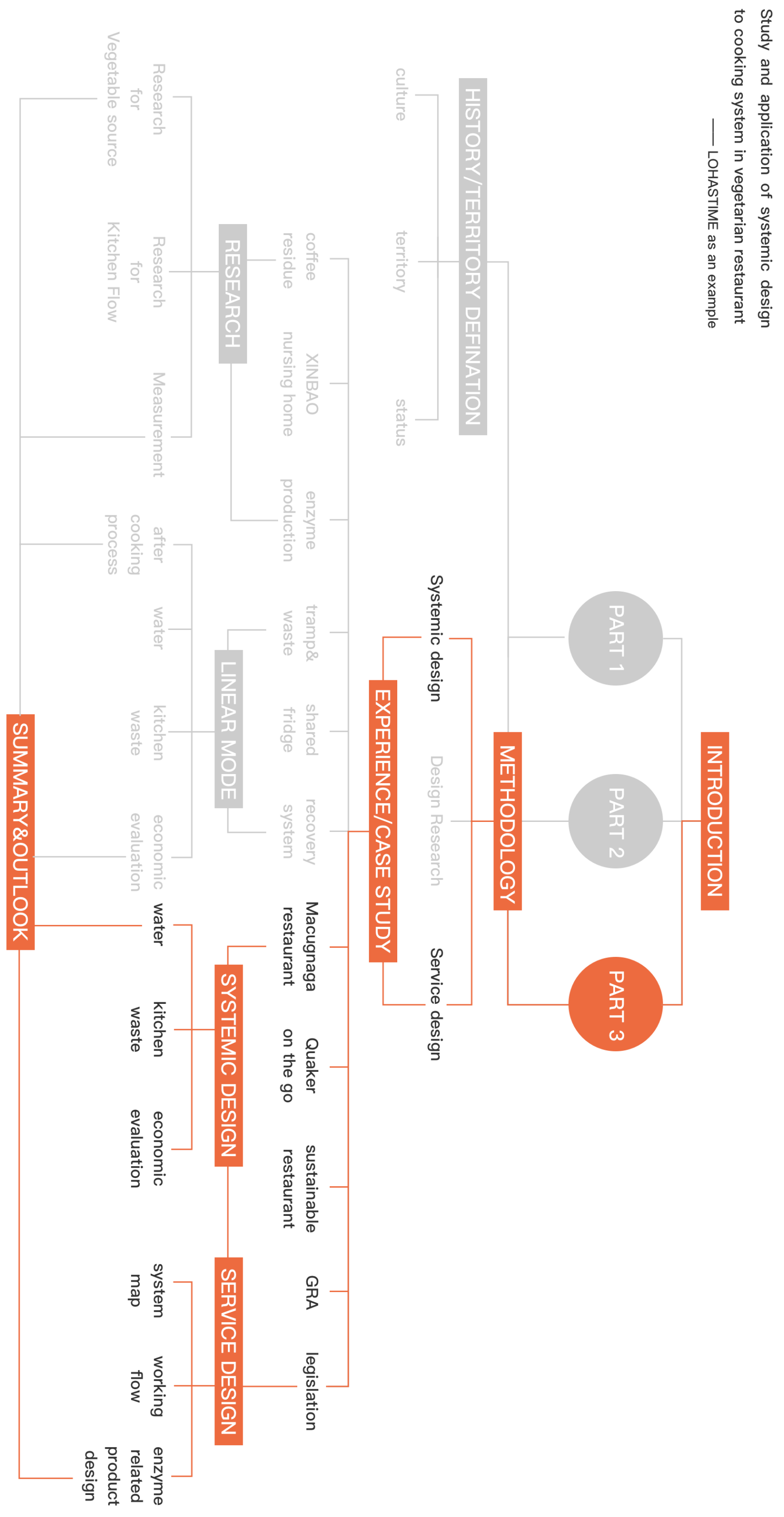


Fig 1.5: Framework of 3 papers

2 SERVEY

My partner Jiang Mengqi's dissertation is focuses on the research and analysis of the current status of the LOHAS Vegetarian Restaurant. This article describes the methods and results of our research. The status quo of LOHAS restaurant is described in detail from the menu settings and sources of vegetables, kitchen equipment and data measurement, staffs and kitchen management.

2.1 SERVEY PLAN AND METHOD

We used the field observation method, expert interviews, and research questionnaires to conduct a one-day observation and investigation of the situation of LOHAS kitchen.

The timing of the research and the cooking process are shown in Table 3.1 below:

Time	Kitchen process	Participant	Survey process	Equipment
9：30	Employees enter the store	Chef	Equipment preparation and data measurement	Camera, video recorder, voice recorder, tape measure, calculator, pen, research outline, research questionnaire
10:00	Delivery & Storage	Buyer、Managers	Observe and record	
11:00-1:30	Processing & Cooking	Chef、Assistant	Record & Dispatch questionnaire	
1：30-2:30	Finishing & Cookware Cleaning	assistant	Record sales in the morning	
2:30-4:00	Interviewed	Chef、assistant、Managers	Interviews and records	
4:00	Food supplements	Managers、Buyer	Observe and record	

4:30-7:30	Processing & Cooking	Chef、assistant	Record & Dispatch questionnaire	
8:30-9:00	Cleaning	Cleaners	Interviews and records	

Fig 2.1: The timing of the research and the cooking process

2.2 MENU SETTINGS AND SOURCES OF VEGETABLES

Seasonal vegetables were the main ingredients in LOHAS, and the place of purchase is Hunan Road Agricultural Products Market. The use of ingredients that are not yet suitable for storage on the same day was used to make food for employees. Vegetables with lower water content are kept in a cold room for storage. While enjoying the seasonal vegetables at LOHAS, the menu changes with seasons.

Shanghai is densely populated and has a small amount of arable land. At present, Shanghai's vegetable supply comes partly from Shanghai's local cultivated land; some are from top-flight cultivated land in Shanghai, and Jiangsu Linyi, Shandong, and Hainan are the largest vegetable supply provinces and cities in Shanghai. Shanghai has a clear four-year climate and vegetables with obvious seasonality. From January to January, the supply of local vegetables is the largest in Shanghai, and it is the smallest from July to September. Among the research period, 90% of Shanghai's green leafy vegetables, Solanaceous vegetables, and bean products were provided by Shanghai's local cultivated land, and most of the rest were from cultivated land in other areas. The source of vegetables purchased by LOHAS is shown in Figure 3.2. The location where the vegetables are purchased during the time of LOHAS is Hunan Road Agricultural Products Market, and the vegetables are sold directly from the local planting base or distributed by large vegetable and fruit operators (such as Shanghai Vegetable Group). In winter, most of the seasonal vegetables used in LOHAS came from local farmland, while fruits and staple foods mainly depended on imports. The LOHAS Vegetarian Restaurant has a weak material connection with local.

LOHASTIME

VEGETABLE RESOURCES

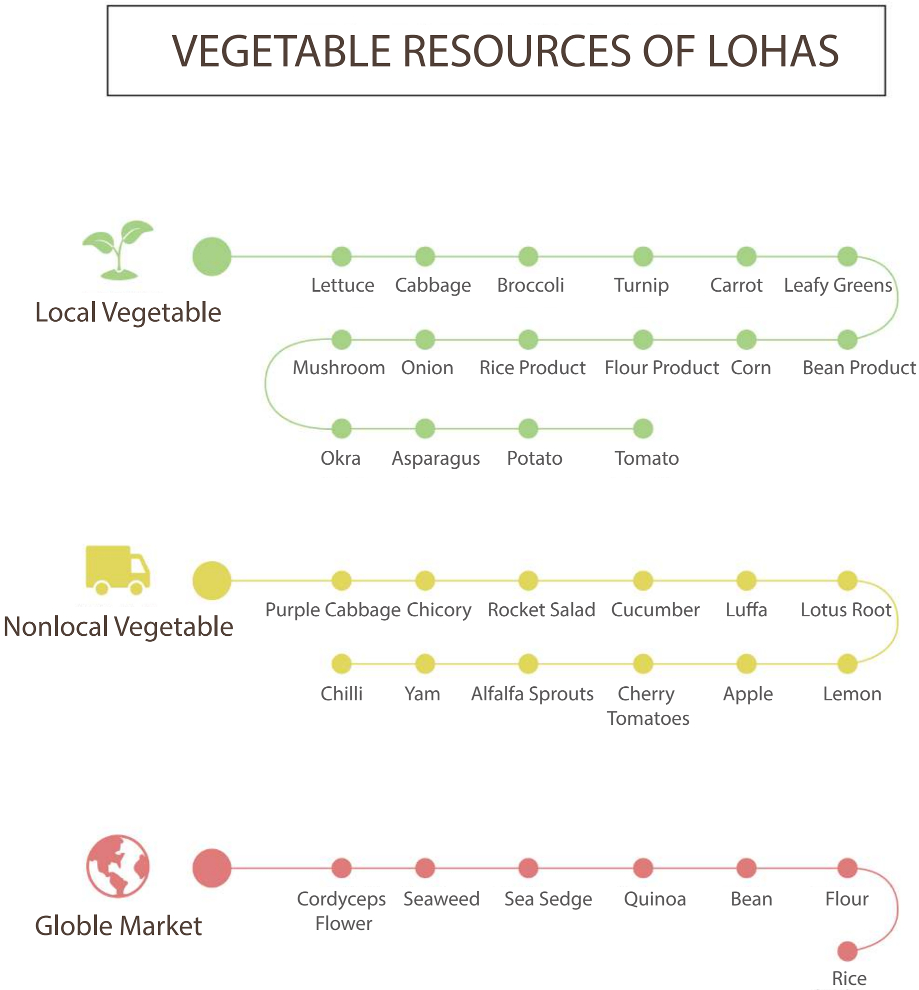


Fig 2.2: The source of vegetables purchased by LOHAS

2.3 KETCHEN EQUIPMENT AND DATA MEASUREMENT

The kitchen at LOHAS is small and compact. The layout of the kitchen is shown in Figure 3.3:

Fig 2.3: The photos of layout of the kitchen

The kitchen equipment capacity measurement data is as follows:

Trash can: 3.33L

Soup pot: ≈ 7.96L

Rice cooker: 4L

Wok: ≈ 7.48L

Cleaning tank: 61.5L

Cleaning bucket: ≈ 26.84L

The cooking energy in the restaurant kitchen is gas and electricity. The gas is not fully burned compared to natural gas, and the transportation cost is high, and there are potential safety hazards.

2.4 STAFFS AND KITCHEN MANAGEMENT

The restaurant has a total of 1 administrator, 2 chefs, 2 assistants, 1 cleaner and 1 purchaser.

The kitchen process and main responsible person are shown in Figure 3.5 below. The planning of the kitchen space was unreasonable in LOHAS. The staffs often collided and the movement is inconvenient, which affected the restaurant's work efficiency.

In the interview, we found that employees' awareness of discarding rubbish was not strong enough to form a habit of correctly discarding rubbish, and the classified dustbin set in the kitchen at LOHAS is not really work.

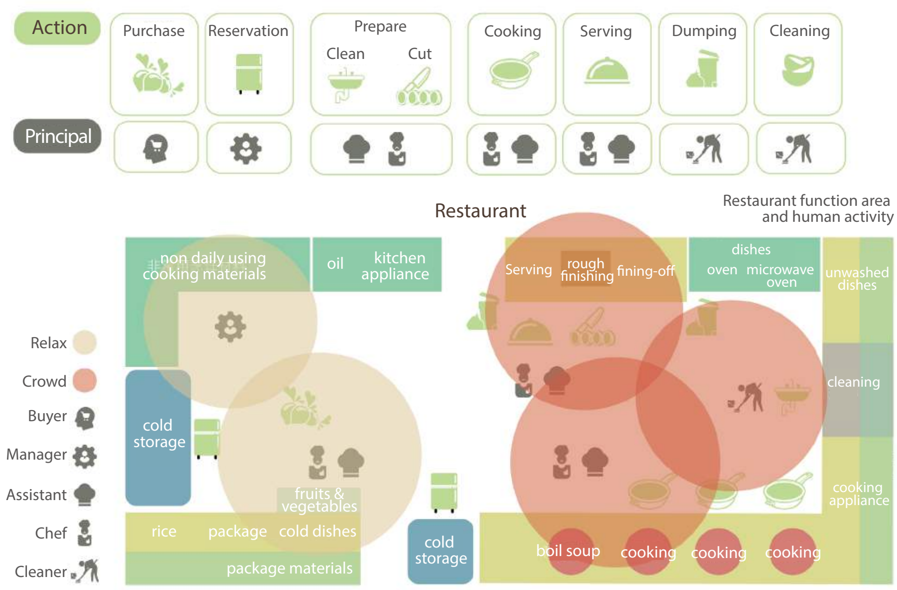


Fig 2.4: Kitchen function division and main responsible person

3 LINEAR SYSTEM OF LOHAS

3.1 Linear system

My partner Zhang Anqi's thesis focused on a linear system analysis of the current status of the LOHAS vegetarian restaurant. This article explains the main results of her analysis. We analyzed the steps in the restaurant's cooking process and the inputs, processes, and outputs in detail for each step. A linear system diagram was drawn, and analyzed the quantity and quality of water and food waste in the system.

Restaurants can be roughly divided into the following process: purchase - storage - cleaning – cut - cooking - dump - cleaning. Through a detailed analysis of the preparation, cooking, and cleaning steps in the kitchen process (see Zhang Anqi's thesis), the integrated linear system is as follows:

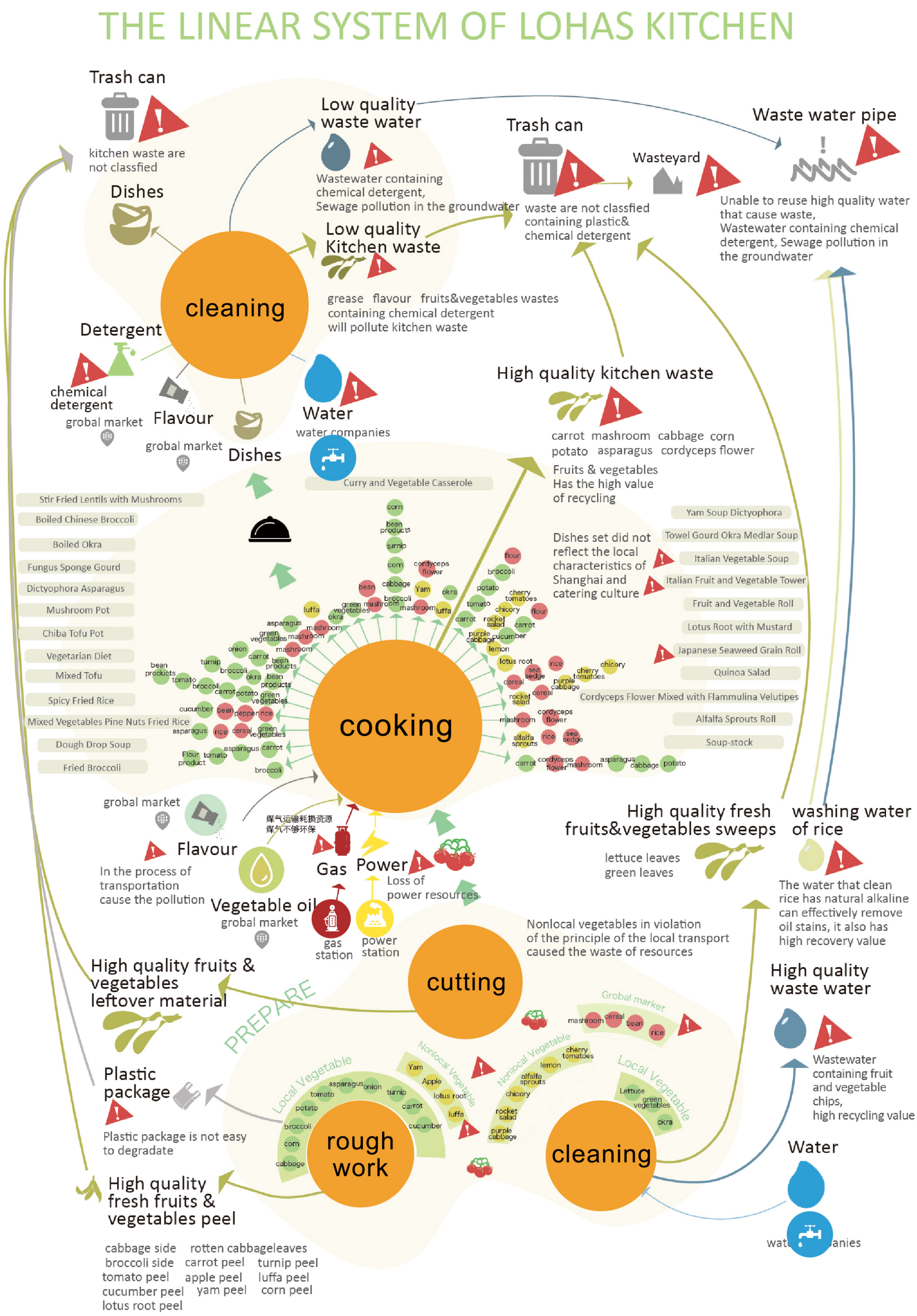


Fig 3.1: linear system of LOHAS kitchen

3.2 WATER ANALYSIS

- **Quality analysis**

After washing the vegetables with water, the waste water after use contains components such as dirt, vegetable peels, pesticides, and dust. 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.

- **Quantitative analysis**

According to calculations, the water consumption of the restaurant at LOHAS is 4.27T a day.

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

M=4.27*30=128.1T

- **Cost calculation**

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

P=4.6*128.1=837.66 yuan

3.3 KITCHEN WASTE ANALYSIS

- **Quality analysis**

The main components of food waste are 80%-90% of water, rice, flour, fresh fruit peel, food waste, vegetable oil, seasoning.

- **Quantitative analysis**

The monthly consumption of vegetables in LOHAS is 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%

3.4 LOHAS AND ECOLOGICAL FARM

The consumption of fresh vegetables in the LOHAS vegetarian restaurant is very large. At present, the main channel for restaurant purchase is the vegetable distribution market. This procurement model cannot trace the source of fruits and vegetables to ensure quality. Shanghai has obvious seasonality, and the area of arable land is limited. The supply of vegetables in this Municipality is partly due to local farmland, and partly to 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, on the one hand, it ensures the quality and solar-powered properties of the supply of ingredients and reduces the cost of vegetable purchases. On the other hand, it explores cooperation models with eco-farms to expand business and increase economic income.

3.5 PROBLEM ANALYSIS AND ECONOMIC EVALUATION

At present, there are still many problems with the LOHAS restaurant.

- **From the perspective of the kitchen process:**

1. Vegetable procurement channels cannot trace the source of vegetables and ensure the quality of vegetables.

2. Incomplete classification of kitchen waste, low utilization rate of kitchen waste.

3. The cleaning pool is not standardized and water resources are wasted.

- **From the perspective of dining room space planning in the restaurant:**

Restaurant kitchen space is compact, equipment location does not meet the process and habits of personnel operation.

- **From perspective of business:**

1. High operating costs

LOHAS currently earns about 50,000 yuan per month, the monthly profit and loss during the winter season is:

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

LOHAS 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. As shown in Figure 4.2.

2. The business model of LOHAS is simple and the traffic is small.

3. Incomplete regional cooperation.

CURRENCY ECONOMY

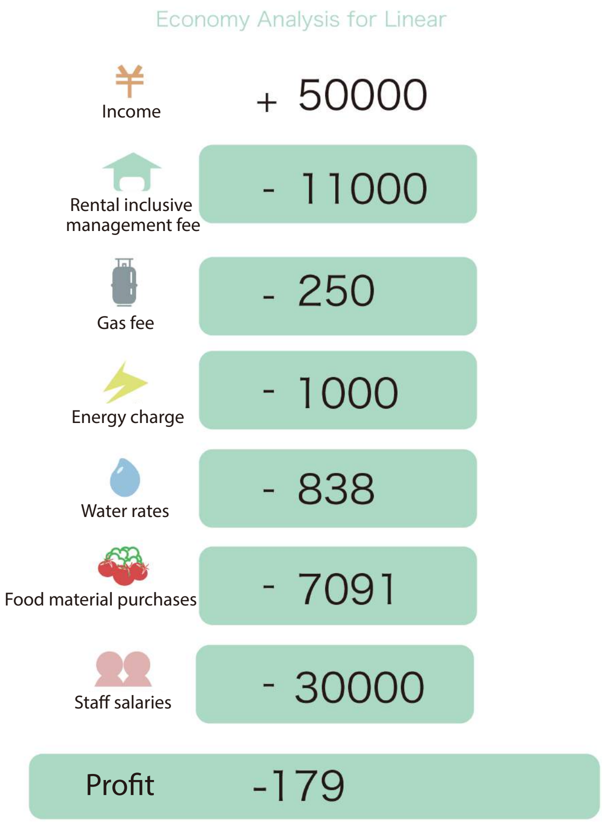


Fig 3.2: LOHAS linear system economic evaluation

4 METHODOLOGICAL APPROACH AND TOOLS

4.1 SYSTEMIC DESIGN

4.1.1 What is systemic design

Systemic design is a new approach to design. It is the design of the production process and the acquisition of sustainable products. One of the guiding principles of system design is that the output of one system is the input of another system, that is, the idea of waste as a resource. The main task of the system designer is to plan the flow of material and energy in the system, pursue the goal of zero emission, create a new economic production model, and create a community that is closely linked with people and regions.

The systemic design defines the relationship among the various components of the system, plans the flow of resources and production methods, enhances the well-being of individuals and communities, and the final result is a system. Through the innovation of the relationship between the production process and the production steps, the systemic design creates a new blue economy model. Compared with the green economy, the blue economy model not only achieves the purpose of resource conservation and environmental friendliness, but also creates economic value while protecting, adapting, and adding value to natural systems (Gunter Pauli, 2012).

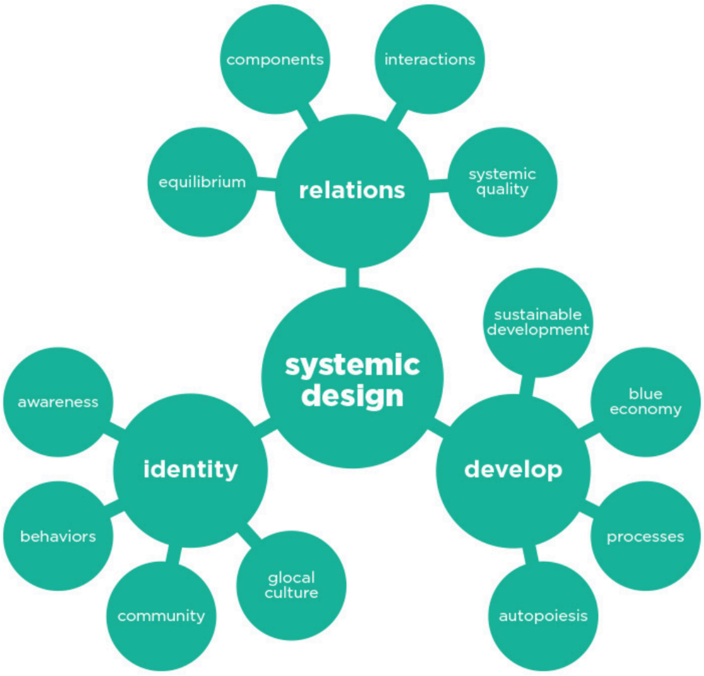


Fig 4.1: System Design Related Fields

4.1.2 Significance and value of systemic design

Linear production processes often only consider the satisfaction of products and functions, and do not consider the reuse of resources and the sustainability of the environment. The production and recycling processes are all efficiency-oriented. Only the causal relationship is emphasized. From manufacturing to the end of product use, a large amount of waste will be generated, and these wastes need to cost society. Using a linear production model is not enough to solve the unsustainable issues we face today.

Systematic thinking is a kind of non-linear thinking. The guiding idea of system design is that each system is an open system, with input and output. We must pay attention to waste as much as we focus on production supply and use of raw materials. Therefore, we must pay attention to improving the quality and quantity of output to reuse. Different production processes can be linked to each other. The output in one process can be transformed into the input in another process. Waste can be turned into resources.

Fig 4.2: Material flow relationship in system mode

In the production process of the systemic mode, each point has inputs and outputs. They interweave and cooperate with each other and establish a more efficient network of relationships. The use of nearby or local resources instead of long-distance resources gives the region a specific cultural identity.

4.1.3 Systemic design methodology

- **Research**

First of all, it is necessary to conduct a systematic and comprehensive investigation of the current situation. The investigation must be detailed to every step and every action in the production process. At the same time, the focus is on the input, the source of the input, what is happening in the system, and how output is handled. The analysis of inputs and outputs is done both in terms of quantity and quality.

- **Scheme analysis**

The research content can be presented in the form of a flow chart. Figure 5.3 shows how to perform a preliminary study of the systemic design, how to split each step in detail, study the input and output of each step, and then study the resource flow relationship between each step.

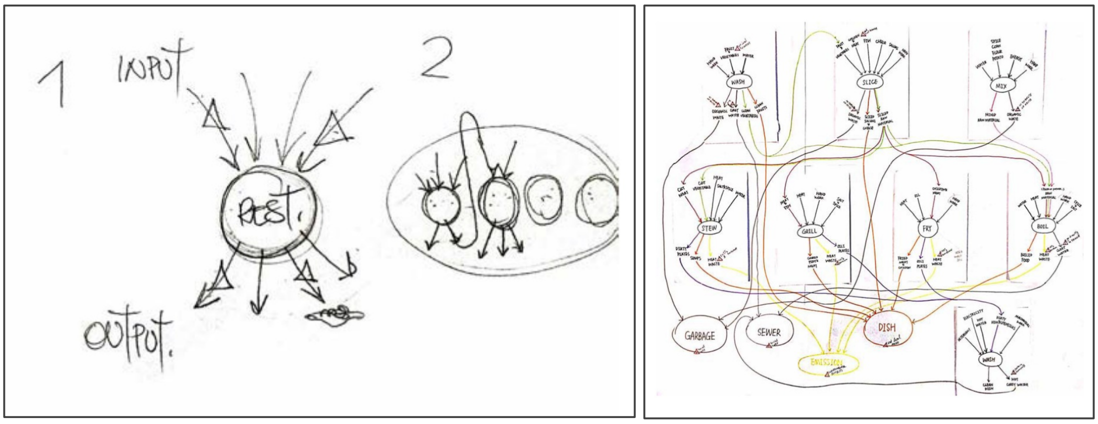


Fig 4.3: Systemic Analysis Process

It should be noted that the system design concept requires a systematic and global understanding of the design object, not only focusing on one part but neglecting the relationship between the part and the whole.

- **Linear system**

After having a comprehensive understanding of the design objects, it is necessary to analyze and find the deficiencies in the various aspects of the system, and assess each deficiency from different perspectives, such as economic efficiency, environmental sustainability, and geographical Contact and production flexibility and so on. And the survey results are expressed in the form of a system flow chart.

- **Explore systemic system**

A global perspective helps us to transform the production process into sustainability, and the method often used in this process is the drawing of flow charts. Hand-painted methods can better organize the thinking of designers to plan the relationship between the flow of matter and energy, the use of resources, and the actions. Designers want to use the output of the system as much as possible to make it an input to another production process, and to make the entire system as zero discharge as possible.

In the process of defining problems and solving problems, many interdisciplinary knowledges will be involved. The task of the system designer is to coordinate and promote the role played by these disciplines and change the wrong result-oriented production methods.

- **Economic analysis**

The systemic design is pragmatic, and it emphasizes the improvement of the actual economic benefits. Economic analysis is an important part of systemic design.

- **Result**

After system design, the possible outcomes are: strengthened links between resources and regions; increased productivity; new or more valuable assets; higher quality services in the community; more job opportunities.

4.2 SERVICE DESIGN

Service design is an effective design activity for planning and organizing related services such as people, infrastructure, communication and communication, and materials involved in a service to improve user experience and service quality. The purpose of the service design is to design the front-end and back-end of the service according to the customer's needs and the capabilities of the service provider to ensure that the service is friendly, competitive and relevant to the customer, and to the service provider. It is sustainable. The design of services for this purpose uses derivative methods and tools from different disciplines, from ethnography (Segelström et al., Ylirisku and Buur, 2007, Buur, Binder et al. 2000; Buur and Soendergaard 2000) to information management. Science (Morelli, 2006), and interaction design (Holmlid, 2007, Parker and Heapy, 2006). The concept and ideas of service design, as above, using visualized expression methods, based on the understanding of stakeholders in the process of culture, skills and services Different degrees of expression are used (Krucken and Meroni, 2006, Morelli and Tollestrup, 2007) The service design may be a change to an existing service, or it may be the creation of a new service.

The process of service design is divided into Analyzing, Generating, Developing and Prototyping (A. Maroni, D Sangiorgi, 2011)

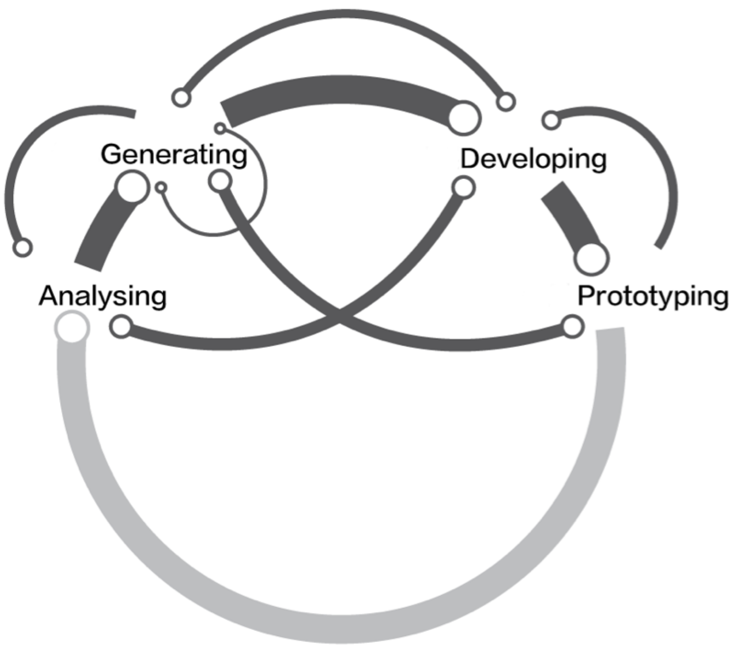


Fig 4.4: Service Design Iteration Process

Designers can use different service design tools for different stages:

- **1. Analysis stage**

These tools can help collect, record, and share background information using different media methods such as video, sound, or text. These tools can be used by users or in interactions with project participants to discover their thoughts and experiences: Myspace, Customer Journey Map, Directed Storytelling, Emotions Map (Emotional Map); Design Documentary; Video-blog; Film Diary; User Diary; Story Collection.

- **2. The generation phase**

These tools help build a shared sense outside of the experience gained through direct or indirect dialogue with project participants. They express and recommend service ideas, aesthetics and stories through different visual ways: Idea Skeches; Glimpses; Service Moodboard.

- **3. Development stage**

These tools provide different formats for elaborating and developing refinement service concepts, enriching stories and systems. They help designers explore part of the service and the overall relationship and assess their feasibility: Micropanoramic; Storyboard; Service Blueprint; Expressive Service Blueprint; (Visual Service Scripts); Service Breakdown; System Map; Service Interaction Design Guildlines; Desirability, Viability, and Availability.

- **4. Prototype stage**

These tools can provide models for quickly testing new service concepts in workshops or real-life scenarios. It allows people to experiment with new service models, reducing the risk of failure and increasing the possibility of producing more meaningful and desirable futures: video sketches; living labs; fast service simulations (FASPE:fast Service prototyping and simulation for evaluation); experience prototype.

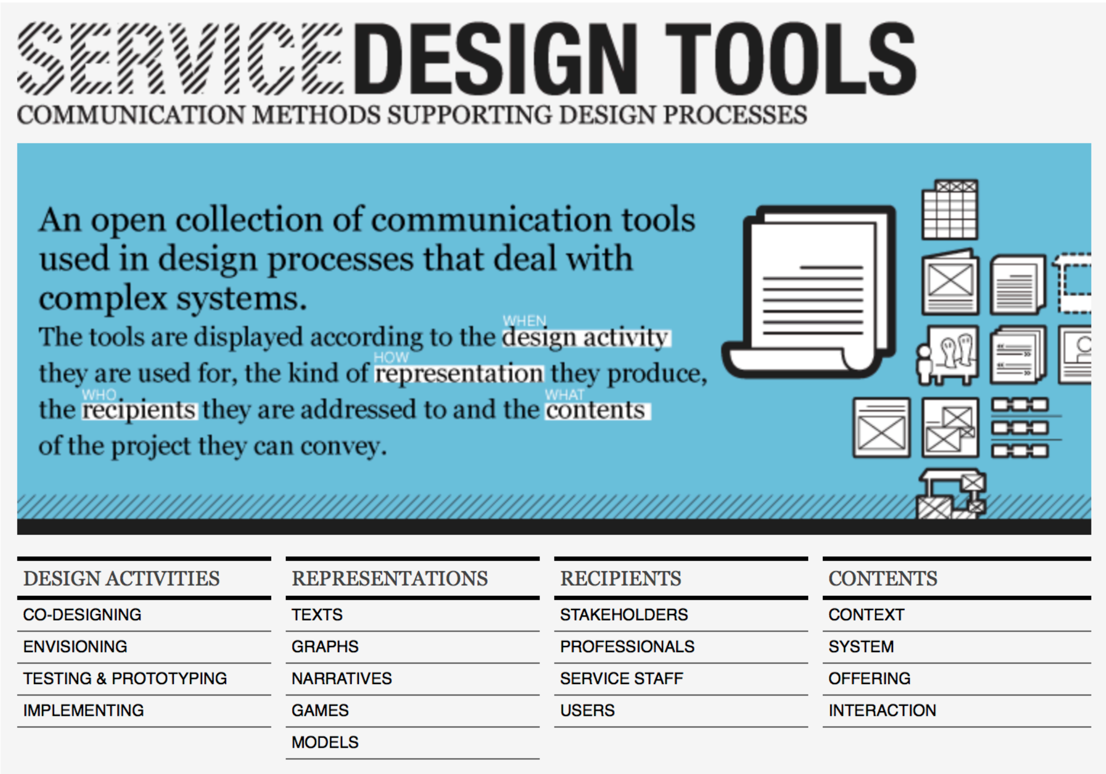


Fig 4.5: Service Design tools

4.3 SYSTEMIC DESIGN WITH SERVICE DESIGN

System design is the design of the production process, and changing the production process means changing the behavior of people and changing the way people use and handle resources. Therefore, it is also necessary to design a product or service that can meet the purpose of the system so that the system can be effective.

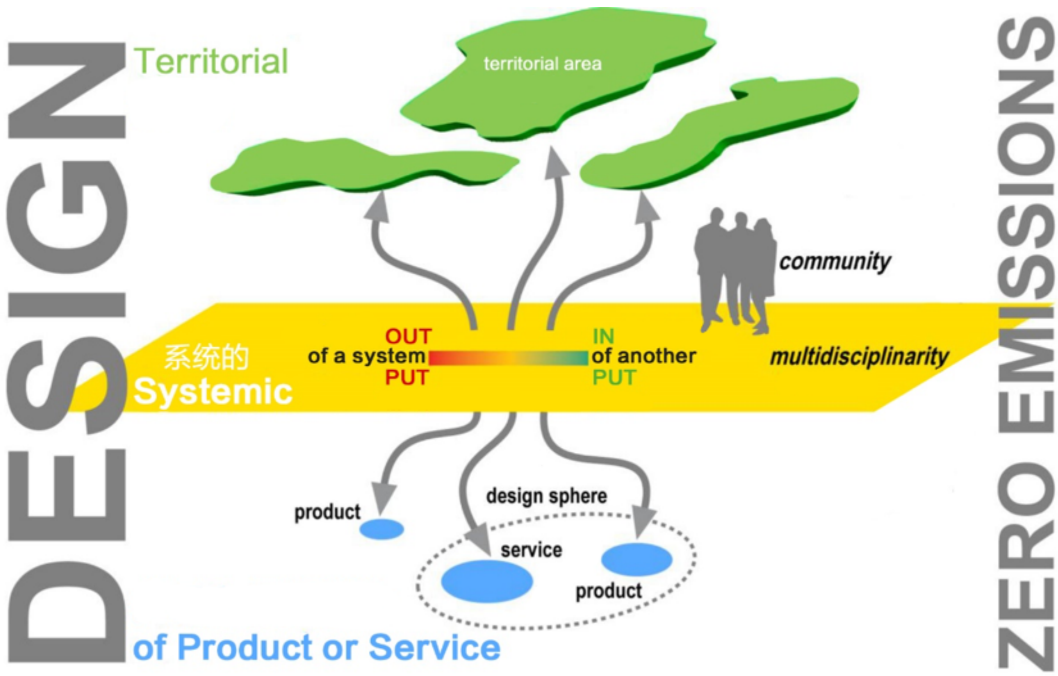


Fig 4.6: System design concept overview

If we think systematically about our lives today, each of our actions is in a system. Each existing product may be regarded as a component of an interconnected complex system. Each product is not considered individually, but instead it is analyzed in a more complex system. The "Design By Components" in the Master of Science in Systems Design at the Politecnico di Torino is the study of how product design meets systematized requirements in a particular geographical system.

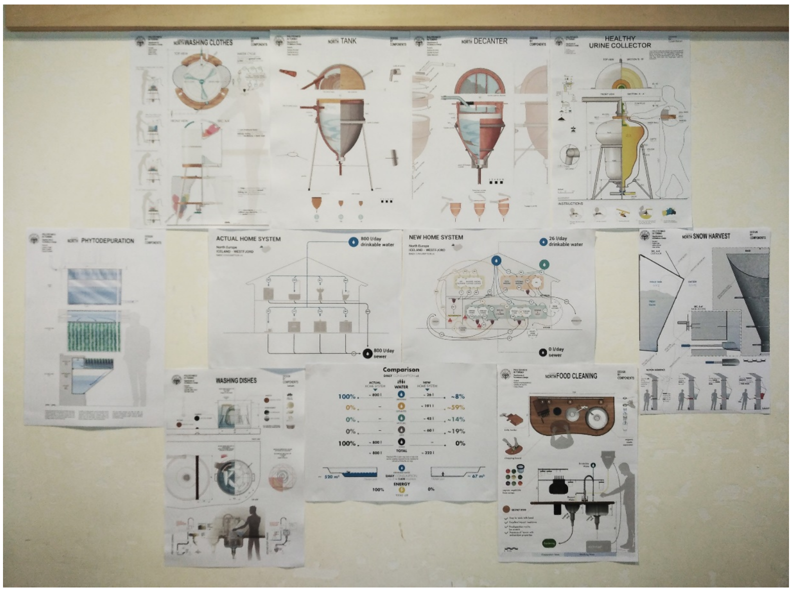


Fig 4.7: Collection of product designs for the system design course at the Politecnico di Torino

In some cases, merely changing existing products or creating new ones cannot satisfy the needs. The solution can also be the design of services. It should be noted that design services also need to start from a systemic perspective, rather than focusing solely on this service unit.

4.4 METHODS APPLIED TO LOHAS

The restaurant is a system that has both resources and material outputs. Therefore, the systemic design method can be used to plan the resource flow and activities of the LOHAS Vegetarian Restaurant and make it sustainable. We uses the systemic design flow chart analysis method to investigate the current situation of the LOHAS restaurant. After analyzing the quality and quantity of the material in the system, the system's resource flow is optimized to form a new system. And compare the economic benefits of the new system and the old system.

For the system to work, people need to use actions. Therefore, we must combine service design methods and tools, design products in the system, and guide people's behavior so that people can truly interact with the system, so that the system can actually function and solve problems.

5 EXPERIENCES, CASE STUDIES AND CONSIDERATIONS

5.1 EXPERIENCES

In the 2014-2015 Tongji University two-semester product service system design course, I have systematically learned service design methodology and tools from the Politecnico di Milano. In the 2015-2016 school year, my experience in studying systemic design at the Politecnico also enabled me to learn the theories and methods of systemic design. Two different design methods allow me to analyze and solve problems from more dimensional perspectives. I will describe the systemic design and service design projects related to food and restaurants that I once participated in.

5.1.1 Macugnaga restaurant

This is a project I participated in when I was studying system design at the Politecnico di Torino. Macugnaga is a tourist village in the north of the Piedmont region of Italy. In this project, we separated to 15 small groups which in reference to different aspects of territory, such as agriculture, forest and livestock, etc. My group focused on restaurant.

Our assignment is work on systemic design after analyzing current mode. The ultimate goal is to create a sustainable restaurant which is reuse resources as much as possible and close to zero waste. In the end, every group will connect with each other and co-create a community which is strongly connect people with their own territory.

Through research we found:

- Typical dishes in Macugnaga restaurant

- Raw materials they need

- Waste solution

Then we analyze input and output of every action in restaurant, trying to find medium among actions. We represented the current situation of restaurant in Macuganga in one scheme. The scheme shows ow of raw materials and energy in 3 parts: input, kitchen and output We analyzed every step in kitchen. Based on this scheme, we found a lot of current problems that could be improved in the future.

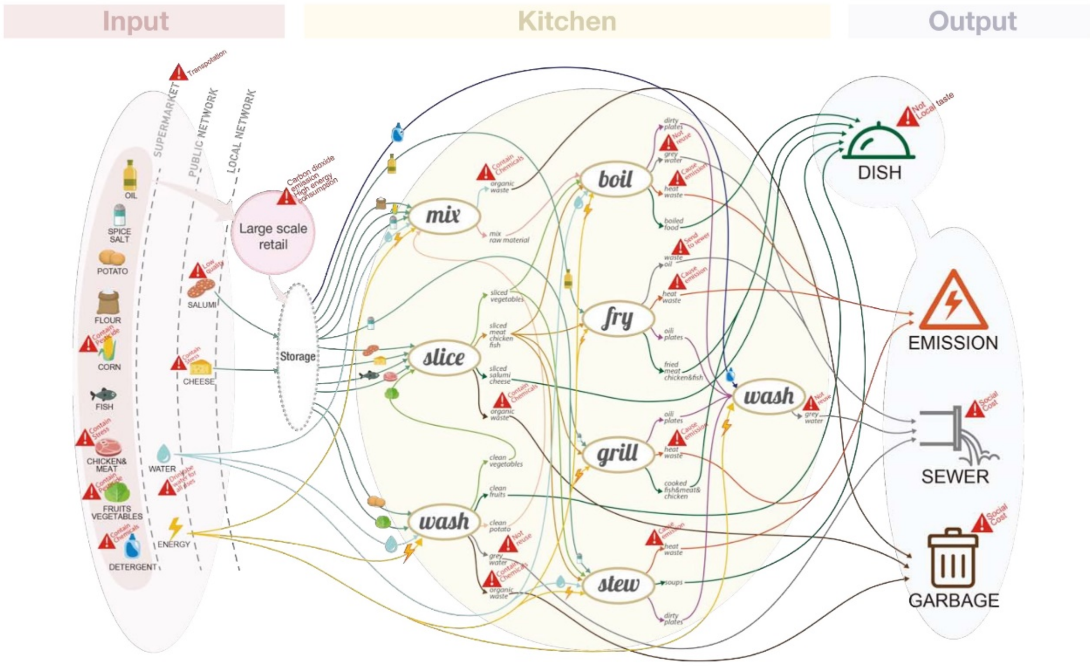


Fig 5.1: Linear scheme of Macugnaga restaurant

We chose several dishes, which cook by local raw materials, so that decrease the cost of transportation. We analyzed waste in every step of preparing dishes. After that, we drew many scheme and tried to explore new way to cook food. Our aim is to reduce and reuse waste as much as possible. Meanwhile, natural and fresh raw materials can increase the quality of dishes.

Take an example of reusing potato skin:

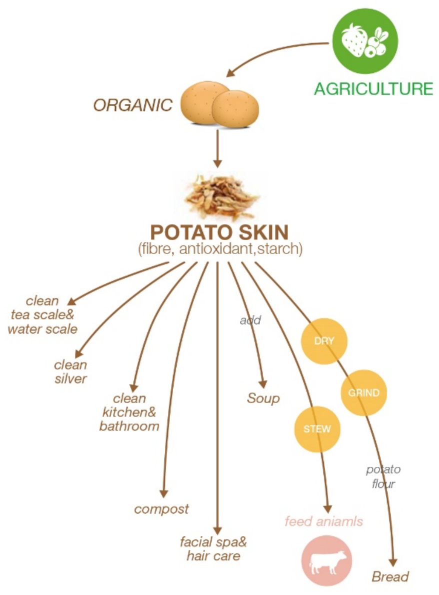


Fig 5.2: Potato Resource Analysis

We decided 6 dishes in the restaurant. All raw materials are from local. Then we considered the connection among them, and we tried to make most use of waste. Waste of one dish can be used for the raw materials of other dishes. 3 new products (fried polenta, tincture and potato peel chips) are made of waste of others.

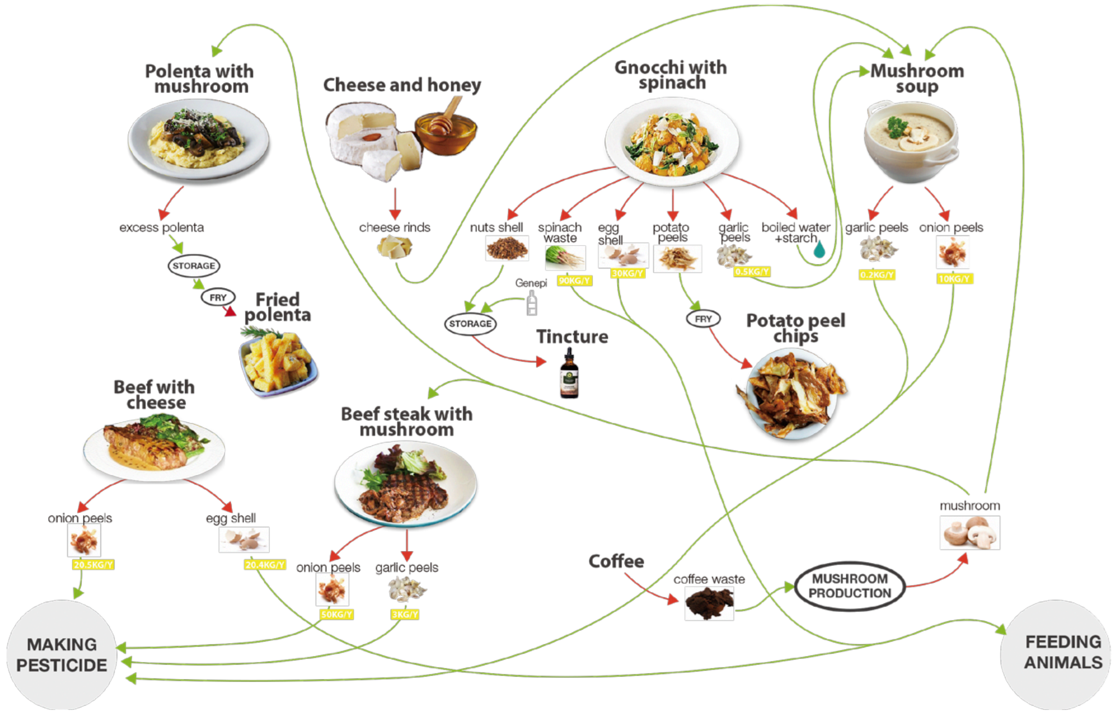


Fig 5.3: Materials flow of dishes

Eventually we designed a systemic system. We designed flow of raw materials with much less waste. We defined components of system, as well as reduced and reused waste as much as possible. The result of our design can strongly connect people with their territory.

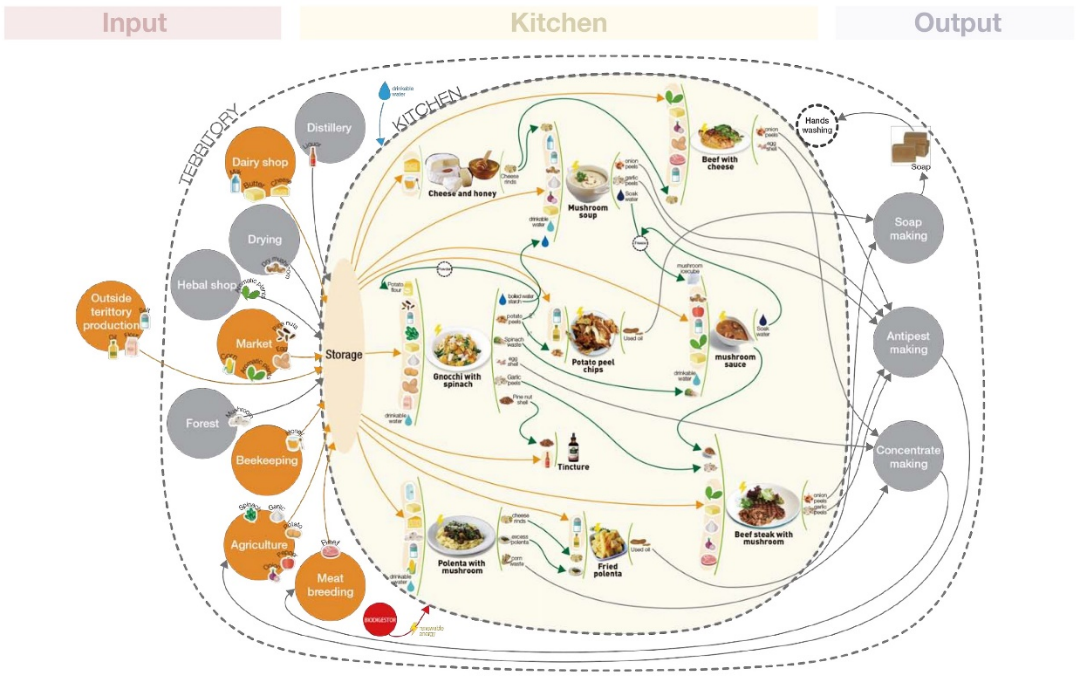


Fig 5.4: Systemic scheme of Macugnaga restaurant

5.1.2 Quaker breakfast on the go

This is a project I participated in when I was studying a service system design course at Tongji University. In this project, a whole set of service design methods and processes were practiced.

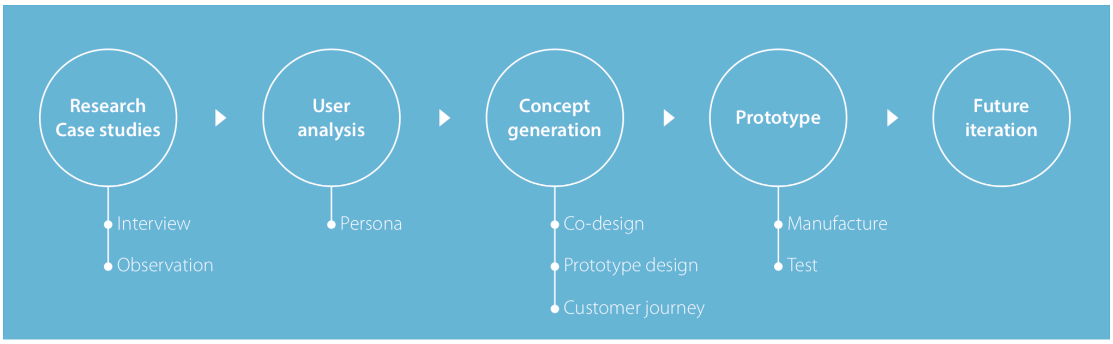


Fig 5.5: Processes of service design project

Quaker is a cereal brand. Quaker Breakfast on the go! is a network of travelling pop-up shops that provides university students with a ready to eat oats breakfast, based on the health goals they want to achieve. Though the app students can also book their breakfast in advance and see Where the pop-up shops are placed.

- **Research**

We Stayed in front of the shelf area in supermarket, interviewing customers who are choosing the products. And we Observed student's breakfast situation around the university and interviewed some of them. We chose "STUDENTS BREAKFAST" to go deeper.

There are variety of street breakfast stalls around university. They open early everyday to sell food.

Students always line up to buy street breakfast, taking them away.

Most foods sold in the morning are fried foods, full of oil and calories.

Fig 5.6: Research photos

- **Pain points**

1. Young students know the importance of breakfast. However, it is hard to prepare by their own. They need high quality and ready-to-go breakfast.

2. Young students would like to choose nutrient and functional food to keep healthy. Street foods around university cannot satisfied their need.

- **Concept**

Based on the research result and the design insight, our design concept is including 4 parts: breakfast recipes, mobile app, Pop-up shop and cup packaging design.

Service design is an iterative process. Based on the creation of the first design concept, various aspects of the concept need to be re-modelled and improved.

Fig 5.7: Prototype of pop-up shop

Fig 5.8: Test processes

5.2 CASE STUDIES

5.2.1 Restaurant: Spoonful Of Sugar

In Beijing, there is a restaurant called Spoonful of Sugar that adheres to the concept of ecological sustainability. Sustainability is reflected not only in the recycling of resources, but also in the use of sophisticated design to make products more durable, thus reducing their forgotten or Discard opportunities.

1. Many of the furniture in the shop is made from waste materials.

Fig 5.9: Chairs made of waste materials

2. The products sold in the shop also fit the sustainable concept.

The restaurant also sells products including organic honey, Longfeng noodles from organic farms, sesame and sesame oil, organic red wine and sparkling wine, as well as organic bath products - the method of sale is based on weight and encourages guests to bring their own containers for purchase. Save resources by reducing packaging waste.

Fig 5.10: Products sold in the shop

3. On the menus of the restaurant, pork and sesame oil are selected for production on cooperative organic farms, while others use products grown by local farmers as much as possible. At present, the spoon sugar is negotiating with the organic vegetable traders in the suburbs of Beijing, hoping to purchase from organic small farms to meet the demand for vegetables in summer.

4. The circulatory system

Spoonful of Sugar has long hired interns from environmental engineering, agriculture, earth sciences and other related backgrounds to provide professional help for their ecological circulatory system.

In the past winter, William from the United States and studying globalization has designed a "hibernation model" for rooftop gardens. His series of measures include: burying earthworms in the soil to enhance activity → clearing annual crops and transplanting cold-resistant crops → planting subtropical crops such as bougainvillea in the soil → collecting nearby fallen ginkgo leaves as wooden boxes as natural Insulation layer → covered woven insulation fabric. At the same time, he also made a design for the coming spring, such as sunflower + cucumber + melon, grape + leeks, beans + carrots + white radish and other symbiotic plants will be arranged in the same wooden box.

Fig 5.11: Rooftop garden circulatory system

Vertical and flat plant stands, Spoonful of Sugar crops as much as possible varieties of crops for the restaurant itself. Some of the plants in the summer, such as basil, were harvested and even shared with other friends who opened restaurants.

The restaurant recycles kitchen waste into this black box to provide fertilizer for plants on the rooftop of the building.

Fig 5.12: Compost bin

5.2.2 Restaurant: Hutong Kitchen No4.4

The founder of the Hutong kitchen No. 44 is an Australian master of environmental protection. He has been working in the environment and circular economy for 15 years. Therefore, he has been committed to building an environmentally sustainable restaurant.

Hutong kitchen No. 44 has formed an ecological self-circulation system instead of a single device. E.g:

- The kitchen waste fermentation system ferments waste into fertilizer and returns to the field.
- The artificial wetland landscape water purification system makes vegetable washing water more useless.
- Rooftop solar photovoltaic system solves the problem of power generation.
- Roof rainwater purification purification cooling system to solve the temperature.
- The house enzyme purified water organic nursery system can collect rainwater.

There are also some other complementary measures in the store. For example, the shop does not provide disposable packaging boxes. These measures all reflect the sustainability of the restaurant.

Fig 5.13: Vegetable washing water is purified by sand and gravel to the tank for centralized secondary use

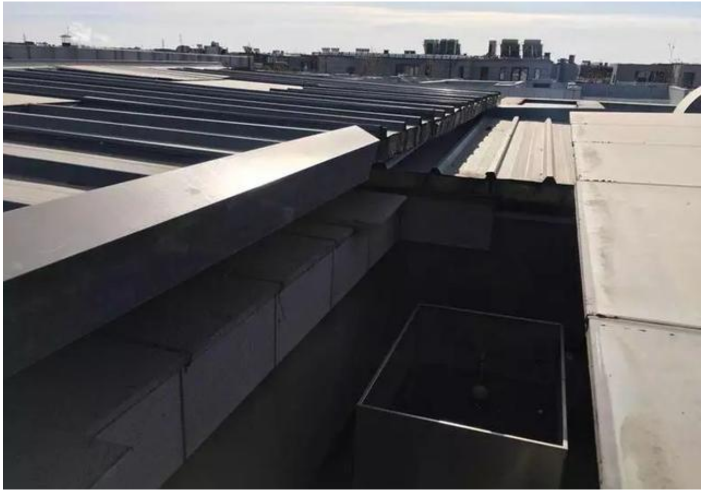


Fig 5.14: Rainwater collection system

Not only that, the Hutong kitchen No. 44 also pays attention to the sustainability of culture. Since the beginning of the restaurant, the ancient cooking method has become its own restaurant culture. Whether in cooking techniques or in the selection of ingredients, the ancient method is upheld. In particular, ingredients are traditionally hand-made, although the cost is high, but the taste is pure and does not need to be added. The inheritance of this old flavor is itself a continuation of the Chinese nation's diet culture.

Fig 5.15: Wild dried bamboo shoots

The ecological food cost is relatively high, and restaurants continue to create other service items to increase restaurant profits. For example, a small farmer's market, ecological soy sauce barrels that can soak in themselves, and natural feasts returning to the rural land. These activities better bring together consumers and make the No. 44 kitchen not just a restaurant. Still a sustainable lifestyle provider.

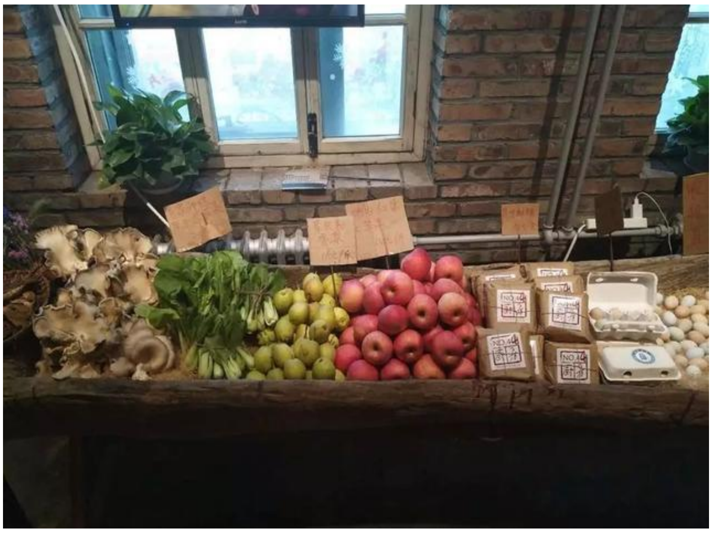


Fig 5.16: a small farmer's market in restaurant

5.3 GLOBAL BEST PRACTICES

5.3.1 GRA

The Green Restaurant Association (GRA) is a national non-profit organization that was started in 1990 to shift the restaurant industry to engage the global sustainability. For 26 years, the GRA has pioneered the Green Restaurant® movement. Using a transparent and turnkey certification system, The GRA has made it easy for thousands of restaurants to profit and successfully become more acidic sustainable.

The GRA has established Green restaurant certification standards. It examines the restaurants that apply for certification from the following seven aspects, and evaluates the stars and scores for the restaurant. Figure 6.17 is the score of Kitchen Sync.

1. Water Efficiency

2. Waste Reduction and Recycling

3. Sustainable Durable Goods & Building Materials

4. Sustainable Food

5. Energy

6. Reusables & Environmentally Preferable Disposables

7. Chemical and Surface Reduction

GREEN RESTAURANT® POINTS

Kitchen Sync

4 Star SustainaBuild™ Certified Green Restaurant®

Environmental Category	Points
Energy	215.46
Food	34
Water	33.25
Waste	64.75
Disposables	18.22
Chemical & Pollution	32.9
Furnishing & Building	38.72
POINT TOTAL	**437.3**

Fig 5.17: The score of Kitchen Sync

According to the official website of GRA, they promised to bring more economic benefits to the green restaurant. The specific way is reflected in:

1. Cost reduction: reflected in energy, water, waste disposal and employee retention. For example, Boloco restaurants achieved $2,000-$8,000 savings in annual waste

hauling fees at several locations with a GRA-designed recycling and composting program.

2. Increase customers: The survey results show that 79% of customers are more willing to patronize certified green restaurants.

3. Improve staff morale: According to the survey results, 78% of employees indicated that they feel more motivated to work in certified green restaurants;

4. Lead legislation: Recycling mandates, foam bans, lighting legislation, and hundreds of laws across the country affect restaurants. GRA develop solution strategies well in advance of laws and regulations, proactively helping restaurant stay ahead of legislation.

5.3.2 Legislation

Since the 1950s, Germany started exploring the use of kitchen waste to produce organic fertilizers, and in 1972 it promulgated the Waste Disposal Act. Japan's Food Recycling Law, which came into effect in May 2001, stipulates that catering companies must increase the proportion of food waste recycling to 20% within five years of 2001; catering companies are obliged to reduce the discharge of food waste. In addition to converting a part of it into feed or fertilizer, it is necessary to further develop other recycling technologies; companies that discharge more than 100 tons of food waste per year will be subject to corresponding penalties.

In order to maximize the effectiveness of various laws and regulations, foreign supervisory bodies follow the principle of transparency and give the public a high degree of supervisory power. In addition to supervision, foreign government agencies have also established clear incentive mechanisms to encourage catering companies to actively improve their operating conditions and promote the development of green catering.

5.4 CONSIDERATIONS AND DESIGN INSIGHTS

After analyzing the system design case of Macugnaga Restaurant, we can know that when designing the sustainable design of LOHAS restaurant using the systemic design method, we need to analyze the production process in the existing linear mode, and the decomposition of each production step to help to find out which design point to optimize. Consider the source of raw materials and local raw materials. Reuse the output generated in the process as much as possible. The reuse approach can be combined with other nearby systems to optimize the formation of the most efficient and sustainable system.

However, while referring to the case of Macugnaga restaurant, it is necessary to distinguish the commonalities and characteristics of the system. System design should be analyzed according to specific conditions. Our vegetarian restaurant system is different from the Macugnaga restaurant system. There are many differences. For example, the actual conditions vary, including venues, construction costs, facilities, etc. More importantly, the region of Macugnaga is located in Italy. This article studies the Chinese restaurants. Different regions will produce different sustainable solutions due to differences in natural conditions, regional culture and lifestyle.

In the experience of service design, we can know how to analyze and solve problems from the perspective of full-link. Among them, tools such as stakeholder maps and experience maps can be applied to the analysis of the LOHAS restaurant cooking process. And several key contact points can be selected to conduct specific program design on the discovered problems. The iterative idea in service design is also very enlightening, any design is constantly improving in continuous testing and iteration, including systemic design.

Some valuable design insights have also been found in some cases. For restaurants, many sustainable initiatives can be used to save resources and reduce waste. Although it has not been fully planned from a systemic point of view, many practices still have implications such as:

- Spread of ideas: Encourage customers to bring containers to buy products without packing boxes.

- Composting from kitchen waste and applying it to rooftop farms.

- Cooperation with local suppliers.

- Try to use products grown by local farmers.

- Build rainwater collection purification system and use rainwater for indoor temperature control.

- Create other service projects to increase restaurant profits and promote a sustainable lifestyle to the public.

- Cultural Sustainability

Some foreign institutions (for example, GRA) and some legislations have shown that foreign countries have already established more mature rules and practices in sustainable restaurants. However, Chinese people generally lack understanding of the sustainability of restaurants, and operators often start from commercial profits. Business interests and sustainability seem to be a paradox, but systemic design has the ability and potential to solve both problems simultaneously.

The catering industry is the first pillar industry in China's tertiary, and one of the fastest growing industries. At the same time, the catering industry is also an industry that brings with it a large amount of wastewater, waste gas and solid waste. In the future, it is hoped that China will also be able to specify sustainable standards and specifications for restaurants and conduct certification of sustainable restaurants so that the development of the sustainable catering industry will enter the normal track of development.

6 Systemic Design of Lohas

This chapter uses systemic design methods to re-plan the material and energy flow in the process. Qualitative and quantitative analysis of each step of the input and output, according to quality reuse of resources in the system. Establish links between resources and internal elements of the system, resources and the external environment of the system to maximize the use of resources, establish links with ecological farms, diners and homeless people, and strengthen the complexity and stability of the local circulatory system.

6.1 WATER SYSTEM

In the LOHAS kitchen process, different quality water resources were wasted in the vegetable cleaning and tableware cleaning steps. At present, there is only one cleaning tank in LOHAS, and the available space is limited. In the vegetable cleaning and tableware cleaning stage, there is no step-by-step cleaning. Only using the showering method to clean vegetables or tableware has caused a lot of waste and increased operating costs. The main components of the water for cleaning vegetables and fruits are: soil, vegetable and fruit crumbs, and pesticides; at present, the sources of fruits and vegetables cannot be traced, and the quality of fruits and vegetables is not stable. In the design of the system, the use of organic vegetables in local ecological farms is increased. When vegetables are soaked, a small amount of environmentally friendly enzymes are added, which can effectively remove the pesticide components in the wastewater during the washing of vegetable and fruit stages. The use of filtration equipment for simple filtration of soil and waste residue, the temporary storage of water resources for cleaning fruits and vegetables, recycling to the follow-up system, can effectively reduce the waste of water resources. The dishwashing water contains kitchen waste, oil, spices and chemical cleaners. The quality of the waste water is low.

In the systemic design, the cleaning steps are subdivided into three steps: soaking, cleaning and showering. In the soaking stage, use natural detergents, such as the rice water or eco-friendly enzymes produced during the cleaning step of the preparation stage, instead of chemical detergents to clean the dishes. At the same time, the water used to clean the fruits and vegetables is circulated and used for initial soaking and scrubbing of the dishes to remove most of the grease and food waste; the second step is to do second clean by the higher quality water, and then to shower and place. The analysis of the kitchen water circulation system is shown in Figure 7.1.

By redesigning the water system, subdividing the cleaning steps, recycling high-quality water resources, and using natural detergents instead of chemical detergents, it not only protects the urban groundwater environment, but also saves water resources and restaurant operating costs.

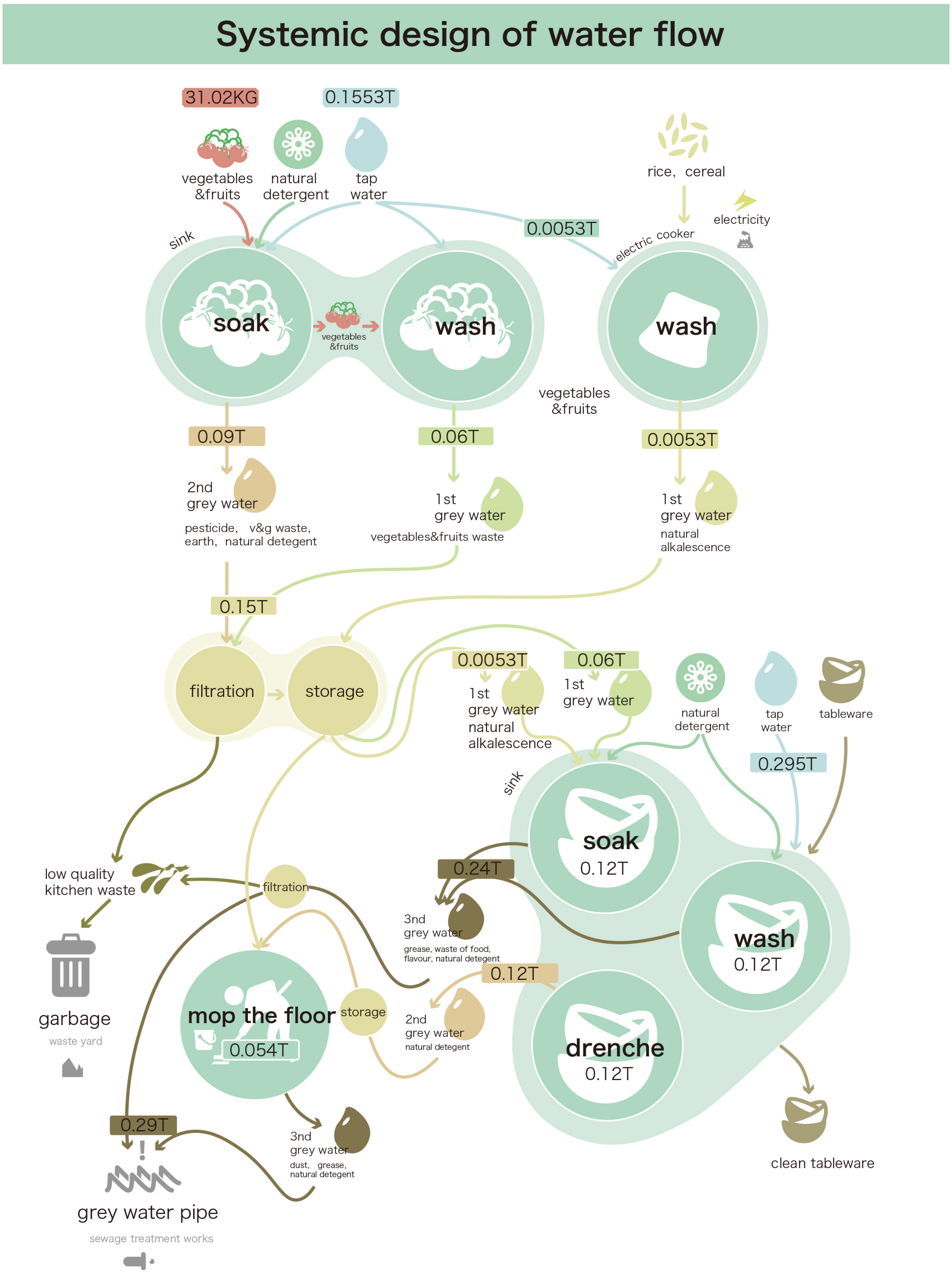


Fig 6.1: Systemic design of water flow

6.2 WATER QUANTITY AND ECONOMIC ANALYSIS

Compared with single sink cleaning, using double-sink in the restaurant can save 48% of water as long as the amount of vegetables washed exceeds 200kg. LOHAS consumes 930.6kg of vegetables per month. If using double-sink to wash vegetables, the monthly consumption of water for cleaning vegetables is 48% of now.

The average daily consumption of water for cleaning vegetables is:

$0.307*48\% \approx 0.15t$

Compared with linear system, systemic mode saves water:

$0.307-0.15=0.157t$

In the systemic design, the water immersing the vegetables can be used to clean the ground after simple filtration, and the water quality of washing vegetables is higher, and it can be used to wash tableware. Soaking and rinsing vegetables is roughly 6:4. Then:

The average daily consumption of water for soaking vegetables is:

$0.15*0.6=0.09t$

The average daily consumption of water for rinsing vegetables is:

$0.15*0.4=0.06t$

The step of cleaning the tableware in the restaurant is carried out step by step, which can greatly reduce the water consumption washing dishes. At LOHAS, there were an average of 40 guests per day. A total of about 40 sets of cutlery, 50 plates and 30 small casseroles, and a number of kitchen cooking utensils were washed and cleaned. According to research, the average water consumption of each small tableware is about 0.4L at each step, a good amount of water for large tableware is 0.6L, cooking utensils is about 25 pieces, and the specific amount of pot cannot be soaked in the cleaning pool. It will be calculated separately.

The average water consumption for each step of washing dishes is: (40*3+50+25)*0.4+30*0.6=96L

The total amount of water needed to wash dishes is: 96*3=288L

The restaurant cleans an average of 8 pots, 2 rice cookers, and 1 soup pot every day. The soaking method of the pots is to put the water containing the natural detergent into them, soak it for a moment and then wash and rinse. Each step uses about 1/3 of the volume of the pot.

The water consumption of the cleaning pot is:

8*7.48+2*4+7.96=75.8L

After optimizing the restaurant water circulation system, the daily water consumption of the tableware and cooking utensils is:

75.8+288=363.8L=0.36T

Compared with the linear system, the daily savings of water resources:

4.27-0.19-0.157-0.36=3.753T

The total monthly savings:

P=3.753*4.6*30≈517.9 Yuan

According to research, the restaurant's medium-sized double-sinks range from RMB 200 to RMB 500. The use of double-sinks not only saves water resources, but also saves

RMB 498 per month. From a long-term perspective, use double-sinks will effectively reduce restaurant operating costs.

As shown in Figure 7.1, two actions are added to the systemic design of water resources: filtering and storage. Because most of the cleaning work is done in the sink, only one filter is needed at the sink to achieve filtration of vegetable residues and food residues in the waste water. The cost of the simple filtration device is about RMB 30; in the new system, the recycling of two kinds of quality water resources is realized. The water soaked in fruits and vegetables may contain some pesticides and soils, and the safety is not guaranteed. It can only be used to clean the ground. The filtered water of washing fruit and rice is basically free from impurities after being filtered, and the rice water is a natural detergent, and can be used for soaking tableware to remove most of the grease on the them.

Daily 1^{st} recycled water production is approximately:

0.06+0.0053=0.0653T=65.3L

Ane it need about 80L containers to store 1^{st} recycled.

Daily 2^{nd} recycled water production is approximately:

0.09+0.12=0.21T=210L

And it need about 220L containers to store 2^{nd} recycled water.

Each container cost price is about 60 yuan, the cost of buying two storage container is: 60*2=120 yuan

The cost of water cycle renovation at LOHAS is:

30+200~500+120=350~650 yuan

6.3 KITCHEN WASTE SYSTEM

Based on the previous analysis, we can see that at present, LOHAS currently produces about 5.6kg of vegetarian kitchen waste per day. The content of waste is mostly fresh fruits and vegetables leaves, and the quality is high. However, due to inaccurate classification, the recycling rate is low. In the systemic design, food and kitchen waste is classified into: 1st fresh vegetable and fruit waste, 2nd fresh vegetable and fruit waste, 1st food waste, and 3rd kitchen waste. Separately recycle these wastes to maximize food waste utilization.

- **1st fresh vegetable and fruit**

1st fresh vegetable and fruit waste are mainly fruits and vegetables that are not very good in terms of taste, or not looks very good, but it does not affect the portion consumed. Fruits and vegetables that are not very good in appearance can be used to make meals for staff. Fruits and vegetables that are not very good in taste, such as broccoli stems, can be used as a daily special dish and sold at a lower price. Through the platform to convey to the diners the idea of reducing waste, teach diners how to cleverly use fruits and vegetables, and help establish a brand image for LOHAS. If the order quantity is small, it can be used as 2nd fresh vegetable and fruit waste recycling.

- **2nd fresh vegetable and fruit waste**

The main content of 2nd fresh vegetable and fruit waste is high quality fresh fruit and vegetable crumbs, which can be used to make environmental enzymes. Environmental enzymes are actually biological enzymes that accelerate the chemical reactions in the natural world. The main component is protein.

The production of environmentally friendly enzymes is simple. Environmental enzyme production is simple. It is a brown liquid obtained by fermenting brown sugar, water, fresh vegetable and fruit waste according to 1:10:3 ratio and fermenting in an anaerobic environment for 3-6 months. It is also called Garbage Enzyme.

It can be used as a natural cleaning agent to remove oil stains. Eco-enzyme slag is rich in nutrients and can be used as a fertilizer to nourish the land. In LOHAS, 1st fresh vegetable and fruit waste has a daily output of 3-5kg. If it is made into environmentally enzyme and sold as a substitute and by-product of chemical cleaning agents. It can effectively use food waste, reduce waste, protect the environment, and increases economic income and establishes a brand image.

Residues of enzymes left over every three months can be transported to ecological farms to grow vegetables as natural fertilizers to improve the land environment. It is best to use plastic bottles of 6L or more that have good sealing properties for the production of enzymes. The fermentation needs to retain 20% of the space to prevent the yeast from overflowing during the fermentation process and affect the quality of enzymes. Such plastic bottles can be collected by diners, using the points system to offset some of the catering expenses. On the one hand, it strengthened the interaction between LOHAS and diners and played an advocacy role. On the other hand, diners are included as participants, not just consumers. They come into the entire system, and enhance their environmental awareness.

- **1st food waste**

1st food waste are kitchen meals that are not eaten by diners. These leftovers were not contaminated, simply because the psychological aspects of the consumer were discarded directly. Such leftovers are packaged and can be placed in community refrigerators for homeless people near the community.

- **3rd kitchen waste**

3rd kitchen waste is low-quality kitchen waste containing 80 to 90% of water, containing a large amount of vegetable oil, seasoning and food residues. This type of kitchen waste can be used to compost food in the restaurant. After successful composting, it is transported to ecological farms to nourish farmland. The vegetarian food waste systemic design is shown in Figure 7.2.

Systemic design of Vegetarian waste

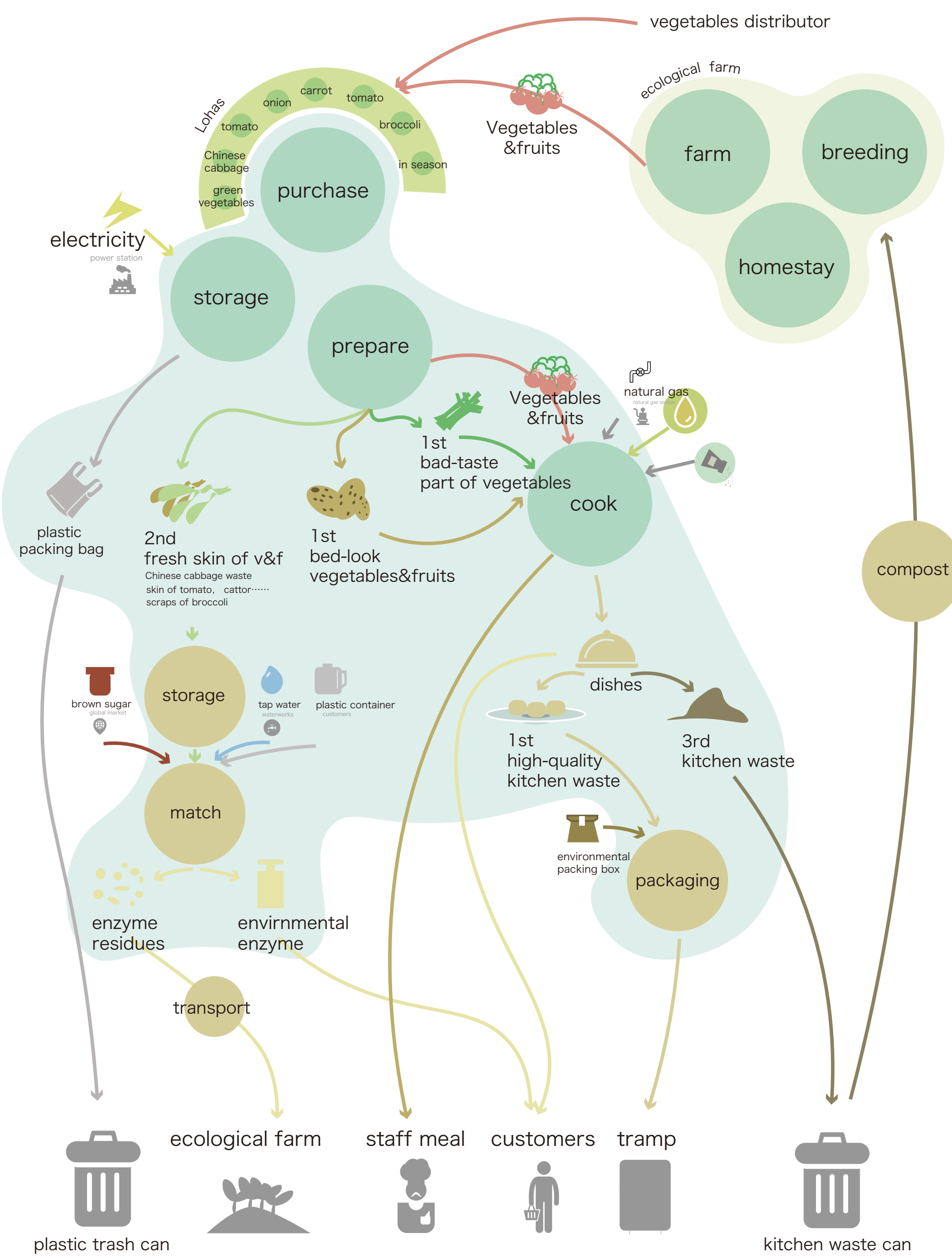


Fig 6.3: Systemic design of vegetarian waste

6.4 KITCHEN WASTE SYSTEM ECONOMIC ANALYSIS

The average daily consumption of fruits and vegetables will not change in the restaurant with the same amount of hospitality. The cost of buying vegetables is determined by the price of seasonal ingredients purchased from ecological farms and vegetable distributors:

P (vegetable cost) = P (ecological farm price) + P (distributor price)

After the systemic designed, the total amount of fruits and vegetables that flowed into the system does not change. The ingredients that enter the cooking step add with the part of poor taste and the part that had poor quality. Compared with the linear system, the staff meal and recommendation dish are increased. The total amount of cooking fruits and vegetables will be >25.42kg. Uneaten dishes are divided into 1st fresh vegetable and fruit and packaged into community refrigerators and distributed to homeless people. The rest of the unrecoverable portions are converted into food waste and transported to ecological farms for composting.

After the systemic designe, the total amount of restaurant-kitchen waste will be < 5.6 kg. The specific total amount depends on the daily business situation. According to the survey, the recommended price of 1kg of organic fertilizer produced from composting is 60 yuan. If the compost material sold to ecological farms is priced at 20 yuan, and the vegetarian food waste from LOHAS is at least 3 kg per day. Then it will sell compost every day and the income is:

P (sells compost material) = 20*3 = 60 yuan

The monthly income of selling compost materials is: 60*30=1800 yuan

Through the systemic design, the restaurant can use at least 3kg of fresh fruit and vegetable waste each day to make environmental enzymes. The ratio is brown sugar: vegetable waste: water = 1:3:10. The density of water is 1 g/m3, and 1 kg of water is one liter of water. When fruits and vegetables are soaked in water, they are mostly floating, so the density of fruits and vegetables can be approximated as 1g/m3. Since fermentation requires at least 20% of the space, the size of the container needed to ferment 3kg of kitchen waste is approximately:

$V \geqslant (10+3)/0.8 \geqslant 16.25L$

In addition to the first three months, LOHAS will produce 16.25L of environmentally friendly enzymes and at least 3kg of enzyme slag every day. The price per liter of eco-friendly enzymes is 30 yuan. In addition to the enzymes used by LOHAS, the restaurant can make a profit every day by selling Eco Enzyme 15L:

15*30=450 yuan

Calculated on a monthly basis for 30 days, the monthly profit is:

450*30=1350

The transportation and combustion of gas will generate waste of resources and pollution. It is not as environmentally friendly as natural gas. The price of Shanghai Gas is 3.8 yuan/m3, and the price of natural gas is 2.5 yuan/m3. If it is replaced with natural gas, the monthly burning cost is:

$P(\text{natural gas}) = 250*25/38 \approx 164$ yuan

Monthly savings:

P=250-164=86 yuan

Because the cost of purchasing ingredients cannot be determined, after the systemic design, the restaurant can save at least 86 yuan in gas costs per month and receive 1,350 yuan in sales of environmentally friendly enzymes and compost materials.

6.5 SYSTEMIC DESIGN OF LOHAS

After systemic design, the LOHAS kitchen process diagram is as follows:

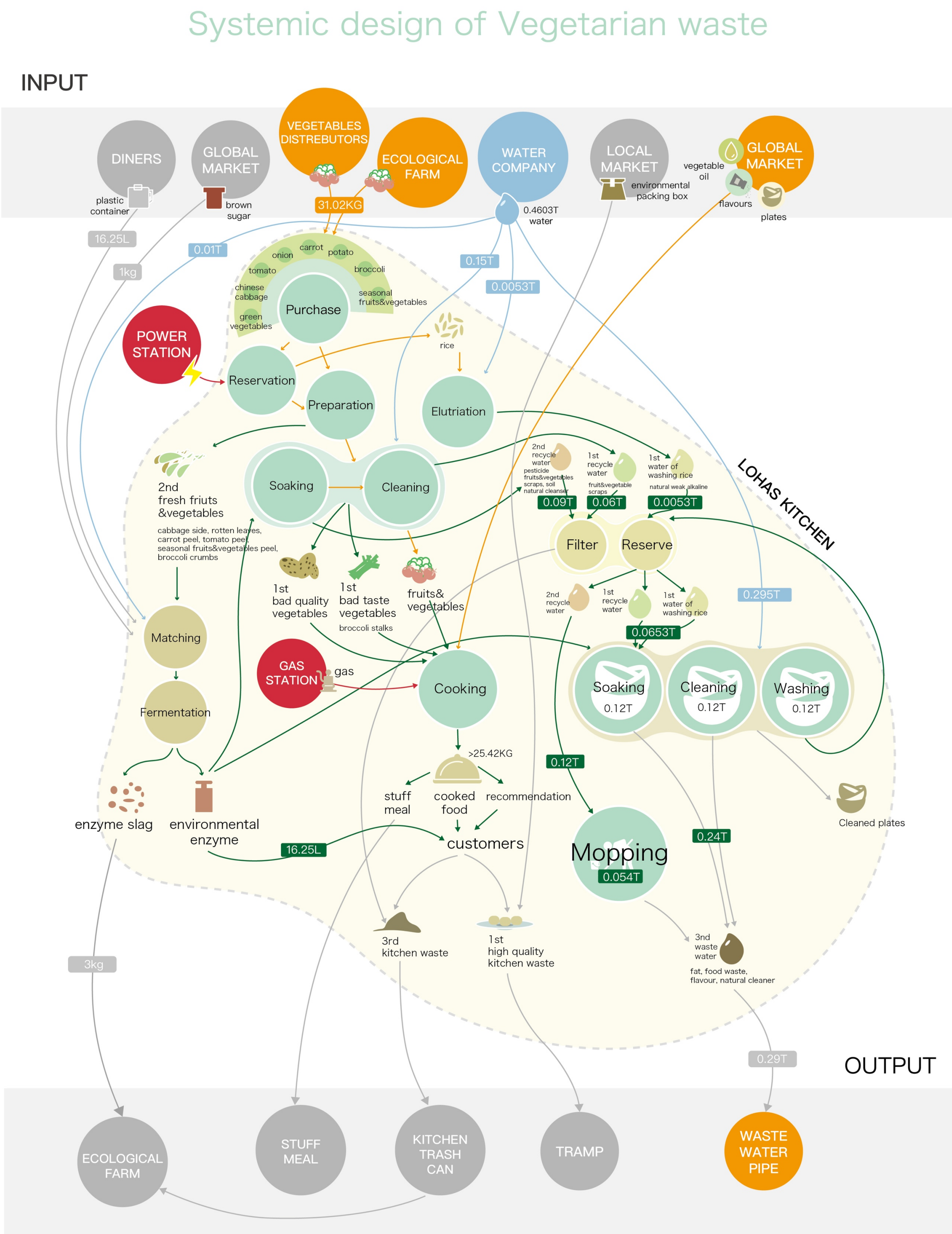


Fig 6.4: Systemic design of vegetarian waste II

6.6 ECONOMIC EVALUATION

After systemic design, the LOHAS kitchen system had maximized the use of water and vegetarian resources and achieved zero waste. The daily water consumption of LOHAS is reduced from 4.27T to 0.46T, which saves 3.61T of water resources per day, saving water bills per month:

P=3.61*4.6*30≈498 yuan

By maximizing the use of vegetarian resources, LOHAS can save at least 86 yuan in gas costs per month, and increase1350 yuan income of selling environmentally enzymes and compost materials.

In order to achieve systemic design, LOHAS will need to purchase 30kg of brown sugar per month for the production of enzymes and 100 green packaging straps for food packaged for homeless people. According to research, the price of 1kg brown sugar is about 30 yuan, and the price of 100 kraft straps is about 60 yuan. Then the monthly increase in the cost of LOHAS is:

P=60+900=960 yuan.

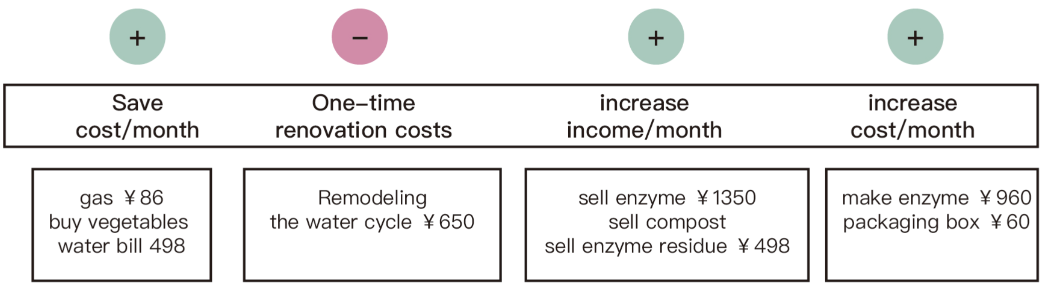


Fig 6.5 Expenses and Benefits Change Form After Systemic design

Assuming that the daily turnover does not change in LOHAS, the first month will need to pay for the renovation. In the first three months there will be no enzyme or enzyme slag, so the first month's economic benefits are:

P=50000-11000-164-1000-340-7091-30000-650-60+1800=1495 yuan

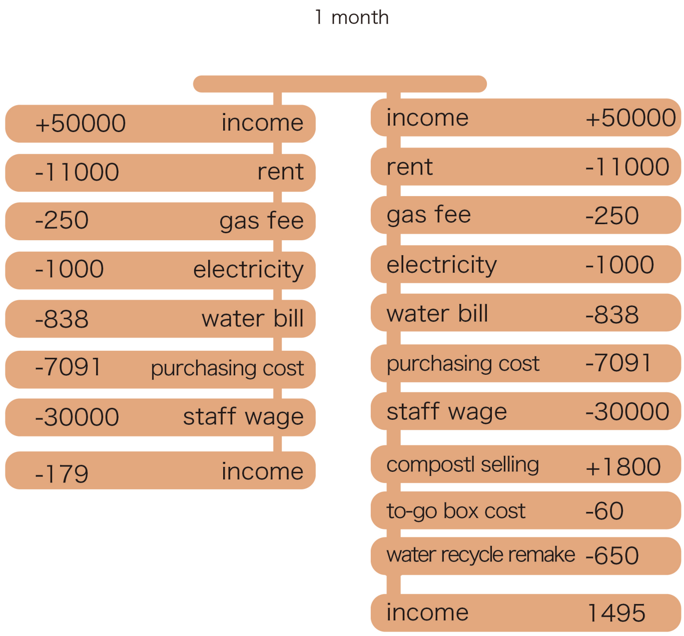


Fig 6.6: 1 month economic benefit assessment of LOHAS system design

Three months later, the production of enzymes and enzyme slag began. The economic benefits are:

P=50000-11000-164-1000-340-7091-30000-960-60+1350+450+1800=2985 yuan

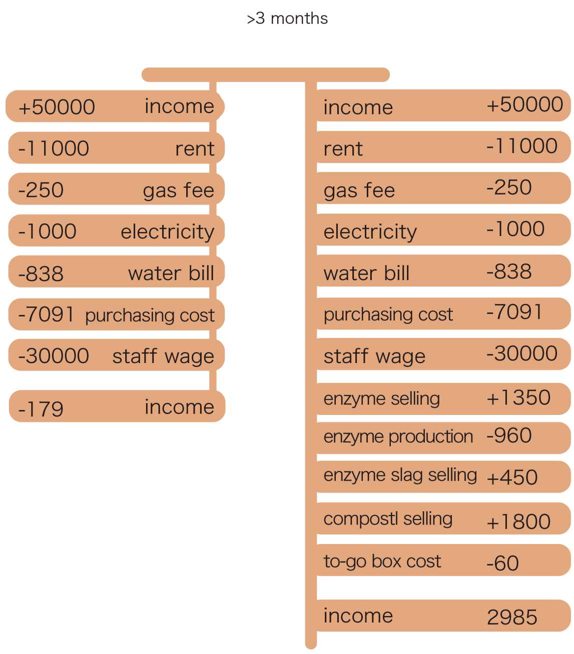


Fig 6.7: 3 months economic benefit assessment of LOHAS system design

The systemic design will maximize the use of LOHAS resources and strengthen the link between LOHAS and the local ecology while changing the single business model and effectively improving the economic efficiency. This chapter conducts a quantitative economic evaluation of the optimized system and compares it with a linear system to quantify the system design results.

7 SERVICE DESIGN OF LOHAS

Based on the needs of a systematic system, this chapter puts forward optimization suggestions for LOHAS kitchen space and improves staff efficiency. We also designed an enzyme production kit and customer scorecard to help staff quickly learn enzyme preparation methods and complete enzyme examinations. Encouraging consumers through the scorecard, and as a member of the system to join the systemic cycle to enhance environmental awareness and strengthen their association with the restaurant.

7.1 SYSTEM MAP

In the linear system, stakeholders directly associated with LOHAS are:

- Fruit and Vegetable Distributors and Global Markets

- Energy company

- Consumer

- LOHAS staff

In a linear system, there is only a simple exchange of material and economic interests among stakeholders, and there is no circulation loop between them, and the system is relatively single. The material, capital, and information flows between these stakeholders are shown in Figures 7.1:

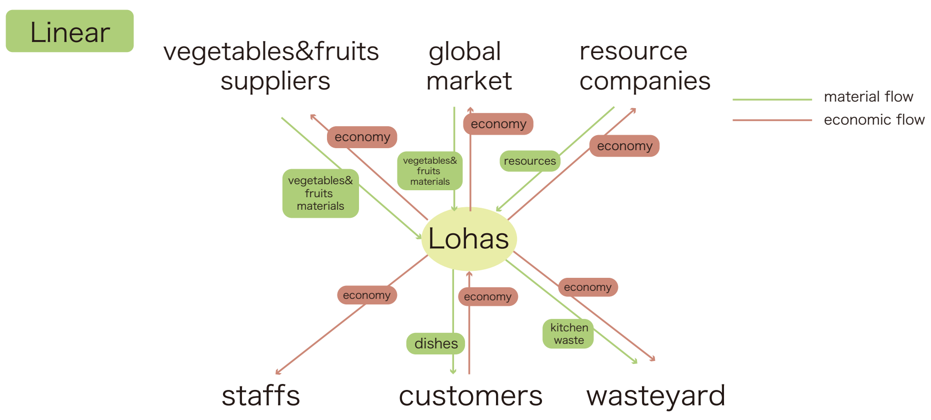


Fig 7.1: The system map of LOHAS in linear mode

In the systemic mode, LOHAS realizes the internal material circulation and maximized the use of resources. At the same time, stakeholders have increased:

- Ecological Farm

- Tramp

It increases links with local businesses. There is not only an economic connection between ecological farms and LOHAS, but also a model of exchange of goods. When LOHAS sell self-made eco-friendly enzymes and compost materials to eco-farms, it deducts some of the prices for local seasonal fresh vegetables, which not only ensures the quality of fruits and vegetables, but also reduces operating costs and achieved a win-win situation. As a platform for LOHAS, it can provide more tourists for eco-farms by promoting eco-farms to diners. As a vegetarian restaurant, diners can enjoy healthy food and enzyme products while enjoying food in it. LOHAS also promotes systematic thinking and environmental protection awareness to diners and enhanced diners' personal environmental awareness. As a member of the system, consumers realize a virtuous cycle of the local system. The material, capital, and information flows between these stakeholders are shown in Figures 7.2:

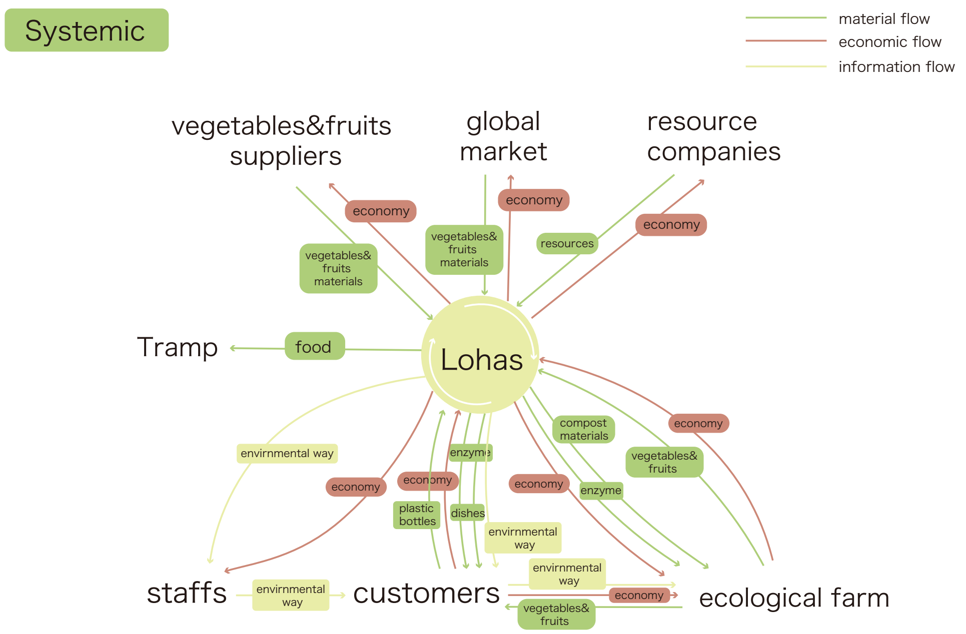


Fig 7.2: The system map of LOHAS in systemic mode

7.2 WORKING FLOW IMPROVEMENT

Through the systematic design of the kitchen process of the LOHAS Vegetarian Restaurant in the previous chapter, the system achieved “zero emission”. In this chapter, according to the LOHAS staff's operation process, we propose reconstruction suggestions for LOHAS kitchen space planning.

According to one-day observations and interviews, there are three most frequent tasks: cooking, cold dishes making, and fill bowls with rice. Staff cooking process is: get the ingredients – rough processing - cleaning - cutting - cooking - dishing up – serving. cold dishes production process: get the ingredients - rough processing - cleaning - cutting - dishing up – serving. Fill bowls with rice flow is: to get rice – put it in utensils – washing - steaming – dishing up – serve. Due to the compact space in the kitchen, and not arranged according to the work process, the staffs are move frequent in the kitchen. The efficiency is very low. The longest time-consuming processes: rough processing, cutting and dishing up are gathered on one work bench.

And the workers are more gathered on one side of the kitchen and are very crowded. LOHAS linear process and spatial relationship as shown below:

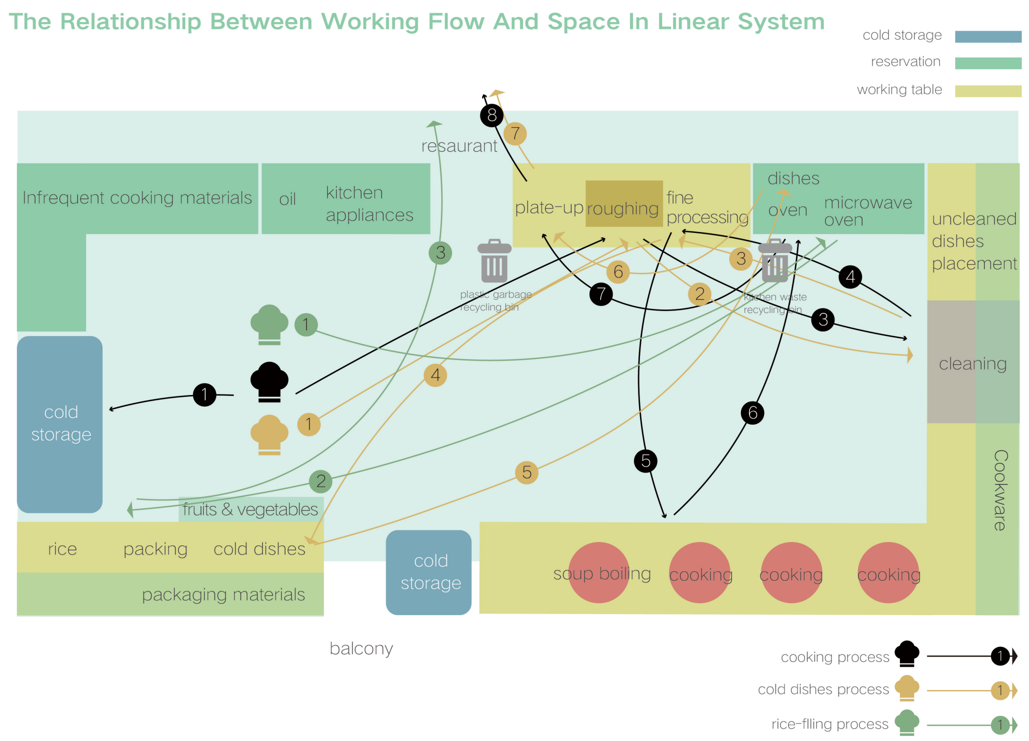


Fig 7.3: The working flow and space in linear mode

As shown in Figure 7.3, the number of dishes in the kitchen is high, but the trays in the linear system are set aside the clearing pool in the kitchen. It has been observed that when the kitchen is busy, the staffs often collide, the efficiency is not high and the operation is not easy. The other side of the kitchen is only involved in the storage of food ingredients, cold dishes production, filling bowls with rich, the space utilization is low. The linear system classification trash cans are placed on both sides of the rough processing table, the left side is used for disposing plastic waste, and the right side is used for discarding food waste. However, according to our observation, since plastic waste is generated during food storage and rough processing, these two steps are closer to the left trash can, and the probability of plastic waste being discarded is less. There are many steps in kitchen waste production, and they are relatively scattered, with a high probability of misplacement during busy hours.

In a systemic mode, the restaurant's workflow is changed. The main process of staffs is: taking material – rough processing - soaking - cleaning - cutting – cooking - dishing up – serving. In order to achieve recycling of water resources, the restaurant needs to be replaced with double-sinks to increase soaking and cleaning steps. The water used for soaking and rinsing is directly into the sewer. The other side sink which is used for washing and showering, there is 8L recycling bins placed under, for recovery the 1st recycled water in the sink.

The process of filling bowls with rice: get rice - put it into utensils - washing - cooking – dishing up. In the systemic mode, rice water and 1st recycled water are simultaneously used in the steps of soaking and washing the dishes, so the rice water is poured into the washing and showering sink for directly recycling. The utensils used for cooking rice are placed beside the rice cooker, because it's easy to pick up.

Restaurant food waste classification according to the quality of food waste, it is divided into three categories: 1st vegetables and fruits waste, 1st food waste, and 3rd kitchen waste. In order to ensure the sanitation of the 1st vegetables and fruits waste, they should be placed directly in the packing box after processing. The kitchen should place three 3L trash cans by color, an orange can should be used to place 3rd kitchen waste. And it is placed on the left side of the kitchen. The other two green trash cans are used to recycle the fresh fruits and vegetables waste. Besides, we icons on them so that staffs can distinguish them easier.

Space renovation according to the cooking process, the positions of the trays and the most used materials were adjusted to reduce the operation steps and improve the operating efficiency. According to the needs of systemic mode, the systematic transformation of space is shown in Figure 7.4:

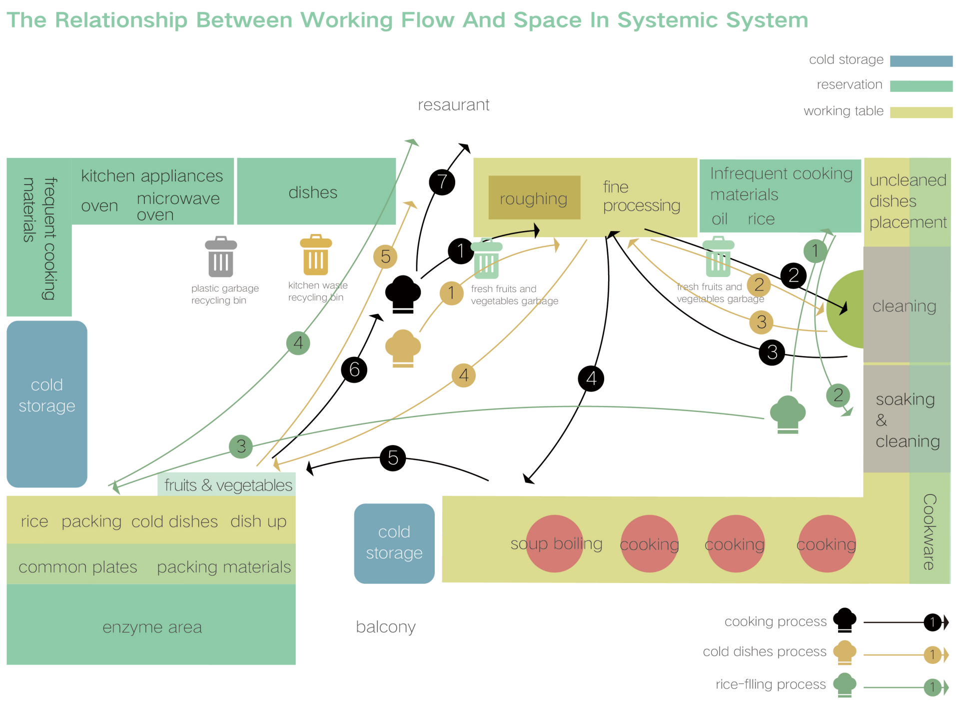


Fig 7.4: The working flow and space in systemic mode

7.3 ENZYMES RELATED PRODUCT DESIGN

Eco-friendly enzymes are also known as Garbage Enzymes. It is produced by matching the ratio of water, fresh vegetable peel and brown sugar to 10:3:1 and fermenting in anaerobic environment for 3-6 months. It can be used as a cleaning agent and deodorant. It can also purify the water environment and accelerate the decomposition and recycling of the material. Fermented enzyme slag can also be used as a fertilizer to improve soil quality and increase crop nutrition. Enzyme production is relatively simple, the main steps are: chopping material - looking for containers - matching - inspection - completed. But need to pay attention to the following points:

- The fresh fruit and vegetable skin rubbish is best chopped to ensure fermentation efficiency.

- The filling cannot exceed 80% of the volume. The container is preferably made of plastic and has a certain elasticity to prevent explosion during fermentation.

- During the first 1-2 weeks of fermentation, the state of the container needs to be checked. If the container deflate, it needs to be deflated to ensure safety.

- If there is blackening of the liquid during the fermentation process, brown sugar must be added to continue the fermentation until a white float appears in the liquid.

At LOHAS, the mobility of the staffs is relatively large. In order to help the staffs to make eco-friendly enzymes faster and easier, this chapter will design ancillary products based on the needs of the system and the habits of the staffs.

7.3.1 Stakeholders map of Enzymes manufacture

- LOHAS Staffs

The staffs at LOHAS are the executor of enzyme production and are responsible for the entire process of enzyme blending, filling, and checking. Staffs need to be familiar with the enzyme production process and be able to examine the issue of enzymes in stages to ensure the quality and safety of enzyme production.

- LOHAS Consumer

At LOHAS, consumers provide plastic containers for enzyme production and obtaine points. Then use points to purchase LOHAS products.

- Ecological Farm

Eco-farms act as consumers in the production of enzymes, purchasing enzyme products and enzyme slags from LOHAS. In the process of enzyme production, only economic and information are exchanged with LOHAS.

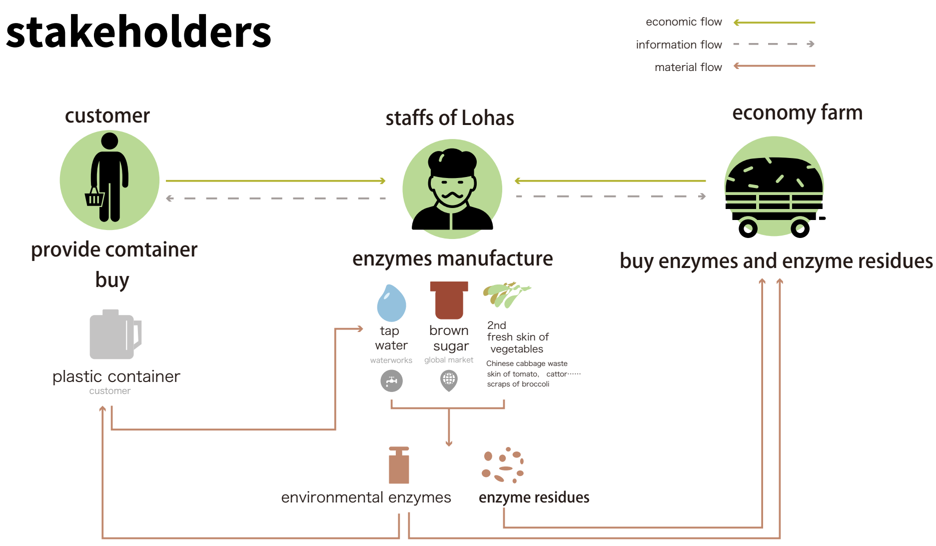


Fig 7.5: Stakeholders map of enzyme production in LOHAS

7.3.2 Functions analysis of cards

The stakeholders associated with the enzyme production process are: LOHAS workers and consumers. Through the enzyme production cards to help staffs quickly learn enzyme production and examination of it. Point cards will record consumer donation and deduct a portion of consumption. And to cultivate consumer's awareness of environmental protection, and strengthen the association of consumers and LOHAS. According to the enzyme production process and consumer spending steps, we use blue print method, which from service design tools, to analysis the functions of cards.

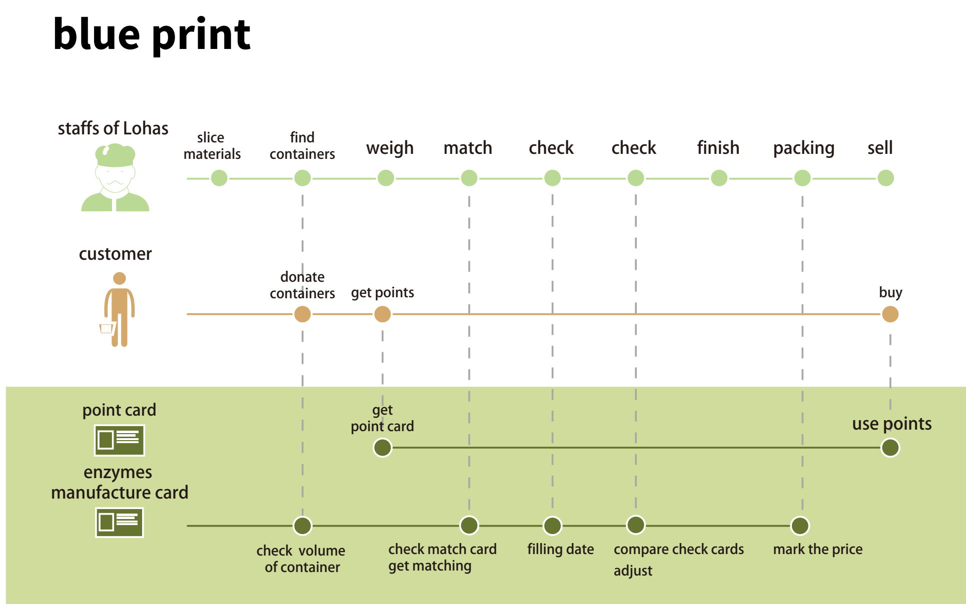


Fig 7.6: Functions analysis of cards

7.3.3 Enzyme production card and points card

The main functions of the enzyme production card are as follows:

- Process guidelines

- Container and Matching Guidance

- Status check card and related instructions

- Marking time

- Price

Enzyme production main card is shown in Figure 7.7 and 7.8, the main card for the enzyme production process guide and record the date. The relationship between the container and the ratio and the common ratio help the staff to complete the ratio.

The additional card is shown in Figure 7.9. There are 5 parts, which are used to compare and record 5 results of the check. They are connected to the straps and can be tied to the enzyme container bottle for easy inspection. When the first check card is used when complete the enzyme ratio, then the staff needs to fill in the details of the matching date, number, and ratio, and at the same time remind the staff to check the bottle body and enzyme status; The 2-5th cards are used to record the inspection results of different periods. The color cards on the 3-5th cards show the state of the enzymes by comparing with the color of the liquid in the bottles, reminding the staff to adjust them in time.

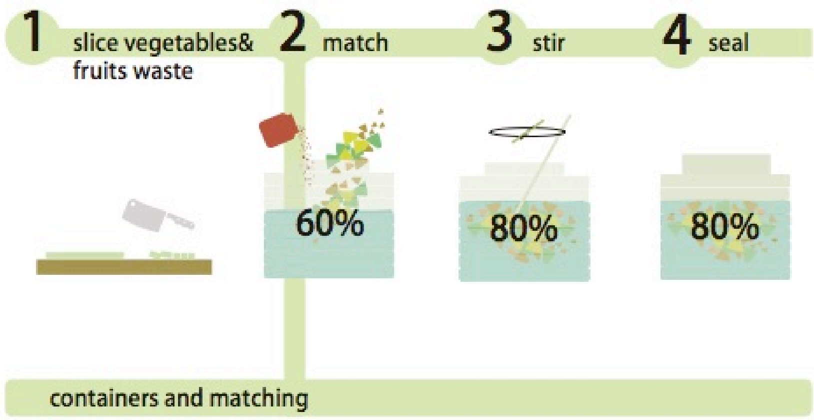
Point card functions:

- Explanation of rules

- Points record

enzymes manufacture card - main card

enzymes manufacture card - main card



x	0.6x	0.06x	0.18x
17L	10L	1KG	3KG
18L	10.8L	1.08KG	3.24KG
19L	11.4L	1.14KG	3.42KG
20L	12L	1.2KG	3.6KG
25L	15L	1.5KG	4.5KG

according this table to match

Fig 7.7: Enzyme production main card I

enzymes manufacture card - main card

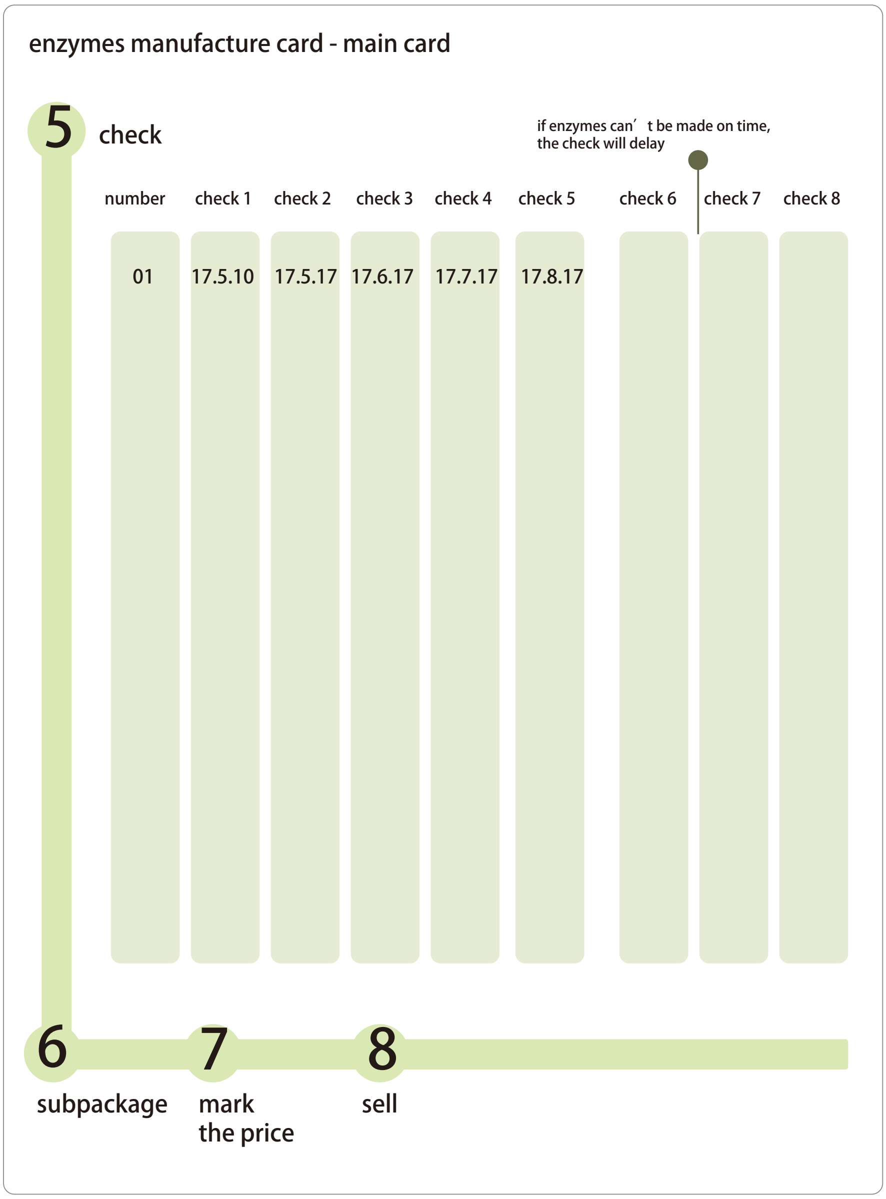


Fig 7.8: Enzyme production main card II

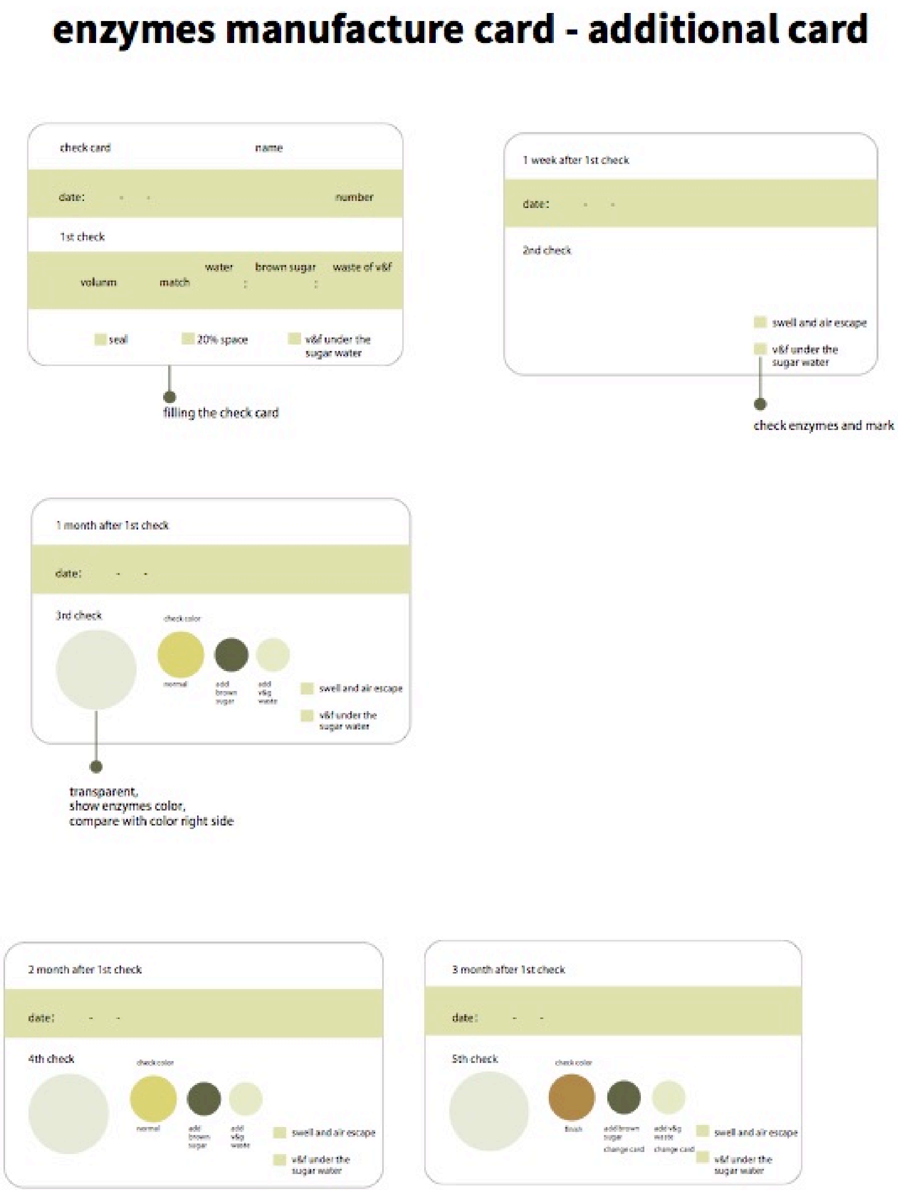


Fig 7.9: Enzyme production additional card

The straps of the cards are glued on the back and can be fixed on the enzyme bottle, which is convenient for timely inspection and recording. There are expansion warning structures on both sides of the straps. The expansion structure is composed of two paper snap structures. When the bottle body is in a normal state, the two structures are close together, and the middle red structure will not be exposed. If the bottle swells, it pulls one end of the strap to expose the red part of the clip. The longer the red part is exposed, the more inflated the bottle is, and the staff is reminded to release air in time to prevent accidents. The state after installing check card and structure of expansion warning are shown in Figure 7.10:

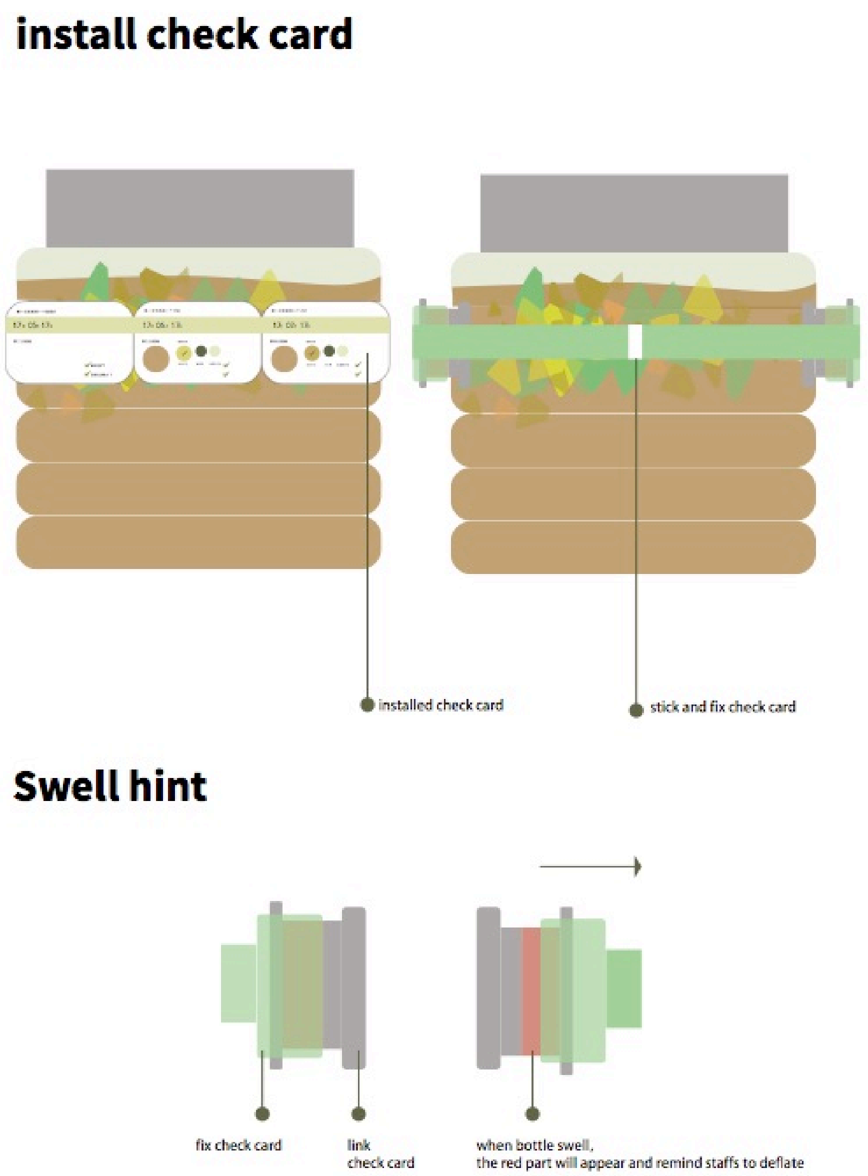


Fig 7.10: Install check card and swell hint

After the enzyme is produced, the staff needs to carry out secondary packaging of enzymes. The large bottle of enzyme is packed into containers of various sizes, filling in the packaging date, capacity and retail price to facilitate sale.

LOHAS uses points card to encourage consumers to participate in the circulatory system. According to the size of the bottle donated by the consumer, the score is integrated and marked. When the points reach 8, the consumer will enjoy a discount for any consumption in the store. The points card for consumers is as follows:

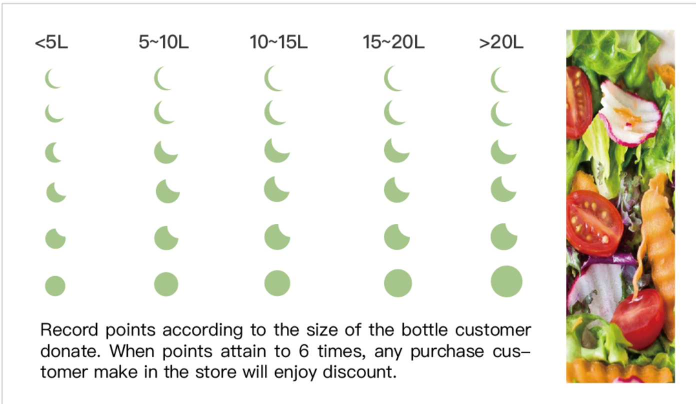


Fig 8.11: Point car

8 SUMMARY AND OUTLOOK

8.1 SUMMARY

This article complements the other two articles and proposes a complete vegetarian restaurant kitchen system model. Systematic thinking and system design methods are used to redefine system procedures, optimize system processes, recover and utilize different quality water and kitchen waste resources, and maximize resource utilization and “zero emissions” in the system. And through the quantitative calculation of economic benefits to quantify the systematic design results, with theoretical and practical significance.

After presenting a new system model, this article also explores how the system actually works. With this system as the background, the people in the system are analyzed. Combined with service design methods and tools, some contact points and pain points in the process are analyzed, and more specific improvements in the system are proposed. In addition to this, a more in-depth design of the enzyme product was made, which improved the system's feasibility and completeness.

This article is based on the characteristics of the region of Shanghai, China, and is a novel attempt to apply the system design. This article's exploration method can provide reference for the processing of kitchen garbage in other small and medium-sized restaurant industries. Due to the different realities and audiences of different systems, the resulting system models and solutions will be different.

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 single profit model of the enterprise, but also changed the role of the consumer. It involved the consumer as a member of the system to participate in the system cycle, making all the substances in the system can be fully cycled. Systemic design builds a complex network of consumers and businesses, corporate and local environments, and companies and related companies, achieving system stability and balance.

8.2 OUTLOOK

Systemic design is a developing discipline, and related theories and practices are still being explored. Although this article has carried on the relatively complete investigation, the analysis and the design to the restaurant kitchen flow. It still has many questions to be solved and improved. This paper is flawed in the following areas and can provide suggestions for future research:

The system model proposed in this paper is based on the actual situation under the guidance of the systemic design methodology. Although the design is based on reality, there is no condition for the system model to be tested in practice. It still remains at the theoretical level, there are gap between ideals and reality. Systematic study is complex and dynamic. The optimization of the system requires dynamic tracking and constant adjustment.

Although this article has analyzed and designed some points in the system model, but limited to our time and energy, we only chose the kitchen process and a related product in the system to do more in-depth design. If want to make all aspects of the system truly effective from a design perspective in the future, can also combine in-depth design with visual design, environmental design, and service design, etc.

The operating conditions of the restaurant are affected by the season, and the operating data of restaurants at different times will be different. This study takes the winter kitchen system as the research object, and cannot fully examine and study the differences and problems that the system shows in the four seasons. In addition, the ecological farm that was co-operated by LOHAS was still under construction. This study failed to obtain detailed data and proposed a cooperative cooperation plan based on the characteristics of the ecological farm. In the subsequent work, we will continue to maintain communication with LOHAS and the head of the ecological farm and do more in-deepen research.

The systemic design is based on the system theory of the system design method. It is different from the local solution based on the linear system. It pays more attention to the nature of the problem. Systemic 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 is unwarranted and isolated. Interdisciplinary thinking and application of system design will bring new possibilities for the solution of social linear system problems.

ACKNOWLEDGEMENTS

During my master study period, I experienced the first year of busy and full-fledged studies, the second year of studying as exchange student in Italy, the third year of job hunting and graduation thesis. In an instant, three years passed in a hurry. I have completed my master study. These day with hardships and joys will come to an end. My heart is filled with emotion.

Thanks to Prof. Luigi Bistagnino, professor of Systemic Design at the Politecnico di Torino. His rigorous attitude and strict requirements help us understand the theory and methods of systemic design. Thanks to Professor Peruccio, who has been helping us all the time. Thank you for the classmates I met in Italy, and miss the time when we were working together.

I am grateful to the Tongji University for providing me with valuable resources. It is precisely because of the opportunity for exchanging to abroad. I have the privilege of going through a one-year systemic design major at the Politecnico di Torino, Italy, which has opened up my design thinking and vision.

Thanks for my parents who care for me all the time!

I hope I will go with nutrition from Politecnico University and go better and better.

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