



PARADIGM SHIFT FROM INCINERATION TO RESOURCE MANAGEMENT, AND TOWN DEVELOPMENT: THE CASE OF OKI TOWN

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This case study identified the following factors as critical for replication:

- ❖ Paradigm shift in change from waste management to resource management, as well as in town revitalisation
- ❖ Step-by-step formulation of policies and strategies in the decision-making process
- ❖ An initiative under the leadership of local government, while supported by a holistic, community-based social system
- ❖ Formation of a visible “loop” of “materials”, “finance” and “people” that takes advantage of all available local resources, and circulates within the region
- ❖ Cross-linkage of human waste treatment and waste treatment
- ❖ Challenge to continuously reframe and reconstruct processes for initiatives

1. OVERVIEW

Cognisant of the disadvantages of incineration (i.e. high disposal costs, barriers to promoting the 3Rs, overuse of resources and impacts on climate change), Oki Town decided to make a radical change with the installation of a biogas plant equipped with a methane fermentation system in 2006, sparking a transition from a conventional incineration-based waste management system to one focused on recycling-oriented resource management of organic waste. As a result, Oki Town’s recycling rate increased from 14.9% in 2005 to 63.1% in 2015. The amount of incinerated waste (called “combustible waste” in Japan) by households decreased by 56% from 2,295 tonnes in 2005 to 1,007 tonnes in 2015, and the amount of landfilled waste (called “incombustible waste” in Japan) by households decreased by 98% from 98 tonnes in 2005 to 2 tonnes in 2015. Meanwhile, waste management expenditures (costs for incineration, recycling, waste water treatment, collection and transportation) and GHG emissions decreased, while the quality of life for local people improved, which plays a pivotal role in regional revitalisation. This case study describes the key activities carried out, major results achieved, and main highlights and lessons learnt for future actions.

2. INTRODUCTION

2.1. OKI TOWN

Oki Town is located in the central part of the Chikugo plain in southern Fukuoka Prefecture in the Kyushu region of Japan (Figure 1). The town has a population of about 14,300 (as of 2018) with about 4,900 households. Oki Town is a traditional agricultural town with a total area of 18.43 km². Canals run the length and breadth of the town and make up about 14% of the entire area. From ancient times, the town has developed mainly around the production of rice, wheat, rush, and rush processing because of its fertile land, rich water sources, and advantageous weather conditions. In recent years, facilities for the cultivation of strawberries, green asparagus, and types of mushrooms, such as *enoki* and *shimeji*, have thrived.



Figure 1: Location of Oki Town (Source: Oki Town; revised by author)

2.2. WASTE MANAGEMENT CONTEXT IN OKI TOWN

In 1973, Oki Town launched a collection service for combustible waste and outsourced incineration treatment to a facility owned by adjacent Okawa City. As the amount of waste increased year by year, the outsourcing costs for incineration and incineration ash treatment increased, which started to put pressure on the town's finances. Oki Town launched waste

reduction initiatives in the early of 1990s through the cooperation of the local government and residents. A pilot waste separation and collection project in model areas was introduced in 1993, and citizens were educated on how to separate waste at the household level. Meanwhile, activities such as the composting of organic waste by EM (Effective Microorganisms) were promoted mainly by a civic group called Earth Club. However, composting did not expand beyond to households that did not own farmland or households living in apartments.

Revisions to Japan's "Waste Management and Public Cleansing Law" of 2002 served as another impetus for Oki Town to press forward with its project to recycle organic waste. At that time, Oki Town was disposing human waste and septic tank sludge from the town into the sea. However, the disposal of human waste and septic tank sludge into the sea was banned in principle with the entry into force of an international agreement called the "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter" in 1972. Therefore, Oki Town faced pressure to consider treatment methods for human waste and septic tank sludge as a replacement for marine dumping (Liu, 2018).

The development of a sewage treatment system together with an incinerator to burn waste using subsidies from the national government would be a normal choice in Japan. However, a few municipal staff members questioned the suitability of this choice as a sustainable way to treat waste and posed their concerns on the overuse of resources and negative impacts on the environment, as well as the implications for climate change. According to a description by Mr. Kimio Sakai, currently Vice Mayor of Oki Town and a core member of the Oki Organic Waste Recycling Project, "There is a risk that the carbon dioxide and toxic dioxins that cause global warming will be generated with the incineration of organic waste. The incineration of waste also puts a significant financial burden on the town and there is a shortage of final disposal sites to landfill incineration ash. However, by separating and collecting organic waste and fermenting it in a biogas plant, methane gas can be recovered and used as energy. In addition, the digestion liquid can be recovered and used as organic fertilizer. Originally organic and human waste was returned to rice paddies and fields as valuable manure. But as chemical fertilisers and pesticides have spread,

the use of manure has decreased and now the soil in the rice fields is dying. We plan to use delicious-tasting local rice and vegetables grown using liquid manure produced from organic waste for school meals in the town to be eaten by the children." This is where a paradigm shift in thinking occurred.

Oki Town carried out a number of activities (Shioya et al., 2016) including the step-by-step formulation of policies and strategies in the decision-making process to orient the Oki Organic Waste Recycling Project towards the realisation of a local sound material-cycle society. A conceptual plan for organic kitchen waste recycling was proposed by the town mayor in 1999, and a specialised waste treatment plant using a methane fermentation system was proposed for resource recovery of organic waste in the town's new energy vision in 2000. Other related issues (both tangible and intangible) are summarised in Table 1. It is worth noting that, in 2008, Oki Town published the "Oki Town Mottainai Declaration (Zero Waste Declaration)" to further promote recycling activities and illustrate the shift from incineration to resource management to

create a more sustainable town (See page 13).

The Oki Recycling Center, "Kururun" (meaning "circulation" in Japanese), a biogas plant equipped with a methane fermentation system, started to operate in the town in October, 2006. All of the organic waste generated in the town (by both the household and business sector), as well as human waste (including septic tank sludge) is separated and collected. Methane fermentation is carried out at Kururun, where the electricity produced by methane gas covers 70% of the electricity demand for the facility. Nicknamed Kuruppi, digestive liquid is used as fertiliser by farmers and in private gardens in the town. Rice (*Kan-no-megumi*, Circular Blessings), oil (*Kan-no-kaori*, Circular Essence), and vegetables grown using Kuruppi are used for school lunches or preferentially sold to town residents at reasonable prices. What town residents eat turns into human waste and septic tank sludge and returns again to Kururun (Figure 2). Oki Town has created a form of town development focused around these recycling activities.

Table 1: Waste management policy and related issues to address the Oki Organic Waste Recycling Project step-by-step

	Year	Contents
Overall Promotion	1999	A conceptual plan of organic kitchen waste recycling was proposed by the town mayor.
	2000	New energy vision was formulated.
	2001	Environment Division in Oki Town was established, and a project team was set up.
	2005	A conceptual plan of biomass town was proposed (first in Japan).
	2008	"Oki Town Mottainai Declaration (Zero Waste Declaration)"
	2017	A conceptual plan for a Recycling Park was proposed.
Physical perspective	2001-2003	The Fukuoka Research Commercialization Center for Recycling Systems, Oki Town, and universities collaborated on joint research to clarify methods for sorting organic waste and the effectiveness of actual applications for liquid manure, which helped the concept take shape.
	2004	A feasibility study was conducted on the commercialisation of the town's new energy vision.
	2005-2006	Oki Town launched the first phase of construction for the plant and adjacent facilities, as a subsidised project to create an environment for the use of biomass.
	2006	"Kururun" started to operate.
	2007-2009	Oki Town launched the second phase of construction for a Roadside Station.
	2010	The local restaurant and JA Fukuoka Oki direct sales depot opened.
Social perspective	2001-2003	Pilot project on the separation and collection of organic kitchen waste in model areas was implemented.
	2005-2006	Briefing on project concept for public hearing. Orientation meeting for the separation and collection of organic kitchen waste.
	2006	Start of route collection of organic kitchen waste throughout the town.
	2007	Set up of award for districts with good organic kitchen waste separation practices. Start to supply brand rice " <i>Kan-no-megumi</i> " for school lunch. Complete study materials to expand learning.
	2013-2015	Zero Waste Contest

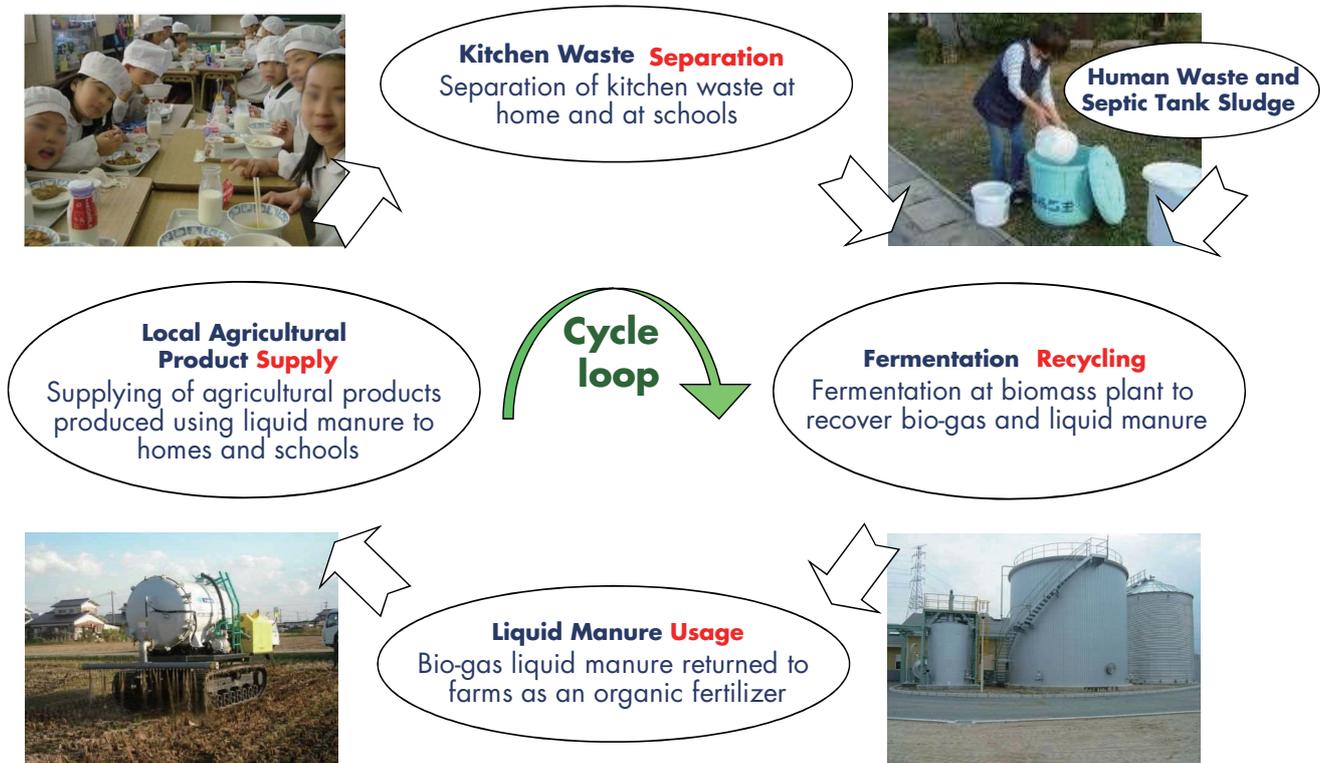


Figure 2: Structure of cooperative recycling efforts (Source: Oki Town; revised by author)

2.3. TREND OF HOUSEHOLD WASTE GENERATION AND RECYCLING RATES

The trend of household waste generation and recycling rates between 1977 to 2016 is shown in Figure 3. As shown in this figure, Oki Town's recycling rate (the amount of "recyclables"/total household waste

generation) increased from 14.9% in 2005 to 63.1% in 2015. The amount of incinerated waste (called "combustible waste" in Japan, mainly consisting of paper, plastic, textile, and others) by households decreased by 56% from 2,295 tonnes in 2005 to 1,007 tonnes in 2015, and the amount of landfilled waste (shown as "incombustible waste" in Figure 3) by households decreased by 98% from 98 tonnes in 2005 to 2 tonnes in 2015.

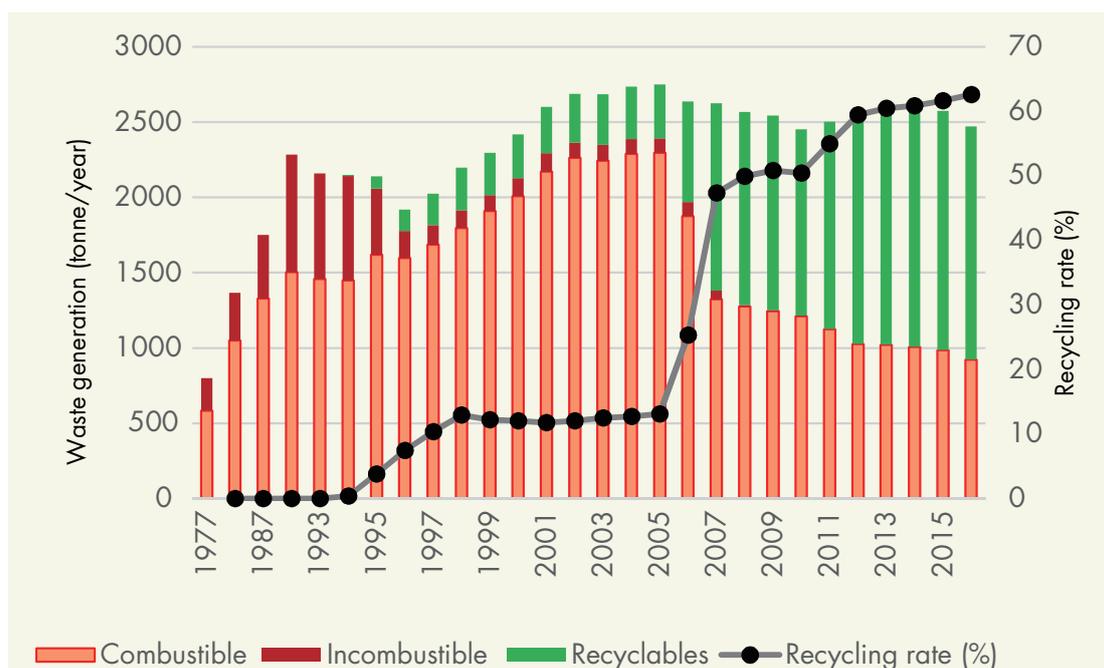


Figure 3: Trend of household waste generation and recycling rates (Source: Oki Town; revised by author)

3. ESTABLISHMENT OF THE SOUND MATERIAL-CYCLE SOCIETY

3.1. METHANE FERMENTATION FACILITY, "KURURUN"

The Oki Recycling Center, Kururun, consists of a methane fermentation facility (including pre-treatment building, methane fermentation tank, gas holder, and liquid manure storage tank; abbreviated as "Kururun" below), an administration and learning building (facility for exchange to learn about recycling systems and mechanisms), and a "bio-hill". Located near the facility is a restaurant and direct sales depot that handle local agricultural products (Figure 4). Human waste and waste treatment facilities are commonly regarded as problematic because of issues with odour and an overall bad image. For this reason, these types of facilities are constructed deep in the mountains or away from residential areas. However, Oki Town has

constructed Kururun right in the centre of the town, and built a restaurant next to the methane fermentation facility, as a way to enhance public awareness, promote public participation, and to create a platform for promoting economy, tourism, agriculture, and various local activities.

The main collection and treatment process used in Kururun is shown in Figure 5. In Oki Town, collection buckets are provided for separating and collecting organic kitchen waste. The town is divided into three areas and organic kitchen waste is collected twice a week in each area. A bucket to store organic kitchen waste (storage capacity of 10L/bucket with water strainer; Figure 5 (a)) is distributed to each household. The town's residents store organic kitchen waste at home until collection day and transfer the organic kitchen waste they have stored at home to a larger bucket (storage capacity of 75L/bucket; 1 for every 10 households; Figure 5 (b)) that has been installed outside. These buckets are closed to prevent odours from leaking outside and to avoid damage from crows and cats. Organic kitchen waste can be discarded any time when the large bucket is set out.



Figure 4: Oki Recycling Center Kururun and surroundings (Source: Oki Town; revised by author)

Two flat-bodied vehicles (2t/vehicle) with power gates (Figure 5 (c)) are used for collection. Three large buckets can be stacked on the loading platform. The vehicles can collect between 150 and 160 buckets a day.

All of the organic kitchen waste generated by households and businesses in the town is collected and transported to the feed chamber at Kururun. An operator inserts the organic kitchen waste into the input port (Figure 5 (d)). At that time, the operators perform a visual inspection to check if foreign objects or contaminants are mixed in with the waste. Empty buckets are washed by a scrubber on the side (Figure 5 (e)). Since waste collection is finished in the morning, scrubbed buckets are delivered in the afternoon to area bases for collection on subsequent days. Crushing and sorting equipment is used to finely cut up organic waste (Figure 5 (f)). Foreign objects and contaminants that could not be visually confirmed earlier are removed

at this time. Later, organic kitchen waste is mixed with concentrated sludge (Figure 5 (a)) and heated in a high-temperature liquefaction tank. Next, this concentration is mixed with human waste and transported to a methane fermentation tank ((Figure 5 (g)). Methane fermentation is a reaction in which organic matter is decomposed in an anaerobic state into methane (about 60%) and carbon dioxide (about 40%) with trace amounts of hydrogen sulphide. Gas that contains these elements is referred to as biogas and the liquid residue that remains after biogas has been removed is called digestive liquid. Meanwhile, human waste and septic tank sludge are transported to a pre-treatment facility on the premises (Figure 4). A system is in place at Kururun where deodorising equipment has been installed. When a shutter to the entrance of the facility is closed immediately, air pressure is lowered and odours do not leak outside the facility.

The methane fermentation tank is maintained within a

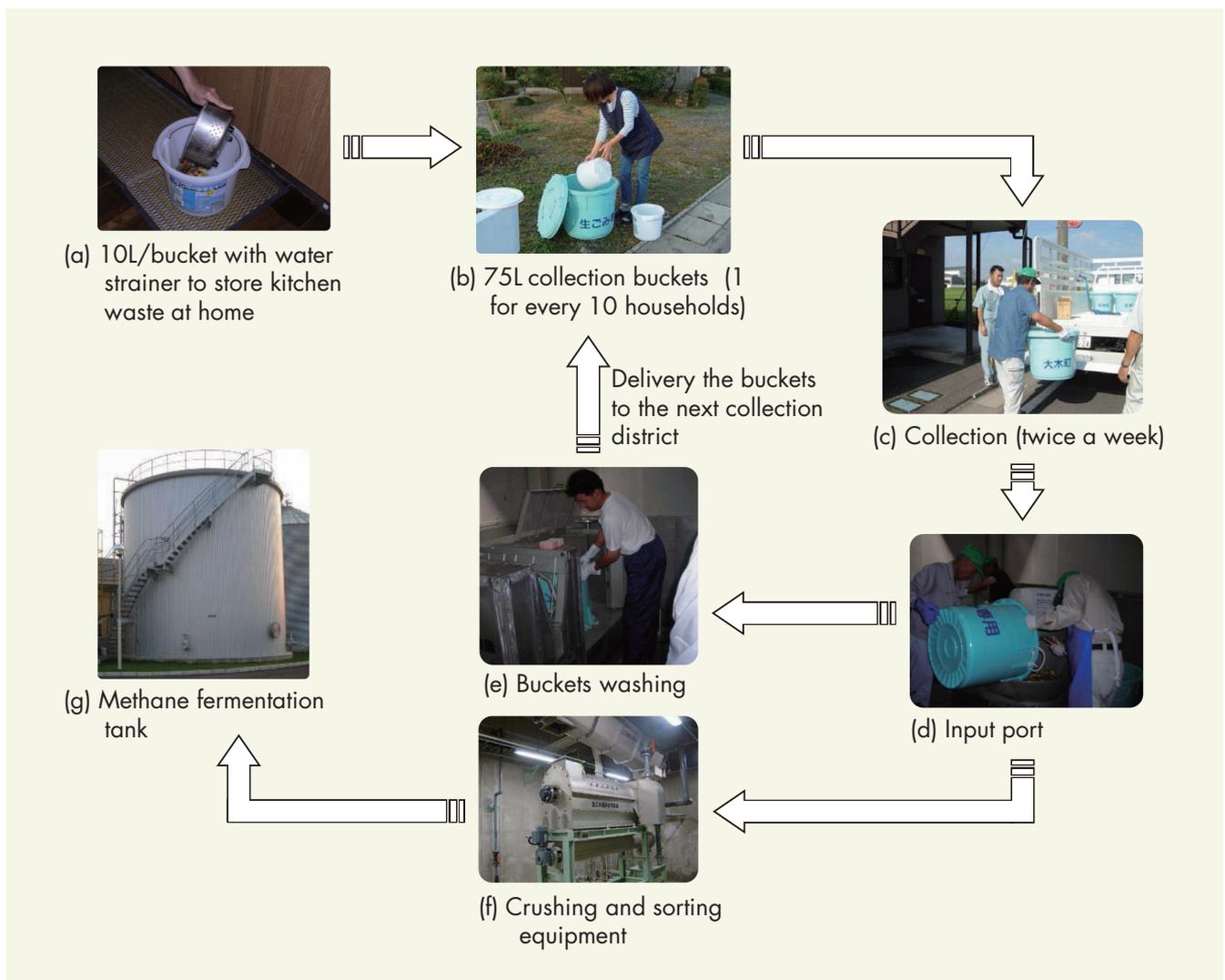


Figure 5: Treatment processes in Kururun (Source: Oki Town; revised by author)

temperature range where microorganisms can be easily activated (about 37°C). Organic waste, septic tank sludge, and human waste decomposes over a period of 22 days after it has been put into the tank. After hydrogen sulphide and other elements are removed, the generated biogas is stored in a gas holder with a safe and secure triple-paned wall. When biogas is used, it is transported to a generator and used as fuel. Biogas power generation can produce about 752 kWh

of electricity each day, all of which is used within the Oki Recycling Center. Hot water warmed with thermal energy generated during power generation is used to heat and keep the methane fermentation tank warm and to wash buckets. The remaining digestive liquid is sprayed as liquid manure at farms in the town, which is a strong and unique benefit for Oki Town. The material flow at Kururun is summarised in Figure 6.

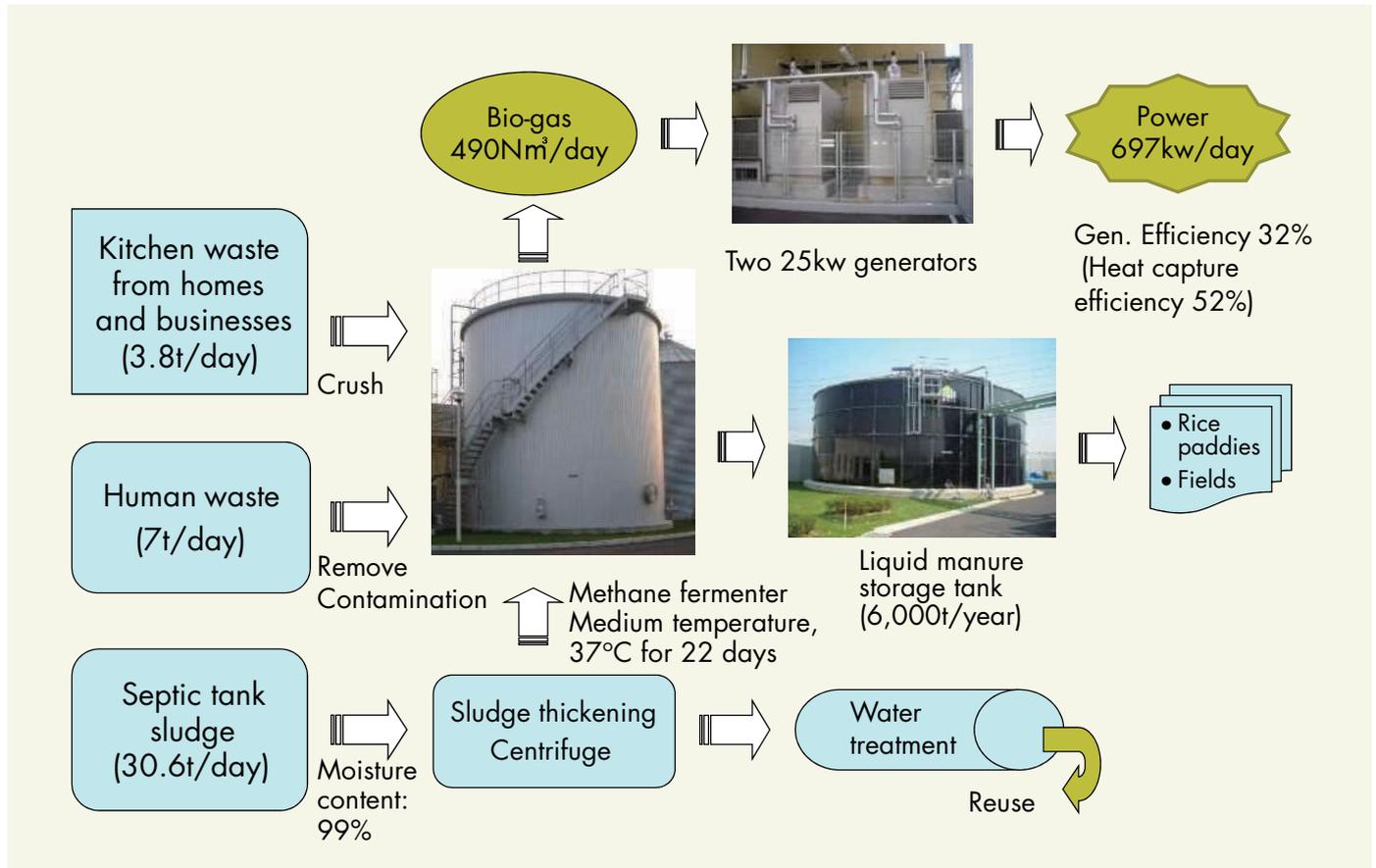


Figure 6: Material flow at Kururun (Source: Oki Town; revised by author)

3.2. RELATED SOCIAL MECHANISMS SUPPORTING “KURURUN”

Waste can be converted into liquid manure at the Kururun facility. However, if there is no waste separation and collection system in place, organic kitchen waste will not be collected, and no cycle will be formed. On the other hand, if the liquid manure that has been produced is not utilised as organic fertilizer by farmers, or if agricultural products produced using liquid manure cannot be sold to consumers as goods, this cycle will not be established. In Japan in particular,

where the rate for waste treatment by incineration is over 80% and intensive agriculture dependent on chemical fertilisers is the primary method of farming, it is clear that the components of digestive liquid are effective as a fertiliser. However, in reality, this does not always work as expected. For example, there are cases where residents oppose the use of digestive liquid as “discharging human waste into rice paddies” or that the practice is “outdated”, and despite the fact that high-quality fertiliser has been produced, it is thrown away in the mountains. There are a number of methane fermentation facilities operating in Japan that are similar to the one in Oki Town, but in fact, there are very few cases where digestive liquid is used

as fertiliser. There are many ongoing efforts in the background that indicate why the local circulation loop (shown in Figure 2) has been successfully formulated in Oki Town (Nakamura and Endo, 2011).

Development of a waste separation and collection system

The development of a waste separation and collection system in place is the key to guarantee the “amount” and “quality” of organic kitchen waste as a resource of Kururun.

Economic incentives are used to ensure a stable supply of organic kitchen waste. Each 10L bucket per household costs ¥1,200 and about 500 have been distributed throughout the town. However, since no fees are levied on the buckets or for disposing waste, the residents of the town can put out their organic kitchen waste free of charge. Meanwhile, Oki Town simultaneously increased the price of garbage bags for conventional burnable waste when it started to collect organic kitchen waste. Furthermore, after starting the collection of organic kitchen waste twice a week, the Environment Division reduced the collection of combustible waste from twice to once a week. The town also encouraged residents to separate organic kitchen waste by setting up a reward system for areas that sort waste well, not only with a feeling of pride (such as reporting in town information paper) but also by receiving small gifts (such as hot spring bathing tickets).

Meanwhile there is a system of monitoring each other to guarantee the quality of waste separation. The primary reason for using collection buckets rather than plastic bags or other such methods is to prevent contamination of the waste and to guarantee the quality of organic kitchen waste. As explained in the introduction of Kururun by Mr. Sakai, one of the factors for reducing contamination is social pressure from other people in the same area, since garbage from multiple households is collected in one bucket. At the beginning when waste began to be sorted, organic kitchen waste contained some plastic and metal remnants. However, the percentage of contaminants in organic kitchen waste collected in Oki Town is now no more than 1%. Contaminants contained in the waste, such as eggshells and shells, are separated, but the bony parts of fish are placed in the fermentation tank as is.

When organic waste is collected from businesses in the town, large buckets (storage capacity of 75L/bucket) that are tagged with the name of the business are distributed free of charge for organic waste and septic tank sludge, such as restaurants and supermarkets. When treated septic tank sludge from businesses is brought in, an analysis of the designated components is carried out as stipulated by law before it is brought in to check for heavy metal contamination that exceeds standards. Waste is weighed with a scale installed at the entrance of Kururun. First, the weight of the truck carrying in the buckets containing organic waste is measured on the loading platform and waste is carried in. All the buckets are lowered to the carry-in entrance and a clean bucket is loaded in its place. A mechanism is used to calculate carried-in waste once a month, where the weight of the truck carrying the empty buckets is measured again when they leave Kururun. The weight of the waste is calculated by subtracting this from the weight when the vehicle arrived. It is collected at ¥5,000 per tonne, which is cheaper than for combustible waste.

Development of liquid manure as a commodity

Oki Town developed a scheme to promote liquid manure from Kururun as a commodity to encourage use by farmers to complete the local circulation “loop” through the following points.

1) Registration of liquid manure as normal fertiliser and demonstration of crop growth using liquid manure

The components of the digestive liquid produced at Kururun (commonly known as Kuruppi) are analysed to check the fertiliser’s contents and safety. This fertiliser is then registered as normal fertiliser. Kuruppi is rich in trace elements and various organic acids that are related to plant activity, such as amino acids and phytohormones, as well as fertiliser components (N, P, K). Of the 41.4 tonnes of waste input into Kururun each day, the percentage that contains organic kitchen waste from homes and businesses is as low as 10% (3.8 t/day, Figure 6), which means that components do not vary much throughout the year. Kuruppi is also recognised as having both properties of a slow and rapid-acting fertiliser and a repellent effect on pests. Crop growth demonstration projects were

also carried out in Oki Town with signboards saying, “Grown with liquid manure”, set up in rice paddies and fields.

2) Fertiliser management and adjustment of components

About 6,000 tonnes of liquid manure are produced annually, which is used for crops, such as paddy rice and wheat that is grown locally. The approximate amount of liquid manure needed for spraying paddy rice and wheat is 5 tonnes per 0.1 ha, which translates into 3,000 tonnes from May to July and 3,000 tonnes from October to November. Since liquid manure continues to be produced even in periods when spraying is not carried out, Oki Town built a 1,200-tonne tank in the Oki Recycling Center and two 1,000-tonne tanks in a nearby Recycling Plaza, which is where a six-month supply of liquid manure is stored. In addition, if there is a component missing in the liquid manure, it is possible to add what is missing to increase the commercial value.

The reliability of the liquid manure increases with the development and distribution of the cultivation history with JA and extension centres such as “*liquid manure can be used in this way with rice, wheat, and vegetables*”.

3) Setting affordable prices and spraying services

Liquid manure is free in Oki Town. The fee for spraying is ¥1,000 per 0.1 ha, which is collected from farmers. Liquid manure is sprayed using a dedicated spraying vehicle (which is owned by town) before paddies are filled with water. This service is helpful for farmers who must manually spray fertiliser, especially for elderly farmers, and is available at a reasonable cost.

4) Establishment of associations using liquid manure

Today, demand for liquid manure is higher than supply and applicants take turns receiving spraying services. The establishment of associations can lead to the stable and fair use of liquid manure.

Development of market for agricultural products grown using liquid manure

Oki Town secured sales routes for agricultural products

grown using liquid manure by branding and promoting locally-produced and locally-consumed products. Rice grown using Kuruppi and based on Fukuoka Prefecture’s standards for farming with reduced pesticides and reduced chemical fertilisers is branded as “*Kan-no-megumi (Circular Blessings)*”. This rice is used for school lunches and is preferentially sold at reasonable prices to town residents.

Empowering residents

Symposiums are actively organised for elementary school classes that offer tours of Kururun, classes to inform them about obstacles to recycling, and with invitations to outside lecturers. Elementary school students who take these classes, eat this food in their school lunches, and get involved in exchanges with farmers are the very picture of “citizens who are proud of the town’s sound material-cycle initiatives”.

4. KEY ACHIEVEMENTS AND BENEFITS

The recycling project in Oki Town has brought about a multifaceted effect, including the reduction of costs in the town, added value for agricultural products, and reduction in CO₂ emissions (Premakumara, 2010; Nakamura and Endo, 2011; Shioya et al, 2016).

4.1. ECONOMIC BENEFITS

1) Reduction of costs for facility construction and waste treatment and lower financial burden

The total project cost of the Oki Recycling Center Kururun and surrounding facilities was about ¥1,100 million between fiscal 2005 and fiscal 2009 (including ¥520 million for the methane fermentation facility Kururun, ¥182 million for the learning building and “bio-hill”, ¥78 million for the liquid manure storage tank, ¥57 million for spraying vehicle and collection vehicle, and ¥220 million for local restaurant facilities, direct sales depot and other types of facilities (in the second phase of construction)), which is approximately one-third to one-fourth that of incineration facilities.

Furthermore, waste management expenditures (combustible waste, incombustible waste, organic waste, human waste treatment, and transportation expenses for collection of each type of waste) decreased by ¥27,786,000 (around 13%) from the fifth year after the start of kitchen waste separation. Wastewater treatment costs could also be reduced with the use of liquid manure as a resource. The excess budget could be applied to enhancing welfare for the townspeople, and for educational projects.

2) Creation of local employment

Employment has been directly created for 61 people with the combination of the number of employees at the Recycling Center and adjoining facilities.

3) Sales of agricultural products grown with liquid manure

Annual sales at the restaurant is ¥100 million. Annual sales at the direct sales depot is about ¥120 million. Half of the visitors to the town who tour the Recycling Center also enjoy eating at the restaurant, illustrating the successful results of this project as an inspection tour business.

4) Savings in fertiliser fees and reduced burden on farmers

Kuruppi is free and farmers are only responsible for spraying fees. Currently, this has reduced the overall burden on Oki Town by about ¥10 million. Some farmers saved about ¥500,000 annually in fertiliser costs.

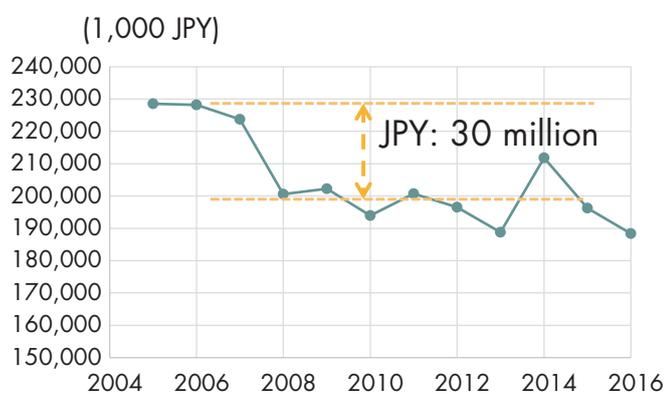


Figure 7: Change of waste management expenditures in Oki Town (Source: Oki Town, revised by author)

4.2. SOCIAL BENEFITS

Kururun plays an important role to promote local agriculture and regional revitalisation. For example, there are 80 farmers registered in the town that ship products to the direct sales depot. If neighbouring areas are included, this number rises to 280 (Shioya et al., 2016). Residents with experience in using related facilities are as follows: Kuruppi (23.5%), restaurant (50.2%), direct sales depot (71.5%), reuse plaza (13.7%). What is notable is that more than half of all people use the restaurant and direct sales depot. This will invigorate local agriculture and enrich the lives of the local people in other ways.

The town's residents who are cooperating in the separation of organic waste generate a sense of unity that they are involved in a single project with the entire community, mainly groups of local residents, and a feeling of pride in their involvement in an advanced initiative in the entire town.

Over 3,000 people from both Japan and overseas visit Kururun annually. The sound material-cycle project connects people both inside and outside of Oki Town.

4.3. ENVIRONMENTAL BENEFITS

The amount of waste incinerated in Oki Town has been reduced by 56% through the separation and recycling of organic kitchen waste, plastics, and disposable diapers. At the same time, a recycling rate of 65.3% was achieved in 2015 (Figure 3). This helped reduce environmental impacts and extend the life of the final landfill site.

Furthermore, there is a major GHGs emission effect. Tsuchida et al. (2014) compared GHGs emissions between two cases (Table 2). One is the on-going "Kururun" methane fermentation system (Table 2, Case A) based on the primary operating data, and the other is outsourcing incineration for organic kitchen waste, and human waste treatment system for human waste and septic tank sludge to facilities of an adjacent municipality (Table 2, Case B). The results showed that the methane fermentation system has led to an annual reduction of 846 t-CO₂eq (i.e. 0.074 t-CO₂eq per tonne).

Table 2: Reduction effect of GHGs emission

Case	GHGs emission	
	t-CO ₂ eq/year	t-CO ₂ eq/tonne
A: "Kururun" methane fermentation system	313	0.027
B: Incineration for organic kitchen waste and human waste treatment system for human waste and septic tank sludge	1,159	0.101
Reduction effect (B-A)	846	0.074

Source: Tsuchida et al. (2014)

5.2. CREATING VERTICAL AND HORIZONTAL COLLABORATION AMONG STAKEHOLDERS

Organic recycling activities in Oki Town are positioned and developed as a project under the local government, in collaboration with local residents, businesses, residents' groups, and the local community through area-level separation and collection. Mr. Masuda Tomihiro, Section Chief of the Environment Division, says, "Since the Environment Division only deals with garbage, we would only have built Kururun if we only considered the issue from the perspective of our own division. However, the reason the idea developed to produce fertiliser at Kururun and offer that to consumers to use for growing vegetables was because there were farmers at the meeting places. From the perspective of the town's residents, this is a project that involves the entire town and not one that the Environment Division should take on itself. There were various ideas from different people because there was such a system of collaboration in place, including a series of ideas on using waste as a resource and not just the construction of a simple waste treatment facility, but to think about the future and effectively use these resources and provide services to the people of the town." The people had differences in opinion on what they wanted to do according to their position, such as wanting to improve the environment or revitalise agriculture, however, they all had the common feeling of wanting to improve Oki Town, the place they lived. Those positively involved in activities learn from one another, help each other, and promote consensus building, which makes these initiatives successful.

5.3. FORMATION OF A VISIBLE "LOOP" THAT TAKES ADVANTAGE OF LOCAL RESOURCES

Oki Town re-examined the issue of organic waste as a local resource and formed a circulation loop for materials (organic resources), finance (revenue), and people (residents, NPOs, administration) within the region through a series of sound material cycles within the area consisting of the production of liquid manure

5. CONCLUSION/ LESSONS LEARNT

5.1. PARADIGM SHIFT FROM WASTE MANAGEMENT TO RESOURCE MANAGEMENT

Through the above series of initiatives, Oki Town is setting a paradigm shift in motion from waste management to resource management, as well as in society. Kururun is a facility for the treatment of kitchen and human waste. Generally, this type of facility is shunned as being problematic, and in many cases, they are constructed outside of the towns. However, by constructing the bio-gas facility in the middle of the town as a symbol and setting up a restaurant and direct sales depot directly adjacent, it will be possible to develop a fertiliser manufacturing facility with a vibrant regional farming community connecting the environment, agriculture, and local food, which will become a base for the development of the city. As a result, the incinerated organic "waste" is transformed to local "resources", and the waste treatment facility is transformed into a fertiliser manufacturing facility which also plays a role as the centre for local development. At the same time, the municipality's work has shifted from waste management to resource management, and from "tedious sorting work" to a review of a "happy way of life". The attitude of residents has shifted with a change from "complaints" to "pride".

It is worthy to note that this paradigm shift from waste management to proper resource management is at the heart of reducing waste sent to landfills and towards the creation of a sustainable society.

→ locally branded rice → meals and consumption by residents. Oki Town also makes full use of what can be used as local resources by recycling plastics, reusing furniture and other such actions.

Synergistic effects can also be seen between initiatives and regions, with the exchange of funds, resources, people, and technology outside the region through networks that lead to the development of new activities and the town revitalisation (Liu, 2018). For example, in April 2017, Oki Town signed a comprehensive agreement on the development of a sustainable material-cycle society with Miyama City. Mutual support will be possible for the maintenance of facilities through cooperation between these two municipalities, in addition to the creation of a material-cycle society with the mutual utilisation of the strengths of both municipalities, such as the local renewable electric power supply industry in Miyama City.

5.4. CHALLENGE TO CONTINUOUSLY REFRAME AND RECONSTRUCT PROCESSES FOR INITIATIVES

Even with well-known initiatives, there are many cases where initiatives start to wane over a few years or a few decades. In the case of sustainable initiatives, it is clear that the purpose and contents of activities are flexibly and dynamically reframed and redeveloped in response to current needs and changes in situations (Liu, 2018).

The construction of a methane fermentation facility in Oki Town in 2006 facilitated a paradigm shift from a conventional incineration-based waste management system to one focused on recycling-oriented resource management for organic waste. These effects gradually spread, and today, the original initiative has been developed into projects that also affect the development of the town, such as the promotion of agriculture and creation of jobs. Mr. Sakai says, "There are no disadvantages to being involved in sound material-cycle projects. When organic waste is removed from garbage bags, we can see what waste remains and it will be even easier to separate paper and plastics." A project to produce oil from waste plastics started in 2010 and the separation and collection

of disposable diapers began in 2011. Oki Town is not satisfied to leave things at the current level and is showing a positive attitude towards the next stage in the separation of waste. Oki Town has also started support activities for the elderly to dispose of waste and a community connecting networks is being created by complementing, encouraging, and evolving with one another through the continued development of activities and creation of more networks.

However, as both Mr. Sakai and Mr. Masuda have commented, "Oki Town is a farming community, but farming has declined considerably compared to the past and it is getting harder to dig out the characteristics of the town in line with that. For farming towns, the decline of farming is nothing but the decline of the town itself. An urgent task will be to rebuild agriculture in the future."

"If the next generation of households do not continue to farm, no one will use liquid manure. Currently, there are only about 100 full-time farmers and 500 farmers with other side businesses. In order to raise income from farming, restaurants and other establishments are expanding management to try to encourage future generations to take over farming." This challenge will most likely continue in the future as Oki Town and other areas around Japan move toward the creation of a local sound material-cycle society.

Oki Town Mottainai Declaration (Zero Waste Declaration)

The future looks ominous for our children.

Climate change caused by global warming is a worsening problem that threatens the very survival of humanity a century hence. Human activity and society's large-scale consumption of resources are the clear causes of this problem.

We therefore publicly resolve with this "Oki Town Declaration on Waste" to rethink our waste-filled lifestyles so that, as a town, we will not create further burdens on our children's future.

1. We will relearn the wisdom of our ancestors, cultivate a spirit of frugality and, as a town, develop a way of life which is free from waste.
2. We will work to recycle garbage, recognising that it was originally a valuable resource, and strive to eliminate garbage incineration and landfill disposal by 2016.
3. We will endeavor to remember that, no matter how minuscule, Oki Town is still a member of the global community, and we will join together with like-minded people wherever they may be in the world to help promote sustainable living.

2008.3

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