Research Paper

A framework for the virtuous circulation of food resources in local cities

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Abstract

Despite relying on imports for much of its food, Japan has a large amount of 'food loss', which is thrown away even though it could be eaten, and the amount exceeds the world's annual food aid to people suffering from hunger, which is 4.2 million tonnes. In its Basic Policy on the Promotion of Food Loss Reduction, the Japanese Government has set a target to halve food loss from households and business premises by 2030 compared to 2000, to create a recycling-oriented society, but no specific system or standards have been set. Under these circumstances, there is a growing movement in local cities to make effective use of food resources and to create recycling-oriented communities. However, at present, there are issues such as insufficient surveys on the actual situation of food loss occurrence and the fact that the full scope of initiatives within a single municipality has not been grasped due to the wide range of initiatives related to food loss. Therefore, this study aimed to understand the actual situation of food loss in one local city and to gain knowledge for building a framework for creating a virtuous cycle of food resources within the region.

Keywords

Food waste, food loss, waste reduction,

1. Introduction

1.1. The theme, Focus, and Significance of This Research

This paper deals with the current situation of food loss in Japan's regional cities and the mechanisms for creating a virtuous cycle of food resources within the region. While Japan relies on imports for much of its food, a large amount of 'food loss' is thrown away when it could be eaten. Japan has set a target to halve food loss from households and businesses by 2030 compared to 2000 levels. To achieve the target, various actors, including the national government, local governments, businesses, and consumers, are working together to promote the reduction of food loss as a national movement. Although people in various positions have started to carry out activities to reduce food loss, the industrial and demographic structures and lifestyles in urban and rural areas are different, so it is necessary to set targets and implement initiatives that suit each situation. This paper aims to understand the actual situation of food loss in Nikko, one of the regional cities, and to gain knowledge for the development of a mechanism to create a virtuous cycle of food resources within the region.

1.2. Paper Structure

This paper first introduces the definition of food loss in Japan and its estimation method, the current situation and reduction targets, the relevant literature on the Japanese Government's measures to reduce food loss, and explains the background of this. The following section describes the survey methodology and the survey target, Nikko City, Tochigi Prefecture. Finally, the study results, discussion, and suggestions for future research are presented.

2. Background

2.1. Review of Pertinent Literature and Research

2.1.1. Definition of food loss in Japan

The Sustainable Development Goals (SDGs) were agreed upon by the UN in 2015. Goal 12.3 states that "By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" (United Nations, 2015, p12). As there are differences in the definitions of food waste and food loss in different countries, the FLW Protocol report uses the expression food loss and waste (FLW) as a generic term that includes differences between countries (FAO,2014).

In Japan, food loss is defined in the basic policy of the Food Recycling Law as "food that is discarded even though it should be eaten" (Ministry of Agriculture, Forestry and Fisheries (MAFF), 2015, p3). However, there is no clear definition of "it should be eaten". MAFF estimates the amount of food loss generated as the amount of food waste that is considered to be the edible part of food waste, and therefore food loss is regarded as the edible part of food waste in Japan. As shown in Figure 1, Business-Related food loss is the edible portion of business waste from food-related businesses and valuable materials such as soy meals, while household food loss is the number of leftovers, direct disposal, and excess removal generated by households.

In addition, the scope of the supply chain in food loss in Japan covers food manufacturing, food retail, food service, and households. As such, it does not cover agricultural produce discarded on farms. In the following, 'food waste' refers to food-related waste and 'food loss' to the edible part of it. For cases outside the country, FLW is used in this paper.
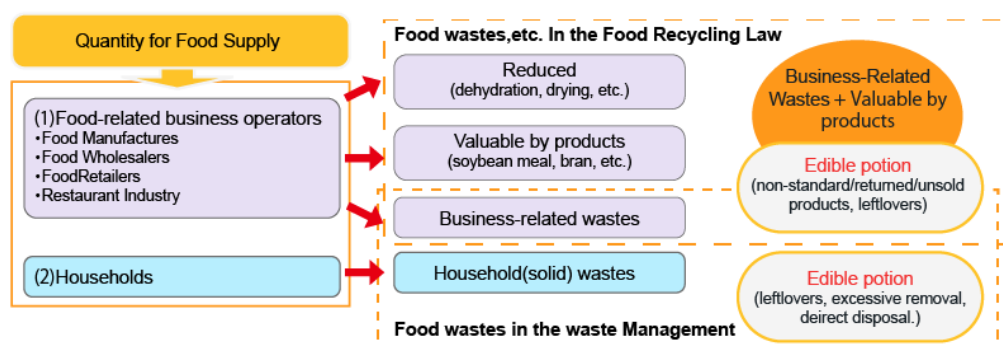

Figure 1. Definition of food loss in Japan

2.1.2. The Act on Promoting Food Loss and Waste Reduction.

In Japan, the Act on Promotion of Food Loss and Waste Reduction (Food Loss Act) came into force on October 1, 2019(Consumer Affairs Agency(CAA),2019). This law was enacted to promote food loss

reduction as a national movement, with the national government, local governments, businesses, and consumers working together and each citizen taking social measures. The law was also part of the Government's plan to take measures to reduce household food waste, in response to target 12.3 of the SDGs 2030 Agenda. To reduce food waste, Japan previously enacted the 2001 Food Recycling Act (CAA,2018). The basic policy of this law was to reduce the amount of business-related food waste for final disposal by controlling its generation and reducing its volume, using it as feed and fertiliser, and recycling it for heat recovery.

In other countries, legislation has been developed to reduce food loss from various perspectives, including exemptions from liability arising from donations, incentives for donations, and penalties for non-compliance. In the USA, the Good Samaritan Act states that donating businesses and organisations are not legally liable for problems such as ill health caused by donated food if there is no finding of intent or gross negligence.

Furthermore, in the UK, the Social Action, Responsibility and Heroism Act provides immunity from liability in cases where the actions of a well-intentioned third party cause unwanted consequences. Japan does not have such a law and currently, if a problem arises with donated food, the responsibility for the problem lies with the food manufacturer. In addition, France imposes an obligation on food shops over 400 m2 to propose donations to food banks and other organisations about the collection of unsold food that can still be consumed. The disposal of products for reasons such as expiry date has been banned. They are required to donate them to civil society organisations that have signed a contract in advance or to re-use them as fertilisers or animal feed (CAA,2022). On the other hand, Japan has no obligations or penalties for food-related businesses.

2.1.3. Methodology for estimating household food losses in Japan.

Kyoto City has conducted a detailed waste compositional analysis since 1980, measuring the amount of food loss each year and detailed kitchen waste(Asari, Yano, Sakai, et al,2020). This analysis is beginning to be conducted not only in Kyoto but also in other local governments. In the basic policy of Waste Management Law, a target was set for municipal districts surveying the amount of food loss generated by households to "increase to 200 local governments, compared to 43 local governments in 2013" (Ministry of the Environment Government of Japan (MOE),2019). To achieve this target, the MOE has been providing financial and technical support for waste compositional analysis since 2017. In this analysis, three categories of food waste classification items were set up, as shown in Figure 2: food scraps, untouched food, and leftovers.

Category	Overview	Example
(1)food scraps	Inedible parts ejected from the cooking process.	Vegetables, fruit peels, fish bones, shrimp shells, eggshells, etc.
(2)deirect disposaldisposal	(2)-1 Items that were completely untouched and discarded after purchase.	Vegetables, fruit, eggs, seafood, meat, bread, confectionery, noodles, canned food, soya products, dairy products, seasonings, etc.
	(2)-2 Items that were untouched and discarded after purchase. Prototypes more than 50%.	
	(2)-3 Items that were untouched and discarded after purchase. Prototypes less than 50%.	
(3)leftlovers	Food served cooked or raw.	Vegetables, fruit, eggs, seafood, meat, bread, confectionery,
(4)other	Unclassifiable items.	Pet food, flower arrangement, etc.

＊Excessive removal counts as food scraps.
＊(2)-1and (2)-2 are difficult to distinguish and should be judged on site

Figure 2.Classification items for household waste.

According to a questionnaire conducted by the Ministry of Environment, 319 local governments, or 19.2% of the total 1741 local governments, were aware of the amount of food waste and food loss generated by

households. Of these, 222 local governments conducted waste compositional analysis. There are still few local governments that have a grasp of the actual situation of food loss. National estimates of household food loss are made by summing the 'results for local governments that have identified and estimated the amount of food loss generated by households' and the 'expanded estimates of the amount generated in local governments that have not identified and estimated the amount generated.

2.1.4. Methodology for estimating Business-Related food losses in Japan.

Under the revised Food Recycling Law, food-related business operators that generate more than 100 tonnes of waste are required to report regularly on the volume of waste generated and the status of the recycling of waste. A questionnaire survey was conducted among these businesses to estimate the food losses generated by the food industry as a whole. This estimate is used as the amount of business-related food loss for Japan as a whole(MAFF,2021).The total food loss in Japan in 2020, calculated according to the estimation methods in 2.1.4 and 2.1.5 is approximately 5.22 million tonnes, with household food loss amounting to 2.47 million tonnes and business-Related food loss of   2.75 million tonnes.

2.1.5. Measures to reduce food loss in Japan.

In Japan, the relevant ministries and agencies involved in food loss reduction are working together to reduce food loss. Under The Act on Promoting Food Loss and Waste Reduction, October is designated as Food Loss Reduction Month and 30 October as Food Loss Reduction Day, and the CAA, the MAFF, and the MOE have together been conducting educational activities on food loss reduction. The Consumer Affairs Agency has prepared the Guide to eating out, which includes practical tips and points to keep in mind to promote eating out. It also published an example of a shop sticker that shows that leftover food can be taken away from the restaurant. In this way, several initiatives are being implemented in Japan, with each of the relevant ministries and agencies working together. Efforts are also spreading to local governments and businesses, and various initiatives are being implemented in various parts of the country.

2.2. The methodology

This paper uses data on the amount of food loss in general waste emissions and household and business-Related waste held by the municipality to understand the current situation and trends in food loss in Nikko City. Nikko City was selected for this study because it is one of the local authorities conducting the compositional survey and data were available. It also aims to understand and study the efforts made to reduce food loss in Nikko City.

2.3. Case Study: Nikko City, Tochigi Prefecture

Nikko City is located in the north-west of Tochigi Prefecture, with a population of 78,087 and an area of approximately 1,450 km^2. It occupies a quarter of the area of Tochigi Prefecture and is the third largest municipality in Japan. Of this area, approximately 82% is forested and the area is rich in the natural environment. The northern and south-western parts of the country are mountainous and steeply mountainous, and the southern part is flat. Nikko City was created in March 2006 through the merger of five municipalities - Imaichi City, Nikko City, Fujiwara Town, Ashio Town, and Kuriyama Village - and is divided into five regions as shown in Figure 3. Nikko has developed on the basis of its rich natural environment, valuable historical and cultural heritage, abundant hot springs, and other favourable tourism resources.

Figure 4 shows the change in the age-grouped population of Nikko City. As the total population declines, the working-age population and the juvenile population will also decline. On the other hand, the old-age population is expected to increase, and Nikko City is expected to experience a further decline in the

Figure 4.Age structure of Nikko City by three different age groups

number of children and elderly population. In Nikko City, there are concerns about the termination of financial support measures following the merger and a decrease in tax revenues due to the decline in the population. At the same time, aid costs are expected to increase due to the falling birthrate and elderly population. Fiscal management is therefore expected to become more difficult. It is therefore essential that efforts are made to secure new revenue sources and to curb expenditure in response to population decline and changes in the demographic composition of the population.
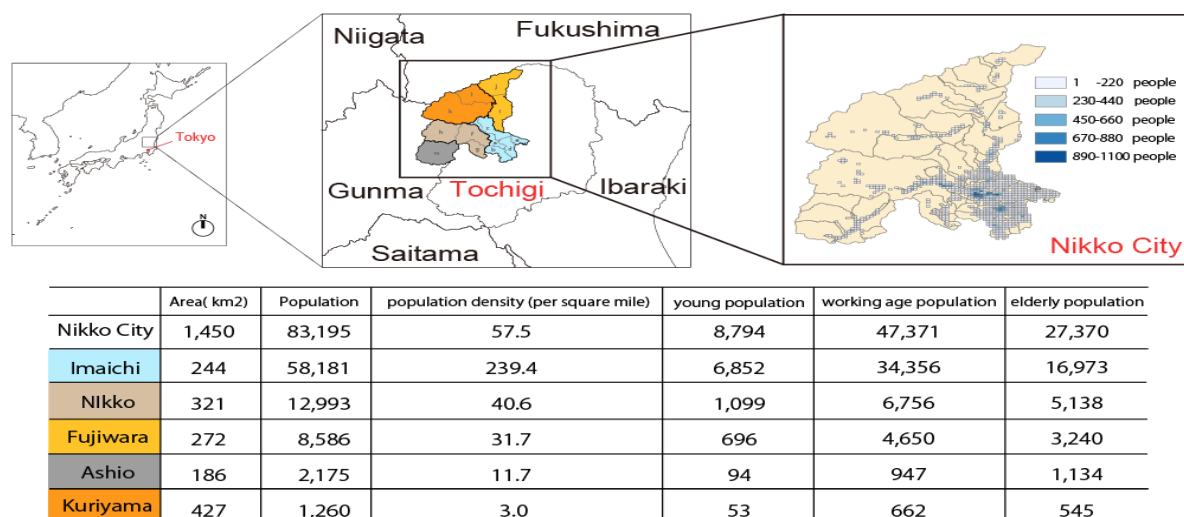

	Area(km2)	Population	population density (per square mile)	young population	working age population	elderly population
Nikko City	1,450	83,195	57.5	8,794	47,371	27,370
Imaichi	244	58,181	239.4	6,852	34,356	16,973
NIkko	321	12,993	40.6	1,099	6,756	5,138
Fujiwara	272	8,586	31.7	696	4,650	3,240
Ashio	186	2,175	11.7	94	947	1,134
Kuriyama	427	1,260	3.0	53	662	545

Figure 3.About Nikko City

	Population	young population	working age population	elderly population	young population ratio (%)	elderly population ratio (%)
2000	98,143	14,286	62,986	20,871	14.6	21.3
2005	94,291	12,243	58,784	23,200	13.0	24.6
2010	90,066	10,484	54,512	24,826	11.6	27.6
2015	83,386	8,794	47,371	27,030	10.5	32.4
2020	77,661	7,410	41,644	27,850	9.5	35.9

＊Based on Census data from 2020.

Figure 4.Age structure of Nikko City by three different age groups

The industrial structure of Nikko City is shown in Figure 5, in terms of the percentage of workers in each of the major industrial categories. The manufacturing industry accounted for the largest share of 18.6%, followed by the wholesale and retail industry at 13.8% and the accommodation and food services industry at 13.3%. In particular, the proportion of the accommodation and food services industry is much higher than that of the national and prefectural governments, indicating that Nikko City has a thriving tourism-related industry.
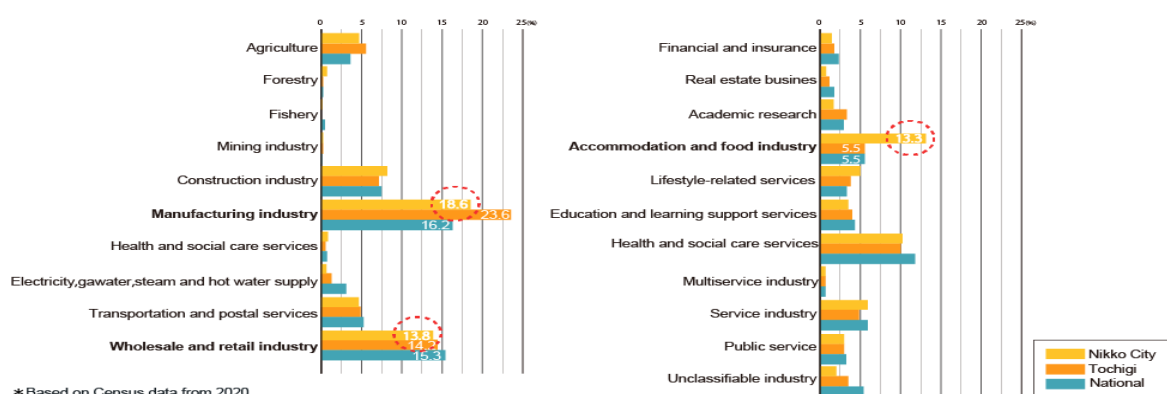
＊Based on Census data from 2020.

Figure 5.Percentage comparison of the number of workers by major industry

3. Research Results

3.1. Survey results in household food losses

In 2020, Nikko City conducted a survey on the amount of food loss generated by households. Imaichi in Figure o, the most populous area in Nikko, was selected as the target area. It is the central urban area of Nikko City, where public utilities and commercial and residential functions are concentrated. The area is divided into five districts, with District a and District b being surveyed. District a is the largest district in Imaichi where the main city hall building and almost all types of public facilities are located. District b is the smallest district in the Imaichi and is a granary with paddy fields covering almost all of the district (Nikko City,2015).

In this survey, household waste discharged at waste collection points in the respective districts was collected on one weekday and one holiday in February. From a total sample of about 1310 kg in the two districts, about 560 kg of food waste was extracted and compositional studies were carried out. Based on the manual of the Ministry of the Environment, the food waste classification items were as shown in Figure 2. However, the survey was conducted with (ii)-2 and (ii)-3 being considered identical. The percentage of food waste in the sample is shown in Figure 6.
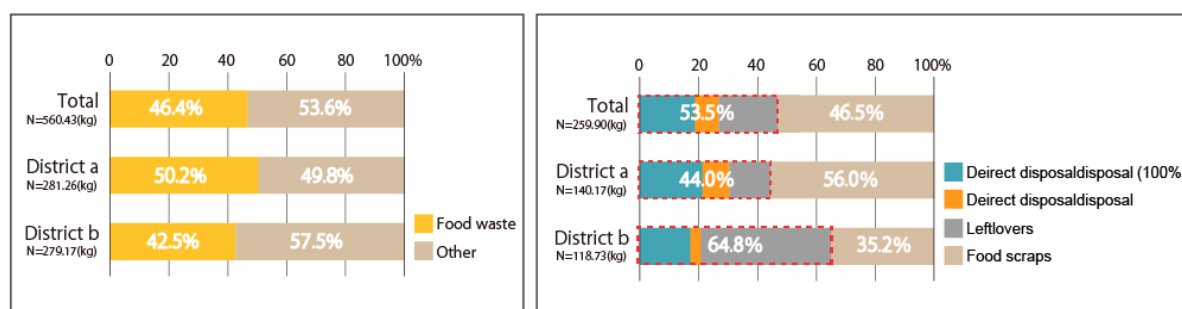

Figure 6. Survey results on household food losses

The amount of food waste in both districts resulted in more than 40% of the sample being food waste. The proportion of food loss was approximately 10% higher in more populated District A than in District B. When direct disposal and leftovers, excluding cooking scraps, were considered as food loss, it was found that food loss accounted for a higher proportion of the food waste volume in District b than in District a.

 Based on the survey results, the amount of food loss per person per day was estimated to be 136.6g. As the amount of food loss per capita is approximately 113 g, it can be said that the amount of food loss in Nikko City is relatively high. Although the amount of household food loss can be estimated from this survey, it is difficult to ascertain the factors that contribute to its occurrence.

3.2. Survey results in Business-Related food losses

Nikko City started conducting Business-Related Waste compositional analysis composition surveys in 2009. As shown in Figure 7, approximately 80.7% and 78.2% of the total in 2017 and 2018, respectively, were kitchen waste. The aim of the survey is to estimate the amount of recyclable and non-recyclable materials from the survey results and to promote waste reduction and re-use in the future. As such, the survey is not designed to determine the actual amount of food loss. Therefore, the kitchen waste in this study includes other non-food waste such as non-sortable containers and packaging, and it is not possible to determine the actual amount of food loss contained in business refuse as it stands.
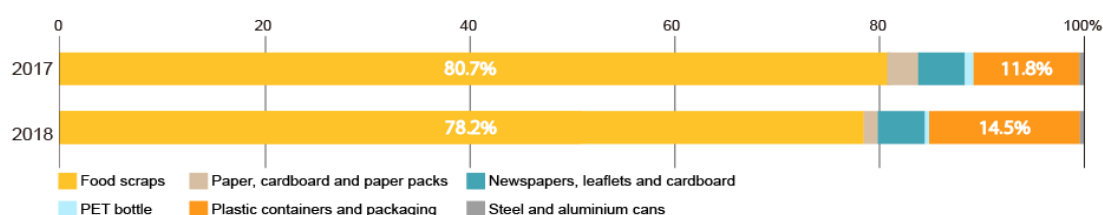
Figure 7. Survey results in Business-Related food losses

3.3. Administrative plan for food loss reduction in Nikko City

Under the Act on Promoting Food Loss and Waste Reduction, local governments have the responsibility to formulate and implement measures appropriate to the characteristics of their area. Nikko City formulated the Second Nikko City General Waste Plan in March 2018 and is currently studying a food loss reduction promotion plan in conjunction with a mid-term review in 2022. In 2020, Nikko City had 16484 tonnes of household refuse and 10437 tonnes of commercial burnable waste. Since a reduction in food loss will lead to a decrease in these waste volumes, this should be fully considered when formulating the plan.

3.4. Administrative plan for food loss reduction in Nikko City

In Nikko, various private entities are working to reduce food loss. This paper focuses on two examples, Food Bank Nikko an Daiya no Mori Shunsaikan, and investigates them.

3.4.1.Food Bank Nikko

In Japan, food bank activities are promoted by MAFF and CAA as a means of reducing food loss(Imamura,2019). MAFF defines food bank activities as efforts to provide unused food products generated during production, distribution, consumption, etc. to people and institutions in need through donations from food companies, farmers, and others (MAFF,2020). Food bank activities started in Japan in the 2000s and the number of food bank organisations was about 142 in 2020. 60% of the organisations operating food banks are NPOs (including certified NPOs) and 20% are unincorporated voluntary organisations.

Food bank Nikko was established in 2014 by a group of people who work helping people - a former Nikko city hall worker, a social welfare council employee and a care worker. The organisation provides food and lifestyle advice to people in various circumstances, including the unemployed, single-parent families, people with disabilities, the elderly, and children. While food bank activities have two objectives - supporting the needy and reducing food loss - Foodbank Nikko is characterized by its focus on supporting people.

3.4.2.'Daiya no Mori, Shunsai Kan.'

Daiya no Mori, Shunsai Kan is a direct sales outlet for agricultural products, where seasonal vegetables and fruit are sold. This direct sales outlet aims to reduce food loss and contribute to the local community by providing vegetables that could be eaten but are disposed of to children's cafeterias and welfare facilities in Nikko City free of charge. Before this project, the remaining unsold items, which had lost their value as a product, were discarded even if they were edible.

4. Discussion and concluding remarks

4.1. A framework for the virtuous circulation of food resources in local cities.

The survey found that in Nikko City there is approximately 1.6 times more household burnable waste than Business-Related burnable waste. Therefore, more needs to be done to reduce food loss in household waste. In order to reduce household food loss, it is necessary to change consumer attitudes. One way to do this is to encourage people to engage in ethical consumption. Ethical consumption means that each consumer engages in consumption activities while taking into account the resolution of social issues that are relevant to them and supporting businesses that address such issues(CAA,2017). Perspectives on ethical consumption practices include consideration for people and society, consideration for the community, and consideration for the environment. Food loss reduction and local production for local consumption are cited as specific examples, and ethical consumption will be important for the virtuous circulation of food resources within the region. However, in a citizen survey in Nagano Prefecture in 2019, 37 % of all respondents said they knew about the term ethical, while 62 % of all respondents said they did not know about it. This reveals that approximately 60% of citizens are unaware of it (Hukuda, Watanabe,2021). As ethical consumption is not yet widespread among citizens, Nikko City needs to focus on promoting it by including it in an administrative plan.

As mentioned above, Nikko has a thriving tourism industry and has more employees in the manufacturing, wholesale and retail trade, and food and beverage services sectors than in other industries. Food waste generated during cooking and products close to the best before date are currently being discharged as Business-Related food waste, and these businesses are considered to have a significant impact on the amount of business food loss generated. In addition, due to the impact of COVID-19, the number of tourists decreased, expected orders were not sold and a lot of food was discarded.

In view of these current conditions, the introduction of food-sharing systems is considered effective in order to circulate food resources within the region. Food sharing services are platforms that match the needs of the supply and demand sides of the supply chain for unused or surplus food to find new sales channels before it is disposed of. Matching patterns for food-sharing services are considered to be of three types (Morita, Tanaka,2020). The first is the direct matching of food and retail outlets with consumers, the second is the matching of food and retail outlets with organisations and associations, and the third is the matching of farmers and production processors with organisations and associations. A concrete example of the first type is 'Too Good To Go', which originated in Denmark and is widespread in Europe. In Japan, 'TABETE' and 'Kuradashi' are well known. Kuradashi works in partnership with the City of Yokohama to reduce food losses from food manufacturers in the city and to support the activities of food banks operating in the city by donating a portion of the purchase price paid by consumers to these organisations. This is the first Public Private Partnership (PPP) project in Japan where food loss reduction and support for food bank activities go hand in hand. In addition, the activities of the food bank in Nikko are currently funded by donations from the community and more support is needed.

Such PPP projects could be effective in Nikko City. By matching retailers and consumers, retailers benefit from the opportunity to sell pre-disposal products and attract new customers, while consumers can purchase the same quality products at a lower price. The project is expected to reduce food loss from food and retail outlets and promote As in the case of Yokohama, a portion of the proceeds from the sales could be used to fund the activities of the food bank, which would further promote its activities. local revitalisation by creating new links between food and retail outlets and local residents.

4.2. Evaluation of food loss reduction efforts

In assessing food loss reduction efforts, it is essential to accumulate appropriate data on the amount of food loss in households and Business-Related burnable waste. The detailed waste compositional analysis of household waste in Nikko is useful in ascertaining the actual amount of food waste and food loss. However, the relationship between individual households, emissions, and the composition of emissions is unclear and emission factors are not known. The regions where the analysis has been conducted vary widely in terms of local characteristics, and differences in the composition of food losses suggest that there are factors related to emissions. Identification of these factors is necessary to verify the effectiveness of the measure. In previous studies, the main items analysed with regard to emission factors include the number of household members, household composition, income and preferences for high-priced products, and the survey methods include consumer questionnaires and diary surveys(Kozima, Matsuoka, Ishikawa,2019). Therefore, a questionnaire survey should be conducted in Nikko City to identify factors.

Although Nikko City conducts the detailed waste compositional analysis in Business-Related waste, it is not possible to identify which industries are having an impact. As surveys are carried out at waste disposal sites. In addition, the actual amount of Business-Related food loss is unknown because the composition survey was not designed to ascertain the actual amount of food loss, making it difficult to determine the effectiveness of efforts aimed at reducing food loss. Therefore, it is considered necessary to conduct a questionnaire survey and regular reporting to food-related businesses in Nikko to ascertain the actual situation.

4.3. Concluding Remarks

Nikko City is developing a plan for food loss reduction, but clear numerical targets and specific policies are needed to work towards food loss reduction. This includes organising the roles of relevant local government departments, working with private entities that provide food sharing services, and providing support to organisations that are involved in activities such as food bank activities. Furthermore, the content should be such that local residents are informed about food loss reduction activities and citizens are encouraged to participate in food loss reduction initiatives. It is then important to build on this plan to establish a mechanism for the successful circulation of the local economy.

5. Acknowledgement

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